LIFETIME MAINTENANCE SCHEDULE v03.13
BY MIKE MILLER

Substantive updates from Lifetime Maintenance Schedule v09.11:

1) The turbocharger warm-up and cool-down procedures section has been eliminated because I determined it is not possible to verify that traditional turbocharger warm-up and cool-down procedures recommended by turbocharged car manufacturers for old cars in the past would have any beneficial effects on late-model BMW turbochargers. However, they can't hurt, either.

2) References to specific battery part numbers have been deleted due to frequent part number changes on the part of battery vendors.

3) The realities of coolant change cost with the N-Series engines are discussed in the Cooling System Preventive Maintenance section.

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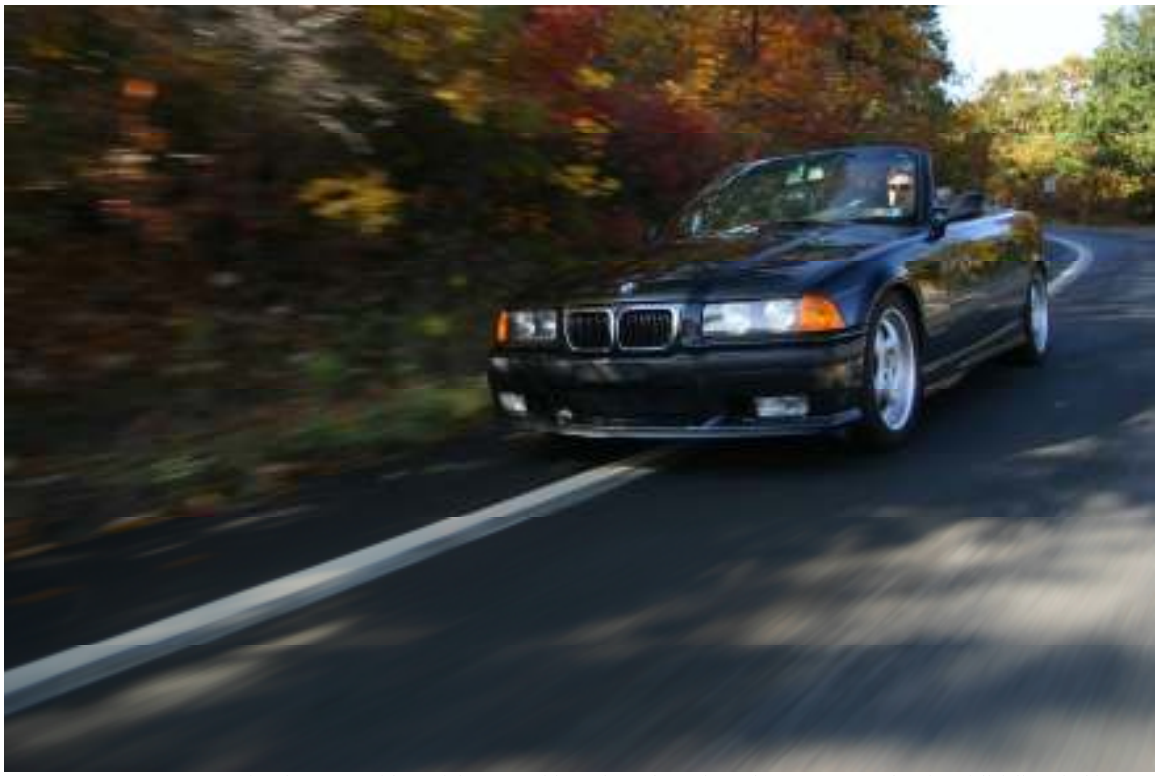


BMW CCA Pocono Mountain Chapter President Rich Warren blasts through rural Northeastern Pennsylvania's fall foliage in his former 1999 M3 convertible with Dinan Stage 2 suspension.

Introduction

This document discusses maintenance for long-term ownership. Long-term means more than 100,000 miles or without a warranty.

If you are going to trade, sell, or return your car during the BMW New Vehicle Limited Warranty or even much before 100,000 miles there is no reason to perform extra maintenance other than helping out subsequent owners of the car. If you get out of the car during the warranty or even much before 100,000 miles, superior maintenance is not likely to affect your ownership experience with one exception, the manual gearbox – it will shift better if you change its oil at the reasonable intervals discussed here.

Many of you really want just the maintenance schedule for your particular BMW, and not necessarily a treatise that covers all BMWs. The girth of information here is calculated to foreclose follow-up questions. Question volume overall is staggering. Most of the revisions to this document are part of that strategy; substantive changes are rare.

History of BMW-recommended Maintenance

The BMW Maintenance Program (formerly known as Scheduled Maintenance) means that BMW will perform scheduled maintenance free of charge during the BMW New Vehicle Limited Warranty period.

According to BMW NA, in 1992 BMW made 3/36 scheduled maintenance coverage available for purchase. In 1993 BMW began covering scheduled maintenance for V12 models (750iL and 850i). Three-year/36,000 mile scheduled maintenance became standard across the BMW line-make in 1996. Three/36 “scheduled” was upgraded to 3/36 “full maintenance” on all BMWs in 2000. The four-year/50,000 mile BMW Maintenance Program (the term “full” was dropped) was introduced across the BMW line-make in 2004.

Research indicates that prior to the advent of Scheduled Maintenance, approximate BMW maintenance recommendations on, for example, the E30 3 Series, were: automatic transmission fluid (ATF) and filter changes every 15,000 miles, manual gearbox and differential oil changes every 30,000 miles, annual brake fluid changes, and coolant changes every two years. Spark plugs, air filter, and fuel filters were typically replaced every 30,000 miles on most BMWs (this is a tune-up) except M cars up to 1995, which got new spark plugs and a valve adjustment every 15,000.

Later advances in computer engine management and spark plug technology legitimately allow 60,000-mile spark plug life if not more.

It seemed that prior to Scheduled Maintenance, BMW owners could not change engine oil often enough according to the dealer. And when the car was in the shop it would often be due for this service or that inspection, all at the owner’s expense.

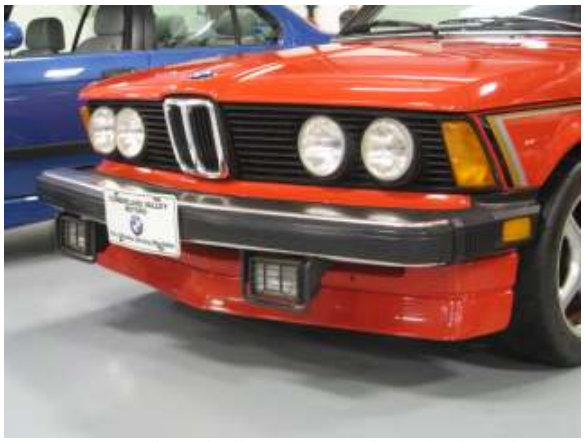
The operative word here is “scheduled.” Once BMW began paying for scheduled maintenance, lo and behold the schedule was continually revised -- seemingly to eliminate maintenance items. Today, it’s not a stretch to write that according to BMW the cars hardly need any maintenance at all. The 1,200-mile break-in service was done away with except for M cars. Engine oil now supposedly lasts 15,000 miles or more. Manual gearbox and differential oil is often characterized as “lifetime fill” in non-M cars. Brake fluid and coolant service intervals were doubled with no change in the original BMW brake fluid and anti-freeze dealers are supposed to use. As of 2005, coolant became “lifetime fill” as well. Queries about the change in original BMW anti-freeze that made it “lifetime fill” did not bring an answer.

So, is today’s BMW Maintenance Program all about marketing and cost reduction – BMW’s costs? Draw your own conclusions. There is no doubt that many buyers view BMWs as high maintenance cars and that can be an impediment to sales – and it is also entirely correct. Nothing can address that more effectively than Free Scheduled Maintenance. In my opinion, extended service intervals and “lifetime fill” came very close on the heels of Free Scheduled Maintenance.

Environmental issues probably also played a part in maintenance reduction for many car manufacturers. Governments around the world are pressuring car manufacturers to reduce liquid waste resulting from maintenance as well as the escape of gasoline vapor and crankcase vapors.

Of course, not maintaining one’s car is not exactly good for the environment, either, because it requires more cars to be scrapped, recycled and produced – these things all cause pollution, even recycling.

Regardless of what side you’re on, it’s important to bear in mind that the lubricants in your car will be drained someday. Doing so during regular maintenance has no additional effect on the environment as long as they are recycled or used properly, such as to heat a building in a waste oil burner.



BMW CCA member Ed Ullom's 1982 320is. Turbocharged and tastefully modified for the street, Ullom has driven it in countless races, autocrosses, and other driving events. It has more than 170,000 miles on the original drivetrain, and it runs perfectly. The secret? Routine maintenance, the Lifetime Way!

What follows is nothing new. It is actually BMW's maintenance schedule, more or less, which was used prior to Free Scheduled Maintenance. It also represents the author's opinion, based upon personal experience and that of readers, tech advisors, and professional BMW technicians both dealer and independent. It was written simply because of the large number of readers asking for this information; I am not telling you how to maintain your car. The fact that my opinions may differ from those of others does not mean anyone – including me -- is necessarily right or wrong. You will get a different answer from every person you ask about routine vehicle maintenance; notably, the only way to verify an ideal fluid change interval is through consistent use of oil analysis.

Break-in Service for New Cars and Rebuilt Driveline Components: 1,200 miles

Before maintenance became "free" during the warranty, BMW performed a break-in service at 1,200 miles on new cars, which included changing the engine oil and filter, manual gearbox oil, and differential oil. With the advent of Free Scheduled Maintenance, BMW stopped performing break-in services except on M cars.

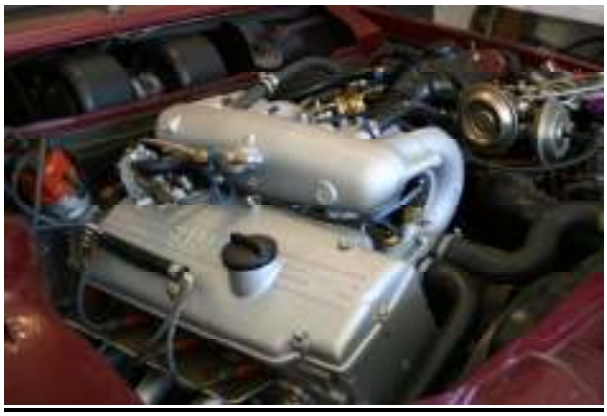
In time the M car break-in service might be expected to go away, too.

Oil analysis has shown the engine and driveline oils in new modern BMWs are literally full of metal at 1,200 miles – as has always been the case with any new car. For this reason, I recommend a 1,200-mile break-in service.

Note: In case of automatic transmission, no ATF and filter change is necessary at 1,200 miles.

As for break-in technique, in my opinion the best bet is an extended road trip comprised of as much mountainous terrain as possible, for as long as possible up to 1,200 miles, and keeping the rpms within the limits BMW recommends on the windshield sticker included with all new BMWs.

A 1,200-mile break-in service is also advisable for rebuilt engines and other rebuilt drivetrain components where one intends to keep the vehicle.



The author's freshly-rebuilt M10-powered 1977 320i.

Oil and Filter Intervals: Variable every 3,000 to 10,000 miles

Initially, I do not recommend specific engine oils because that is a never-ending debate. I will discuss what I use and what BMW recommends in the U.S. market, as well as some other options. BMW recommends their Castrol 5W-30 synthetic motor oil in all BMWs except contemporary M cars, for which they recommend their Castrol TWS Motorsport 10W-60 synthetic motor oil. BMW recommends Castrol SLX Professional OE 5W-30 for

the Efficient Dynamics diesel engines (which does not include the E28 524td). The factory oil change interval is controlled electronically, but is presently about every 15,000 miles. If you are running BMW's oil, oil analysis has indicated that oil and filter change intervals of 5,000-7,500 miles are prudent for long-term ownership.

If you have an M car with the S54, S62, or S85 engine, be advised that Red Line Oil has a 10W-60 product available now for these M engines.

Previously, the commercially available Castrol products sold at Wal-Mart bore no resemblance (other than brand name) to the Castrol products sold at the BMW dealer and through BMW parts houses. As of this writing, some BMW technicians believe the patent on the original BMW 5W-30 oil has run out and it is now marketed as Castrol Edge for less at Wal-Mart. Without petrochemical analysis there seems to be no way of confirming this assertion.

In Europe, BMW endorses Elf (confusingly called Total in the U.S. market) 5W-30 and 5W-40, and LubroMoly 5W-30, 0W-40, and 5W-40 for the non-M cars. These are PAO synthetics like Red Line, and I'd have no problem running them 7,500 to 10,000 miles. Of course, they are not available at Wal-Mart; like Red Line, they may be available locally but more than likely you'll have to order them and have them shipped to you.

Because you guys generally want to know, in my cars (remember, I don't care what oil you use!) I use Red Line synthetic oil (www.redlineoil.com) in 5W-30, 10W-40, 15W-50, 10W-60, or 20W-50, depending on factory recommendation, ambient temperatures, and severity of service (track use, sustained high rpm use), with a drain interval – 7,500 to 10,000 miles depending on engine and severity of service. Under racing or track conditions I'd use a short interval; same for carbureted engines which tend to get some fuel into the oil. I would *test* the same intervals with very high end "designer synthetics" such as Agip, Amsoil, Lubrication Engineers Monolec Ultra, Elf (Total), Lubro Moly, or Motul.

Old fashioned petroleum oil usually calls for 3,000-to-5,000 mile drain intervals, again verified by oil analysis.

Notes on engine oil

1) The best way to validate any oil drain interval with any oil in any engine is by oil analysis. I use www.blackstone-labs.com.

2) Engines with cork gaskets should use petroleum oil, not synthetic oil. In the BMW world that means the M10 engine among other antiques.

3) Because many of you ask: my 2005 Dinan S2-325Ci received a break-in service at 1,200 miles using Red Line 10W-40 (along with Red Line MTL in the manual gearbox and Red Line 75W-90 in the differential), followed by oil and filter changes using the same product at 10,000, 20,000, 30,000, 40,000, 50,000, and 60,000 miles. At the 40,000-mile oil change, I had Blackstone Labs perform an oil analysis. The results were excellent, showing no wear, viscosity good and well within the 40W range, TBN of 1.4 indicating some active additive left. A TBN (total base number) measures the amount of active additive left in a sample of oil. (Knowing the TBN is useful for people who want to verify their oil change interval). The 10,000-mile interval is perfect for Red Line 10W-40 in this engine, in this car, with me as the driver. Oil analysis is really the only way to validate *your* oil choice and *your* drain interval.

How to help turbochargers last as long as possible

Many readers who own BMWs powered by turbocharged engines ask how they can help the turbochargers last longer.

They are concerned with the cost of post-warranty ownership of the modern BMW and want to know how to approach it. It's worth noting that as of this writing a very senior BMW master technician reports zero turbocharger failures even though some N54 turbo engines he services have over 100,000 miles. Concern is not unwarranted, but maintain perspective – if your car needs a turbocharger at 150,000 miles it is not necessarily due to something you did or did not do. The best thing you can do is use very high quality full synthetic oil in a viscosity that can withstand tremendous heat, and change it at an interval appropriate to the product, verified by oil analysis.

The same master technician recommended oil and filter change intervals of no longer than 7,000 miles in cars intended to be kept past the warranty.

Readers with longer memories often ask about traditional turbocharger warm-up and cool-down procedures they recall from the 1970s and 1980s. Essentially, in order to guard against oil "coking" in the turbocharger bearing car manufacturers back then recommended low-rpm driving until the oil reached operating temperature and an oil "cool-down" period before engine shut down. Oil "coking" ruined turbocharger bearings but that does not seem to be happening with the late-model BMW turbochargers.

What has changed? Well, for one thing while engine oil is a moving target it is safe to say that today's synthetic oil withstands high heat better than mineral based oil from the 1970s and 1980s. For another thing, late model (2007-on) BMW turbochargers are cooled by engine coolant.

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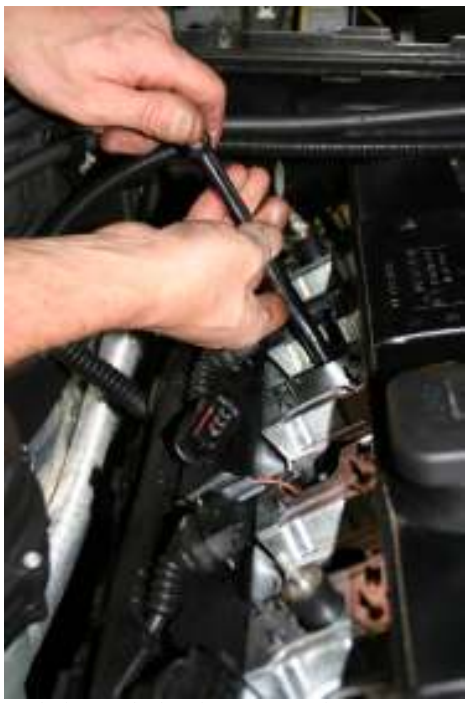
Spark Plugs: Variable every 10,000 to 60,000 miles



Replacing spark plugs in an M54 engine.

There is no reason to deviate from the factory-recommended Bosch or NGK spark plug specification, changed at 30,000-to-60,000-mile intervals, depending upon the car and severity of service. Basically, any BMW engine produced after 1993 (with multiple-coil ignition systems) including the S54, S62, S65, and S85 can easily run 60,000 miles on a set of spark plugs – but 100,000 miles may risk stripped cylinder head threads in extreme northern climates, and leaving spark plugs in service that long can compromise performance and fuel economy.

The exception is the modern gasoline-powered turbocharged engines, for which an approximate 45,000-mile interval is normally called for by the condition based service system (CBS). This is covered, the first time, under the BMW Maintenance program. However, the onboard computer *will not,* at this writing, indicate the need for spark plug

replacement. The “need” for spark plug replacement is indicated by the key memory, read by the dealership service advisor when the car is at the dealer for service, sometime around the third oil change, which is sometime around 45,000 miles. As always, BMW maintenance is one thing and getting someone else to pay for it may be another thing.

Some technicians recommend a 30,000-mile spark plug replacement interval on the modern turbocharged BMW engines. Original BMW spark plugs are highly recommended.

BMW has part numbers and applications for “100,000-mile spark plugs.” These are good too, and may be capable of 100,000 miles of service in the appropriate applications (not the N54 engine) assuming no other problems, which might cause them to foul during that time. However, in engines with spark plugs recessed into the middle of the cylinder head, oil can leak into the spark plug recesses past the valve cover gaskets. This is a hidden leak if the plugs are left in service for an extended period of time, because no one looks in there until they’re changing the plugs or chasing a problem. An oil leak in the spark plug recesses, left to fester, can cause ignition coil failure and even ECU failure. So, even if you want to leave the plugs in service, you should at least check the spark plug recesses for signs of oil leakage at least every 60,000 miles. And at the point you’re in there, you might as well replace the plugs. And then there is the matter of getting them out after 100,000 miles when no anti-seize compound was used at factory installation – there have been cases of stripped threads in the cylinder head. These are the issues with 100,000-mile plugs.

Moreover, while you may not have any problems running spark plugs for 100,000 miles in some BMWs, this does not mean the plugs will not be worn, or that that wear is not affecting engine performance. In other words, for optimum engine performance, most BMWs want spark plugs about every 60,000 miles.

Note that older M cars with the S14 and S38 engines want plugs about every 15,000 miles.

Stay away from platinum plugs in BMWs for which they are not the factory-recommended spark plugs. These don’t last as long as the regular Bosch copper or silver

plugs and NGK plus, and have been known to fail in other ways. The regular old Bosch Platinum single electrode plug is, however, a very good choice for cars *OTHER THAN* BMWs.

Old, pre-motronic engines need spark plugs replaced every 10,000-12,500 miles. If they have ignition points and condenser, replace them at the same time.

Original BMW Bosch Spark Plugs vs. Aftermarket Bosch Spark Plugs

Like just about everything else on the modern BMWs, Bosch spark plug choice is complicated and confusing. The short answer is if you order the spark plugs from BMW (sometimes there is a choice between Bosch or NGK), then you are good to go and there is no confusion. But they are expensive.

Savvy enthusiasts have found that Bosch has a part number for commercially-available spark plugs that cross-references to the BMW original equipment Bosch spark plugs, often at a fraction of the price. The problem is, the commercially-available (aftermarket) Bosch spark plugs do not always appear to be exactly the same as the original BMW Bosch plugs even though they cross-reference and they do work. Sometimes there are physical differences apparent visually.

Some dealership technicians report occasional problems with the commercially-available Bosch Platinum +4 spark plugs in BMW engines. I have never seen this personally, but physical inspection does reveal differences in insulator design between the original BMW Bosch spark plugs for the modern cars and the commercially-available Bosch Platinum +4.

We're talking about the newer multiple-coil BMWs above. Now, when we're talking about older BMWs with a single ignition coil, where the original BMW specified spark plugs are Bosch copper or silver plugs, everything is completely different. On those cars, there is absolutely no difference between the original BMW spark plugs and commercially-available Bosch copper or silver plugs at this writing – but that may change in the future.

I realize this requires a certain intimate knowledge of Bosch spark plugs, and I don't know what to tell you about that except to ask if you don't know, or just buy them from BMW. Finally, we have to note that Bosch changes its part numbering system from time-to-time, which further confuses matters.

Distributor or Ignition Cap and Rotor: Variable 30,000 to 90,000 miles

Pre-motronic point-fired ignitions should get a new cap and rotor every 30,000 miles. Motronic cars, every 90,000. Once BMW went to the multiple-coil ignition systems these parts were eliminated.

Oxygen Sensors: Variable 60,000 to 150,000 miles

The BMW-recommended oxygen sensor replacement interval varies by model and model year from every 60,000 miles on the older one-wire sensors to 150,000 miles on the new cars. The interval for your car is set forth in the service booklet, in the glovebox.

I have no problem with the BMW-recommended oxygen sensor replacement intervals assuming the sensor doesn't fail before the interval -- the newer the car the more likely premature failure becomes.

Instead you can leave oxygen sensors in service until they fail and set the check engine/service engine soon light. The beauty of replacing them preventively at the recommended intervals is that you can most likely avoid check engine/service engine soon lights at least for oxygen sensor failure.

From 1996-on, BMWs have primary and secondary oxygen sensors – one before and one after the catalytic converter. The primary oxygen sensor(s) (pre-cat) send information to the DME that controls engine operation. The secondary oxygen sensor(s) (post-cat) merely monitor catalytic converter function and have no effect on engine operation.

Oil Filter: Change with the engine oil, not between, not after, but with…

Original BMW filters are recommended for price and quality, or MANN, Mahle or Knecht filters.

Air Filter: Variable every 15,000 to 30,000 miles

Stock paper element, check every 15,000 miles, tap out dirt, replace if necessary, standard interval 30,000 miles, use Original BMW filters or aftermarket filters such as Knecht, MANN or Mahle.

Oiled cotton gauze filters should be cleaned every 15,000 to 30,000 miles depending on condition, use only approved cleaner and oil, and follow the manufactuer's cleaning procedures. But really, I would very much prefer to simply replace an oiled cotton gauze filter rather than clean it. This is particularly true on cars with mass airflow sensors.

Interior Air Filter: Variable every 15,000 to 30,000 miles

On cars so equipped, the interior air filter service life really depends on where you drive and on older models, how often you operate the climate control system, especially if you do not use the re-circulate mode. If the system is on all the time, figure on replacing the interior air filter every 15,000 miles. Otherwise, every 30,000 miles will probably be sufficient. For some models BMW has two types of interior air filters: A regular, cheaper one, and a more costly activated carbon one. Obviously, the more expensive one works better and I'd recommend it for urban dwellers and people with pollen or dust allergies.

Fuel Filter: Variable every 30,000 to 60,000 miles

Replace every 30,000 miles on models produced up to 1992 (small fuel filter, including the 1992 E30 convertible) and every 60,000 miles on models produced from 1992-on, (large fuel filter), also replace the fuel filter any time the fuel pump is replaced. Use original BMW filters or Knecht, MANN, or Mahle.

Bimmers up to about 2005 have an integral fuel pressure regulator on the fuel filter, raising the price to $60-$80. And you'll need to order new hose clamps, too. Note the installed position of the old fuel filter on the modern cars – it is possible to install the new one with the hoses oriented incorrectly and then the car won't run.

According to factory technicians, BMW is now teaching new technicians in school that the new cars have "lifetime fuel filters." The instructors say this means that when the car arrives at the shop on a roll back because the fuel filter is clogged and the engine won't start, the fuel filter's lifetime is over, and that is the time to replace the fuel filter. Ridiculous? I certainly think so. Why wait for a breakdown to perform this simple maintenance?

In reality, the service life of a fuel filter depends entirely on the cleanliness of the fuel it filters. It's possible for a fuel filter to last indefinitely if it always filters clean gasoline. It's also possible for a fuel filter to last a block and a half if you fill up with sufficiently dirty gasoline. Usually gasoline cleanliness is in between those two extremes. There's no way to really tell how much dirt is trapped in a fuel filter without cutting it open or back-blowing the fuel into a receptacle. This is why the fuel filter is best replaced as a routine maintenance item.

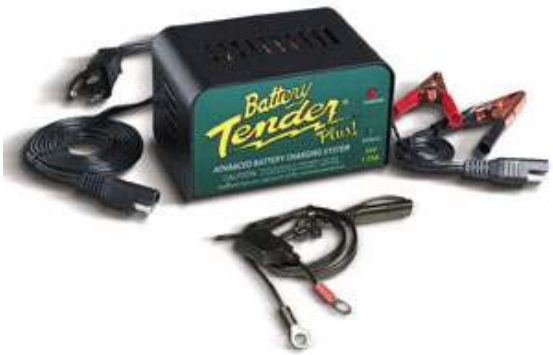
Fuel filters from the mid-2000s on are now in the fuel tank, a one-piece assembly with the pressure regulator and hoses, and the cost a great deal more than the old style fuel pumps; three-figure prices are common. This is where we've come from the $1 inline filter for the old 2002! Is it worth the savings to wait for a breakdown in order to replace the fuel filter? That is up to you.

Battery Maintenance: Use a Battery Tender for period of inactivity longer than a few days.

Contemporary BMWs since the 1990s draw battery power all the time, even with the engine shut down. Multiple electronic control units are always drawing on the battery. This means when the car is stored for periods of "about" one or two weeks or more with no battery tender attached to the charging system, the battery will discharge and fail to

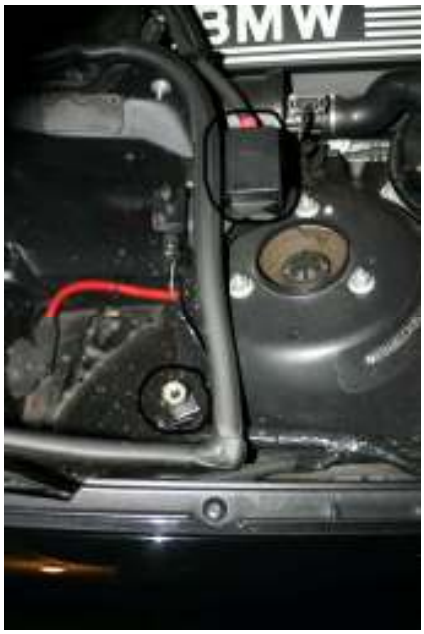
start the car. Sometimes it can be jump started or charged, but usually the battery will be rock dead.

I recommend a Deltran Battery Tender Plus (www.batterytender.com) for storing these cars longer than a week. The Battery Tender Plus is not a trickle charger, which will overcharge the battery. It is a voltage-sensing battery maintainer, which sense when voltage drops below 12-volts and then activates at a 1.25-amp charge until battery voltage reaches 13.5-volts. Then it reverts to monitoring mode. Stay away from trickle chargers – they are not for use when the car is stored unattended.



It is not necessary to access the remote-mounted battery to use the Battery Tender Plus. The Battery Tender Plus connects to the positive (+) power tap under the hood, which is located under a black plastic cover marked (+). The ground connector of the Battery Tender Plus connects to any underhood ground including the grounding lug which is located near the positive power tap. The unit also comes with a hardware cable, which can be connected to the power tap and grounding lug and routed to the grill area or under the bumper for ease of use.

See photo below. E46 3 Series shown.



Deltran also has a waterproof version Battery Tender for cars parked outdoors as well as a solar-powered Battery Tender.

Starting in 2006 BMW began using gel cell-type batteries as original equipment and replacement parts. Immediately, people began asking if the Deltran Battery Tenders are "compatible" with gel cell batteries and an Internet brouhaha ensued. Years later, I have never once heard of a Deltran Battery Tender damaging a gel cell battery.

Finally, beginning at various times in recent years BMW began building cars with cigarette lighter plugs that are not hot with the key off. This means the cigarette lighter plug version of the BMW Advanced Battery Charging System will not work on the newer cars. How newer? I don't know the cutoff. You have to check and see if your cigarette lighter plug works with the car shut down. If it does, you can use the cigarette lighter plug version of the BMW Advanced Battery Charging System. If it doesn't, then you need to use the alligator clip version and connect it to the positive power tap and grounding lug under the hood.

Battery Replacement and Registration

At battery replacement time many of my readers write in for a replacement battery recommendation, and they want to go anywhere but the dealer. Sometimes you can and sometimes you can't go aftermarket, depending currently upon the model and model year BMW in question.

History

Historically and in terms of longevity, there used to be a big distinction between the original equipment BMW batteries that come with the cars, and replacement original BMW batteries that we buy from dealerships.

Replacement original BMW batteries, which have always been very expensive, did not seem to live nearly that long back in the 1990s and early 2000s. It was not uncommon to hear of failures after only two or three years. For this reason, when it became time to replace an original BMW battery, I used to recommend an aftermarket alternative for cost savings and/or greater durability.

BMW of North America got a new replacement battery supplier in 2005, and they do not appear to have durability problems. BMW technicians seem to like them.

Special Considerations for Battery Venting

Modern BMW's must have battery ventilation due to their mounting locations -- usually in the trunk or under the back seat. Vented batteries have a provision for a vent tube, which leads outside the car and functions to vent potentially explosive gases from the battery compartment. Failure to install a properly vented battery in these cars can result in a battery explosion.

Underhood battery mounting locations do not require a vented battery.

For aftermarket replacement BMW batteries, I've always preferred Interstate Batteries

(www.interstatebatteries.com). Sears and NAPA also sell batteries that will fit in some BMWs, and some have provisions for the required vent tube.

Battery Discharge Due to Inactivity

The battery in any modern BMW (E36-era forward) will discharge in a matter of days or weeks (depending on battery condition, equipment and model BMW) if the car is left sitting without a Battery Tender connected. The reason is that modern BMWs have many control units that draw power even when the engine is shut down.

After replacing the battery in any BMW built from the E36 era-on (early 1990s/late 1980s) it is necessary to drive about 50 miles at highway speeds in order to fully charge the brand new battery. If you just drive home from the shop and park the car for a few days with no Battery Tender, chances are you'll have another dead battery.

Battery Registration

The little-understood "battery registration" process on modern BMWs has caused a great deal of confusion.

I discussed it with an uber BMW master technician who currently works at a BMW dealership. He said "battery registration" is simply telling the engine management computer (ECU) and other components that the car has a new battery.

The negative battery cable has an electronic control unit on the battery end of it called an intelligent battery sensor (IBS). The IBS measures the state of battery charge and sends this information to the ECU. The ECU uses this information to control how much charging voltage is needed from the alternator to support vehicle electricity needs. A battery deteriorates normally over time and depending upon service demands and driving profile. The IBS reads this and the ECU tells the charging system to increase voltage and amperage output incrementally as the battery matures. Therefore, at battery replacement time, if you don't tell the ECU it has a new battery it will overcharge the new battery causing it to wear out faster.

The registration process takes place in the ECU, which is the main player in this system. Also, when the IBS sees that battery voltage is too low for normal vehicle operation it can start shutting down vehicle functions to conserve power while keeping the vehicle operational. This would be accompanied by a check control warning of excessive battery discharge.

At the current level of open-source technology we are starting to see aftermarket attempts at battery registration devices, but I cannot opine on its effectiveness yet.

Valve Adjustment: Variable every 15,000 to 30,000 miles

Perform every 15,000 to 30,000 miles on the M10, M20, and M30 engines depending on how hard they are used; every 30,000 miles on the S54 engine; other modern BMW engines do not require valve adjustments because they use hydraulic lifters.

Timing Belt, Tensioner Pulley, and Front Cam Seal

Replace every five years or 50,000 miles on vehicles so equipped, 40,000 miles or four years on the E30 325iX (1988-1991), Water pump replacement also recommended as preventative attendant service, but not required,

Note that only two BMW engines in the U.S. market use timing belts: The M20 six-cylinder installed in various (but not all) BMWs from 1986-1992, and the M21 six-cylinder diesel engine in the E28 524td. All the rest have timing chains, which do not require preventive replacement.

Engine Drive Belts

Replace O.E. or O.E.M. BMW poly-ribbed serpentine belts every 60,000 miles. Replace O.E.M. Continental or Pirelli or original BMW V-belts every 30,000 miles. Replace “auto store” quality V-belts every 15,000 miles.

Engine Coolant Service: Every two years

The factory coolant change interval used to be every two years. Starting in the late 1990s, BMW lengthened the coolant change interval to every three years, then every four years. As of 2004, BMW says coolant is "lifetime fill." There was no discernable change in original BMW anti-freeze during this transition, other than who pays for the service during the warranty period.

I recommend changing engine coolant at two-year intervals, using only factory BMW anti-freeze mixed 50-50 with distilled water (reason – BMW anti-freeze is phosphate free, phosphates cause aluminum oxidation, which blocks cylinder head coolant passages and causes head gasket failure, others may claim to be "aluminum safe" or "phosphate free" – make your choice, but I've used BMW anti-freeze exclusively in many cars and have *never* had an aluminum oxidation or head gasket problem).

Coolant changes are no longer "straightforward" with the Smart Phone BMWs from about 2006-on. It is impossible to completely drain the coolant from the engine block without removing at least one exhaust manifold, and the electric coolant pump has to be run during a coolant change. Running the electric cooling pump without running the engine requires a special BMW battery charger and the BMW service computer. This means that at the current level of open-source technology and information, coolant changes are dealer-only services.

Outside of the shop, I think that as a practical matter the best I could do with electric coolant pump BMWs is drain and fill the radiator.

Background and explanation: In the old days of the two-year coolant change interval, the process was simple and the coolant was inexpensive. Today, we have the extreme opposites on both counts. In order to maintain credibility, my Lifetime Maintenance Schedule has to balance ideal maintenance for long-term ownership with a realistic assessment of what can be done effectively while also being financially feasible – it has to be reasonable. Reasonable does not mean cheap, but it has to pass the sniff test.

By way of example, if a shop tells you a coolant change now costs $700 due to the complexity of the car, skyrocketing overhead and cost of the required equipment, coolant and skills, that is not unlike a kid offering to mow your grass but it will cost $700 due to the complexity of your lawn, skyrocketing college tuition costs, his expensive lawn mower and his years of experience. Neither passes the sniff test of reasonability regardless of valid explanations for the high prices.

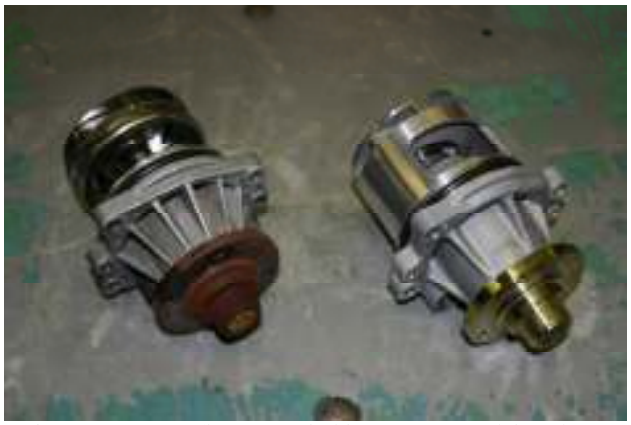
Coolant and Fuel Hoses: Every 120,000-150,000 miles

I replace coolant and fuel hoses every 120,000-150,000 miles. I highly recommend use of O.E. or O.E.M. hoses only, along with the original hose clamps or Wurth/Zebra replacements. The original BMW hose clamps are far superior to anything you'll find in a U.S. auto store. The newer the BMW, the more I think about 120,000-mile hose replacements at least for the upper and lower radiator hoses.

Cooling System Preventive Maintenance
M50, M52, M54, S50, S52 (US-spec) Six Cylinder Engines

The M50 six-cylinder and M60 V8 engines debuted in the early 1990s, and within a few years BMW enthusiasts and others were reporting what seemed then to be premature cooling system parts failures – water pump plastic impellers disintegrated, plastic/aluminum radiators failed, plastic expansion tanks failed and thermostats may as well have been attached with Velcro. Despite attempts by BMW to make the plastic parts and water pumps last longer over the years and models, what seemed premature has now become accepted as the new normal. Even a switch to metal impellers did not result in net-longer life for these coolant pumps because instead of the impeller failing, the bearing failed prematurely.

In my work answering tech questions for approximately 100,000 readers of *Bimmer* and *Roundel* magazines (combined), the anecdotal evidence has been overwhelming. That is why, years ago, I began recommending preventive cooling system parts replacement not only to ensure reliability, but also to protect front engine melt down.



OE/OEM water pump (l), compared with EMP Stewart High Performance Water Pump. The pump on the left has a metallic Impeller – that doesn't make any difference in longevity. Both the plastic and metallic impeller OE/OEM pumps fail prematurely, just in different ways.

It doesn't matter if you have the plastic or metallic impeller; both fail prematurely only in different ways. The original design of the OE pump had a plastic impeller, which would disintegrate and cause overheating and sometimes engine damage. The later OE design had a metallic impeller, and the bearing would seize, causing overheating and sometimes engine damage or destruction. Now we're back to plastic impellers.

I recommend the following preventive replacement schedule for the cooling system on this car:

Every 60,000 miles: water pump, thermostat, plastic thermostat housing if so equipped (or replace it once with the aftermarket aluminum thermostat housing)

Every 90,000 miles: radiator, expansion tank, fan and fan clutch if so equipped (for cars you're going to keep forever, consider using the all-aluminum radiator and expansion tank from www.zionsvilleautosport.com and you won't have to do it again at 180,000)

Every 120,000-150,000 miles: all coolant and fuel hoses

Alibi Clause: It should be noted that I have feedback from a learned and trusted technician who believes that many BMW expansion tank failures result from topping off the coolant to the maximum level or beyond. *He recommends filling the cooling system to the minimum level* so that the coolant has more room to expand. He says cars that he services exclusively don't have expansion tank problems even after 300,000 miles.

On its face this seems counter-intuitive. However, if you think about how modern BMW cooling systems are built as a closed system with no real way to release pressure other than breaking, it follows logically that if the expansion tank is filled to the point that the coolant cannot expand anymore and pressure increases due to heat, then at some point the expansion tank will break.

Now, that's all well and good as long as no one touches the coolant cap except someone who knows this little nugget of information. Take your car to someone else, and of course they'll top off the coolant just like they do in every other car.

Intervals:

Every two years: drain and fill coolant, including draining the engine block by opening the drain plug on the right side under the exhaust manifolds, replace using fresh original BMW anti-freeze mixed 50-50 with distilled water.

As for the EMP Stewart Heavy Duty Water Pump, they have proven themselves worth it for people who are going to keep their car for the long haul and also track junkies. They are marketed as a "high performance" water pump and much is made of their supposedly improved efficiency. However, the performance of the original water pumps was never a problem. Their durability is the problem.

It actually pains me to recommend replacing the entire cooling system preventively before 100,000 miles, as above. Yet experience has shown this maintenance is cheap compared to the alternative. It is unbelievable how many engines are destroyed in these cars by premature cooling system failures.

Does your BMW have the problematic cooling system parts?

The S54 and S62 M engines do not seem to suffer from premature cooling system failures absent racing (including driving schools). It's hard to tell with the V12s since they're so rare; same with the S65 and S85.

The N-series engines have electric water pumps and do not seem to suffer the sort of regular and systematic cooling system failures that led me to recommend replacing the entire system on the above engines as a preventive measure. If your BMW is a 2006 or newer and *not* an E46, then you've got an N-series engine.

The word from dealership technicians is that N Series engines will go into limp home mode if the coolant begins to actually overheat for whatever reason, including electric water pump failure, and they will actually shut down the engine if it actually overheats. I would place "moderate" faith in this advice, because the ECU can be programmed and reprogrammed for reasons that are unknowable to me.

I'm told electric water pumps are not life of the car parts either, and they cost a great deal more than mechanical water pumps. The difference that militates against recommending preventive replacement of electric water pumps is that, as of this writing, engines have not been known to melt down because if it, thanks to limp home mode. Finally, electric water pump service life is tied more closely to hours in service rather than mileage.

The M42 and M44 BMW four-cylinder engines do not have the consistent premature failure rate of cooling system parts that would lead me to recommend preventive cooling system replacement. This doesn't mean they last forever. I would say if you've got 150,000 miles on the water pump, thermostat, radiator and expansion tank then you might want to think about preventive replacement if you're going to keep the car.

Cooling System Preventive Maintenance Not Recommended for N-Series Engines

N-Series Engine Water Pumps are electrical and wholly different from the notoriously problematic water pump of yore. That doesn't mean they last forever, though, and it is several times more expensive. The thing with an electric water pump is that mileage is

less a factor that total running time; the electric motor in the pump is what wears out, and it is running all the time the engine is running. If the car sits in traffic a lot, you may get fewer miles out of an electrical water pump than someone who doesn't sit in traffic, i.e., a rural BMW owner.

This is different from a mechanical water pump, where the standard failure mode is bearing failure.

I do not recommend preventive replacement of the electrical water pump due to cost, and also because there is less chance of engine melt-down than was the case in the past. Once the electrical water pump starts to go bad the engine will go into limp home mode. This enables you to get to the shop before engine meltdown. The older M50-family six cylinder engines and M60-family V-8 engines didn't go into limp home mode. The water pump failed and then you literally had seconds to shut down the engine before meltdown. That is what prompted me to recommend preventive replacement of those water pumps.

If the coolant "really starts to overheat" on the N-series engines, the ECU will shut off the engine. At that point you've got a break-down. So, if the engine goes into limp home mode and you get a coolant temperature warning in the onboard computer, it's time to pull off the highway and get the car to a BMW shop, dealer or independent.

Some urbanites fret about limp-home mode because they think it's dangerous. I can see circumstances where that may be the case in a major metropolitan area but in reality it's no different than any other car problem you may have that impairs forward motion. People like me who drive old cars deal with it all the time. I see their point, but one can only be “so safe” on the crowded highways around a big city; ultimately it comes down to that lifestyle or economic choice.

Power Steering Fluid: Every 30,000 miles

This is a commonly-neglected operating fluid and changing it at a reasonable interval can easily make the power steering pump, rack or box last a great deal longer.

I put the car on four jack stands, remove the plastic cover under the front of the engine, remove the power steering fluid reservoir cap, then open one of the power steering fluid pipes or hoses at the pump. Work the steering wheel back and forth (engine off) until no more fluid comes out. Reattach the pipe or hose, replacing any crush washers involved with new parts from BMW, and then fill the reservoir, start the engine and continue filling according.

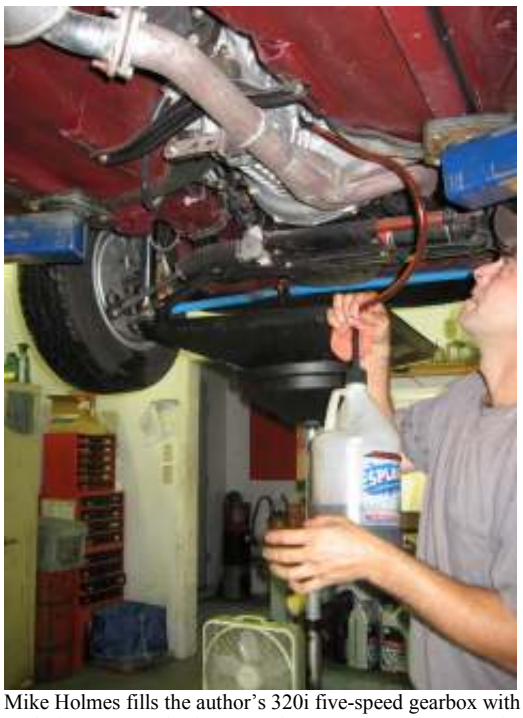
Almost all older BMWs use automatic transmission fluid in the power steering system, except for a select few that require special Pentosin hydraulic oil. Nothing will balls up the works faster than using one when you should be using the other. Check the sticker on the reservoir, check the owner's manual, and if you are still confused, take the car to a pro or e-mail me. The rule of thumb is, if the car has a self-leveling rear suspension, then it uses Pentosin. Problem is, people tend to remove the self-leveling rear suspension because it's too expensive to repair or they want high performance shocks and springs. This can trap future owners into putting ATF into the power steering system when they should have used Pentosin.

All 2006-on BMWs except the 2006 E46 require Pentosin CHF 11.S special hydraulic oil in the power steering system. These cars all have a sticker on the top of the power steering fluid reservoir cap setting forth whether they require Pentosin CHF 11.S.

Do not screw this up, or you will be in a world of hurt. Pentosin CHF 11.S is not compatible with ATF or any other lubricant or hydraulic oil!

If your car uses ATF in the power steering system, Red Line D4 ATF is fine if you want to use a premium product. I don't recommend Red Line Synthetic Power Steering Fluid for use in BMWs.

Manual Gearbox Oil: Every 30,000 miles



Mike Holmes fills the author's 320i five-speed gearbox with Red Line MTL at the former Helmut's German Auto Service in Windsor, Vt.

Only synthetic oil should be used in BMW manual gearboxes, drain interval 30,000 miles.

BMW-specified factory synthetic gearbox oil is MTF-LT-2 available at the dealer, and the spec often changes. It is a good product; I just wouldn't leave it in service forever.

Red Line products are also widely used and preferred (www.redlineoil.com).

All the BMW gearbox rebuilders I know use Red Line MTL exclusively, regardless of model year or gearbox. The general consensus seems to be that MTL is the better lubricant. I do not use ATF in any manual gearbox.

Red Line MT-90 as slightly higher viscosity than their MTL product, which can be useful in reducing gearbox rattle, which can occur in neutral with the clutch pedal out in vehicles that do not have dual mass flywheels. The rattle does not affect gearbox function. The Getrag 280 gearbox in the E28 and E34 M5 and E24 M6 favors Red Line MT-90.

BMW sequential manual gearboxes (SMG) use the same lubricant as the "real" manual – MTF-LT-2 or Red Line MTL. At this writing BMW is now up to MTF-LT-3 – I don't know what the difference is from MTF-LT-2.

M Double Clutch Gearbox: every 30,000 miles if you can get the oil

BMW is trying "lifetime fill" with the optional M Double Clutch Gearbox on the E90-family M3, and this gearbox requires a special lubricant: BMW DCTF-1 Pentosin. Personally I wouldn't buy a DCT, but if I had to maintain one I would change its oil at 1,200 miles, 30,000 and every 30,000 miles thereafter.

Automatic Transmission Fluid (ATF) and Filter: Variable every 15,000 to 60,000 miles

Used automatic transmissions (lower shelf) waiting for new homes at Euro Depot in New Hampshire. They won't be waiting long, thanks to "lifetime fill" automatic transmission fluid!

For older automatics using synthetic ATF, drain interval 30,000 miles. Old fashioned petroleum ATF, drain interval 15,000 miles

The short answer for the modern BMWs with "lifetime fill" ATF: Change it and the filter at least every 60,000 miles using ONLY the factory BMW proprietary ATF or current equivalent.

Long answer: At various production dates in the mid-1990s, which vary according to model, BMW switched to their so-called "lifetime fill" ATF in automatic transmissions, as well as manual gearbox lubricant and differential oil. The reason for this, as far as anyone can tell, is marketing and not engineering – the idea being to foster the notion of the low-maintenance BMW.

There was no explanation of what “lifetime” meant, i.e., lifetime of the car, the component, or for that matter the driver. If it was the component, then obviously anything could be “lifetime fill”. The factory’s initial position was that these lubricants never need to be changed. Then, some time later, it came out that “lifetime” means 100,000 miles. Many dealerships are now recommending manual gearbox and differential oil changes be done at customer expense every 60,000 miles. Every independent BMW technician I know recommends a 30,000-60,000-mile interval, and many recommend Red Line synthetic oils, but not for automatics with “lifetime fill” – you need the factory proprietary ATF for “lifetime fill” automatics.

Older automatic transmission models, which do not have “lifetime fill” should have ATF and filter services every 15,000 miles if using petroleum ATF; every 30,000 miles with synthetic.

However, the modern automatic transmissions are different. No one knows exactly what BMW’s proprietary ATF is, so no one knows if there are viable alternatives. We do know that BMW dealerships charge about $500 for an ATF and filter service, due to the price of the ATF. And that’s assuming you can get them to do the job, which is not often the case.

Bavarian Autosport (www.bavauto.com), Pelican Parts (www.pelicanparts.com), and perhaps others are now importing the proprietary “lifetime fill” ATF at reasonable prices, which they sell along with filter kits, for independent BMW shops and do-it-yourselfers.

It is risky to drain a previously un-maintained automatic transmission with high mileage, even though if it were my car I would probably chance it. Still, I have seen it happen too many times, where a well-meaning owner or technician performs an ATF and filter service on a neglected but well-shifting automatic, and then all of the sudden it starts slipping. I can’t explain it, but my feeling is the fresh ATF flushes a bit of sludge from a place where it was doing no harm to a place where it does do harm. Overfilling, under-filling, and cleanliness are also issues in ATF and filter servicing, but these should not be problematic for a professional BMW technician, dealer or independent.

BMW has backed off its lifetime fill mantra for automatic transmissions, currently recommending an ATF and filter change every 100,000 miles for the current BMW models at this writing.

My inclination is to tell people to change “lifetime” ATF and filter every 60,000 miles. However I have seen BMW automatic transmissions that were maintained break anyway. In that event, say it happens at 90,000 miles, you would like to have the money you spent on the ATF and filter change to put toward your new automatic transmission. And if I told you to spend it on maintenance you’re probably not going to be very happy with me. On the other hand, I have seen maintained automatics last 200,000 miles. I have also seen un-maintained automatics last 200,000 miles, although both are very rare. There's just no predicting with these transmissions. When you choose to buy an automatic transmission, you also buy into the vagaries of the darn things, which is one reason technicians hate them. Whether to maintain a modern BMW automatic is up to you.

At automatic transmission replacement time, we are confronted with the reality that the local transmission shop cannot rebuild BMW automatic transmissions, even those built by GM (BMW’s GM transmissions bear no resemblance to GM transmission in domestic cars). There are some domestic specialists who concentrate in BMW automatic transmission rebuilding, and you’ll see their ads in *Roundel* and *Bimmer*. However, I have no current experience with domestic rebuilders. My experience in the past is…well, the owner wound up buying a BMW factory rebuilt automatic transmission every time, and this is the course I recommend to readers – “back to the dealer.”

Some of you, having seen the light, may be interested in converting to a manual gearbox. This is always possible, but for most of us it won’t be less expensive than a replacement automatic transmission. This is because of all the other parts and additional labor required. And the newer the car the harder and more expensive the job will be. It is certainly a doable swap, but there’s no cost savings even if you do the work yourself. The exception would be if you have access to a manual gearbox donor car for little or no expense.

All-Wheel-Drive Transfer Cases: Every 30,000 miles

E30 325iX: ATF Dexron® III formulation (Red Line D4 ATF is a great choice)

E46/16 325xi/xiT, 330xi: MTF-LT-1 83 22 9 408 942 (MTF-LT-2 = 5 Liters) or Red Line MTL

E53 X5 All models with NV125 transfer case: ATF Dexron III (Red Line D4 ATF)

E53 X5 All models with X-Drive transfer case: TF0870 83 22 0 397 244 (1 Liter)

Note: Due to conflicting information from BMW and in the parts system, E53 X5 transfer case type, 2003 model year-on, must be identified visually before ordering or changing the operating fluid. The question is whether you have the NV-125 (non-xDrive) transfer case or the newfangled ATC-500 (xDrive) transfer case. BMW told me the cutoff production date was up to 02/2005 for the NV-125. Realoem says 10/2003. As is often the case where a production split exists, the only way to know for sure is to visually inspect the transfer case before ordering the operating fluid and certainly before changing it. In turn, this requires the ability to distinguish between the two transfer case types. Diagrams are on realoem.com. If you are unsure, take the vehicle to a professional BMW technician.

E60 All models: TF0870 83 22 0 397 244 (1 Liter)

E61 All models: TF0870 83 22 0 397 244 (1 Liter)

E70 All models: TF0870 83 22 0 397 244 (1 Liter)

E83 X3 All models with X-Drive transfer case: TF0870 83 22 0 397 244 (1 Liter)

E90, E91 and E92 All models: TF0870 83 22 0 397 244 (1 Liter)

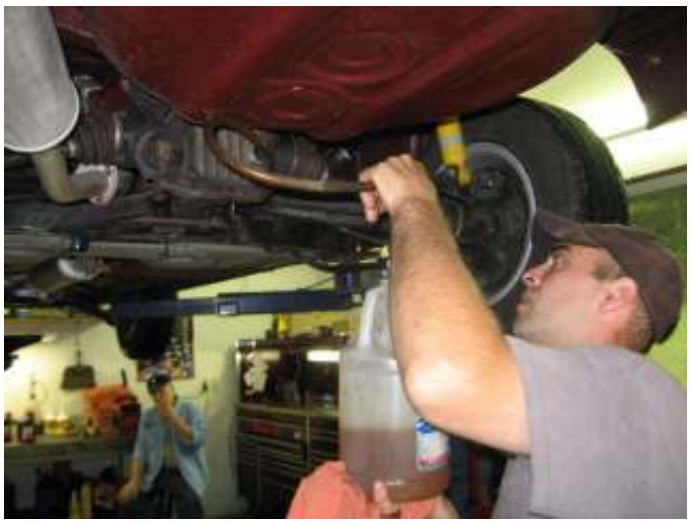
Note: There is no aftermarket substitute for TF0870. Before opening the container, shake the container to evenly mix the additives with the oil.

The xDrive transfer case must be reset electronically at the dealership after the oil is changed. You can change the transfer case oil yourself or have it done wherever you want, but the vehicle does have to go back to the dealer to have the transfer case reset. I believe this “resetting” procedure is only possible on the BMW service computer at the current level of open source technology.

Specifically the “reset” uses the actuator inside the transfer case to gauge the thickness of the remaining clutch material. The transfer case then relearns the end stops of the clutch pack to compensate for wear. The electric motor inside the X-Drive transfer case then knows how much it has to apply the clutch pack in order to transfer power when necessary.

Ordinarily under BMW’s condition-based service the xDrive transfer case oil wear sensor will set a code (but no light) indicating the “need” for a transfer case oil change. This has been known to happen as early as 50,000 or as late as over 60,000 miles. I don’t trust the sensor – it’s just a quart of oil. But you do have to pay for the reset, because as of now (Mar. 2013) it is “dealer only.”

Differential Oil: Every 30,000 miles



Mike Holmes fills the author's 320i differential with Red Line 75W-90 at the Former Helmut's German Auto Service in Windsor, Vt.

Once again, BMW's specified synthetic differential oil is all good…just not forever. Note BMW has different products for open and limited slip differentials.

For open non-limited slip differentials, BMW recommends its Castrol SAF XO product.

I use and also recommend Red Line 75W-90 synthetic gear oil, drain interval 30,000 miles in all BMW differentials except as noted below.

Here is where it gets very confusing. I will try to make this as clear as possible:

The E46 M3, E90/91 M3, E60 M5, and E63/64 M6 must use Castrol SAF-XJ, BMW part number 82 22 2 282 583, or Red Line 75W-140 (not 75W-140NS).

The 75W-140 viscosity is required by the Variable M Differential Lock in the above-referenced cars.

The 75W-140 is not required for other BMW limited slip differentials, but you may use it if you want.

Once BMW came out with the Variable M Differential Lock, they discontinued the old factory 75W-90 limited slip oil. There is tremendous confusion out there today, with many people thinking that all BMW limited slip differentials require 75W-140 oil. This is wrong; only the Variable M Differential Lock requires 75W-140.

BMW has a long history of mandating that Special Lubricant X must be used or else (insert parade of horribles here). But a few years later, Special Lubricant X is no longer available, having been replaced by Special Lubricant Y for use in the new cars. Then, Special Lubricant Y is magically approved for use in the older cars that supposedly would have self-immolated if they got anything but Special Lubricant X. Whenever they do this, which is pretty often, it throws the Internet folks into a dither.

Red Line 75W-90 vs. 75W-90NS

The difference between Red Line 75W-90 Synthetic Gear Oil and Red Line 75W-90NS Synthetic Gear Oil is that the former has friction additives for limited slip differentials whereas the latter does not. However, both are the same price, and there is no problem using the 75W-90 Synthetic Gear Oil with friction additives in an open, non-limited-slip, differential – the open diff doesn't mind the friction additives at all.

For my purposes in my home DIY shop, this means I only have to stock one differential gear oil rather than two (three if you count the 75W-140).

For my purposes in answering BMW tech questions, this means I recommend 75W-90, because if I discuss the differences between 75W-90 and 75W-90NS once, I'll have to do it every day, and there remains the fact that limited slip differential owners will then have a 50-50 chance of getting it wrong.

So, if your BMW has an open, non-limited-slip, differential, there is no problem using the 75W-90NS if you want. If you don't know what a limited slip differential is, then you probably haven't read this far, but use 75W-90.

Note that BMW did away with the differential drain plug as of the current non-M cars, which I find incredible, but it is what it is. We can still drain the differential through the fill hole, but this requires a suction device such as an oil extractor and a quarter-inch plastic tube to reach the bottom of the differential. Most oil extractors come with three-eighths-inch plastic tubing, which is too big. You need a reducer and quarter-inch tubing. And change the oil as hot as possible – you'll get more metal out of it the sooner you drain it after driving the car.

Diffs getting smaller, weaker

Another note on BMW differentials: since the E30 era, BMW differentials, with the exception of the M variable lock differential, have become progressively smaller. The pinion gear and its roller bearing are huge in the E30, smaller in the E36, and smaller still in the E46. The differential oil capacity has also become less and less with each generation of 3 Series cars since the E30.

Now, with the E90 3 Series, we have a very small pinion gear, no drain plug, and an oil capacity under 0.5 U.S. quarts. Moreover, and most incredibly, BMW did away with the strong tapered roller bearing in favor of old fashioned ball bearings. Worse, they are mounted in plastic bearing cages.

E90 family cars are simply too new for differential longevity predictions, but it's not looking good. BMW differential rebuilder Brett Anderson thinks maintaining the diff with oil changes is still the way to bet, but he is suspicious of plastic bearing cage failure, which of course is not lubrication-related. The bright side? E90 family rebuilt differentials from BMW (open only) are $1,350; E30 limited slip differentials cost about $2,500.

Brake Fluid: Once a year

BMW Master Technician John Franchetti hooks up a pressure bleeder during a brake fluid change on a supercharged E46 330Ci convertible.

I recommend once a year brake fluid changes for optimal maintenance, and also prior to each driving school or track event. BMW progressively extended the interval to two years and now three years with no change in the brake fluid, just in who pays for the service – the company or us – during the warranty period. BMW used to recommend a one-year interval back when we paid for it.

I recommend ATE SL, Pentosin Super, or original BMW brake fluid for normal street use, and ATE Type 200 or Pentosin Racing Brake Fluid for racetrack driving only. Racing brake fluid may be used in street cars if it is changed frequently – more than once a year. Racing brake fluid is not advisable for street cars because it attracts more water faster, and because it may lack anti-corrosion additives.

Note that ATE Super Blue is the exact same product as ATE Type 200, except with blue dye. Personally, I can't stand the blue dye because it turns everything blue – the reservoir,

my Vacula brake bleeder, my hands, etc. Blue brake fluid helps race teams identify the source of leaks in race cars, and that is its only benefit as far as I'm concerned.

Original BMW, ATE SL.6, or Pentosin LV is recommended for BMWs that call for low-viscosity brake fluid, such as the xDrive models. I don't see how this can make a difference except in extreme cold weather, but I also don't see how low viscosity brake fluid can hurt anything.

Maintenance Records

It is important to keep records of vehicle maintenance, not only for your own reference but also for that of your mechanic and future owners of the vehicle. Always make sure your BMW technician has access to your maintenance records. This can help him diagnose problems as well as advise what maintenance is due. Keep the records in the car, where you or a mechanic will look if there is a problem. The factory service booklet, contained in the glovebox vehicle document portfolio, is the logical place to record maintenance. If you're the type of person who has to see everything on a computer screen, you can always keep a separate file on your hard drive – but that alone will not help your technician when he's trying figure out what has already been done and when. For that information he's going to look in the glovebox.

Storing the BMW (or any vehicle)

Question number one when considering storing a BMW is, are you able to store the car indoors? If you have to store the car outdoors for an extended period of time that is necessarily going to involve a fair amount of deterioration. And the longer it sits, the more it will deteriorate. We can help you preserve it to the best extent possible, but if you want to keep the car nice, you need to find dry, rodent-free indoor storage.

This precludes barns. Only animals thrive in barns; vehicles deteriorate rapidly in barns.

Either way, I recommend starting with a good detailing inside and out. Use a good wax, rubber care, and leather and vinyl treatments.

I prefer to cover stored cars if they are indoors, in a dry location. Outside, it's a toss up. A good cover can protect the car, but you have to tie it down thoroughly to keep the cover on the car for a year. If it starts flapping around in the wind, it can damage the paint. And the expensive cover will be history by the time you get back.

If the car is stored outdoors uncovered, you should cover as many interior surfaces as possible to protect them from UV rays. You can use old blankets and get a sunshade for the front windshield from BMW.

Whether stored inside or out, close the HVAC system vents by shutting down the system, stuff stainless steel wool into the tailpipes and air intake, and put some mothballs under the hood. This is about all you can do to protect the car from rodents.

Use the recommended amount of Sta-Bil (read the bottle) fuel treatment at the gas station before filling up the tank and driving to the storage location.

Use of a Battery Tender Plus (www.batterytender.com) or the equivalent BMW Advanced Battery Charging System is required, or your battery will be history long before you return from a trip or military deployment. A modern BMW will discharge its battery in a couple of weeks, rock dead. This is due to the number of electronic control units that are powered up all the time even when the car is in sleep mode.

If you store the car outdoors, Battery Tender makes a waterproof version for use with outdoor electrical outlets. If not, Deltran also makes a solar-powered battery charger that sits on the dashboard or between a sunscreen (advisable for outdoor storage) and the windshield but this unit requires a 12-volt socket that is hot with the key off – most BMWs produced since do not have power at the 12-volt socket with the key off.

If you have no outdoor power source, you really need to get the BMW solar powered battery charger UNLESS the car is going to be stored for a matter of several years, in which case you really have no choice but to simply remove the battery.

I prefer to keep power to the control units, though. Modern BMWs don't like being without their little electron friends for very long. Store a modern BMW without power for a year, and chances are good you'll have electronic problems when the car awakens.

Finally, bear in mind that if you store the car outdoors, in a parking lot paved with blacktop, sitting on four jack stands, that blacktop is going to get hot and soft once summer arrives. Get some 3/4-inch pressure-treated plywood and cut it into squares large enough to place between the blacktop pavement and the jack stands. Otherwise, the jack stands are liable to sink into the hot black top this summer and create a nasty welcome-home surprise.

Upon return, change the engine oil and the brake fluid, and if the coolant is more than two years old, change that, too. Do not forget to adjust tire pressure and remove the stainless steel wool and moth balls.

Also, if the engine has hydraulic lifters they are going to bleed down during storage, so when you finally restart the engine it is going to have a ticking noise and a misfire, possibly setting a check engine light. Don't worry, both will go away.

Actual questions assembled as a short FAQ in a no-doubt futile attempt to stave off follow-up questions:

1) Question: "My BMW is a garage queen. It will be ten years before I hit 30,000 miles! How does this affect maintenance?"

Only coolant, brake fluid, and to some extent engine oil are time-related maintenance items. Your gear oil can be in service for 20 years and it makes no difference because there is no combustion taking place inside a manual gearbox or differential. Same for the automatic transmission fluid. These operating fluids wear on mileage, not time.

Even with respect to coolant, I really think heat cycles have a major effect on the chemical integrity of coolant, so that garage queens may not necessarily benefit from two-year coolant changes. The problem is, unless it is discolored or has stuff floating around in it, there is really no way to know for sure what condition the coolant is in

without chemical analysis, which costs more than the original BMW anti-freeze you would need to just change it.

2) Question: "I want to maintain my BMW for the long haul, past the warranty, and past 100,000 miles, but the dealer says NO! I'm not very good at asserting myself. What to do?"

First and foremost, BMW will only pay for "scheduled maintenance" during the warranty period. Any maintenance you want performed over and above BMW's scant specifications is a customer-pay job – YOU pay, not BMW. That's the old fashioned way!

Secondly, we have to recognize that just as dealership quality varies, there are dealers out there who refuse to maintain cars any other way but the factory way, which, today, means virtually no maintenance. And there are other dealers who will maintain cars to customer specifications without backtalk.

This is YOUR car and it will be your repair bills and your money once the warranty is expired. You can maintain the car whatever way you want, and anyone who tells you differently shouldn't work for you anymore. My best advice is if you get backtalk at one dealer, call another one. And don't hesitate to use independent BMW service professionals.

To find an independent BMW shop, visit www.bimrs.org and www.bimmershops.com.

3) Question (this one usually comes from guys wearing tweed sport coats with leather elbow patches who smoke, or at least own, a corn cob pipe):

"I used to maintain my old 2002 right here at home. In fact, I still drive the '02 when my new 335i needs another high pressure fuel pump! (Wouldn't start down the VFW last night. Don't know why I put up with it. Damn fast, though! I'm thinking about twin turbos for my riding lawn mower. Would that impair durability?) The dealer makes me park the old '02 out back because, you know, it's two different

colors (three if you count rust as a color) and it doesn't have any doors. Anyways, can I do all this expensive maintenance stuff myself on the new car?"

It depends on your skill level and tool/equipment collection, but probably yes. Routine maintenance will probably be the final bastion of the BMW do-it-yourselfer. Engine, manual gearbox, transfer case, and differential oil changes remain they same as they ever were. On the latest BMWs (the ones without differential drain plugs) is some finesse required – we have to draw the oil out through the fill hole using a hand pump of some sort. Brake fluid changes and coolant changes remain pretty much the same as well, although coolant changes can be quite challenging in practice if not in theory. However, I recommend professional BMW service for automatic transmissions.

4) Question: "My BMW is a race car! Even if it still has license plates, I do 10 [or whatever] high performance driving events per year, and we all know that really means my BMW is a race car! Do you recommend different maintenance for race cars?"

We may call these events driving schools or autocrosses, but to the car the service demands are the same as racing. As any racing team mechanic will tell you, you cannot perform too much preventive maintenance on a race car. There are plenty of guys out there who just change every operating fluid after every track event, and I cannot say they are overdoing it especially with modern BMWs, which are heavy and high-powered.

Obviously that can be pretty expensive if you're paying a professional BMW technician to maintain the race car. If you're doing the work yourself it's not so bad cost-wise.

5) Question (and one of my personal favorites): "I live so far north that I can stand on my back porch and shoot squirrels in Canada. Heck, I may even live in Canada! I'm not really sure which country I live in, but there does seem to be a lot of inordinately friendly people walking around. In spite of all that, or maybe because of it, I am one of those crazy people who drive a BMW M car in arctic temperatures! It has four studded snow tires that I'm thinking about just replacing with tank tracks, and it sits outside on permafrost covered with ice most of the time like Admiral Byrd's old shack in Antarctica while my wife's brand new Subaru gets

the heated garage because, you know, it has to be in perfect condition for her to trade-in next year. I know I really should have an X3, but I need my 400 hp E39 M5 [or whatever] when I have to go to the general store five miles away in the town of Frozen Rabbit! Should I still run 10W-60 engine oil?"

First off, this question related to M cars only, where 10W-60 oil is specified. Secondly, put the Subaru outside. It's stupid to leave the aging but incredibly expensive to repair BMW Motorsport special outside to rot while the new car gets the garage.

The answer to the oil question really depends more on how you drive the car. The issue with relatively high viscosity oil in extremely cold temperatures is that it doesn't warm up as quickly as relatively low viscosity oil, nor does the high viscosity oil flow as well as low viscosity oil at extremely cold temperatures. You can address this most effectively by putting the car in your heated garage, or even a non-heated garage.

So, where you have primarily short trips where the engine is really not warming up to operating temperature anyway, you're exacerbating the situation with high viscosity oil in extremely cold temperatures.

The question is, what is the cut-off temperature above which you should use one oil and below which you should use lower-viscosity oil, and that is a difficult question to answer. I think there will be an element of arbitrariness in anyone's answer to this question. Here is mine: 10W-60 in ambient temperatures predominantly over 10 degrees F., and 5W-30 below that.

6) Question: "I have never lived anywhere north of Attapulgus, Georgia, where the average weather is 900 degrees with 900 percent humidity. But now that I've graduated from college I've decided to leave my entire extended family behind to chase money, which, I think, will make me happier. I've taken a job in Boston. Are there any special maintenance requirements for my non-M BMW due to the cold winters? They've got some traffic problems there, I think."

No. Get four snow tires for the car, and get some wool for you: www.johnsonwoolenmills.com recommended. Don't pack your Gumby collection; you'll be back.

Author's 2005 Dinan S2-325Ci in winter mode.

7) Question: I bought a new diesel-powered BMW. Does this affect your maintenance advice?

I've never maintained a diesel engine any differently than a gasoline engine except for the obvious lack of ignition parts on the diesel. That includes the last time BMW brought diesels to the U.S., which was the 1986 model year (524td) as well as the occasional VW and Mercedes diesel back when I worked at a shop. I don't see any reason why I'd maintain a diesel differently today, except to remind you that additional maintenance over BMW's scant maintenance schedule really only pays off after the long haul, past the warranty and past 100,000 miles. Ask yourself how long you're going to keep the vehicle.

8) I have a 2002 M5 with the original battery. I store it every winter using a Battery Tender, but this winter the Battery Tender didn't work. Come spring 2011, the battery was rock dead. What happened?

There are four common scenarios:

1) The battery had a bad cell or was otherwise worn out at the time the car was placed in storage or during the time it was in storage. This is likely given the age of your battery.

2) The Battery Tender had a bad connection either at the cigarette lighter or the underhood power tap and grounding lug.

3) The Battery Tender was plugged into a GFI outlet that tripped for no reason. If you must use a GFI outlet, I recommend a 20-amp industrial grade outlet on a 20-amp circuit, and not a cheap residential grade outlet, which is usually 15-amp outlet on a 20-amp circuit. Other things on that circuit can cause the GFI circuit breaker to trip, and it is not always because the load rating was exceeding. Sometimes it's because the outlet is just junk.

4) The regular circuit breaker (or fuse) for the circuit into which the Battery Tender was plugged has tripped or blown. Note that a Battery Tender draws, at most, 1.25 amps. This can never blow a circuit breaker or a fuse alone. It is always other things drawing on the same circuit. Common culprits are high-draw devices like electric heaters, blower fans, garage door openers or any other type of electric motor (clothes washer, clothes drier, dishwasher, etc.), or a large number of high-wattage light bulbs.

Items three and four come down to wiring issues in the space where the car is stored.

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