StarTuned®

Information for the Independent Mercedes-Benz Service Professional

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Inside:

Mercedes-Benz

Who's Your *Part*ner in Success? Mercedes-Benz's PartsPro

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.

Wouldn't it be nice if there were a way to get the parts you need without the hassle and uncertainty, so you can get back to the important business of actually fixing cars and taking care of your customers?

With the Mercedes-Benz PartsPro wholesale certification program, now there is!

PartsPro is a rigorous program intended to train Mercedes-Benz dealership parts department personnel on how to better take care of you and ultimately your customers. PartsPro certified dealers have elevated their commitment to supporting the independent repair channel, and will provide you with the highest level of customer service. They focus on the things that matter most to you!

Convenience...Accuracy... Profitability...Delivery

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

For a dealership to achieve PartsPro Certification, parts department personnel must first undergo intensive "customer-centric" training which teaches personnel how to better help YOU.

There's far more to PartsPro than just customer-service training. The dealership must make specific commitments to provide "Best in Class" service in areas such as logistics, which includes ISP-focused parts availability, regular delivery service, outside sales people to provide you personalized service, as well as a dedicated phone line and "will call" pick up area.

Then there's technical help

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.

Only those dealerships that meet the stringent certification requirements earn the right to display the "PartsPro" logo. Additionally, they receive ongoing consultation and training to ensure that they are consistently providing the very best support to you, the ISP customer.

We hope you are already receiving industry leading service from your Mercedes-Benz dealer; however, once your dealer is PartsPro Certified, we believe you'll be thrilled with the new "Best in Class" parts-procurement experience!

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

StarTuned®

December 2018

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, online 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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In This Issue

Cover Photo Credit: Jan Mocnak

Mercedes-Benz
The best or nothing.

Modern Mercedes-Benz A/C Compressors

An air conditioning compressor does two things that its name implies. First, it's responsible for "conditioning" the air in the vehicle's cabin. It not only cools it down, but also reduces the moisture content, or humidity. Second, it compresses refrigerant vapor to high pressure and sends it to the condenser. All air conditioners work the same way whether they are installed in a building, or in a car. The refrigerator or freezer is an air conditioner as well.

The heart and soul

The basic principles of automotive air conditioning systems have not changed much in recent years, but the compressor sure has. The workhorse of the air conditioning system, the compressor is powered by a drive belt connected to the crankshaft of the engine, or in more modern engines and especially hybrids and electrics, driven by an electric motor. Any compressor draws in low-pressure refrigerant vapor to start the refrigeration cycle. Much like the human heart that pumps blood through the circulatory system, the compressor pumps the air conditioner's life blood (refrigerant) through the system.

Thermodynamic review

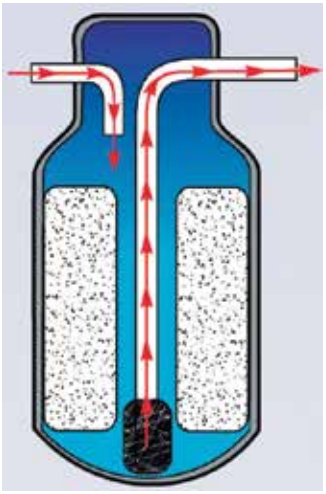
As mentioned, A/C system principles have not evolved as much as compressors have. Let's take a quick review

Some have clutches, some don't. Some are the scroll type, some aren't. How do you know if they're doing what they're supposed to do?

In 1958, Mercedes-Benz introduced its first fully air conditioned passenger car. It used a York-type two-cylinder vertical compressor, which was big and heavy, but durable.

of all the components in a modern system and how they cooperate with the compressor.

The condenser is used to change the high-pressure refrigerant vapor into a liquid. It is mounted in front of the engine's radiator, and it looks very similar to a radiator. The vapor is condensed to a liquid because of the high pressure that is driving it in, and this generates a great deal of heat. The heat is then removed from the condenser by air flowing over it. Most Mercedes-Benz vehicles you service will have additional electric cooling fans to aid in this process. This is essential to the longevity of the compressor.



A saturated or contaminated receiver drier will cut performance and damage the system.

After the condenser, the now-liquid refrigerant moves to the receiver dryer. This is a small reservoir vessel for the liquid refrigerant, and removes moisture that may have infiltrated the refrigerant. Moisture in the system wreaks havoc, with ice crystals causing blockages and mechanical damage.

The pressurized refrigerant flows from the receiver drier to the expansion valve or block. This removes pressure from the liquid refrigerant so that it now expands and becomes a vapor in the evaporator. This change-of-state is what absorbs the heat inside the cabin.

The evaporator is located in the interior of the vehicle in the HVAC ducting system. As mentioned, the cold low-pressure refrigerant passes into the evaporator vaporizing and absorbing heat from the air in the passenger compartment. The blower pushes air through the evaporator thus circulating "coolness" inside the car.

The moisture in the air is reduced, and the condensate is collected and drained away via the evaporator drain tube.

There's always been a need for cooling

According to some documents we've read, experiments in air conditioning through the 1930s included liquid nitrogen, a "vapor jet" system that used a water-alcohol mixture, an "air cycle" system that used a turbine-powered compressor and a gasoline vaporization system that required 26 gallons of gas an hour!

In the 1930s, according to Americans on Vacation, drivers in southwestern states could rent a "hang-on" air conditioner that contained cold water or ice in a cylinder that attached to the car window. It cooled the interior when air blew through it. In the early days of air conditioning an ice-block experiment was run to see how effective cooling could happen. Blocks of ice were placed in the back seat to see how much energy would be required to cool a car. With the back seats removed and a hole drilled into the floor for drainage, the engineers would drive for a while, then stop and weigh the ice, to determine how fast the ice was melting. Their conclusion:

"With the ambient temperature at 95 degrees in bright sunshine, with 40 percent relative humidity and the windshield open half an inch (windshields opened in those days), it required heat removal at 12,000 BTUs per hour to maintain an interior temperature of 85 degrees, at 65 mph." The objective was to bring the temperature down by only 10 degrees they concluded because in the early 1930s it was believed that if the temperature was cooled much in excess of 10 degrees it might cause a person to faint from shock when emerging from the air-conditioned space. With the change in these antiquated ideas, the need for air conditioning systems and as we shall see compressors, needed to evolve and change.

Reciprocating piston compressors

The York-Tecumseh style compressor was an early design, which was standard equipment on many Mercedes-Benz vehicles from 1959 to 1979. While a rarity these days, it can be identified by its large square shape reminiscent of a lawn mower engine, being a reciprocating piston pump.

A reciprocating piston compressor, which vibrates more than the axial or rotary type

The reciprocating motion causes it to vibrate more than modern Sanden compressors. It also had higher torque requirements for peak pumping, and it doesn't like high rpm operating speeds.

There are two types of piston compressors currently in use, the opposed axial variety (also often referred to as the swash plate type), and the single-row axial or wobble-plate type. These may contain five, six, seven, or ten pistons around their diameter, thus the term "axial." They're easy to spot with their barrel shape, aluminum color, and small overall size. Even though they are commonly referred to as rotary, they're really not.

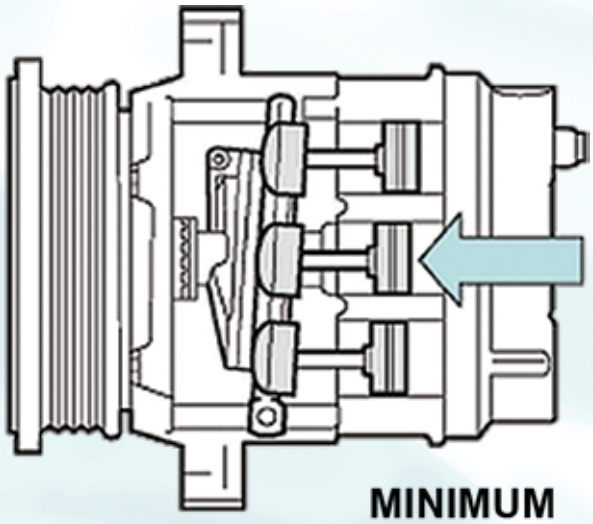
With either type of piston compressor, the pumping action of the pistons draws low-pressure, low-temperature refrigerant vapor from the evaporator in through suction valves. The refrigerant exits the compressor through discharge valves as a high pressure/high temperature vapor. This happens because the pistons are pumping the refrigerant against a calibrated restriction in the system. Depending on the type of system, the calibrated restriction is contained in either the orifice tube or the expansion valve.

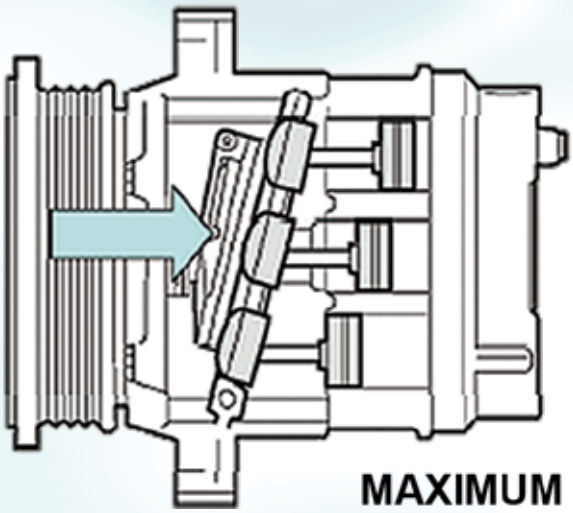
Each cylinder in the compressor contains one suction and one discharge flapper-type reed valve. As the piston moves away from the suction valve, the valve opens and refrigerant is drawn into the cylinder. After reversing direction, the piston compresses the low-pressure, low-temperature vapor into a high-pressure, high-temperature vapor. This exits through the discharge valve on its way to the condenser.

Also included in this category is the scroll-type compressor, well known for its low noise and high performance. The compressor chamber consists of a pair of spiral-shaped scrolls; one fixed and one rotating. Although the idea of a scroll compressor is not new, actual production versions are a relatively recent technology. The first scroll compressor patent dates back to 1905 and Léon Creux, a French engineer, but it was not until the early 1970s that precision machining technology made a working prototype possible.

Rotary

These include Electrical (ES) Compressors also known as the Electrical driven Scroll compressor. It has a variable displacement and is hermetically closed reducing leakage of refrigerant. This compressor also has the capability of A/C operation also when the engine is switched off. The Compressor chamber consists of a pair of spiral-shaped scrolls; one fixed and one rotating. Another type of rotary compressor is the Through Vane (TV) Compressor. It is A rotating type compressor with a Compressor chamber consisting of a rotor with two vanes sliding through the rotor. Two different displacements are available from Nippondenso, 120 cc and 140 cc.





The swash plate in a variable displacement compressor is "hinged" so it can tilt at different angles. The higher tilt creates greater piston movement and higher pumping volume, or displacement, of refrigerant. When the swash plate angle is almost perpendicular to the compressor shaft, it generates almost no refrigerant displacement and consumes negligible energy.

Clutchless compressors?

When the air conditioner is turned on, a sudden large power drain occurs both in the torque required to spin the compressor, and the amperage required to engage the clutch. This can be mitigated by keeping the compressor engaged all the time and varying its displacement according to demand, hence its load. It also spares the moving parts the shock of going from zero to thousands of rpm instantaneously.

The variable-displacement compressor is an axial design with the pistons driven by a wobble plate or a swash plate. Since the angle of that plate determines the length of the stroke, changing that angle varies the distance the piston moves, thereby regulating the amount of refrigerant pumped (displaced). The plate angle is controlled by means of linkage and springs, and it's adjusted by changing refrigerant pressure in the compressor housing.

When housing pressure is increased, it pushes on the back side of the pistons keeping them "higher" in their bores, closer to the cylinder head. This reduces the angle of the swash plate and shortens the stroke, decreasing displacement. When housing pressure decreases, a spring pushes the adjusting linkage away from the cylinder head, increasing plate angle and lengthening the piston stroke for more displacement. Housing pressure is controlled by a valve with ports and passages that connect to the suction (low-side) and discharge (high-side) chambers of the compressor head.

Trouble shooting

There are different means of determining the efficiency of each type of compressor and model. It's vitally important that you consult the service manual for the specifications and characteristics of the vehicle you are working on. The basic approach to diagnosis, however, remains pretty much the same. The major differences will be in whether or not you're dealing with a variable displacement clutchless compressor, or one of the more conventional pumps.

It's easy to find out if you're dealing with a VDC – no clutch!

If you have a complaint of a low or no cooling on a clutched system, there are important service bulletins available from Mercedes-Benz. Start with the basics. Is the clutch engaging? If not, is the PCM commanding it on? The following steps from SDS will help with your diagnosis.

Prerequisites:

1. Before parts can be replaced, the exact quantity of the refrigerant in the system must be determined by evacuating the system.
2. If the fill level of the refrigerant circuit is too low, parts should only be replaced if the torque limiter is broken.
3. If the fill level of the refrigerant circuit is too low and the torque limiter is damaged, the leak test (Test 6 "Leak in refrigeration circuit") must be performed first using the "Technology Guide –Vehicle Climate Control" located in SDS SD Media, then the system must be refilled and checked. If the amount of refrigerant is less than 80% of the proper charge, it's too low, which may be the cause of the air conditioning shutting down or malfunctioning. Most high-quality AC recovery/recharging machines will do a leak test after evacuation. Any detectable, measurable leak is unacceptable, so a repair will be necessary.

Remedy A – Broken Torque Limiter:

1. Ensure the alternator freewheel (when applicable) is not damaged and that the belt pulley of the compressor rotates in the belt drive.
2. If the alternator freewheel is blocked, replace it. Some compressors have a replaceable belt pulley, but with others a new compressor is required. Refer to your authorized Mercedes-Benz parts distributor using the applicable part number.

Any AC recovery/recharging machine also does leak testing.

3. If the alternator freewheel is not blocked and black refrigerant/oil is evacuated from the system, replace the AC compressor.

Remedy B – Blockage in the Refrigeration Circuit

1. Identify through SDS function test "Refrigeration circuit test" that the refrigerant circuit has not been underfilled or overfilled.
2. Inspect along the AC lines to check for blockage at the points with marked temperature differences. A thermal imager is handy in this case.
3. Identify and replace the blocked components in the refrigeration circuit.

Remedy C – Electrical Fault in Refrigerant Compressor

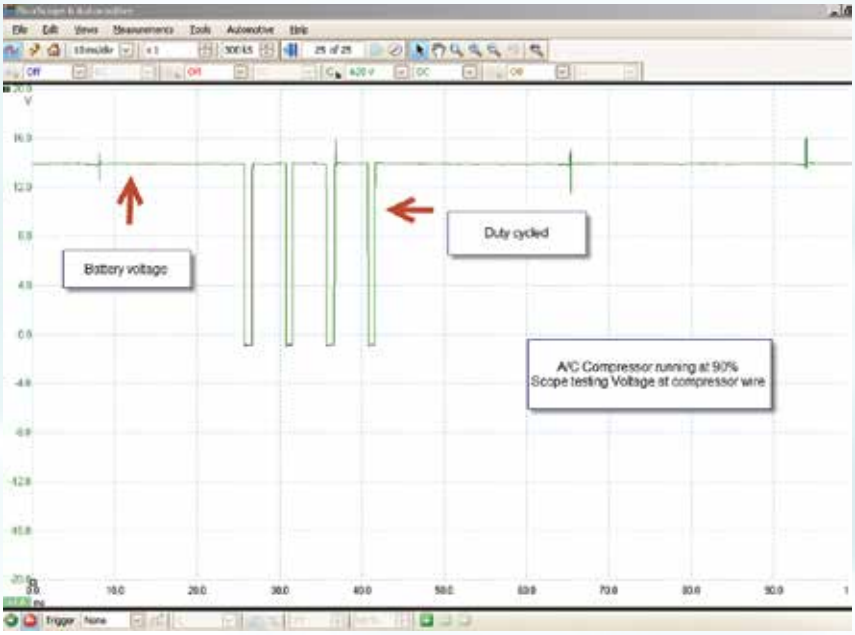
1. Identify through SDS function test "Refrigeration circuit test" that the refrigerant circuit has not been underfilled or overfilled.
2. After ruling out a short circuit in the actuation and ground wiring, replace the refrigerant compressor only.

Note:

- Always empty the oil from the new compressor before installing.
- Refill the compressor with the proper oil, ensuring that the quantity is correct (refer to WIS document BF83.00-Z-9999AZ). Take into consideration whether an individual component or multiple components are to be replaced.
- Always perform a leak test on the system after any repairs to the refrigerant circuit, but before filling it with refrigerant.

You can't go by pressures alone

The control unit uses a PWM (Pulse Width Modulated) signal to the compressor control solenoid to vary the output level of the compressor. The ability of the control unit to consider evaporator temperature, engine rpm, high-side pressure, accelerator pedal position, and ambient temperature when deciding to increase or decrease refrigerant flow from the compressor makes this system completely interactive. When seen on a running engine, a clutchless compressor gives the appearance of a regular clutch-type unit with the clutch engaged because the front hub plate is always spinning. The clutchless compressor will reduce the swash plate angle to 2% when the system is not activated



After checking with your scan tool, verify the signal to the compressor with a lab scope.

Your next AC machine? Note that R744 means CO2.

Testing a new Mercedes-Benz equipped with a CO2-charged AC system

by the control unit, producing nearly equal suction and discharge pressures. With the compressor shaft turning and pressures almost equal, many technicians assume the compressor is defective and will mistakenly want to replace it. You'll have to go into your scan tool and watch the PIDs for the control solenoid to see whether or not the problem is in the compressor or the electronics.

The Future is Here

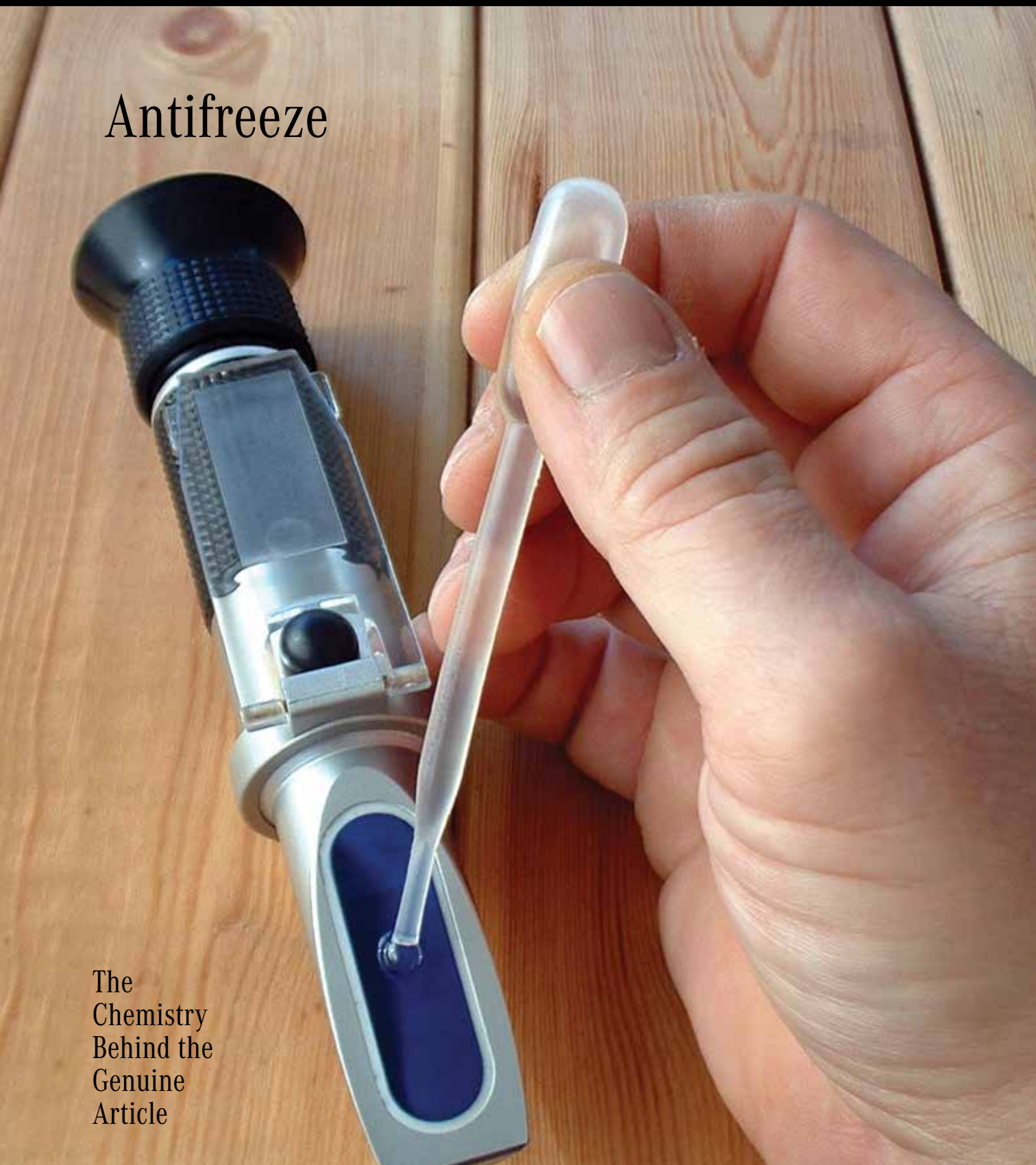
Mercedes-Benz will be the first carmaker to equip production models with CO_2 air conditioning systems. CO_2 systems are said to perform better than conventional systems and to be more environmentally friendly. The move is in response to an EU directive that went into effect in 2017. The legislation is based on the EU's climate protection requirements and Mercedes-Benz has been involved in drafting the standards for the use of the new technology. It says the standards will help other carmakers to begin development of their own systems quickly.

CO_2 systems operate at a pressure 10 times higher than today's typical R134a refrigerant systems, at more than 100 Bar! As such, the new systems require designs and components that can handle the increased pressure safely. To sustain and contain a required pressure on the order of 1,500 psi, Mercedes-Benz had to redesign everything – all-new compressors, hoses, seals, you name it.

The new R744 compressor has a 31cc capacity, a fifth of the PX R134a unit it replaces, but manufacturer (and Mercedes-Benz supplier) Sanden claims its "cooling performance and function exceeds conventional compressors." Its packaging and weight is also said to match that of the PX R134a compressor, and it's able to withstand the tremendous operating pressure. Sanden also says the R744 pump includes internal design features for reduced noise, and new control technology that improves its stability and safety.

Mercedes-Benz will be the first to both award development contracts and place production orders for CO_2 air-con systems and their components. The new technology will debut on European S- and E-Class models.

Antifreeze



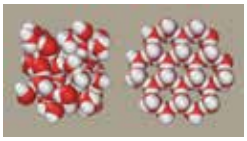
The Chemistry Behind the Genuine Article

Mercedes-Benz chemical engineers and metallurgists have worked out the fine points of this, and would not be overjoyed to know you've been putting something non-specified in your customer's vehicles.

The dictionary definition of antifreeze is, "Any substance that lowers the freezing point of water, protecting a system from the ill effects of ice formation." That alone tells us that automotive engineers needed to develop something with the proper characteristics to work in automobile cooling systems beyond plain water. Water, of course, has great cooling and heat transfer properties, but aside from the freezing problem there are other concerns with using strictly water. Here, we'll take a look at coolant/antifreeze combinations and the history of their development.

Antifreeze in its simplest form

The term "engine coolant" is widely used in the automotive industry, which covers its primary function of convective heat transfer, but doesn't hint at lowering the freezing point. When used in an automotive context, corrosion inhibitors are added to help protect vehicles' radiators, water pumps, cylinder heads, and blocks. As mentioned earlier, water is a great heat dissipater and is what the first designers of the internal combustion engines would have used except for two properties that were deal-breakers. One is its freezing point of 32 deg. F./0 deg. C. Water expands with great force when it freezes, and in a closed cooling system something has to give. That's going to be some critical component such as a cylinder head or block.



Of course, water molecules expand when frozen, which will break any casting.

This is an example of corrosive action causing pitting in an aluminum housing.

Opposite Page: Antifreeze concentration is one thing, but composition is quite another.

The second problem with water is the corrosion factor. Obviously, water and iron are a recipe for rust. Iron swiftly oxidizes. In other words, it rusts in the presence of moisture and oxygen. Later engines use aluminum components combined with iron parts. Initially, aluminum doesn't react with water, but the properties of that metal rapidly develop a thin layer of aluminum oxide a few microns thick that prevent it from further reacting with water. When this layer begins to corrode, a reaction develops that releases highly-flammable hydrogen gas. Aluminum chloride hydrolyzes in water making a mist when it comes into contact with air because hydrochloric acid drops form during the reaction with water vapor. This is where the corrosion occurs in aluminum.

Early engine antifreeze was simply methanol, otherwise known as methyl alcohol. Since radiator caps were vented, as opposed to sealed, the methanol was soon lost to evaporation, requiring frequent replenishment to avoid freezing. Methanol also accelerates the corrosion of the metals, especially aluminum, used in most engine and cooling systems. It's a weak acid that attacks the oxide

coating that normally protects aluminum from corrosion. Ethylene glycol was developed, and replaced methanol as an engine cooling system antifreeze. It has very low volatility compared to methanol and water. Before the 1950s, cooling systems were unpressurized and the engine typically ran cooler than modern versions do. It should be noted that ethylene glycol also has a much higher boiling point than water at 387 deg. F./198 deg. C. By pressurizing the cooling system with a radiator cap, the boiling point of the fluid is increased further, permitting higher engine temperatures and better fuel efficiency. Pressurized systems do not appreciably change the freezing point. Later, propylene glycol was introduced due to its more-benign environmental characteristics, but its use has been limited mainly to the food industries, although it has seen some automotive use.

Dynamite!

Ethylene glycol is a colorless, odorless, viscous dihydroxy alcohol. It has a sweet smell and taste, but is poisonous if ingested. It is often colored a greenish gold or yellow for the automotive industry. Ethylene glycol was first synthesized in 1856 by French chemist Charles-Adolphe Wurtz, but, very little was done with the substance until the 20th century. It was first produced commercially in 1917, but at that time is was used primarily in the manufacture of dynamite.

In addition to being an effective substitute for glycerol as an ingredient of high explosives, ethylene glycol also turned out to have a number of characteristics that made it an ideal antifreeze. In addition to mixing readily with water in any proportion, it has a much lower freezing point than water and its boiling point is nearly twice as high.

Ethylene glycol was first used as an automotive antifreeze in 1926, and it saw widespread use in military applications during World War II. After the war, it became the dominant chemical antifreeze. The molecular formula is (C2H4O) nH2O, where n = number of ethylene oxide units corresponding to a molecular weight of 6000, (about 140). Now you're thinking, "Why do I need to know this?" Well, you don't necessarily, but the engineers who develop these compounds do and what you put into the vehicles you service will matter as we will see later in this article.

Generally, the color of an antifreeze has no bearing on its properties – it's an identifier. Coolants developed for different vehicle applications are dyed different colors.

What's wrong with the good old green stuff?

Oxidation and corrosion occur inside the cooling system. Corrosion occurs when oxygen and dissolved minerals or salts in the coolant react with metal surfaces. It can also be the result of electrolysis, an electro-chemical reaction between dissimilar metals (such as aluminum and cast iron), or from stray electrical currents that pass though

For many decades, cooling systems have been pressurized by the use of a cap that determines the psi at which it vents.

Don't be fooled by all the different colors. Specification and ingredients are the key!

the coolant due to poor grounding between the engine and chassis. It's possible to do a voltage check of the coolant with the negative lead of your DMM to battery ground, and the positive lead in the coolant. You should see less than 0.1 V. If it's 0.3 V or higher, and all vehicle grounds are good, replacing the coolant should reduce the voltage to an acceptable level.

In general, corrosion inhibitors keep the coolant slightly alkaline chemically (as opposed to acidic). This keeps corrosion in check as long as there is enough inhibitor present to neutralize the acids. Over time, the coolant becomes acidic. At this point, corrosion begins and bad things start to happen. Compound this with the ever-increasing usage of various and dissimilar metals in the modern automobile engine and it's a recipe for trouble. "Green" formula coolant contains fast-acting, but relatively short-lived corrosion inhibitors that last about two to three years, or 24,000 to 36,000 miles.

About 93% to 95% of most antifreeze is ethylene glycol, another few percentage points are water or maybe a solvent to keep rust and corrosion inhibitors in solution, and the remainder are those inhibitors. The inhibitors make a huge difference, and they're what the discussion of what to use is all about.

By the way, at concentrations above 70% antifreeze, the freeze point of the coolant actually starts to rise, so more antifreeze is not better. The 50-50 mixture provides the best combination of freeze and boil-over protection, and good heat transfer from the engine.

Organic acid technology (OAT)

Organic Acid Technology describes the ingredients responsible for the corrosion protection offered by an antifreeze of this type. OATs are long-life chemicals based on minimally-depleting carboxylate technology. Carboxylates provide corrosion protection by chemically interacting at the metallic corrosion sites, rather than by forming a layer of inhibitors that cover the total surface. In other words, instead of painting a layer of protection on the metals the actual chemistry is changed by carboxylates in order to provide the protection needed. This technology provides superior protection to all components of the cooling system including those materials such as the aluminum and magnesium found in modern-day engines. Unlike with traditional antifreeze, the need for regular additions of supplemental coolant additives at scheduled service intervals is no longer required, providing a true long-life product that can represent significant cost savings. In some heavy-duty diesel applications, you may see a reference to a coolant extender, which can be used with an OAT antifreeze to top-up certain additives at the product's half-life, typically around 300,000 miles (480,000 km). In general, OAT-based corrosion inhibitors are recognized for their non-toxic properties that make them readily biodegradable, addressing any environmental and occupational health and safety issues.

First-generation OATs were specific to automotive applications. This was quickly followed by their use in heavy-duty diesels (as in Asia and Europe), or in North America where OAT was used along with nitrite or nitrite and molybdate to ensure adequate wet-sleeve liner cavitation protection.

Manufacturers have become increasingly aware of the varying needs of different regions where compounds and formulas are concerned. European countries have extremely hard water. As antifreeze and water are a 50/50 mix, water quality drastically impacts the overall mix (see sidebar). European manufacturers began to move away from phosphate-based technology because of its tendency to form scale. On the other side of the world, Japanese manufacturers began to move away from silicates due to issues with silicate gel drop-out.

Hybrid Organic Acid Technology (HOAT)

Silicated Hybrid Organic Acid Technology (HOAT) antifreezes, which are sometimes referred to as "G-05," contain organic acids in combination with one or more inorganic inhibitors. As the name suggests, it is a hybrid of the traditional green inorganic coolant properties and OAT properties. The most common inhibitor is silicate. The addition of silicates increases corrosion protection for aluminum engines, radiators, and heater cores, and helps protect the water pump against erosion wear. Generally, silica additions improve the corrosion resistance due to the formation of protective oxide films, which act as a barrier to oxygen diffusion to the metal surface.

If you look at the chart of the makeup of the Mercedes-Benz spec 325.0, you'll see the addition of Silica (Si) and Boron (B). Boron has traditionally been used in HOAT and OAT as it acts as an excellent corrosion inhibitor and helps to extend fluid life by slowing down the development of bacteria and helping the fluid to be more inherently stable.

Table 3: Specifications for Operating Fluids sheet number and coolant type				
Coolant sheet no.	Antifreeze with corrosion inhibitor sheet no.	Inhibitors		Free of
		Inorganic	Organic	
326.0	325.0	Si, B	X	Nitrite, amine, phosphate
326.3	325.3		X	Nitrite, amine, phosphate, borat, 2-ethylhexanoic acid
326.5	325.5	SI	X	Nitrite, amine, phosphate, borat, 2-ethylhexanoic acid
326.6	325.6	SI	X	Nitrite, amine, phosphate, borat, 2-ethylhexanoic acid

This is the specifications chart for Mercedes-Benz 325.0 antifreeze. Most of what you service will take this type.

What about Universal Antifreeze?

Universal formula antifreezes are marketed as being suitable for all passenger cars and light trucks, regardless of year, make, or model, or of the type of coolant that's already in the cooling system. Some of these claims have been challenged in court on the basis that no single additive package can match the conflicting requirements of the different OEMs. Even so, the makers of universal coolant say their products can be used in any vehicle, whether it matches the original coolant chemistry or not. The universal coolants use OAT-based corrosion inhibitors with proprietary organic acids to provide broad spectrum protection. The coolant may be dyed yellow or amber (yellow-orange).

The service life of most universal formula products is typically five years or 150,000 miles, with one exception. When used to top off a cooling system in an older vehicle that contains standard green antifreeze, the service life of the product is reduced to that of the original type, which is two to three years, or 24,000 to 36,000 miles.

The main advantages of a universal coolant is that it simplifies the selection process to a single product, and it eliminates the need to carry the many different types of coolant (green, orange, yellow hybrid, blue, pink, red, and even purple) to cover the market. Those who are opposed to universal coolants say one product simply cannot match the conflicting requirements of all vehicle manufacturers, and that it is safer to offer specific types that meet these specifications. Consequently, many parts stores carry not only the many different types of antifreeze (often in multiple brands), but also a universal coolant for customers who prefer that kind of product.

Clearly, the Mercedes-Benz specification of 325.0 is the right choice for those of you servicing that company's vehicles. First of all, it's a long-life antifreeze and therefore doesn't need changing as often. If you consider price, the cost of the genuine article is only slightly higher than cheaper alternatives and really is a no-brainer in terms of the overall cost of maintaining a vehicle.

The genuine article

Testing

Keeping accurate maintenance records will go a long way towards knowing the time and frequency of service for the cooling system. Testing the coolant mixture is pretty straightforward. You can use the old floating-balls type of hydrometer, which will give you the ethylene glycol count, but not much else. Then there's the refractometer, on which you place a drop of coolant, then look through to determine the refractive index of the mixture. The simplest thing, which is quite accurate, is the quick and easy test strip. Simply dip the strip, compare the results with the color chart on the bottle, and you'll have a test result showing you freeze point, and nitrite and PH levels. You can also staple it to the repair order to show the customer.


Using coolant test strips will tell you the condition of the antifreeze/water mixture.

What about mixing coolants?

Here again we can enter into lots of debate. Can you mix different types of coolants? A quick search of the Internet will give a thousand different answers to this question, some ranging from no problems whatsoever to the cooling system clogging and causing the engine to overheat and blow up. Since the actual chemical makeup of the antifreezes on the market is about 93% to 95% ethylene glycol and the rest solvents and additives, and since they are mixed 50% with water, we doubt the reports that it will do serious harm short-term if someone has added the wrong product either accidentally or just without due diligence. It's the additives that will react with each other and possibly cause some long-term -issues.

One brand of antifreeze, let's say "orange," has two additives. One is called sebacate, the other 2-EHA (which stands for 2-ethylhexanoic acid). The inhibitor 2-EHA works well in hard water and is more effective than sebacate at lower pH levels (when the coolant moves from the alkaline end toward the acid side), particularly for cast iron. When there's a low coolant level in the coolant passages, the exposed cast iron rusts. Apparently, that rust is washed away later by flowing coolant, and is deposited in the heat exchangers (radiator and heater cores). It eventually produces the rust powder problems that have been so widely observed and is even the basis of some lawsuits.

That said, if you are working on a Mercedes-Benz automobile, don't do it! Why take the chance? Trust the engineers and metallurgists on this one and use the real stuff. If you find that perhaps the owner or someone else has mixed coolants in your customer's car, simply change it out. Explain to your customers that taking the utmost care of their vehicles and making them last is your top priority and you need to flush out the system and begin with a fresh batch of the latest-specification antifreeze. It should be noted that the older Mercedes-Benz antifreeze was a goldish yellow in color. The new antifreeze is blue. As long as they both meet the specification of the 325.0, they are okay to use together, but the resulting color might be ugly. We would suggest changing the antifreeze altogether so that you and the customer both know what's in the automobile.

Ethylene Glycol-Based Engine Coolant Protection Chart

Capacity Cooling System (Quarts)	PROTECTION CHART Quarts of Engine Coolant Required for Protection to Temperatures (°F) Shown										
	2	3	4	5	6	7	8	9	10	11	12
6	0	-34				A 50/50 mixture (coolant/distilled water) is recommended as it provides freeze protection down to -34 °F (-37 °C) and boiling protection up to 265 °F (129 °C). DO NOT ALLOW the concentration of coolant to fall below 40% or exceed 60% as engine parts could become damaged or not work properly. Shaded blocks show 50% concentration to the next higher full quart.					
7	6	-18	-54								
8	10	-8	-34								
9	14	0	-21	-50							
10	16	4	-12	-34	-62						
11	18	8	-6	-23	-47						
12	19	10	0	-15	-34	-57					
13	21	13	3	-9	-25	-45					
14	22	15	6	-5	-18	-34	-54				
15	23	16	8	0	-12	-26	-43				
16	23	17	10	2	-8	-19	-34	-52			
17	24	18	12	5	-4	-14	-27	-42			
18	24	19	14	7	0	-10	-21	-34	-50		
19	25	20	15	9	2	-7	-16	-28	-42		
20	25	21	16	10	4	-3	-12	-22	-34	-48	
21		22	17	12	6	0	-9	-17	-28	-41	
22		22	18	13	8	2	-6	-14	-23	-34	-47

ETHYLENE GLYCOL HYDROMETER SCALE - For cooling systems larger than shown, use double the quantity required for a system one-half as large. For systems smaller than shown, use half the quantity required for a system twice as large.

Here is the ideal mixing ratio to use.

Water Watch

Photo credit: Jan Mocnak

Should I be adding regular tap water to my antifreeze, or is there a better choice?

Besides tap water, there are basically two other choices: deionized and distilled. Deionized water is “softened” in that it has been treated to remove all ions – typically, that means dissolved mineral salts. Distilled water has been boiled so that it evaporates and then is re-condensed, leaving most impurities behind.

Organics and inorganic minerals are the most common impurities found in water. Organics can typically be removed via filtering methods, including physical filters, carbon filters, and reverse-osmosis membranes. After this pre-treatment, the water can be sent through a DI system, which contains two types of resin: cation and anion. These resins attract positive and negative ions, respectively, replacing them with H+ and OH-. H+ combined with OH- becomes H2O – water. The combination of filters and DI resins can remove nearly all contaminants.

Distillation is one of the oldest methods of purifying water. Filtered water is boiled into steam, which is collected in a sterile container where it condenses and becomes liquid again. Because water has a lower boiling point than most contaminants (including minerals), they are left behind when the water turns into steam. The resulting water is, therefore, very pure. In addition, some water is double- or triple-distilled.

Ordinary tap water can be used for the engine coolant mixture, if it’s not hard. But why risk it when there’s a very cheap alternative?

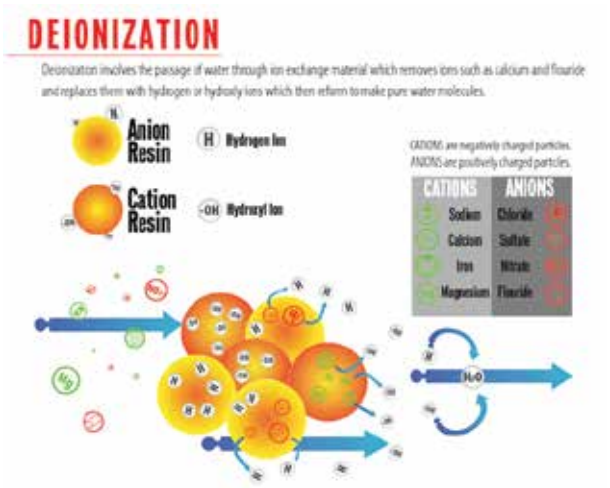
This map indicates that most of the country has hard water.

Table 5: Water quality

Water quality		min	max
Earth alkali ions	mmol/l		2, 7
Hardness	°dH		15
Chloride	mg/l		80
Chloride + sulfate	mg/l		160
pH-value	-	6,5	8,0

1 °dH = 0.1783 mmol/l alkaline earth ions = 7.147 mg/l Ca^{2+} or 4.336 mg/l Mg^{2+}

Here's the analysis of the water that's safe for the coolant mix in Mercedes-Benz vehicles.



Deionized water would be ideal, but it's hard to find and relatively expensive.

Distilled water is very easy to find. Most grocery stores sell it for less than a dollar per gallon. Deionized water is another matter altogether. We've tried to source some in the small town where our shop is located, and couldn't find any. Many online sources are available, but it's not cheap, especially when you add shipping.

What does Mercedes-Benz Recommend?

According to publication BB00.40-P-0310-01A, "Use the cleanest and softest possible water for processing the coolant. Drinking water often satisfies the requirements. Information concerning the water quality of drinking water is available from the local water-plant authorities, or the official water utilities on request. If there is no available information regarding the water quality, or if no suitable water is available, then distilled or deionized water should be used to prepare the coolant. Sea water, brackish water, brine and industrial waters are not suitable. Salts may promote corrosion or form disruptive deposits. The analysis values of the water for mixing coolants must be within the limits of table 5."

So, unless you know your tap water is extremely hard then it is probably all right to use. Better yet, play it safe and buy distilled water in bulk and have it on hand. Using that and Genuine Mercedes-Benz antifreeze you can rest assured you are putting the best product you can in your customer's cars.

To us, the obvious choice is distilled water. It's cheap and ubiquitous.

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With our competitively priced Genuine Remanufactured Parts, you no longer have to settle for anything less than Mercedes-Benz quality. But that's just part of the story. You see, our AIRMATIC® struts, catalytic converters, turbochargers and steering racks all carry a 24-month, no mileage-restriction warranty. So our parts are not only a great deal. They're a great value. And since they're genuine Mercedes-Benz, you can have confidence they'll last, and so will your relationship with your customers.

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Glass, but not Windshields

The secrets of perfect installation of movable glass.

Some of our customers don't care about wind noise, but a few are extraordinarily picky. We don't blame them, either. They're driving a Mercedes-Benz, after all, and the interior should be as quiet as a church. Most of them, however, get really upset with water leaks, and understandably so. Both of these annoyances are often caused by the

E-Klasse Cabriolet (BR207)

same issue: mis-adjusted glass. Let's take a look at both finding and fixing these often elusive problems.

Sedans and wagons rarely have wind noise complaints, mostly because the doors have a full frame around the windows that supports the glass at all four edges, minimizing the chances for any kind of gap to open up and cause a problem. Coupes, cabriolets, and roadsters are a different story: They depend on the pressure of the glass against a compliant rubber seal to prevent air and water leaks, and this pressure comes from a correctly installed and adjusted glass window.

Movable roof systems add to the complexity, since the soft top or hard top can also fall out of alignment and open a gap. We'll take a look at a few different models, but, of course, our usual advice to look up the correct procedure for your specific vehicle in the Workshop Information System (WIS) still applies.

Before we can correct the adjustment of door glass, we need to find, unambiguously, the exact location of the air or water leak. Complicating things are the facts that air noises can appear to be coming from places far from the actual source, and that water drips downhill, but is also influenced by the movement of the vehicle so can appear to be coming from a location also far from the source.

The key to finding the leak is to duplicate the customer's use conditions. Press the customer to give you the symptoms and operating conditions as carefully and precisely as possible. Of course, this is a standard technique that is needed regardless of the type of repair, but it is especially important with these kind of harder-to-find complaints.

If possible, take a test drive with the customer. Bring along a handkerchief and a cardboard paper-towel tube: The handkerchief is used to cover suspected

These are your basic tools for locating air and water leaks. The text explains how they're used.

leak areas, which will noticeably dampen the noise. The tube is used as a hearing aid to better pinpoint the source of a leak. Of course, have the customer drive the vehicle while you use these tools – nothing's worse than crashing your customer's car. Likewise, when you're troubleshooting after the customer has left, have someone else drive so you can focus on the leak and he or she can focus on driving. Just like texting and driving, doing this kind of work alone is extraordinarily dangerous, to both you and others on the road.

Another part of your diagnostic toolbox is a roll of wide painter's tape. Use this to mask off seams around the glass, doors, mirrors, anyplace that can contribute to air noise. Tape is also useful for water leaks to temporarily waterproof an area while water testing.

Mercedes-Benz recommends the use of an ultrasonic leak detector for finding leaks. The typical method is to place the ultrasonic transmitter inside the vehicle and use the detector and headphones to listen around seams and gaps. Since the ultrasonic sound waves have a smaller wavelength than normal audible sounds, they "fit" through tighter gaps and will help you locate even the tiniest leaks.

The Mercedes-Benz recommended kit is the OmiSonic Ultrasound Diagnostic System. Included in the kit are not only the ultrasonic transmitter and receiver with headphones, but a variety of sound probes to focus the search as closely as needed. There are other, similar, choices on the market, in varying price ranges, some under $100. For a shop that might need to find a leak

The Mercedes-Benz recommended ultrasonic leak detection tool. This kit comes with an ultrasonic transmitter and receiver, along with a headphones and a variety of probes to simplify leak locating without needing a test drive.

(including in vacuum, pressure, and fluid lines) the better-quality systems are worth the money, but for occasional use you can often get away with a cheaper tool.

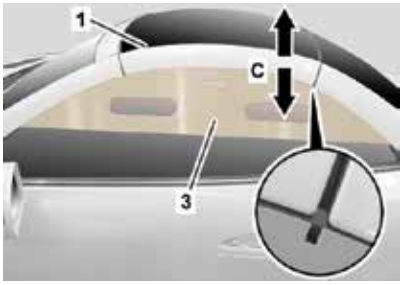
The ultrasonic tool can also help find water leaks, as the gap needed for water to get in will always be larger than the gap needed for air to cause a problem. In many cases, though, a good water test can help a lot. There are a few tricks we'd like to share with you when conducting a water spray test.

The first is to try to find the leak without water. Water is obviously wet, and needs additional precautions that a visual or ultrasonic test does not. Then, line the inside of seams with paper towels, held in place with that painter's tape. This is not only to keep the interior of the car from getting wet, but to help visually verify the leak. The large rolls of continuous paper towels often found in restroom dispensers are best because the type of paper shows water much better than household paper towels.

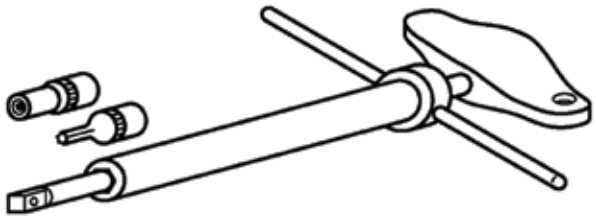
During the water test, spray a small area – maybe just a foot long – with a forceful stream of water for at least a minute, then wait several minutes to see if water has penetrated into the car. If you spray everywhere, you really won't accomplish much other that verifying that a leak exists because you can't be sure where the leak is coming from. If you go slowly and do it right, you'll only have to do it once, meaning time will be saved.

Before we leave the topic of troubleshooting, we have to remind you of the possibility of clogged drains: The A/C box drain, the sunroof drains, and any engine compartment drains should always be checked since even in a sedan this can be the cause of a wet floor mat.

In a roadster, before performing any window glass adjustments, make sure that both the door and the hard top are correctly adjusted. The door is checked by looking at the body gaps, which should be even



A Mercedes-Benz roof profile check tool. Trying to adjust the windows on a convertible or roadster without verifying the roof profile is pointless and will only lead to frustration. Borrow or buy one from your local dealer.

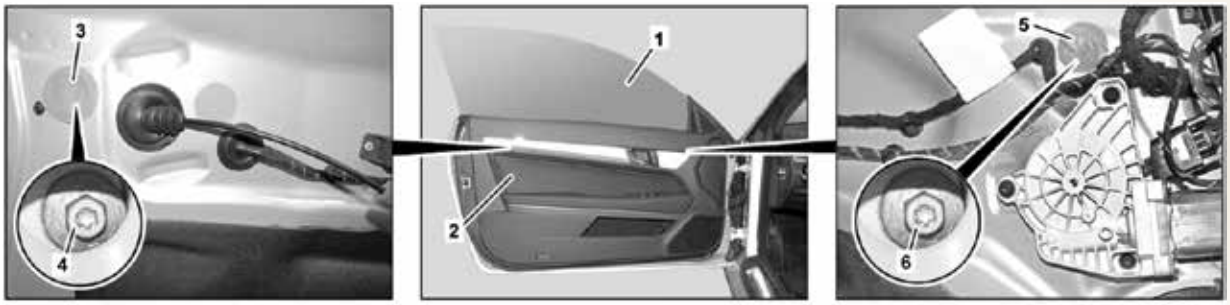


This special concentric socket wrench (W209 589 00 09 00) is an essential tool for adjusting windows. Even if you only use it once a year, the price is well worth it for the speed and convenience.

and flush around the door. The roof profile is checked with a template available as a special tool borrowed or bought from your local Mercedes-Benz dealer. Don't skip this step because with an incorrect roof profile it is impossible to adjust the windows correctly.

Once we have the door and the roof squared away, it's time to deal with the seals. Check them by eye and by touch for even the slightest imperfection. Replace anything that's not quite right. By the way, this goes for windows in full-frame doors as well. Feel the window channel with a finger tip, and if you find a high or low spot, take care of it. This is also the technique for automatic closing windows that self-reverse at times. Find the imperfection in the window channel and correct it. Back in the days of the W140 S-Class, the first model with automatic window closing, we remember a service bulletin suggesting the use of a "hard wooden wedge, such as oak, to open the window track" if needed. An armstrong method indeed.

The next step is to put the window into what is known as the "Basic Position." WIS describes the exact method and measurements for each model, but the procedure is usually about the same, and does not always require you to remove the inner door panel. You'll find the work instructions for "Adjust crank window on front door" in



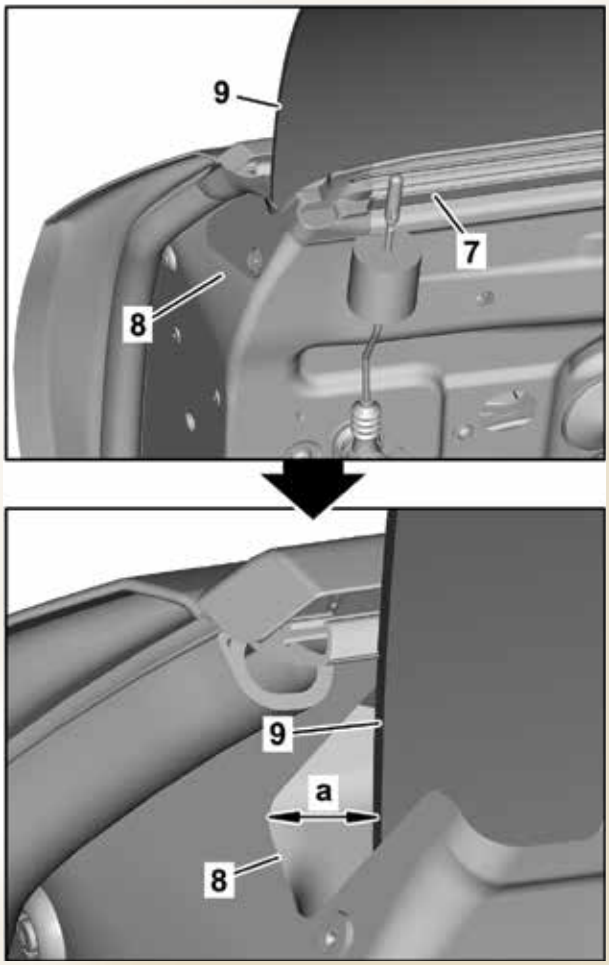
Adjustment bolts. After removing the inner door liner and tape sealing circles, the adjustment bolts are accessed by moving the window down a few inches. It is critically important for sidebag performance to replace the sealing circles when the work is completed.

service group 72. Basic tools you'll need include a body feeler gauge, painter's tape, pencil, measuring calipers, a very long T25 driver, and the special Concentric Socket Wrench (W209 589 00 09 00).

This wrench is absolutely worth buying, even if you use it only once. It's a socket for the locking nut that is concentric with the bit for the adjustment screw. Tightening the locking nut after adjusting the screw requires the screw to be held in place, nearly impossible without this tool, and trivial with it.

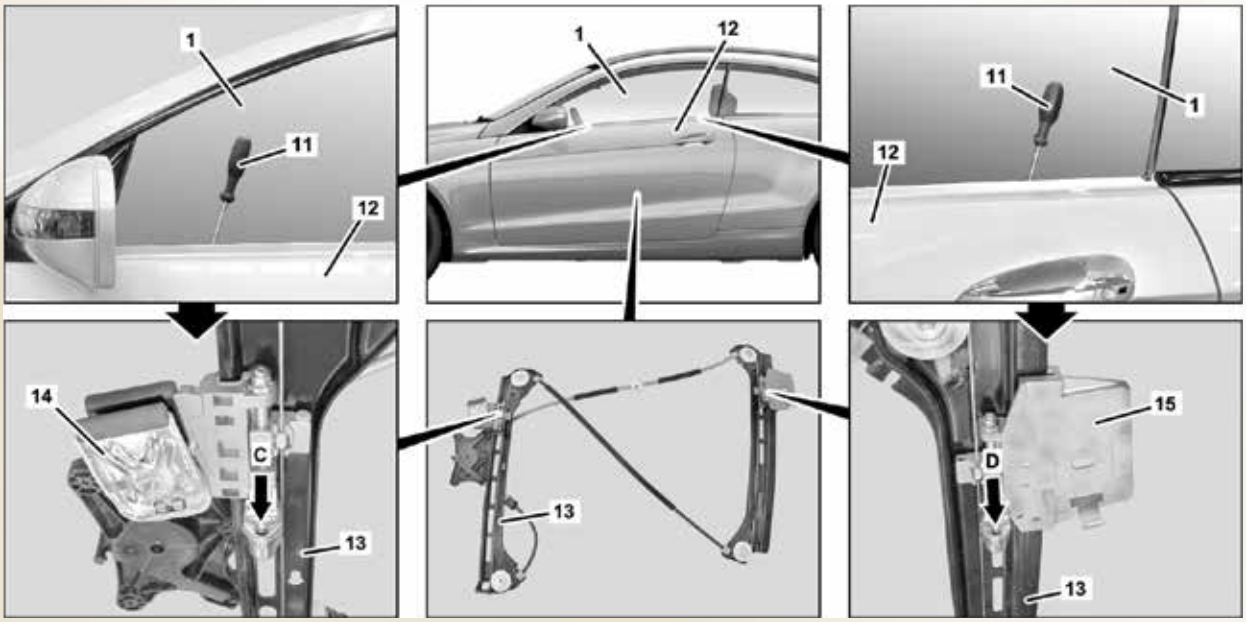
Here we'll outline the procedure for a Model 207 E-Class convertible, as explained in WIS document AR72.10-P-1950EC, but other models are similar, differing mainly in their precise dimensions, but some models have a somewhat different procedure depending on how the window lifter mechanism is configured. Once you start the procedure, you have to go all the way through it to be sure the window is fully adjusted.

The first step in the E-Class is to remove the window sealing rails and the inner door lining. Refer to the image "Adjustment bolts." Remove the "duct tape" sealing circles (3, 5) from over the adjustment bolts (4, 6) and, with the door window switches temporarily reconnected, lower the front window until the bolts can be seen through the holes.

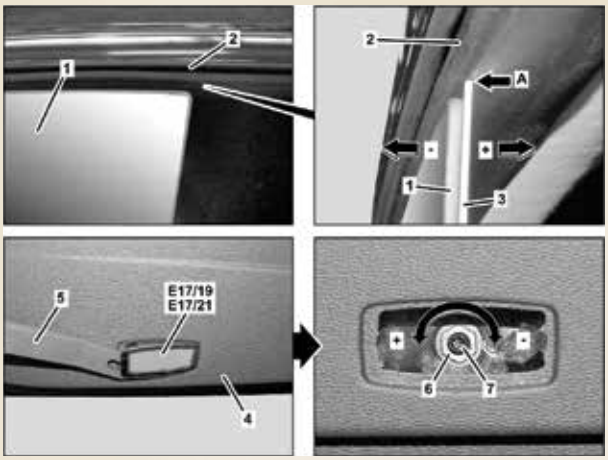


The Basic setting. Measure the distance "a" from the rear of the window to the metal edge of the door, and adjust to the specification.

To adjust the height, start by making reference marks on some tape placed near the top edge of the glass as shown. See the text for the dimensions.



The adjustment screws for the glass height are accessed through the gap between the outer edge of the glass and the door frame. Use a very long T25 driver to access the screws.



The top right mage shows the setting for the window tension against the door seal. A feeler gauge (3) is used to check the gap. The concentric wrench is used to make the in/out adjustment using the bolt-screw combination shown at lower right. This can be accessed without removing the inner door panel by removing the door lamp.

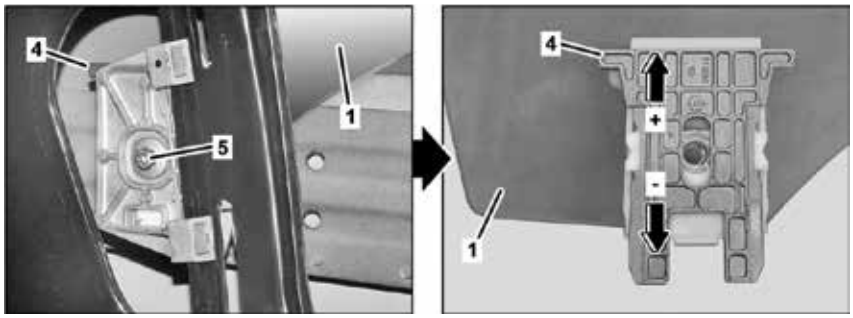
WARNING: After removing any seals or covers from the door, be absolutely sure to reinstall them, replacing them if necessary if there is any chance they might not seal properly. The SRS Airbag system uses in-door pressure sensors to detect a side collision, which is far sooner than the vehicle acceleration sensors can detect such a collision with a “soft” component such as a door. This allows the SRS system to inflate the sidebag protection at the right time. Failing to ensure a properly-sealed door can disable or reduce the effectiveness of this system, and nobody wants the legal liability in the inevitable lawsuit, or the personal guilt.

Set the basic position in the “X” direction by measuring the gap from the very rear of the window glass (9) to the edge of the metal door frame (8) as shown in the image. Dimension “a” should be 16.5 mm as measured with your calipers. If it’s not correct, loosen the adjustment bolts and move the window so that the dimension is 16.5 mm, then retighten the bolts. Replace the sealing circles and, reconnecting the door switch, completely close the window to complete the Basic Setting.

Next, adjust the glass height, the “Z” direction. Start by marking some reference lines on the glass. Put a piece of painter’s tape near the front top edge of the glass, and another near the rear top edge of the glass. Measuring down from the top, mark a line (“b”) 10 mm down from the top edge, about 25 mm from the mirror triangle rubber molding at the front, and a line (“c”) 10 mm down, about 40 mm from the rear edge. Close the front door, and with the window switch connected, close the glass completely. Then open the door, causing the glass to move downward slightly to the ‘short stroke’ position, and disconnect the door switches.

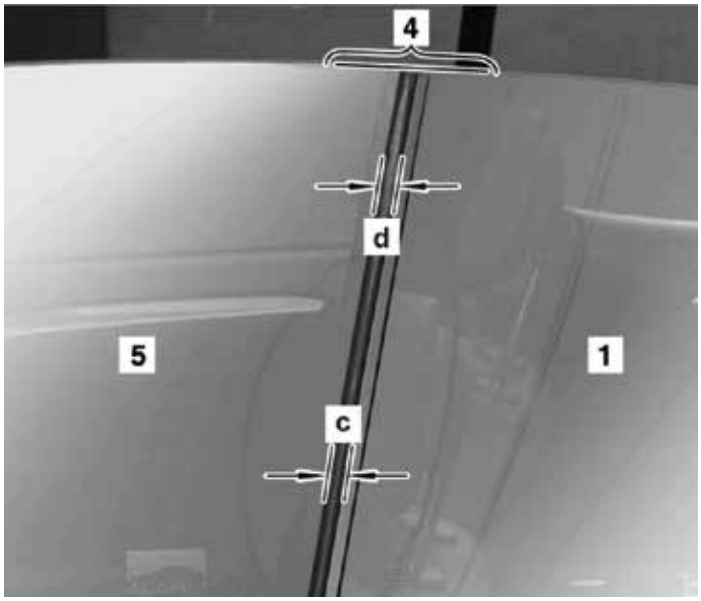
With the glass in this slightly lowered position, close the door and use an 8mm feeler gauge to check the distance between the rubber roof seal and the line on the tape. Starting with the front, turn the adjustment screw, if

necessary, to achieve a distance of 8 mm. Repeat for the rear. The adjustment screws for front and rear are accessed through the gap between the outer door skin and the glass, along the window track, down several inches. Clockwise lowers the glass, counterclockwise raises it.



If the adjustment screw (7 in a the previous photo) gets tight while turning it, stop! The screw has limited range and will strip if forced. To change the adjustment range, move the wedge shim (4) a little by loosening the holding bolt (5) at the rear of the window lifter mechanism.

Once the adjustment is correct, reconnect the window switch and move the window up and down several times. With the glass raised, disconnect the switch, close the door, and re-check the adjustment. When all is set properly, remove the tape from the glass and proceed to the tension ("Y") adjustment, which is the tilt in and out.



After setting the front window, check that the rear window is aligned. If not, there are separate work instructions in WIS for the adjustment procedure.

Reconnect the window switch and move the glass a few millimeters below the short stroke position so it does not move up when closing the front door. Disconnect the switch and close the door. Measure the distance near the rear corner of the glass from the inside of the window glass (1) to the inner edge of the groove in the top sealing frame (A) using a feeler gauge (3) as shown. For the 207 Coupe, the dimension is 2 to 3 mm, while for the cabriolet the dimension is 6 to 7 mm. If adjustment is necessary, open the front door and place the concentric wrench on the adjustment screw (7) and locking bolt (6). Note that this is also accessible without removing the inner door panel by removing the door-mounted lamp (E17/19 for example) by prying at the rear.

Loosen the locking nut while holding the adjustment screw steady, then turn the adjustment screw, clockwise to move the top of the glass outwards (-), and counter-clockwise to move the glass inwards (+). Once the adjustment is correct, hold the adjustment screw steady and tighten the locking bolt to 9 Nm. You'll be opening and closing the door a few times as you make this adjustment.

If you feel the adjustment screw is starting to get tight, stop! It only moves so much, and forcing it will strip the threads. If this happens, the wedge shim (4) on the rear of the window lifter mechanism must be adjusted to get enough range for the screw. Loosen the bolt (5) and move the shim up to move the glass outwards and down for inwards. Retighten the bolt (9 Nm) and repeat the adjustment screw procedure.

The last step is to adjust the rear window glass to meet the front window glass, if necessary. Close both side windows completely and check dimensions "c" and "d". The dimension specification is 9 to 10 mm for both. If this needs adjustment, there's a fairly involved procedure to follow, detailed in WIS document AR67.30-P04200-05EA.

We hope this introduction to movable glass adjustment to address wind and water leaks has been informative and helpful. By its nature, the process is somewhat complex and, thankfully, rarely needed. We chose the 207 E-Class model because this process is very typical of these adjustments, but each model has its own specific dimensions, settings and procedures, so please consult WIS to find the ideal method to use for the vehicle at hand.

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Collision:
Precision Frame Straightening

Tape measures and levels are ancient history. Today, you need the right equipment and procedures to put things back where they need to be EXACTLY.

Mercedes-Benz requires vehicles needing structural restoration to be repaired on a straightening bench that is dedicated to the specific model and approved by the company. Examples of structural areas include any that involve axle mounting points, damage to longitudinal members (frame rails), floor cross-support beams, A, B, and C-Pillars, and side reinforcements.

Stable anchoring system

A dedicated straightening bench features jigs that function as both a stable anchoring system and a precision reference point. Jigs hold the vehicle in place and the target component stable while you disassemble down to a location where you will section, or to a part from which you will build back out. They allow you to disassemble damaged components while avoiding further destruction of any portion that you need to salvage. Once attached, jigs permit you to cut, pull and straighten a component without altering the position of adjacent undamaged parts.

Factory reference point

Mercedes-Benz partners with collision repair bench manufacturers to develop straightening equipment and jig sets that are dedicated to one Mercedes-Benz vehicle model. These jig kits are designed to fit key structural anchoring points and components for an individual Mercedes-Benz platform with zero tolerance. When used properly, they allow you to restore the damaged area to factory dimensions.

You attach jigs to beams that mount laterally across the bench. Refer to the vehicle data sheet to determine cross beam and jig positions. Using the correct data sheet ensures that all control (anchor) points and pulls as you proceed are specific to the vehicle you are repairing.

Once in place, beams and jigs provide a three-dimensional anchoring system that verifies whether or not key locations match their factory reference dimensions. And the jigs bolt to the reference locations so control points do not shift as you make pulls.

Reduced need to measure

A dedicated straightening bench with three-dimensional anchoring jigs allows the technician to know when a component or point is in its correct position without having to measure. The magic of a dedicated straightening bench is that a jig in its proper data sheet location will only point to or mate correctly with a

component when the damaged area has been restored to its factory specified position. Until you pull the damaged area to the position that is correct in three dimensions (length, width and height), the component will not fully meet the jig.

Set anchor points in undamaged areas

Your first mounting locations must be points not affected by collision damage. You then straighten one small amount of damage and either install the replacement component or place additional jigs related to that now-corrected area.

You pull in small increments. You often can see on the work if you miss a target, but the software offers precision beyond what the eye can see. On-screen results alert you when there is zero difference between the desired and the actual location of the pulled point. With a little practice, you'll get to where you confidently pull without overshooting the target.

Zero tolerance precision

Once you complete a pull for a component or location, that result becomes an anchoring point for additional pulls. You continue this process until you can begin replacing or repairing components. Your repairs are based on zero-tolerance precision without introducing the risk of measuring error. The complicated math involved in locating a position in three dimensions is handled by the software and verified on screen in real time as you conduct the pull. Elimination of the potential for measuring error is the reason Mercedes-Benz does not publish body dimension data, and does not approve the use of comparative measurements of known-good components or vehicles to determine collision repair location points.

A dedicated fixture bench with three-dimensional anchoring jigs takes a little longer to set up, but it makes up for it in the precision offered by its zero-tolerance location of points. It also saves time on the back end by not having to measure each pull in multiple dimensions. Even laser and sonic measuring systems, although semi-automated, are not faster than not having to measure at all.

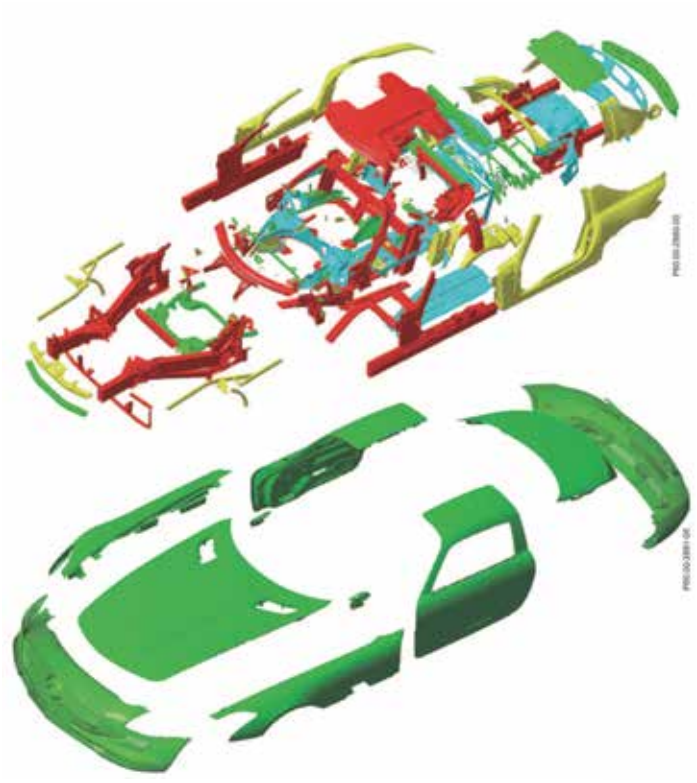
Sedan, Coupe, Cabriolet...

A dedicated straightening bench is set up differently for each vehicle model or platform, for what areas sustained damage, and for the level of vehicle disassembly at the start of structural repair. Which jigs are mounted on the bench is dependent upon the mix of these variables.

For example, the 2005 to 2012 Mercedes-Benz A-Class hatchback (model 169.0) uses a different jig setup from the 2005 to 2008 B-Class 5-door hatchback (model 245.2).

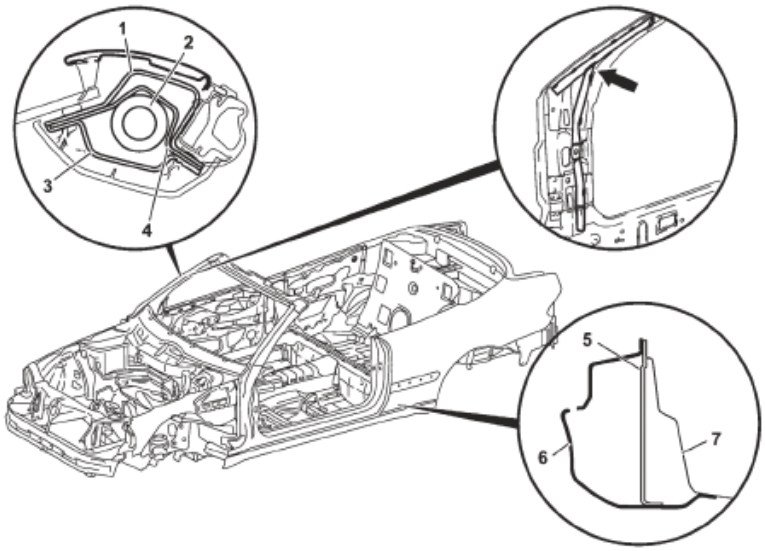
Jigs and component location

A comparison of differences between key structural parts on a CLK Cabriolet versus the CLK Coupe gives an example of how the jig setup of a dedicated bench



Repairs to welded structural components fall into the Mercedes-Benz Repair Stage 3. Repairs in that category require the highest level of technician training as well as the most sophisticated equipment. You may conduct any straightening of welded structural components only on a Mercedes-Benz-approved body repair bench using dedicated (model-specific) jig sets.

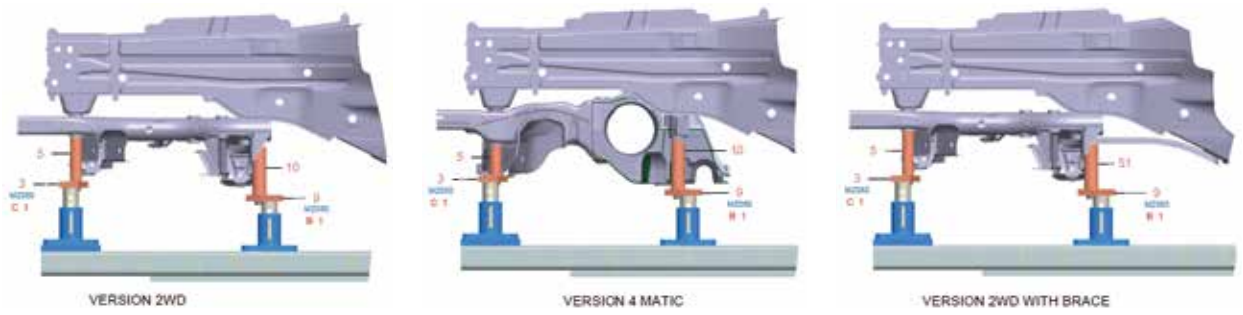
simplifies component placement issues that could be subject to human error if done manually. The body of the CLK Cabriolet (model 208.4) is essentially based on the floor, front end, and rear assemblies of the CLK Coupe (model 208.3). Despite this shared platform base, panel thicknesses of structural parts such as the longitudinal members, A- and B-Pillars are larger for the CLK Cabriolet (convertible) than for the CLK Coupe. The panel thicknesses create point-to-point measurement differences that, although not easily discernible to the eye, result in different jig locations on a dedicated bench. You must also adjust component placement to accommodate the related weld joint thickness variation. For structural repairs, you must mount these vehicles on a Mercedes-Benz-approved dedicated straightening bench.



Panel thicknesses of the longitudinal member (5 and 6 in this image, attached to the floor panel - 7) and A-Pillar (1 through 4 in image) and B-Pillar are larger for the CLK Cabriolet (model 208.4) convertible than for the CLK Coupe (model 208.3). The tiny differences in point-to-point distances (and resulting weld joint setup) could easily be missed unless you use a dedicated bench and jig system.

Vehicle configuration differences

A dedicated straightening bench accommodates some structural



The anchoring jig for the engine cradle with brace (part number 51, lower image) is different from that for the cradle that has no brace (part number 10, upper image). The anchoring jigs for the non-braced 2WD and 4WD (4 MATIC) engine cradles are identical, as neither has a brace.

differences based on vehicle configuration options. An example is the anchoring jig for the engine cradle on the two-wheel drive C-Class (W205). One version of the 2WD features a brace that supports the rear of the engine cradle through an additional connection to the longitudinal member. There is a different anchoring piece for the 2WD cradle with a brace than for the cradle version that has no brace (Celette jig set number 7205.5C).

Jig sets can also be set up differently to mount a vehicle with or without mechanical components (engine, drivetrain) installed.

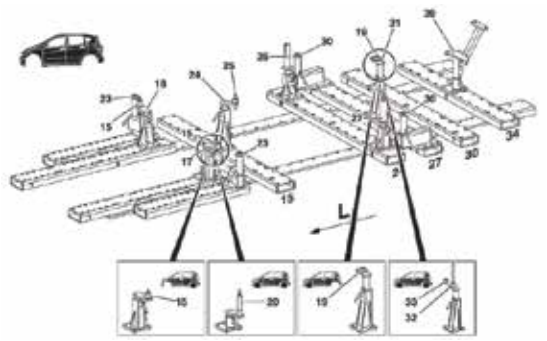
Mercedes-Benz, Celette & Car Bench

Mercedes-Benz develops its repair procedures before a new vehicle is put into production. It crashes multiple cars, rebuilds them using different methods each time, then selects from among those results the repair procedures that offer a level of structural integrity equal to that of factory specifications.

Mercedes-Benz works with two straightening bench manufacturers – Celette and Car Bench – to jointly develop straightening benches and dedicated jig sets for each new model. Both offer dedicated jig systems for individual Mercedes-Benz models.

Do not use pinch welds or jacking points

Engineers combine information about the straightening requirements of different structural materials with what they learned from post-collision repair testing and use the results to select potential anchor points around the vehicle structure. The vehicle data card identifies as potential anchor points only those connections that have been proven able to absorb the pulling force needed to straighten the attached components or materials. A correctly located body point is bolted to the jig while you straighten, weld, or glue.



The jig setup for anchoring the rear of the 2005-2012 A-Class five-door hatchback uses different straightening tools depending upon whether the rear axle has been removed (use straightening tool number 39 or 31 in combination with jig number 19), or is still in the vehicle (use straightening tool number 31 in combination with jig number 33). Always set up the right side of the straightening bench to match the left.

Mercedes-Benz explicitly states that floor pan pinch welds and rocker panel jacking points cannot be used to anchor the vehicle for structural repairs. When straightening structural components, the vehicle may work loose or warp if clamped at pinch welds or jacking points, which are not designed for sustaining maximum force. Straightening systems that rely on pinch welds or rocker panel jacking points may be used only for damage diagnosis, never for structural component repair.

Certified Collision Repair Facilities

Mercedes-Benz Certified Collision Repair Facilities must use Mercedes-Benz approved dedicated straightening equipment and fixtures, and are required to follow the company's procedural instructions to perform structural repairs. Failure to do so may result in decertification of the repair facility.

Motivational speakers say that dedication is critical to life success. Mercedes-Benz engineers say that a dedicated straightening bench is a prerequisite for structural repair effectiveness. Both are correct.

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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 M-B dealers
	BQ 1 09 0195	6/1 Quart Cases		
	BQ 1 09 0196	55 Gallon Drum		
Mercedes-Benz GEO 229.5 5W-40	A000989790211BIFU	Liter	Fully Synthetic formula specifically designed for Mercedes-Benz engines that require the 229.5 Specification	Mercedes-Benz Engines that require 229.5 Specification Oil
	A000989790217BIFU	208 Liter		
	A000989790219BIFU	Bulk - No Equipment		
Mercedes-Benz High Performance EO 229.5 0W-40	A000989810211BIBU	Liter 5KG	Fully Synthetic formula specifically designed for Mercedes-Benz AMG engines that require the 229.5 Specification	Mercedes-Benz Engines that require 229.5 Specification Oil
	A000989810217BIBU	208 Liter 15KG		
Mercedes-Benz GEO 229.6 5W-30	A000989820211BJEU	Liter 40KG	Fully Synthetic formula specifically designed for Mercedes-Benz engines that require the 229.6 Specification	Mercedes-Benz Engines that require 229.6 Specification Oil
	A000989800217BJEU	208 Liter 20KG		
Mercedes-Benz GEO 229.71 0W-20	A000989830211BNXU	Liter 35KG	Fully Synthetic formula specifically designed for Mercedes-Benz engines that require the 229.71 Specification	Mercedes-Benz Engines that require 229.71 Specification Oil
	A000989830217BNXU	208 Liter 15KG		
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		
Mercedes-Benz GEO 229.52 5W30	A000989800219BMEU	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
	A000989800211BMEU	Liter 170KG		
	A000989800217BMEU	208 Liter 50KG		
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
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		

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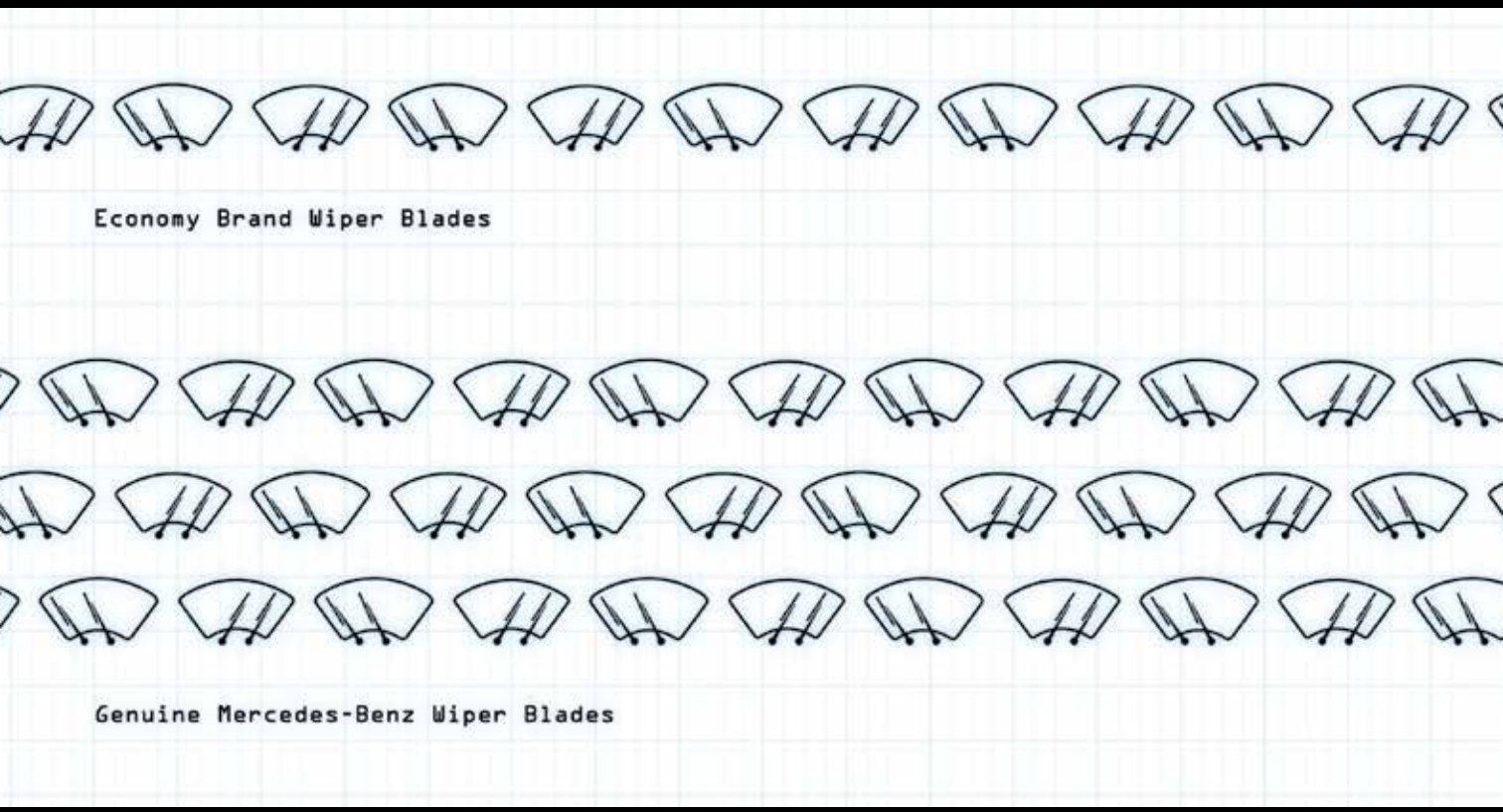
Product Name	Part Number	Quantity	Product Description	Recommended Consumer App.
Mercedes-Benz SPEC.				
Mobil 1 15W-50	BQ 1 09 0023	55 Gallon Drum	Boosted, higher viscosity, advanced full synthetic formula designed for performance vehicles	HT/HS applications. Racing and Flat tappet applications
	BQ 1 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
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 15W-40	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 Aftertreatment 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 10W-30	BQ 1 09 0086	Bulk - No Equipment		
Mobil Delvac 1 5W-40	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 80W-90	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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