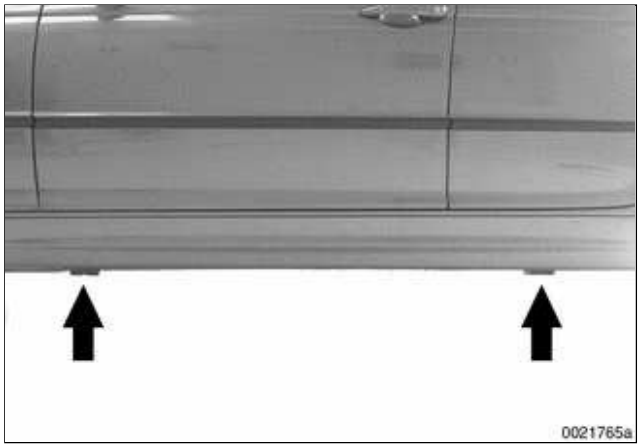
Getting Started

Most of the necessary maintenance and minor repair that an automobile will need can be done with ordinary tools. Below is some important information on how to work safely, a discussion of what tools will be needed and how to use them.

Safety

Although an automobile presents many hazards, common sense and good equipment can help ensure safety. Many accidents happen because of carelessness. Pay attention and stick to safety rules in this manual.

Lifting the car



The proper jacking points should be used to raise the car safely and avoid damage. The jack supplied with the car can only be used at the four side points (arrows)—just behind the front wheels or just in front of the rear wheels.

WARNING!

- ***Never work under a lifted car unless it is solidly supported on jack stands that are intended for that purpose.***

- ***When raising the car using a floor jack or a hydraulic lift, carefully position the jack pad to prevent damaging the car body. Plastic pads are provided for this purpose by the manufacturer at the jacking***

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points.

- ***Watch the jack closely. Make sure it stays stable and does not shift or tilt. As the car is raised, it may roll slightly and the jack may shift.***

Raising car safely

- Park car on flat, level surface.

- If changing a tire, loosen lug bolts before rasing car. See ⇒ Changing a tire.



➢ Place jack into position. Make sure jack is resting on flat, solid ground. Use a board or other support to provide a firm surface for the jack, if necessary

- Raise car slowly while constantly checking position of jack and car.

- Once car is raised, block wheel that is opposite and farthest from jack to prevent car from unexpectedly rolling.

WARNING!

- ***Do not rely on the transmission or the emergency brake to keep the car from rolling. They are not a substitute for positively blocking the opposite wheel.***

- ***Never work under a car that is supported only by a jack. Use jack stands that are designed to support the car. See ⇒ Tools.***

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Working under car safely

- Disconnect negative (–) cable from battery so that no one can start car. Let others know what you will be doing.

CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

- Raise car slowly as described above.

- Use at least two jack stands to support car. Use jack stands designed for the purpose of supporting a car. For more information on jack stands, see ⇒ Tools.

WARNING!

- ***A jack is a temporary lifting device and should not be used alone to support the car while you are under it.***

- ***Do not use wood, concrete blocks, or bricks to support a car. Wood may split. Blocks or bricks, while strong, are not designed for that kind of load, and may break or collapse.***

- Place jack stands on firm, solid surface. If necessary, use a flat board or similar solid object to provide a firm footing.

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- Lower car slowly until its weight is fully supported by jack stands. Watch to make sure that the jack stands do not tip or lean as the car settles on them.

- Observe all jacking precautions again when raising car to remove jack stands.

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Advice for the Beginner

The tips in the paragraphs that follow are general advice to help any do-it-yourself BMW owner perform repairs and maintenance tasks more easily and more professionally.

Planning ahead

To prevent getting in too deep, know what the whole job requires before starting. Read the procedure thoroughly, from beginning to end, in order to know just what to expect and what parts will have to be replaced.

Cleanliness

Keeping things organized, neat, and clean is essential to doing a good job. When working under the hood, fender covers will protect the finish from scratches and other damage. Make sure the car finish is clean so that dirt under the cover does not scratch the finish.

Any repair job will be less troublesome if the parts are clean. For cleaning old parts, there are many solvents and parts cleaners commercially available.

For cleaning parts prior to assembly, commercially available aerosol cans of parts cleaner or brake cleaner are handy to use, and the cleaner will evaporate completely.

WARNING!

Most solvents used for cleaning parts are highly flammable as well as toxic, especially in aerosol form. Use with extreme care. Do not smoke. Do not use these products indoors or near any source of heat, sparks or flame.

Non-reusable fasteners

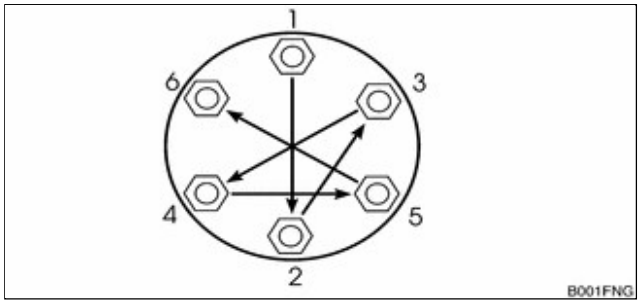
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Many fasteners used on the cars covered by this manual must be replaced with new ones once they are removed. These include but are not limited to: bolts, nuts (self-locking, nylock, etc.), cotter pins, studs, brake fittings, roll pins, clips and washers. Genuin BMW parts should be the only replacement parts used for this purpose.

Some bolts are designed to stretch during assembly and are permanently altered rendering them unreliable once removed. These are known as torque-to-yield fasteners. Always replace fasteners where instructed to do so. Failure to replace these fasteners could cause vehicle damage and personal injury. See an authorized BMW dealer for applications and ordering information.

Tightening fasteners

When tightening the bolts or nuts that attach a component, it is always good practice to tighten the bolts gradually and evenly to avoid misalignment or over stressing any on portion of the component. For components sealed with gaskets, this method helps to ensure that the gasket will seal properly.



Where there are several fasteners, tighten them in a sequence alternating between opposite sides of the component. Repeat the sequence until all the bolts are evenly tightened to the proper specification.

For some repairs a specific tightening sequence is necessary, or a particular order of assembly is required. Such special conditions are noted in the text, and the necessary sequence is described or illustrated. Where no specific torque is listed, ⇒ Table a can be used as a general guide for tightening fasteners.

WARNING!

⇒ Table a is a general reference only. Th

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values listed in the table are not intended to be used as a substitute for torques specifically called out in the text.

Note:

- *Metric bolt classes or grades are marked on the bolt head.*
- *Do not confuse wrench size with bolt diameter. For a listing of the common wrenches used on various bolt diameters, see ⇒ Basic tool requirements.*

Table a. General bolt tightening torques in Nm (max. permissible)

Bolt diameter	Bolt Class (according to DIN 267)					
	5.6	5.8	6.8	8.8	10.9	12.9
M5	2.5	3.5	4.5	6	8	10
M6	4.5	6	7.5	10	14	17
M8	11	15	18	24	34	40
M10	23	30	36	47	66	79
M12	39	52	62	82	115	140
M14	62	82	98	130	180	220
M16	94	126	150	200	280	340
M18	130	174	210	280	390	470

Gaskets and seals

Gaskets are designed to crush and become thinner as the mating parts are bolted together. Once a gasket has been used, it is no longer capable of making as good a seal as when new, and is much more likely to leak. For this reason, gaskets should not be reused.

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Some gaskets—such as head gaskets—are directional. Make sure that these are installed correctly. This same logic applies to any part used for sealing, including rubber O-rings and copper sealing washers.

In places where a shaft must pass through a housing, flexible lip seals are used to keep the lubricating oil or grease from leaking out past the rotating shaft. Seals should never be reused once they have been removed. When removing a seal, be careful not to damage the metal surfaces.

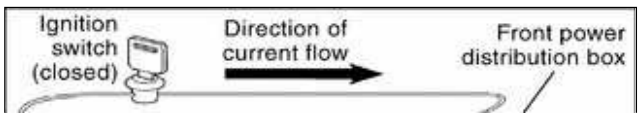
The key to seal installation is to get the seal in straight without damaging it. Use a seal driver that is the same diameter as the seal housing to gently and evenly install into place. If a proper size seal driver is not available, a socket of the right size will do.

Some seals are directional and special installation instructions apply. Make sure a seal is installed with the lip facing the correct way. Note the installation direction of the old seal before removing it.

Electrical testing

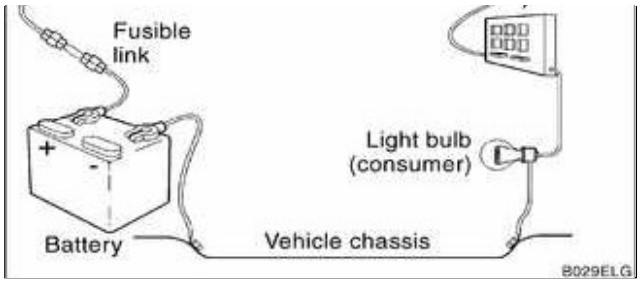
Many electrical problems can be understood and solved with only a little fundamental knowledge of how electrical circuits function

Electric current only flows in a complete circuit. To operate, every electrical device in the car requires a complete circuit including a voltage source and a path to ground. The positive (+) side of the battery is the original voltage source, and ground is any return path to the negative (–) side of the battery, whether through the wiring harness or the car body. Except for portions of the charging system, all electrical current in the car is direct current (DC) and flows from positive (+) to negative (–).



Switches are used to turn components on or off by completing or interrupting the circuit. A

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switch is “open” when the circuit is interrupted, and “closed” when the circuit is completed. See ⇒ 600 Electrical System–General for electrical troubleshooting.

Wire repairs

Repairs to a wiring harness require special care to make the repair permanent. The wire ends must be clean. If frayed or otherwise damaged, cut off the end. If the wire is too short, splice in a new piece of wire of the same size and make two connections.

Use connectors that are designed for the purpose. Crimped-on or soldered-on connectors are best. Crimp connectors and special crimping pliers are widely available. I soldering, use needlenose pliers to hold the wire near the solder joint and create a “heat dam”. This keeps the heat and the solder from traveling up the wire. Always use a solder made specifically for electrical work (rosin core).

Note:

Twisting wires together to make a repair is not recommended. Corrosion and vibration will eventually spoil the connection and may lead to irreparable damage to sensitive electronic components.

Insulate the finished connection. Electronics stores can supply heat-shrinkable insulating tubing that can be placed onto the wire before connecting, slid over the finished joint, and shrunk to a tight fit with a heat gur or hair dryer. The next best alternative is electrical tape. Make sure the wire is clean and free of solder flux or other contamination. Wrap the joint tightly to seal out moisture. See ⇒ 600 Electrical System–General for more information.

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Buying Parts

Many of the maintenance and repair tasks in this manual call for the installation of new parts, or the use of new gaskets and other materials when reinstalling parts. Most often, the parts that will be needed should be on hand before beginning the job. Read the introductory text and the complete procedure to determine which parts will be needed.

Note:

For some bigger jobs, partial disassembly and inspection are required to determine a complete parts list. Read the procedure carefully and, if necessary, make other arrangements to get the necessary parts while your car is disassembled.

Genuine BMW parts

Genuine BMW replacement parts from an authorized BMW dealer are designed and manufactured to the same high standards as the original parts. They will be the correct material, manufactured to the same specifications, and guaranteed to fit and work as intended by the engineers who designed the car. Some genuine BMW parts have a limited warranty.

Many independent repair shops make a point of using genuine BMW parts, even though they may at times be more expensive. They know the value of doing the job right with the right parts. Parts from other sources can be as good, particularly if manufactured by one of BMWs original equipment suppliers, but it is often difficult to know.

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BMW is constantly updating and improving their cars, often making improvements during a given model year. BMW may recommend a newer, improved part as a replacement, and your authorized dealer's parts department will know about it and provide it. The BMW parts organization is best equipped to deal with any BMW parts needs.

Non-returnable parts

Some parts cannot be returned, even for credit. The best example is electrical parts, which are almost universally considered non-returnable. Buy electrical parts carefully, and be as sure as possible that a replacement is needed, especially for expensive parts such as electronic control units. It may be wise to let an authorized BMW dealer or other qualified shop confirm your diagnosis before replacing an expensive non-returnable part.

Information you need to know

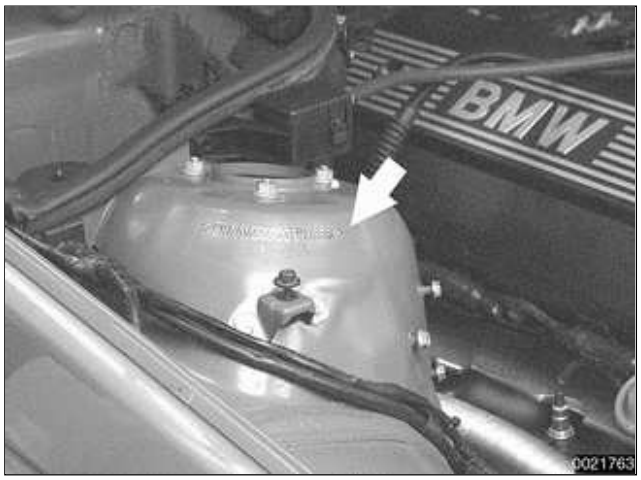
Model. When ordering parts it is important that you know the correct model designation for your car. Models covered in this E46 manual are 323i/Ci, 325i/Ci, 325Xi, 328i/Ci, 330i/Ci 330Xi in Sedan, Coupe, Convertible and Sport Wagon body styles.

Model year. This is not necessarily the same as date of manufacture or date of sale. A 1999 model may have been manufactured in late 1998, and perhaps not sold until early 2000. It is still a 1999 model. Model years covered by this manual are 1999 to 2001.

Date of manufacture. This information is necessary when ordering replacement parts or determining if any

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of the warranty recalls are applicable to your car. The label on the driver's door below the door latch will specify the month and year that the car was built.



- Vehicle Identification Number (VIN). This is a combination of letters and numbers that identify the particular car. The VIN appears on the state registration document, and on the car itself. One location is on the right front strut tower in the engine compartment (**arrow**), another in the lower left corner of the windshield.

Engine code. 3 Series cars covered in this manual are powered by 6-cylinder engines. For information on engine codes and engine applications, see ⇒ 100 Engine–General.

Transmission code. The transmission type with its identifying code may be important when buying clutch parts, seals, gaskets, and other transmission-related parts. For information on transmission codes and applications, see ⇒ 200 Transmission–General.

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Tools

Most maintenance can be accomplished with a small selection of the right tools. Tools range in quality from inexpensive junk, which may break at first use, to very expensive and well-made tools for the professional. The best tools for most do-it-yourself BMW owners lie somewhere in between.

Many reputable tool manufacturers offer good quality, moderately priced tools with a lifetime guarantee. These are your best buy. They cost a little more, but they are good quality tools that will do what is expected of them. Sears' Craftsman® line is one such source of good quality tools.

Some of the repairs covered in this manual require the use of special tools, such as a custom puller or specialized electrical test equipment. These special tools are called out in the text and can be purchased through an authorized BMW dealer. As an alternative, some special tools mentioned may be purchased from the following tool manufacturers and/or distributors:

Assenmacher Specialty Tools 6440 Odell Place, Boulder, CO 80301 303-530-2424 http://www.asttool.com
Baum Tools Unlimited, Inc. P.O. Box 5867, Sarasota, FL 34277-5867 800-848-6657 http://www.baumtools.com
Schley Products, Inc. 5350 E. Hunter Ave., Anaheim Hills, CA 92807 714-693-7666

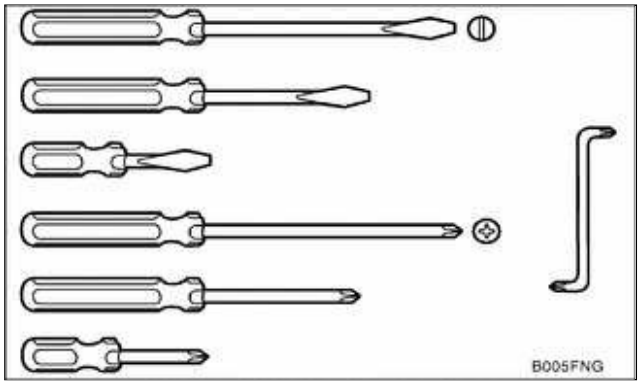
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http://www.sptool.com

Zelenda Machine and Tool Corp.
65-60 Austin Street, Forest Hills, NY
11374-4695
718-896-2288
http://www.zelenda.com

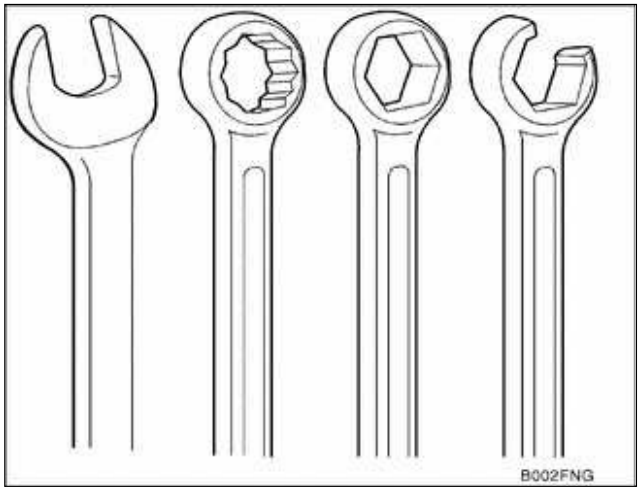
Basic tool requirements

The basic hand tools described below can be used to accomplish most of the simple maintenance and repair tasks.



- Screwdrivers. The common flat-blade type and the Phillips type will handle almost all screws used on BMWs. Two or three different sizes of each type will be required, since a screwdriver of the wrong size will damage the screw head.

A complete set of screwdrivers should also include Torx® type screwdrivers.



- Wrenches. Wrenches come in different styles, including open-end, 12-point box-end, 6-point box-end and flare nut. The basic open-end wrench is the most widely used, but grips on only two sides. The box-end wrench has better grip on all six sides of a nut or bolt.

A 12-point box-end can loosen a nut or bolt where there is less room for movement, while a 6-point box-end provides better grip. For hex fasteners on fluid lines, like brake lines and fuel lines, a flare-nut wrench offers the advantages of a box-end wrench with a slot that allows it to fit over the line.

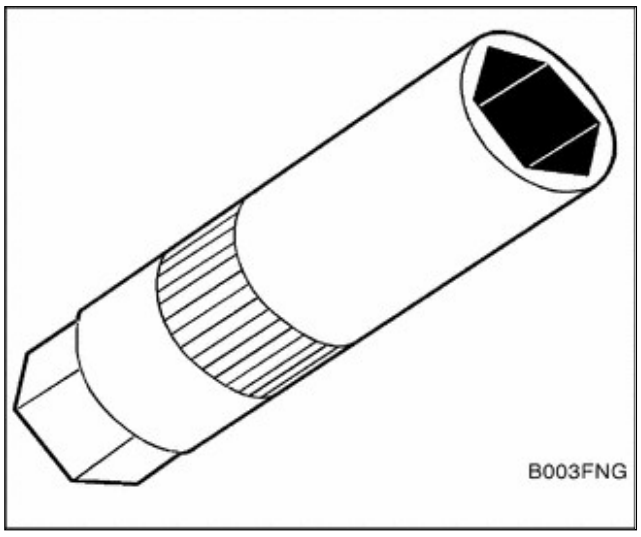
The combination wrench is the most universal. It has one open-end and one box-end. 10 mm and 13 mm wrenches are the most common sizes needed. A more complete set of wrenches would include 6 mm through 19 mm sizes.

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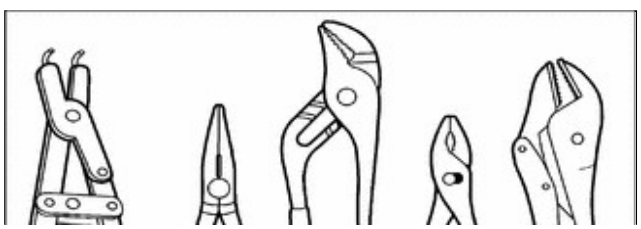
Sockets. Sockets are used with a ratchet handle for speed and convenience and can be combined with extensions and universal joints (swivels) to reach fasteners more easily. The most common drive sizes are 1/4 in., 3/8 in., and 1/2 in.

Sockets come in 6-point and 12-point styles. The 6-point offers a better grip on tight nuts and bolts. 6mm to 19mm sockets are the most needed sizes. Below is a list of typical bolt diameters and the corresponding wrench sizes.

Common bolt diameters and wrench sizes	
M5	8 mm
M6	10 mm
M8	12 mm or 13 mm
M10	17 mm
M12	19 mm
M14	22 mm

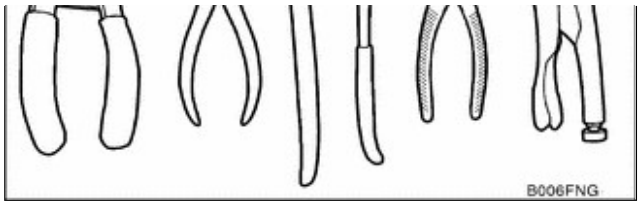


- Spark plug socket. A special socket for spark plugs is the correct size, is deep enough to accommodate a spark plug's length, and includes a rubber insert to both protect the spark plug from damage and grip it for easier removal.



- Pliers. There are many types of pliers including snap-ring, needlenose, adjustable-joint, slip-joint (Channellock®), and locking (Vise-Grip®) most of which are used for

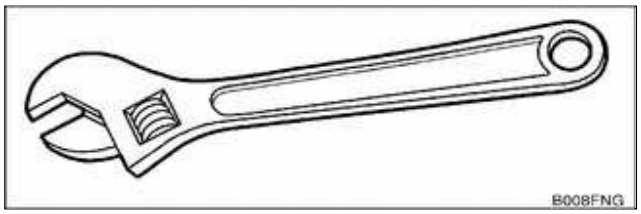
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holding irregular objects, bending, or crimping. Some have special applications.

Needlenose pliers are used for gripping small and poorly accessible objects, and are useful for wiring and other electrical work. Locking pliers such as the Vise-Grip® are useful because of their tight grip.

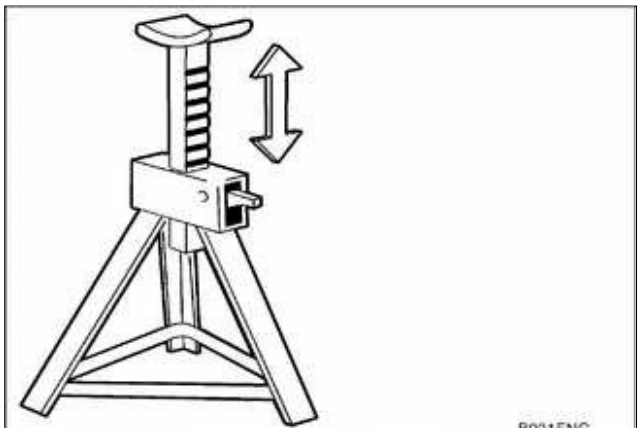
Snap-ring and circlip pliers with special tipped jaws are used to remove and install snap-rings or circlips. Channel-lock® or water pump pliers have adjustable jaws that can be quickly changed to match the size of the object being held to give greater leverage.



- An adjustable wrench can be a useful addition to a small tool kit. It can substitute in a pinch if two wrenches of the same size are needed to remove a nut and bolt. Use extra care with adjustable wrenches, as they tend to loosen, slip, and damage fasteners.

Compared to a wrench of the correct size, an adjustable wrench is always second best. They should only be used when the correct size wrench is not available. Choose one of average size range, about 6 to 8 inches in length.

Jack stands



- Strong jack stands are extremely important for any work that is done under the car. Use only jack stands that are designed for the purpose. Blocks of wood, concrete, bricks, etc. are not safe or suitable substitutes.

WARNING!

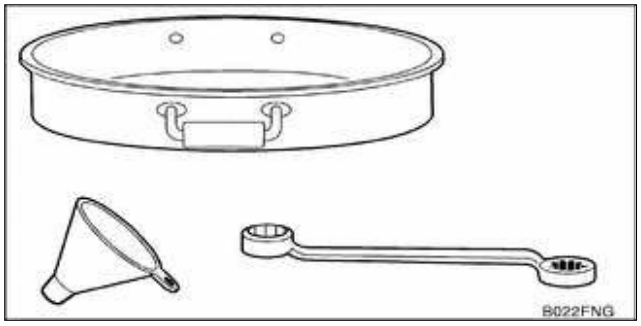
A jack should be used only to raise the vehicle and should not be used

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to support the car for a long period. Always use jack stands to support a raised vehicle.

Jack stands are available in several styles. The best ones are made of heavy material for strength, have a wide base for stability, and are equipped to positively lock in their raised positions. Get the best ones available.

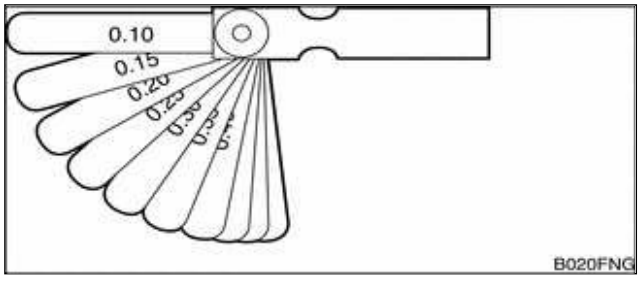
Oil change equipment



- Changing engine oil requires a 17 mm socket or wrench to loosen and tighten the drain plug and a drain pan (at least 8 qt. capacity). A wide, low drain pan will fit more easily under the car. Use a funnel to pour the new oil into the engine.

The M52/M54 engines use an oil filter canister with a disposable filter cartridge insert. Therefore, an oil filter wrench is not required. See ⇒ 020 Maintenance for oil change instructions.

Feeler gauges



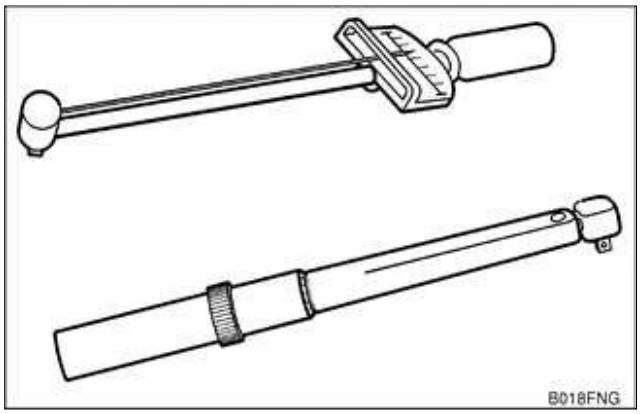
- Feeler gauges are thin metal strips of precise thickness, used to measure small clearances. They are normally available as a set, covering a range of sizes.

Torque wrench

A torque wrench is used to precisely tighten threaded fasteners to a predetermined value. Many of the

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repair procedures in this manual include BMW-specified torque values in Newton-meters (Nm) and the equivalent values in foot-pounds (ft-lb).



- Several types of torque wrenches are available. An inexpensive beam-type (top) is adequate but must be read visually. A ratchet-type (bottom) can be preset to indicate (click) when the torque value has been reached. They all do the same job, but offer different convenience features at different prices. The most convenient ones have a built-in ratchet, and can be preset to indicate when a specific torque value has been reached. Follow the wrench manufacturer's directions for use to achieve the greatest accuracy.

A torque wrench with a range up to about 150 Nm (185 ft-lb) has adequate capacity for most of the repairs covered in this manual. For recommended torque values of 10 Nm or below, the English system equivalent is given in inch-pounds (in-lb). These small values may be most easily reached using a torque wrench calibrated in inch-pounds. To convert inch-pounds to foot-pounds, divide by 12.

Digital multimeter



- Many of the electrical tests in this manual call for the measurement of resistance (ohms) or voltage values. For safe and accurate tests of sensitive electronic components and systems, a multimeter or Digital Volt/Ohmmeter (DVOM) with high input impedance (at least 10,000 ohms) should be used. Some meters have automotive functions such as dwell and pulse width that are useful for troubleshooting ignition and fuel injection problems.

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CAUTION!

Vehicle electronic systems may be damaged by the high current draw of a test light with a normal incandescent bulb. As a general rule, use a high impedance digital multimeter or an LED test light for all electrical testing.

BMW special tools

Many repairs covered in this manual call for the use of BMW special tools. This, however, does not automatically mean that the job is too complicated or out of reach of the do-it-yourselfer.

Many of the BMW special tools mentioned in this manual are simply the best thing to use to do the job correctly. In these cases, the tool is identified with a BMW part number. See your authorized BMW dealer parts department for information on how to order special tools.

There are some jobs for which expensive special tools are essential, and not a cost-effective purchase for one-time repair by the do-it-yourself owner. This manual includes such repairs for the benefit of those with the necessary experience and access to tools. For the do-it-yourselfer, the need for special tools is noted in the text, and whether or not BMW dealer service is recommended.

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Emergencies

Changing a tire

- Stop car on as flat a surface as possible, in a place where you can be easily seen by other drivers. Avoid stopping just over the crest of a hill.

- Turn on emergency flashers, and set out flares or emergency markers well behind car. Chock wheel (wheel chock located in trunk) diagonally opposite to the one being changed. Passengers should get out of car and stand well away from road.

WARNING!

If a tire goes flat while driving, pull well off the road. Changing a tire on a busy street or highway is very dangerous. If necessary, drive a short distance on the flat tire to get to a safe place. It is much better to ruin a tire or rim than to risk being hit.

- Take jack and tools from tool area beneath trunk mat. Remove spare tire from tire storage tray.

- Loosen wheel bolts while car is on ground, but leave them a little snug.



Place jack in lifting point nearest wheel being changed. Use a board to provide a firm footing for jack if ground is soft. Raise car only far enough so that wheel is fully off ground and then

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remove wheel nuts and wheel.

- Install spare wheel. Install wheel nuts and tighten them hand tight using lug nut wrench.

- Lower car. With all wheels on ground, fully tighten nuts in a crisscross pattern. Torque wheel nuts when installing wheel. Check inflation pressure of spare tire.

Tightening torque	
Wheel to wheel hub	100 ± 10 Nm (74 ± 7 ft-lb)

Car will not start

If the engine turns over slowly or not at all, especially on cold mornings, the battery may not be sufficiently charged. Jump-starting the battery from another car may help.

CAUTION!

On cars with manual transmission, push starting (or tow starting) a car is not recommended by BMW.

If the engine is turning over at normal speed with the starter motor, the battery and starter are fine. If the starter will not operate, see ⇒ 121 Battery, Alternator, Starter for information on the starter and starter immobilization systems.

Check to make sure that there is fuel in the tank. Do not rely on the fuel gauge as it may be faulty. Instead, remove the gas filler cap and rock the car. If there is gas in the tank, you should hear a sloshing sound at the filler neck.

See ⇒ OBD On Board Diagnostics at

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the rear of this manual for diagnostic code reading procedures.

Jump starting

Cars with discharged or dead batteries can be jump-started using the good battery from another car. When jump-starting the engine, always note the following warnings.

WARNING!

- ***Battery acid (electrolyte) can cause severe burns, and will damage the car and clothing. If electrolyte is spilled, wash the surface with large quantities of water. If it gets into eyes, flush them with water for several minutes and call a doctor.***

- ***Batteries produce explosive and noxious gasses. Keep sparks and flames away. Do not smoke near batteries.***

- ***Do not jump-start the engine if you suspect that the battery is frozen. Trapped gas may explode. Allow the battery to thaw first.***

- ***Do not quick-charge the battery (for boost starting) for longer than one minute, and do not exceed 16.5 volts at the battery with the boosting cables attached. Wait at least one minute before boosting the battery a second time.***

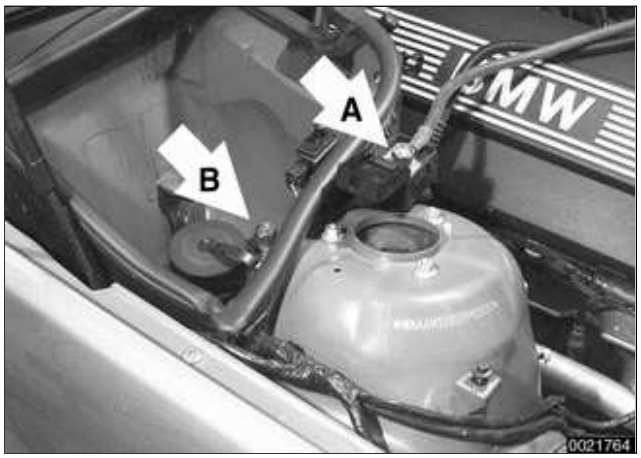
- Place cars close together, but do not allow them to touch each

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other.

- Turn off engine of car with good battery.

- Turn off ignition switch of car with discharged battery.



- Connect one end of positive (+) cable to positive (+) post of good battery. Remove cover from the positive (+) junction post (**A**) in engine compartment and connect other end of the positive (+) cable to the junction post.

- Connect one end of negative (–) cable to negative (–) battery post of good battery. Connect opposite end of negative cable (–) to ground lug (–) in engine compartment (**B**).

- Start car with good battery and run engine at about 2,000 rpm, then start car with dead battery.

- With engine at idle, switch on blower motor and rear window defogger to avoid a damaging voltage surge from alternator.

- Carefully disconnect jumper cables, starting with negative cable on ground lug. Turn all electrical consumers off.

Note:

The engine should be run for at least an hour to recharge the battery.

Indicator and warning lights

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Many of the vehicle systems are self-monitored both statically and dynamically while driving. Generally, a red warning lamp that comes on during driving should be considered serious. If you cannot immediately determine the seriousness of the warning light, stop the vehicle in a safe place and turn the engine off as soon as possible. Consult the owner's manual in the glove box for additional information on the warning lamp and the recommended action.

If the Malfunction Indicator Lamp (MIL), "Check Engine" or "SERVICE ENGINE SOON" warning light, comes on or flashes, it indicates that an emissions-related fault has occurred. Faults such as a faulty oxygen sensor or a faulty fuel injector can cause the exhaust or evaporative emissions to exceed a specified limit. When these limits are exceeded, the MIL will be turned on. The car can be safely driven with the light on, although the emission systems should be checked as soon as possible. See ⇒ OBD On Board Diagnostics for more information on the MIL and the On-board diagnostic system.

Towing

The cars covered by this manual should be towed with a tow truck using wheel lift or flat bed equipment. Do not tow the car on all four wheels except for very short distances to move it to a safe place.

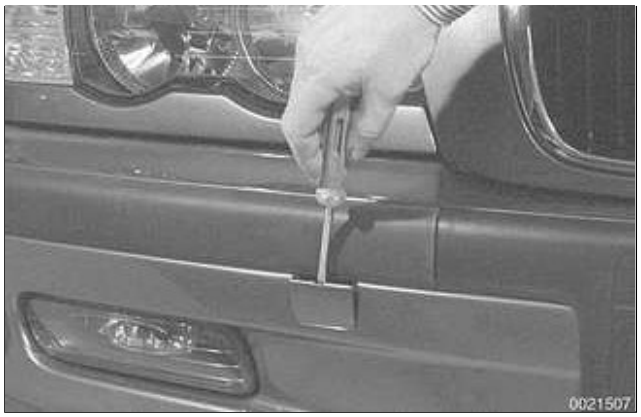
CAUTION!

Do not tow with sling-type equipment. The front spoilers and bumper covers may sustain damage.



To access threaded towing eye socket, pry open trim (**arrow**) on front or rear

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bumper.

Note:

A towing eye is provided in the luggage compartment tool kit. The towing eye can be screwed into the front or rear bumper.



➢ Install towing eye into threaded hole.

- Standard transmission: A maximum towing distance of 20 miles is acceptable with the rear wheels on the ground and the transmission out of gear. If the car needs to be towed further, have the rear wheels placed on dollies.

- Automatic transmission: If absolutely necessary, car can be towed with rear wheels on ground, but the tow should not exceed 25 miles (40 km), at speeds at or below 30 mph (48 km/h).

    - Be sure transmission fluid has been topped off before starting tow.

    - Always tow car with transmission lever in “N” (neutral). If tow must exceed 25 miles (40 km), add one quart of ATF to transmission, or better yet, remove driveshaft.

    - Be sure to drain or pump out added fluid once tow has been completed.

Note:

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- *ATF draining and filling is covered in ⇒ 240 Automatic Transmission. Be sure to read the filling and draining procedure, as special service equipment is required to check the fluid level.*

- *Driveshaft removal is covered in ⇒ 260 Driveshaft.*

Spare parts kit

Carrying a basic set of spare parts can prevent a minor breakdown from turning into a major annoyance. Many of the following items won't allow you to do major repair work on the car, but they will help in the event of the failure of something that can disable the car or compromise its safety.

Spare parts kit – basic
♦ Poly-ribbed drive belt(s) ♦ Engine oil (one or two quarts) ♦ Engine coolant (1 gallon of premixed 50/50 BMW anti-freeze and water) ♦ Fuse assortment (7.5A, 10A, 15A, 20A, 30A, 50A) ♦ Radiator hoses (upper and lower)

Spare parts kit – additional contents

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Spare parts kit – additional contents

- Exterior lighting bulbs (headlight, brake light, turn signal, and taillight)
- Wiper blades
- Brake fluid (new unopened bottle, DOT 4 specification)
- Main relay for DME system

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General

The information given in this repair group includes the routine checks and maintenance steps that are both required by BMW under the terms of the vehicle warranty protection and recommended by BMW to ensure long and reliable vehicle operation.

Note:

Aside from keeping your car in the best possible condition, proper maintenance plays a role in maintaining full protection under BMW's new-car warranty coverage. If in doubt about the terms and conditions of your car's warranty, an authorized BMW dealer should be able to explain them.

Service Interval Indicator (SII)

For the 1999 and later 3 Series (E46), BMW introduced an extended oil change interval of approximately 15,000 miles depending on engine operating conditions. The introduction of BMW High Performance Synthetic Oil has made this longer interval possible.

1999 to 6/2000 models. BMW uses a unique system to determine maintenance intervals. BMW's Service Interval Indicator (SII), calculates maintenance intervals based not only on elapsed mileage, but also on such inputs as engine speed, engine temperature, number of starts, length of trips, and the amount of fuel used. At the appropriate time, the system indicates, through lights in the instrument cluster, when the next routine maintenance is due.

6/2000 and later models. For the

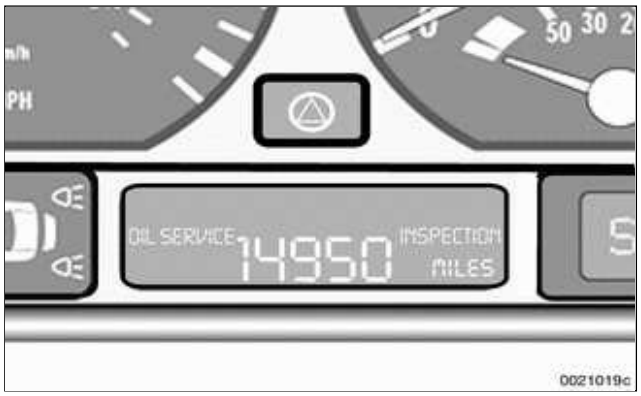
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mid-2000 models BMW introduced new service interval software which calculates service based on the amount of fuel used. When SII detects total fuel consumption that equals the preset limits (in gallons), the instrument cluster indicates that service is required.

Using a 328i as an example:

- Standard transmission model: SII illuminates after consumption of 601 gallons of fuel.
- Automatic transmission model: SII illuminates after consumption of 667 gallons.

After the service is performed the SII can be reset to zero.



The SII displays the mileage remaining before service is due. The type of service (OIL SERVICE or INSPECTION) is also illuminated in the display.

Note:

An OIL SERVICE interval will always be followed by an INSPECTION interval, which will then be followed by an OIL SERVICE interval, and so on.

When the ignition is turned on, the service recommendation and miles remaining are displayed for a few seconds. A flashing message and a negative (-) symbol in front of the number indicate that the service interval has been exceeded by the distance displayed.

The On-Board Computer uses the rate of fuel consumption in the period immediately preceding to calculate the mileage before the next service is due.

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Service Interval Indicator (SII), resetting

The SII signals the need for basic routine maintenance:

- Engine oil and oil filter change, after the engine has been warmed up.
- BMW-recommended additional maintenance as listed in ⇒ Table a.

Note:

For reference, the BMW oil service requirements are approximately equivalent to the maintenance that other European manufacturers specify at intervals with a maximum of every 15,000 miles or 12 months.

When the specified maintenance has been carried out, the SII memory should be reset.

1999 to 6/2000 models



In vehicles equipped with the DLC in the right side engine compartment, the SII may be reset using BMW service and scan tool DIS or MoDiC, or a specialty tool from another manufacturer. Plug the tool (**arrow**) into the DLC

CAUTION!

Follow the manufacturer's directions when resetting the SII. If the reset procedures are done incorrectly, the reset tool or the electronic Service Interval Indicator may be damaged.

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Aftermarket reset tools that can reset all models with the DLC can be purchased from one of the following suppliers:

Assenmacher Specialty Tools 6440 Odell Place, Boulder, CO 80301 303-530-2424 http://www.asttool.com
Baum Tools Unlimited, Inc. P.O. Box 5867, Sarasota, FL 34277-5867 800-848-6657 http://www.baumtools.com
Peake Research, Automotive Products Division P.O. Box 28776, San Jose, CA 95159 408-369-0406 http://www.peakeresearch.com

6/2000 and later models

On vehicles without the data link connector (DLC) in the engine compartment the reset tool can no longer be used. Instead, the SII can be reset with the trip odometer reset button in the instrument cluster:

- The ignition key must be in OFF position.
- Press and hold trip odometer button in instrument cluster, and turn ignition key to ACCESSORY position.
- Keep button pressed for approx. 5 more seconds until any of the following appear in the display: "Oil Service" or "Inspection", with "Reset" or "Re".

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- Press button again and hold for approx. 5 seconds until "Reset" or "Re" flash.
- While display is flashing, press button briefly to reset SII.
- After display has shown new interval, the following will appear in display for approx. 2 seconds: "End SIA".

The system can only be reset again after the vehicle has been driven approx. 50 to 75 miles (consumes at least 2.5 gal. fuel). If the display shows "Reset" or "Re" when resetting, the minimum driving distance has been fulfilled and the system can be reset again. It is possible to interrupt and end the reset procedure by changing the position of the ignition key.

Inspection I and Inspection II

The Service Interval Indicator signals the need for more comprehensive maintenance and inspection. There are two sets of inspection requirements. These inspections alternate throughout a car's maintenance history. If the last inspection interval was Inspection I, the next inspection interval (following an oil service) will be Inspection II, the next after that will be Inspection I, and so on.

Inspection I tasks are listed in ⇒ Table b. Inspection II includes most of the tasks from Inspection I with additional Inspection II tasks. A complete listing of Inspection II tasks is in ⇒ Table c.

Note:

For reference, the BMW Inspection I

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and Inspection II requirements are approximately equivalent to the maintenance requirements that other European manufacturers specify. Inspection I is normally due at intervals with a maximum of 30,000 miles or 24 months. Inspection II is normally due at intervals with a maximum of 60,000 miles or 48 months.

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Maintenance Tables

The intervals for most tasks listed in the maintenance table below are determined by the SII.

Except where noted, the maintenance items listed apply to all models and model years covered by this manual. The columns on the right side of each table give quick-reference information about the job. The text in the "additional repair information" column refers to repair groups.

Table a. Oil service

Maintenance item	Tools required	New parts required	Warm engine required	Dealer service recommended	Additional repair information
Engine compartment maintenance					
Change oil and oil filter					⇒ 020
Reset Service Interval Indicator (SII).					⇒ 020
Replace interior ventilation microfilter.					⇒ 020
Under car maintenance					
Check overall thickness of front and rear brake pads. If replacement is necessary: Examine brake disc surfaces. Clean brake pad contact points in calipers. Grease wheel centering hubs (alloy wheels only). Check thickness of parking brake linings only when replacing rear brake pads. Check operation of parking brake and adjust as necessary.					⇒ 340
Check and adjust tire pressures, including spare					⇒ 020

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Table b. Inspection I service					
Maintenance item	**Tools required**	**New parts required**	**Warm engine required**	**Dealer service recommended**	**Additional repair information**
Under car maintenance					
Change engine oil and filter.					⇒ 020
Check transmission and differential(s) for external leaks.					⇒ 230 ⇒ 240
Check CV joint boots for damage or leaks.					⇒ 311 ⇒ 331
Visually check fuel tank, fuel lines and connections for leaks.					⇒ 160
Check condition, position, and mounting of exhaust system. Visually check for leaks.					⇒ 180
Check power steering system for leaks. Check power steering fluid level and adjust if necessary.					⇒ 320
Check steering rack and tie rods for tightness. Check condition of front axle joints, steering linkage and steering shaft joints.					⇒ 320
Check overall thickness of front and rear brake pads using special BMW tool. If replacement is necessary: Examine brake disc surfaces. Clean brake pad contact points in calipers. Grease wheel					⇒ 340

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Table b. Inspection I service					
Maintenance item	**Tools required**	**New parts required**	**Warm engine required**	**Dealer service recommended**	**Additional repair information**
centering hubs (alloy wheels only). Check thickness of parking brake linings only when replacing rear brake pads. Check operation of parking brake and adjust as necessary.					
Check front control arm bushings for damage or wear.					⇒ 310
Check brake system connections and lines for leaks, damage and incorrect positioning.					⇒ 340
Check parking brake actuator. Adjust if necessary.					⇒ 340
Check all tire pressures (including spare) and correct if necessary. Check condition of tires (outer tread surfaces), tread wear pattern; in case of uneven tread wear, perform a wheel alignment if requested.					⇒ 020
Inspect entire body according to terms of rust perforation limited warranty. (Must be performed at least every two years.)					
Engine compartment maintenance					
Read out on-board diagnostic (OBD II) system.					⇒ 100 ⇒ 130

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Table b. Inspection I service					
Maintenance item	**Tools required**	**New parts required**	**Warm engine required**	**Dealer service recommended**	**Additional repair information**
Check engine coolant system/heater hose connections for leaks. Check coolant level and antifreeze protection level. Add coolant as necessary.					⇒ 170
Check windshield washer fluid level and antifreeze protection. Add washer fluid as necessary.					⇒ 611
Replace ventilation microfilter. (Note: reduce replacement intervals in dusty operating conditions).					⇒ 020
Reset service interval indicator.					⇒ 020
Body/electrical					
Check operation of air conditioner.					⇒ 640
Check operation of headlights, parking lights, back-up lights, license plate lights, interior lights, glove box light, engine compartment light, trunk light, turn signals, emergency flashers, stop lights, horns, headlight flasher and dimmer switch					⇒ 630
Check instrument panel and dashboard lights.					⇒ 620
Check wipers and windshield washer					⇒ 611

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Table b. Inspection I service					
Maintenance item	**Tools required**	**New parts required**	**Warm engine required**	**Dealer service recommended**	**Additional repair information**
system. Check aim of washer jets and adjust if necessary.					
Check condition and function of seat belts.					⇒ 720
Visually examine all airbag units for torn covers, obvious damage or attachment of decals, decorations or accessories.					⇒ 721
Check central locking system and double lock.					⇒ 515
Replace batteries for alarm remote controls in all master keys.					⇒ 515
Check operation and condition of all door, hood and trunk latches.					⇒ 410 ⇒ 515
Check heater, air conditioner blower, and rear window defogger operation.					⇒ 640
Convertible models: Activate automatic roll-over protection system via diagnostic link. Note: first remove hardtop or lower convertible top.					⇒ 541
Check all warning/indicator lights, check control.					⇒ 620
Check operation of rear view mirrors.					
Road test					

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Table b. Inspection I service					
Maintenance item	**Tools required**	**New parts required**	**Warm engine required**	**Dealer service recommended**	**Additional repair information**
Check braking performance, steering, heating, air conditioner operation. Check manual transmission and clutch operation or automatic transmission operation.					

Table c. Inspection II service					
Maintenance item	**Tools required**	**New parts required**	**Warm engine required**	**Dealer service recommended**	**Additional repair information**
Engine compartment maintenance					
Replace air filter element. (Note: reduce replacement intervals in dusty operating conditions).					⇒ 020
Brake system service					
Replace brake fluid every 2 years (time interval begins from vehicle production date).					⇒ 340
Cooling system service					
Replace coolant every 4 years (time interval begins from vehicle production date).					⇒ 170
Oxygen sensor service					
Replace oxygen sensor every 100,000 miles.					⇒ 180

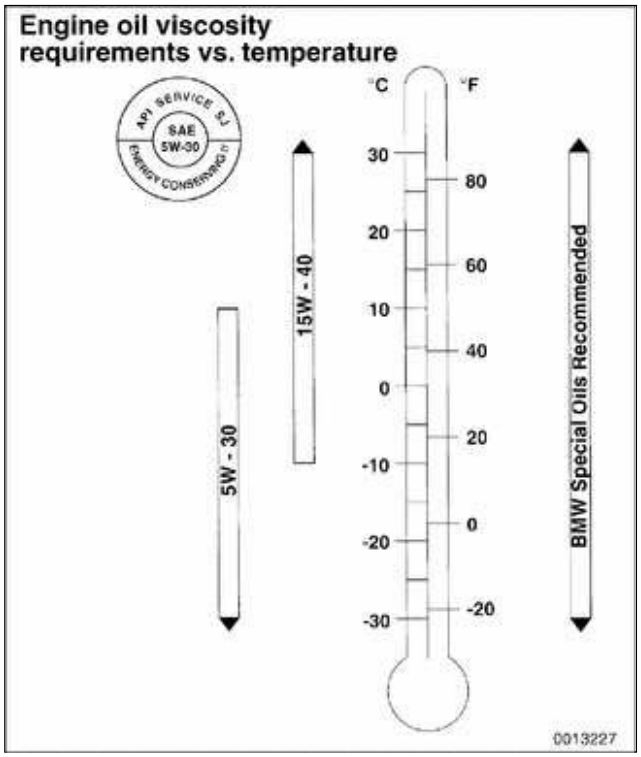
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Table c. Inspection II service					
Maintenance item	**Tools required**	**New parts required**	**Warm engine required**	**Dealer service recommended**	**Additional repair information**
Spark plug service					
Replace spark plugs every 100,000 miles.					⇒ 020

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Fluid and Lubricant Specifications



The illustration shows engine oil viscosity (SAE grade) vs. operating temperature range for the BMW engines covered in this manual.

Fluid and lubricant capacities and specifications for E46 cars are listed in ⇒ Table d.

WARNING!

The use of fluids that do not meet BMW's specifications may impair performance and reliability, and may void warranty coverage.

Table d. Fluids and lubricants		
Fluid	**Approximate capacity**	**Specification**
Engine oil with filter change		
Rear wheel drive	6.5 liters (6.9 US qt.)	Synthetic oil with API rating SH or higher
All wheel drive	7.5 liters (8 US qt.)	
Manual transmission oil		
Getrag S5D 250G	1.1 liters (1.15 US qt.)	BMW 83 22 9 408 942 (MTF-LT-1)
ZF S5D 320Z	1.3 liters (1.37 US qt.)	
ZF S5D 280Z	1.35 liters (1.42 US qt.)	
Automatic transmission fluid (ATF) (drain and fill) (additional fluid required when installing a dry torque converter)		

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Table d. Fluids and lubricants		
Fluid	**Approximate capacity**	**Specification**
ZF A5S 325Z	Complete refill: 9.0 liters (9.5 US qt.) Oil and filter change: 4.0 liters (4.2 US qt.)	BMW 83 22 9 407 807 (Exxon LT 71141) BMW 83 22 0 024 359 (Texaco ETL 8072B)
GM A5S 360R		
GM A5S 390R		
Differential, front or rear(drain and fill) (Lifetime fluid; no fluid change required)		
Front differential	Fill: 0.7 liter (0.74 US qt.) Refill: 0.6 liter (0.63 US qt.) Rear wheel drive: 0.9 liter (0.95 US qt.) All wheel drive: 1.0 liter (1.06 US qt.)	BMW SAF-XO synthetic oil
Rear differential		
Power steering fluid		
All models	Permanently sealed (no drain plug)	Dexron III® ATF
Brake fluid		
All models		SAE DOT4
Engine coolant		
All models	8.4 liters (8.9 US qt.)	50% BMW anti-freeze/ 50% distilled water

CAUTION!

Multi-viscosity engine oils should not be

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used in the manual transmission. Use of such an oil could shorten the service life of the transmission.

Brake fluid

Brake fluid absorbs moisture easily, and moisture in the fluid affects brake performance and reliability. This is why brake fluid should be flushed from the system every two years. When replacing or adding brake fluid, use only new fluid from previously unopened containers. Do not use brake fluid that has been bled from the system, even if it is brand new. Use only DOT 4 brake fluid.

Note:

See ⇒ 340 Brakes for more brake fluid information.

Engine coolant (anti-freeze)

BMW recommends coolant that is a 50/50 mixture of distilled water and phosphate/nitrate free anti-freeze containing ethylene glycol. Anti-freeze raises the boiling point and lowers the freezing point of the coolant. It also contains additives that help prevent cooling system corrosion.

Differential gear oil

BMW recommends using only a specially formulated synthetic gear oil (SAF-XO) that is available through an authorized BMW dealer parts department. For additional information on this lubricant and any other lubricants that may be compatible, contact an authorized BMW dealer service department.

Power steering fluid

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The power steering fluid is Dexron III® ATF, or equivalent. The system is permanently filled and does not have a drain. Routinely adding ATF is not required unless the system is leaking.

Transmission fluid, automatic

The automatic transmissions installed in the E46 models are filled with special automatic transmission fluids, depending on transmission type and model year.

Note:

- *The transmission lubricant type can be found on the "type-plate" on the side of the transmission. See ⇒ 240 Automatic Transmission.*
- *Consult an authorized BMW dealer for alternate fluid use and the most-up-to-date information regarding transmission operating fluids.*

Transmission fluid, manual

The manual transmissions installed in the E46 models are normally filled with a special lifetime fluid (MTF-LT-1). Consult ⇒ 230 Manual Transmission for further information.

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Engine Oil Service

With the introduction of synthetic oil and extended oil change intervals, a new oil filter with improved filter paper design was introduced. The new filter paper resists deterioration caused by high oil temperatures over an extended time.

Note:

Early style oil filter numbers with BMW part numbers 11 42 1 427 908 or 11 42 1 745 390 should not be used in the 1999 and later BMW models.

Use any synthetic low viscosity oil to top off the engine oil level between oil changes, as long as it meets the API classification SH. Castrol is now the supplier of both the mineral based oil used in earlier models and the synthetic based oil used from model year 1999.

Oil recommendation	
BMW High Performance Synthetic (part number 07 51 0 017 866)	5W-30

Note:

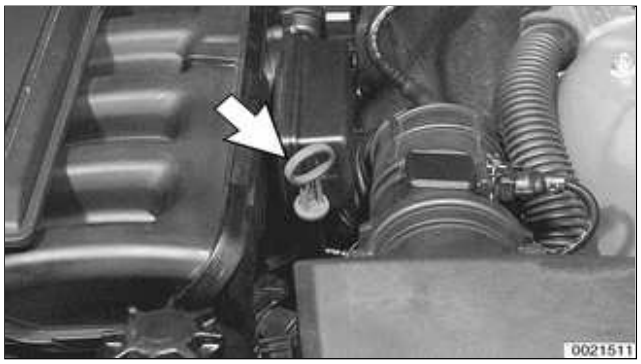
- *The use of engine oil additives is not recommended when using BMW High Performance Synthetic engine oil.*

- *BMW is constantly upgrading recommended maintenance procedures and requirements. The information contained here is as accurate as possible at the time of*

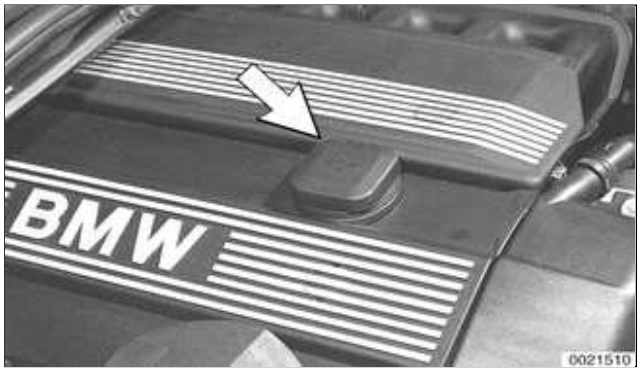
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publication. If there is any doubt about what procedures apply to a specific model or model year, or what intervals should be followed, remember that an authorized BMW dealer has the latest information on factory-recommended maintenance.

Engine oil, checking level



- Engine oil level is checked with a dipstick (**arrow**) in engine block.
  - Check oil level with car on a level surface, after engine has been stopped for at least a few minutes.
  - Check level by pulling out dipstick and wiping it clean. Reinsert it all way and withdraw it again.
  - Oil level is correct if it is between two marks near end of stick.



- Add oil through filler cap (**arrow**) on top of cylinder head. Add only amount needed to bring oil level to MAX mark on dipstick, using an oil of correct viscosity and grade. Too much oil can be just as harmful as too little.

Engine oil and filter, changing

A complete oil change requires new oil, a new oil filter insert kit, and a new drain plug sealing washer. The tools needed, a 17 mm drain plug socket or box wrench and a drain pan (8 - 10 US

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qt. capacity), are described in ⇒ 010 General.

Note:

If using a "fast-lube" service facility for oil changes, make sure the technician hand-starts and torques the engine oil drain plug using hand-tools. Power tools can strip the threads of the plug and the oil pan.

- Run engine for a few minutes to warm engine oil. Shut engine off.

- With car on level ground, place drain pan under oil drain plug.



➢ Using a 36 mm wrench, loosen and remove oil filter housing cover (**arrow**). Remove filter cartridge and discard any O-rings.



➢ On Coupe or Convertible model: Remove oil drain plug access panel in center of front end reinforcement plate below engine.



➢ Using a socket or box wrench, loosen drain plug at oil drain pan. Remove plug by hand and let oil drain into pan.

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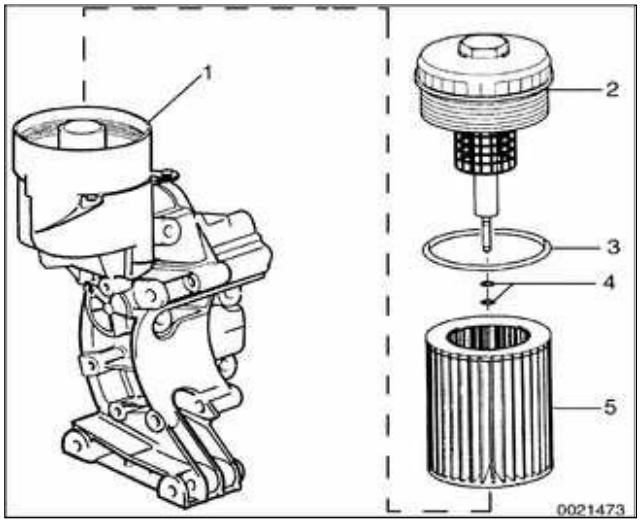


CAUTION!

Pull the loose plug away from the hole quickly to avoid being scalded by hot oil. It will run out quickly when the plug is removed. If possible, use gloves to protect your hands.

- When oil flow has diminished to an occasional drip, reinstall drain plug with a new metal sealing washer and torque plug.

Tightening torques	
Engine oil drain plug (M12 bolt)	25 Nm (18 ft-lb)



Working at oil filter housing:

- Lubricate and install new oil filter O-rings.
- Install a new filter cartridge and housing cover.
- Tighten cover.

1 - Filter housing

2 - filter housing cover -tighten to 25 Nm (18 ft-lb)

3 - O-ring (always replace)

4 - O-rings (always replace)

5 - Filter element

Tightening torque	
Oil filter cover filter housing	25 Nm (18 ft-lb)

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- Refill crankcase with oil. Approximate oil capacity is listed in ⇒ Table d. Use dipstick to check correct oil level.

- Start engine and check that oil pressure warning light immediately goes out.

- Allow engine to run for a few minutes to circulate new oil, then check for leaks at drain plug and oil filter. Stop engine and recheck oil level.

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Engine Compartment Maintenance

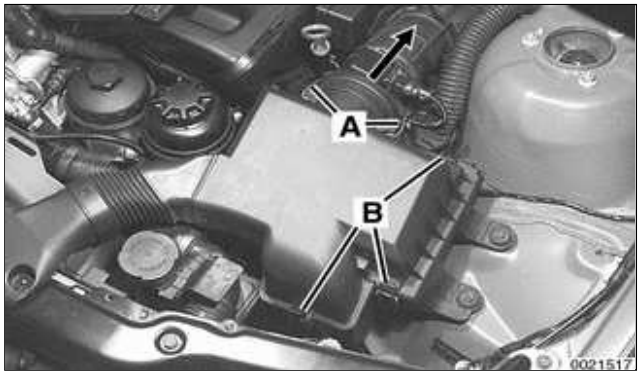
The information under this heading describes routine maintenance other than oil change done in the engine compartment. It is not necessary for the car to be raised and supported off the ground. Information on oil change is given earlier in this group.

Accelerator linkage

The accelerator and throttle linkage should be lubricated periodically. Use a general purpose oil on the joints and bearings of the linkage. Use a multipurpose grease on the bearing points of the throttle plate.

Air filter, replacing

The specified replacement intervals for the air filter are based on normal use. If the car is operated primarily in dusty conditions, the air filter should be serviced more frequently.



- Release mass air flow sensor clips (**A**) and pull sensor assembly out of air filter upper housing (**arrow**).
  - Release upper air filter housing clips (**B**).



- Lift air filter upper housing, and then remove filter element insert from cartridge.
  - On installation, install O-ring for

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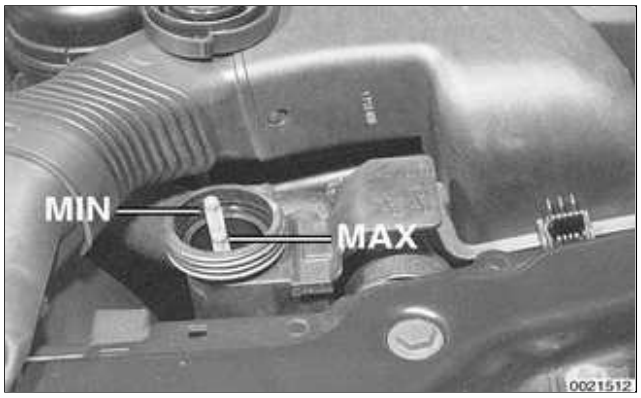
mass air flow sensor (**arrow**) into retaining clips in air filter upper housing.

Cooling system service

Routine cooling system maintenance consists of maintaining the coolant level and inspecting hoses. Because the coolant's anti-corrosion and anti-freeze additives gradually lose their effectiveness, replacement of the coolant every four years is recommended.

CAUTION!

Use only BMW approved phosphate-free anti-freeze when filling the cooling system. Use of anti-freeze containing phosphates is considered to be harmful to the cooling system.



- The float in the radiator tank indicates coolant level, and should be inspected while the coolant is cold. When the upper mark on the float is level with the top of the filler neck, coolant is at the minimum allowable level. When the lower mark on the float is level with the top of the filler neck, the coolant is at the maximum level.

Hose connections should be tight and dry. Coolant seepage indicates either that the hose clamp is loose, that the hose is damaged, or that the connection is dirty or corroded. Dried coolant has a chalky appearance. Hoses should be firm and springy. Replace any hose that is cracked, that has become soft and limp, or has been contaminated by oil.



- As a preventive measure, replacement of the cooling system hoses every four years is also recommended. The

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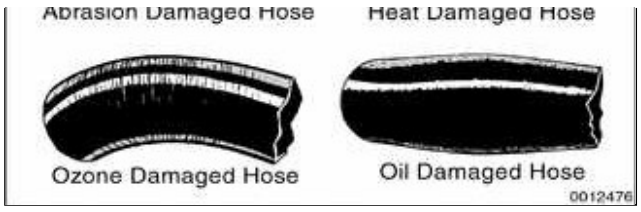


illustration shows examples of damage to coolant hoses. Any of conditions shown is cause for replacement. (Courtesy of Gates Rubber Company, Inc.)

Engine drive belt service

Drive belts and pulleys transfer power from the engine crankshaft to various accessories. E46 models use two poly-ribbed (serpentine) belts:

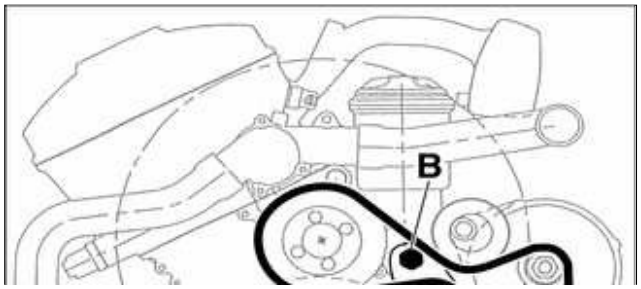
- The outer belt only turns the A/C compressor
- The inner, longer belt activates the alternator, coolant pump and power steering.

Automatic belt tensioners are used to keep the belts tensioned properly. Unless a tensioner mechanism malfunctions, the poly-ribbed belts do not require tension adjustment.

Inspect drive belts with the engine off. If the belt shows signs of wear, cracking, glazing, or missing sections, it should be replaced immediately. To reduce the chance of belt failure while driving, replacement of the belts every four years is recommended.

Note:

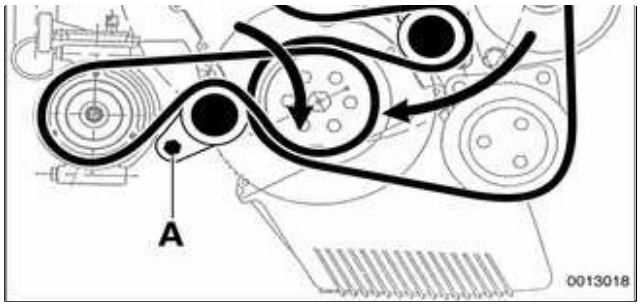
When belts are replaced with new ones, store the old set in the luggage compartment for emergency use.



To remove drive belts:

- Use long-handled wrench to turn A/C belt tensioner release lug (**A**) clockwise (against spring tension). Remove A/C belt.

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- Similarly, turn main engine drive belt tensioner lug (**B**) clockwise and remove belt.

WARNING!

Observe care when replacing belts. Personal injury could result if a tensioner springs back into position uncontrollably.

CAUTION!

Mark drive belt rotation direction if removing and reusing an old belt.

- When installing a new belt, gently pry it over the pulleys. Too much force may damage the belt or the accessory.

Idle speed

Engine idle speed can change due to a number of factors, including normal wear. The idle speed in E46 models is electronically adaptive and non-adjustable. See ⇒ 130 Fuel Injection for more information.

Oxygen sensors

The engine management system in E46 models is equipped with multiple oxygen sensors. A regulating sensor is mounted before each catalytic converter and a monitoring sensor downstream of each converter. The regulating sensor monitors engine combustion efficiency and helps to control the fuel injection system and exhaust emissions. The monitoring sensor is used by the on-board diagnostic (OBD II) system to monitor the function of the catalytic converter.

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OBD II enhanced emission standards require the engine control module (ECM) to monitor the oxygen content in the exhaust both before and after the catalytic converter. This allows for tighter control of the tail pipe emissions and also allows the ECM to diagnose converter problems. If the ECM detects that catalytic converter or oxygen sensor efficiency has degraded past a certain pre-programmed limit, it will turn on the Check Engine light, and store a diagnostic trouble code (DTC) in the ECM. See ⇒ OBD On Board Diagnostics in the rear of this manual for more information on OBD systems.

Replacement of oxygen sensors at the specified intervals ensures that the engine and emission control system will continue to operate as designed. Extending the replacement interval may void the emission control warranty coverage. See ⇒ 180 Exhaust System for information on replacing the oxygen sensors.

Tightening torque	
Oxygen sensor to exhaust manifold	50 Nm (37 ft-lb)

Note:

A special socket for replacing the oxygen sensor is available from most automotive parts stores. The socket has a groove cut down one side to allow the sensor to be installed without damaging the wire harness.

Power steering fluid, checking level



To check power steering fluid level in fluid reservoir:

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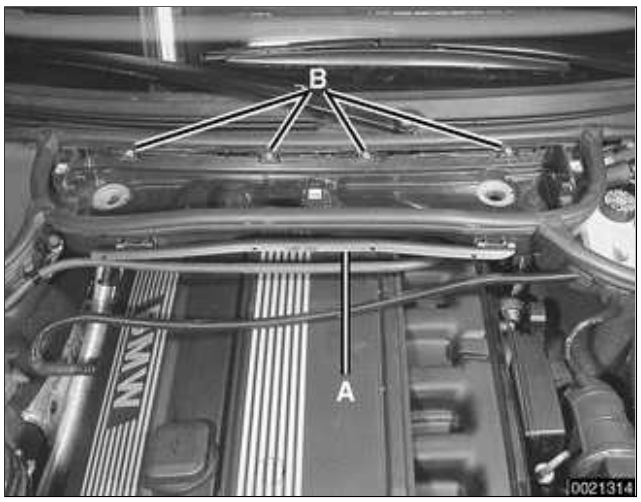


- Park car on level ground with engine off.
- Level is correct if it is between **MIN** and **MAX** marks on dipstick.
- If level is below **MIN** mark, start engine and add fluid to reservoir to bring level up.
- Stop engine and recheck level.
- Hand-tighten reservoir cap.

Power steering fluid	
Recommended fluid	Dexron III® ATF

Spark plugs, replacing

E46 engines use a "coil-over" configuration, with one ignition coil above each spark plug.



Remove microfilter housing:

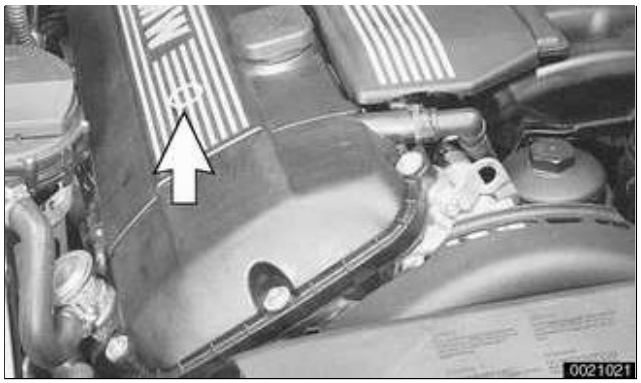
- Remove microfilter for interior ventilation. See ⇒ Ventilation microfilter, replacing
- Open wiring harness loom (**A**), remove harness and lay aside.
- Unfasten screws (**B**) and take off lower microfilter housing.



Remove engine cover over ignition coils:

- Remove oil filler cap.

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- Remove plastic trim covers (**arrows**).
- Remove cover hold down bolts.



➢ Remove ignition coil grounding harnesses (**arrows**).



➢ Remove ignition coils:

- Pull up on spring clips to disconnect ignition coil harness connectors.
- Remove coil mounting bolts. Remove coils.

- Remove spark plugs.

- Installation is reverse of removal, bearing in mind the following:

- Lightly lubricate new spark plug threads with copper-based anti-seize compound.
- Thread plugs into cylinder head by hand to prevent cross-threading.

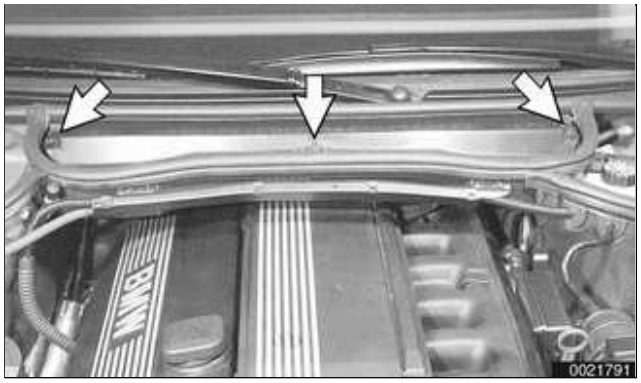
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- Be sure to reinstall coil grounding harness.

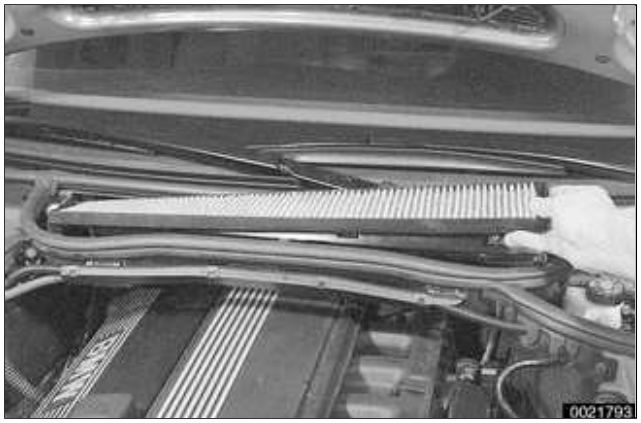
Spark plug recommendations	
Bosch	FGR7 DQP
NGK	BKR6 EQUP

Tightening torque	
Spark plug to cylinder head	25 Nm (18 ft-lb)

Ventilation microfilter, replacing



- Working at cowl housing inside engine compartment, twist microfilter cover retainers (**arrows**) 90° each and pull cover up.



- Pull filter out and replace.

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Other Mechanical Maintenance

Battery, checking and cleaning

The battery is located in the right side of the luggage compartment. Simple maintenance of the battery and its terminal connections will ensure maximum starting performance, especially in winter when colder temperatures reduce battery power.

Note:

Design characteristics of the convertible body cause vibrations in the trunk area. Therefore, E46 Convertibles require a special battery designed for constant vibration. When replacing the battery, be sure the replacement is designed specifically for the Convertible.

Battery cables should be tight. The terminals, the cable clamps, and the battery case should be free of the white deposits that indicate corrosion and acid salts. Even a thin layer of dust containing conductive acid salts can cause battery discharge.

- To remove battery corrosion:

- Disconnect battery cables. Disconnect negative (-) cable first.

- Remove battery from trunk.

- Clean terminal posts and cable clamps with a wire brush.

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- Clean main chassis ground terminal next to battery. Corrosion can be washed away with a baking soda and water solution that will neutralize acid. Apply solution carefully, though, since it will also neutralize acid inside battery.

- Reconnect cable clamps, positive (+) cable first.

- Lightly coat outside of terminals, hold down screws, and clamps with petroleum jelly, grease, or a commercial battery terminal corrosion inhibitor.

WARNING!

- ***Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.***

- ***Battery acid is extremely dangerous. Take care to keep it from contacting eyes, skin, or clothing. Wear eye protection. Extinguish all smoking materials and do not work near any open flames.***

Battery electrolyte should be maintained at the correct level just above the battery plates and their separators. The correct level is approximately 5 mm (1/4 in.) above the top of battery plates or to the top of the indicator marks (if applicable). The battery plates and the indicator marks can be seen once the filler caps are removed. If the electrolyte level is low, replenish it by adding distilled water

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only.

Note:

The original equipment battery in E46 models is maintenance free. The original electrolyte will normally last the entire service life of the battery under moderate climate conditions.

Battery, replacing



The original equipment BMW battery is equipped with a built-in hydrometer "magic eye" (**arrow**). Battery condition is determined by the color of the eye:

- Green: Adequate charge
- Black: Inadequate charge; recharge
- Yellow: Defective battery; replace

Batteries are rated by ampere hours (Ah), the number of hours a specific current drain can be sustained before complete discharge, or by cold cranking amps (CCA), the number of amps available to crank the engine in cold weather conditions. In general, replacement batteries should always be rated equal or higher than the original battery.

CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

The battery is held in place by a single hand screw and plate. A secure battery hold-down is important in order to prevent vibrations and road shock from

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damaging the battery.

Note:

- *Always disconnect the negative (-) cable first, and connect it last. While changing the battery, clean away any corrosion in or around the battery tray.*

- *Design characteristics of the convertible body cause vibrations to oscillate in the trunk area. Therefore, the convertible model uses a special battery and battery retaining mechanism designed for this constant vibration.*

- *More battery and charging system information is in ⇒ 121 Battery, Alternator, Starter.*

Brake fluid, replacing

BMW strictly recommends replacing the brake fluid every two years. This will help protect against corrosion and the effects of moisture in the fluid.

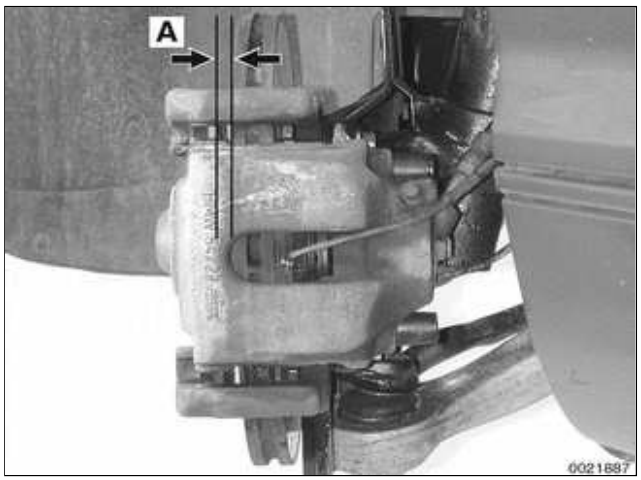
Note:

See ⇒ 340 Brakes for brake fluid flushing procedures.

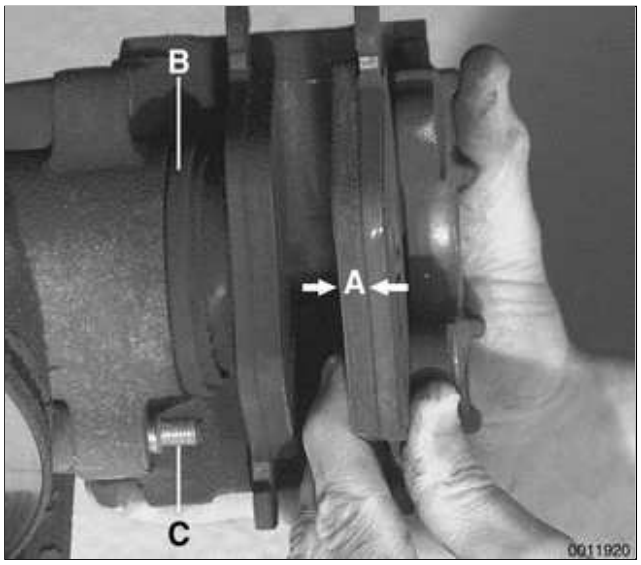
Brake pad/rotor wear, checking

All E46 cars are fitted with disc brakes at all four wheels. Although the brakes are equipped with a brake pad warning system, the system only monitors one wheel per axle. It is recommended that pad thickness should be checked whenever the wheels are off or brake work is being done.

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- Disc brake pad wear can be checked through opening in caliper:
  - Measure distance (**A**) of brake pad "ear" to brake rotor. See ⇒ 340 Brakes. Compare to specification below.



- Unbolt caliper from steering arm to properly inspect:
  - Brake pad thickness (**A**)
  - Brake rotors
  - Condition of caliper seal (**B**)
  - Condition of caliper slider bolts (**C**)

Note:

Brake caliper removal and installation procedures are given in ⇒ 340 Brakes.

Brake pad lining minimum thickness	
Front or rear pad Dimension **A**	3.0 mm (0.12 in.)

Brake system, inspecting

Routine maintenance of the brake system includes maintaining the brake fluid in the reservoir, checking brake pads for wear, checking parking brake function, and inspecting the system for fluid leaks or other damage:

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- Check that brake hoses are correctly routed to avoid chafing or kinking.
- Inspect unions and brake calipers for signs of fluid leaks.
- Inspect rigid lines for corrosion, dents, or other damage.
- Inspect flexible hoses for cracking.
- Replace faulty hoses or lines, see ⇒ 340 Brakes.

WARNING!

Incorrect installation or overtightening hoses, lines, and unions may cause chafing or leakage. This can lead to partial or complete brake system failure.

Parking brake, checking

The parking brake system is independent of the main braking system and may require periodic adjustment depending on use. Adjust the parking brake if the brake lever can be pulled up more than 8 clicks. Check that the cable moves freely. A description of the parking brake and parking brake adjustment can be found in ⇒ 340 Brakes.

Note:

The parking brake may lose some of its effectiveness if it is not used frequently. This is due to corrosion build-up on the parking brake drum. To remove corrosion, apply the parking brake just until it begins to grip, then pull the lever

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up one more stop (click). Drive the car approximately 400 meters (1,300 ft.) and release the brake. To recheck the adjustment of the parking brake see ⇒ 340 Brakes.

Clutch fluid, checking

The hydraulic clutch and the brake system share the same reservoir and the same brake fluid. Clutch fluid level and brake fluid level are checked at the same time.

Note:

- *See ⇒ 340 Brakes for more information.*
- *See ⇒ 210 Clutch for information on the clutch and the hydraulic clutch operating system.*

Drive axle joint (CV joint) boots, inspecting

CV joint protective boots must be closely inspected for cracks and any other damage that will allow contaminants to get into the joint. If the rubber boots fail, the water and dirt that enter the joint will quickly damage it.

Note:

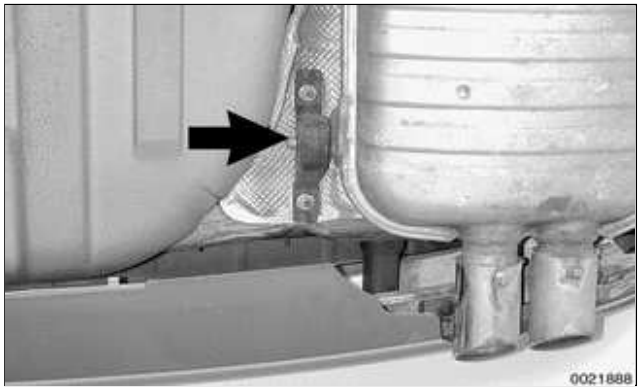
Replacement of the CV joint boots and inspection of the joints are described in ⇒ 311 Front Axle Final Drive and ⇒ 331 Rear Axle Final Drive.

Exhaust system, inspecting

Exhaust system life varies widely according to driving habits and

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environmental conditions. If short-distance driving predominates, the moisture and condensation in the system will not fully dry out. This will lead to early corrosion damage and more frequent replacement.



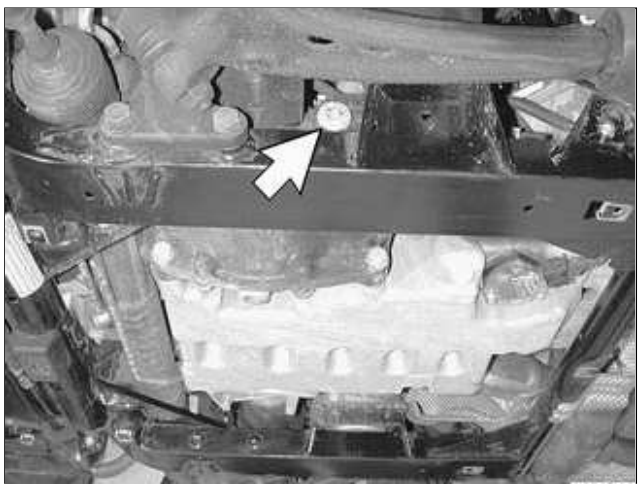
- Scheduled maintenance of the exhaust system is limited to inspection:
  - Check to see that all the hangers (**arrow**) are in place and properly supporting the system and that the system does not strike the body.
  - Check for restrictions due to dents or kinks.
  - Check for weakness or perforation due to rust.

Note:

Alignment of the system and the location of the hangers are described in ⇒ 180 Exhaust System.

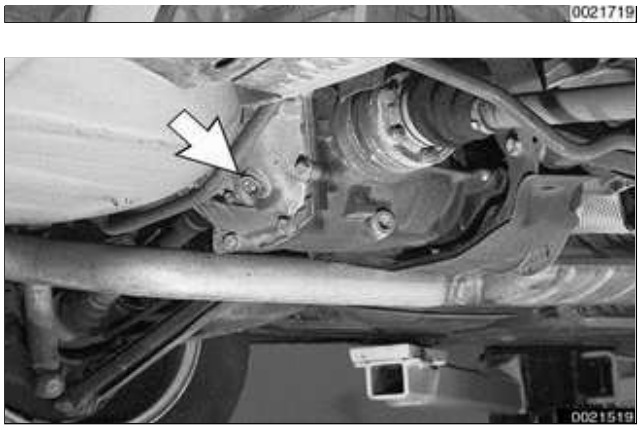
Differential oil level, checking

The differential units in E46 models are filled with lifetime oil that ordinarily does not need to be changed.



- All wheel drive models: Check front differential fluid level at front differential filler plug (**arrow**).

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- Check rear differential oil level at rear differential filler plug (**arrow**).
  - Check lubricant level with car on a level surface:
    - Remove oil filler plug.
    - Level is correct when fluid just reaches edge of filler hole.
    - If necessary, top up fluid.
    - Install and tighten oil filler plug when oil level is correct.

The differential should be filled with a special BMW lubricant available through an authorized BMW dealer.

Note:

- *Use a 14 mm or 17 mm Allen socket to remove the drain plug.*
- *If the car is raised in the air, it should be level.*

Tightening torques	
Front differential filler plug to housing	65 Nm (48 ft-lb)
Rear differential filler plug to housing	70 Nm (52 ft-lb)

Fuel filter, replacing

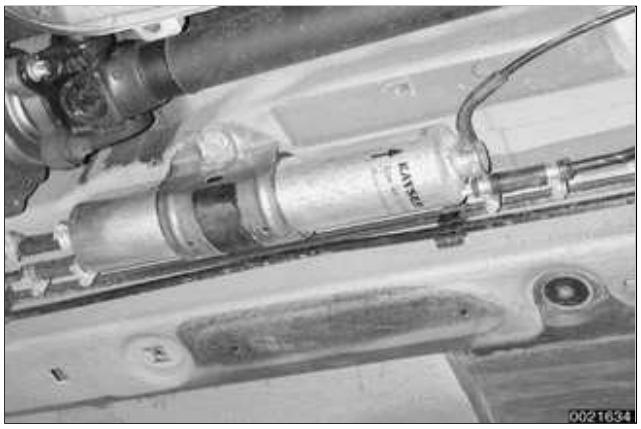
The fuel filter is located beneath the center of the car, approximately under

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the driver's seat. A protective cover must be removed to access the filter.



- Fuel filter for M52 TU engine is shown in illustration.



- E46 cars with M54 engine are equipped with a fuel filter that has a built in fuel pressure regulator.

  - Disconnect battery negative (-) cable.

  - Drain fuel filter from inlet side into a container and inspect drained fuel. Check for rust, moisture and contamination.

  - When replacing fuel filter:

    - Clamp filter inlet and outlet hoses to lessen fuel spillage.

    - Loosen center clamping bracket and hose clamps on either end of filter.

    - Note arrow or markings indicating direction of flow on new filter.

    - Install new filter using new hose clamps.

WARNING!

Fuel will be expelled when the filter

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is removed. Do not smoke or work near heaters or other fire hazards. Keep a fire extinguisher handy.

CAUTION!

Clean thoroughly around the filter connections before removing them.

Note:

When installing fuel filter cover, take care to reinstall foam rubber seal in front of cover correctly to prevent flooding of filter with rain splash water.

Fuel tank and fuel lines, inspecting

Inspect the fuel tank, fuel lines, and fuel system for damage or leaks. Check for fuel leaks in the engine compartment or fuel odors in the passenger compartment. Check for faulty flexible fuel lines by bending them. If any leaks are present, fuel should be expelled. Check for any evaporative emissions hoses that may have become disconnected, checking carefully at the charcoal canister and evaporative emissions purge system.

WARNING!

When checking for fuel leaks, the engine must be cold. A hot exhaust manifold or exhaust system could cause the fuel to ignite or explode causing serious personal injury. Ventilate the work area and clean up spilled fuel immediately.

Note:

See ⇒ 130 Fuel Injection and ⇒ 160 Fuel Tank and Fuel Pump for component locations and additional information.

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Suspension, front, inspecting

Inspection of the front suspension and steering includes a check of all moving parts for wear and excessive play. Inspect ball joint and tie-rod rubber seals and boots for cracks or tears that could allow the entry of dirt, water, and other contaminants.

On All wheel drive models check front differential fluid level and check CV joint boots for cracks.

Note:

See ⇒ 310 Front Suspension and ⇒ 331 Rear Axle Final Drive

Suspension, rear, inspecting

Differential and rear drive axle service consists of checking and changing the gear oil, inspecting for leaks, and checking the rear drive axle rubber boots for damage.

The areas where leaks are most likely to occur are around the drive shaft and drive axle mounting flanges.

Note:

For more information on identifying oil leaks and their causes, see ⇒ 330 Rear Suspension and ⇒ 311 Front Axle Final Drive.

Tires, checking inflation pressure

Correct tire pressures are important to handling and stability, fuel economy, and tire wear. Tire pressures change with temperature. Pressures should be checked often during seasonal temperature changes. Correct inflation

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pressures can be found on the driver's door pillar and in the owner's manual. Note that tire pressures should be higher when the car is more heavily loaded.

WARNING!

Do not inflate any tire to a pressure higher than the tire's maximum inflation pressure listed on the sidewall. Use care when adding air to warm tires. Warm tire pressures can increase as much as 4 psi (0.3 bar) over their cold pressures.

Tires, rotating

BMW does not recommend tire rotation. Due to the car's suspension design, the front tires begin to wear first at the outer shoulder and the rear tires begin to wear first at the middle of the tread or inner shoulder. Rotating the tires may adversely affect road handling and tire grip.

Transmission service, automatic

The automatic transmission is not equipped with a dipstick. Therefore, checking the ATF level is an involved procedure which includes measuring and maintaining a specified ATF temperature during the checking procedure.

Note:

For more complete ATF service information, including checking ATF level and ATF filter replacement procedures, see ⇒ 240 Automatic Transmission.

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Transmission service, manual

Manual transmission service consists of inspecting for leaks and checking the fluid.

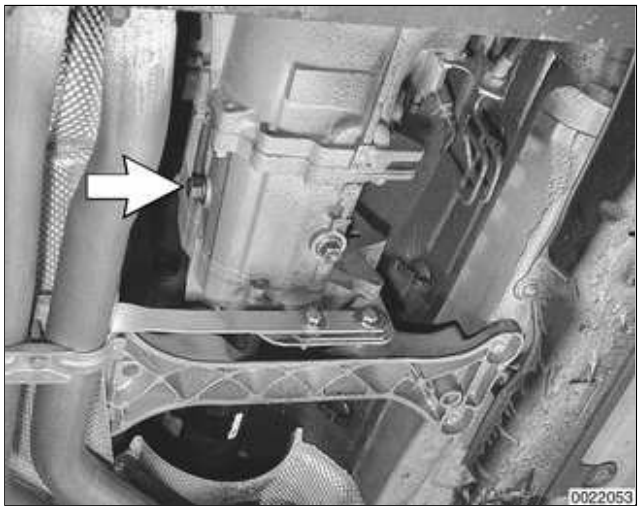
Evidence of transmission leaks is likely to be seen around the driveshaft mounting flange and at the bottom of the bellhousing.

Note:

For more information on identifying oil leaks and their causes, see ⇒ 230 Manual Transmission and ⇒ 210 Clutch.

Transmission fluid, checking and filling (manual transmission)

The manual transmission in E46 models is filled with lifetime oil that ordinarily does not need to be changed.



- Check manual transmission oil level at transmission filler plug (**arrow**). Make sure car is on level surface.

Note:

Transmission fluid level checking and replacement procedures are covered in ⇒ 230 Manual Transmission.

Wheels, aligning

BMW recommends checking the front and rear alignment once a year and

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whenever new tires are installed.

Note:

See ⇒ 320 Steering and Wheel Alignment for a more detailed discussion of alignment requirements and specifications.

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Body and Interior Maintenance

Body and hinges, lubricating

The door locks and lock cylinders can be lubricated with an oil that contains graphite.

The body and door hinges, the hood latch, and the door check rods should be lubricated with SAE 30 or SAE 40 engine oil. Lubricate the seat runners with multipurpose grease. Do not apply any oil to rubber parts. If door weather-strips are sticking, lubricate them with silicone spray or talcum powder. The hood release cable should be lubricated as well.

The use of winter lock de-icer sprays should be kept to an absolute minimum, as the alcohol in the de-icer will wash the grease out of the lock assemblies, and may cause the locks to corrode internally, or become difficult to operate.

Exterior washing

The longer dirt is left on the paint, the greater the risk of damaging the glossy finish, either by scratching or by the chemical effect dirt particles may have on the painted surface.

Do not wash the car in direct sunlight. If the engine hood is warm, allow it to cool. Beads of water not only leave spots when dried rapidly by the sun or heat from the engine, but also can act as small magnifying glasses and burn spots into the finish. Wash the car with a mixture of lukewarm water and a car

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wash product. Rinse using plenty of clear water. Wipe the body dry with a soft cloth towel or chamois to prevent water-spotting.

Interior care

Dirt spots can usually be removed with lukewarm soapy water or a dry foam cleaner. Use spot remover for grease and oil spots. Do not pour the liquid directly on the carpet or fabric, but dampen a clean cloth and rub carefully, starting at the edge of the spot and working inward. Do not use gasoline, naptha, or other flammable substances.

Leather upholstery and trim

Leather upholstery and trim should be periodically cleaned using a slightly damp cotton or wool cloth. The idea is to get rid of the dirt in the creases and pores that can cause brittleness and premature aging. On heavily soiled areas, use a mild detergent (such as Woolite®) or other specially formulated leather cleaners. Use two tablespoons to one quart of cold water. Dry the trim and upholstery completely using a soft cloth. Regular use of a good quality leather conditioner will reduce drying and cracking of the leather.

Polishing

Use paint polish only if the finish assumes a dull look after long service. Polish can be used to remove tar spots and tarnish, but afterwards a coat of wax should be applied to protect the clean finish. Do not use abrasive polish or cleaners on aluminum trim or accessories.

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Seat belts

Dirt and other abrasive particles will damage seat belt webbing. If it is necessary to clean seat belts, use a mild soap solution. Bleach and other strong cleaning agents may weaken the belt webbing and should be avoided.

WARNING!

Do not clean the seat belt webbing using dry cleaning or other chemicals. Allow wet belts to dry before allowing them to retract.

The condition of the belt webbing and the function of the retractor mechanisms should be inspected.

Note:

See ⇒ 720 Seat Belts for seat belt inspection information.

Special cleaning

Tar spots can be removed with a bug and tar remover. Never use gasoline, kerosene, nail polish remover, or other unsuitable solvents. Insect spots also respond to tar remover. A bit of baking soda dissolved in the wash water will facilitate their removal. This method can also be used to remove spotting from tree sap.

Washing chassis

Periodic washing of the underside of the car, especially in winter, will help prevent accumulation of road salt and rust. The best time to wash the underside is just after the car has been driven in wet conditions. Spray the chassis with a powerful jet of water.

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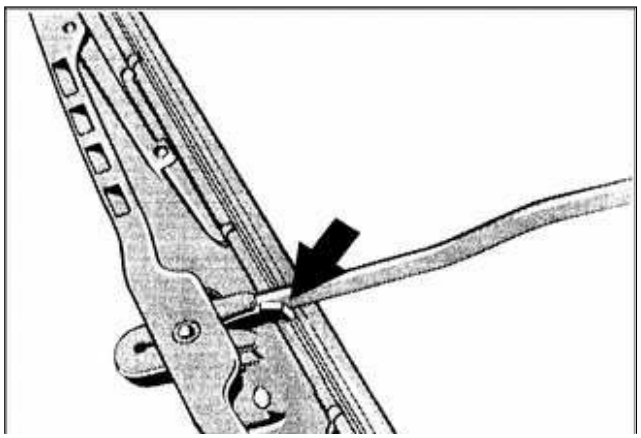
Commercial or self-service car washes may not be best for this, as they may recycle the salt-contaminated water.

Waxing

For a long-lasting, protective, and glossy finish, apply a hard wax after the car has been washed and dried. Use carnauba or synthetic based products. Waxing is not needed after every washing. You can tell when waxing is required by looking at the finish when it is wet. If the water coats the paint in smooth sheets instead of forming beads that roll off, a new coat of wax is needed. Wax should not be applied to black trim pieces, rubber, or other plastic parts.

Windshield wiper blade maintenance

Common problems with the windshield wipers include streaking or sheeting, water drops after wiping, and blade chatter. Streaking is usually caused when wiper blades are coated with road film or car wash wax. Clean the blades using soapy water. If cleaning the blades does not cure the problem, they should be replaced. BMW recommends replacing the wiper blades twice a year, before and after the cold season.

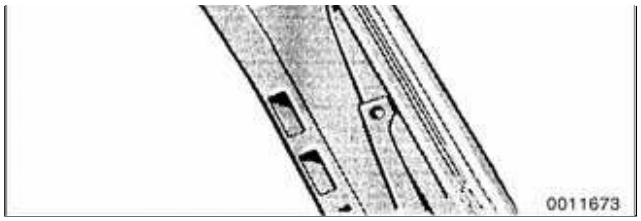


To replace wiper blade, depress retaining tab (**arrow**) and slide blade out of arm.

On older cars, check the tension spring that holds the wiper to the glass. Replace the wiper arm if the springs are weak.

Drops that remain behind after wiping are caused by oil, road film, or diesel exhaust coating the windshield. Use an

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alcohol or ammonia solution, or a non-abrasive cleanser to clean the windshield.

Wiper blade chatter may be caused by dirty or worn blades, by a dirty windshield, or by bent or twisted wiper arms. Clean the blades and windshield as described above. Adjust the wiper arm so that there is even pressure along the blade, and so that the blade is perpendicular to the windshield at rest. Lubricate the wiper linkage with a light oil. The linkage is located under the hood on the driver's side. If the problem persists, the blades are excessively aged or worn and should be replaced.

Note:

See ⇒ 611 Wipers and Washers for more information.

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On-Board Diagnostics (OBD II)

OBD II is an acronym for On-Board Diagnostics II, the second generation of on-board self-diagnostic equipment requirements. These standards were originally mandated for California vehicles. Since 1996 they have been applied to all passenger vehicles sold in the United States.

On-board diagnostic capabilities are incorporated into the hardware and software of the engine control module (ECM) to monitor virtually every component that can affect vehicle emissions. OBD II works to ensure that the vehicles remain as clean as possible over their entire life.

Each emission-influencing component is checked by a diagnostic routine to verify that it is functioning properly. If a problem or malfunction is detected, the OBD II system illuminates a warning light on the instrument panel to alert the driver. This malfunction indicator light (MIL) will display the phrase "Check Engine" or "Service Engine Soon."

The OBD II system also stores important information about the detected malfunction so that a repair technician can accurately find and fix the problem.

Note:

- *Specialized OBD II scan tool equipment is needed to access the fault memory and OBD II data.*

- *The OBD II fault memory (including the MIL) can only be*

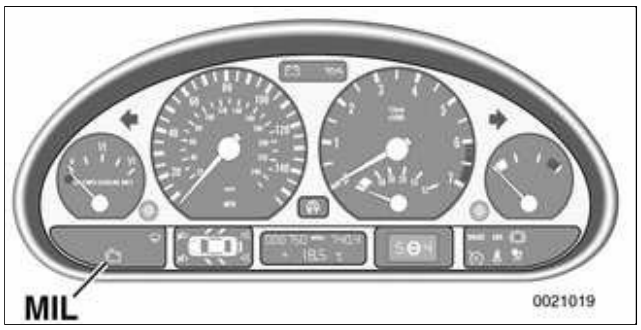
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reset using the special scan tool. Removing the connector from the ECM or disconnecting the battery will not erase the fault memory.

The extra hardware needed to operate the OBD II system consists mainly of the following:

- Additional oxygen sensors downstream of the catalytic converters
- Fuel tank pressure sensor and device to pressurize fuel storage system
- Several engine and performance monitoring devices
- Standardized 16-pin OBD II connector under the dash
- Upgraded components for the federally required 100,000 mile or 10 year reliability mandate

Malfunction Indicator Light (MIL)



The OBD II system is designed to illuminate the Malfunction Indicator Light (MIL) when emission levels exceed 1.5 times the Federal standards.

Note:

On model year 1999 and 2000 cars, the MIL is labeled Check Engine. On model year 2001 cars, the MIL is labeled Service Engine Soon.

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The MIL will come on under the following conditions.

- An engine management system fault is detected for two consecutive OBD II drive cycles.
- A catalyst damaging fault.
- A component malfunction (such as catalyst deterioration) causes emissions to exceed 1.5 times OBD II standards.
- Manufacturer-defined specifications are exceeded.
- An implausible input signal is generated.
- Misfire faults occur.
- A leak is detected in evaporative system.
- The oxygen sensors observe no purge flow from purge valve/evaporative system.
- The engine control module (ECM) fails to enter closed-loop operation within specified time.
- The engine control module (ECM) or automatic transmission control module (TCM) enters "limp home" operation mode.
- Key is in "ignition on" position before cranking (bulb check function).

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Additional information, MIL:

- A fault code is stored within the ECM upon the first occurrence of a fault in the system being checked.
- Two complete consecutive drive cycles with the fault present illuminate the MIL. The exception to the two-fault requirement is a catalyst damaging fault, which will turn the light on immediately.
- If the second drive cycle was not complete and the specific function was not checked as shown in the example, the ECM counts the third drive cycle as the next consecutive drive cycle. The MIL is illuminated if the function is checked and the fault is still present.
- Once the MIL is illuminated it will remain illuminated unless the specific function has been checked without fault through three complete consecutive drive cycles.
- The fault code will be cleared from memory automatically if the specific function is checked through 40 consecutive drive cycles without the fault being detected.

Note:

In order to automatically clear a catalyst damaging fault from memory, the condition under which the fault occurred must be evaluated for 80 consecutive drive cycles without the fault reoccurring.

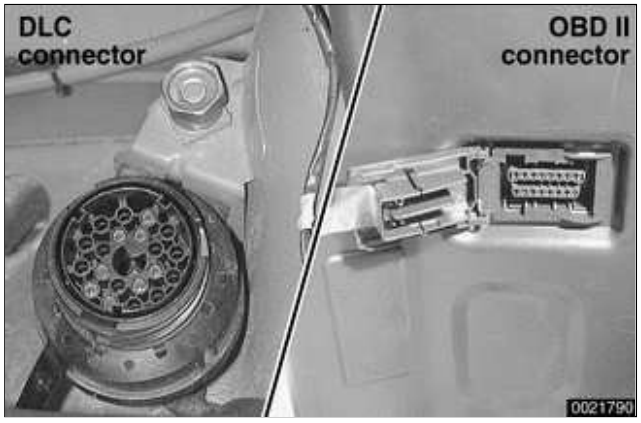
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With the use of a universal or 'generic' scan tool connected to the DLC (Diagnostic Link Connector), diagnostic trouble codes (DTCs) can be obtained, along with the conditions associated with the illumination of the engine service light. Using a more advanced or BMW-dedicated scan tool, additional 'proprietary' information is normally available.

Scan tool and scan tool display

Owing to the advanced nature of OBD II adaptive strategies, all diagnostics need to start with a scan tool. The aftermarket scan tools can be connected to either the 16-pin OBD II Data Link Connector (DLC) or the BMW 20-pin DLC in the engine compartment. Data from the OBD II DLC may be limited, depending on scan tool and vehicle.

OBD II standards mandate that the 16-pin DLC must be located within three (3) feet of the driver and must not require any tools to be exposed. The communication protocol used by BMW is ISO 9141.



Starting with June 2000 production, the 20-pin BMW diagnostic port (**Data Link Connector** or **DLC**) which was previously located in the engine compartment has been deleted. All diagnostic, coding and programming functions are incorporated into the **OBD II** diagnostic port, located under left side of dashboard.

Note:

- *On cars built up 06-2000: when accessing emissions related DTCs through the 16-pin OBD II DLC, the BMW 20-pin DLC cap must be*

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installed.

- *Professional diagnostic scan tools available at the time of this printing include the BMW factory tools (DISplus and MoDiC) and a small number of aftermarket BMW-specific tools. The CS2000 from Baum Tools Unlimited, the Retriever from Assenmacher Specialty Tools, and the MT2500 from Snap-On Tools are examples of quality OBD scan tools.*

- *In addition to the professional line of scan tools, inexpensive `generic' OBD II scan tool software programs and handheld units are readily available. These tools do have limited capabilities, but they are nonetheless powerful diagnostic tools. These tools read live data streams and freeze frame data as well as a host of other valuable diagnostic data.*

- *For the do-it-yourself owner, simple aftermarket DTC readers are also available. These inexpensive BMW-only tools are capable of checking for DTCs as well as turning off the illuminated MIL and resetting the service indicator lights.*

Diagnostic monitors

A diagnostic monitor is an operating strategy that runs internal tests and checks a specific system, component or function. This is similar to computer self tests.

Completion of a drive cycle ensures that all monitors have completed their

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required tests. The ECM must recognize the loss or impairment of the signal or component and determine if a signal or sensor is faulty based on 3 conditions:

- Signal or component shorted to ground
- Signal or component shorted to B+
- Signal or component missing (open circuit)

The OBD II system must monitor all emission control systems that are on-board. Not all vehicles have a full complement of emission control systems. For example, a vehicle may not be equipped with secondary air injection, so naturally no secondary air readiness/function code would be present.

OBD II requires monitoring of the following:

- Oxygen sensor monitoring
- Catalyst monitoring
- Misfire monitoring
- Evaporative system monitoring
- Secondary air monitoring
- Fuel system monitoring

Monitoring these emissions related functions is done using DME input sensors and output accouters based on preprogrammed data sets. If the

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ECM cannot determine the environment or engine operating conditions due to missing or faulty signals it will set a fault code and, depending on conditions, illuminate the MIL.

Oxygen sensor monitoring: When drive conditions allow, response rate and switching time of each oxygen sensor is monitored. In addition, the heater function is also monitored. The OBD II "diagnostic executive" knows the difference between upstream and downstream oxygen sensors and reads each one individually.

All oxygen sensors are monitored separately. In order for the oxygen sensor to be effectively monitored, the system must be in closed loop operation.

Catalyst monitoring: This strategy monitors the two heated oxygen sensors per bank of cylinders. It compares the oxygen content going into the catalytic converter to the oxygen leaving the converter.

The diagnostic executive knows that most of the oxygen should be used up during the oxidation phase and if it sees higher than programmed values, a fault will be set and the MIL will illuminate.

Misfire detection: This strategy monitors crankshaft speed fluctuations and determines if a misfire occurs by variations in speed between each crankshaft sensor trigger point. This strategy is so finely tuned that it can even determine the severity of the misfire.

The diagnostic executive must determine if misfire is occurring, as well as other pertinent misfire information.

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- Specific cylinder(s)
- Severity of the misfire event
- Emissions relevant or catalyst damaging

Misfire detection is an on-going monitoring process that is only disabled under certain limited conditions.

Secondary air injection monitoring: Secondary air injection is used to reduce HC and CO emissions during engine warm up. Immediately following a cold engine start (-10 to 40ï¿½C), fresh air/oxygen is pumped directly into the exhaust manifold. By injecting oxygen into the exhaust manifold, catalyst warm-up time is reduced.

System components:

- Electric air injection motor/pump
- Electric motor/pump relay
- Non-return valve
- Vacuum/vent valve
- Stainless steel air injection pipes
- Vacuum reservoir

The secondary air system is monitored via the use of the pre-catalyst oxygen sensors. Once the air pump is active and air is injected into the system, the signal at the oxygen sensor will reflect a lean condition. If the oxygen sensor signal does not change, a fault will be

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set and identify the faulty bank(s). If after completing the next cold start a fault is again present, the MIL will be illuminated.

Fuel system monitoring: This monitors receives high priority. It looks at the fuel delivery needed (long/short term fuel trim) for proper engine operation based on programmed data. If too much or not enough fuel is delivered over a predetermined time, a DTC is set and the MIL is turned on.

Note:

Fuel trim refers to adjustments to base fuel schedule. Long-term fuel trim refers to gradual adjustments to the fuel calibration adjustment as compared to short term fuel trim. Long term fuel trim adjustments compensate for gradual changes that occur over time.

Fuel system monitoring monitors the calculated injection time (ti) in relation to engine speed, load, and the pre-catalytic converter oxygen sensor(s) signals as a result of residual oxygen in the exhaust stream.

The diagnostic executive uses the precatalyst oxygen sensor signal as a correction factor for adjusting and optimizing the mixture pilot control under all engine operating conditions.

Evaporative system monitoring: This monitor checks the sealed integrity of the fuel storage system and related fuel lines.

This monitor has the ability to detect very small leaks anywhere in the system. A pressure test is be performed on the EVAP system on a continuous basis as the drive cycle allows.

On MS 42.0 cars, a leak detection pump (LDP) is used to pressurize and

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check system integrity. On MS 43.0 cars, a more sophisticated DMTL (Diagnostic Module - Leak Detection) pump is used.

Drive cycle

The OBD II drive cycle is an important concept in understanding OBD II requirements. The purpose of the drive cycle is to run all of the emission-related on-board diagnostics over on a broad range of driving conditions.

The drive cycle is considered completed when all of the diagnostic monitors have run their tests without interruption. For a drive cycle to be initiated, the vehicle must be started cold and brought up to 160ï¿½F and at least 40ï¿½F above its original starting temperature.

Once the drive cycle is completed, the system status or inspection/maintenance (I/M) readiness codes are set to "Yes."

System status codes will be set to "No" in the following cases:

- The battery or ECM is disconnected.
- The ECM's DTCs have been erased after completion of repairs and a drive cycle has not be completed.

A scan tool can be used to determine if on-board diagnosis is complete as well as the status of the I/M codes. All required tests must be completed before the I/M readiness codes will be set to "Yes".

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Readiness codes

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BMW Fault Codes (DTCs)

Below is a comprehensive listing of BMW DTCs and the corresponding SAE P-codes.

Table a. Diagnostic trouble codes (DTCs)

BMW code	P-code	Fault type and function	Signal type and range	Explanation
1		Ignition coil cyl.2	Input analog timing (100 mV)	DME initiates secondary ignition for each cylinder then looks for feedback through shunt resistor in harness to determine if ignition actually occurred.
2		Ignition coil cyl.4	Input analog timing (100 mV)	DME initiates secondary ignition for each cylinder then looks for feedback through shunt resistor in harness to determine if ignition actually occurred.
3		Ignition coil cyl.6	Input analog timing (100 mV)	DME initiates secondary ignition for each cylinder then looks for feedback through shunt resistor in harness to determine if ignition actually occurred.
5	P0202	Injector circuit cyl. 2	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
6	P0201	Injector circuit cyl. 1	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
8	P0101	Mass air flow circuit range/perf.	Input analog (0-5V)	Failed signal range check against predefined diagnostic limits.
10		Engine coolant temp. circuit range/perf.	Input analog (0-5V)	Signal range is checked against predefined diagnostic limits within specific engine operations.
11		Coolant temp. coolant outlet	Input analog (0-5V)	Signal range is checked against predefined diagnostic limits within specific engine operations.
14	P0111	Intake air temp. range/performance	Input analog (0-5V)	Signal range is checked against predefined diagnostic limits within specific engine operations.
18	P1397	Exhaust cam position sensor malfunction	Input analog phase shift (0-5V)	Internal check of phase shift from camshaft sensor - should change during every crankshaft revolution.Phase shift occurs due to 2:1 relationship between camshafts.
19	P1529	VANOS solenoid activation, exhaust	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
21	P1525	VANOS solenoid activation, intake	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
22	P0203	Injector circuit cyl. 3	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
23	P0206	Injector circuit cyl. 6	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
24	P0204	Injector circuit cyl. 4	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
25	P0135	Oxygen sensor heater pre-cat (Bank1)	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
27	P1550	Idle control valve closing coil	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
29		Ignition coil cyl.1	Input analog timing (100 mV)	DME initiates secondary ignition for each cylinder then looks for feedback through shunt resistor in harness to determine if ignition actually occurred.
30		Ignition coil cyl.3	Input analog timing (100 mV)	DME initiates secondary ignition for each cylinder then looks for feedback through shunt resistor in harness to determine if ignition actually occurred.
31		Ignition coil cyl.5	Input analog timing (100 mV)	DME initiates secondary ignition for each cylinder then looks for feedback through shunt resistor in harness to determine if ignition actually occurred.

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
33	P0205	Injector circuit cyl. 5	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
35	P1453	Secondary air injection pump	Output digital on/off (active low)	TDME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
36	MS 43	Main relay malfunction	Input analog (0-12V)	Signal range check between DME ignition analog input and main relay power circuit analog input.
38	MS 43	Clutch switch faulty	Input digital (0-12V)	Plausibility check of clutch switch and DME internal values such as load and engine speed.
39		Brake light switch, and brake light plausibility test	Input digital (0-12V)	When brake light switch is active, brake light test switch must be also active. If not, fault is stored.
40		Brake light switch, pedal sensor plausibility test	Input digital / analog (0-12V / 0-5V)	If pedal sensor is showing angle greater than "limp home angle" and additionally brake light switch is active, fault is stored.
42		Multi functional steering wheel, redundant code	Input binary stream (0-12V)	Every signal from cruise control switch is transferred redundantly. A fault is set whenever two redundant information paths are showing a different status.
43		Multi functional steering wheel, control switch	Input binary stream (0-12V)	When status from cruise control showing set/accelerate and deceleration are same time, fault is set.

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
45		Multi functional steering wheel, toggle-bit	Input binary stream (0-12V)	Every 0.5 sec. a message that includes a toggle bit (toggles between 0->1 and 1->0) is transmitted. Change bit is monitored to indicate proper function.
47	MS 43	Torque monitoring level 1	DME internal values logical	
48	MS 43	Internal control module	DME HW test memory	
49		ECU internal test	DME HW test	
50	P1145 MS 42	Running losses valve (3/2), final stage	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
	MS 43	ECU internal test	DME HW test	
51	MS 43	ECU internal test	DME HW test	
52		Rear exhaust valve flap	Output digital steady (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
53	P1509	Idle control valve opening coil	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
55	P0155	Oxygen sensor heater pre-cat (Bank 2)	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
56		Ignition feedback, interruption at	Input analog (32V)	Check for correct signal voltage. If voltage is 32V

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
		shunt resistor		(limitation voltage) then secondary ignition voltage is detected and shunt resistor may be faulty.
57	P0325	Knock sensor 1 circuit, (Bank 1) circuit continuity	Input analog amplitude (13-19kHz)	Plausibility check between knock sensor amplitude during knocking with internal knock detection mapped DME values.
59	P0330	Knock sensor 2 circuit, (Bank 2) circuit continuity	Input analog amplitude (13-19kHz)	Plausibility check between knock sensor amplitude during knocking with internal knock detection mapped DME values.
61	P0141	Oxygen sensor heater post-cat (Bank 2)	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
62	P0412	Secondary air injection system switching valve	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
65	P0340	Intake cam position sensor, malfunction	Input analog phase shift 0-5V	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
68		EVAP system, purge control valve circuit	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
69		Relay fuel pump	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
				transistor and component exists.
74		AC compressor relay	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
79	P0161	Oxygen sensor heater post-cat (Bank 1)	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
83	P0335	Crankshaft position sensor, malfunction	Input digital (0-12V)	Checks for correct signal pattern and correct number of expected flywheel teeth.
100	P0601	Internal control module, memory check sum or communication	DME internal values logical	Internal hardware test of RAM, ROM, and Flash Prom.
103	P1519	VANOS faulty reference value intake	DME internal values logical	Maximum VANOS adjustment angle, checked at every engine start must be within a specified limit.
104	P1520	VANOS faulty reference value exhaust	DME internal values logical	Maximum VANOS adjustment angle, checked at every engine start must be within a specified limit.
105	P1522	VANOS stuck (Bank 1) intake	DME internal values	Monitoring of a desired VANOS adjustment within a predefined diagnostic time limit.
106	P1523	VANOS stuck (Bank 2) exhaust	DME internal values	Monitoring of a desired VANOS adjustment within a predefined diagnostic time limit.
109	P1580	Motor throttle valve pulse width not plausible	Output digital pulse width (0-12V)	Throttle position control algorithm checks for problems with mechanical coupling

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
				spring within motor throttle body.
110	P1542	Pedal sensor potentiometer 1	Input analog (0-5V)	Failed signal range check against predefined diagnostic limits.
111	P1542	Pedal Sensor Potentiometer 2	Input analog (0-5V)	Failed signal range check against predefined diagnostic limits.
112	P0120 MS 42	Motor throttle valve potentiometer 1	Input analog (0-5V)	Failed signal range check against predefined diagnostic limits.
	MS 43	Throttle position sensor 1	Input analog (0-5V)	Failed signal range check against predefined diagnostic limits.
113	P0120	Motor throttle valve potentiometer 2	Input analog (0-5V)	Failed signal range check against predefined diagnostic limits.
114	P1580 MS 42	Motor throttle valve final stage	DME internal test	Final stage inside DME (special H-bridge), will set internal flag whenever a short to ground, a short to battery voltage or a disconnection occurs.
	MS 43	A second pedal sensor range check failure is determined	DME internal values logical	If pedal sensor malfunction is determined, followed by a second malfunction, a signal is sent.
115	P1623 MS 42	Output voltage 5V for potentiometer operation 1	DME internal (5V)	Check for proper 5 volts supply to potentiometers is possible within a predefined voltage limit.
	MS 43	Range check for throttle position adaptation	Input analog (0-5V)	Range check for closed position of throttle sensors.
116	P1623	Output voltage for potentiometer operation 2	DME internal (5V)	Check for proper 5 volts supply to potentiometers is possible within a predefined voltage limit.

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
117	P1542	Pedal sensor potentiometer plausibility	Input analog (0-5V)	If there is a difference greater than specified between two redundant signals from potentiometer, fault will be set.
118	P0120 MS 42	Motor throttle feedback potentiometer plausibility	Input analog (0-5V)	If there is a difference greater than specified between two redundant signals from potentiometer, fault will be set.
	MS 43	Throttle position sensor 1; plausibility check sensor 1 to mass air flow meter	DME internal values	Signal range is checked against predetermined diagnostic limits. Rationality check with mass air flow meter.
119	P1580 MS 42	MDK, throttle mechanical sticking	DME internal test	Throttle doesn't reach desired opening angle within a specified time.
	MS 43	Throttle position sensor 2; plausibility check sensor 1 to mass air flow meter	DME internal values	Signal range is checked against predetermined diagnostic limits. Rationality check with mass air flow meter.
120	P1542 MS 42	Pedal sensor/ motor throttle valve potentiometer not plausible	DME internal values logical motor	Signal from motor throttle valve potentiometer must be equal signal from pedal sensor potentiometer plus any adaptive values.
	MS 43	Plausibility check between brake switch and pedal sensor	Input digital / analog	Plausibility check between constant pedal value and brake switch. First pedal value must be constant and for next step brake switch must be active.
122	P1101	Oil temp. sensor malfunction	Input analog (0-5V)	Signal range is checked against predefined diagnostic limits and calculated temperature.
123	P1622	Electric thermostat control, final stage	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
				disconnection between output transistor and component exists.
124	P1593	DISA, range/perf.	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
125		Coolant fan, final stage	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
126	P1470 MS 42	LDP-magnetic valve	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
	MS 43	DMTL valve	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
127		Fuel pump	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
128		EWS signal not present or faulty	Input binary stream bit data (0-12V)	During time out check no signal was present within specific time or faulty information from serial interface (parity, overrun, etc.).
130		CAN time out (ASC1)	Input binary stream bit data (0-12V)	CAN message between DME/EGS not received within expected time.

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
131		CAN time out (instr 2)	Input binary stream bit data (0-12V)	CAN message between DME/EGS not received within expected time.
132		CAN time out (instr 3)	Input binary stream bit data (0-12V)	CAN message between DME/EGS not received within expected time.
133		CAN time out (ASC3)	Input binary stream bit data (0-12V)	CAN message between DME/EGS not received within expected time.
135	MS 43	Limp home position adaptation necessary	DME internal values logical	Limp home position must be in specified range. If range is exceeded, a fault is set.
136	MS 43	Motor throttle valve open / closing test failed	DME internal values logical	From limp home mode position, throttle valve will be open, afterwards it must fall back into limp home position. If fall back position is not in specified range, fault is set.
140	P1475	LDP reed-switch not closed	Input digital on/off (0-12V)	With shut off valve open and no pressure on system, reed contact should be closed, showing a "high signal". If not the case in beginning of every diagnostics check, a signal is sent.
140	MS 43	DMTL pump final stage	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
141	P1477	EVAP: reed switch not closed, doesn't open or doesn't close	Input digital on/off (0-12V)	Within predetermined time LDP reed switch signal must change from high to low or from low to high or LDP reed switch is "low" for longer than predetermined time.
142	P1477	EVAP: reed switch not closed, doesn't open or doesn't close	Input digital on/off (0-12V)	Within predetermined time LDP reed switch signal must change from high to low or from low to high or LDP reed

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
				switch is "low" for longer than predetermined time.
142	MS 43	DMTL module fault	DME internal values logical	
143	P1476	EVAP: clamped tube check	Input digital frequency (0-12V)	Frequency of LDP pumps reed switch is lower then predetermined limit. Volume of leak is determined to be too small (i.e. pinched or restricted hose)
146	MS 43	Range check voltage supply pedal sensor 2 and throttle position sensors	DME internal input analog	Supply voltage for sensors must be within a specified range.
147	MS 43	Range check voltage supply pedal sensor 2 and throttle position sensors	DME internal input analog	Supply voltage for sensors must be within a specified range.
149	P1140	Motor throttle feedback potentiometer and air mass sensor signal not plausible	Input analog (0-5V)	Signal from motor throttle valve potentiometer must be suitable to signal from air mass sensor. A fault is set if difference exceeds specified limit.
150	P0130	Oxygen sensor pre-cat (Bank 1), short to battery volt.	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical shorts exist on input line. Voltage signal has to be within a predetermined range (0.1V -1V) or a fault will set.
151	P0130	Oxygen sensor pre-cat (Bank 1), short to ground	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical shorts exist on input line. Voltage signal must be within a predetermined range (0.1V -1V) or fault will set.
152	P0130	Oxygen sensor pre-cat (Bank 1), disconnection	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical disconnection exist

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
				on input line.
153	P0150	Oxygen sensor pre-cat (Bank 2), short to battery volt.	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical shorts exist on input line. Voltage signal must be within a predetermined range (0.1V -1V) or fault will set.
154	P0150	Oxygen sensorpre-cat (Bank 2), short to ground	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical shorts exist on input line. Voltage signal must be within a predetermined range (0.1V -1V) or fault will set.
155	P0150	Oxygen sensor pre-cat (Bank 2), disconnection	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical disconnection exist on input line.
156	P0136	Oxygen sensor post-cat (Bank 1), short to battery volt.	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical shorts exist on input line. Voltage signal must be within a predetermined range (0.1V -1V) or fault will set.
157	P0136	Oxygen sensor Post Cat. (Bank 1), short to ground	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical shorts exist on input line. Voltage signal must be within a predetermined range (0.1V -1V) or fault will set.
159	P0156	Oxygen sensor Post Cat. (Bank 2), short to battery volt.	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical shorts exist on input line. Voltage signal must be within a predetermined range (0.1V -1V) or fault will set.
160	P0156	Oxygen sensor post-cat (Bank 2), short to ground	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical shorts exist on input line. Voltage signal must be within a predetermined range (0.1V -1V) or fault will set.

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
160	MS 43	Throttle valve position controller	DME internal values logical	
161	MS 43	Throttle valve position controller	DME internal values logical	
162	MS 43	Throttle valve position controller	DME internal values logical	
168	MS 43	Throttle valve position, throttle sticking	DME internal test calculated	
169		MDK final stage shut off	DME internal test	This fault indicates problem on pedal sensor, throttle potentiometer or throttle. A separately stored fault code indicates problem.
171	P0601	System has been shut down due to safety controller	DME internal test	Safety controller has shut down motor throttle valve function due to not plausible MDK input values.
172	P1542	Pedal sensor potentiometer short between two potentiometer paths	DME internal check	5 volts for potentiometers are switched on within a specific time pattern.
173	P0120	Motor throttle valve potentiometer contact short	Rationality check	Motor throttle valve potentiometer
174	P0120	Motor throttle valve potentiometer adaptation of idle end position	Input analog (0-5V)	Signal for idle position must be within a specified range. If range is exceeded, fault is set.
175		Pedal sensor potentiometer 1 adaptation of the idle end position	Input analog (0-5V)	Signal for idle position must be within a specified range. If range is exceeded, fault is set.
176	P1542	Pedal sensor potentiometer 2 adaptation of the idle end position	Input analog (0-5V)	Signal for idle position must be within a specified range. If range is exceeded, fault is set.

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
188	P1132	Oxygen sensor heater, pre-cat (Bank 1), insufficient	Output digital pulse width (active low)	DME internally calculated heater power is checked against predefined diagnostic limits.
189	P1133	Oxygen sensor heater, pre-cat (Bank 2), insufficient	Output digital pulse width (active low)	DME internally calculated heater power is checked against predefined diagnostic limits.
190	P1186	Oxygen sensor-heater, post-cat (Bank 1), insufficient	Output digital pulse width (active low)	DME internally calculated heater power is checked against predefined diagnostic limits.
191	P1187	Oxygen sensor heater, post-cat (Bank 2), insufficient	Output digital pulse width (active low)	DME internally calculated heater power is checked against predefined diagnostic limits.
197	MS 43	Signal range check	DME internal analog input	
202	P0170	Fuel trim (Bank 1), O2 control limit	DME internal values logical	Controller for lambda is too long beyond a min. or a max.
203	P0173	Fuel Trim (Bank 2), O2 control limit	DME internal values logical	Controller for lambda is too long beyond a min. or a max.
204	P0505	Idle control system, idle speed not plausible	DME internal values logical	Functional check between actual engine speed (RPM) and predetermined RPM exceeds maximum deviation of +200/-100 RPM.
208		EWS, engine speed check not ok	DME internal test	Engine speed signal is transferred by EWS to DME. Fault is set if transferred signal is not reflecting engine speed due to input problem in EWS.
209		EWS, content of message	Input binary stream bit data (0-12V)	Content of binary message received from EWS invalid.
210		Ignition feedback, faulty (>2 cylinders)	Input analog timing (100 mV)	Check for correct signal timing after each ignition has been initiated by feedback

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
				signal. If more than two ignition signals are not recognized than there might be a problem in feedback line.
211	P1510	Idle control valve stuck	DME internal values logical	Functional check against a calculated value by monitoring flow though air mass meter to determine if idle valve is mechanically stuck open. Tested during closed throttle.
214	P0500	Vehicle speed sensor	Input digital frequency (0-12V)	Signal range is checked against predefined diagnostic limits. No vehicle speed is observed after specific time when compared to engine speed and load equivalent to moving vehicle.
215	P0136	Oxygen sensor post-cat (Bank 1), disconnection	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical disconnection exist on input line.
216	P0136	Oxygen sensor post-cat (Bank 2), disconnection	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical disconnection exist on input line.
217	P0505	CAN time out (EGS1)	Input digital binary information(0-12V)	CAN message between DME/EGS was not received within expected time.
219		CAN-chip, bus off	Input digital binary information (0-12V)	Hardware test determines if CAN bus is off line. Data transmission is disturbed.
220	P1184	Oxygen sensor post-cat (Bank 1) slow response time	Input analog (high is lean) (0-5V)	Checks amount of time oxygen sensor stays in rich or lean state. If it remains there too long in either, fault will set.
221	P1185	Oxygen sensor post-cat (Bank 2) slow response time	Input analog (high is lean) (0-5V)	Checks amount of time oxygen sensor stays in rich or lean state. If it remains there too long in either fault will set.

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
222	P0125	Insufficient coolant temp. to permit closed loop operation	Input analog (0-5V)	Comparison of actual coolant temperature against calculated DME value which varies with load signal.
223	P1180	Oxygen sensor post-cat (Bank 1), switching time slow	Input analog (high is lean) (0-5V)	Checks amount of time oxygen sensor takes to switch from rich to lean and vice versa. If too long, fault will set.
224	P1181	Oxygen sensor post-cat (Bank 2), switching time slow	Input analog (high is lean) (0-5V)	Checks amount of time oxygen sensor takes to switch from rich to lean and vice versa. If too long, fault will set.
225	P1192	Post-cat sensor (Bank 1); trim control	Input analog (0-5V)	Rationality check for O2 control adaptation with post catalyst sensor bank 1.
226	P0193	Post-cat sensor (Bank 2); trim control	Input analog (0-5V)	Rationality check for O2 control adaptation with post catalyst sensor bank 2.
227	P0188	Fuel trim (Bank 1), O2 control adaptation limit	DME internal values logical	Range control of adaptation values.
228	P0189	Fuel trim (Bank 2), O2 control adaptation limit	DME internal values logical	Range control of adaptation values.
229	P0133	Oxygen sensor pre-cat (Bank 1, slow response time	Input analog (high is lean) (0-5V)	Checks amount of time oxygen sensor takes to switch from rich to lean and vice versa. If too long, fault will set.
230	P0153	Oxygen sensor pre-cat (Bank 2), slow response time	Input analog (high is lean) (0-5V)	Checks amount of time oxygen sensor stays in its rich or lean state. If it remains there too long in either fault will set.
231	P1178	Oxygen sensor pre-cat (Bank 1), switch time too slow	Input analog (high is lean) (0-5V)	Checks amount of time oxygen sensor takes to switch from rich to lean and vice versa. If it takes too long to

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
				switch fault will set.
232	P0179	Oxygen sensor pre-cat (Bank 2), switch time too slow	Input analog (high is lean) (0-5V)	Checks amount of time oxygen sensor takes to switch from rich to lean and vice versa. If it takes too long to switch fault will set.
233	P0420	Catalyst efficiency (Bank 1), below threshold	Input analog (0-5V)	Compares value of pre-cat oxygen sensor to value of post-cat oxygen sensor to measure oxygen storage capability / efficiency of catalytic converter. Post-cat oxygen sensor must be relatively lean.
234	P0430	Catalyst efficiency (Bank 2), below threshold	Input analog (0-5V)	Compares value of pre-cat oxygen sensor to value of post-cat oxygen sensor to measure oxygen storage capability / efficiency of catalytic converter. Post-cat oxygen sensor must be relatively lean.
235	P1190	Pre-cat sensor (Bank 1):trim control	Input analog (high is rich) (0-1V)	Rationality check for O2 control adaptation with pre-cat sensor bank 1
236	P1191	Pre-cat sensor (Bank 2):trim control	Input analog (high is rich) (0-1V)	Rationality check for O2 control adaptation with pre-cat sensor bank 2
238	P0301	Cyl. 1 misfire detected	DME internal values logical	Crankshaft speed/acceleration is monitored by crank sensor. Time for each cylinder combustion is compared against avg. of others. If time for cylinder 1 is longer, fault will set.
239	P0302	Cyl. 2 misfire detected	DME internal values logical	Crankshaft speed/acceleration is monitored by crank sensor. Time for each cylinder combustion is compared against avg. of others. If time

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
				for cylinder 2 is longer, fault will set.
240	P0303	Cyl. 3 misfire detected	DME internal values logical	Crankshaft speed/acceleration is monitored by crank sensor. Time for each cylinder combustion is compared against avg. of others. If time for cylinder 3 is longer, fault will set.
241	P0304	Cyl. 4 misfire detected	DME internal values logical	Crankshaft speed/acceleration is monitored by crank sensor. Time for each cylinder combustion is compared against avg. of others. If time for cylinder 4 is longer, fault will set.
242	P0305	Cyl. 5 misfire detected	DME internal values logical	Crankshaft speed/acceleration is monitored by crank sensor. Time for each cylinder combustion is compared against avg. of others. If time for cylinder 5 is longer, fault will set.
243	P0306	Cyl. 6 misfire detected	DME internal values logical	Crankshaft speed/acceleration is monitored by crank sensor. Time for each cylinder combustion is compared against avg. of others. If time for cylinder 6 is longer, fault will set.
244		Segment timing faulty, flywheel adaptation	Input analog (0-5V)	Flywheel segments are monitored during deceleration to establish baseline for misfire calculation. If segments are too long/short (bad flywheel) and exceed limit, fault will be set.

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
245	P1423	Secondary air injection (Bank 1), flow too low	Input analog (0-5V)	Checks to see if oxygen sensor reacts to increase in unmetered airflow generated by secondary air pump operation. Oxygen sensor must sense lean condition or fault will set.
246	P1421	Secondary air injection (Bank 2), flow too low	Input analog (0-5V)	Checks to see if oxygen sensor reacts to increase in unmetered airflow generated by secondary air pump operation. Oxygen sensor must sense lean condition or fault will set.
247	P1432	Secondary air valve stuck open	Input analog (0-5V)	Checks to see if oxygen sensor reacts to increase in unmetered airflow generated by secondary air pump operation. Oxygen sensor must sense lean condition or fault will set.
248	P1184	Post-cat sensor; signal after decel phase not plausible; (Bank 1)	Input analog (0-5V)	Signal is checked for a lean signal in decel and a transition between lean to rich after decel
249	P1185	Post-cat sensor; signal after decel phase not plausible; (Bank 2)	Input analog (0-5V)	Signal is checked for a lean signal in decel and a transition between lean to rich after decel
250	P0440	Functional check purge valve	Input analog (0-5V)	This functional check looks for reaction of oxygen sensor signal during canister purging. Oxygen sensor, air flow meter and RPM values must react to purging of canister.

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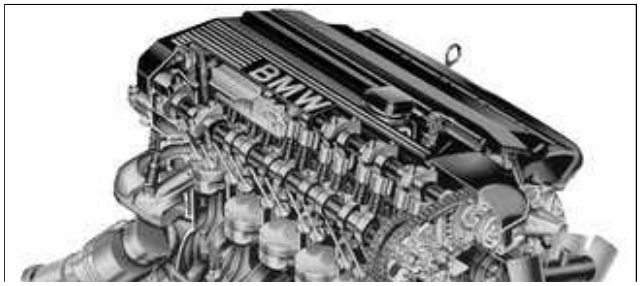
General

This section covers system descriptions and general information on engines and engine management systems. Also covered is basic engine troubleshooting.

For specific repair procedures, refer to the appropriate repair group:

- ⇒ 110 Engine Removal and Installation
- ⇒ 113 Cylinder Head Removal and Installation
- ⇒ 116 Cylinder Head and Valvetrain
- ⇒ 117 Camshaft Timing Chains
- ⇒ 119 Lubrication System
- ⇒ 120 Ignition System
- ⇒ 130 Fuel Injection
- ⇒ 170 Radiator and Cooling System

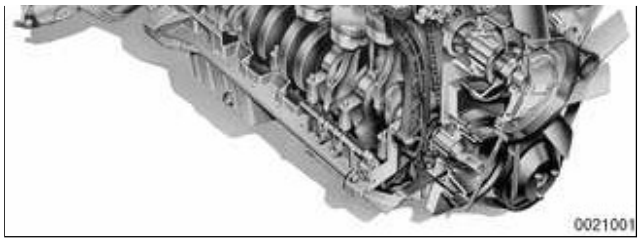
Engine



M52 TU 6-cylinder engine is a technical update (hence the designation TU) of the earlier 2.8 liter M52 engine. The main `technical update' for M52 TU was the addition of double VANOS.

In model year 2001, the M54 (2.5 and

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3.0 liter) engines were introduced. This engine incorporates all the technical features of the M52 TU engines with addition of fully electronic throttle control and enhanced emission controls.

⇒ Table a. Engine specifications lists engine specifications for the vehicles covered by this manual.

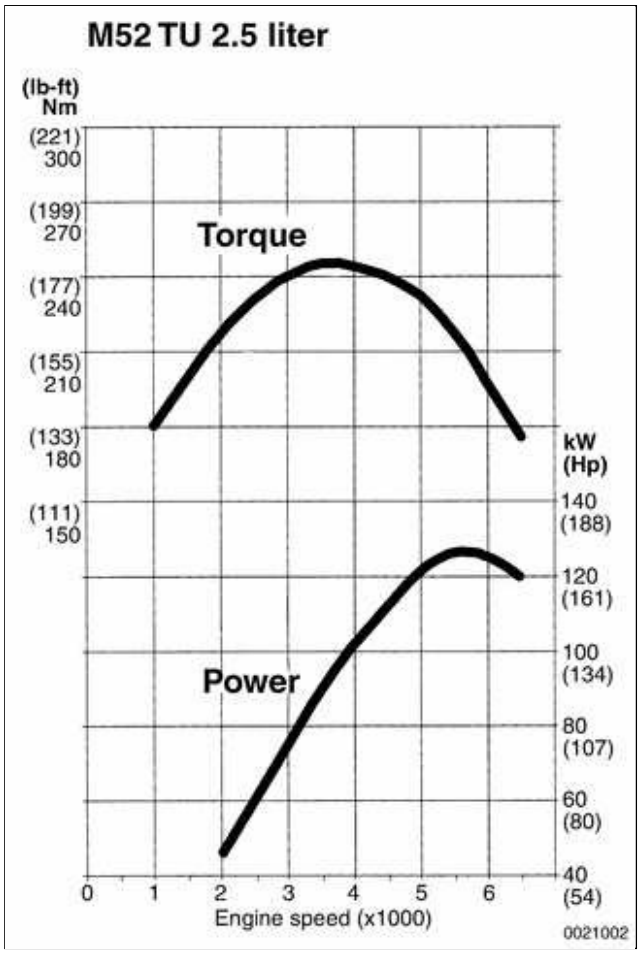
Table a. Engine specifications

Model year	Engine code	No. of cylinders	Displacement cc (cu. in.)	Bore/ stroke	Compression ratio	Torque lb-ft/rpm	Horsepower Hp/rpm
323i 1999 - 2000	M52 TU B25	6	2494 (152.2)	84 mm (3.307 in.) 75 mm (2.953 in.)	10.5: 1	181/3,500	170/5,500
325i/Ci/xi 2001	M54 B25	6	2494 (152.2)	84 mm (3.307 in.) 75 mm (2.953 in.)	10.5: 1	175/3,500	184/6,000
328i/Ci 1999 - 2000	M52 TU B28	6	2793 (170.4)	84 mm (3.307 in.) 84 mm (3.307 in.)	10.2: 1	206/3,500	193/5,500
330i/Ci/xi 2001	M54 B30	6	2979.3 (181.8)	84 mm (3.307 in.) 89.6 mm (3.528	10.2: 1	214/3,500	225/5,900

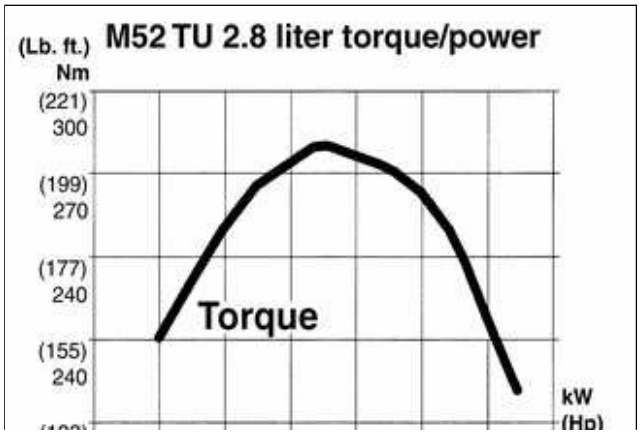
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Model year	Engine code	No. of cylinders	Displacement cc (cu. in.)	Bore/ stroke	Compression ratio	Torque lb-ft/rpm	Horsepower Hp/rpm
				in.)			

Torque/power graphs

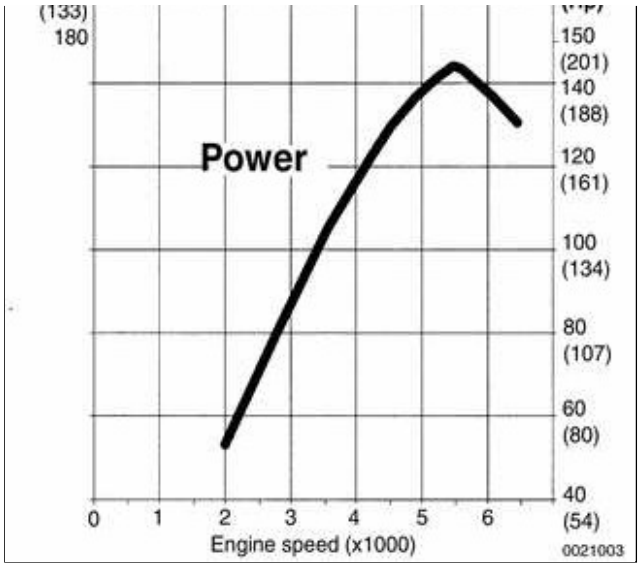


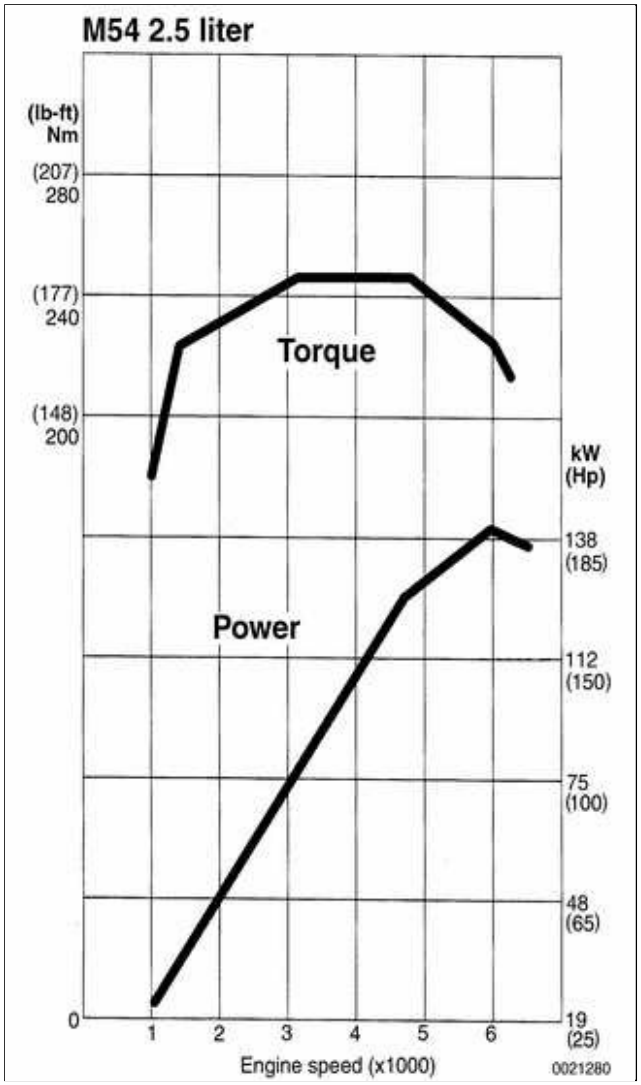
M52 TU 2.5 liter



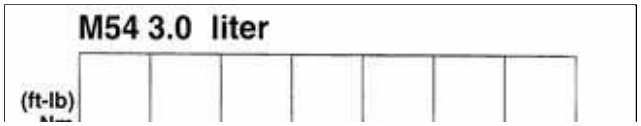
M52 TU 2.8 liter

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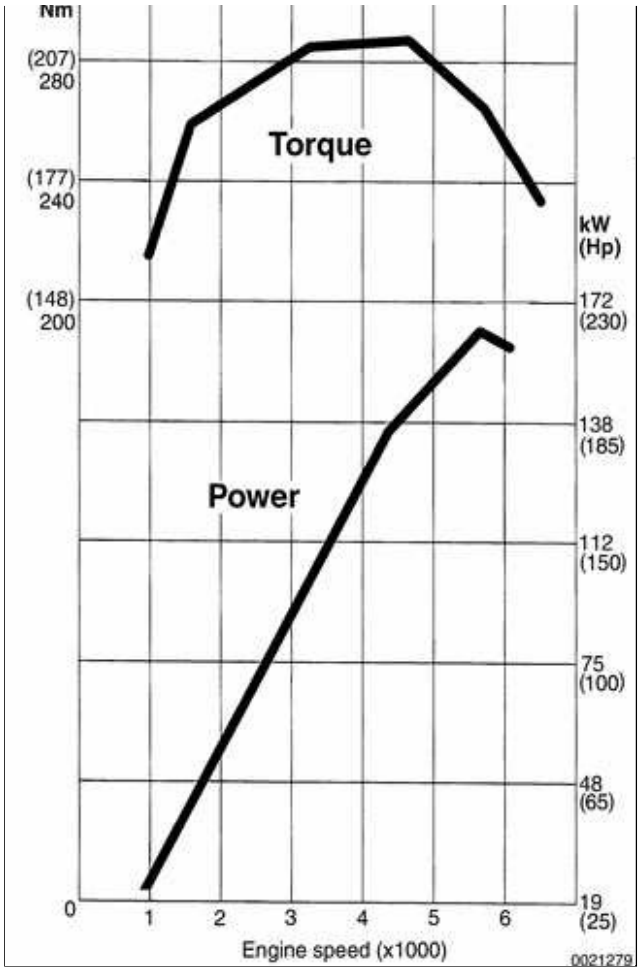


M54 2.5 liter



M54 3.0 liter

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Cylinder block and crankshaft

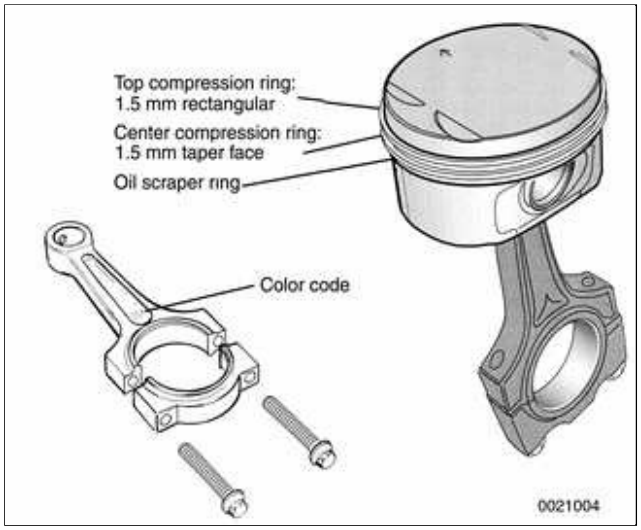
The cylinder block is cast aluminum alloy (AlSi9Cu3) with cast iron cylinder liners. The cylinders are exposed on all sides to circulating coolant.

The counterweighted crankshaft rotates in replaceable split-shell main bearings. Oilways drilled into the crankshaft provide bearing lubrication. Oil seals pressed into alloy seal housings are installed at both ends of the crankshaft.

The 2.5 liter crankshaft is cast iron. The 2.8 and 3.0 liter engines use a forged steel crankshaft to accommodate the higher torque. The crankshaft for the 3.0 liter engine is adapted from the S52 M3 engine.

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Connecting rods and pistons

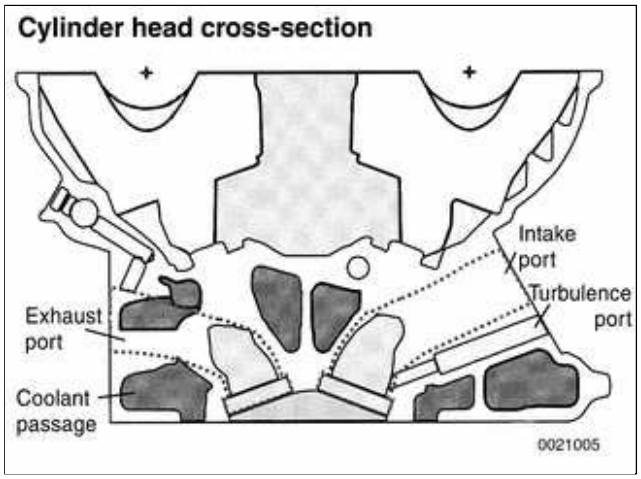


- The forged steel connecting rods use replaceable split-shell bearings at the crankshaft end and solid bushings at the piston pin end.

The pistons are of the three-ring type with two upper compression rings and a lower one-piece oil scraper ring. Full-floating piston pins are retained with circlips.

The 2.8 and 3.0 liter engines use a graphite coating on the piston skirts to reduce friction and noise.

Cylinder head and valvetrain



- Cooling passages in the cylinder head are designed for optimum coolant circulation, allowing the head to operate at lower temperatures than the cylinder block.

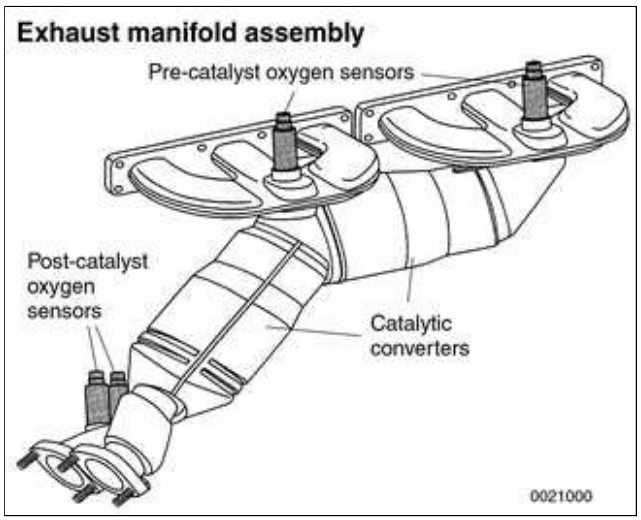
The aluminum cylinder head uses chain-driven double overhead camshafts and four valves per cylinder. The cylinder head employs a crossflow design for greater power and efficiency. Intake air enters the combustion chamber from one side while exhaust gasses exit from the other.

Oilways in the head provide lubrication for the camshafts and valvetrain.

Valve clearance is set by self-adjusting (zero-lash) hydraulic lifters for reduced valve noise and the elimination of routine valve adjustment.

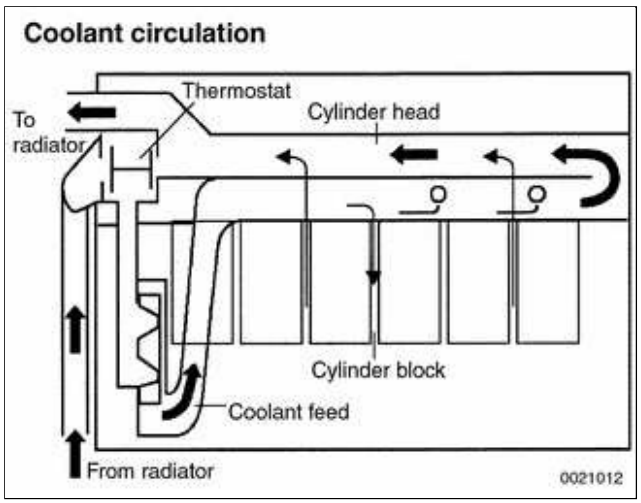
Exhaust manifolds

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- Each exhaust manifold assembly incorporates a catalytic converter. The converters are mounted close to the engine for faster heat up. Pre- and post-catalyst oxygen sensors are a mounted in each exhaust manifold.

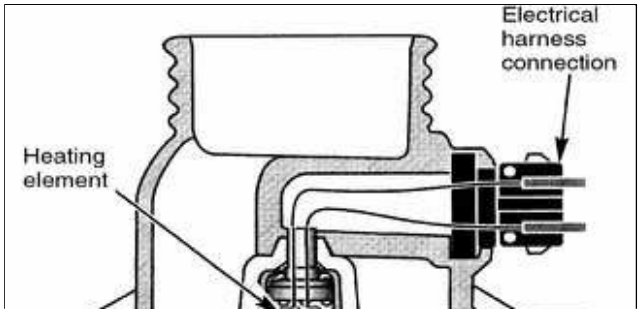
Cooling system



- The cooling system circulation is designed so that coolant flows directly from the coolant pump to the cylinder head. The coolant is fed from the coolant pump through a cast coolant feed passage to the rear of the cylinder head. From there it flows forward to the thermostat housing, radiator and heater valve.

  The coolant passages in the cylinder block are only connected to the coolant supply through the holes in the head gasket. A reduced volume of the coolant flows through the cylinder block.

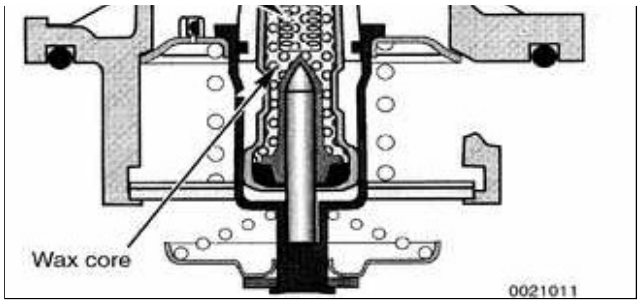
  All models are equipped with a DME-controlled electric cooling fan. On some models, a supplemental cooling fan is used. See ⇒ 170 Radiator and Cooling System for specific configuration and application information.



- An electrically heated thermostat controls the flow of coolant through the radiator based on coolant and outside temperature, engine load, and driving speed, rather than just coolant temperature.

  The DME-controlled heated thermostat

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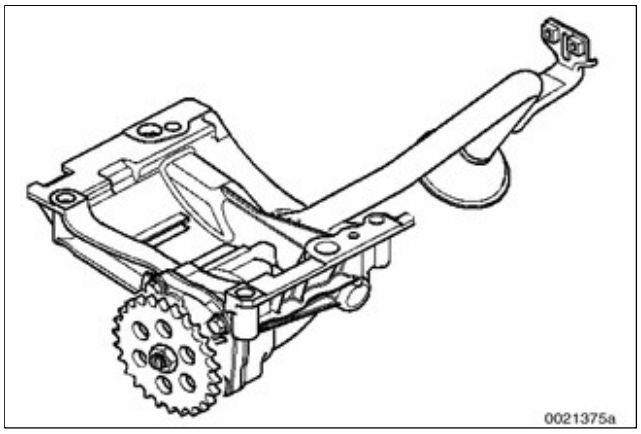
allows the engine to be operated at higher controlled temperatures during low and part throttle. This optimizes operating temperatures in both cylinder head and block, reduces friction and thereby fuel consumption.

The cooling system is designed to:

- Reduce operating temperatures of cylinder head. The result of lower temperatures is increased torque due to improved volumetric efficiency.
- Increase operating temperature of cylinder block.

Lubrication system

The lubrication system is pressurized whenever the engine is running. The oil pump draws oil through a pickup in the bottom of the oil pan, then forces it through a replaceable oil filter and into the engine oil passages.



The chain-driven oil pump is bolted to the bottom of the cylinder block inside the oil pan. A pressure relief valve limits the maximum system pressure. A bypass valve prevents the oil filter from bursting and insures engine lubrication should the filter become plugged. See ⇒ 119 Lubrication System for additional information.

Resonance/turbulence intake system

The intake manifold, made of molded plastic, is configured as two sets of three runners. This design enhances low end

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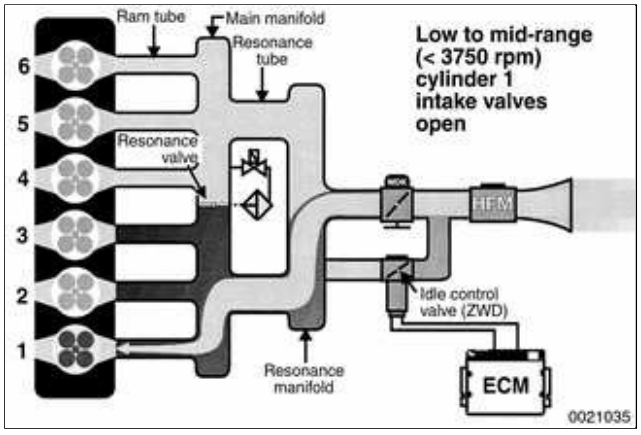
torque by changing the intake air flow configuration for varying engine speeds. This helps achieve optimum torque throughout the entire RPM range.

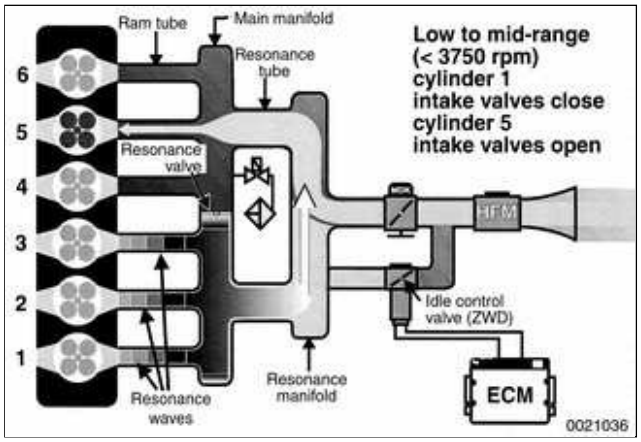
During engine operation, a closed resonance valve gives the intake air charge the dynamic effect of long intake runners at low to mid-range RPM (up to 3750 rpm). This helps increase torque.

During mid-range to high rpm operation (above 4100 rpm), the solenoid is de-energized and the resonance valve is sprung open. This allows intake air to be drawn through both resonance tubes, providing the air volume necessary for additional power at the upper rpm range.

Note:

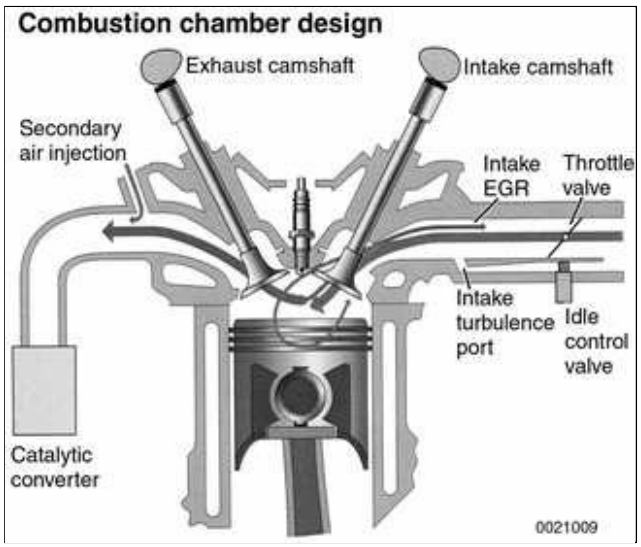
The rpm for resonance valve activation may vary slightly depending on temperature.





In addition, when the valve is closed, a dynamic effect is produced. For example, as intake air is flowing into cylinder 1, the intake valves will close. This blocks the onrushing air. The cylinder 1 air flow will stop and expand backward (resonance back pulse) to fill cylinder 5. The resonance wave along with the intake velocity enhances cylinder filling.

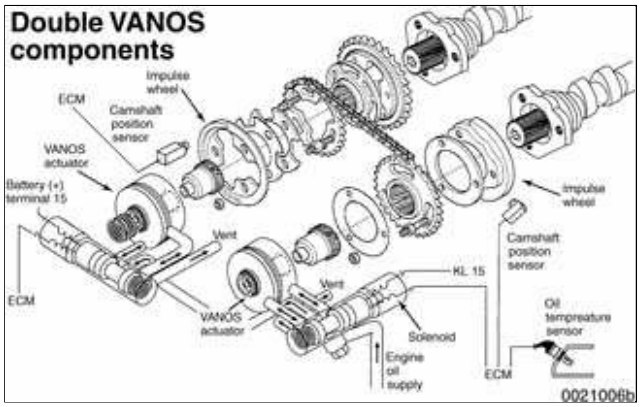
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- The intake manifold includes intake turbulence ports. The 5.5 mm (0.217 in.) turbulence ports channel idle and low speed air directly from the idle speed control valved to one intake valve of each cylinder.

  Routing intake air to one intake valve per cylinder causes the air charge to swirl in the cylinder. Together with the high flow rate of intake air across the small (5.5 mm) port, intake fluctuations are reduced for more stable combustion.

VANOS (Variable Camshaft Timing)



- A double VANOS system is used on both the M52 TU and the M54 engines. VANOS is fully variable and operates independently on both intake and exhaust sides.

  When the VANOS solenoid is actuated, engine oil pressure is applied to the front side of the gear cup piston. This forces the gear cup into the camshaft helical gears to change camshaft timing.

  In addition to offering increased power, the double VANOS system offers the following advantages:

  - Increased torque at lower and medium RPM ranges
  - More efficient combustion and improved idle quality
  - Internal EGR in part-load range for lower NOx emissions.
  - Quicker warm-up cycle for catalytic

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converter and faster reduction in emissions.

- Overall improved fuel economy.

See ⇒ 117 Camshaft Timing Chains for VANOS system testing and repair information.

Engine management system

The Siemens engine management systems used in E46 cars combine fuel injection, ignition and other functions under the control of the engine control module (ECM) They are compliant with second generation on-board diagnostics (OBD II) standards. See ⇒ OBD On Board Diagnostics at the back of this manual for additional information.

Table b. Engine management systems	
Year: **Engine**	**DME system**
1999 - 2000: M52 TU B25 M52 TU B28	Siemens MS 42.0
2001: M54 B25 M54 B30	Siemens MS 43.0

Engine control module (ECM)



The engine control module (ECM) is mounted in the electronics box (E-box) next to the brake master cylinder.

- The ECM is flash-programmable and features 5 electrical harness connectors with a total of 134 pins.

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- Connector 1: Voltages and grounds
- Connector 2: Ancillary signals (oxygen sensors, CAN, etc.)
- Connector 3: Engine signals
- Connector 4: Vehicle signals
- Connector 5: Ignition signals

Note:

The flash EEPROM (chip) is specifically `programmed' to the vehicle. It has the capability to be programmed up to 13 times.

ECM inputs:

- Hot film mass air flow (MAF) sensor monitors intake air with no moving parts.
- Pre- and post-catalytic converter oxygen sensors monitor engine emissions and catalyst efficiency.
- MS 42.0: Static Hall-effect sensors are used to detect camshaft position as soon as the ignition is turned ON, before the engine is started.
- Dynamic Hall-effect crankshaft position sensor is mounted at the flywheel end of the engine block and is integral to misfire detection.
- Engine coolant temperature sensor

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(ECT) in cylinder head supplies coolant temperature information to the ECM.

ECM outputs:

- Fuel injector opening duration.
- Intake and exhaust valve timing via the VANOS system.
- The radiator cooling fan and the heated coolant thermostat.
- Motor-driven throttle valve: MDK in MS 42.0 or EDK in MS 43.0.
- Idle speed control valve (MS 42.0)
- Resonance valve in the intake manifold.

ECM outputs (cont.):

- MS 42.0: Fuel pressure via 3/2 way valve monitors running losses (evaporative losses during engine operation).
- Secondary air injection (if applicable) to reduce HC and CO.
- Multiple spark ignition system.
- Maximum vehicle speed and cruise control.
- Brake booster vacuum pump.

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- Fuel purge valve and fuel tank leakage diagnosis pump (LDP or DM-TL).

Fuel metering: The ECM meters pressurized fuel by changing the opening time (pulse width) of the fuel injectors. The exact amount of fuel injected is determined by the amount of time the injectors are open. To ensure that injector pulse width is the only factor that determines fuel metering, fuel pump pressure is maintained by a pressure regulator. The injectors are mounted to a common fuel rail.



- The ECM monitors engine operating conditions to determine injector opening duration. Each injector can be individually controlled for cylinder selective fuel trim. The fuel-injectors inject fuel at an angle in a dual cone spray pattern.

Air intake: Air entering the engine passes through a pleated paper air filter in the air cleaner. Intake air mass is then measured by a mass air flow (MAF) sensor. A reference current is used to heat a thin film in the sensor when the engine is running. The current needed to hold the temperature of the film constant is the basis of the electronically converted voltage measurement corresponding to the mass of the intake air.

Idle speed control: Idle speed is electronically controlled via the idle speed control valve by bypassing varying amounts of air around the closed throttle valve. Idle speed is not adjustable. The ECM determines idle speed by controlling a dual-winding rotary idle control valve. The basic functions and parameters of idle speed control are as follows:

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- Control of cold air intake volume. For example, at air temperatures below 0°C (32°F), electronic throttle control (MDK/EDK) is also opened during idle.
- Smooth idle speeds regardless of load and inputs
- Lower rpm range
- Smooth transition from acceleration to deceleration

Idle speed stabilization is active during the following conditions:

- Engine warm up
- A/C activation
- Drive gear selected (auto. transmission)
- During passenger compartment heating
- During different cooling fan speeds

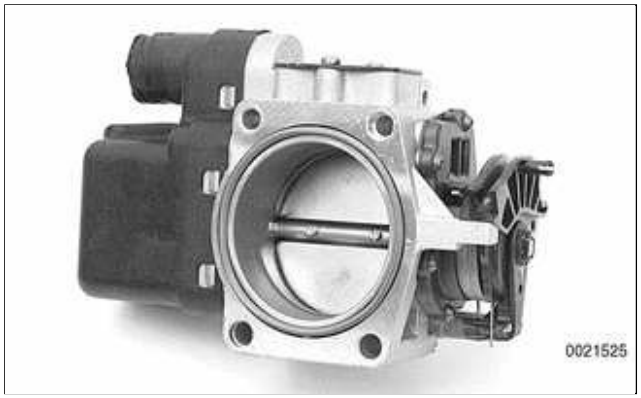
If the ECM detects a fault in the idle control valve, it will increase or decrease air flow, depending on the nature of the fault:

- If the fault causes decreased air flow (idle control valve closed), the electronic throttle control (MDK or EDK) will compensate to maintain idle. The EML lamp will illuminate to inform the driver of a fault.

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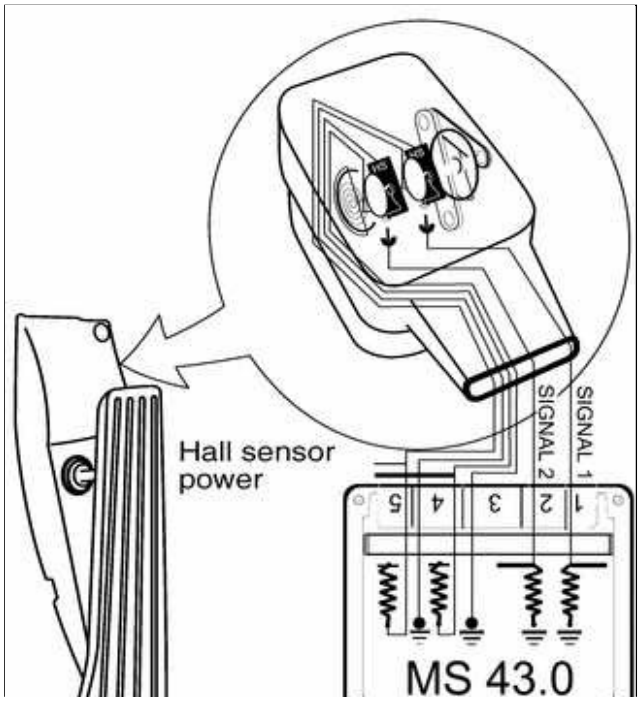
- If the fault causes increased air flow (actuator failed open), VANOS and knock control are deactivated. This reduces engine performance noticeably.

Throttle control: The throttle valve plate is electronically operated for precise throttle operation, OBD II compliant for fault monitoring, and ASC/DSC and cruise control. This integrated electronic throttle reduces additional control modules, wiring and sensors. Adjusting electronic throttles is not permitted and the throttle assembly must be replaced as a unit if found to be faulty.



- The throttle assembly for the MS 42.0 system is referred to as the MDK (Motor Driven Throttle Valve). The MDK is identified as follows:

  - A throttle cable is used to actuate the accelerator pedal position potentiometers and also serves as a backup to open the throttle plate (full control) when the MDK system is in the failsafe mode.



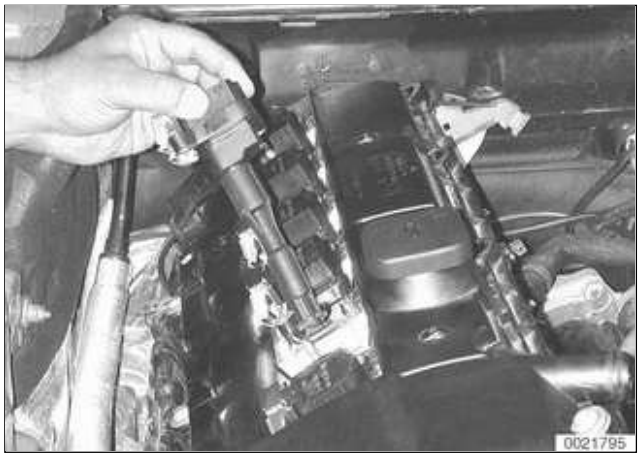
- The throttle assembly for the MS 43.0 system is referred to as the EDK (Electronic Throttle Valve). The EDK is identified as follows:

  - The accelerator position potentiometers (PWG) are located in the accelerator pedal assembly.

  - The EDK is fully electronic. The accelerator pedal is not mechanically linked to the EDK.

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- Ignition function: a distributorless ignition system with individual ignition coils for each cylinder is employed. The coils are mounted over the spark plugs and connect to the plugs via a short lead.

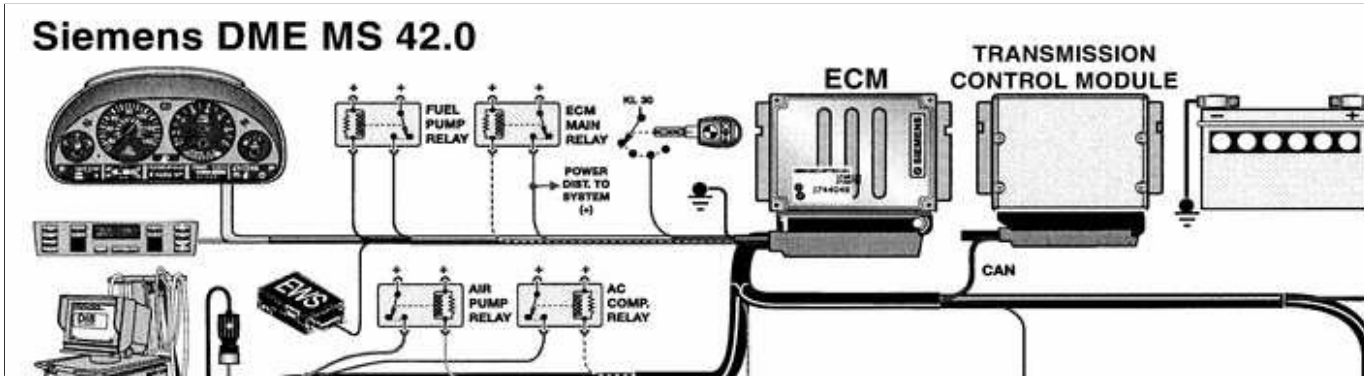
  The Siemens systems use multiple spark ignition to reduce emissions and extend spark plug life.

  Knock control. Knock (detonation) sensors monitor and control potentially damaging ignition knock through the ECM. The knock sensors function like microphones and are able to convert mechanical vibration (knock) into electrical signals. The ECM is programmed to react to frequencies that are characteristic of engine knock and adapt the ignition timing point accordingly. See ⇒ 120 Ignition System for further details.

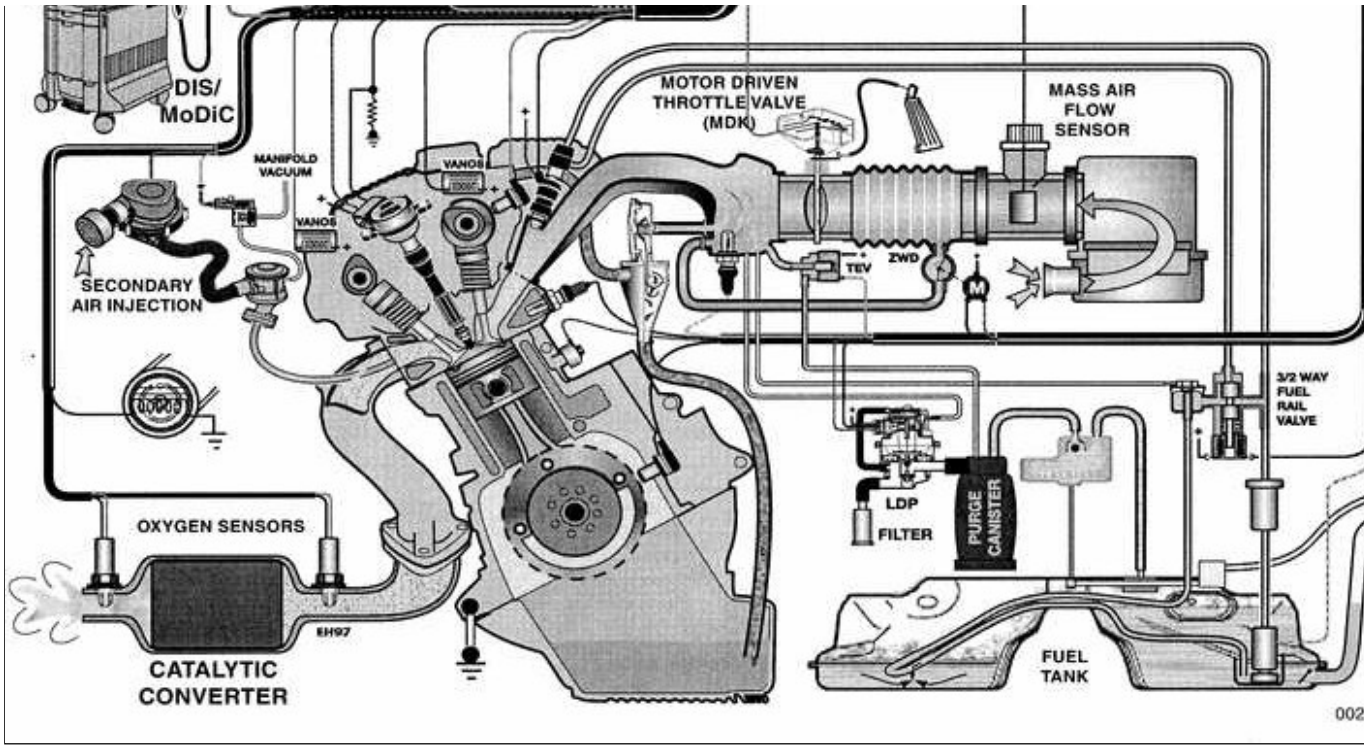
  Note:

  M52 TU and M54 engines are designed to operate best with fuel octane of at least 91 anti-knock index (AKI). The adaptive engine management system, however, will allow use of fuel rated 87 AKI.

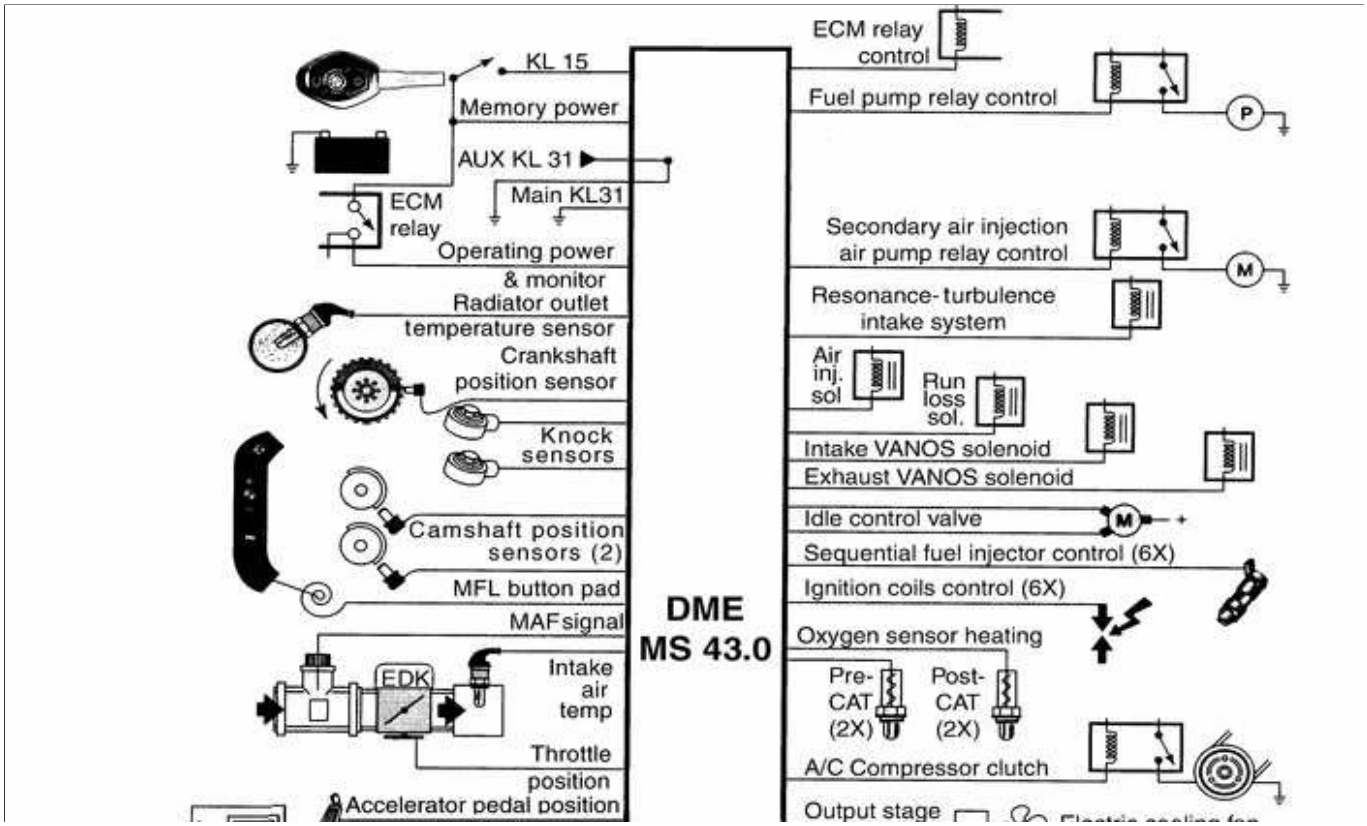
Siemens DME MS 42.0



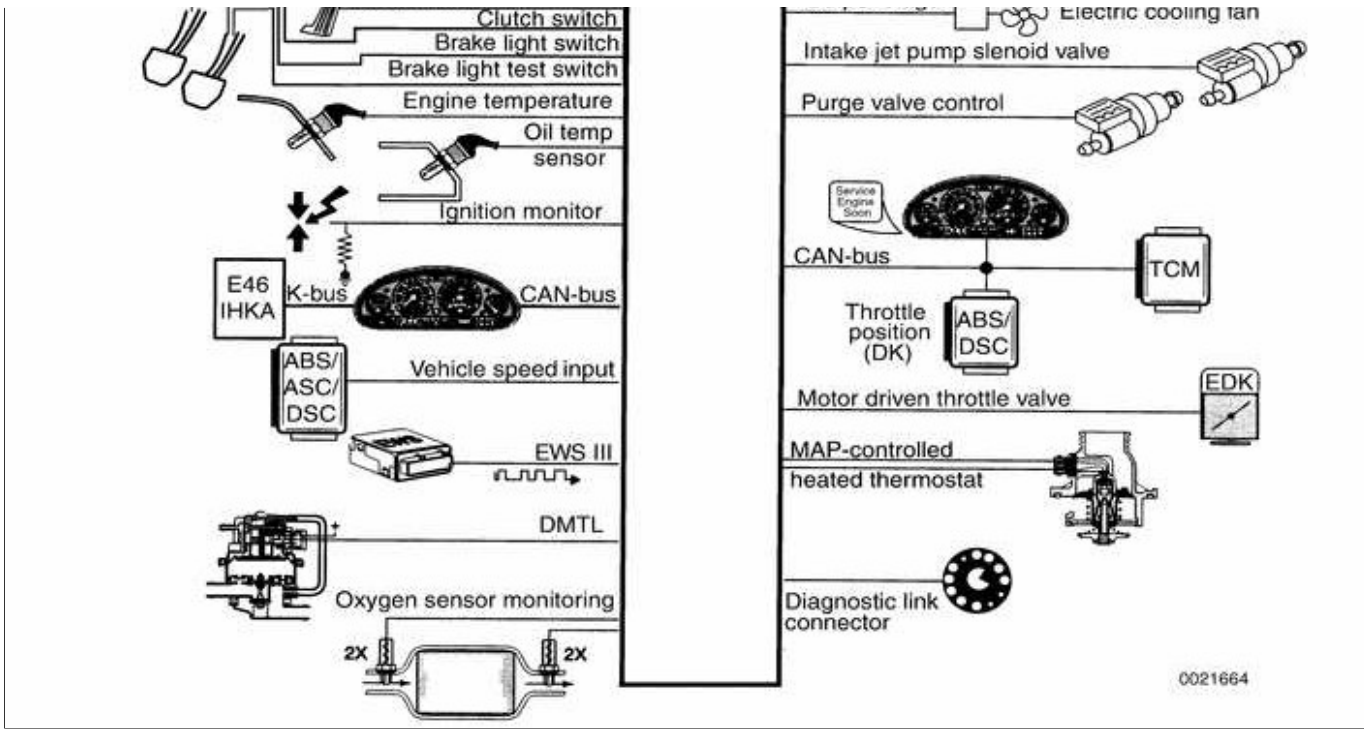
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Siemens DME MS 43.0



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Driveability Troubleshooting

The Siemens systems are sophisticated self-diagnosing OBD II systems. These systems continuously monitor components and record and store valuable diagnostic information.

If the `Check Engine' or `Service Engine Soon' light [also known as the malfunction indicator lamp (MIL)] is illuminated, the first diagnostic test should be to hook up a BMW-compatible scan tool and check the fault memory.

The powerful diagnostic capabilities of these systems have the potential to save hours of diagnostic time, incorrect component replacement and possible damage to system components. See ⇒ OBD On Board Diagnostics at the back of this manual.

Two of the most common causes of driveability problems are system voltage levels and poor grounds.

System voltage

The DME system requires that the system (battery) voltage be maintained within a narrow range. Voltage levels outside the operating range can cause havoc. When troubleshooting an illuminated MIL, make sure the battery is fully charged and capable of delivering all its power to the electrical system.

To make a quick check of the battery charge, measure the voltage across the battery terminals with all cables attached and the ignition off. A fully charged battery will measure 12.6 volts or slightly more, compared to 12.15

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volts for a battery with a 25% charge.

Even a fully charged battery cannot deliver power unless it is properly connected to the electrical system. Check the battery terminals for corrosion or loose cable connections. If the battery does not maintain the proper voltage, the charging system may be at fault. See ⇒ 121 Battery, Alternator, Starter.

If a battery cable connection has no visible faults, but is still suspect, measure the voltage drop across the connection. A large drop indicates excessive resistance, indicating that the connection is corroded, dirty, or damaged. Clean or repair the connection and retest.

Note:

For instructions on conducting a voltage drop test and other general electrical troubleshooting information, see ⇒ 600 Electrical System–General.

The DME system operates at low voltage and current levels, making it sensitive to small increases in resistance. The electrical system is routinely subjected to corrosion, vibration and wear, so faults or corrosion in the wiring harness and connectors are not uncommon.

Visually inspect all wiring, connectors, switches and fuses in the system. Loose or damaged connectors can cause intermittent problems, especially the small terminals in the ECM connectors. Disconnect the wiring harness connectors to check for corrosion, and use electrical cleaning spray to remove contaminants.

Main grounds

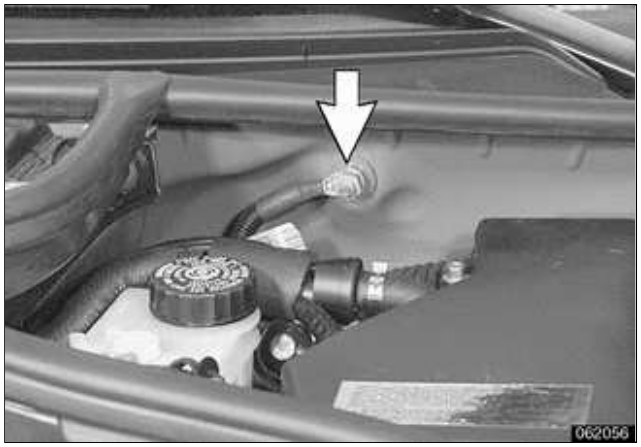
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Good grounds are critical to proper DME operation. If a ground connection has no visible faults but is still suspect, measure the voltage drop across the connection. A large voltage drop indicates high resistance, indicating that the connection is corroded, dirty or damaged. Clean or repair the connection and retest.

Note:

For instructions on conducting a voltage drop test and other general electrical troubleshooting information, see ⇒ 600 Electrical System–General.

Below is a listing of the main grounds for the fuel and ignition circuits of the DME system.



- Main ground (**arrow**) for engine management system in left rear of engine compartment on bulkhead behind E-box.

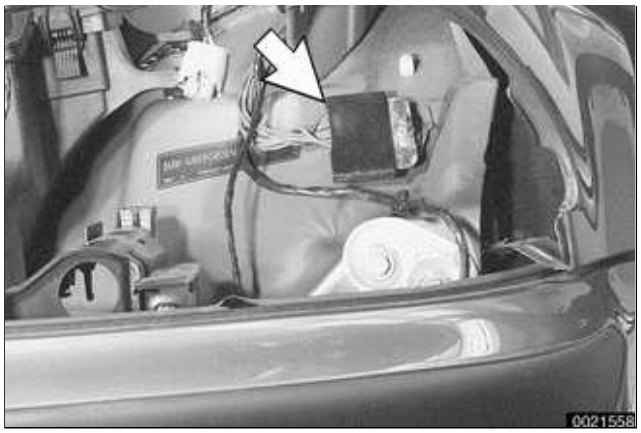


- Main grounds for ignition coils (**arrows**).

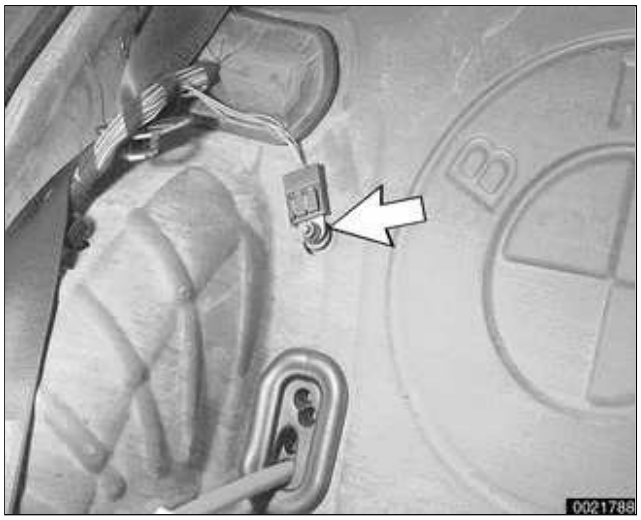


- Main chassis ground harness connection (**arrow**) in left front of

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engine compartment, behind left headlight assembly (headlight assembly shown removed).



- Main fuel pump ground (**arrow**) behind right rear seat back rest.

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Engine Removal and Installation

Be sure to cover all painted surfaces before beginning the removal procedure. As an aid to installation, label all components, wires and hoses before removing them. Do not reuse gaskets, O-rings or seals during reassembly.

WARNING!

Due to risk of personal injury, be sure the engine is cold before beginning the removal procedure.

- Remove engine hood or place hood in service position. See ⇒ 410 Fenders, Engine Hood.

Note:

It is not necessary to remove the engine hood, but it is helpful and will make engine removal and installation easier.

Intake manifold, removing and installing

Note:

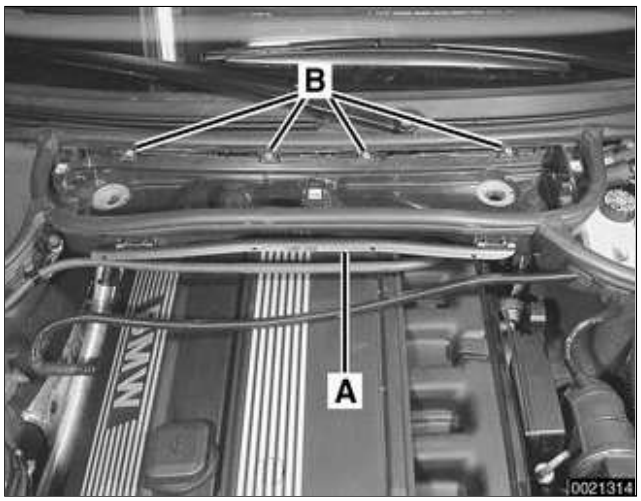
The intake manifold must be removed to facilitate engine assembly removal.

- Disconnect negative (-) battery cable in luggage compartment.

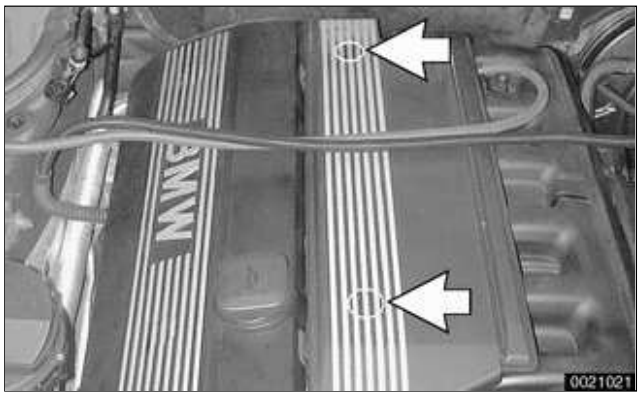
CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

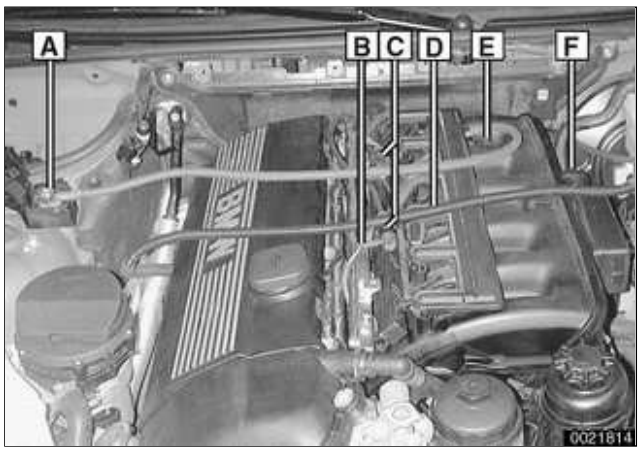
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- Remove housing for interior ventilation microfilter.
  - Remove upper cover and microfilter.
  - Open wiring harness loom cover (**A**) and remove wires.
  - Unfasten screws (**B**) and remove lower microfilter housing.



- Remove intake manifold cover:
  - Remove plastic trim covers (**arrows**).
  - Remove cover hold down bolts and lift off cover.

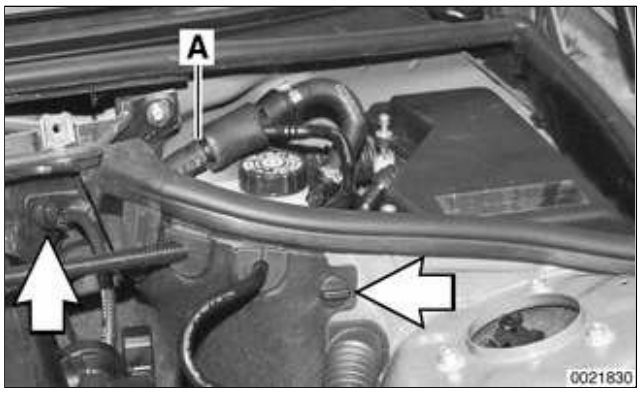


- Working above engine, detach the following:
  - **A** Positive engine lead at B+ terminal
  - **B** Manifold vacuum line
  - **C** Oxygen sensor connectors
  - **D** Electrical harness connector for intake air temperature sensor
  - **E** Positive lead hold-down bracket
  - **F** Resonance valve electrical connector

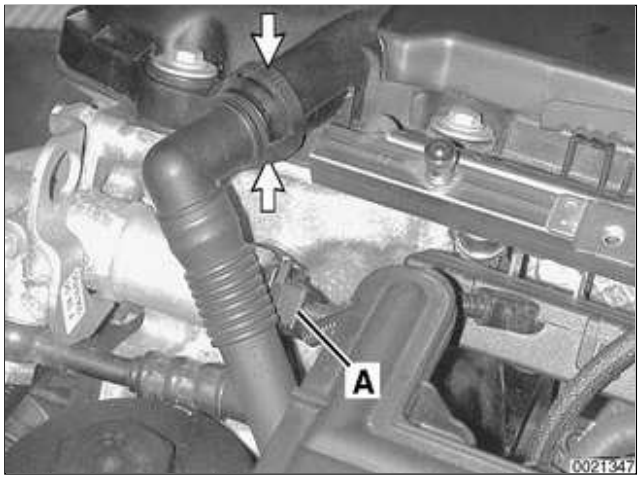
CAUTION!

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If oxygen sensor harness connectors are separated, be sure to mark them so that they can be reassembled as before.



- Working at left rear of engine compartment:
  - Peel rubber edge seal off top of panel.
  - Twist plastic panel retainers (**arrows**) 90° and pull out to remove.
  - Disengage panel from hoses and wiring harnesses and remove from engine compartment.
  - Separate brake booster vacuum hose at one way valve (**A**). Plug hose ends.



- Detach engine vent hose from cylinder head cover by squeezing sides of spring clip (**arrows**). Detach VANOS solenoid electrical harness connector (**A**).

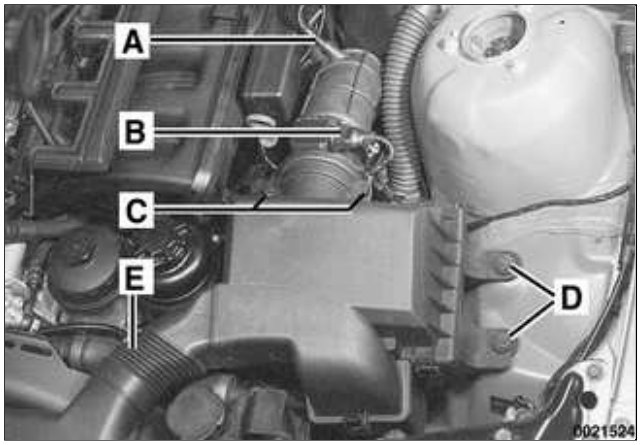


- Detach fuel injector electrical connectors from injectors:
  - Use small screwdriver to pry one corner of wire lock clip on fuel injector 1 connector.
  - Repeat for all injectors.

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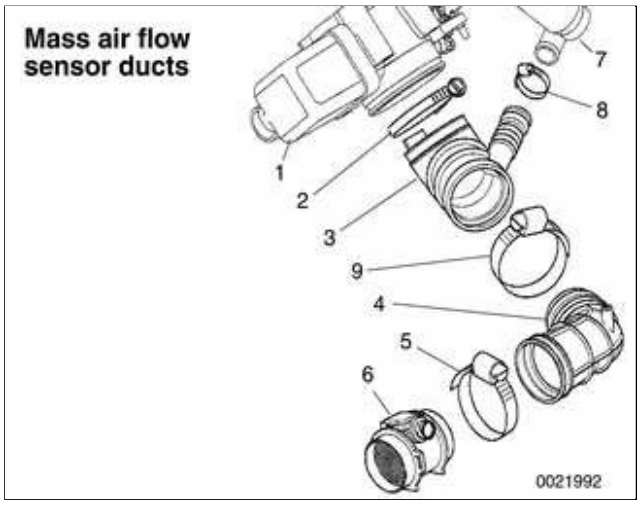
- Lift off connector loom and lay aside.



- Remove complete air filter housing:
  - Detach vacuum line at intake boot (**A**).
  - Disconnect electrical harness connector on mass air flow sensor (**B**).
  - Release mass air flow sensor clips (**C**).
  - Remove filter housing mounting screws (**D**).
  - Detach air duct connection (**E**) and lift complete air filter housing out of engine compartment, pulling it forward away from mass air flow sensor.

Note:

In this step, mass air flow sensor remains attached to rubber air duct.



- Loosen clamps **2** and **8** and remove mass air flow sensor and air ducts.

1 - Throttle assembly

2 - Hose clamp 77 - 84 mm

3 - Y-duct

4 - Air duct

5 - Hose clamp 83 - 90 mm

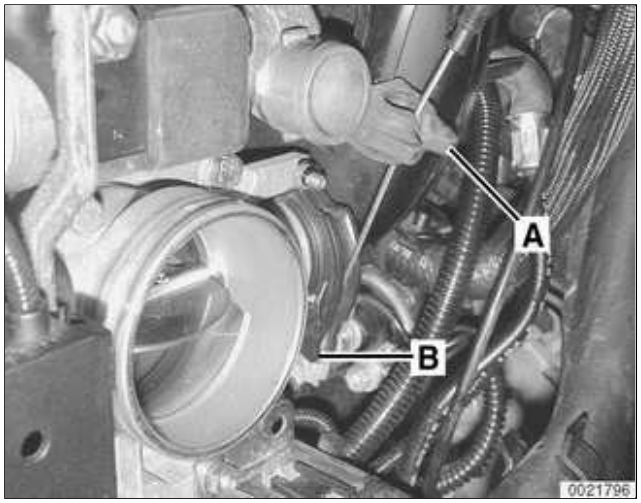
6 - Mass air flow sensor

7 - Idle control valve

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8 - Hose clamp 28 - 33 mm

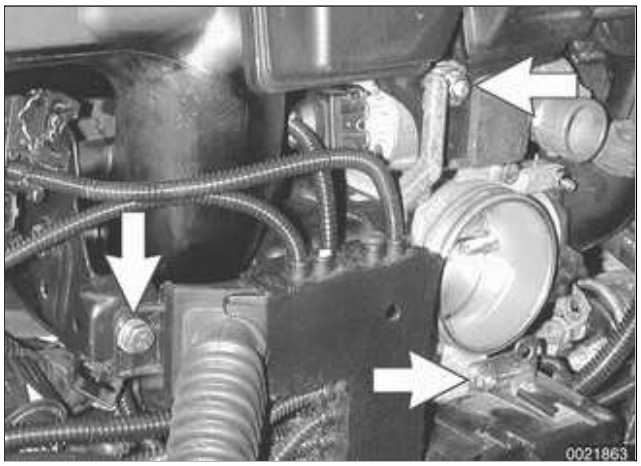
9 - Hose clamp 77 - 84 mm



- Where applicable: Pull throttle cable upwards out of rubber retainer (**A**) and unhook ball end of cable (**B**) from throttle actuator.

Note:

Models equipped with M54 engines do not use a throttle cable mounted to throttle housing.



- Remove nuts and bolt (**arrows**) retaining wiring harness conduit to throttle body.

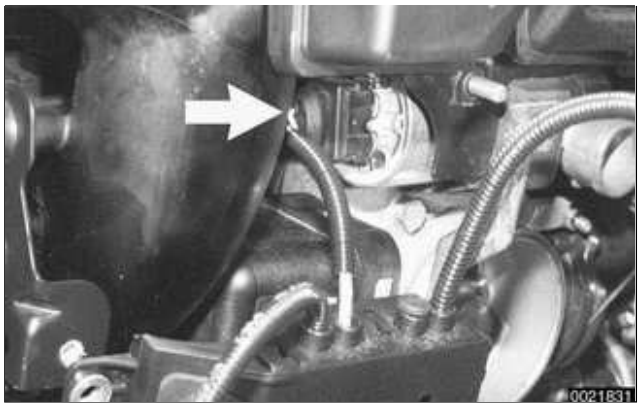


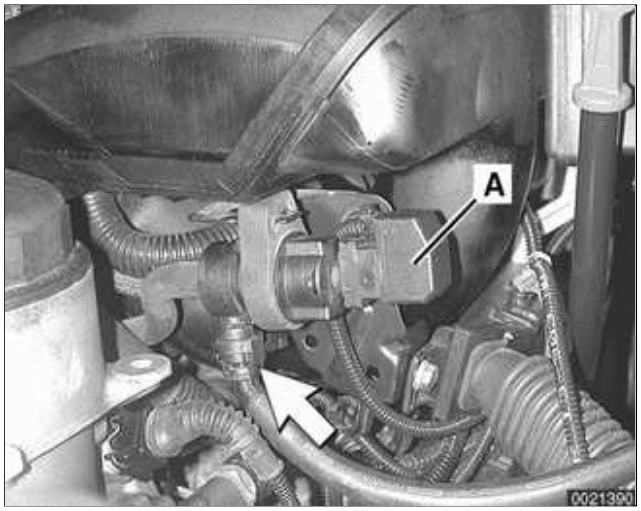
- Working at throttle housing: Turn harness plug (**arrow**) counterclockwise and remove.



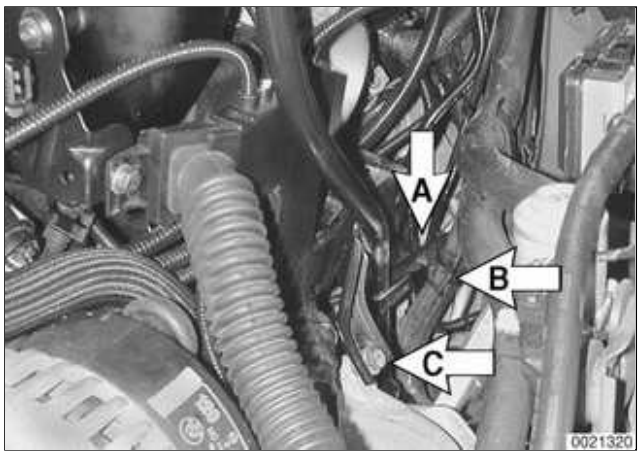
- Disconnect electrical harness connector at idle speed control valve (**arrow**).

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- Detach electrical harness connector at fuel tank venting valve (**A**). Disconnect hose at quick disconnect fitting (**arrow**).



- Remove dipstick guide tube:
  - Detach wiring harness brackets from tube (**A**).
  - Detach fuel lines from tube (**B**).
  - Remove lower guide tube mounting bolt (**C**). Pull out dip stick guide tube.



- Remove schræder valve cap (**arrow**) from air connection on fuel rail. Using a tire chuck, blow fuel back through feed line using a brief burst of compressed air (maximum of 3 bar or 43.5 psi).

WARNING!

- ***Fuel in fuel line is under***

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pressure (approx. 3 - 5 bar or 45 - 75 psi) and may be expelled under pressure. Do not smoke or work near heaters or other fire hazards. Keep a fire extinguisher handy. Before disconnecting fuel hoses, wrap a cloth around fuel hoses to absorb any leaking fuel. Catch and dispose of escaped fuel. Plug all open fuel lines.

- ***Always unscrew the fuel tank cap to release pressure in the tank before working on the tank or lines.***

- Raise car and support in a safe manner.

CAUTION!

Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

- Remove protective engine splash guard.



- Working beneath car (on left side under driver seat), remove fuel filter cover and clamp fuel hose(s).



- Detach fuel hose(s) from fuel line(s) (**arrows**) using special fuel line removal tool 16 1 050 or equivalent. Seal off fuel line(s) with BMW special

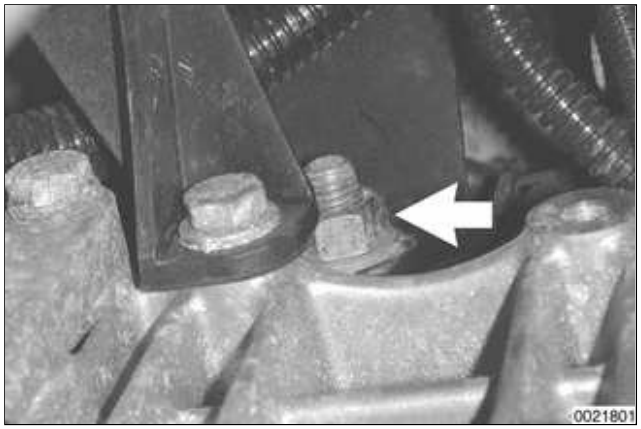
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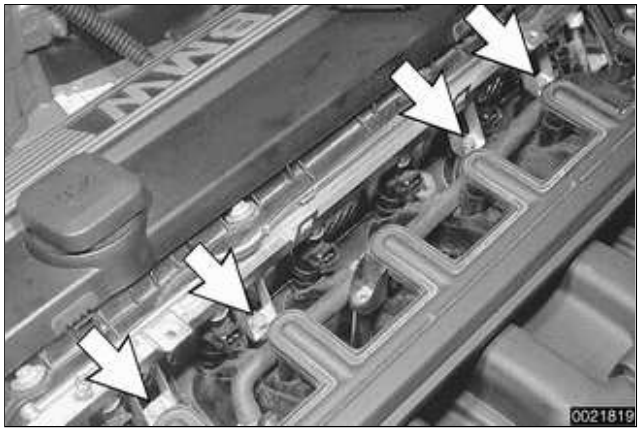
tools 13 5 281/13 5 282.

CAUTION!

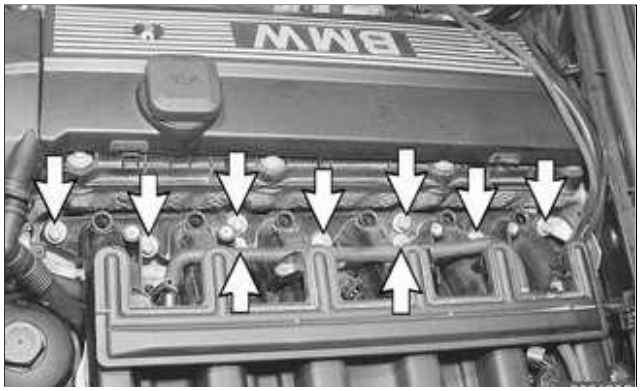
Fuel may be expelled under pressure. Do not smoke or work near heaters or other fire hazards. Keep a fire extinguisher handy. Before disconnecting fuel hoses, wrap a cloth around fuel hoses to absorb any leaking fuel. Plug all open fuel lines.



- Working underneath car, remove lower intake manifold support mounting bolt (**arrow**), located adjacent to left engine mount.



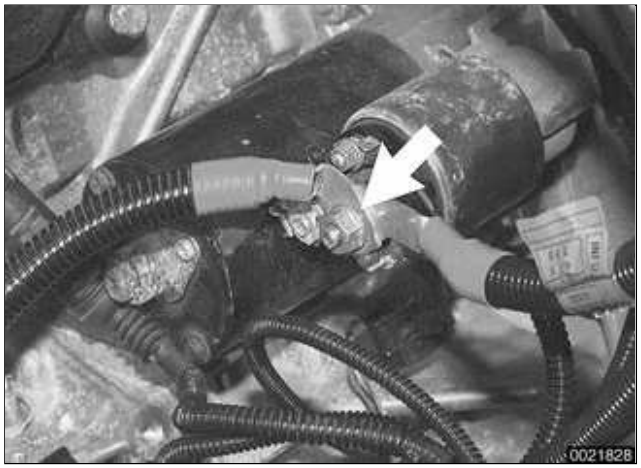
- Remove fuel rail mounting bolts (**arrows**).
  - Carefully pry fuel rail off manifold.
  - Separate fuel line support bracket at rear of intake manifold.
  - Thread fuel line(s) out of rear of engine compartment while lifting fuel rail out.



- Remove manifold mounting nuts (**arrows**).

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- Lift up manifold just enough to detach positive cables from starter motor terminal 50 (**arrow**).

  - Remove intake manifold from cylinder head while carefully checking for electrical connections or hoses.

CAUTION!

Stuff clean rags into open intake ports to prevent any parts from falling into the engine intake.

  - Intake manifold Installation is reverse of removal.

- Use new fuel injector seals.

- Carefully check intake manifold gasket and replace if necessary.

- Inspect O-ring seal between mass air flow sensor and air filter housing. To facilitate reassembly, coat seal with acid-free grease. nothing

CAUTION!

When reattaching throttle assembly harness connector, connector is fully tightened when arrows on connector and plug line up.

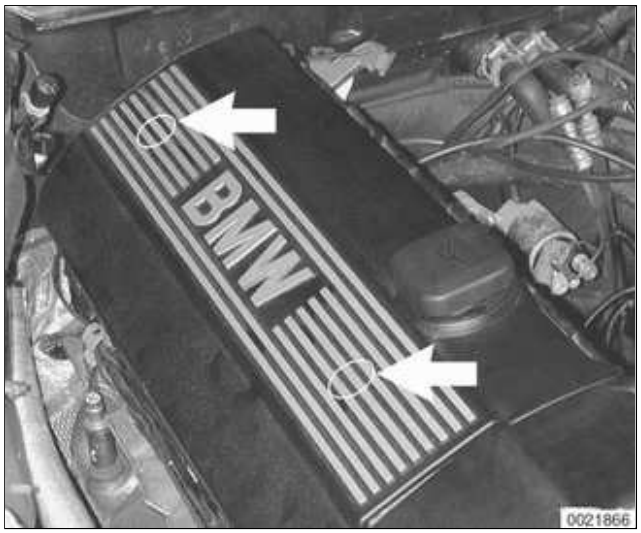
Tightening torques	
Intake manifold to cylinder head	
M7	15 Nm (11 ft-lb)
M8	22 Nm (16 ft-lb)

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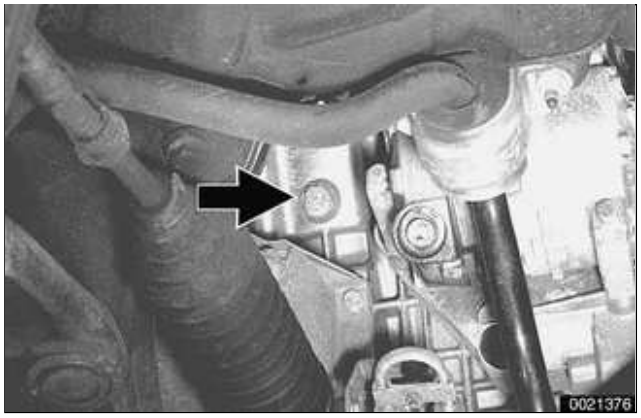
Engine assembly, removing and installing

Note:

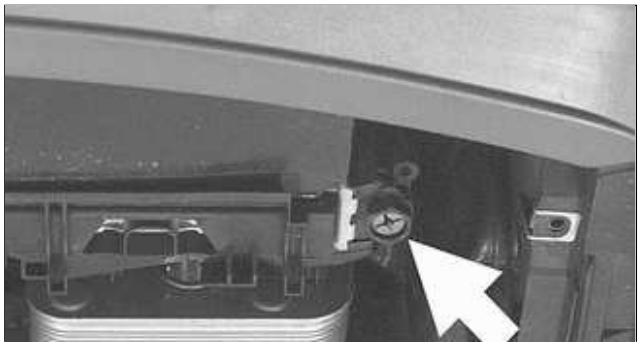
The intake manifold must be removed as described earlier to facilitate engine assembly removal.



- Remove cylinder head top cover:
  - Remove plastic trim covers (**arrows**).
  - Remove cover hold down bolts and lift off cover.



- Drain engine coolant and remove coolant hoses.
  - Remove expansion tank cap on radiator.
  - Place a 3-gallon pail beneath engine to capture coolant.
  - Remove coolant drain plug located on exhaust side of cylinder 2 of engine block (**arrow**).



- Drain radiator into a 3-gallon pail by removing plastic drain plug completely (**arrow**).

WARNING!

Use extreme caution when draining and disposing of engine coolant. Coolant is poisonous and lethal to

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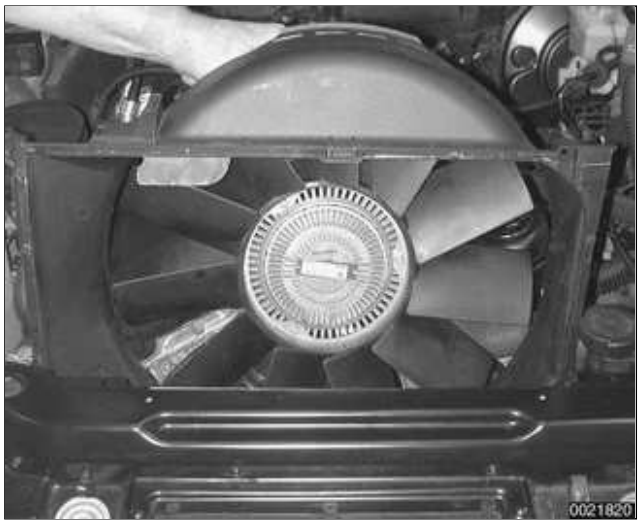
humans and pets. Pets are attracted to coolant because of its sweet smell and taste. Consult a veterinarian immediately if coolant is ingested by an animal.

Note:

Catch and dispose of drained coolant according to local, state, and federal laws.



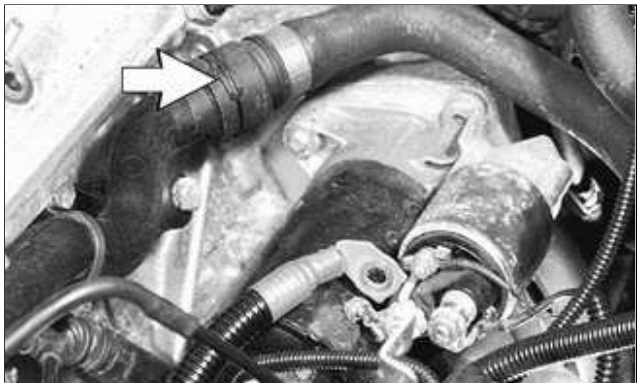
- Remove hoses from thermostat housing by releasing locks (**arrows**).



- On vehicles equipped with automatic transmissions: Remove radiator cooling fan and radiator as described in ⇒ 170 Radiator and Cooling System.

CAUTION!

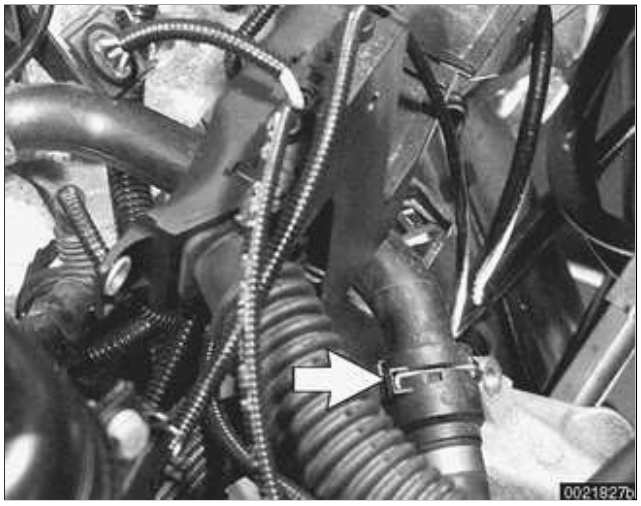
32 mm radiator fan mounting nut has left hand threads.



- Detach coolant hose at rear left side of engine above starter by releasing lock (**arrow**).

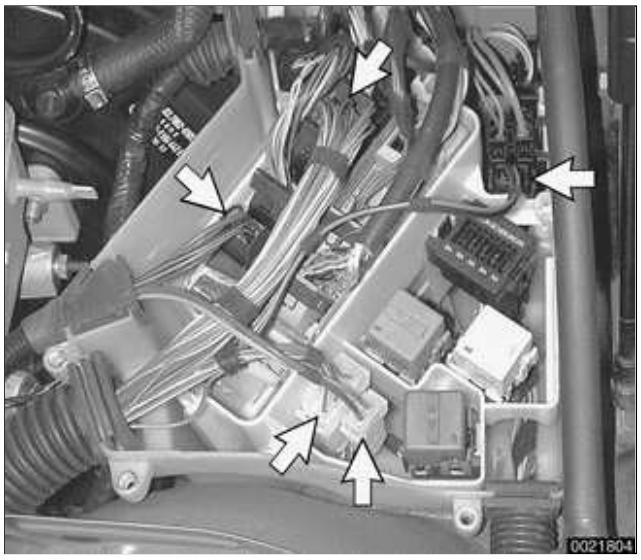
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- Detach coolant hose at front left side of engine by engine mount by releasing lock (**arrow**).

  - Unbolt power steering fluid reservoir and pull aside without detaching hoses. Tie to fender with cord or stiff wire.



- Working at E-box at left rear of engine compartment:

  - Detach engine electrical harness connectors (**arrows**).

  - Lift off harness looms and lay over engine.

  - Remove poly-ribbed drive belts. Mark belt direction of rotation if belts will be reused. See ⇒ 020 Maintenance.

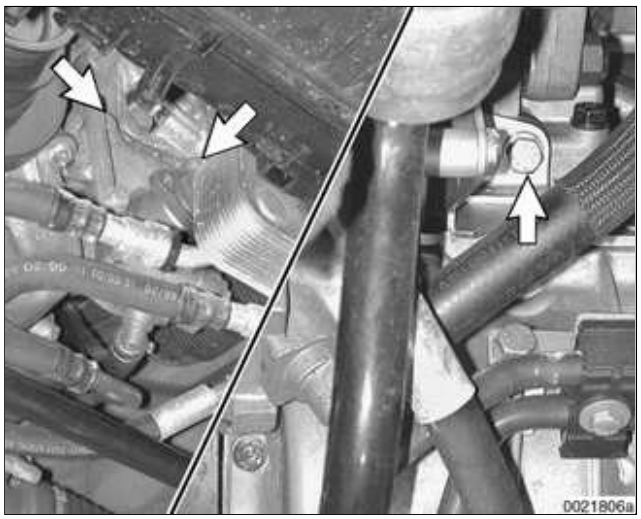
  - All wheel drive models: Remove front axle differential and output shaft bearing pedestal. See ⇒ 311 Front Axle Final Drive.

  - Remove transmission from car. See ⇒ 230 Manual Transmission or ⇒ 240 Automatic Transmission.

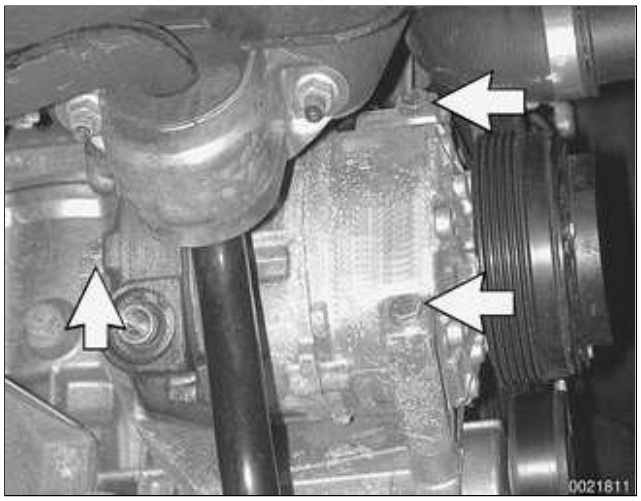
Note:

Detach automatic transmission cooler lines from radiator, remove brackets holding lines to side of engine, and store lines in a clean environment.

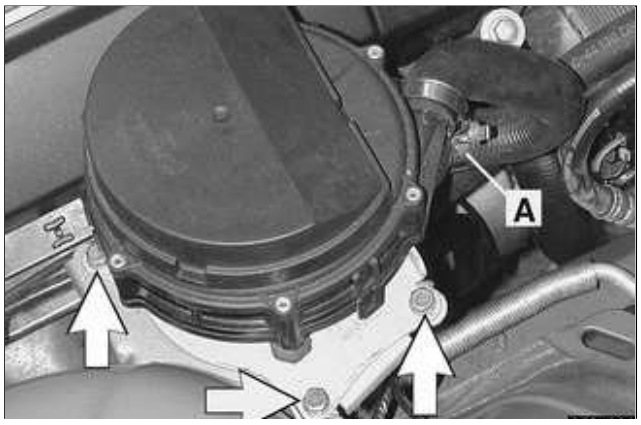
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- Remove power steering pump:
  - Remove steering pump pulley.
  - Remove front and rear pump mounting bolts (**arrows**).
  - Hang pump from body using stiff wire.



- Remove A/C compressor mounting bolts (**arrows**) and A/C compressor from its mounting bracket without disconnecting, distorting, or deforming any refrigerant lines. Hang from body using stiff wire.
  - Remove windshield and headlight washer reservoir:
  - Remove bolt on top of reservoir.
  - Lift tank and disconnect electrical connections to pump and to washer fluid level sensor.
  - Disconnect hoses to windshield washer and headlight washer. Tilt reservoir to prevent fluid from leaking out.



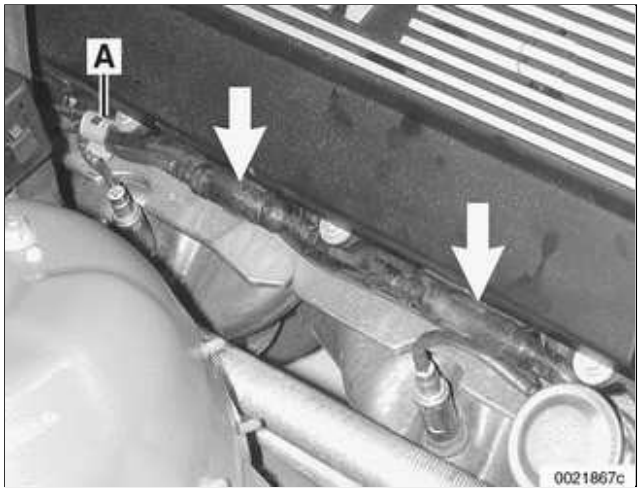
- Remove secondary air pump:
  - Remove hose at one-way valve (**A**).
  - Remove bolts at support bracket on strut tower **(arrows**).
  - Disconnect electrical harness from

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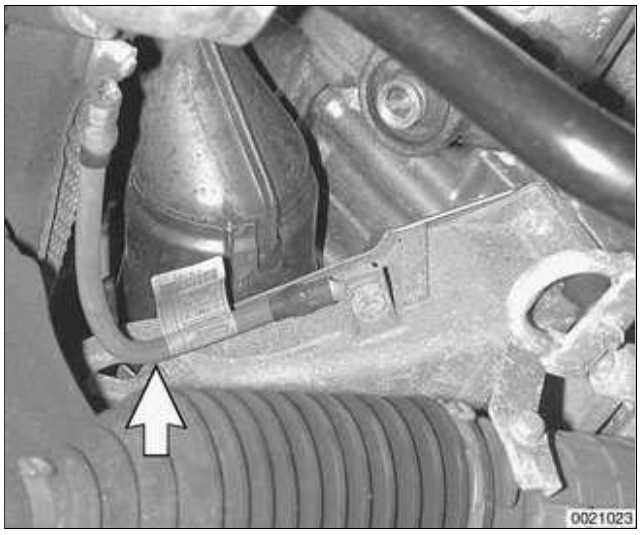


bottom of secondary air pump.

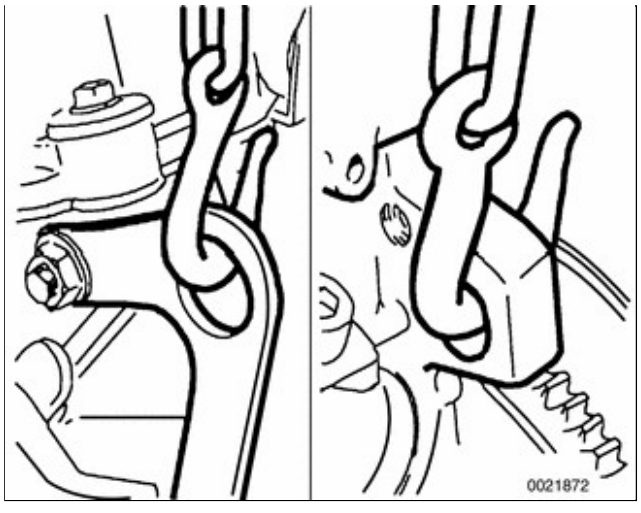
- Remove bracket from strut tower.



- Separate oxygen sensor electrical harness connectors (**arrows**) and mounting clip (**A**) on right side of engine.



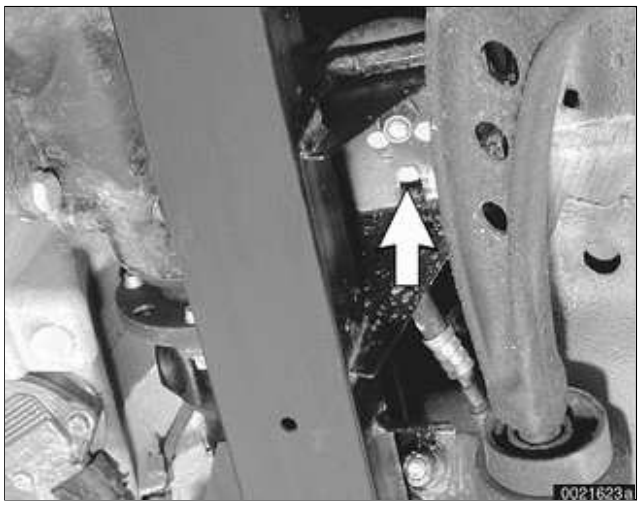
- Remove chassis ground strap (**arrow**) at right engine mounting pedestal.



- Install an engine lifting device (BMW 11 0 000 or equivalent) to the front and rear engine supports and raise engine until its weight is supported. Detach left and right engine mounts.

  - Carefully raise engine out of car, checking for any wiring, fuel lines, or mechanical parts that might become snagged as engine is removed.

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- When reinstalling, make sure locating pin on left engine mount (**arrow**) seats correctly in slot of subframe boss.

- Installation is reverse of removal, noting the following:

- Replace all gaskets, O-rings and seals.

- Change engine oil and filter and check all other fluid levels. See ⇒ 020 Maintenance.

- Refill and bleed cooling system. See ⇒ 170 Radiator and Cooling System.

- Use new fuel injector seals.

- Carefully check intake manifold gasket and replace if necessary.

- Inspect O-ring seal between mass air flow sensor and air filter housing. To facilitate reassembly, coat seal with acid-free grease.

CAUTION!

When reattaching throttle assembly harness connector, connector is fully tightened when arrows on connector and plug line up.

- Check that engine drive belts properly engage pulley grooves.

- Install exhaust manifolds using new gaskets and self-locking nuts. Use copper paste on threads. See ⇒ 180 Exhaust System.

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Tightening torques	
Coolant drain plug to cylinder block	25 Nm (18 ft-lb)
Engine mount to subframe	
M10	45 Nm (33 ft-lb)
Exhaust manifold to cylinder head	
M6	10 Nm (8 ft-lb)
M7 or M8	20 Nm (15 ft-lb)
Intake manifold to cylinder head	
M7	15 Nm (11 ft-lb)
M8	22 Nm (16 ft-lb)
Radiator cooling fan to coolant pump	40 Nm (30 ft-lb)
Radiator drain screw to radiator	2.5 Nm (22 in-lb)

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General

This group covers E46 cylinder head removal and installation as well as cylinder head/valve diagnosis procedures.

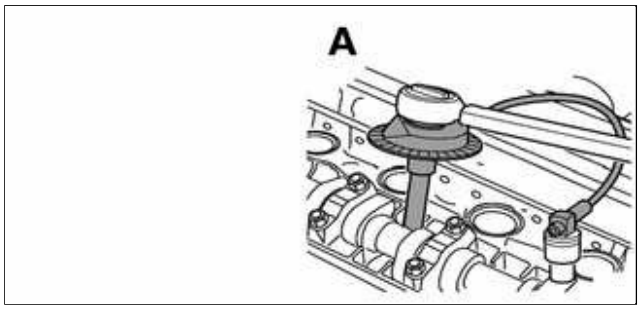
The information given in this repair group assumes that the engine is installed in the engine bay. In order to remove the cylinder head from the engine block, the VANOS control unit and the camshafts must be removed from the cylinder head. For cylinder head and valvetrain reconditioning information, see ⇒ 116 Cylinder Head and Valvetrain.

Note:

If a head gasket problem is suspected, a compression test or leak-down test will usually detect the fault. See ⇒ Diagnostic Testing later in this group.

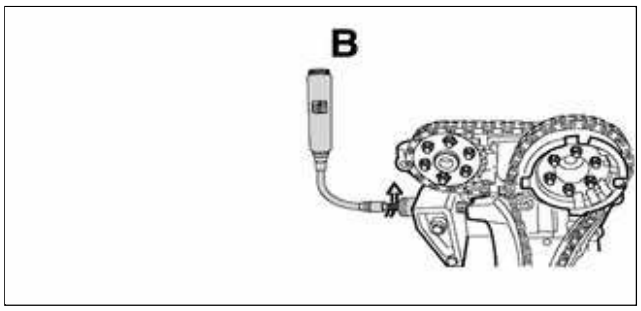
Special tools

Special BMW service tools are required to properly remove and install the cylinder head on engines covered by this manual. The special tools are used to time the valvetrain to the crankshaft, to remove the VANOS control unit, the camshafts and the Torx (E12) head bolts. Read the entire procedure through before beginning the job.

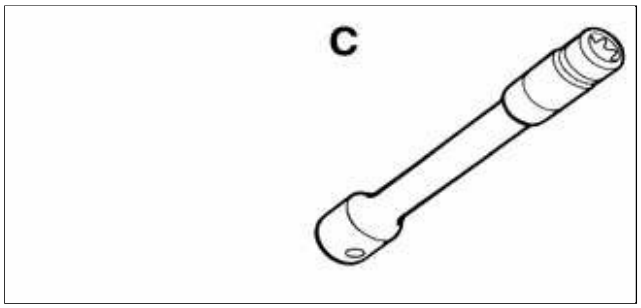


A Rotary angle dial gauge BMW special tool 00 9 120

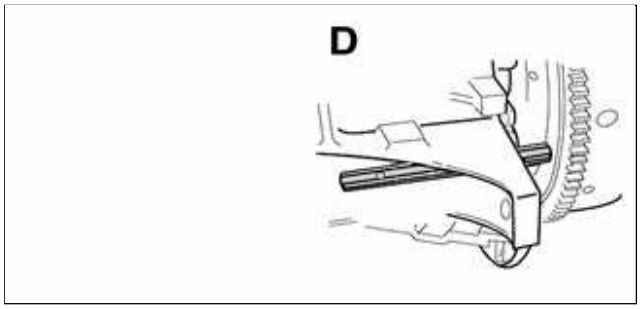
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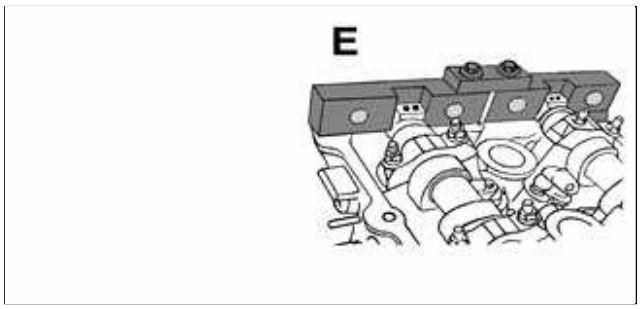
- Torque wrench w/ flex extension BMW special tool 00 9 250



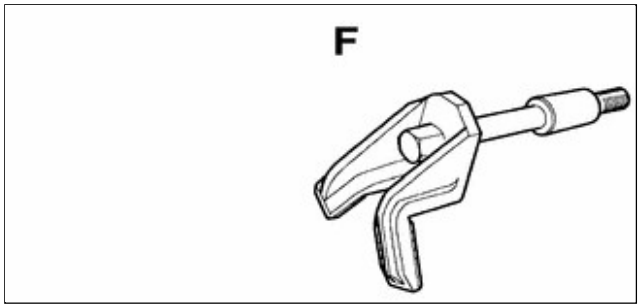
- E-12 Torx socket BMW special tool 11 2 250



- Crankshaft locking tool BMW special tool 11 2 300



- Camshaft locking tool BMW special tool 11 3 240



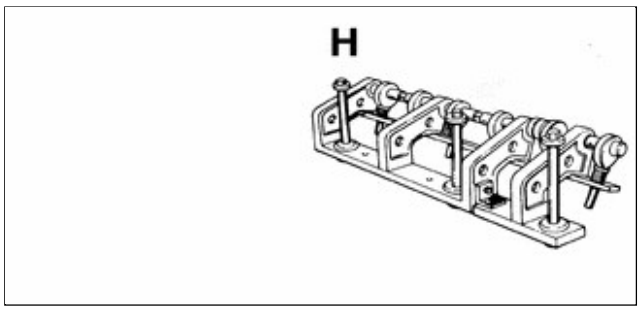
- Camshaft locking tool bracket BMW special tool 11 3 244



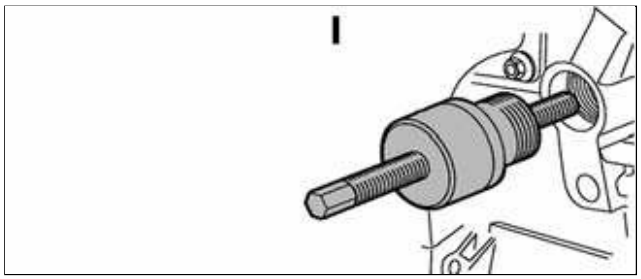
- Lifter retaining suction cup BMW special tool 11 3 250

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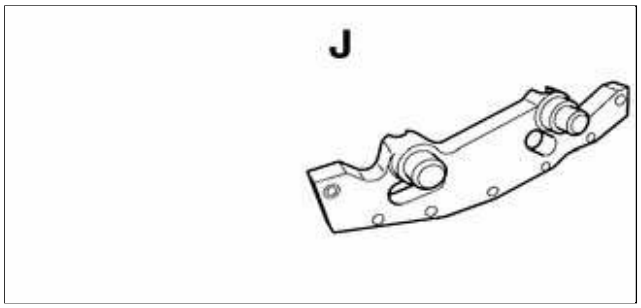




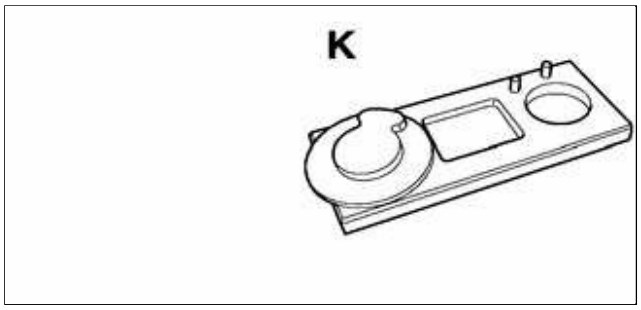
- Camshaft bearing cap removal tool BMW special tool 11 3 260 /11 3 270



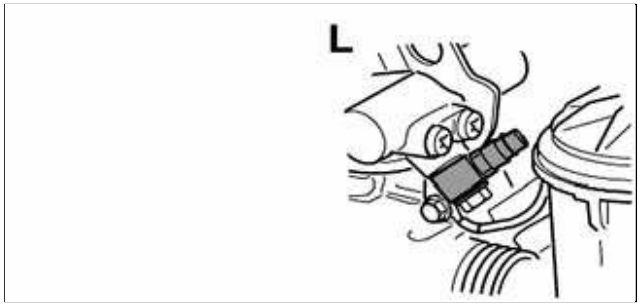
- Timing chain tensioner tool BMW special tool 11 4 220



- VANOS adjustment plate BMW special tool 11 6 150

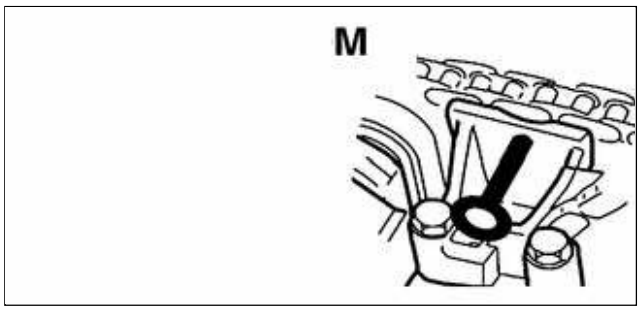


- Secondary sprocket setup tool BMW special tool 11 6 180



- Air line adapter BMW special tool 11 3 450

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➢ Secondary chain tensioner lock pin
BMW special tool 11 3 292

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Cylinder Head Removal

WARNING!

Due to risk of personal injury, be sure the engine is cold before beginning the removal procedure.

Cylinder head removal and installation is a complicated repair procedure. VANOS control unit, timing chain, and camshaft removal and installation all require special tools. Read the entire procedure before beginning the repair.

CAUTION!

Cover all painted surfaces before beginning the removal procedure. As an aid to installation, label all components, wires, and hoses before removing them. Do not reuse gaskets, O-rings or seals during reassembly.

To assist the technician in this repair, the procedure has been organized into discrete jobs. Please be advised that these individual jobs must be accomplished in the order in which they appear.

⇒ Intake manifold, removing

⇒ Cylinder head cover, removing

⇒ VANOS control unit, removing

⇒ Camshafts and valvetrain, removing

⇒ Cylinder head assembly, removing

Intake manifold, removing

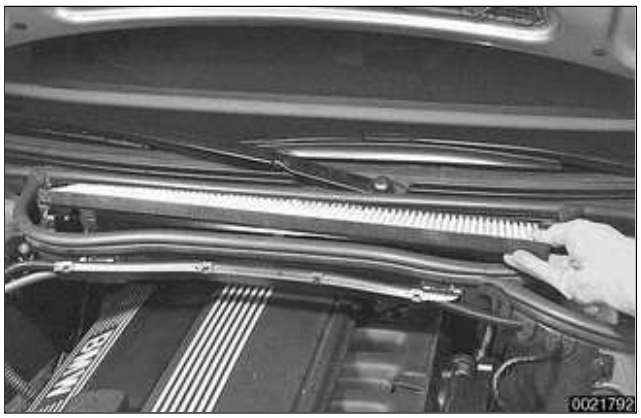
- Disconnect negative (-) battery cable in trunk.

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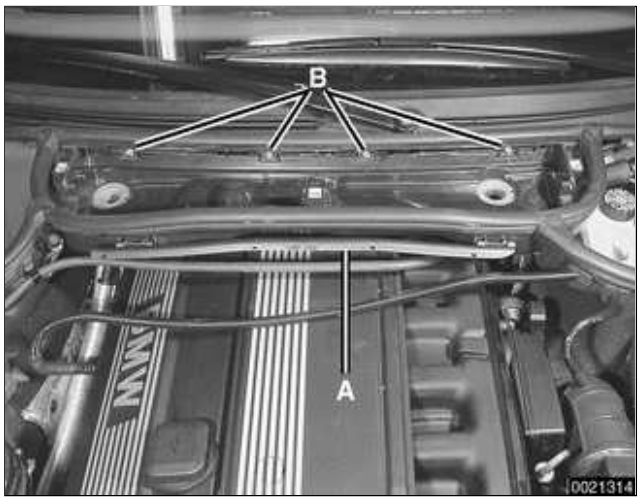
CAUTION!

- ***Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.***

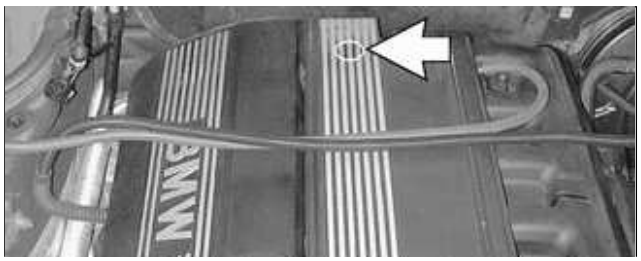
- ***Disconnecting the battery may erase fault code(s) stored in control module memory. Check for fault codes using special BMW diagnostic equipment.***



- Remove microfilter for interior ventilation.



- Remove housing for interior ventilation microfilter.
  - Open wiring harness loom cover (**A**) and remove wires.
  - Unfasten screws (**B**) and remove lower microfilter housing.

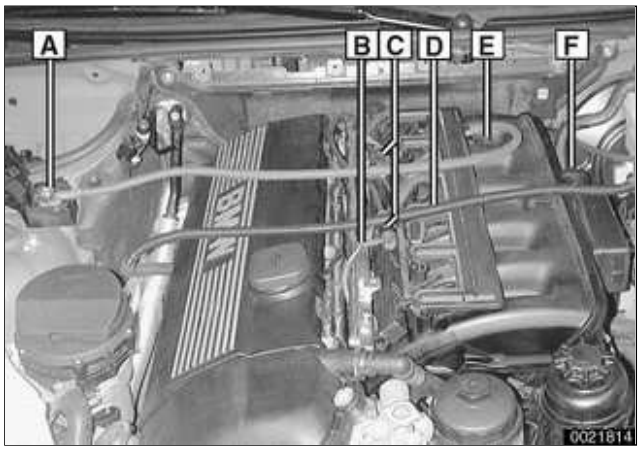


- Remove intake manifold cover:
  - Remove plastic trim covers (**arrows**).

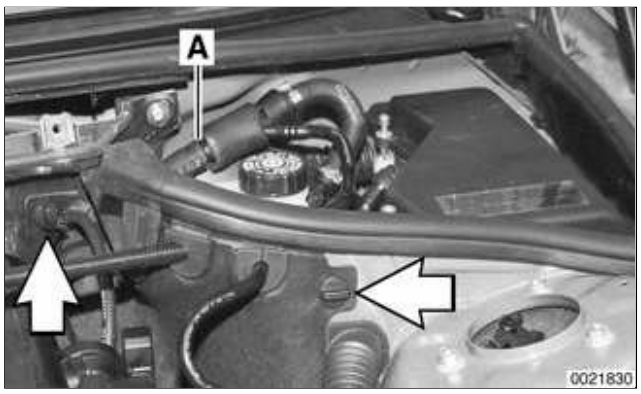
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- Remove cover hold down bolts from intake cover and lift off cover.

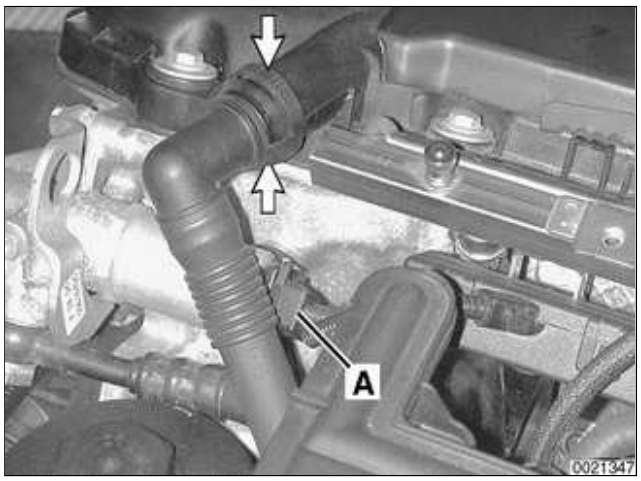


- Working above engine, disconnect the following:
  - **A** Positive engine lead at B+ terminal
  - **B** Manifold vacuum line
  - **C** Oxygen sensor connectors (label connectors before disconnecting)
  - **D** Electrical harness connector for intake air temperature sensor
  - **E** Positive lead hold-down bracket
  - **F** Intake manifold resonance valve electrical connector

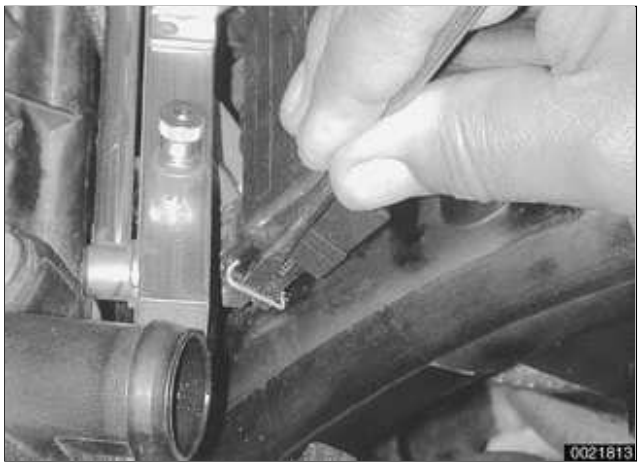


- Working at left rear of engine compartment:
  - Peel rubber edge seal off top of panel.
  - Separate brake booster vacuum hose at intake jet pump (**A**). Plug hose ends.
  - Twist plastic panel retainers (**arrows**) 90° and pull out to remove.
  - Disengage panel from hoses and wiring harnesses and remove from engine compartment.

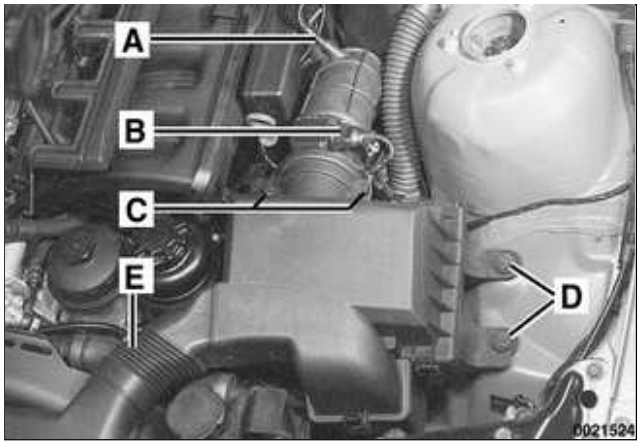
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- Disconnect engine vent hose from cylinder head cover by squeezing sides of spring clip (**arrows**). Disconnect VANOS solenoid electrical harness connector (**A**).



- Disconnect fuel injector electrical connectors from injectors:
  - Use small screwdriver to pry one corner of wire lock clip on fuel injector 1 connector.
  - Repeat for all injectors.
  - Lift off connector loom and lay aside.



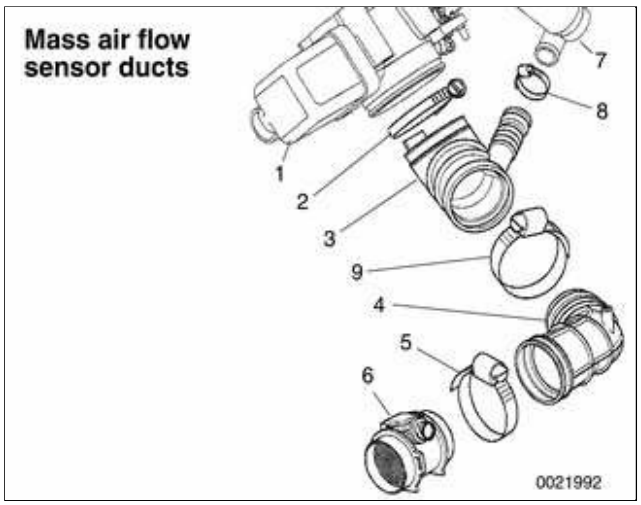
- Remove complete air filter housing:
  - Disconnect vacuum line at intake boot (**A**).
  - Disconnect electrical harness connector on mass air flow sensor (**B**).
  - Release mass air flow sensor clips (**C**).
  - Remove filter housing mounting screws (**D**).
  - Disconnect air duct connection (**E**) and lift complete air filter housing out of engine compartment,

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pulling it forward away from mass air flow sensor.

Note:

In this step, mass air flow sensor remains attached to rubber air duct.



- Loosen clamps **2** and **8** and remove mass air flow sensor and air duct.

1 - Throttle assembly

2 - Hose clamp 77 - 84 mm

3 - Y-duct

4 - Air duct

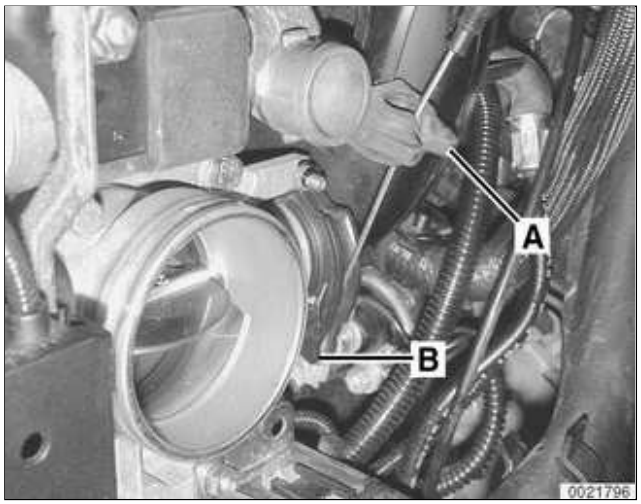
5 - Hose clamp 83 - 90 mm

6 - Mass air flow sensor

7 - Idle control valve

8 - Hose clamp 28 - 33 mm

9 - Hose clamp 77 - 84 mm



- Where applicable: Pull throttle cable upwards out of rubber retainer (**A**) and unhook ball end of cable (**B**) from throttle actuator.

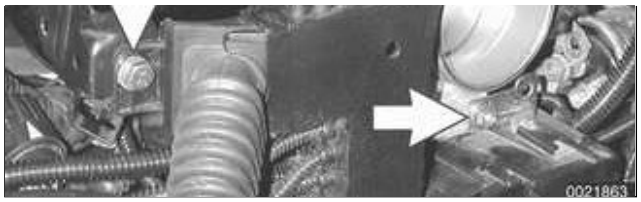
Note:

Models with M54 engines do not use a throttle cable.



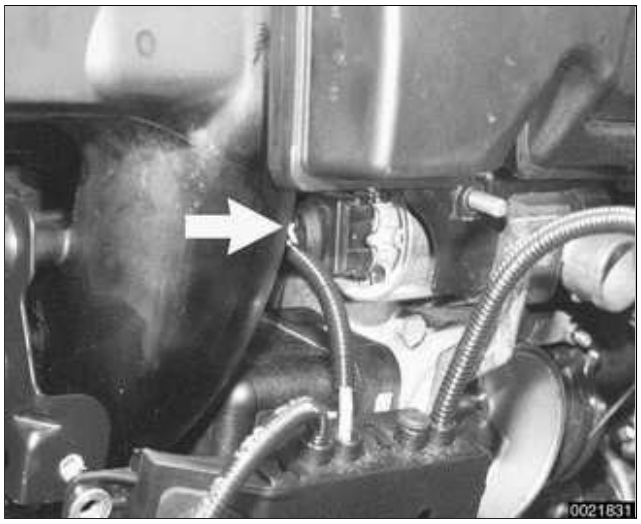
- Remove nuts and bolt (**arrows**) retaining wiring harness conduit to throttle body.

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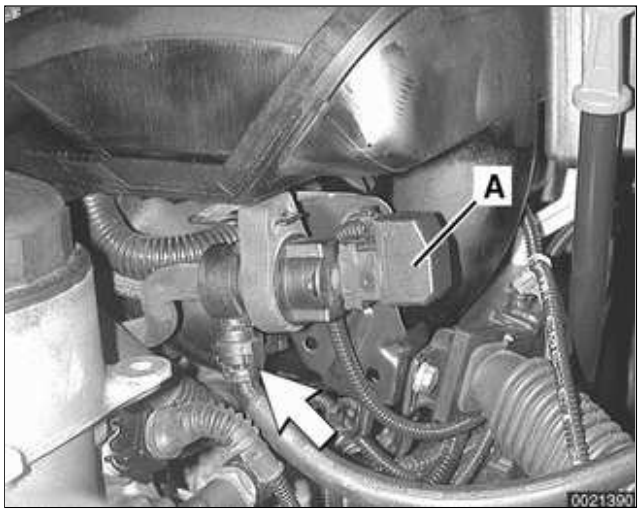




- Working at throttle housing:
  - Turn harness plug (**arrow**) counterclockwise and remove.

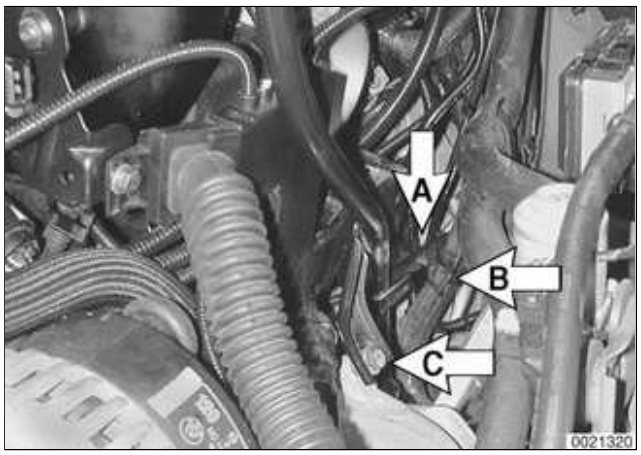


- Disconnect electrical harness connector at idle speed control valve (**arrow**) directly above throttle housing.

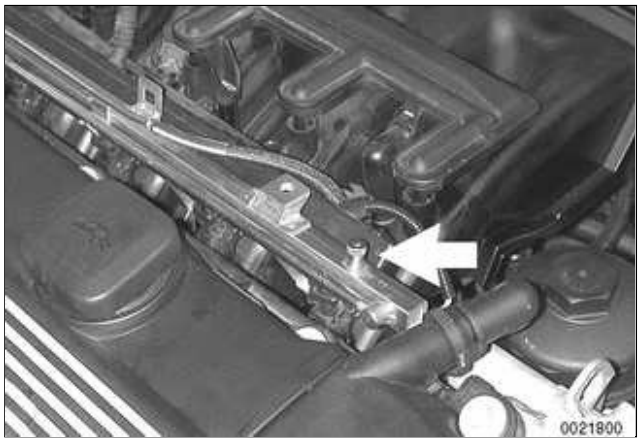


- Working under front corner of intake manifold, disconnect electrical harness connector at fuel tank venting valve (**A**). Disconnect vent hose at quick disconnect fitting (**arrow**).

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- Remove dipstick guide tube:
  - Disconnect wiring harness brackets from tube (**A**).
  - Disconnect fuel lines from retaining clips (**B**).
  - Remove lower dip stick guide tube mounting bolt (**C**). Pull out guide tube.



- Remove schræder valve cap (**arrow**). Using a tire chuck, blow fuel back through feed line using a brief burst of compressed air (maximum of 3 bar or 43.5 psi).

WARNING!

- ***Fuel in fuel line is under pressure (approx. 3 - 5 bar or 45 -75 psi) and may be expelled under pressure. Do not smoke or work near heaters or other fire hazards. Keep a fire extinguisher handy. Before disconnecting fuel hoses, wrap a cloth around fuel hoses to absorb any leaking fuel. Catch and dispose of escaped fuel. Plug all open fuel lines.***
- ***Always unscrew fuel tank cap to release pressure in the tank before working on the tank or lines.***

- Raise car and support in a safe manner.

WARNING!

Make sure the car is stable and well supported at all times. Use a

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professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

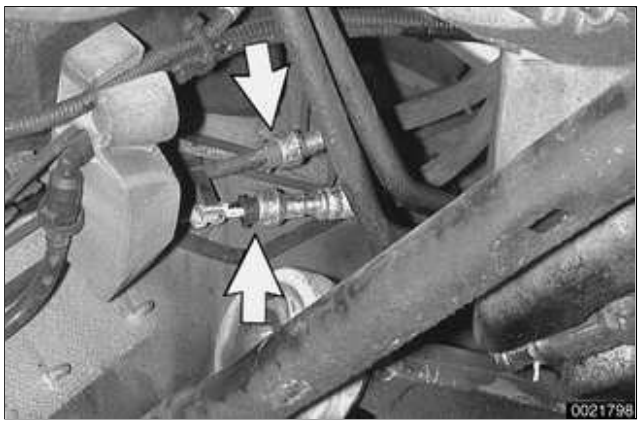
- Remove protective engine splash guard from beneath engine compartment.



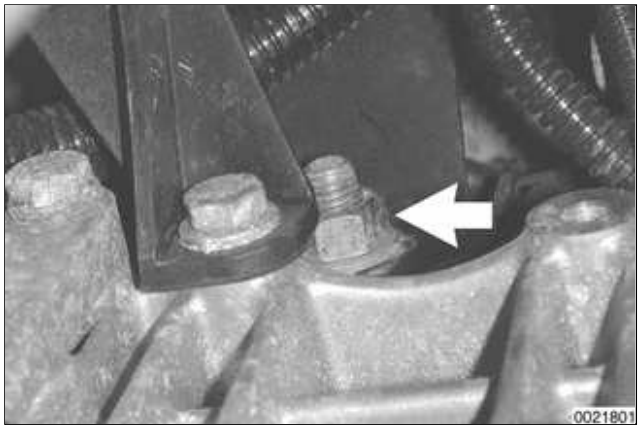
- Working beneath car (on left side under driver seat), remove fuel filter cover and clamp off fuel hose(s) (**arrows**).

Note:

M54 engines equipped with a non-return fuel rail use only a single supply line.



- Disconnect fuel hose(s) from fuel line(s) (**arrows**) using special fuel line removal tool 16 1 050 or equivalent. Plug open fuel line(s) with BMW special tools 13 5 281/13 5 282.



- Working underneath car, remove lower intake manifold support mounting bolt (**arrow**), located adjacent to left (driver's side) engine mount.



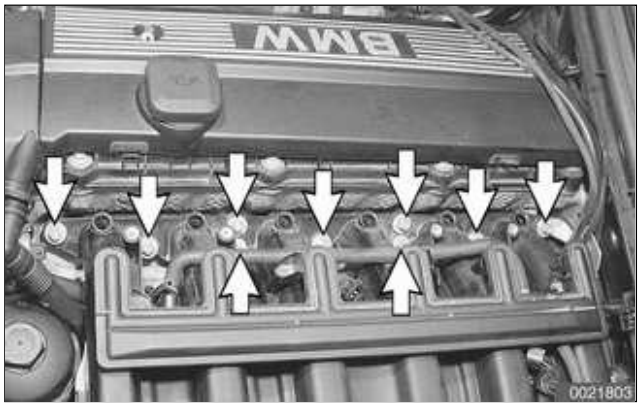
- Remove fuel rail mounting bolts (**arrows**).

  - Carefully pry fuel rail off manifold.

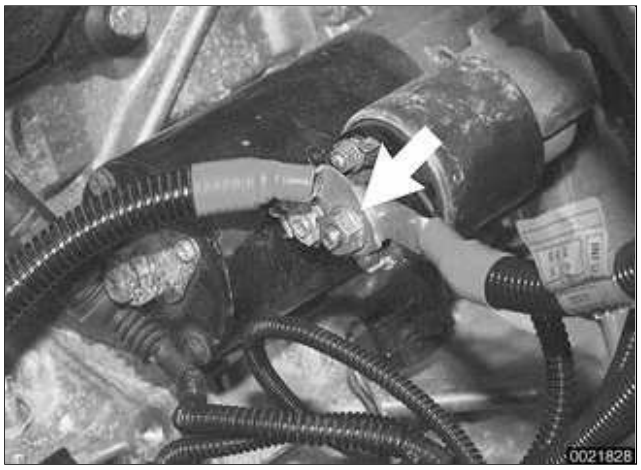
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- Separate fuel line support bracket at rear of intake manifold.
- Thread fuel line(s) out of rear of engine compartment while lifting fuel rail out.



- Remove intake manifold mounting nuts (**arrows**).



- Lift up manifold enough to disconnect positive cables from starter motor terminal (**arrow**).
- Remove intake manifold from cylinder head while carefully checking for any remaining electrical connections or hoses.

CAUTION!

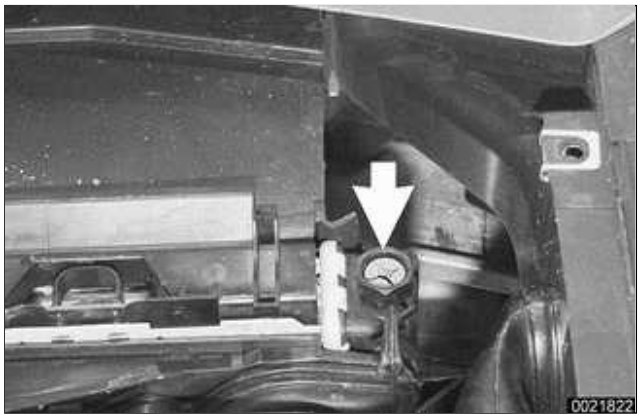
Stuff clean lint free rags into open intake ports to prevent any foreign matter from falling into the ports.



- Drain engine coolant from engine block:
- Remove expansion tank cap on radiator.
- Place 3-gallon pail beneath engine to capture coolant.
- Remove coolant drain plug located on exhaust side of cylinder

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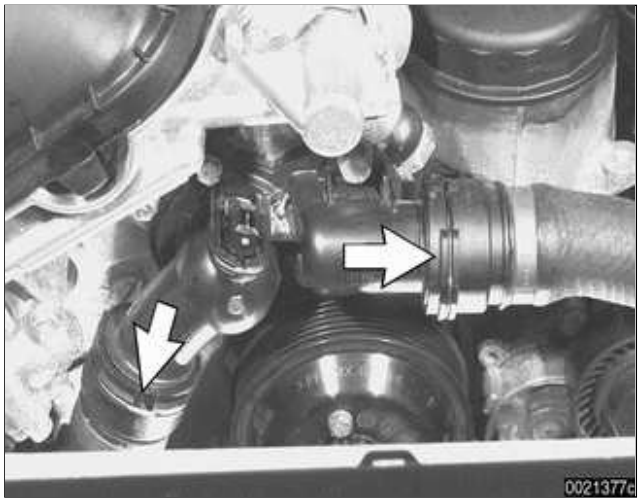
2 of engine block (**arrow**).



- Drain radiator into a 3-gallon pail by removing plastic drain plug at lower left end of radiator (**arrow**).

WARNING!

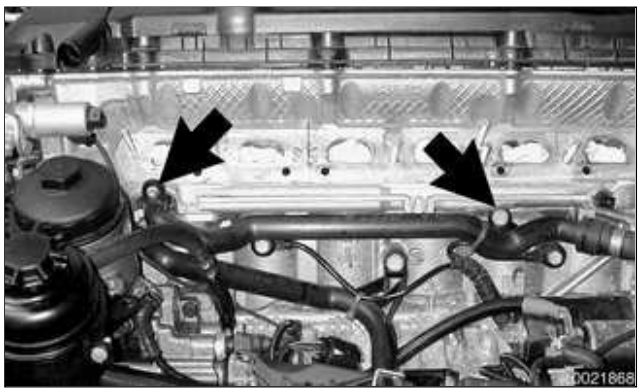
Use caution when draining and disposing of engine coolant. Coolant is poisonous and lethal to humans and pets. Pets are attracted to coolant because of its sweet smell and taste. Consult a veterinarian if coolant is ingested by an animal. Dispose of drained coolant according to local, state, and federal laws.



- Remove hoses from thermostat housing by releasing locks (**arrows**).
  - Disconnect electrical harness at thermostat housing.
  - Remove radiator cooling fan and shroud as described in ⇒ 170 Radiator and Cooling System

CAUTION!

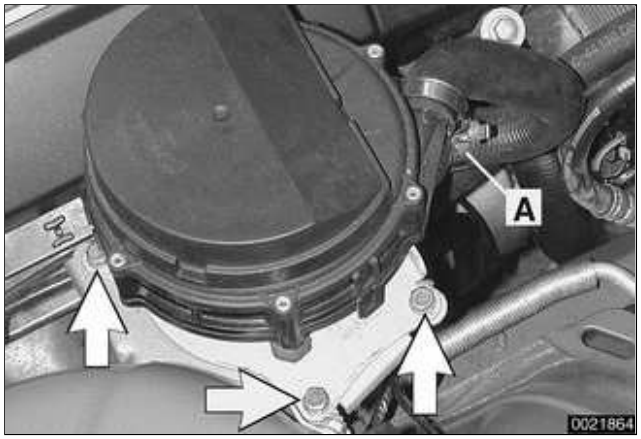
On cars with viscous clutch cooling fan, radiator fan mounting nut (32 mm) has left-hand threads.



- Remove fasteners (**arrows**) from heater bypass tube and set tube to side leaving heater hose connected.
  - Unbolt power steering fluid reservoir and pull aside without disconnecting hoses. Tie to fender with cord or stiff wire.
  - Remove windshield and headlight washer reservoir:

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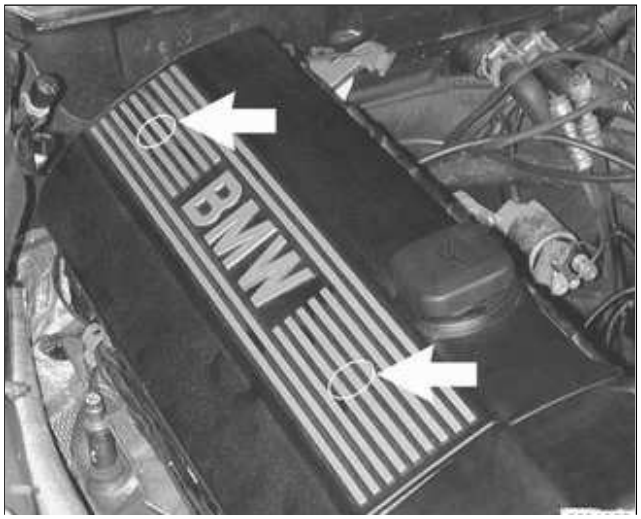
- Remove bolt on top of reservoir.
- Lift tank and disconnect electrical connections to pump and to washer fluid level sensor.
- Disconnect hoses to windshield washer and headlight washer. Tilt reservoir to prevent fluid from leaking out.



➢ Remove secondary air pump:

- Disconnect hose at one-way valve (**A**).
- Remove bolts at support bracket on strut tower (**arrows**).
- Lift up pump and disconnect electrical harness from bottom of pump. Remove pump.
- Unbolt and remove pump bracket from strut tower.

Cylinder head cover, removing

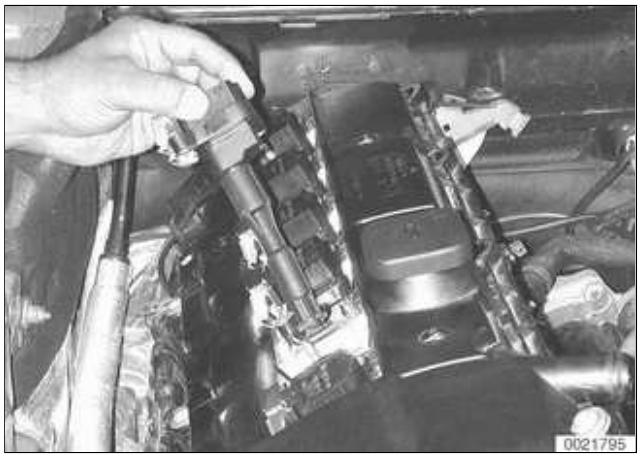


➢ Remove cylinder head top cover:

- Remove plastic trim covers (**arrows**).
- Remove cover hold down nuts and lift off cover.

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➢ Remove ignition coils.

- ♦ Disconnect ignition coil harness connectors.
- ♦ Remove coil mounting fasteners.
- ♦ Remove coils.
- ♦ Remove ground straps.
- ♦ Set coil harness to left side of engine compartment.

- Remove cylinder head cover mounting fasteners and remove cylinder head cover.

Note:

The cylinder head cover mounting bolt insulators and gaskets should be reinstalled in their original locations. The three grounds mount to the first, second and fourth central studs. Make note of their arrangement during removal.

- Remove spark plugs.

CAUTION!

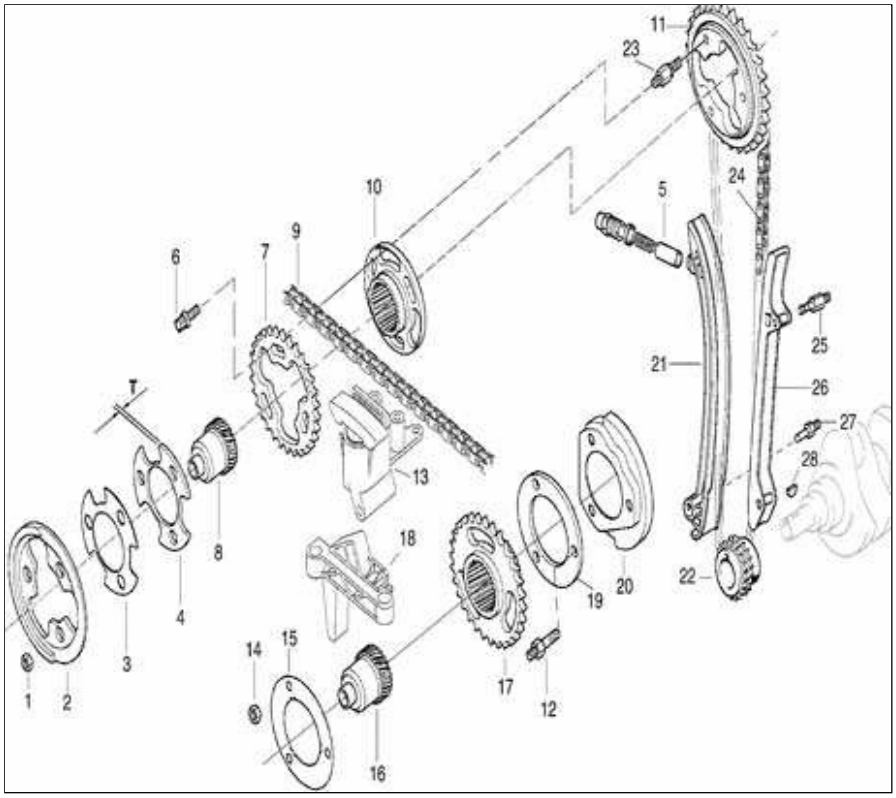
Stuff clean lint free rags into open intake ports to prevent any foreign matter from falling into the ports.



➢ Remove oil baffle cover from above intake camshaft.

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Double VANOS components (M52 TU, M54 engine)

1 - Impulse wheel mounting nut

2 - Exhaust camshaft impulse wheel

3 - Spring plate

4 - Thrust spacer (T = 3.5 mm)

5 - Splined shaft

6 - Torx screw

7 - Exhaust secondary sprocket

8 - Secondary timing chain

9 - Splined sleeve

10 - Primary sprocket

11 - Threaded locating stud

12 - Secondary chain tensioner

13 - Secondary chain lower guide

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14 - **Sprocket mounting nut**

15 - **Spring plate**

16 - **Splined shaft**

17 - **Intake camshaft sprocket**

18 - **Locating stud**

19 - **Thrust spacer**

20 - **Intake camshaft impulse wheel**

21 - **Chain tensioner rail**

22 - **Crankshaft sprocket**

23 - **Primary chain tensioner**

24 - **Primary chain**

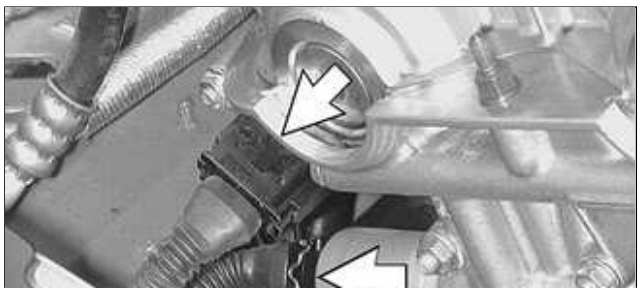
25 - **Locating stud**

26 - **Guide rail**

27 - **Locating stud**

28 - **Woodruff key**

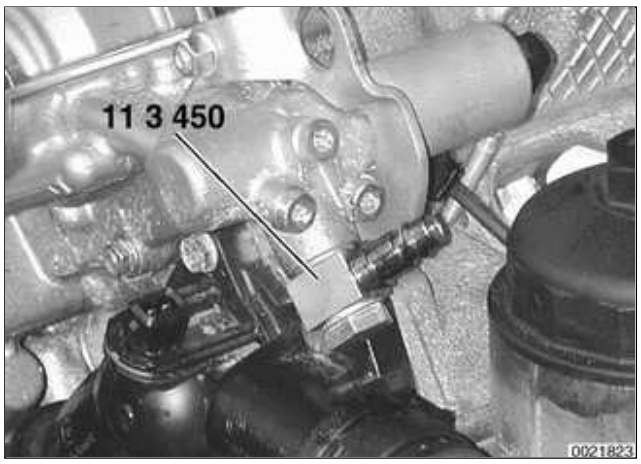
VANOS control unit, removing



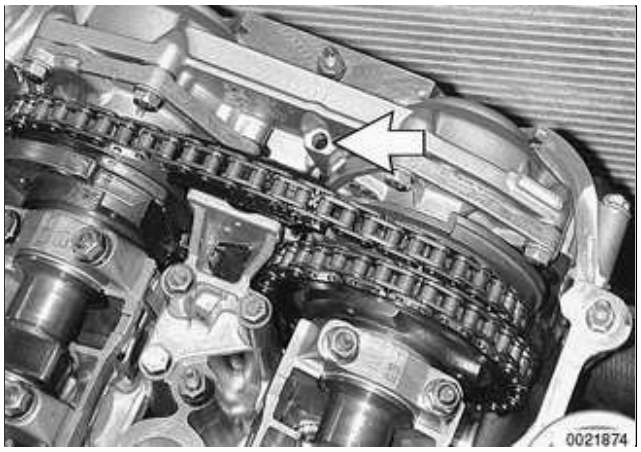
- Disconnect electrical connections at exhaust camshaft position sensor and exhaust camshaft VANOS control valve (**arrows**).

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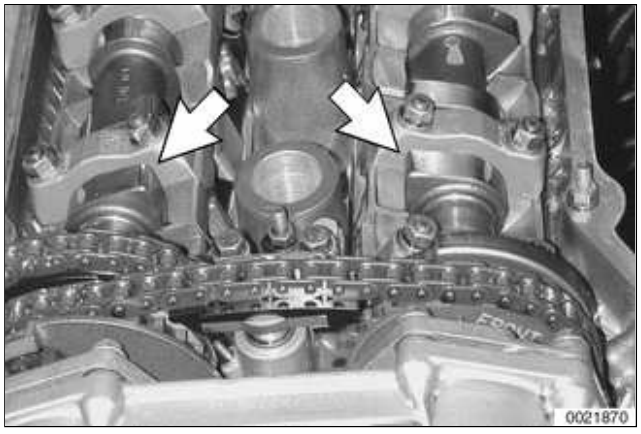


- Remove banjo bolt from VANOS unit oil pressure line. Use banjo bolt to attach BMW special tool 11 3 450 (compressed air fitting) to VANOS control unit.



- Cover oil hole (**arrow**) in VANOS unit with shop towel to capture oil which will spray when compressed air is applied.

  - Connect compressed air line to air fitting. Apply air pressure set to 2 - 8 bar (30 - 110 psi).



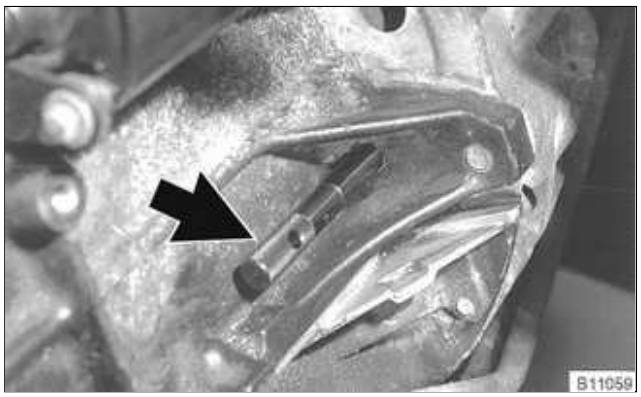
- With compressed air line connected, rotate engine in direction of rotation (clockwise) until cylinder 1 intake and exhaust camshaft lobes face each other (**arrows**) in the top dead center (TDC) position for cylinder 1.

  - Rotate engine at least twice, leaving the cylinder 1 intake and exhaust camshaft lobes facing each other, as shown.

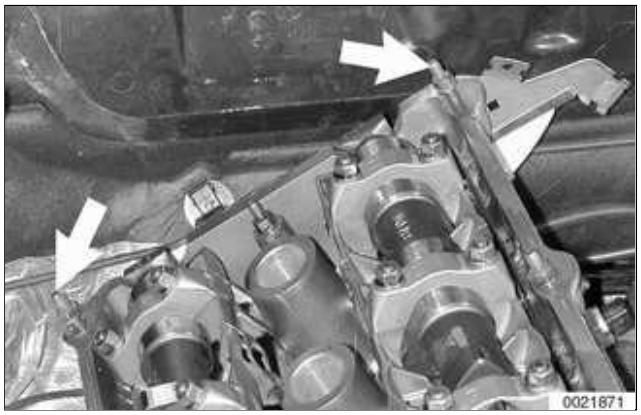
CAUTION!

Do not rotate engine counterclockwise to reach the top dead center position. Instead, complete another two complete rotations.

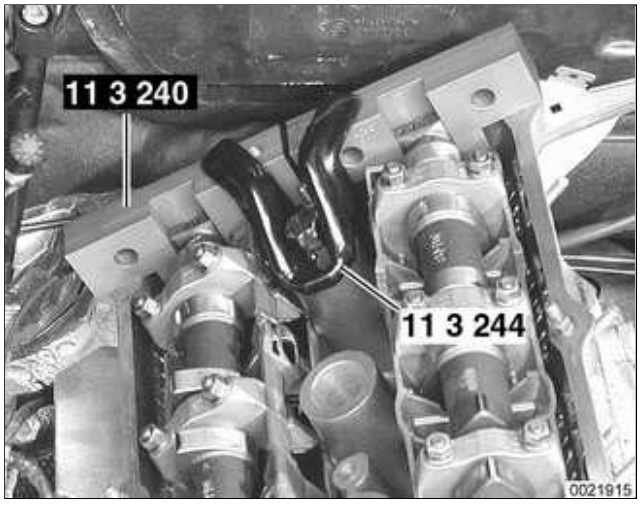
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- Remove sealing plug from special tool bore on lower left side of engine block near flywheel. Secure crankshaft in TDC position with BMW special tool 11 2 300 (**arrow**).



- Unscrew and remove two cylinder head cover studs (**arrows**) at rear of cylinder head.

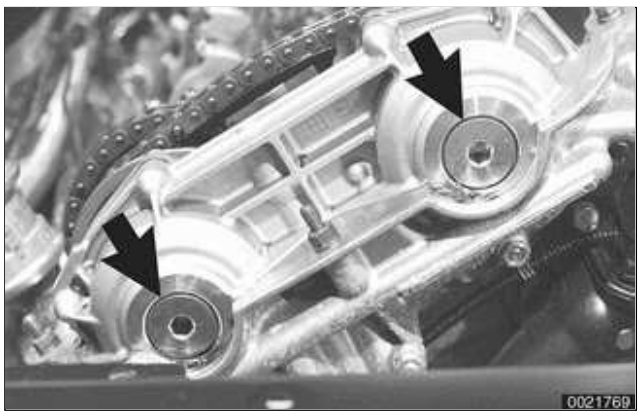


- Secure camshafts in TDC position using BMW special tools 11 3 240 and 11 3 244.

  - Disconnect compressed air line, leaving compressed air fitting attached to VANOS unit.

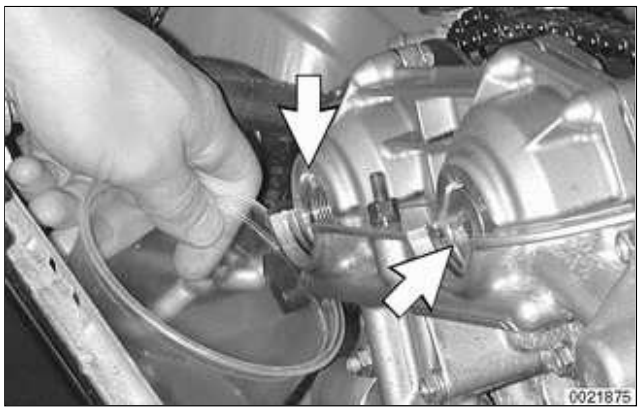
CAUTION!

Oil will drain from pressure line. Have a drain container and rags ready. Do not allow oil to run onto drive belts.

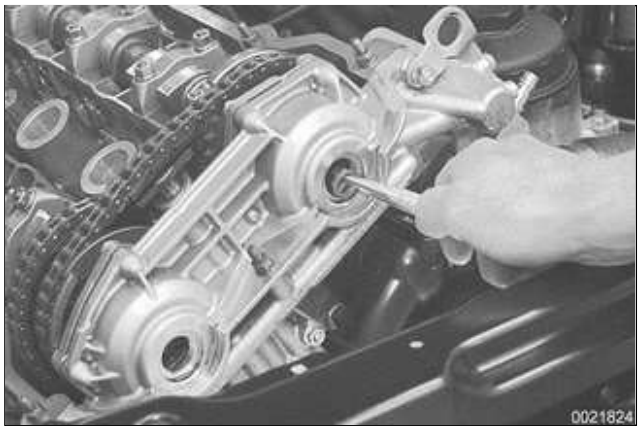


- Unscrew sealing plugs (**arrows**) from VANOS unit.

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- Oil will drain from plugs (**arrows**) when removed. Have a container and rags ready. Do not allow oil to run onto drive belts.



- Pull sealing caps straight out of VANOS unit with BMW special tool 11 6 170, or with short nose pliers.

Note:

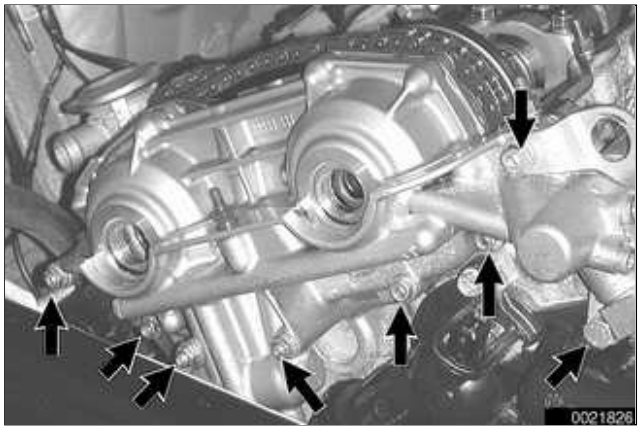
Additional oil may drain from VANOS unit.



- Remove set screws (left-hand thread) on ends of intake and exhaust camshafts.

CAUTION!

Set screws have left hand threads. Remove in clockwise motion.



- Remove VANOS unit:

  - Remove engine support eye fasteners from side of VANOS unit.
  - Remove VANOS mounting nuts (**arrows**) from cylinder head and pull VANOS unit and metal gasket off.

CAUTION!

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Do not crank the engine with VANOS unit removed. The splined shaft on the intake camshaft might slip out of the VANOS spline teeth, causing the intake cam to no longer be positively connected to the timing chain, allowing for possible piston/valve interference.

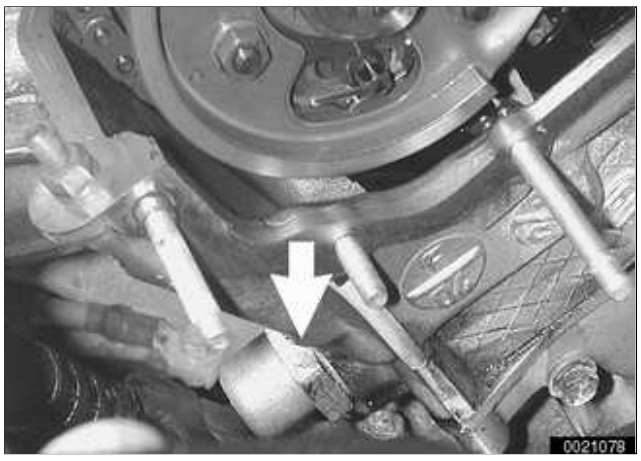
Note:

The VANOS unit will contain a small quantity of oil. Place shop towels to catch oil as unit is removed or tilted.

CAUTION!

If the VANOS adjustment unit is replaced, or if operations are completed that may change the timing of the camshafts, the camshaft timing must be checked as described later in this chapter.

Camshafts and valvetrain, removing



- Remove primary camshaft chain tensioner cylinder (**arrow**).

CAUTION!

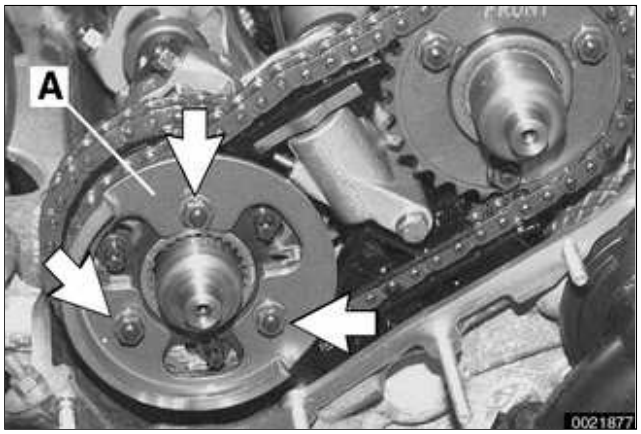
Primary camshaft chain tensioning piston is under spring pressure.



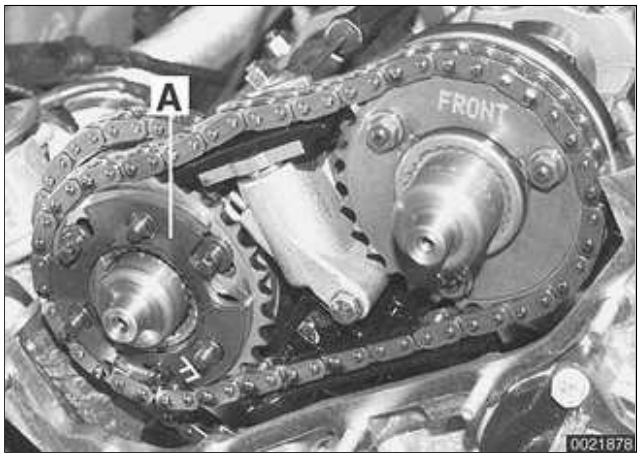
- Press down on secondary chain tensioner and lock into place using BMW special tool 11 3 292 or a similar size pin.

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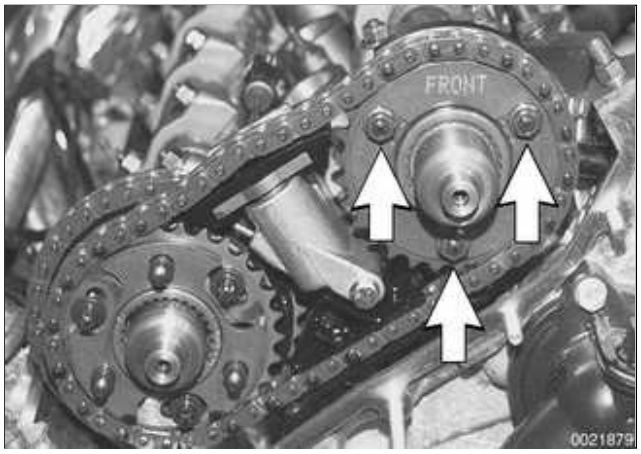




- Remove exhaust camshaft impulse wheel mounting nuts (**arrows**). Remove impulse wheel (**A**).



- Remove spring plate (**A**).

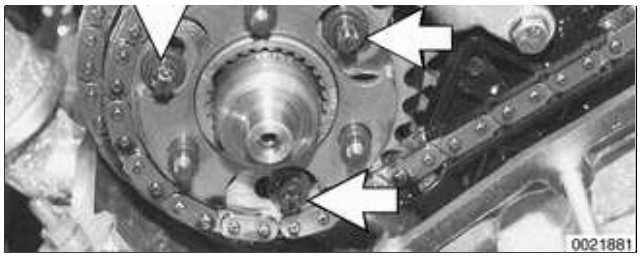


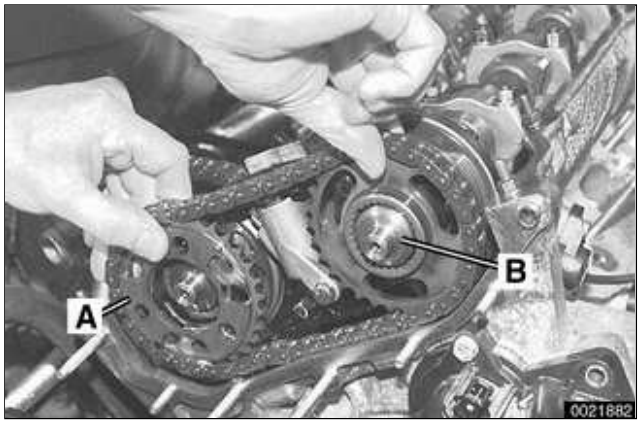
- Remove intake camshaft sprocket mounting nuts (**arrows**) and remove spring plate (labelled **FRONT**).



- Remove torx screws from exhaust camshaft sprocket (**arrows**).

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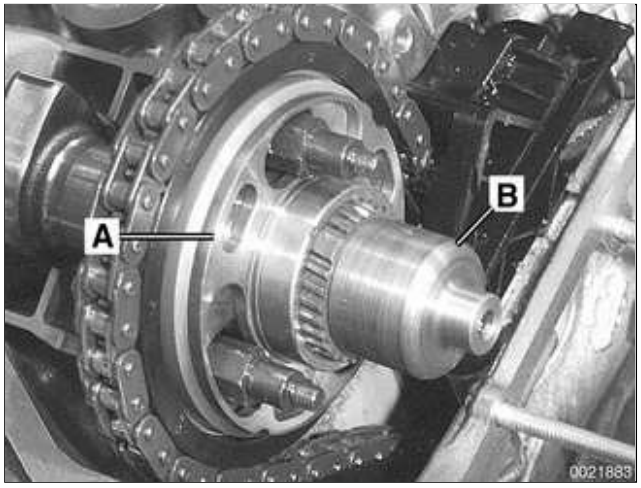




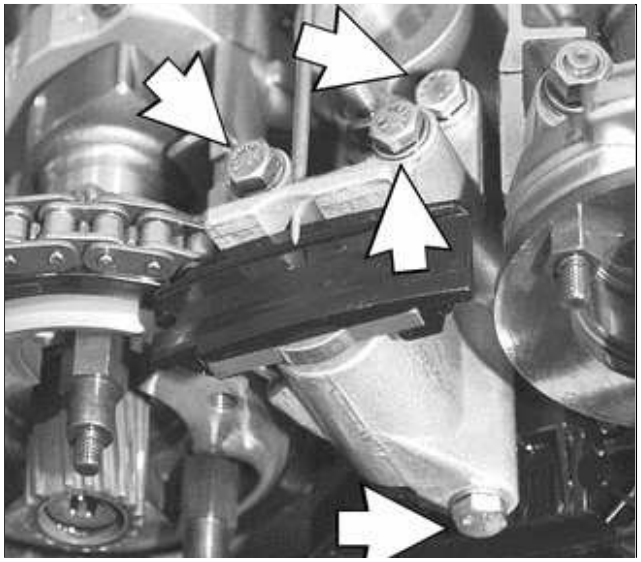
- Lift off exhaust and intake sprockets together with secondary chain, thrust spacer (**A**) from exhaust camshaft, and splined shaft (**B**) from intake camshaft.

CAUTION!

Splined shafts share the same part number for both intake and exhaust camshafts. Remove and mark used splined shafts in order and reinstall in original locations.



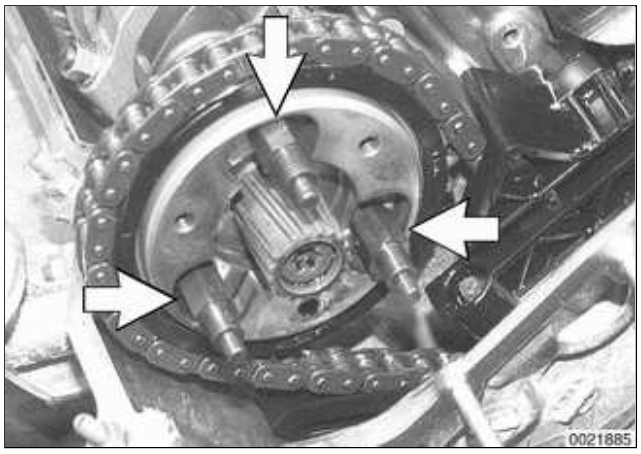
- Remove exhaust camshaft splined sleeve (**A**) and shaft (**B**).



- Remove secondary chain tensioner mounting bolts (**arrows**). Remove tensioner from between camshafts while keeping retaining pin in place.

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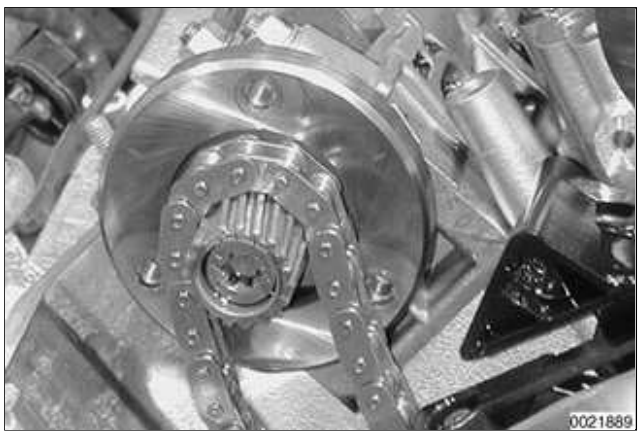




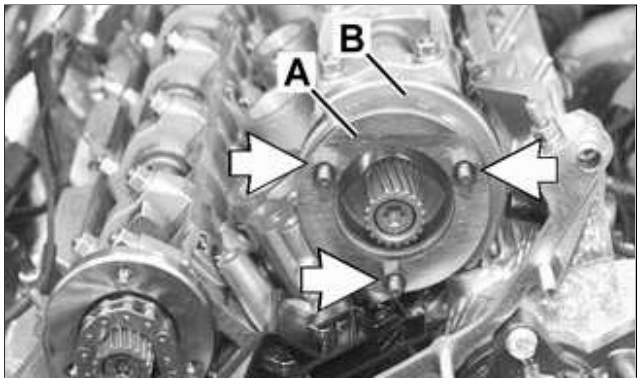
- Remove primary chain sprocket mounting studs (**arrows**) on exhaust camshaft.



- Lift primary chain sprocket off exhaust camshaft. Remove sprocket from chain.



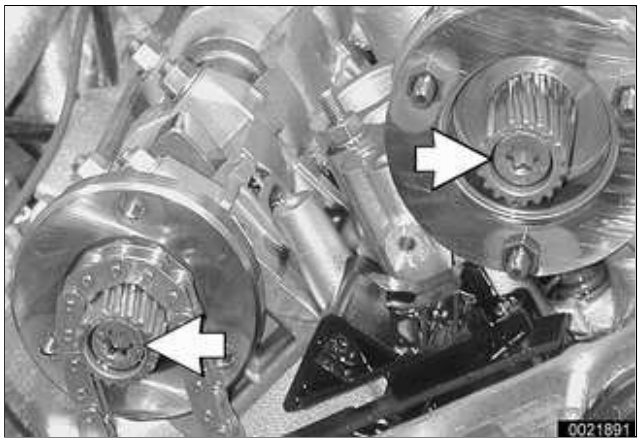
- Place timing chain on end of exhaust camshaft.



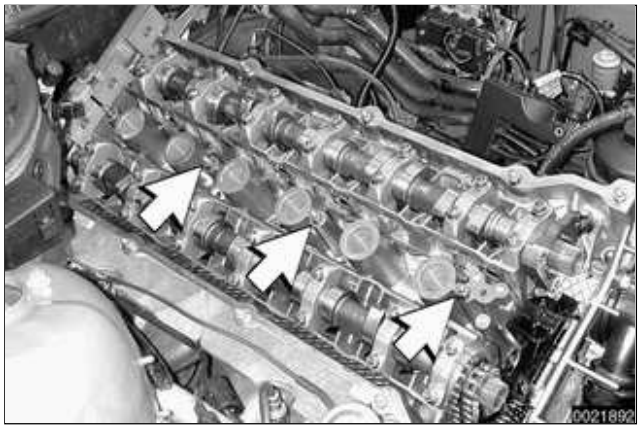
- Remove locating studs (**arrows**) from intake camshaft. Lift off intake camshaft thrust spacer (**A**) and impulse wheel (**B**).

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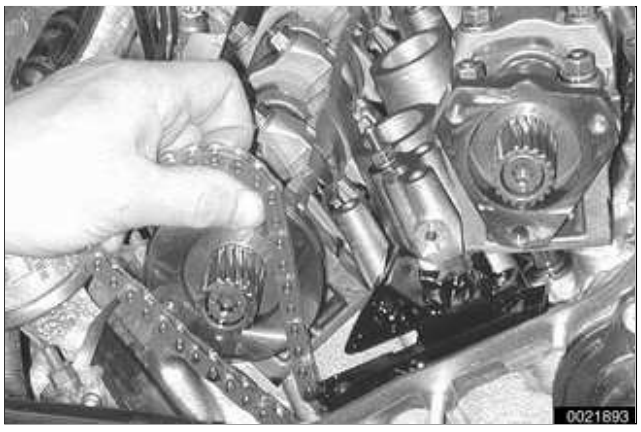


- Do not remove end spline retaining screws from camshafts (**arrows**).



- Remove cylinder head cover mounting studs (**arrows**) from center of cylinder head.

  - Remove flywheel locking tool from transmission bellhousing so that crankshaft is no longer secured.



- Lift primary chain and hold under tension, then rotate engine against direction of rotation (counterclockwise) approximately 30°.

  CAUTION!

  To prevent damaging valves while working on camshafts, no pistons should be in the TDC position.

  - Remove BMW special tools 11 3 240 and 11 3 244 from rear of cylinder head.



- Remove retaining nuts (**arrows**) and bearing cap 1 of intake camshaft.

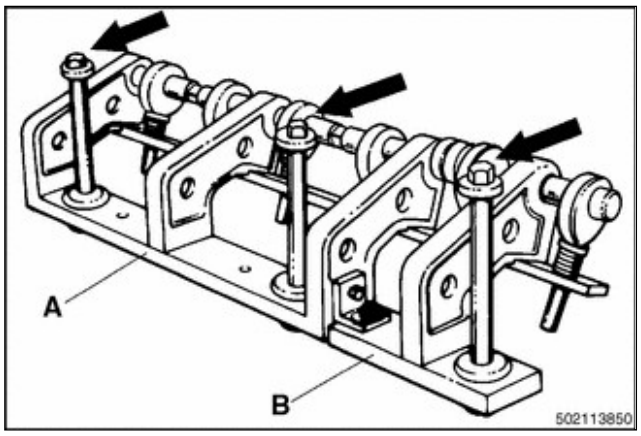
  CAUTION!

  Intake camshaft bearing cap 1 is

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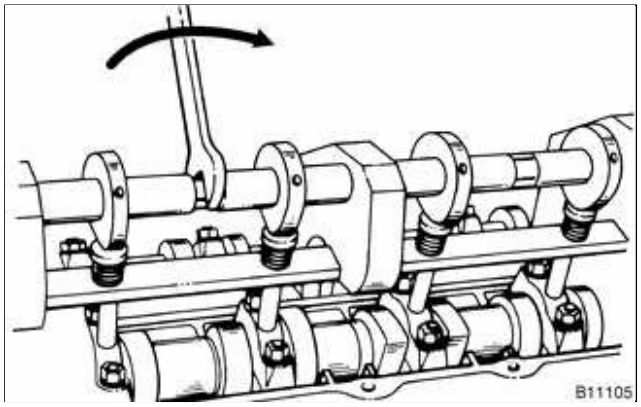
centered with adapter sleeves. To avoid camshaft damage, it must be removed before any other caps.



- Fit BMW special tools 11 3 260 (**A**) and 11 3 270 (**B**) to cylinder head and screw long bolts (**arrows**) into spark plug threads. Tensioners will align with the bearing caps on the intake camshaft.

CAUTION!

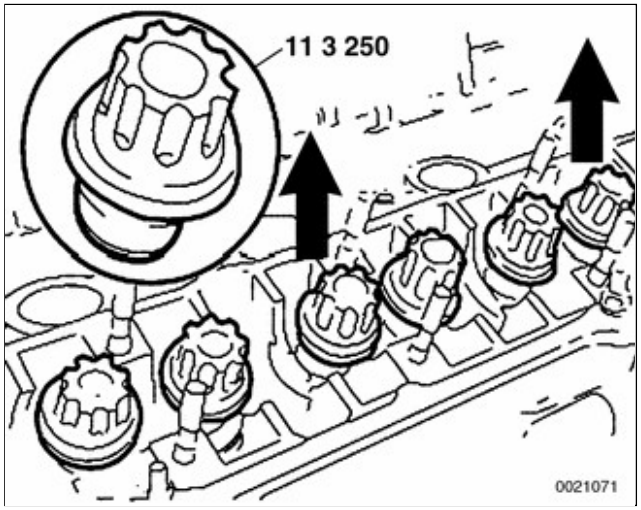
Do not over torque bolts into spark plug holes.



- Turn eccentric shaft of special tool to pretension intake camshaft bearing caps. Remove nuts on remaining bearing caps.

  - Release tension on eccentric shaft and remove BMW special tools 11 3 260 and 11 3 270. Remove bearing caps and set aside in order. Remove camshaft and store safely.

  - Repeat procedure for exhaust camshaft.



- Secure hydraulic lifters in lifter bores using BMW special tool 11 3 250, or remove lifters using a magnetic pick-up tool. With lifters secure or removed, lift out camshaft bearing carriers from cylinder head.

CAUTION!

- ***Do not let the hydraulic lifters fall out as the camshaft carrier is removed.***

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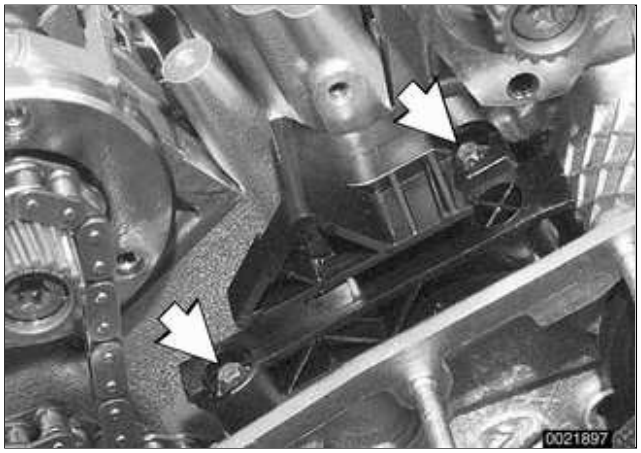
- ***Hydraulic lifters should be stored in an upright position.***
- ***Used hydraulic lifters must be replaced into original lifter bores.***

Cylinder head assembly, removing

- Remove exhaust manifolds. See 180 Exhaust System.



➢ Remove intake camshaft position sensor (**arrow**) from side of cylinder head.



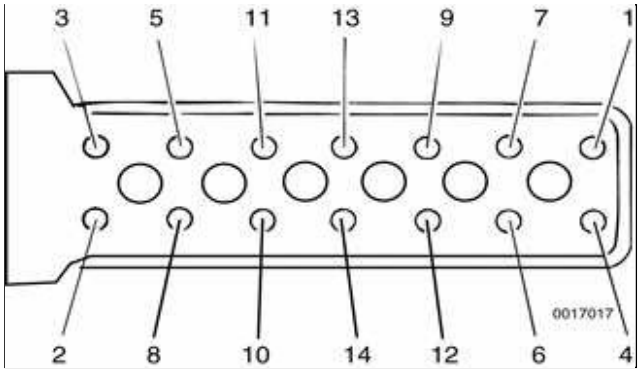
➢ Remove secondary chain lower guide bolts (**arrows**). Remove chain guide. The bolt on the intake camshaft side is a long bolt that extends into the lower timing chain cover.



➢ Remove screws (**arrows**) holding lower timing chain cover to cylinder head. (Photo shows camshafts in place).

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- Using BMW special tool 11 2 250 or equivalent, loosen cylinder head bolts in several stages in sequence shown. Discard head bolts.

Note:

BMW special tool 11 2 250 is a thin-walled Torx E12 socket with an extended reach. The cylinder head bolts are recessed into the head below the camshaft towers with little working space.

- Lift off cylinder head. Refer to ⇒ 116 Cylinder Head and Valvetrain to evaluate the head.

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Cylinder Head Installation

Clean cylinder head and gasket surfaces of cylinder block and all timing chain covers.

Remove foreign matter and liquid from bolt holes.

CAUTION!

Do not use a metal scraper or wire brush to clean the aluminum cylinder head or pistons. If necessary, use a hard wooden or plastic scraper. Also available are abrasive discs to be used in conjunction with an electric drill. Be sure to use the correct disc for the type of metal being cleaned.

Evaluate cylinder head as shown in ⇒ 116 Cylinder Head and Valvetrain.

Note:

- *If the cylinder head has been machined, a special 0.3 mm (0.011 in.) thicker gasket should be installed. The thicker gasket is available from an authorized BMW dealer.*

- *Cylinder head and valve specifications are covered in ⇒ 116 Cylinder Head and Valvetrain.*

Lubricate camshafts, camshaft carriers, bearing caps, hydraulic lifters, friction washers, splined shafts and spline hubs with assembly lubricant before installation.

To assist the technician in cylinder head installation, the procedure has been organized as separate

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operations. Please be advised that these individual jobs must be accomplished in the order in which they appear.

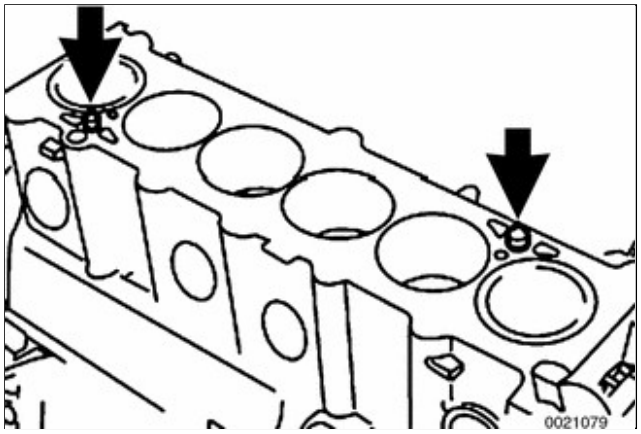
⇒ Cylinder head assembly, installing

⇒ Camshafts and valvetrain, installing

⇒ VANOS control unit, installing

⇒ Cylinder head cover, manifolds, cooling system, installing

Cylinder head assembly, installing



- Check that two cylinder head locating aligning sleeves (**arrows**) are correctly positioned in block and are not damaged.

  - Apply permanently elastic sealing compound 3 Bond® 1209 to joints with timing belt cover.

  - Place new cylinder head gasket on cylinder block.

Note:

The word OBEN, printed on the gasket, should face up. The cylinder head gasket will fit correctly in only one orientation.

  - Set cylinder head in position, guiding primary chain through cylinder head opening.

CAUTION!

Make sure the crankshaft, which had been rotated approximately 30° opposite the direction of engine rotation from TDC, is still in that

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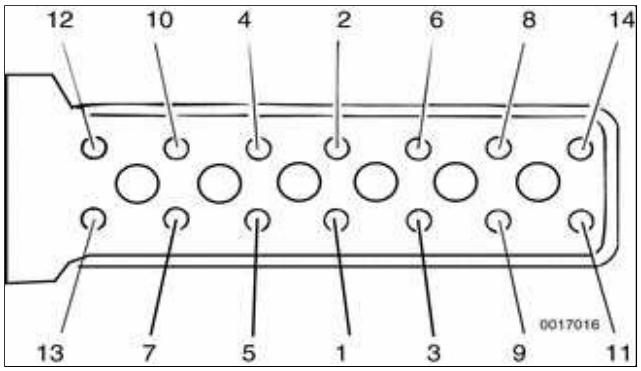
position before lowering the cylinder head into position. All pistons must be out of TDC position to prevent valve/piston interference when the camshafts are installed.

- Lightly lubricate new cylinder head bolts. Install bolts and washers finger tight. Install cylinder head-to-lower timing chain cover bolts finger tight.

Note:

- *Cylinder head bolts should not be reused. They are stretch-type bolts and must always be replaced whenever loosened.*

- *Check that all washers for the head bolts are in place before installing the bolts. Some of the washers may be staked to the cylinder head.*



Tighten cylinder head bolts in correct sequence (1-14).

CAUTION!

The bolts should be tightened in three stages as listed below. The final stages require the use of a BMW special tool 11 2 110 or a suitable protractor to tighten the bolts to a specified torque angle.

- Secure cylinder head bolts by torquing an additional 90° each for Stage 2 and 3.

Tightening torques	
Cylinder head to engine block (Torx E12 M10 bolts)	
Stage 1	40 Nm (30 ft-lb)

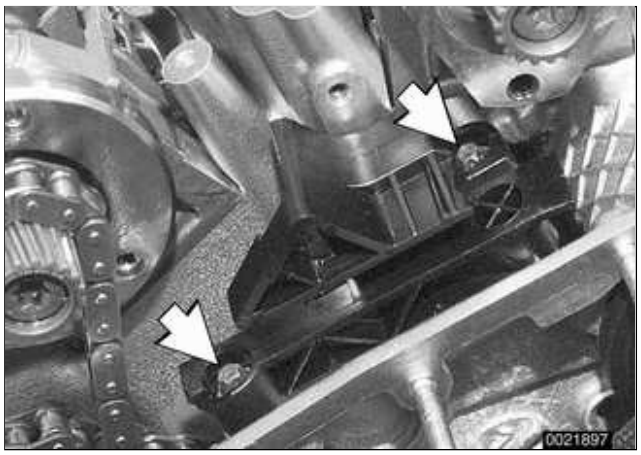
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Tightening torques	
Stage 2	+90°
Stage 3	+90°



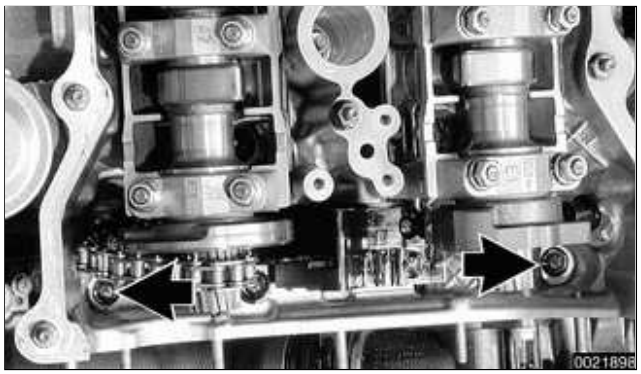
- Install intake camshaft position sensor (**arrow**).

  - Install exhaust manifolds. See 180 Exhaust System.



- Install lower secondary chain guide. Tighten Torx bolts (**arrows**) to specifications. The bolt on the intake camshaft side is long and extends into the engine block.

Tightening torque	
Secondary chain guide to cylinder head	10 Nm (89 in-lb)



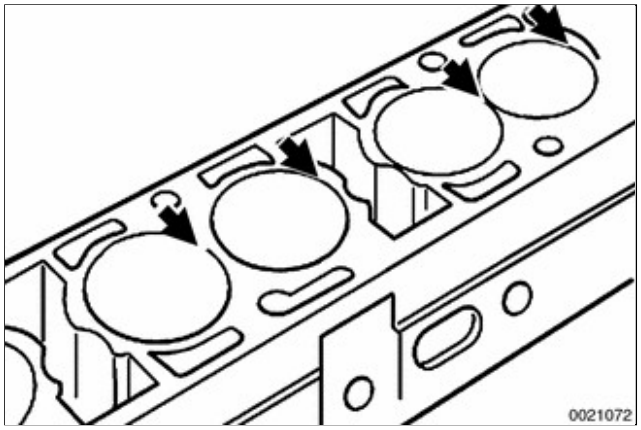
- Install and tighten cylinder head-to-lower timing chain cover bolts (**arrows**). (Photo shows camshafts in place)

Camshafts and valvetrain, installing

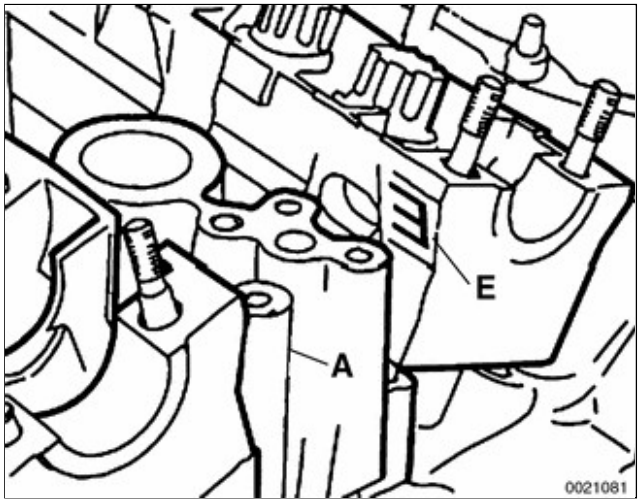
CAUTION!

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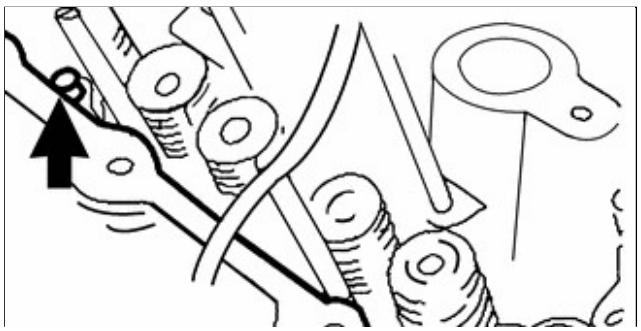
A minimum waiting time is required for the hydraulic lifters to "bleed down" after installing the camshafts into the cylinder head, but before synchronizing the crankshaft and valve train timing. When the camshafts are removed, the hydraulic lifters can expand. This expansion can cause increased valve lift when the camshafts are bolted down, possibly resulting in piston interference.



- Before installing camshaft carriers, examine bearing points (**arrows**) on hydraulic lifter bores for signs of wear.



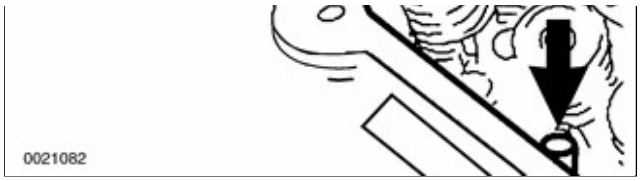
- Install camshaft carriers with hydraulic lifters into cylinder head. Note marks on carriers: (**E**) for intake side and (**A**) for exhaust side.

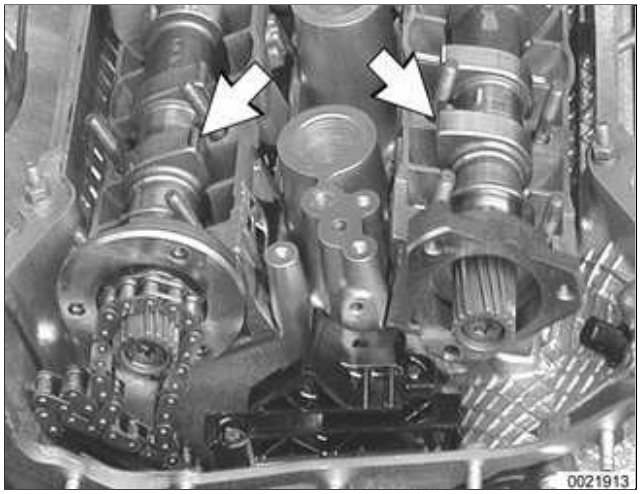


- Center camshaft carrier on pins (**arrows**) at bearing positions 2 and 7.

  - Lift timing chain and place exhaust camshaft onto exhaust camshaft carrier. Place intake camshaft on intake camshaft carrier.

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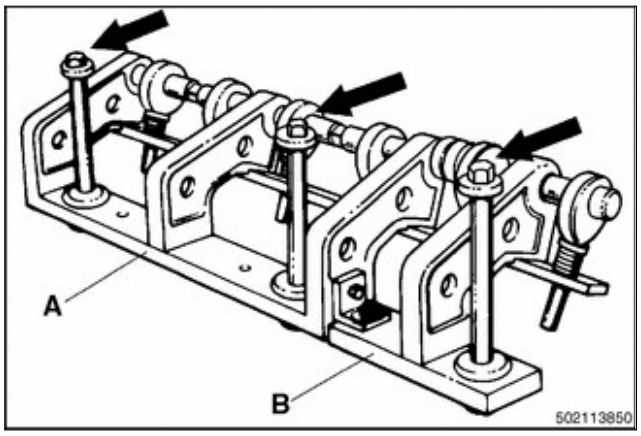


- Rotate camshafts so that intake and exhaust lobes for cylinder 1 face each other (**arrows**).

CAUTION!

Be sure that crankshaft is still positioned at least 30° back from TDC.

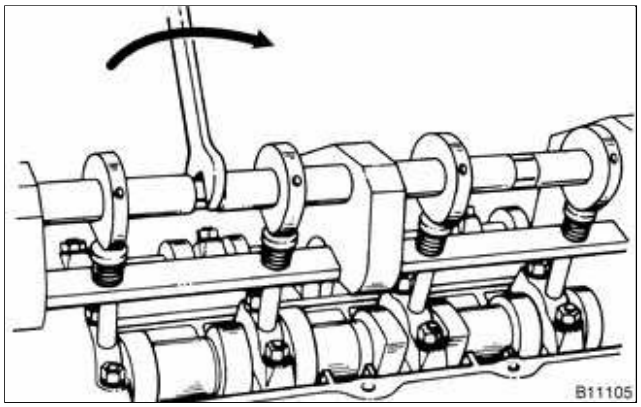
  - Place bearing caps on cams, but do not install retaining nuts.



- Fit BMW special tools 11 3 260 (**A**) and 11 3 270 (**B**) to cylinder head over intake camshaft and screw long bolts (**arrows**) into spark plug threads.

CAUTION!

Do not overtighten bolts into spark plug holes.



- Turn eccentric shaft of special tool to pretension bearing caps. Install and torque nuts on intake camshaft bearing caps.

Tightening torque	
Camshaft bearing cap to cylinder head (M7)	14 Nm (10 ft-lb)

  - Release tension on eccentric shaft and remove BMW special tool 11 3 260/270.

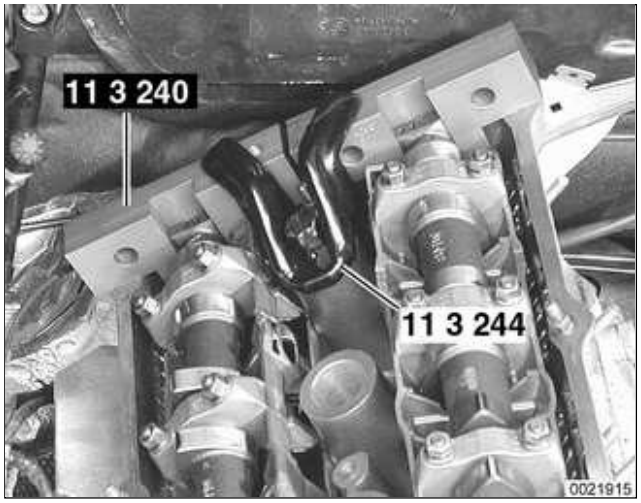
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- Repeat procedure for exhaust camshaft.

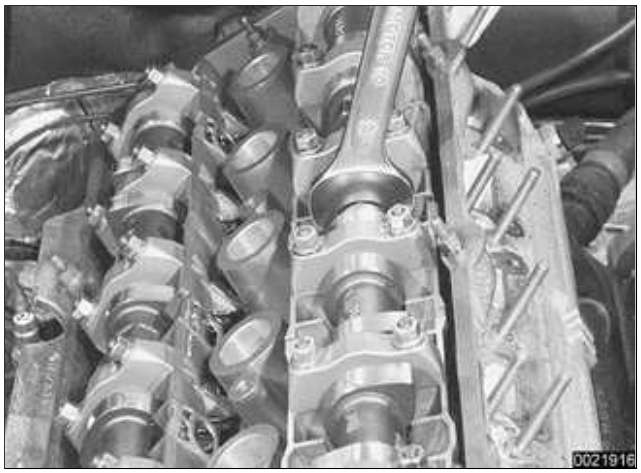
Note:

Before the next step, observe waiting time for lifter bleed down before continuing with camshaft installation.

Crankshaft / valve timing waiting times	
68°F (20°C) and higher	4 minutes
50 - 68°F (10 - 20°C)	11 minutes
32 - 50°F (0 - 10°C)	30 minutes

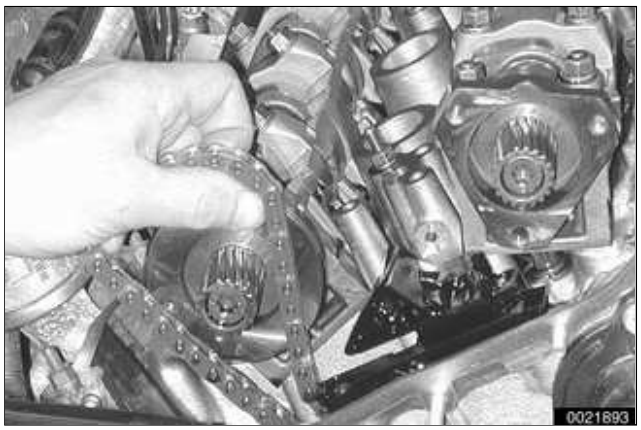


- Secure camshafts in TDC position using BMW special tools 11 3 240 and 11 3 244.



- If necessary, turn camshaft so that special tools are squarely seated on cylinder head.

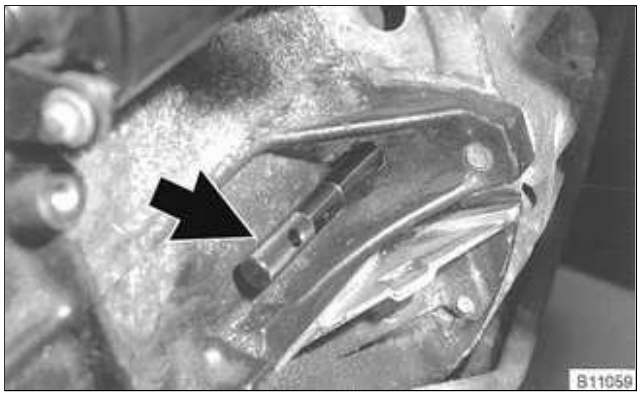
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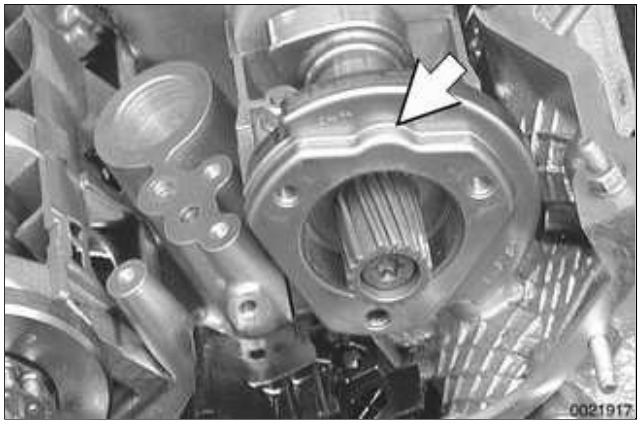
- Lift timing chain and hold under tension.



- While maintaining tension on timing chain, rotate crankshaft from 30° before TDC in direction of rotation up to cylinder 1 TDC position (**0|T** on front pulley lined up with pointer on lower timing chain cover).

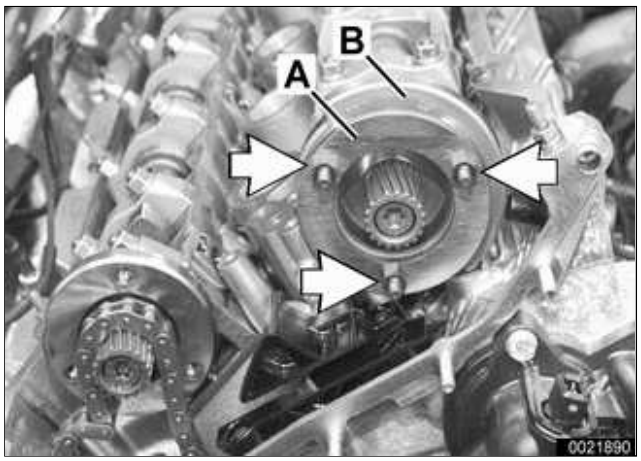


- Secure crankshaft in TDC position with BMW special tool 11 2 300 (**arrow**).



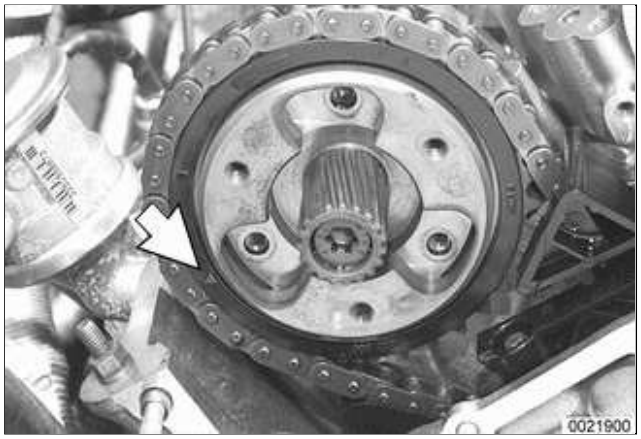
- Slide impulse wheel on intake camshaft, aligning boss with raised portion on camshaft (**arrow**).

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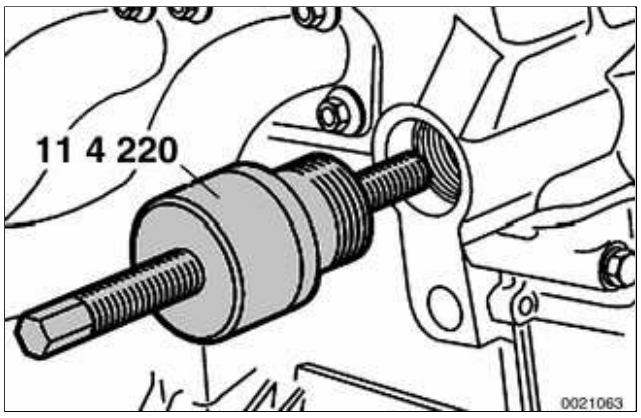


- Fit thrust spacer to intake camshaft and tighten down with threaded locating studs (place longer threaded portion of studs into camshaft).

Tightening torque	
Impulse wheel studs to intake camshaft (M7)	20 Nm (15 ft-lb)



- Fit top sprocket to primary timing chain and install on exhaust camshaft so that pointer on sprocket (**arrow**) lines up with cylinder head sealing surface.

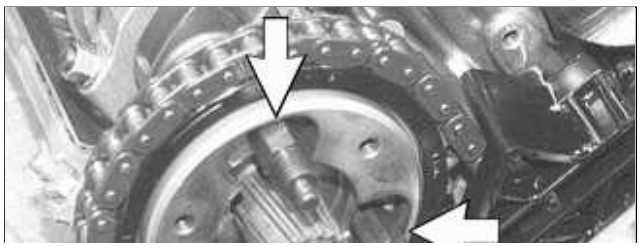


- Insert BMW special tool 11 4 220 into timing chain tensioning piston bore and bring adjustment screw into contact with tensioning rail, but do not pretension timing chain.

Note:

BMW special tool 11 4 220 is a dummy primary chain tensioner and simulates the function of the tensioner.

  - Recheck that arrow on top primary sprocket is aligned with upper edge of cylinder head. Reposition sprocket if necessary.



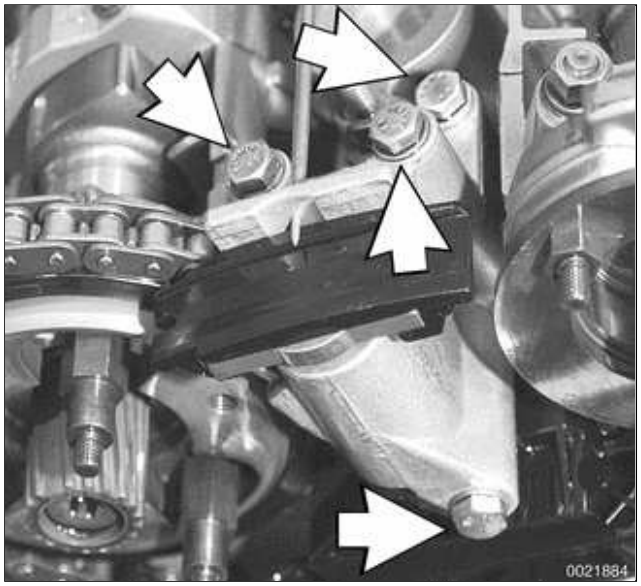
- Insert and tighten down threaded locating studs (**arrows**) in end of exhaust camshaft.

Tightening torques

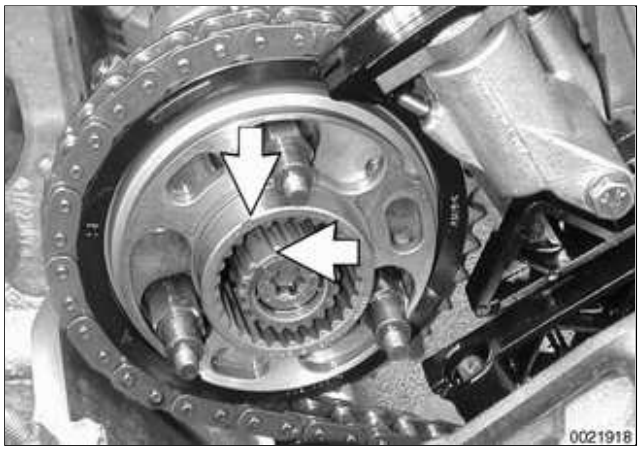
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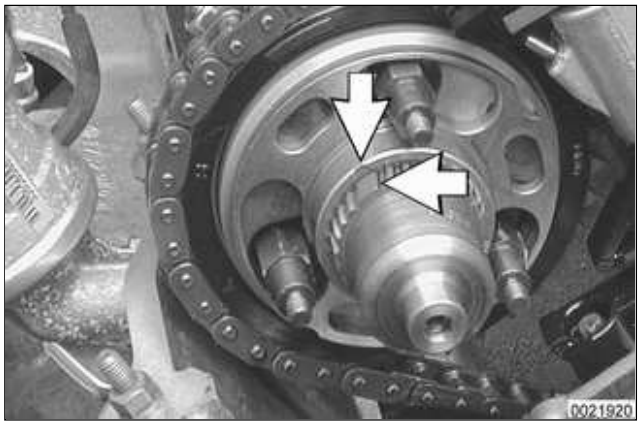
Tightening torques	
Exhaust camshaft locating stud	20 Nm (15 ft-lb)



- Install secondary chain tensioner on cylinder head (**arrows**). Keep tensioner compressed using BMW special tool 11 3 292 or suitable pin.

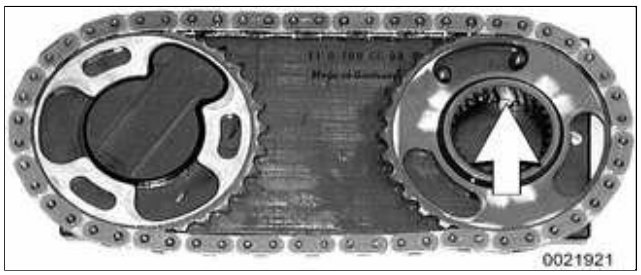


- Fit exhaust camshaft splined sleeve. Confirm that gap in sleeve splines aligns with corresponding gap in camshaft splines (**arrows**).

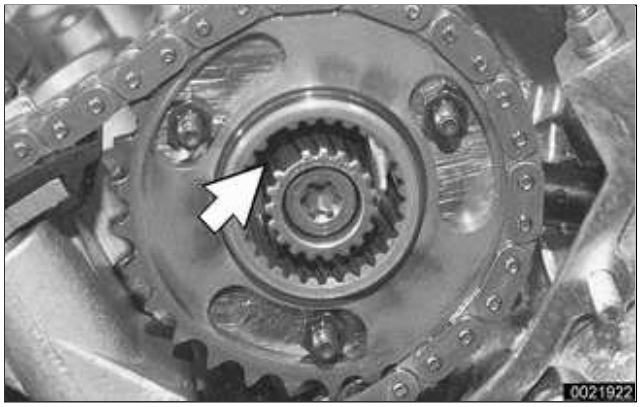


- Slide splined shaft onto exhaust camshaft. Be sure that locating tooth of shaft (**arrow**) fits into spline gaps of camshaft and splined sleeve.
  - Slide splined shaft in further until three small slots on splined sleeve are centered on three threaded holes in primary chain sprocket.

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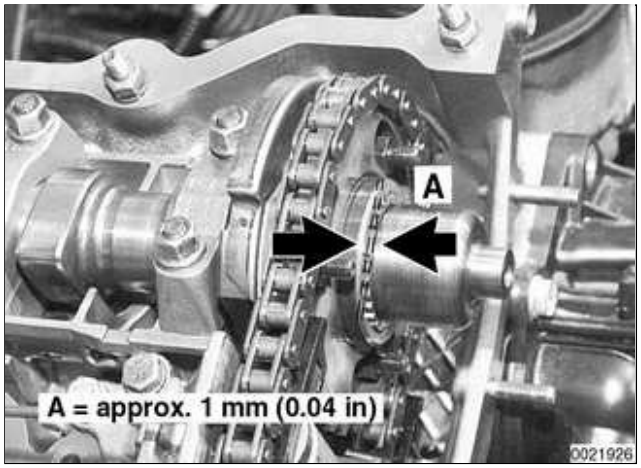
- Place intake and exhaust sprockets in BMW special tool 11 6 180. Position spline gap on intake sprocket (**arrow**) as shown and place secondary chain on sprockets.



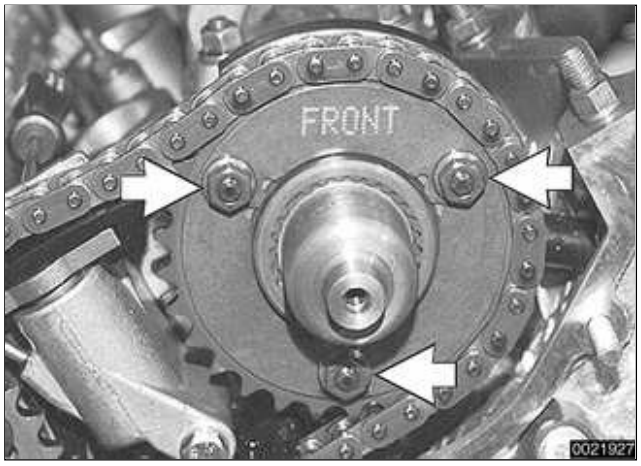
- Remove chain and sprockets from tool and slide sprockets on camshafts. Confirm that gap in intake sprocket splines lines up with corresponding gap in camshaft splines (**arrow**).

CAUTION!

Do not alter position of sprockets with respect to chain when removing from special tool 11 6 180.



- Slide splined shaft onto intake camshaft until approx. 1 mm (0.04 in.) of splines (**arrows**) are visible. Confirm that locating tooth of shaft fits into spline gaps on camshaft and sprocket.



- Install intake camshaft spring plate so that **FRONT** mark is visible. Install mounting nuts (**arrows**) finger tight.



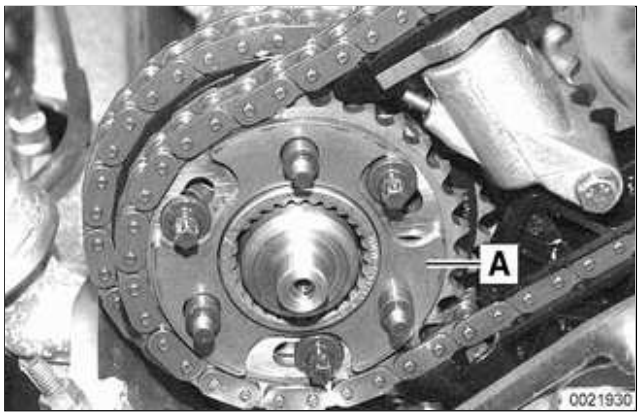
- Insert sprocket mounting bolts (**arrows**) on exhaust side camshaft

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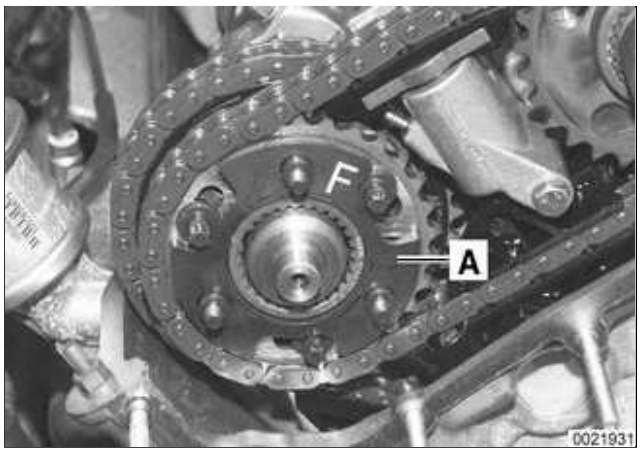


assembly.

- Initially tighten to approx. 5 Nm (44 in-lb) and then back off by half a turn.



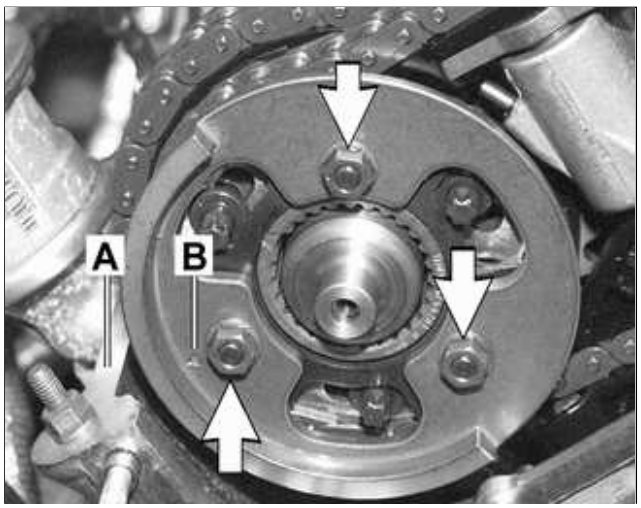
- Fit thrust spacer (**A**) on exhaust camshaft.



- Install spring plate (**A**) to exhaust camshaft. Make sure that **F** mark is visible.

Note:

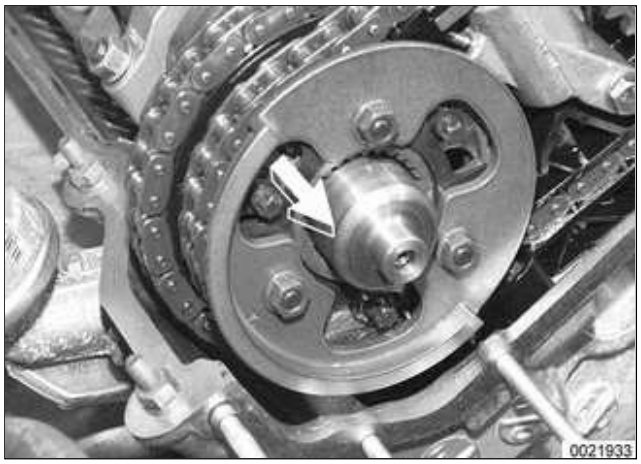
If F mark is no longer visible, install spring plate so that convex side points forward (toward front of car).



- Install exhaust camshaft impulse wheel, aligning pointer (**B**) with top edge of cylinder head (**A**). Install mounting nuts (**arrows**) finger tight.

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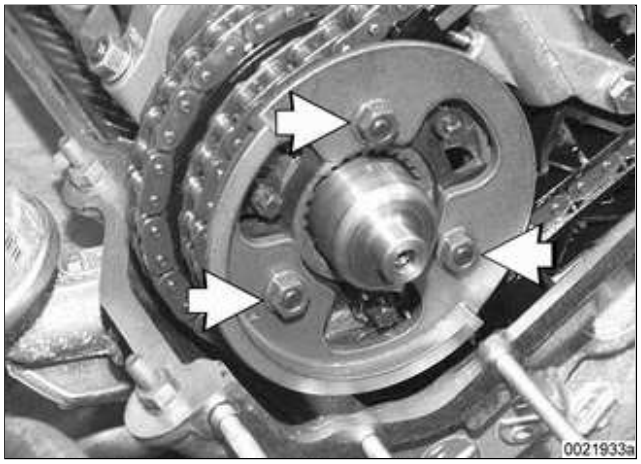


- Pull out exhaust camshaft splined shaft to stop.
  - Press down on secondary chain tensioner and remove tensioner lock-down tool.

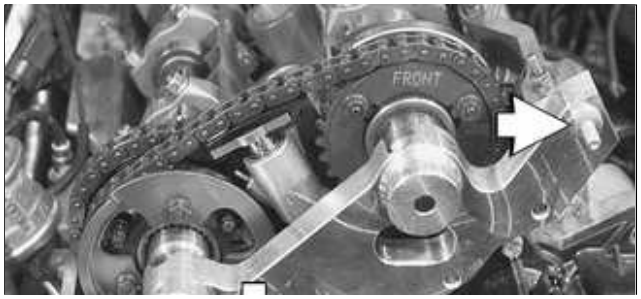


- Preload primary chain:
  - Tighten adjusting screw on BMW special tool 11 4 220 to specified torque.

Tightening torque	
Primary chain tensioner preload	0.7 Nm (6 in-lb)



- Preload exhaust camshaft spring plate by pressing on impulse wheel while tightening mounting nuts (**arrows**) finger tight.



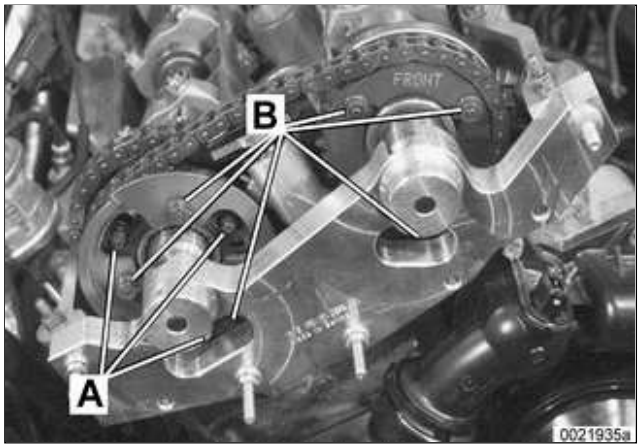
- Install BMW special tool 11 6 150 (VANOS setup bracket) to front of cylinder head timing case. Install nuts (**arrows**) finger tight, then tighten down uniformly until special tool is in full contact with cylinder head.

CAUTION!

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Make sure all gasket material is removed from face of cylinder head. Clean sealing face and keep free of oil. If any foreign material is present on the sealing surface, the camshaft timing will be incorrect.



- Secure camshaft sprockets and impulse wheels:
  - Tighten mounting screws (**A**) on exhaust camshaft impulse wheel to approx. 5 Nm (44 in-lb).
  - Tighten mounting nuts (**B**) on exhaust and intake sprocket assemblies to approx. 5 Nm (44 in-lb).
  - Torque down mounting screws (**A**) and nuts (**B**) to final specifications.

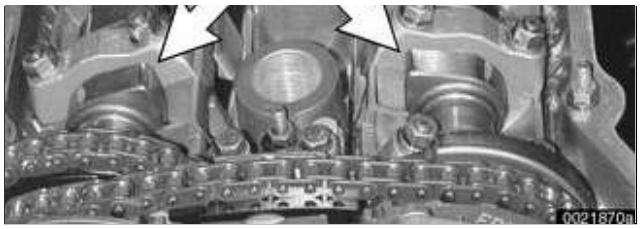
Tightening torques	
Sprocket assembly to camshaft	
initial torque	5 Nm (44 in-lb)
Sprocket assembly wheel to camshaft	
M7 Torx screws (**A**)	20 Nm (15 ft-lb)
M6 mounting nut (**B**)	10 Nm (8 ft-lb)

- Remove flywheel locking tool from transmission bellhousing so that crankshaft is no longer secured.
- Remove camshaft locking tools from cylinder head.



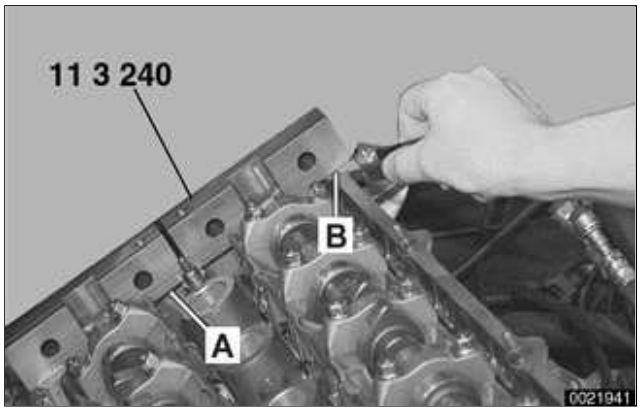
- Turn engine over twice in direction of rotation until cylinder 1 intake and exhaust camshaft lobes (**arrows**) face

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each other.

- Secure crankshaft in TDC position with BMW special tool 11 2 300.



- Place BMW special tool 11 3 240 over camshafts and measure clearances.

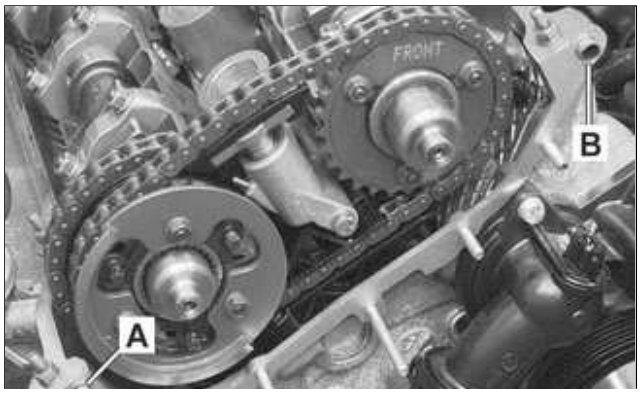
Note:

- *If the exhaust side of the tool (A) is not flush with the head, camshaft timing is incorrect. Reset camshaft timing as described in ⇒ 117 Camshaft Timing Chains.*

- *Due to flexible sprocket design, VANOS unit tolerances and play in the VANOS splines, when the camshaft timing is set correctly, the intake side of special tool 11 3 240 (B) may be up to 1 mm (0.04 in) above the surface of the cylinder head. This is normal. Reassemble engine. Otherwise, reset camshaft timing as described in ⇒ 117 Camshaft Timing Chains*

- Remove BMW special tool 11 6 150 from front of cylinder head.

VANOS control unit, installing



- Clean contact edges of cylinder head face and VANOS unit and apply a thin coat of sealing compound 3-Bond®1209 or equivalent to surfaces.

CAUTION!

- ***Make sure all gasket material is***

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removed from face of cylinder head. Clean sealing face and keep free of oil. If any foreign material is present on the sealing surface, the camshaft timing will be incorrect.

- ***Check locating dowel (A) and dowel sleeve (B) at top of cylinder head for damage or incorrect installation.***

- Replace steel gasket.

- Install VANOS unit to front of cylinder head.

Note:

If Double VANOS control unit is being replaced, be sure to check and adjust camshaft timing as described in ⇒ *117 Camshaft Timing Chains.*

- Reinstall engine support hook.

Tightening torque	
VANOS unit to cylinder head	
M6 nut	10 Nm (89int-lb)
M7 nut	14 Nm (10 ft-lb)

- Reconnect electrical harness connectors to camshaft position sensors and VANOS solenoid valves.



Insert and tighten down VANOS hydraulic piston set screws (**arrows**) in splined shafts on intake and exhaust camshafts.

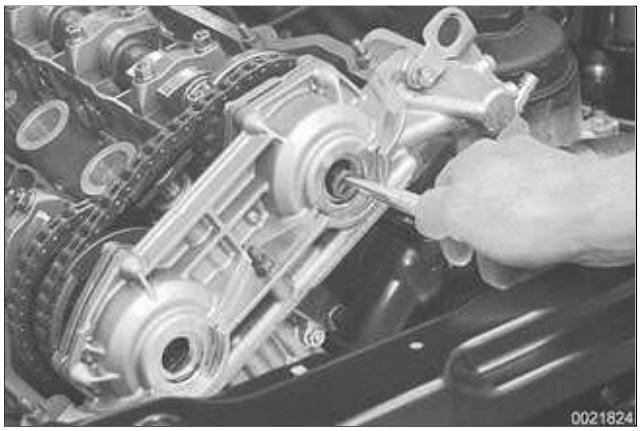
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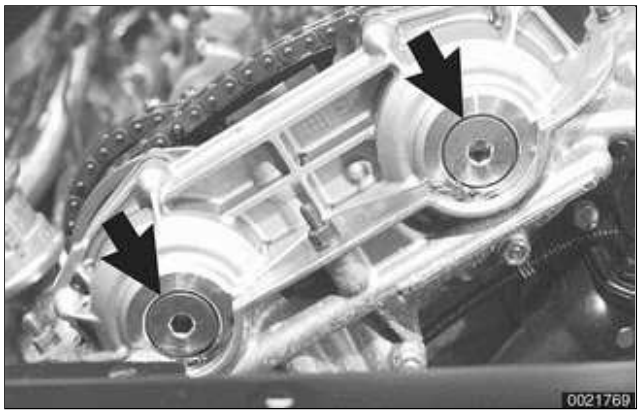


Set screws have left hand thread. Tighten counterclockwise.

Tightening torque	
Hydraulic piston to splined shaft	
M6 set screw	10 Nm (89 in-lb)

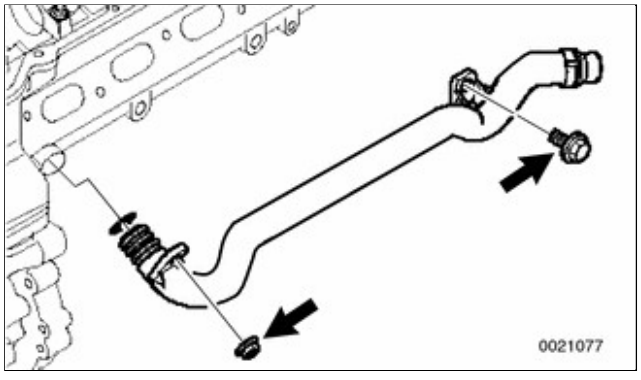


- Replace sealing caps inside VANOS unit with BMW special tool 11 6 170, or short flat nosed pliers.



- Insert and secure VANOS sealing plugs (**arrows**) with new sealing O-rings.

Tightening torque	
Sealing plug to VANOS unit	50 Nm (37 ft-lb)



- Install coolant pipe fasteners at base of cylinder head and tighten fasteners (**arrows**).

Note:

Use new sealing O-ring on coolant pipe.

- Install VANOS oil line banjo bolt with new seals. Attach oil line to VANOS unit.

Tightening torque

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Tightening torque	
Oil line to VANOS unit (banjo bolt)	32 Nm (24 ft-lb)

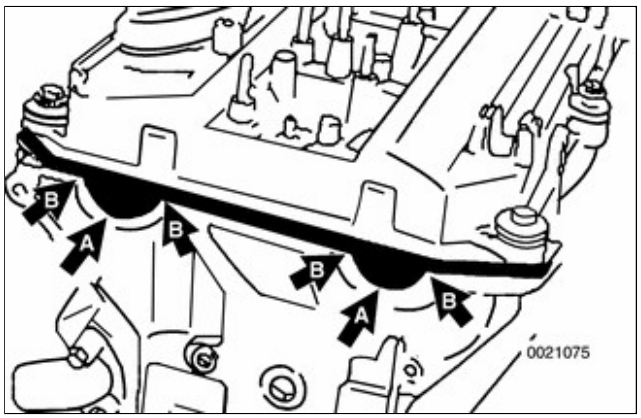
- Remove BMW special tool 11 4 220 and reinstall chain tensioner cylinder.

Tightening torque	
Primary chain tensioner cylinder to cylinder head	70 Nm (52 ft-lb)

- Remove flywheel locking tool from transmission bellhousing. Replace special tool bore sealing plug.

- Remove camshaft locking tools from cylinder head.

Cylinder head cover, manifolds, cooling system, installing



Install intake camshaft cover and cylinder head cover.

- Check for correct seating of half-moon seals (**A**) in back of cylinder head cover.

- Use a small amount of 3-Bond®1209 or equivalent sealant at corners (**B**) of half-moon cutouts.

- Seat gasket and seal corners in front of cylinder head at VANOS unit.

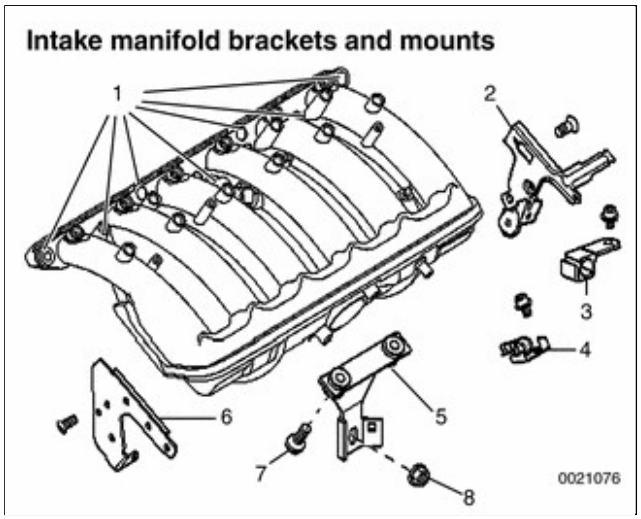
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Tightening torque	
Cylinder head cover to cylinder head (M6)	10 Nm (89 in-lb)

- Install exhaust manifolds using new gaskets and nuts. Coat manifold studs with copper paste prior to installing nuts.

Tightening torque	
Exhaust manifold to cylinder head (M7)	20 Nm (15 ft-lb)

- Install electrical harness connectors for oil pressure sender and coolant temperature sensor before installing intake manifold.



Intake manifold Installation is reverse of removal.

1 - Manifold mounting nuts -tighten to 15 Nm (11 ft-lb)

2 - Fuel pipe bracket

3 - Fuel pipe bracket

4 - Vacuum pump bracket

5 - Manifold mounting bracket

6 - Tank venting valve bracket

7 - Mounting bracket to manifold bolt (M6) -tighten to 10 Nm (7 ft-lb)

8 - Mounting bracket to cylinder block nut (M10) -tighten to 47 Nm (33 ft-lb)

♦ Use new fuel injector seals.

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- Carefully check intake manifold gasket and replace if necessary.

- Inspect O-ring seal between mass air flow sensor and air filter housing. To facilitate reassembly, coat seal with acid-free grease.

CAUTION!

When reattaching throttle assembly harness connector, connector is fully tightened when arrows on connector and plug line up.

Tightening torques	
Intake manifold to cylinder head	
M7	15 Nm (11 ft-lb)
M8	22 Nm (16 ft-lb)
Mounting bracket to cylinder block (M10)	47 Nm (33 ft-lb)
Mounting bracket to intake manifold (M6)	10 Nm (7 ft-lb)

- Installation of remaining parts is reverse of removal, noting the following:

- Refill cooling system as described in ⇒ 170 Radiator and Cooling System.

- Change engine oil and filter as described in ⇒ 020 Maintenance.

- If necessary, adjust accelerator cable.

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- Reconnect battery.

CAUTION!

To prevent damaging engine electronic systems, install all ground wires previously removed, including the ground wires for the ignition coils.

Tightening torques	
Coolant drain plug to cylinder block	25 Nm (18 ft-lb)
Radiator cooling fan to coolant pump	40 Nm (30 ft-lb)
Radiator drain screw to radiator	2.5 Nm (22 in-lb)
Spark plug to cylinder head	25 Nm (18 ft-lb)

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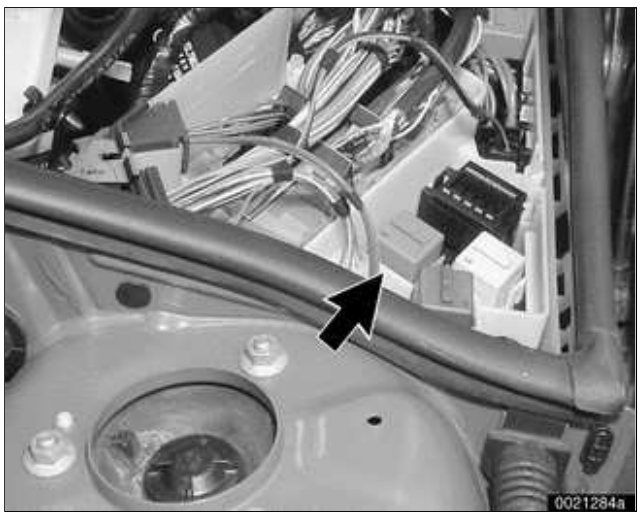
Diagnostic Testing

Cylinder compression, checking

A compression gauge is needed to make a compression test. For accurate test, the battery and starter must be capable of cranking the engine at least 300 rpm, and the engine should be at normal operating temperature.

Note:

Performing a compression test may cause a fault to set in the ECM and may illuminate the engine service light. The light can only be turned out using either BMW special service scan tools or an equivalent aftermarket scan tool. Disconnecting the battery will not erase the fault memory nor turn out the light.



- Disable ignition system by removing DME main relay (**arrow**) from the electronics box (E-box) in left rear of engine compartment

WARNING!

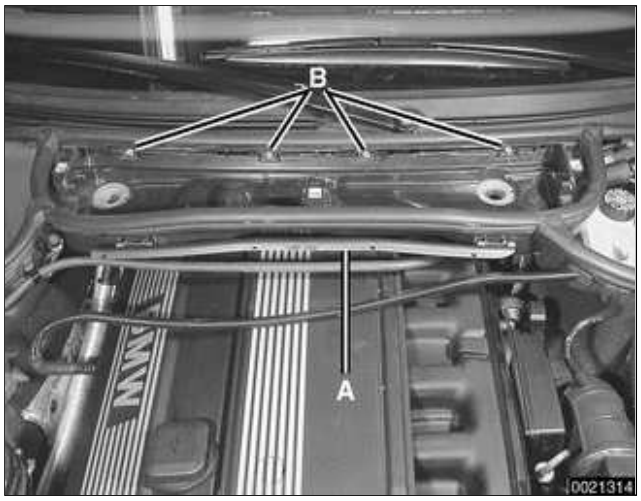
- ***The ignition system produces high voltages that can be fatal. Avoid contact with exposed terminals and use extreme caution when working on a car with the ignition switched on or the engine running.***

- ***Do not touch or disconnect ignition components while the engine is running or being cranked by the starter.***

CAUTION!

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Failure to remove the DME main relay or attempting to disable the ignition system by other methods may result in damage to the engine control module (ECM).



- Remove housing for interior ventilation microfilter.
  - Remove upper cover and microfilter.
  - Open wiring harness loom cover (**A**) and remove wires.
  - Unfasten screws (**B**) and remove lower microfilter housing.
  - Remove oil filler cap.
  - Remove engine cover over ignition coils. Replace oil filler cap.



- Remove ignition coils.
  - Pull up on spring clips to disconnect ignition coil harness connectors.
  - Remove coil grounding straps.
  - Remove coils.
  - Remove spark plugs.

Note:

Check the spark plugs for oil deposits that may indicate poor cylinder sealing, then set them aside in order. Used spark plugs should be reinstalled in the same cylinder from which they were

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removed.



- Install compression gauge in first cylinder's spark plug hole, tight enough to form a good seal.

  - With parking brake set, transmission in PARK or NEUTRAL, and accelerator pedal pressed to floor, crank engine with starter. Record highest value indicated by gauge.

Note:

- *The compression gauge reading should increase with each compression stroke and reach near its maximum reading in about 4-6 strokes.*

- *All cylinders should reach maximum compression in the same number of strokes. If a cylinder needs significantly more strokes to reach maximum compression, there is a problem.*

  - Release pressure at compression gauge valve, then remove gauge from spark plug hole. Repeat test for each cylinder and compare results with values given below.

Compression pressures	
Minimum	10 - 11 bar (142 - 156 psi)
Maximum difference between cylinders	0.5 bar (7 psi)

  - Compression readings may be interpreted as follows:

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- Low compression indicates a poorly sealed combustion chamber.
- Relatively even pressures that are below specification normally indicate worn piston rings and/or cylinder walls.
- Erratic values tend to indicate valve leakage.
- Dramatic differences between cylinders are often the sign of a failed head gasket, burned valve, or broken piston ring.

- Reinstall spark plugs and ignition coils.

Note:

Used spark plugs should be reinstalled in the same cylinder from which they were removed.

- Remainder of installation is reverse of removal. Be sure to reinstall all wires disconnected during test, especially ground wires at coils and cylinder head cover (where applicable).

Tightening torque	
Spark plug to cylinder head	25 Nm (18 ft-lb)

Wet compression test

To further help analyze the source of poor compression, a wet compression test is the next step:

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- Repeat compression test, this time with about a teaspoon of oil squirted into each cylinder. (The oil will temporarily help seal between piston rings and cylinder wall, practically eliminating leakage past rings for a short time.)

- If this test yields higher compression reading than "dry" compression test, there is probably leakage between piston rings and cylinder walls, due either to wear or to broken piston rings.

- Little or no change in compression reading indicates other leakage, probably from valves.

Cylinder leak-down test

The most conclusive diagnosis of low compression symptoms requires a cylinder leak-down test. Using a special tester and compressed air, each cylinder, in turn, is pressurized. The rate at which the air leaks out of the cylinder, as well as where the air leaks out, can accurately pinpoint the magnitude and location of the leakage.

Before attempting any repair that requires major engine disassembly, use a leak-down test to confirm low compression.

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General

This repair group covers cylinder head and valvetrain service and repair. Procedures described here require that the cylinder head first be removed as described in ⇒ 113 Cylinder Head Removal and Installation.

Note:

- *For timing chain and VANOS repair information, see ⇒ 117 Camshaft Timing Chains.*
- *If it is determined that the cylinder head will require significant reconditioning work, a remanufactured cylinder head may be a good alternative. Remanufactured cylinder heads are available from an authorized BMW dealer.*

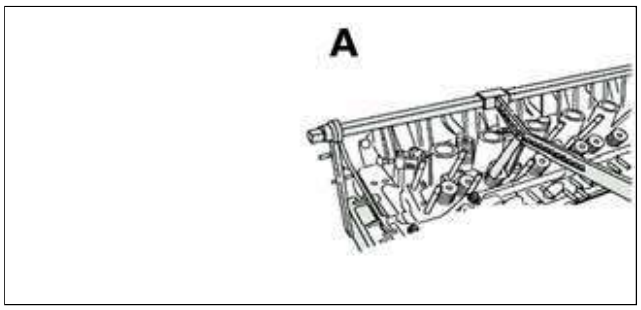
The information given in this repair group is organized according to engine code. For engine application information, see ⇒ 100 Engine–General.

Special tools

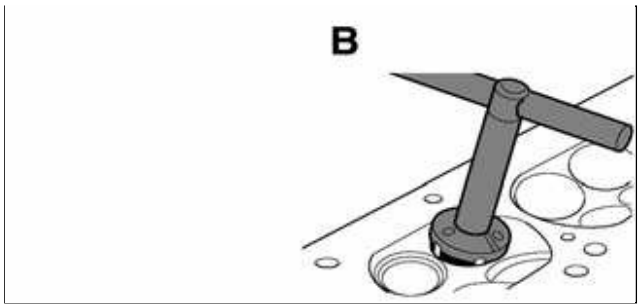
BMW special tools are required for most cylinder head service described in this repair group. Many of these tools are expensive and only available through an authorized BMW dealer. If the special tools are not available, have the cylinder head disassembled and removed by an authorized BMW dealer. Be sure to read each procedure thoroughly before starting a job to determine which special tools and equipment will be necessary.

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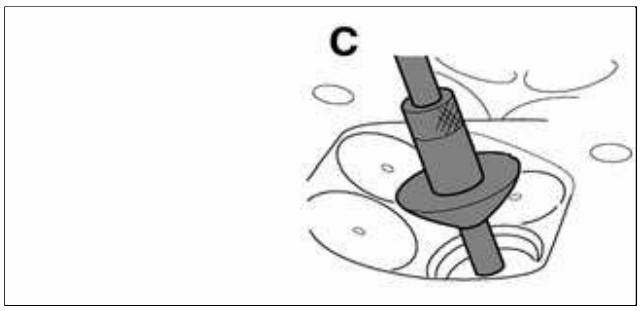
Most of the repairs to a cylinder head require precision machine work to specific tolerances. This type of work should be performed by an authorized BMW repair facility or an ASE certified machinist.



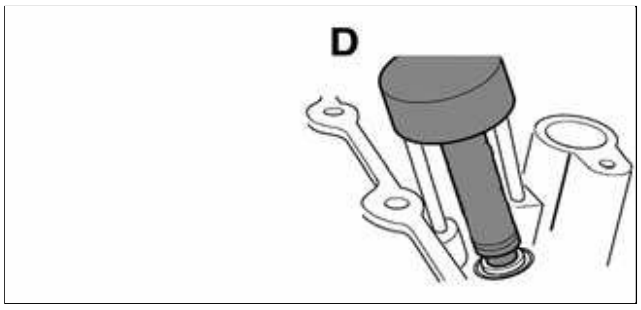
- Cylinder head jig BMW 00 1 490



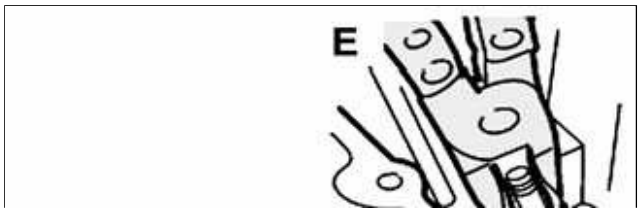
- Valve seat grinder BMW 00 3 520



- Valve guide reamer BMW 00 4 210



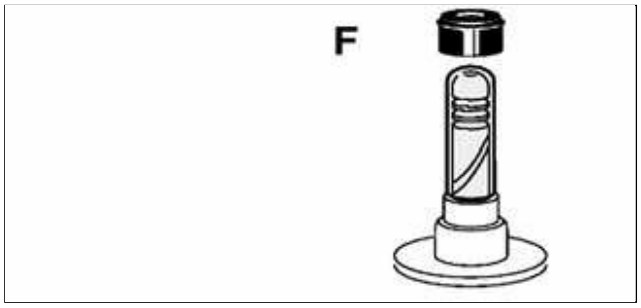
- Valve stem seal driver BMW 11 1 200



- Valve stem seal puller BMW special tool 11 1 480

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- Valve stem seal guide BMW special tool 11 1 960

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Cylinder Head

This section provides the specifications and special reconditioning information necessary to repair the cylinder heads covered by this manual.

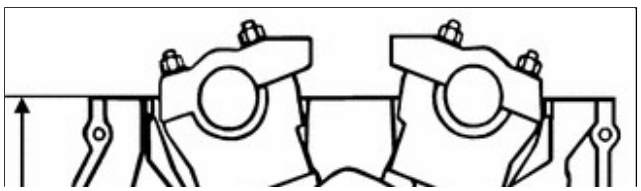
The disassembled cylinder head should be inspected for warpage and cracks. Check the valve guides and valve seats for wear before machining a warped head. Always decarbonize and clean the head before inspecting it. A high-quality straight edge can be used to check for warpage.

Visually inspect the cylinder head for cracks. If a cracked cylinder head is suspected and no cracks are detected through the visual inspection, have the head further tested for cracks by an authorized BMW dealer or an ASE certified machinist. A cracked cylinder head must be replaced.

Note:

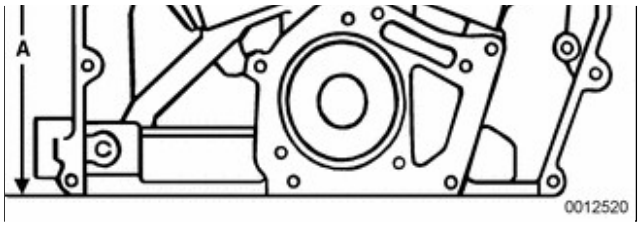
When disassembling and inspecting the cylinder head on an engine, be sure to check the camshaft carrier bearing surfaces for warpage.

A warped cylinder head can be machined provided no more than 0.3 mm (0.012 in.) of material is removed. If further machining is required, the head should be replaced. Removing more than this amount will reduce the size of the combustion chamber and adversely affect engine performance. A 0.3 mm thicker gasket is available from an authorized BMW parts department for machined heads.



Before machining the head to correct for warpage, measure the total height (**A**) (thickness of the cylinder head). Minimum height specifications are

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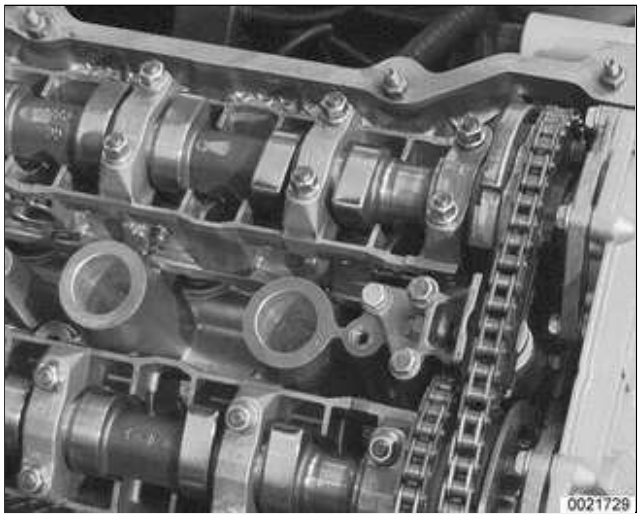
given in ⇒ Table a.

Table a. Cylinder head height	
New	**Minimum height (dimension A)**
140.0 mm (5.512 in)	139.7 mm (5.500 in)

Valves, leak test

To test the valves for leakage, the cylinder head must be disassembled with camshafts and camshaft carriers removed. Install the valve assemblies and the spark plugs in each cylinder. Place the cylinder head on a workbench with the combustion chamber facing upward. Fill each combustion chamber with a thin non-flammable liquid, such as a parts cleaning fluid. After fifteen minutes, check the level of the fluid. If the fluid level in any cylinder drops, that cylinder is not sealing properly.

Camshaft



Camshaft wear is usually caused by insufficient lubrication. Visually inspect camshaft lobes and journals for wear. Camshaft wear specifications are given in ⇒ Table b.

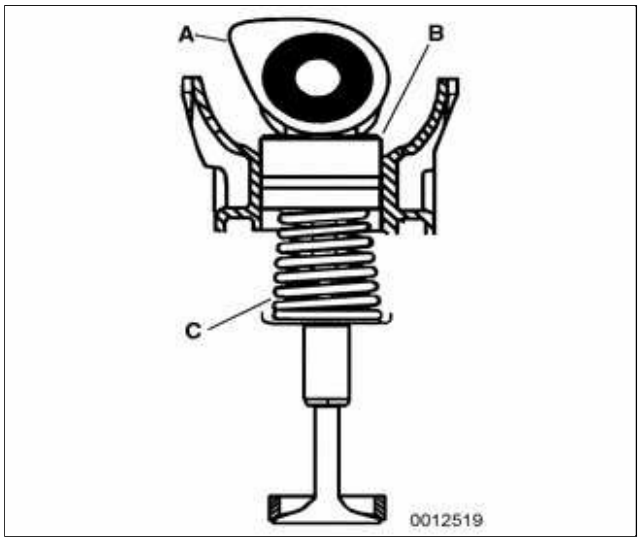
Table b. Camshaft wear specifications	
Axial play	0.150-0.330 mm (0.0060-0.013 in.)
Radial play (Plastigage)	0.020-0.054 mm (0.0008-0.0021 in.)

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If the camshaft is being replaced due to cam lobe wear, it is recommended that the corresponding lifters should also be replaced to avoid damaging the new camshaft.

Hydraulic lifters, checking and replacing



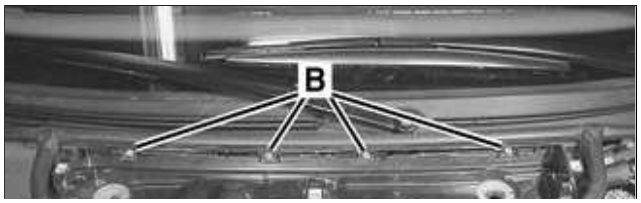
- Modern BMW 6 cylinder engines use self-adjusting hydraulic lifters to keep the valve clearances within a limited working range. (**A**) section view of camshaft , (**B**) hydraulic lifters are sealed units and require no maintenance, (**C**) valve with conical valve spring.

Under some circumstances, such as a cold start, the cam followers may become noisy. Hydraulic lifter noise is usually a high-pitched tapping or chattering noise. In most instances, this is considered normal as long as the noise goes away in a few minutes (maximum 20 minutes). If the noise does not go away, either the lifter is faulty or the oil pressure to the lifter is low. Hydraulic lifter replacement requires that the camshaft first be removed.

Note:

Before checking hydraulic lifters, make sure engine oil is fresh and at the proper level.

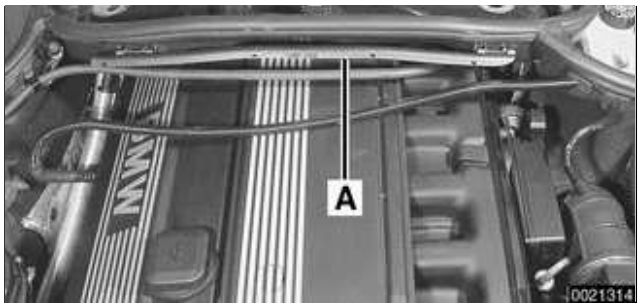
- Run engine until it reaches normal operating temperature.



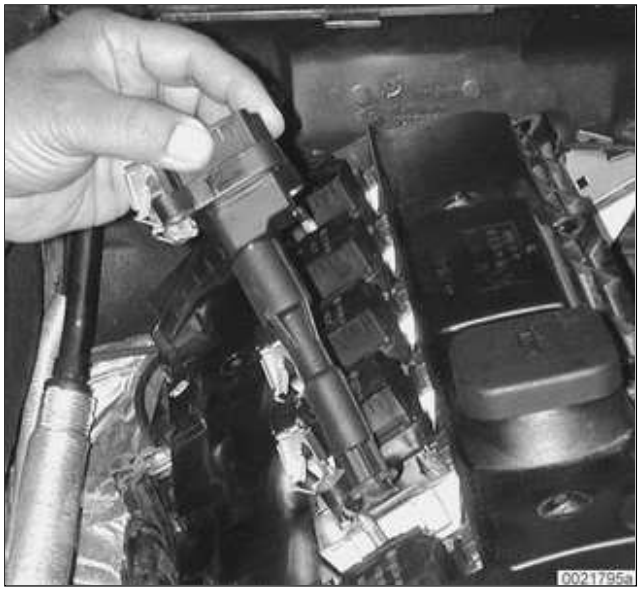
- Remove microfilter housing:

  - Remove microfilter for interior ventilation.

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- Open wiring harness loom (**A**), remove harness and lay aside.
- Unfasten screws (**B**) and take off lower microfilter housing.
- Remove engine cover.
- Detach positive and ground connections from intake manifold and cylinder head cover, as necessary.



➢ Remove ignition coils.

- Disconnect ignition coil harness connectors and lay harness aside.
- Remove coil grounding straps.
- Remove coils.
- Remove spark plugs.
- Remove cylinder head cover mounting fasteners and remove cylinder head cover.

Note:

The cylinder head cover mounting bolt insulators and gaskets should be reinstalled in their original locations. Make note of their arrangement during removal.



➢ Remove oil baffle cover from above intake camshaft.

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- Use a plastic or wooden stick to press down on top of lifter. If there is any noticeable clearance, the lifter is faulty and should be replaced.

Note:

When checking a hydraulic lifter, make sure the corresponding camshaft lobe is facing up so that there is no valve spring pressure on the follower.

- To replace a hydraulic lifter, remove appropriate camshaft. Refer to camshaft removal procedures given in ⇒ 113 Cylinder Head Removal and Installation.

- Once camshaft is removed, withdraw faulty lifter and replace with new one. Inspect lifter bores for wear and scoring.

- Camshaft, timing chain and cylinder head cover reassembly is reverse of disassembly.

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Valves

Valves, removing and installing

- Remove cylinder head as described in ⇒ 113 Cylinder Head Removal and Installation.

CAUTION!

- ***Do not let the hydraulic lifters fall out as the camshaft carrier is removed. Special suction cups are available from BMW to hold the hydraulic lifters in place during carrier removal.***

- ***Hydraulic cam lifters should be stored in an upright position. If necessary, use a magnetic tool to aid in removal of the lifters.***

- Remove valves using a valve spring compressor.

CAUTION!

Label each valve assembly as it is removed so it can be installed in its original position.

- Remove and discard valve stem oil seals from valve guides. See ⇒ Valve stem oil seals later in this section.

- Valve installation is reverse of removal.

Valve specifications are listed in ⇒ Table c. Remove carbon deposits from

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the valves using a wire brush or wire wheel.

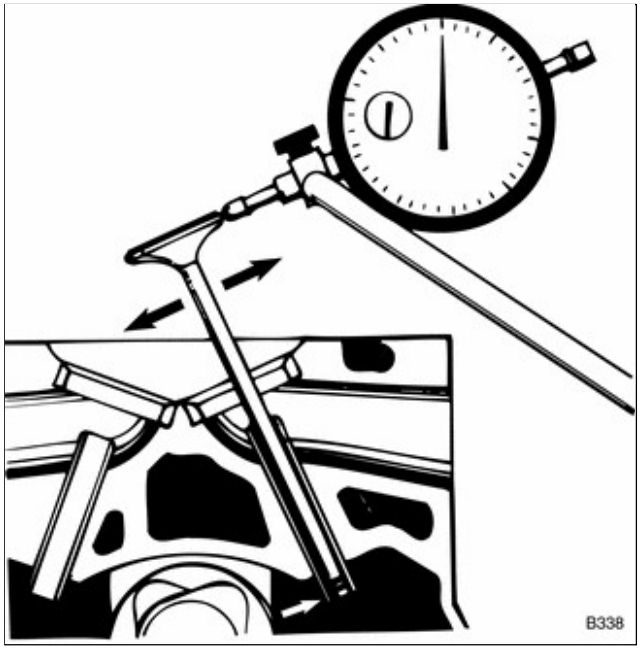
Table c. Valve specifications	
Specification	**M 52TU 2.5/2.8 engines (1999 - 2000) M 54 2.5/3.0 engines (2000 - 2001)**
Valve head dia.	
Intake	33.0 mm (1.299 in.)
Exhaust	30.5 mm (1.201 in.)
Valve stem dia. Standard	
Intake	$6.0^{-0.015}$ mm
	($0.2362^{-0.0006}$ in.)
Exhaust	$6.0^{-0.015}$ mm
	($0.2362^{-0.0006}$ in.)
Oversize 1	
Intake	$6.1^{-0.025}$ mm
	($0.2401^{-0.0010}$ in.)
Exhaust	$6.1^{-0.040}$ mm
	($0.2401^{-0.0016}$ in.)
Oversize 2	
Intake	$6.2^{-0.025}$ mm
	($0.2441^{-0.0010}$ in.)

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Table c. Valve specifications	
Specification	**M 52TU 2.5/2.8 engines (1999 - 2000) M 54 2.5/3.0 engines (2000 - 2001)**
Exhaust	$6.2^{-0.040}$ mm
	($0.2441^{-0.0016}$ in.)

Valve guides

BMW does not supply valve guides as replacement parts. If a valve guide is excessively worn, it should be reamed to accept oversized valve stems. Valve guide specifications are listed in ⇒ Table d.



Valve guides should be checked for wear using a new valve. Be sure to thoroughly inspect the cylinder head to ensure that it can be reused before reworking the guides.

Note:

- *International Organization for Standardization (ISO) tolerance classes are listed in ⇒ Table c. ISO allowances are based on nominal sizes and should be used to determine proper fit. Most machine shops should have this information available.*

- *Replacement valve guides may be available through aftermarket suppliers. Valve guide replacement requires special tools and a press. It is also necessary to heat the cylinder head and chill the*

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valve guides when replacing the guides.

BMW supplies oversize valves. See ⇒ Table d for additional information.

Table d.Valve guide specifications	
Specifications	**M52TU / M54 engine(1999 - 2001)**
Valve guide wear, maximum (valve tilt clearance measured with new valve)	0.5 mm (0.020 in.)
Valve guide inside diameter, installed (tolerance per ISO allowance H7)	
Standard	6.0 mm (0.236 in.)
Oversize 1	6.1 mm (0.240 in.)
Oversize 2	6.2 mm (0.244 in.)

Valve stem oil seals

The purpose of the valve stem oil seal is to prevent excess oil from entering the combustion chamber. The sign of faulty valve stem oil seals is excessive oil consumption and smoke from the exhaust immediately after starting and during deceleration

Note:

Valve stem oil seals should not be reused. If valves are removed, new valve stem oil seals should be installed.

Valve stem oil seal replacement requires that the cylinder head be

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disassembled and the valves removed as described above under ⇒ Valves, removing and installing.

Note:

BMW special tools are available to remove the valve stem oil seals. As an alternative, standard valve seal removal tools are available from most automotive parts stores.

Lubricate new seal and install using hand pressure only. Be sure to install valve spring seat(s) before installing seal.

Valve seats

The valve seats should be resurfaced whenever new valves or valve guides are installed. Cutters are required to resurface the seats. Always check the valves for leaks after reconditioning a valve seat as described above. ⇒ Table e lists valve seat dimensions.

Note:

Standard size replacement valve seats are not available from BMW. Replacement valve seats are only available from BMW in 0.4 mm oversize (oversized in both height and diameter). The manufacturer does not provide specifications for valve seat replacement for the engines covered by this manual.

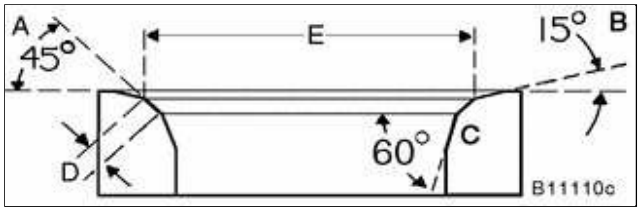


Table e. Valve seat specifications	
Specification	**M52TU/M54 engines (1999-2001)**
A: Valve seat angle	45°

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Table e. Valve seat specifications	
Specification	**M52TU/M54 engines (1999-2001)**
B: Correction angle, outside	15°
C: Correction angle, inside	60°
D: Valve seat width	
intake	1.65 ± 0.25 mm (0.065 ± 0.010 in)
exhaust	1.65 ± 0.25 mm (0.065 ± 0.010 in)
E: Valve seat outside dia.	
intake	32.4 mm (1.276 in)
exhaust	30.0 mm (1.181 in)

Valve springs

The valve springs should be checked for fatigue. To quickly check the springs, line them up in a row. Place a straight edge across the top of the springs. Any spring that is significantly shorter than the others is worn and should be replaced.

Note:

Valve spring specifications and wear limits are not available from BMW.

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General

This repair group covers timing chain and Variable Camshaft Timing (VANOS) repair information.

The timing chains are lubricated by engine oil and do not require maintenance. Worn timing chains and sprockets can lead to noisy operation and erratic valve timing. A faulty tensioner can also cause timing chain noises.

Note:

See ⇒ 100 Engine–General for engine code and application information.

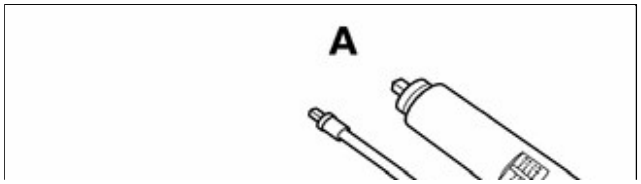
Special tools

Special BMW service tools are needed to remove and disassemble the timing chain, the VANOS control unit, the camshafts and the valvetrain. Many of these tools are expensive and only available through an authorized BMW dealer. Be sure to read each procedure thoroughly before starting a job to determine which special tools will be necessary.

In addition, VANOS system diagnosis can only be carried out by using BMW specific electronic scan tools, such as BMW DIS or MoDiC or equivalent.

CAUTION!

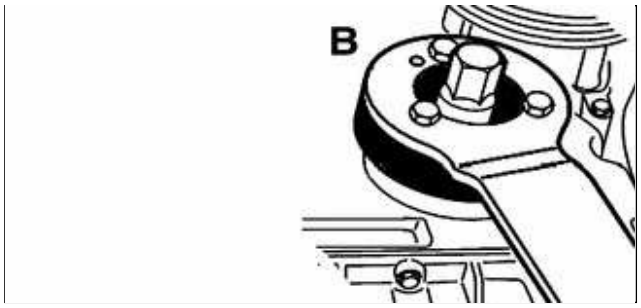
The VANOS system must be removed and installed exactly as described later in this repair group.



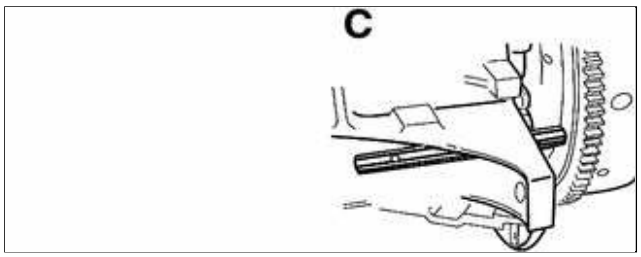
- Torque wrench w/ flex extension BMW 00 9 250

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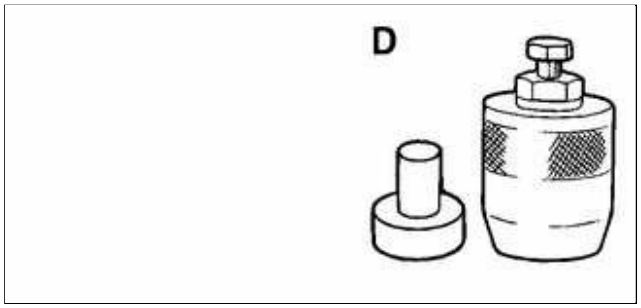




- Crankshaft hub locking tools BMW 11 2 150 /11 2 410



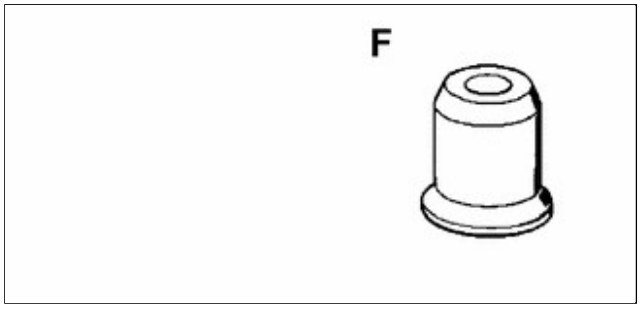
- Crankshaft locking tool BMW 11 2 300



- Seal extractor tool BMW 11 2 380

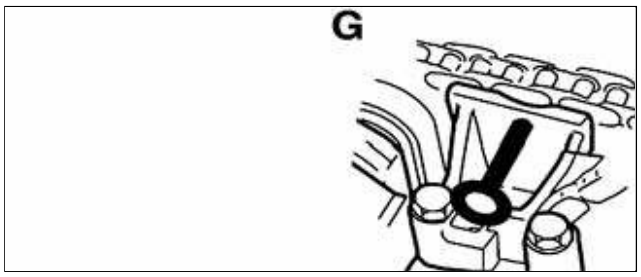


- Camshaft locking tools BMW 11 3 240/11 3 244

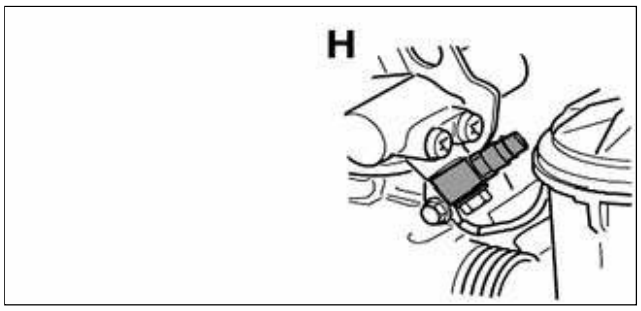


- Installer bush BMW 11 3 280

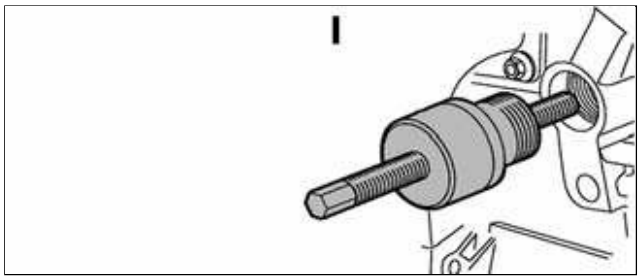
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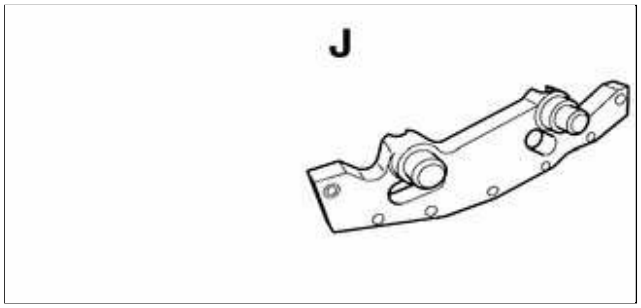
- Secondary chain tensioner locking pin BMW 11 3 292



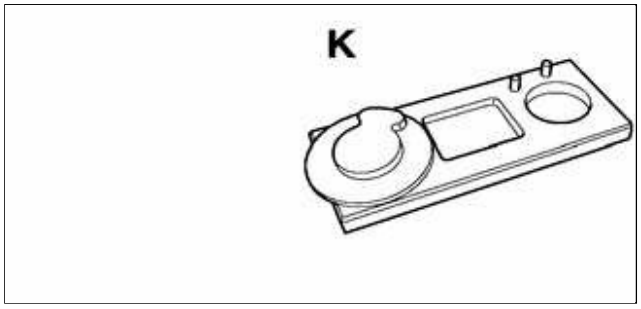
- Air line fitting BMW 11 3 450



- Primary chain tensioner tool BMW 11 4 220



- VANOS setup bracket BMW 11 6 150



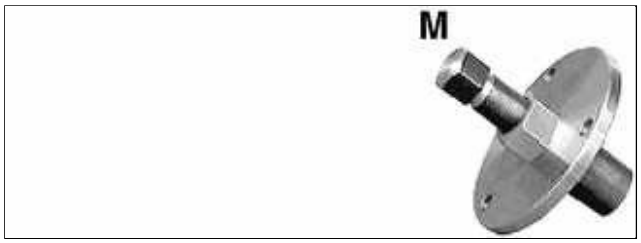
- Secondary sprocket tool BMW 11 6 180



- Crankshaft hub locking tool BMW 11 8 190 /11 8 200

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- Puller for crankshaft hub BMW 11 8 210

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Crankshaft Front Oil Seal

The crankshaft front seal is located in the lower timing cover on the front of the engine, behind the vibration damper.

Note:

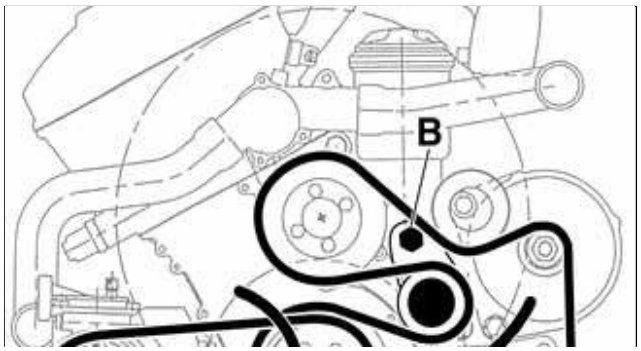
Cars built up to January 2000 are fitted with a 2-piece vibration damper and hub assembly. Cars built from January 2000 use an integral vibration damper and hub assembly. If the early vibration damper needs to be replaced, only the single piece with integral hub is available from BMW.

- Disconnect negative (-) cable from battery.

CAUTION!

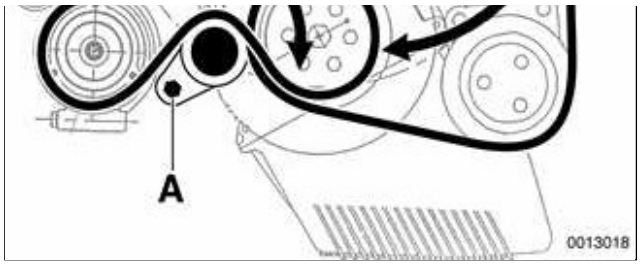
- ***Disconnecting the battery may erase fault code(s) stored in control module memory. Check for fault codes using special BMW diagnostic equipment.***

- ***Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.***



- Remove drive belts:
  - Use long-handled wrench to turn A/C belt tensioner hex (**A**) clockwise (against spring tension). Remove A/C belt.

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- Similarly, turn main engine drive belt tensioner hex (**B**) clockwise and remove belt.

- Secure crankshaft hub using special holding tools:

- Up to 1/2000 production: use special tools 11 2 150 and 11 2 410.

- From 01/2000 production: use special tools 11 8 190 and 11 8 200.

CAUTION!

Do not use BMW special tool 11 2 300 to hold crankshaft stationary to loosen or tighten crankshaft hub center bolt. Use only the special tools specified, or equivalent hub holding tool.

Note:

The crankshaft hub center bolt is tightened to a torque of 410 Nm (300 ft-lb).

- On cars built up to 1/2000 (2-piece vibration damper assembly), remove vibration damper mounting bolts and remove vibration damper and pulley from hub.

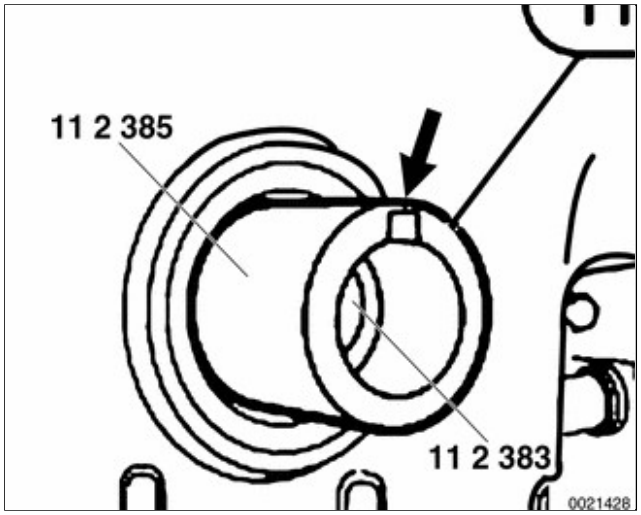
- Remove crankshaft hub (up to 1/2000 production) or vibration damper (1/2000 and later production).

Note:

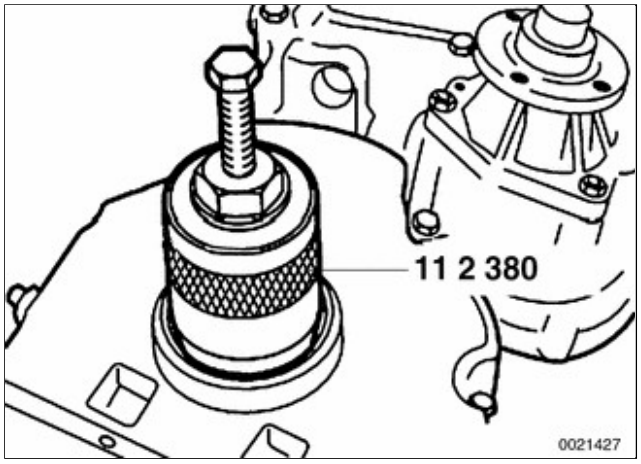
If necessary, use BMW special tool 11 8 219 or equivalent puller to remove

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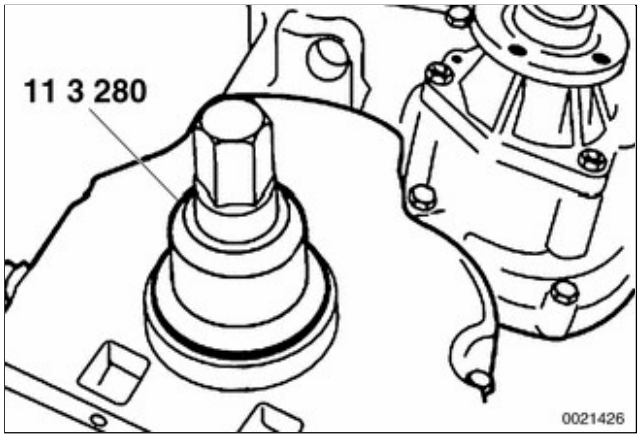
hub from crankshaft.



- Place special tool 11 2 383 on end of crankshaft to cover threaded hole, and fit special tool 11 2 385, aligning groove in 11 2 385 with keyway on crankshaft (**arrow**).



- Put special tool 11 2 380 over tools installed on crankshaft, and screw in until it makes firm contact with the seal. Tighten screw in end of 11 2 380 to draw out seal.



- To install new seal, coat with oil, and use special tool 11 3 280 and crankshaft center bolt to draw seal in flush with timing case cover.

  - Install crankshaft hub (up to 1/2000) or vibration damper (from 1/2000) to crankshaft. Install new crankshaft center bolt finger tight.

  - Torque crankshaft hub center bolt, using special tools 11 2 150/11 2 410 (up to 1/2000) or 11 8 190/11 8 200 (from 1/2000). nothing

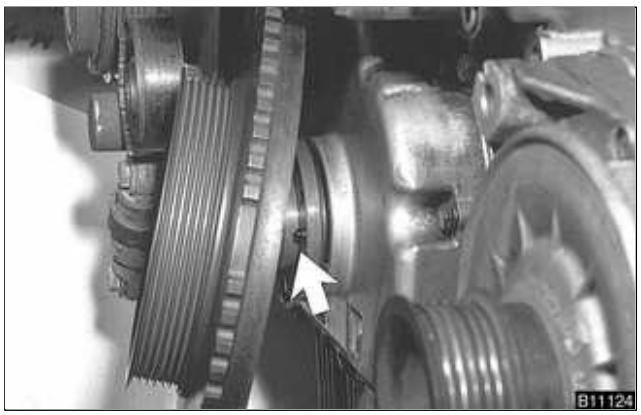
Tightening torque	
Vibration damper	410 Nm (302

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Tightening torque	
hub to crankshaft	ft-lb)

CAUTION!

Do not use BMW special tool 11 2 300 to hold crankshaft stationary to loosen or tighten crankshaft hub center bolt. Use only the special tools specified, or equivalent hub holding tool.



- Install vibration damper mounting bolts, where applicable. Note hub locating dowel (**arrow**).

Tightening torque	
Vibration damper to crankshaft hub (M8)	22 Nm (16 ft-lb)

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Camshaft Timing Chains, Removing

Camshaft timing chain removal requires that the engine oil pan be removed. This requires raising the engine and/or lowering the front suspension subframe. See ⇒ 119 Lubrication System. Also required is removal of the VANOS unit and disassembly of the intake and exhaust camshaft sprocket assemblies as described later in this repair group.

Special BMW service tools are needed for timing chain removal and installation procedures. The special tools assure proper timing of the valvetrain. Precise marks to set the timing on the camshafts are not provided for reassembly. Read the procedures through before beginning the job.nothing

CAUTION!

If the camshafts are not properly timed, the pistons can contact the valves.

- Disconnect negative (-) cable from battery.

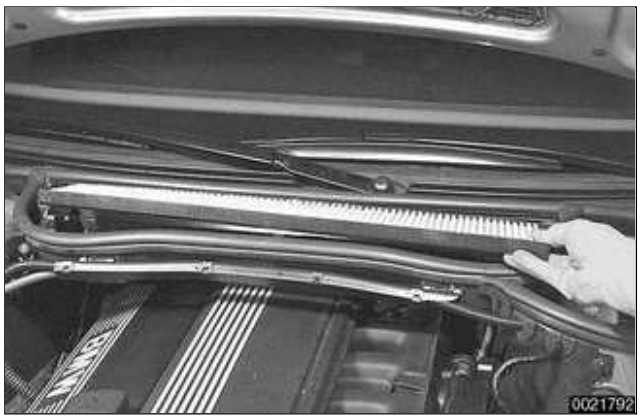
CAUTION!

- ***Disconnecting the battery may erase fault code(s) stored in control module memory. Check for fault codes using special BMW diagnostic equipment.***

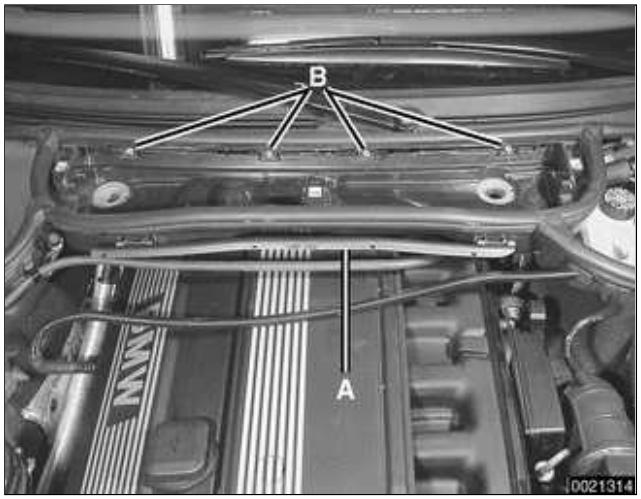
- ***Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page***

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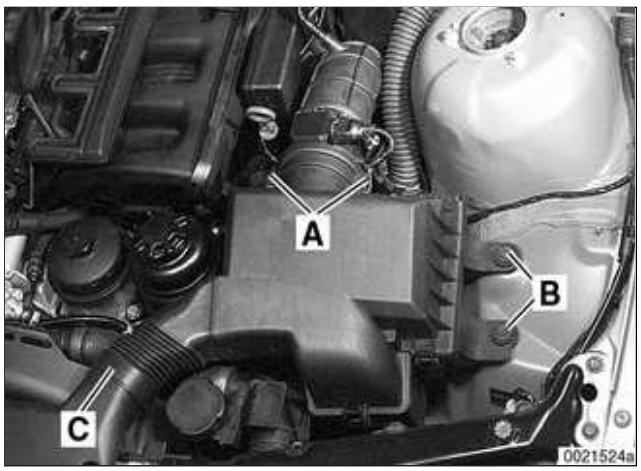
viii.



- Remove microfilter for interior ventilation.



- Remove microfilter housing:
  - Open wiring harness loom (**A**), remove harness and lay aside.
  - Unfasten screws (**B**) and take off lower microfilter housing.

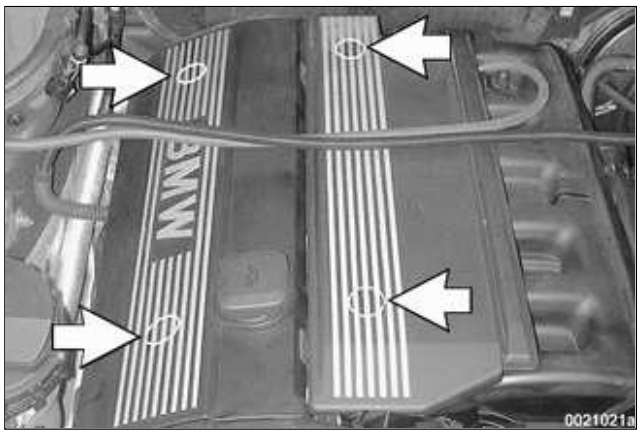


- Remove complete air filter housing:
  - Release mass air flow sensor clips (**A**).
  - Remove filter housing mounting screws (**B**).
  - Disconnect air duct connections (**C**) and lift complete air filter housing out of engine compartment, pulling it forward away from mass air flow sensor.

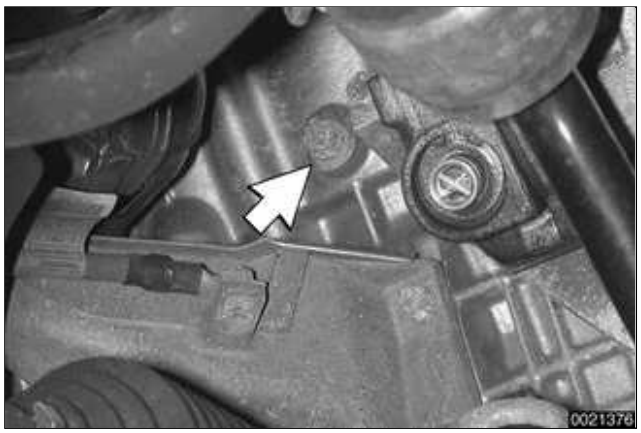
Note:

Mass air flow sensor remains attached to air duct in above step.

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- Remove engine covers:
  - Remove plastic trim covers (**arrows**).
  - Remove cover hold down bolts.



- Drain engine coolant and remove coolant hoses.
  - Remove expansion tank cap on radiator.
  - Place a 3-gallon pail beneath engine to capture coolant.
  - Remove engine block drain plug on exhaust side near cylinder 2 (**arrow**).

WARNING!

- ***Allow engine to cool before opening or draining cooling system.***
- ***Use caution when draining and disposing of engine coolant. Coolant is poisonous and lethal to humans and pets. Pets are attracted to coolant because of its sweet smell and taste. Consult a veterinarian immediately if ingested by an animal.***

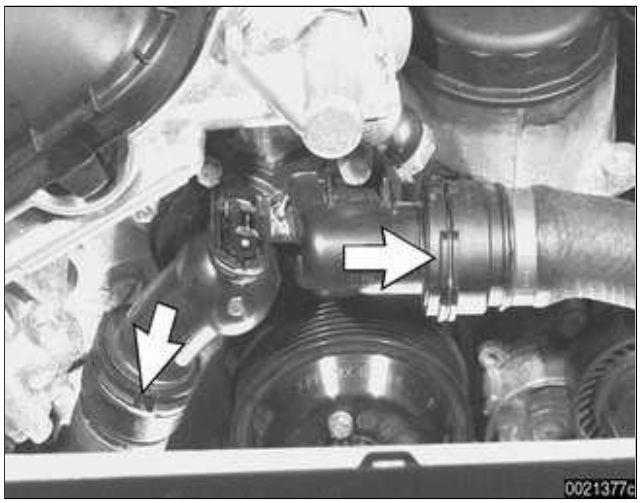
- Drain radiator into 3-gallon pail by removing plastic drain plug at lower left corner of radiator.

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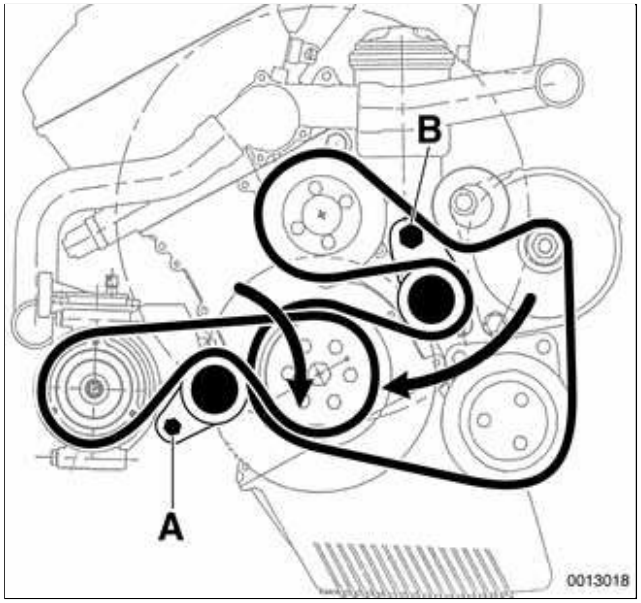
- Remove radiator cooling fan shroud and viscous clutch cooling fan (cars with automatic transmission) or electric cooling fan (cars with manual transmission). See ⇒ 170 Radiator and Cooling System

CAUTION!

On cars with viscous clutch, 32 mm cooling fan mounting nut has left hand threads.



➢ Release locking clips and pull hoses from thermostat housing (**arrows**). Unbolt and remove thermostat houses.



➢ Remove drive belts:

- ♦ Use long-handled wrench to turn A/C belt tensioner hex (**A**) clockwise (against spring tension). Remove A/C belt.
- ♦ Similarly, turn main engine drive belt tensioner hex (**B**) clockwise and remove belt.
- Remove coolant pump pulley.
- Remove alternator cooling duct at radiator support.

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- Drain engine oil and remove oil pan as described in ⇒ 119 Lubrication System.

- On cars produced up to 1/2000 with 2-piece vibration damper: Remove vibration damper mounting bolts and separate vibration damper and pulley from crankshaft hub.

Note:

Cars built up to January 2000 are fitted with a 2-piece vibration damper and hub assembly. Cars built from January 2000 use an integral vibration damper and hub assembly.

- Using BMW special holding tool, secure crankshaft hub to prevent crankshaft from turning. Loosen but do not remove crankshaft hub center bolt.

CAUTION!

Do not use BMW special tool 11 2 300 (flywheel locking tool) to hold crankshaft stationary to loosen or tighten crankshaft hub center bolt. Use only the special tools specified, or equivalent hub holding tool.

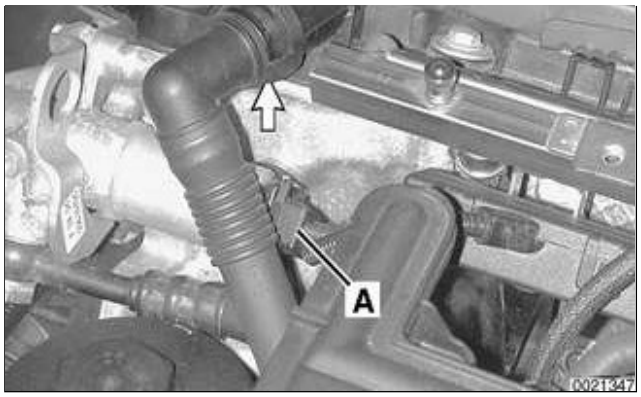
Note:

The crankshaft hub center bolt is tightened to a torque of 410 Nm (300 ft-lb). BMW special tools 11 2 150 and 11 2 410 (up to 1/2000 models) or 11 8 190 and 11 8 200 (1/2000 and later models) should be used to hold the crankshaft stationary while the bolt is loosened.



- Working at top center of engine, disconnect vent hose by squeezing at

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fitting (**arrows**).

- Disconnect electrical connection at intake camshaft position sensor (**A**).



➢ Remove ignition coils and spark plugs:

- ♦ Pull up on retaining clips to disconnect ignition coil harness connectors.
- ♦ Remove grounding straps at coil mounting studs.
- ♦ Remove all ignition coils.
- ♦ Remove spark plugs.

- Remove cylinder head cover mounting fasteners and remove cylinder head cover.

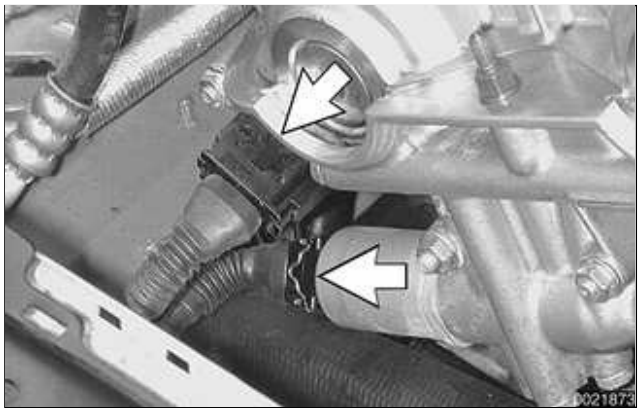
Note:

The cylinder head cover mounting bolt insulators, gaskets and coil grounds should be reinstalled in their original locations.

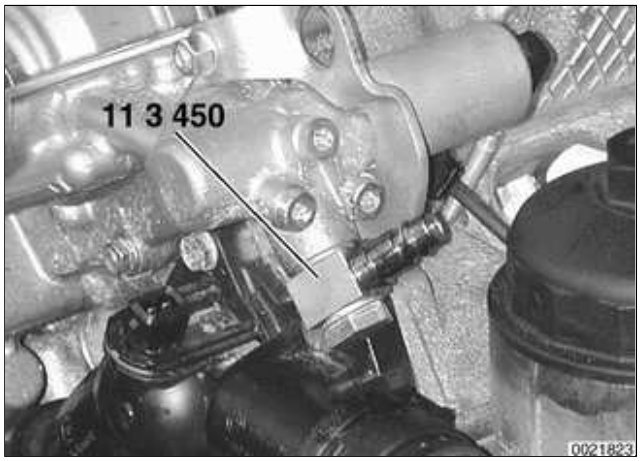


➢ Remove oil baffle cover from intake camshaft.

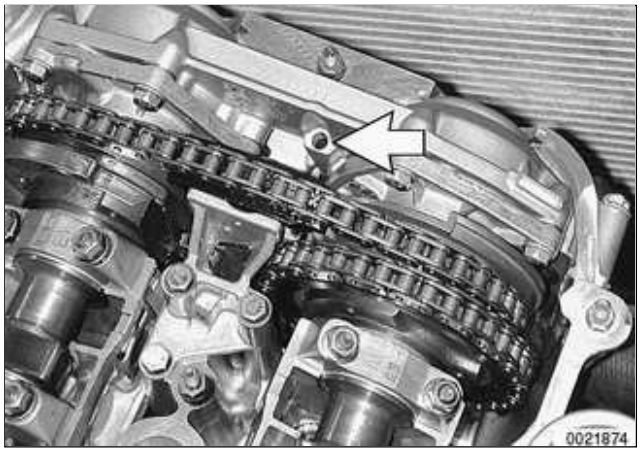
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- Working at left front of cylinder head, disconnect electrical connections at exhaust camshaft position sensor and exhaust camshaft VANOS control valve (**arrows**).

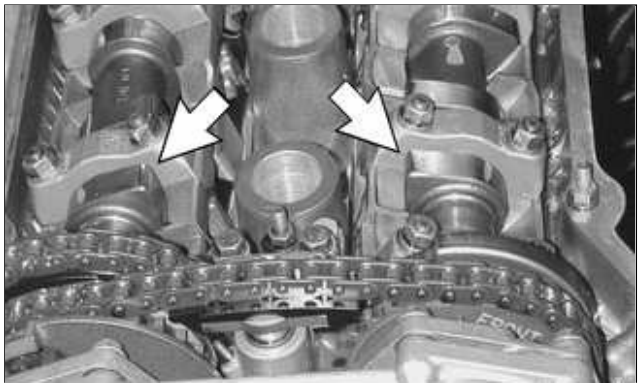


- Remove banjo bolt from VANOS control unit oil pressure line. Use banjo bolt to attach BMW special tool 11 3 450 (compressed air fitting) (**arrow**) to VANOS unit.



- Cover oil hole in VANOS unit (arrow) with shop towel to capture oil which will spray when compressed air line is connected.

  - Connect compressed air line to air fitting. Apply air pressure set to 2 - 8 bar (30 - 110 psi).



- With compressed air line connected, rotate engine in direction of rotation (clockwise) at least two full rotations, leaving cylinder 1 intake and exhaust camshaft lobes facing each other, as shown (**arrows**).

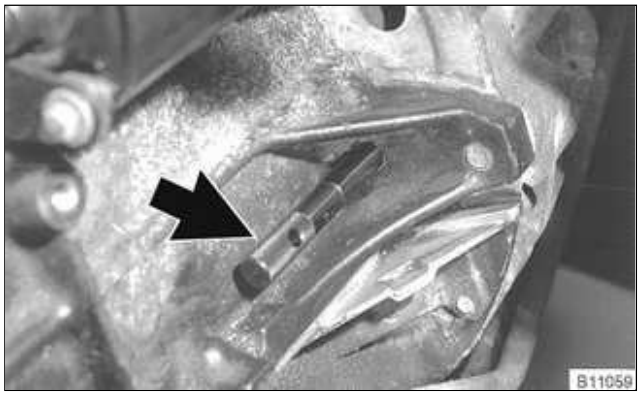
CAUTION!

Do not rotate engine

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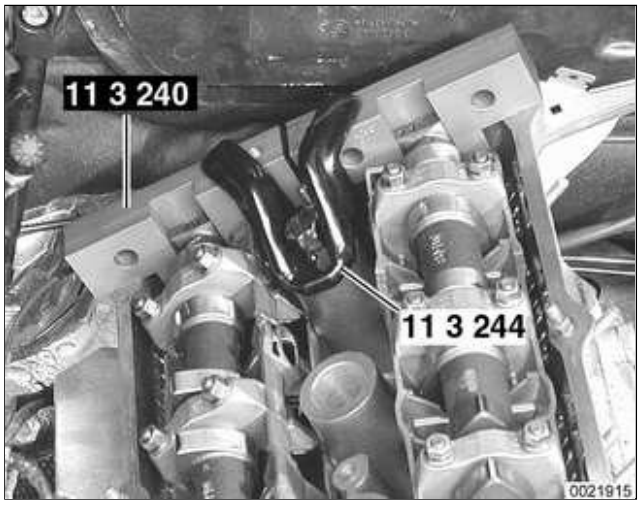
counterclockwise to reach the top dead center position. Instead, complete another two complete rotations.



- Remove sealing plug from bore on lower left side of engine block below starter. Secure crankshaft in TDC position with BMW special tool 11 2 300 (**arrow**).



- Unscrew and remove threaded studs (**arrows**) at rear of cylinder head.

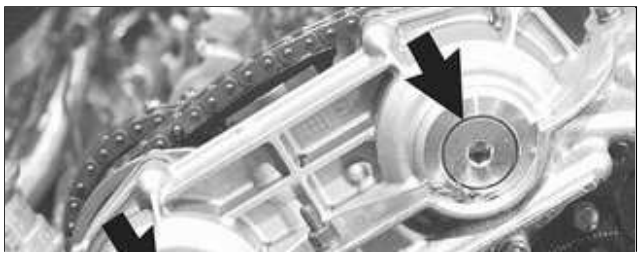


- Secure camshafts in TDC position using BMW special tools 11 3 240 and 11 3 244.

  - Detach compressed air line, leaving compressed air fitting attached to VANOS unit.

Note:

Oil will drain from pressure line. Have a container and rags ready.



- Unscrew sealing plugs from VANOS unit (**arrows**).

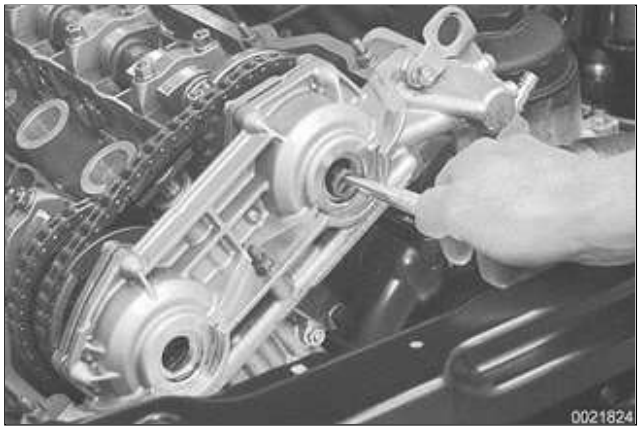
Note:

Oil will drain from sealing plug bores.

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Have a container and rags ready.



- Pull sealing caps straight out of VANOS unit with BMW special tool 11 6 170, or with short nose pliers.

Note:

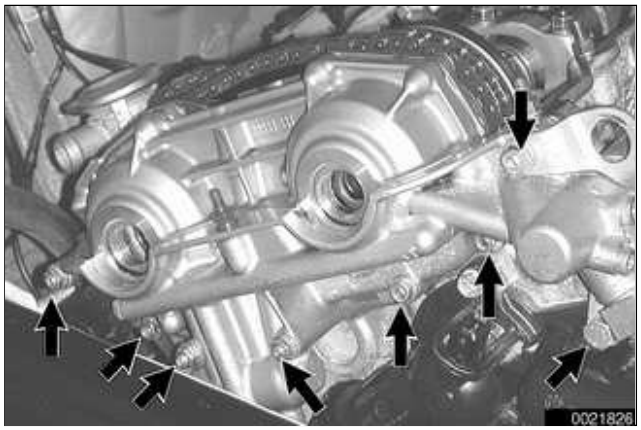
Additional oil may drain from VANOS unit.



- Remove set screws (left hand thread) on ends of intake and exhaust camshafts.

CAUTION!

Set screws have left hand threads. Remove with a clockwise motion.



- Remove VANOS unit:
  - Remove fasteners from engine support eye.
  - Remove VANOS mounting nuts (**arrows**) from cylinder head. Slide VANOS unit and metal gasket off.

CAUTION!

Do not crank or turn over engine with VANOS unit removed. Piston/valve interference is possible.

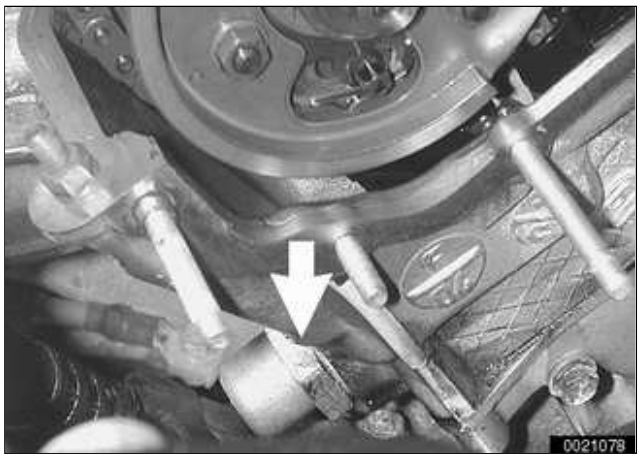
Note:

- *The VANOS unit will contain*

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residual oil. Place shop towels beneath adjustment unit when removing.

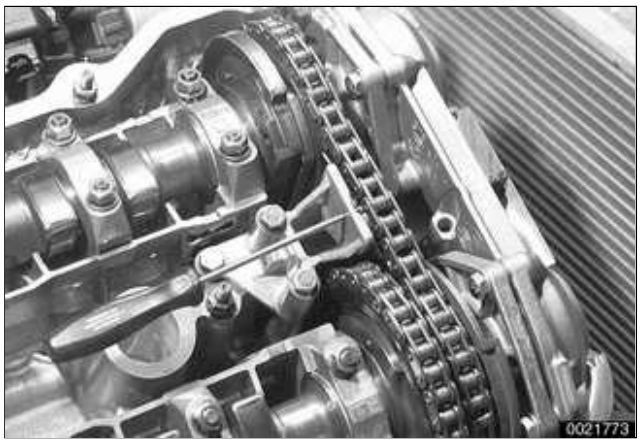
- *If the VANOS control unit is replaced, or if repair operations are completed that may change camshaft timing, the camshaft timing must be checked as described later in this chapter.*



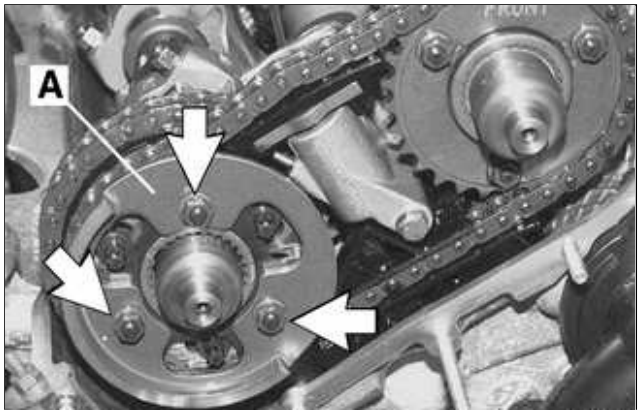
- Remove primary camshaft chain tensioner (**arrow**) from timing chain cover.

CAUTION!

Primary camshaft chain tensioning piston is under spring pressure.



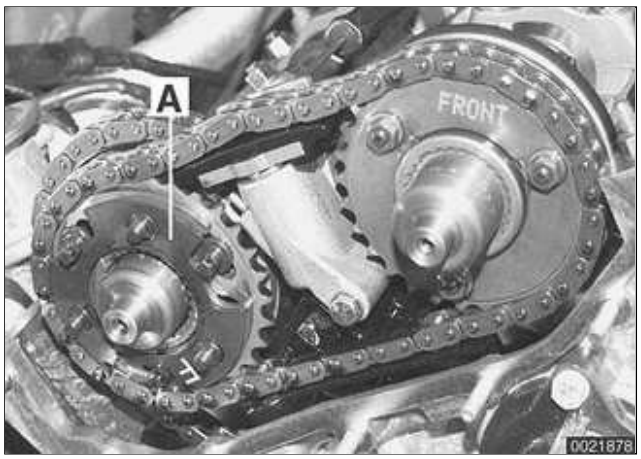
- Press down on secondary chain tensioner and lock into place using BMW special tool 11 3 292 or a similar size rod.



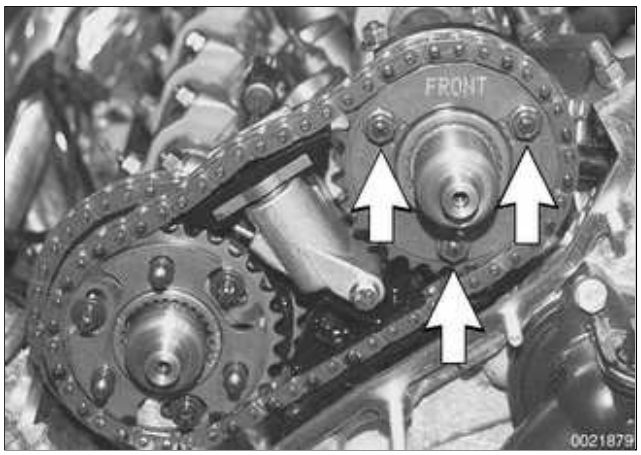
- Remove exhaust camshaft impulse wheel mounting nuts (**arrows**). Remove impulse wheel (**A**).

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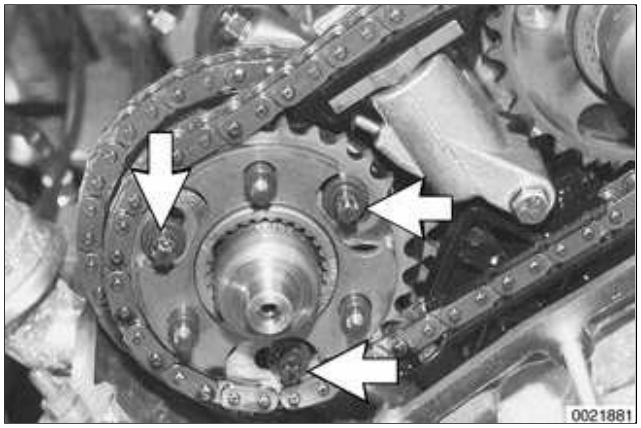




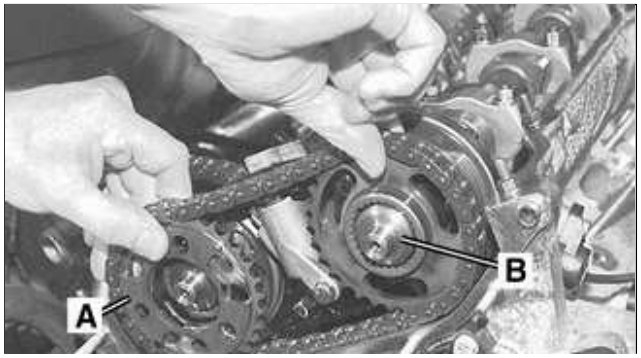
- Remove spring plate (**A**).



- Remove intake camshaft sprocket mounting nuts (**arrows**) and remove spring plate (labelled **FRONT**).



- Remove torx screws from exhaust camshaft sprocket (**arrows**).



- Lift off exhaust and intake sprockets together with secondary chain, thrust spacer (**A**) and splined shaft (**B**).

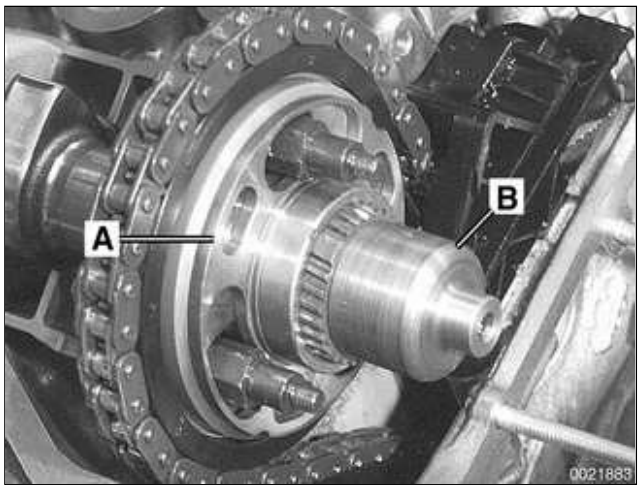
CAUTION!

Splined shafts for both intake and exhaust camshafts share the same part number. Remove and mark used

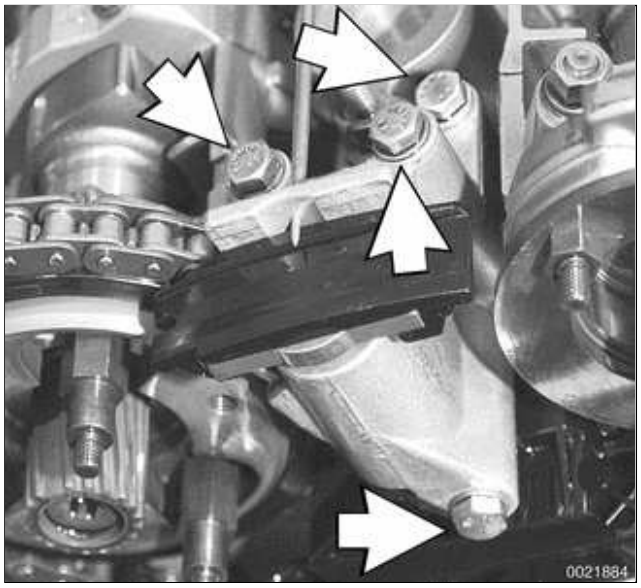
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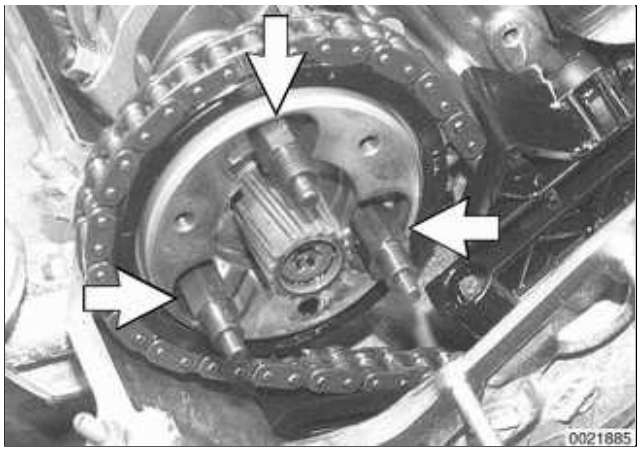
splined shafts in order to reinstall in original locations.



- Remove exhaust camshaft splined sleeve (**A**) and shaft (**B**).



- Remove secondary chain tensioner mounting bolts (**arrows**). Remove tensioner while keeping locking pin in place.

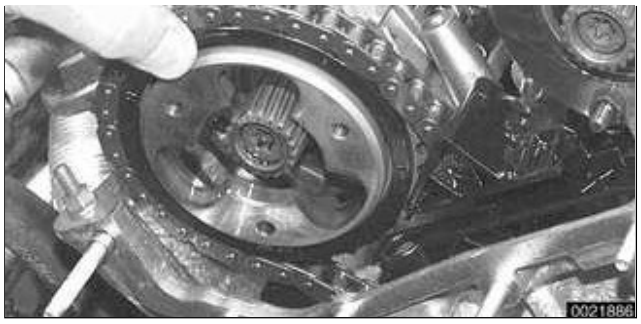


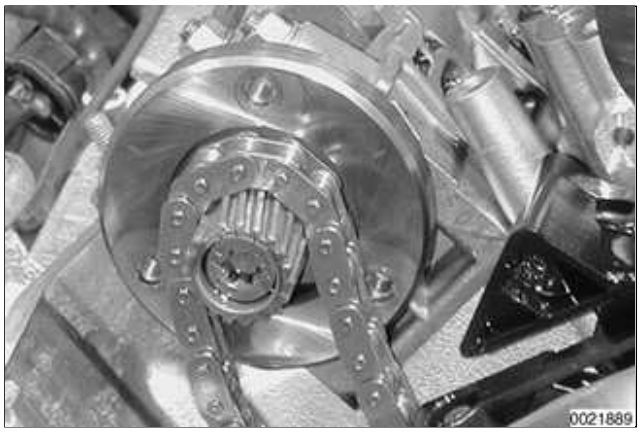
- Remove primary chain sprocket mounting studs (**arrows**) on exhaust camshaft.



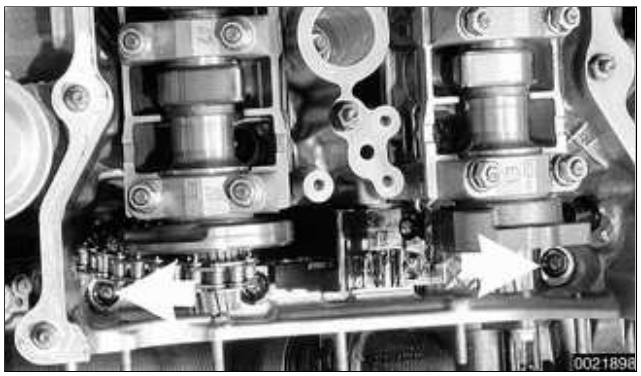
- Lift primary chain sprocket off exhaust camshaft. Remove sprocket from chain.

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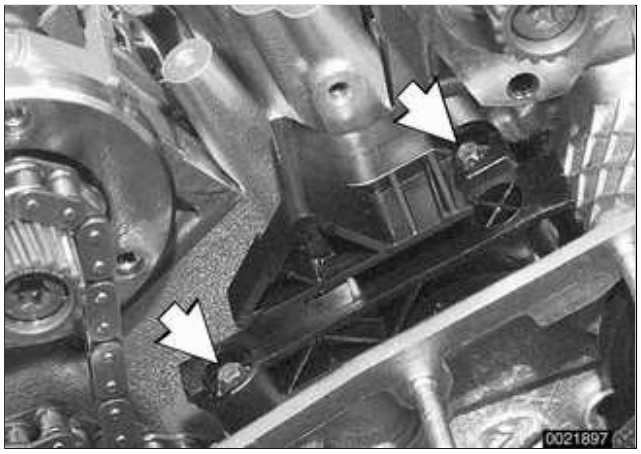




- Set timing chain on exhaust camshaft end.



- Working in cylinder head cavity, remove timing chain cover bolts (**arrows**).



- Remove secondary chain lower guide bolts (**arrows**). Remove chain guide.

Note:

Bolt on intake camshaft side is long and extends into timing chain cover.

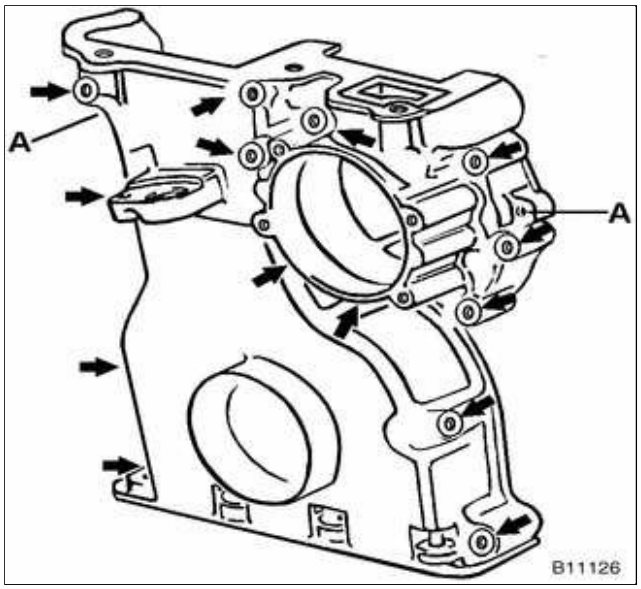
- Remove crankshaft hub center bolt and remove crankshaft hub (to 1/2000 models) or vibration damper (models from 1/2000).

CAUTION!

The crankshaft must not be allowed

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to rotate when the timing chains are loosened or removed. The pistons can contact the valves.



- Using a drift of less than 5 mm diameter, drive two locating dowels (**A**) in left and right sides of lower timing chain cover toward rear of car. Remove cover mounting bolts (**arrows**) and carefully lift cover off.

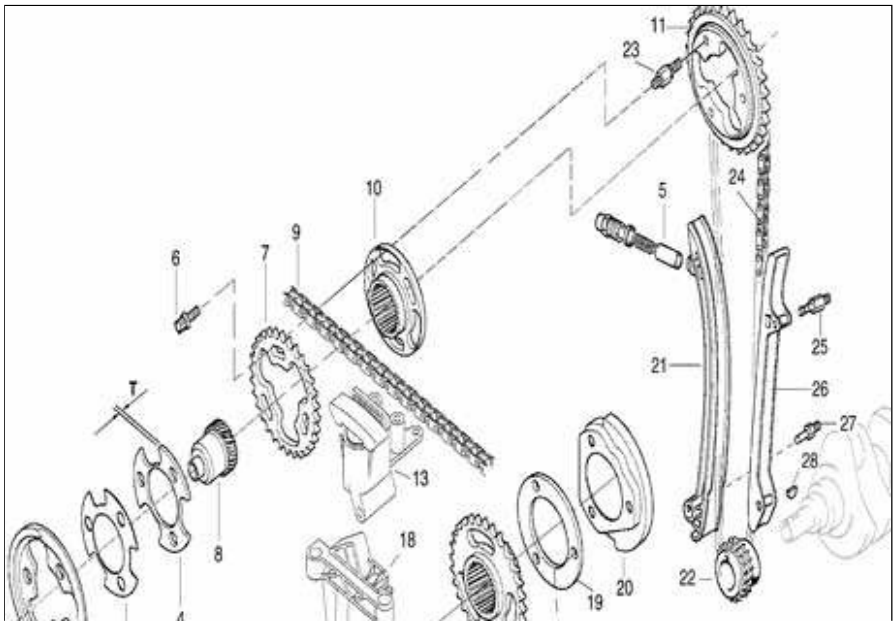
CAUTION!

Use care when removing the cover from the cylinder head gasket. If the cover is stuck, use a sharp knife to separate it from the head gasket.

Note:

- *The chain cover can be removed with the coolant pump installed.*
- *Use care when removing the cover from the coolant pipe at rear.*

- Push primary chain tensioner guide rail aside and remove chain.



Double VANOS components (M52 TU, M54 engine)

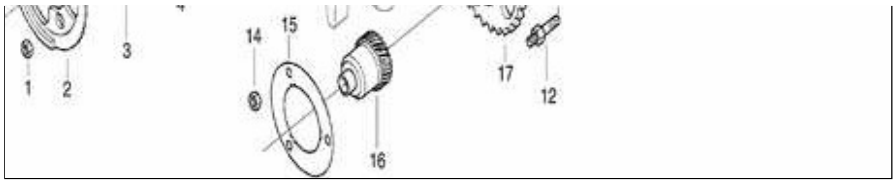
1 - Impulse wheel mounting nut

2 - Camshaft impulse wheel (exh.)

3 - Spring plate

4 - Thrust spacer (T = 3.5 mm)

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5 - Primary chain tensioner

6 - Torx screw

7 - Exhaust secondary sprocket

8 - Splined shaft

9 - Secondary timing chain

10 - Splined sleeve

11 - Primary sprocket

12 - Threaded stud

13 - Secondary chain tensioner

14 - Sprocket mounting nut

15 - Spring plate

16 - Splined shaft

17 - Intake camshaft sprocket

18 - Secondary chain lower guide

19 - Thrust spacer

20 - Camshaft impulse wheel (intake)

21 - Chain tensioner rail

22 - Crankshaft sprocket

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23 - **Threaded stud**

24 - **Primary chain**

25 - **Threaded stud**

26 - **Guide rail**

27 - **Threaded stud**

28 - **Woodruff key**

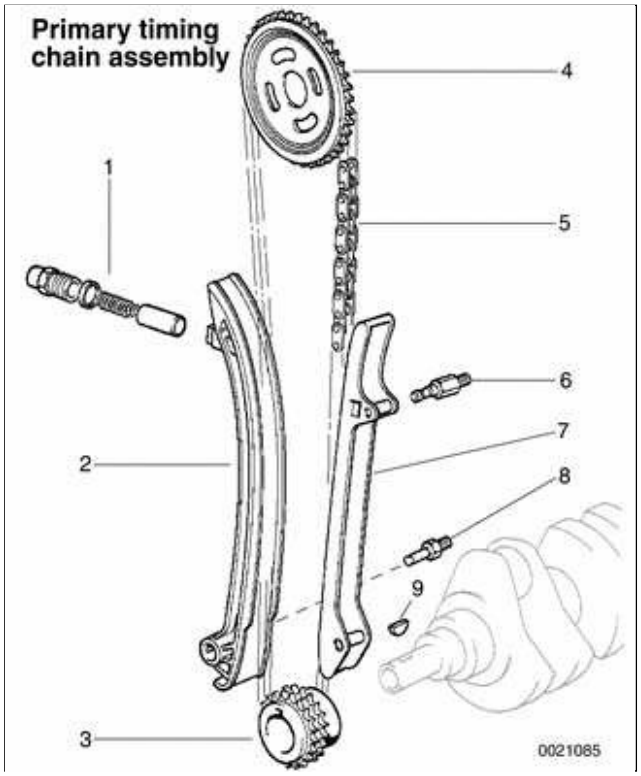
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Camshaft timing chains, Installing

CAUTION!

The procedure outlined below assumes that the camshafts and the crankshaft are locked in the TDC installation position with special locking tools as shown earlier.



- Inspect timing chain sprockets. Inspect guide rail and tensioner rail for deep grooves caused by chain contact. Replace any part that is worn or damaged.

1 - Primary chain tensioner

2 - Chain tensioner rail

3 - Crankshaft sprocket

4 - Exhaust camshaft sprocket

5 - Primary chain

6 - Anchor bolt

7 - Guide rail

8 - Anchor bolt

9 - Woodruff key

Note:

If any sprockets are being replaced due to wear, the chain should also be replaced. If the crankshaft sprocket requires replacement, the oil pump drive sprocket and chain must be removed. See ⇒ 119 Lubrication System for oil pump removal information.

- Install primary timing chain to crankshaft sprocket and hang

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upper end from exhaust camshaft.

- If necessary, replace crankshaft seal as described earlier.

- To install lower timing case cover:

♦ Clean cover and cylinder block sealing surfaces.

♦ Use new gaskets and coolant pipe O-ring.

♦ Drive timing cover dowels in until they just protrude slightly from sealing surface.

♦ Apply a small bead of silicon sealer (3-Bond 1209® or equivalent) to corners of cylinder head where timing cover meets cylinder head and engine block.

♦ Tap cover into position to engage dowels.

♦ Install all bolts hand tight, including two Torx bolts from above.

♦ Install secondary chain lower guide.

♦ Drive dowels in flush to front of cover.

♦ Tighten cover mounting bolts alternately and in stages.

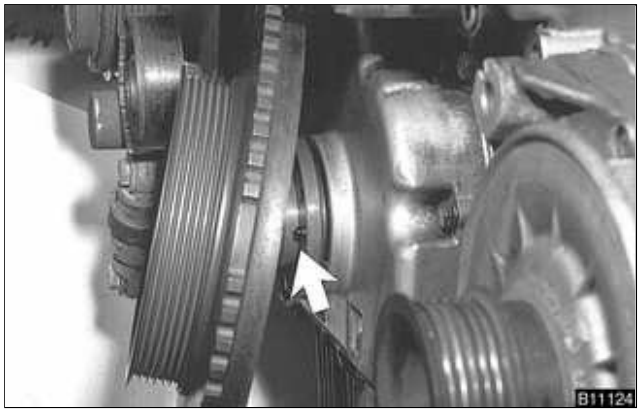
Tightening torques

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Tightening torques	
Lower timing cover to cylinder block (M6)	10 Nm (89 in-lb)

- Install oil pan with new gasket. See ⇒ 119 Lubrication System.

Tightening torque	
Oil pan to engine block (M6)	
8.8 grade	10 Nm (89 in-lb)
10.9 grade	12 Nm (9 ft-lb)

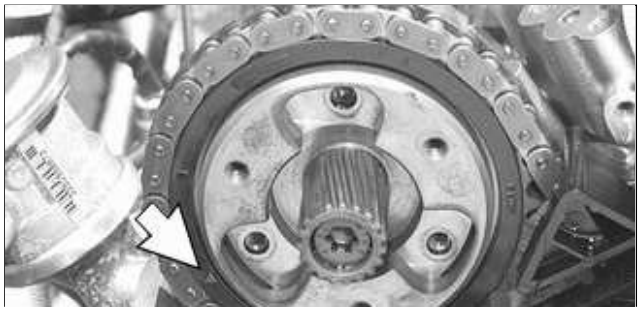


- Install crankshaft hub or vibration damper to crankshaft. Install crankshaft center bolt finger tight. Make sure hub is fully seated, noting alignment dowel (**arrow**), where applicable.

Note:

Cars built up to January 2000 are fitted with a 2-piece vibration damper and hub assembly. Cars built from January 2000 use an integral vibration damper and hub assembly. If the early vibration damper needs to be replaced, only the single piece with integral hub is available from BMW.

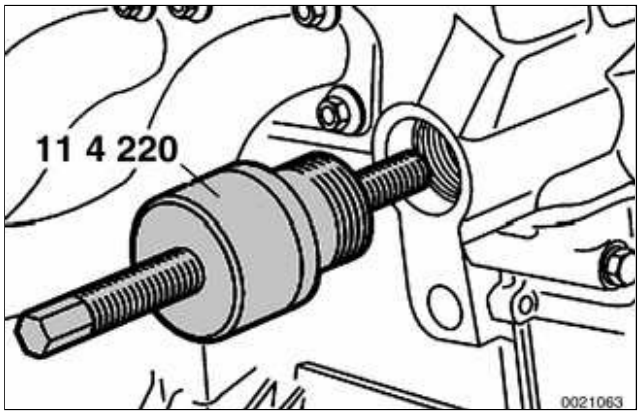
Tightening torque	
Vibration damper to crankshaft hub (M8)	22 Nm (16 ft-lb)



- Fit top sprocket to primary timing chain and install on exhaust camshaft so that pointer (**arrow**) on sprocket lines up with cylinder head sealing surface.

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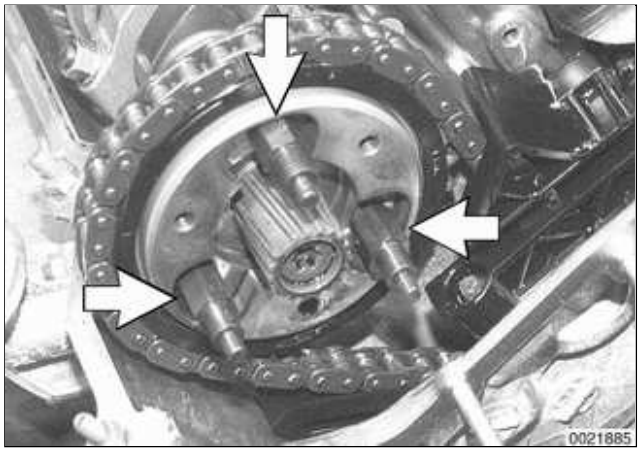


- Insert BMW special tool 11 4 220 in cylinder head and screw in adjustment screw by hand just until it contacts tensioning rail.

Note:

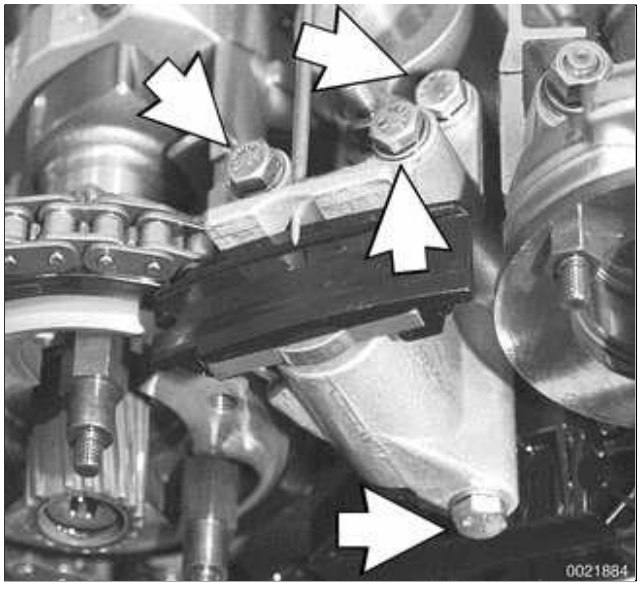
BMW special tool 11 4 220 is a dummy primary chain tensioner and simulates the function of the tensioner.

  - Make sure arrow on top primary sprocket is still lined up with upper edge of cylinder head. Reposition sprocket if necessary.



- Install and tighten down threaded locating studs (**arrows**) in end of exhaust camshaft.

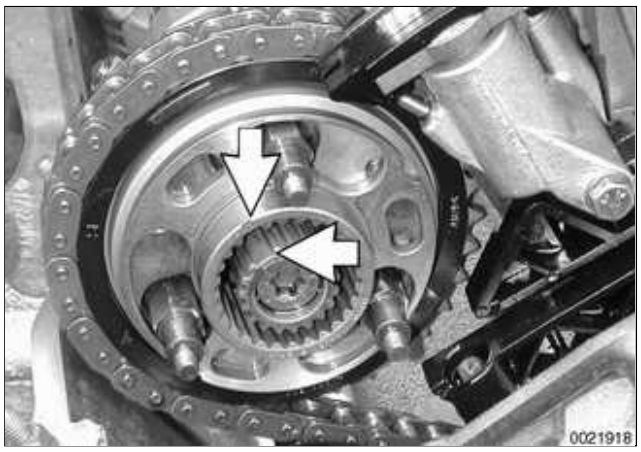
Tightening torques	
Exhaust camshaft locating stud	20 Nm (15 ft-lb)



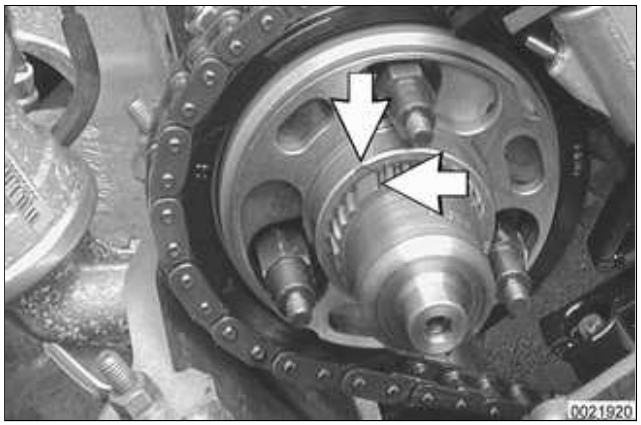
- Install secondary chain tensioner on cylinder head.

  - Make sure tensioner is locked in compressed position as described earlier.

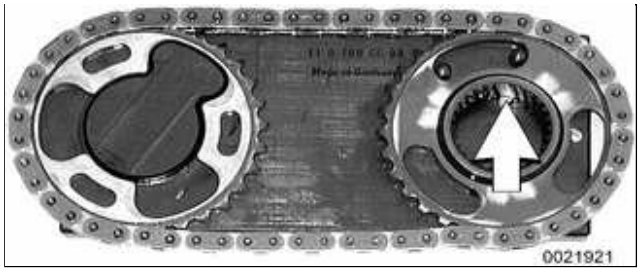
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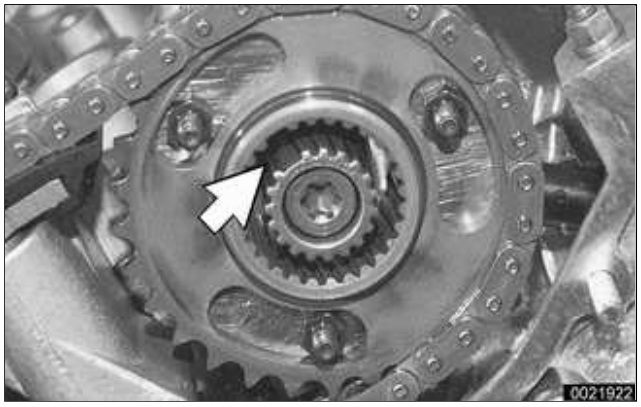
- Fit exhaust camshaft splined sleeve, aligning gap in sleeve splines with corresponding gap on camshaft splines (**arrows**).



- Slide splined shaft onto exhaust camshaft, aligning larger tooth with corresponding gap of splined sleeve.
  - Slide splined shaft in further until 3 small slots in splined sleeve are centered on 3 threaded holes in sprocket.



- Place intake and exhaust sprockets in BMW special tool 11 6 180. Position spline gap on intake sprocket (**arrow**) as shown and place secondary chain on sprockets.



- Carefully remove chain and sprockets from tool and slide onto camshafts. Align gap in intake sprocket splines with corresponding gap in camshaft splines (**arrow**).

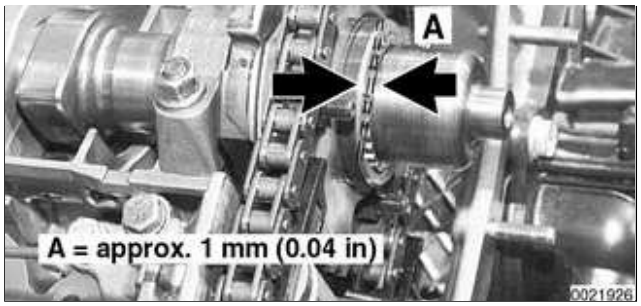
CAUTION!

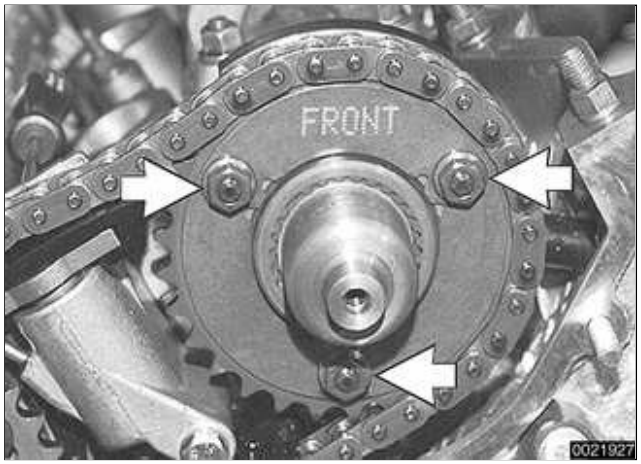
Do not alter position of sprockets with respect to chain when removing from special tool 11 6 180.



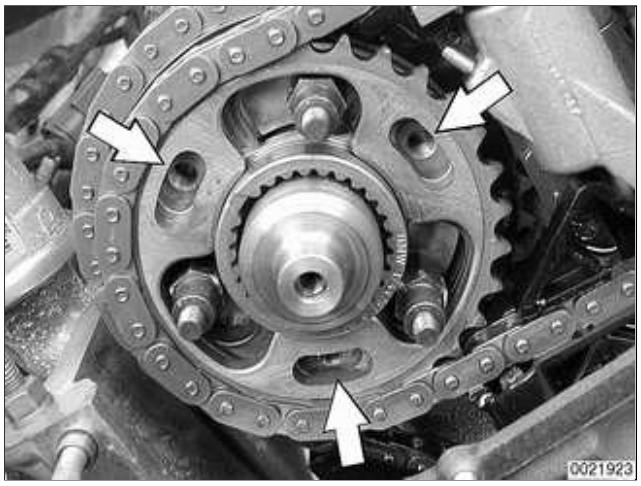
- Slide splined shaft onto intake camshaft until approx. 1 mm (0.04 in.) of splines can still be seen.

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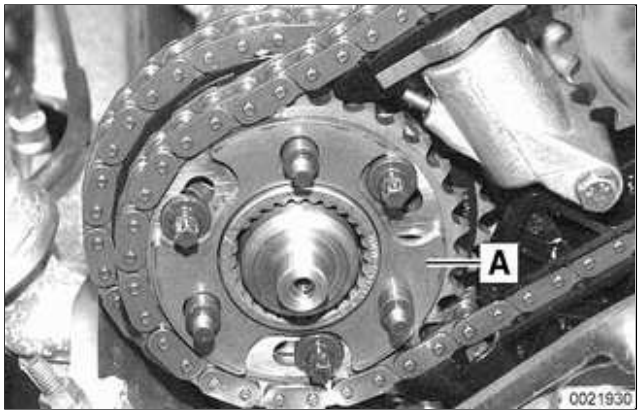




- Install intake camshaft spring plate so that FRONT mark is visible. Install mounting nuts (**arrows**) finger tight.

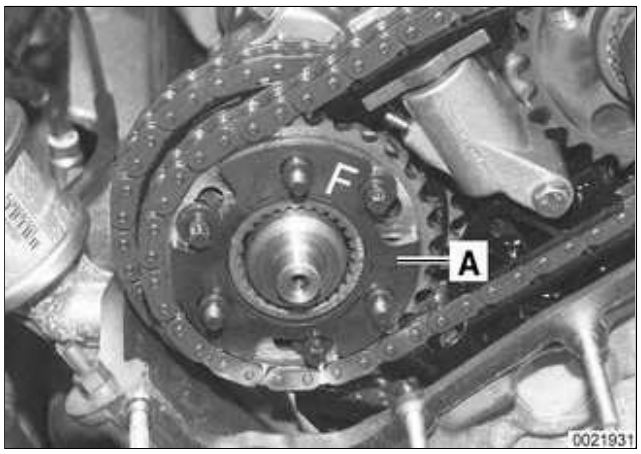


- Working at exhaust side, insert sprocket mounting Torx screws into threaded holes (**arrows**).
  - Initially tighten screws to approx. 5 Nm (44 in-lb). Back off half a turn.



- Fit thrust spacer (**A**) on exhaust camshaft.

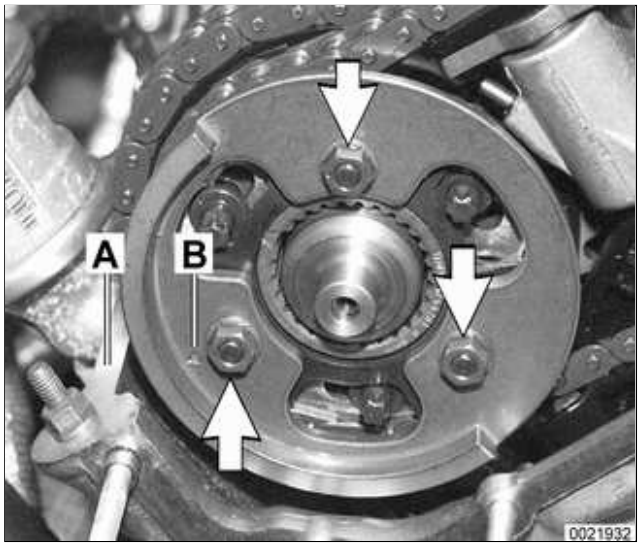
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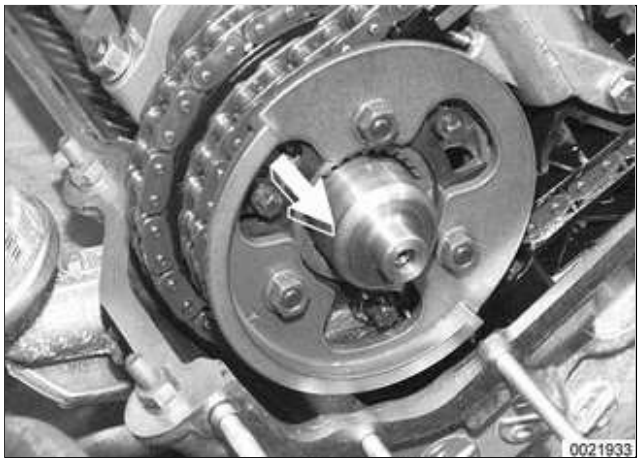
- Install spring plate (**A**) to exhaust camshaft. Make sure that **F** marking is visible.

  Note:

  If F marking is no longer visible, install spring plate so that convex side points forward (toward front of car).



- Install exhaust camshaft impulse wheel, aligning mark (**B**) with top edge of cylinder head (**A**). Install mounting nuts (**arrows**) finger tight.



- Pull out exhaust splined shaft until it stops.

  - Press down on secondary chain tensioner and remove tensioner lock-down tool.



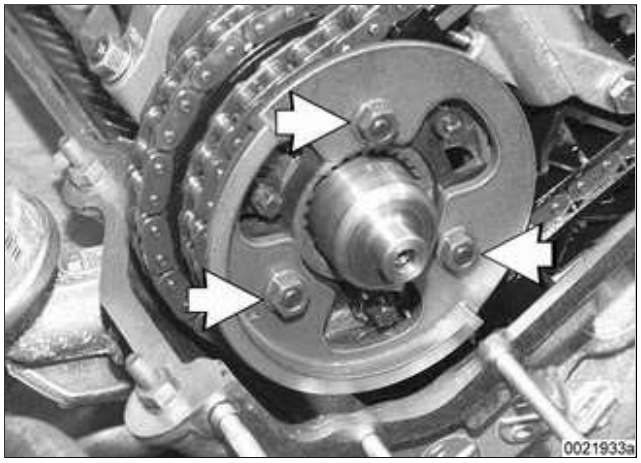
- Preload primary chain:

  - Tighten adjusting screw on BMW special tool 11 4 220 to specified torque.

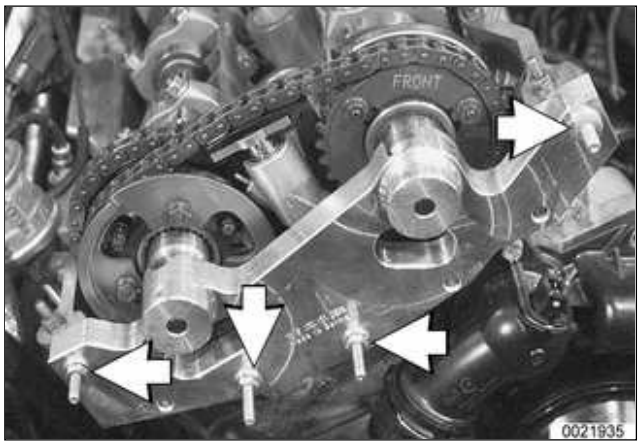
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Tightening torque	
Primary chain tensioner preload	0.7 Nm (6 in-lb)



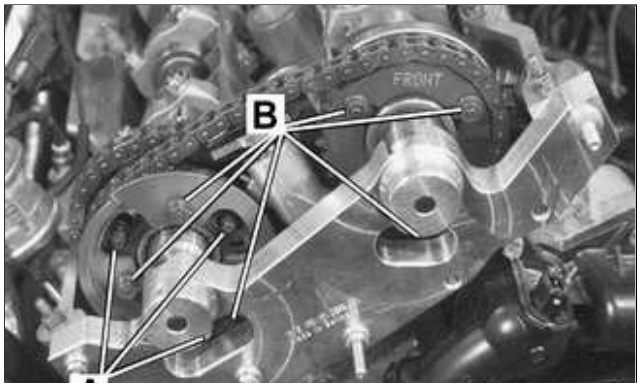
- Preload exhaust camshaft spring plate by pressing on impulse wheel while tightening mounting nuts (**arrows**) finger tight.



- Install BMW special tool 11 6 150 (VANOS setup bracket) to front of cylinder head timing case.
  - Tighten tool mounting nuts (**arrows**) by hand, and then tighten down uniformly until special tool is firmly contacting cylinder head.

CAUTION!

Make sure all gasket material is removed from face of cylinder head. Clean sealing face and keep free of oil. If any foreign material is present on the sealing surface, the camshaft timing will be incorrect.



- Secure camshaft sprockets and impulse wheels:
  - Tighten mounting screws (**A**) on exhaust camshaft impulse wheel to approx. 5 Nm (44 in-lb).
  - Tighten mounting nuts (**B**) on

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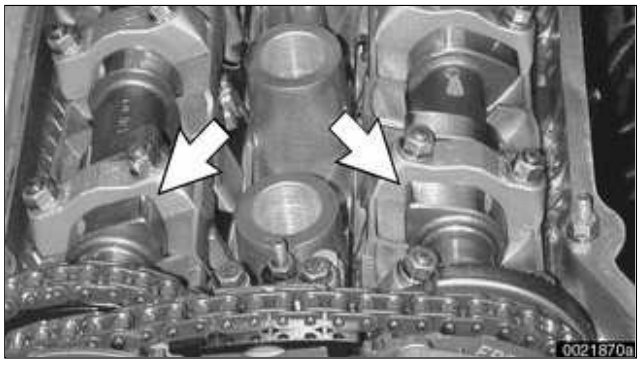
exhaust and intake sprocket assemblies to approx. 5 Nm (44 in-lb).

- Torque down mounting screws (**A**) and nuts (**B**) to final specifications.

Tightening torques	
Sprocket assembly to camshaft initial torque	5 Nm (44 in-lb)
Sprocket assembly to camshaft	
M7 Torx screw (**A**)	20 Nm (15 ft-lb)
M6 mounting nut (**B**)	10 Nm (89 in-lb)

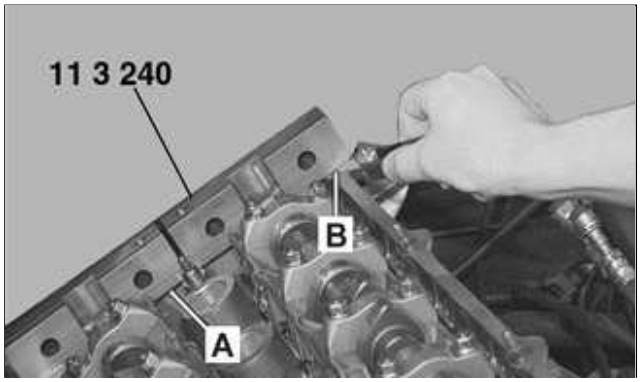
- Remove flywheel locking tool from transmission bellhousing so that crankshaft is no longer secured.

- Remove camshaft locking tools from rear of camshafts.



- Crank engine over by hand twice in direction of rotation until cylinder 1 intake and exhaust camshaft lobes (**arrows**) face each other.

- Secure crankshaft in TDC position with BMW special tool 11 2 300.



- Place BMW special tool 11 3 240 over camshaft ends and measure clearance of tool to cylinder head surface.

Note:

- *If the exhaust side of the tool is not flush with the head (gap **A**), retime the camshafts as described later in*

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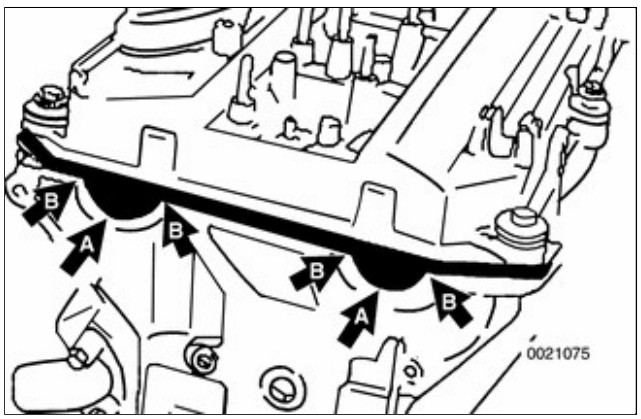
this repair group.

- *Due to flexible sprocket design, VANOS unit tolerances, and play in the VANOS splines, when the camshaft timing is set correctly, the intake side of special tool 11 3 240 may be up to 1 mm (0.04 in) above the surface of the cylinder head (gap **B**). This is normal. Otherwise, retime the camshafts as described later in this repair group.*

- Remove VANOS setup bracket from front of cylinder head.

- Install VANOS unit. See ⇒ VANOS control unit, given later.

- Install intake camshaft oil baffle



➢ Install cylinder head cover.

- Check for correct seating of half-moon seals (**A**) in back of cylinder head cover.

- Use a small amount of 3-Bond®1209 or equivalent sealant at corners (**B**) of half-moon cutouts. Seal corners in front of cylinder head at VANOS unit.

Tightening torque	
Cylinder head cover to cylinder head	10 Nm (89 in-lb)

- Reassemble remainder of engine:

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- Torque crankshaft hub center bolt, using special tools 11 2 150/11 2 410 (to 1/2000) or 11 8 190/11 8 200 (from 1/2000).

CAUTION!

Do not use BMW special tool 11 2 300 (flywheel locking tool) to hold crankshaft stationary to loosen or tighten crankshaft hub center bolt. Use only the special tools specified, or equivalent hub holding tool.

- Reinstall air filter housing, engine covers, interior ventilation microfilter housing.

- Secure all coolant hoses, thermostat housing, engine coolant drains.

- Reinstall engine oil drain plug.

- Refill engine oil and coolant before running engine. Check for leaks.

Tightening torques	
Coolant drain plug to cylinder block	25 Nm (18 ft-lb)
Radiator cooling fan (viscous clutch) to coolant pump	40 Nm (30 ft-lb)
Radiator drain screw to radiator	2.5 Nm (22 in-lb)
Vibration damper hub to crankshaft	410 Nm (302 ft-lb)

- Use scan tool to check VANOS operation with engine idling.

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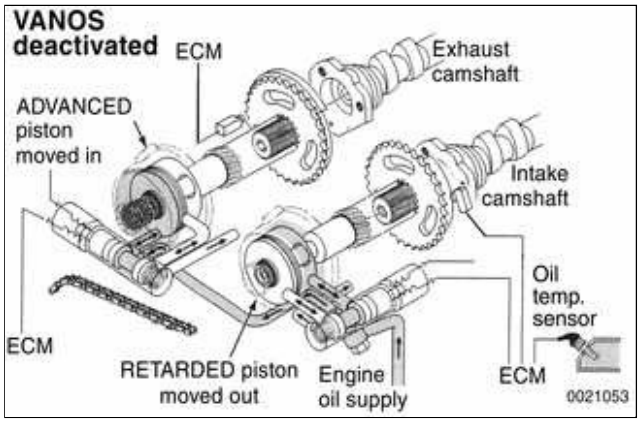
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Vanos

The main components of the double VANOS system are:

- Intake and exhaust camshafts with helical spline inserts
- Camshaft sprockets with adjustable gears
- VANOS actuators (two position piston housing with internal/external helical spline cup)
- Three-way solenoid switching valves
- Camshaft position impulse wheels
- Hall effect camshaft position sensors

Camshaft position is varied based on engine rpm, throttle position signal, intake air and coolant temperature.



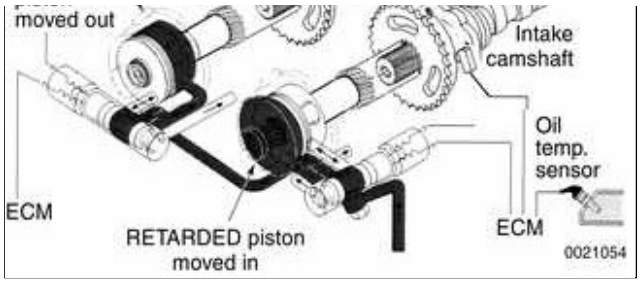
When engine is started, camshafts are in deactivated position:

- Intake camshaft is held in RETARDED position by oil pressure.
- Exhaust camshaft is held in ADVANCED position by preload spring and oil pressure.



Within 2 - 5 seconds (50 engine revolutions), the ECM begins monitoring and controlling camshaft

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positions.

The Double VANOS system allows full variability of camshaft timing up to the limits of the system. When the ECM detects that the camshafts are in optimum position, the solenoids are modulated at approximately 100 - 220 Hz to maintain oil pressure on both sides of the actuator pistons to maintain timing.

In models with DME MS 43.0 (model year 2001), the engine control module (ECM) detects camshaft position before the engine starts, thereby adjusting camshaft timing immediately upon start-up

Note:

- *BMW does not provide diagnostic information or specifications for the Double VANOS system. VANOS system troubleshooting and diagnostics is best accomplished using a scan tool.*

- *Diagnostic Trouble Codes (DTCs) pertaining to the VANOS system are listed in ⇒ Table a. See also ⇒ OBD On Board Diagnostics at the back of this manual.*

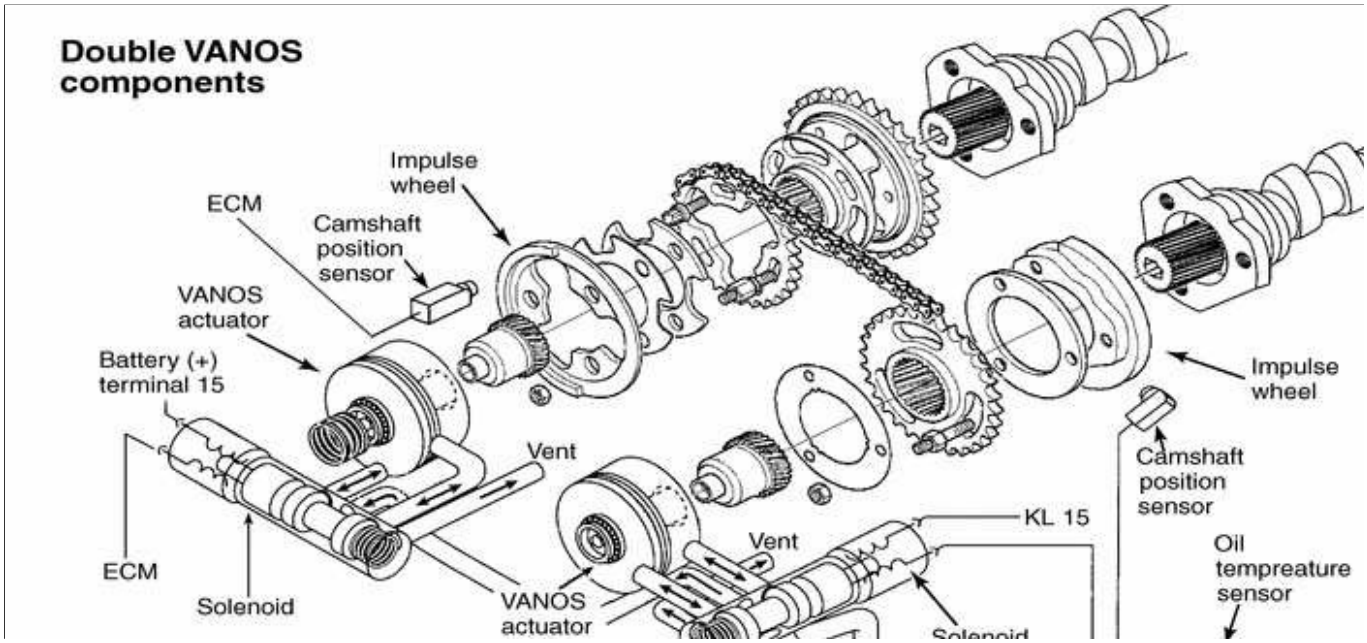
- *Elevated oil temperatures can cause VANOS to deactivate. Oil that is too thick (high viscosity) may cause a DTC to be set in the ECM. If VANOS is deactivated (limp-home mode), there will be a noticeable loss of power.*

Table a. VANOS fault codes		
BMW code	**P-code**	**Fault description**

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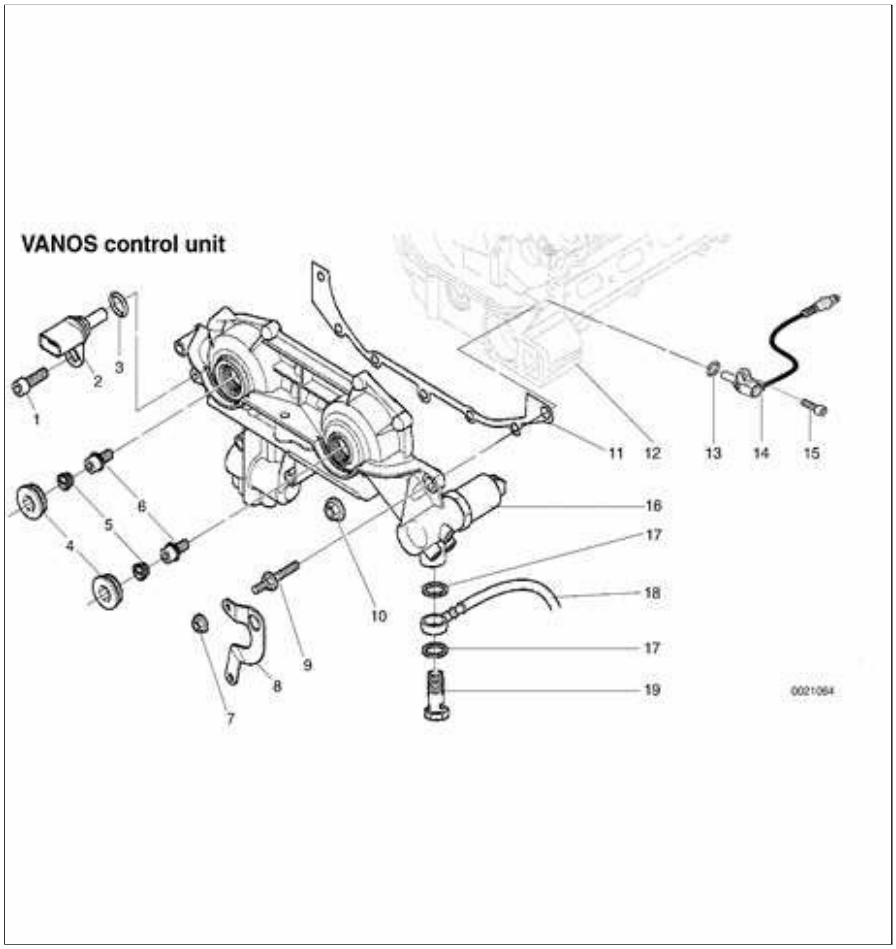
Table a. VANOS fault codes		
BMW code	**P-code**	**Fault description**
19	P1529	VANOS solenoid valve activation, exhaust
21	P1525	VANOS solenoid valve activation, intake
103	P1519	VANOS faulty reference value intake
104	P1520	VANOS faulty reference value exhaust
105	P1522	VANOS stuck (Bank 1) intake
106	P1523	VANOS stuck (Bank 2) exhaust

Double VANOS components



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VANOS control unit

1 - **Bolt M6**

2 - **Exhaust camshaft position sensor**

3 - **Sealing ring**

4 - **Camshaft end sealing plug**

- tighten to 50 Nm (37 ft-lb)

5 - **Camshaft seal cap**

6 - **VANOS hydraulic piston set screw**

- CAUTION: left hand thread
- tighten to 10 Nm (89 in-lb)

7 - **Nut M7**

- tighten to 14 Nm (10 ft-lb)

8 - **Engine lifting hook**

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9 - **Stud M7**

10 - **Nut M6**

- tighten to 10 Nm (89 in-lb)

11 - **Gasket**

12 - **Cylinder head**

13 - **Sealing ring**

14 - **Intake camshaft sensor**

15 - **Bolt M6**

16 - **VANOS control unit**

17 - **Copper sealing ring**

18 - **VANOS oil feed line**

19 - **Banjo bolt**

- tighten to 32 Nm (24 ft-lb)

VANOS control unit, removing

Note:

If the Double VANOS control unit is being replaced, camshaft timing must be checked as described later in this group. This procedure requires multiple special tools. Be sure to read the procedures through before beginning the repair.

- Working inside trunk, disconnect

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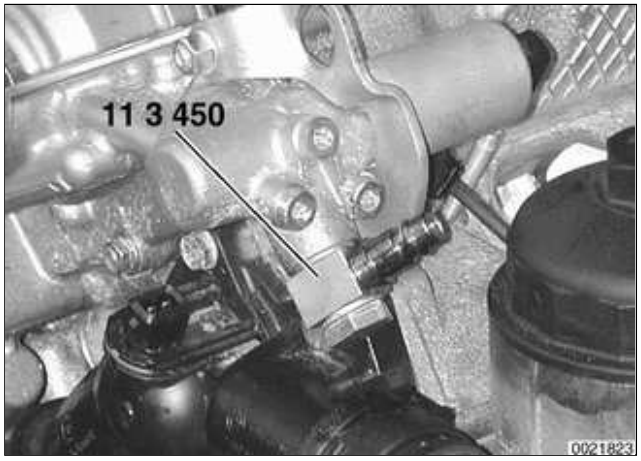
negative (-) battery cable.

CAUTION!

- ***Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.***

- ***Disconnecting the battery may erase fault code(s) stored in control module memory. Check for fault codes using special BMW diagnostic equipment.***

- Remove complete air filter housing, cylinder head cover, intake camshaft plastic cover and spark plugs, as described earlier in ⇒ Camshaft Timing Chains, Removing.



➢ Remove banjo bolt from VANOS unit oil pressure line. Use banjo bolt to attach BMW special tool 11 3 450 (compressed air fitting) to VANOS unit.

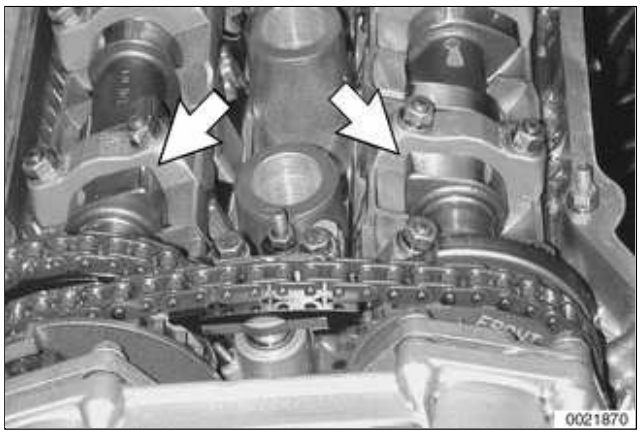
CAUTION!

- ***Oil will drain from pressure line. Have a container and rags ready. Do not allow oil to run onto drive belts.***

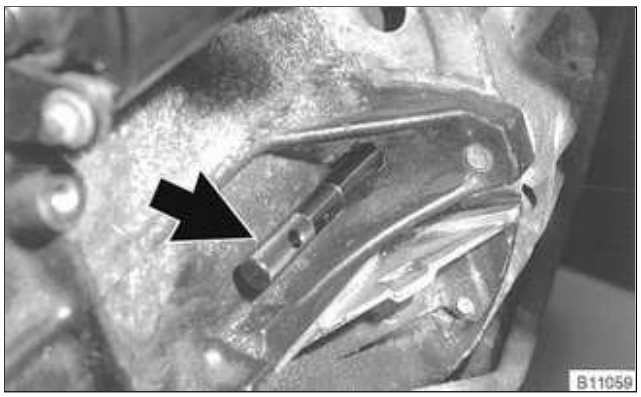
- ***Cover top of VANOS unit with lint-free shop cloth. Compressed air will force oil to spray out of oil bore on top of unit.***

- Connect compressed air line (with line pressure set to 2 - 8 bar or 30 - 110 psi) to air fitting.

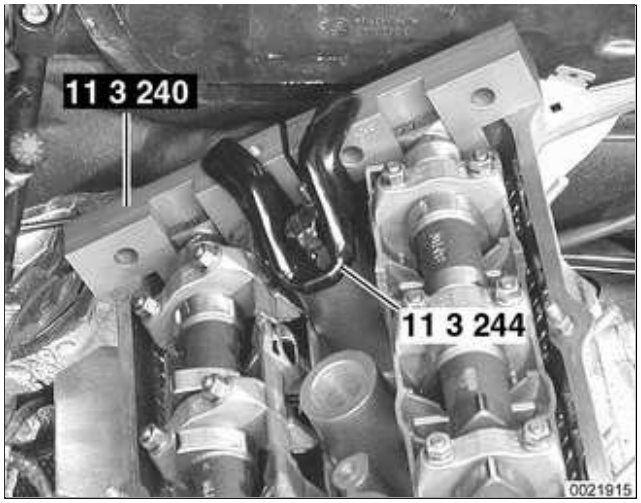
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- With compressed air line connected, turn engine at least twice in direction of rotation until cylinder 1 intake and exhaust camshaft lobes (**arrows**) face each other.



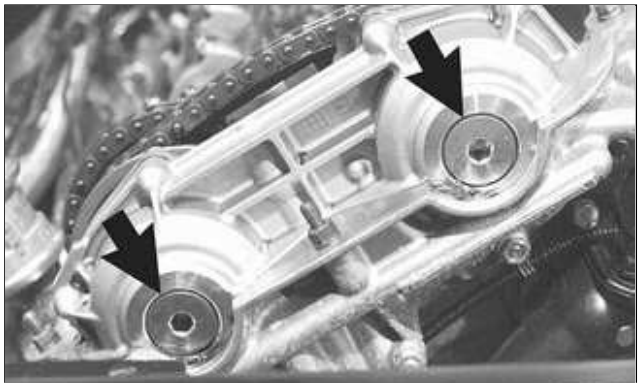
- Remove sealing plug from bore on lower left side of engine block (flywheel end). Secure crankshaft in TDC position with BMW special tool 11 2 300 (**arrow**).
  - Unscrew and remove cylinder head cover studs at rear of cylinder head.



- Secure camshafts in TDC position using BMW special tools 11 3 240 ans 11 3 244.
  - Detach compressed air line, leaving compressed air fitting attached to VANOS unit.

Note:

Oil will drain from fittings when air line is removed. Have a container and rags ready. Do not allow oil to run onto drive belts.



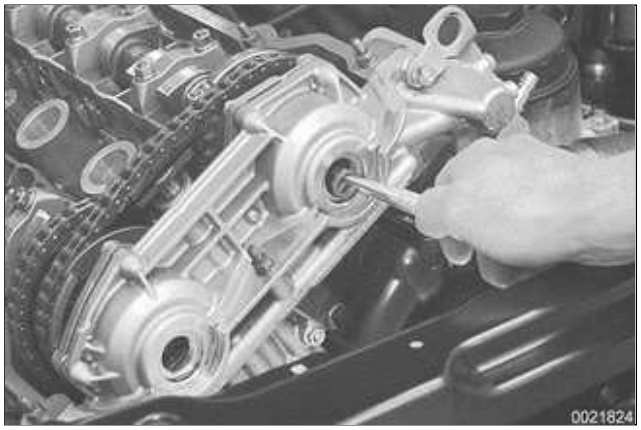
- Unscrew sealing plugs (**arrows**) from VANOS unit.

Note:

Oil will drain from plugs when removed. Have a container and rags ready. Do not allow oil to run onto drive belts.

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- Remove sealing caps from inside VANOS unit with BMW special tool 11 6 170, or with short flat nose pliers.

Note:

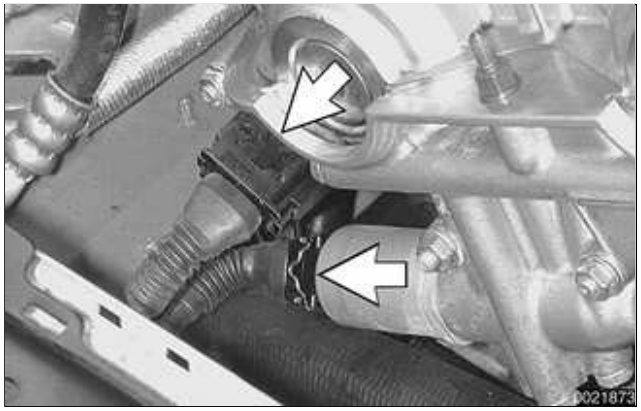
Additional oil may drain from VANOS unit.



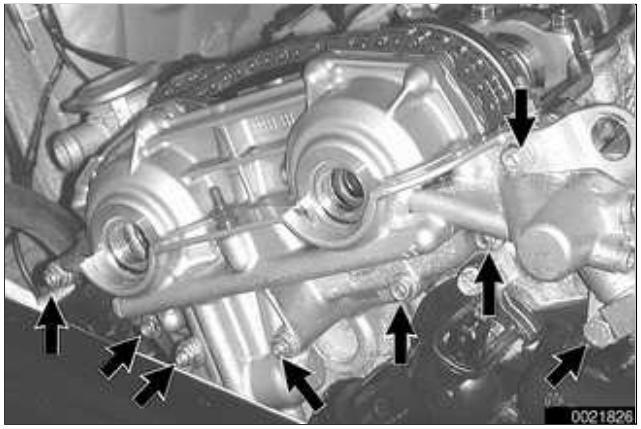
- Remove set screws (left hand thread) on ends of intake and exhaust camshaft hydraulic pistons.

CAUTION!

Set screws have left-hand threads. Remove with a clockwise motion.



- Disconnect electrical harness connectors from camshaft position sensors and solenoid valves on both exhaust and intake sides of VANOS unit.



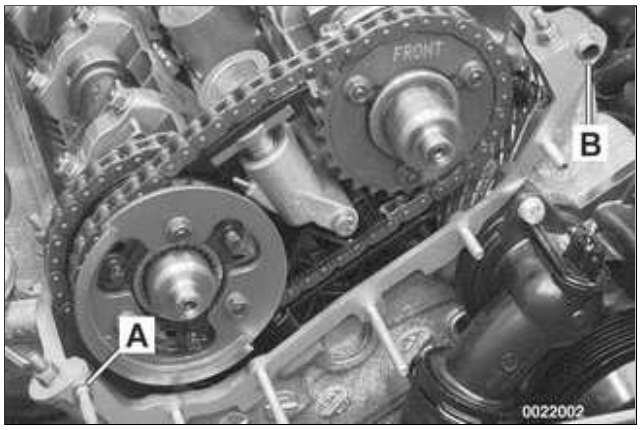
- Remove VANOS unit:
  - Remove fasteners from engine support eye.
  - Remove VANOS mounting nuts (**arrows**) from cylinder head. Slide VANOS unit and metal gasket off.

CAUTION!

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Do not crank or turn over engine with VANOS unit removed. Piston/valve interference is possible.

VANOS control unit, installing



- Clean contact edges of cylinder head face and VANOS unit and apply a thin coat of sealing compound (3-Bond®1209 or equivalent) to surfaces.

CAUTION!

- ***Make sure all gasket material is removed from face of cylinder head. Clean sealing face and keep free of oil. If any foreign material is present on the sealing surface, the camshaft timing will be incorrect.***

- ***Check locating dowel (A) and dowel sleeve (B) at top of cylinder head for damage or incorrect installation.***

Note:

- *If the Double VANOS control unit is being replaced, be sure to check and adjust camshaft timing as described later in this group.*

- *If work being carried out has no effect on camshaft timing, it is not necessary to recheck the timing. It is recommended however that the VANOS operation be checked using a compatible scan tool.*

- Using new gasket, install VANOS unit to cylinder head.

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- Reinstall engine support eye.

Tightening torque	
VANOS unit to cylinder head	
M6 nut	10 Nm (89 in-lb)
M7 nut	14 Nm (10 ft-lb)

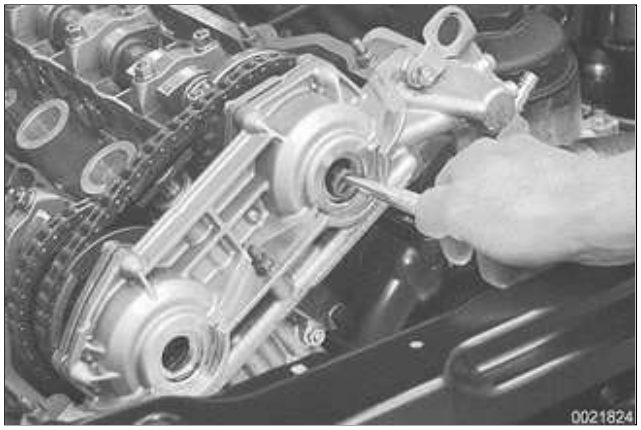


- Insert and tighten down VANOS hydraulic piston set screws on intake and exhaust camshafts.

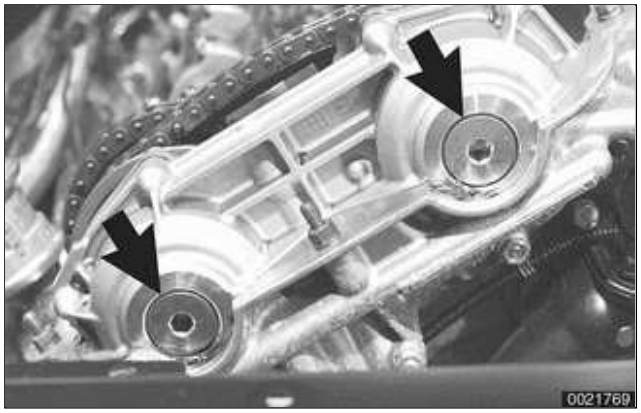
CAUTION!

Set screws have left hand thread. Tighten counterclockwise.

Tightening torque	
Hydraulic piston to splined shaft M6 set screw	10 Nm (89 in-lb)



- Replace sealing caps inside VANOS unit with BMW special tool 11 6 170, or short flat nosed pliers.



- Insert and secure VANOS sealing plugs (**arrows**), using new sealing O-rings.

Tightening torque	
Sealing plug to VANOS unit	50 Nm (37 ft-lb)

- Remove compressed air fitting from VANOS unit.

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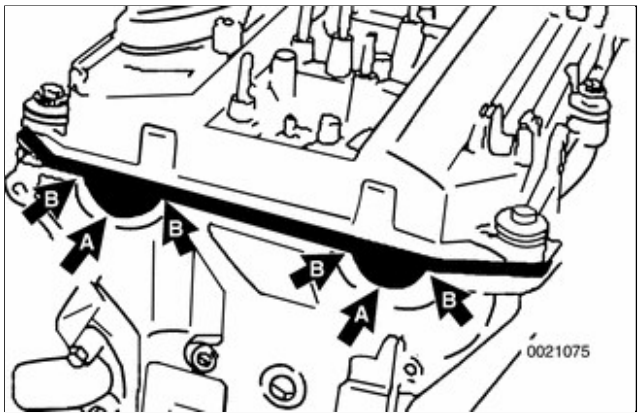
- Fit VANOS oil line banjo bolt with new seals. Attach oil line to VANOS unit.

Tightening torque	
Oil line to VANOS unit (banjo bolt)	32 Nm (24 ft-lb)

- Attach electrical harness connectors to camshaft position sensors and VANOS solenoid valves.

- Remove BMW special locking tools from rear of cylinder head.

- Remove BMW special locking tool from flywheel and replace dust guard.



➢ Install intake camshaft plastic baffle and then install cylinder head cover.

- Check for correct seating of half-moon seals (**A**) in back of cylinder head cover.

- Use a small amount of 3-Bond®1209 or equivalent sealant at corners (**B**) of half-moon cutouts.

- Similarly, seat gasket and seal corners in front of cylinder head, at VANOS unit.

Tightening torque	
Cylinder head cover to cylinder head (M6)	10 Nm (89 in-lb)

- Remainder of installation is reverse

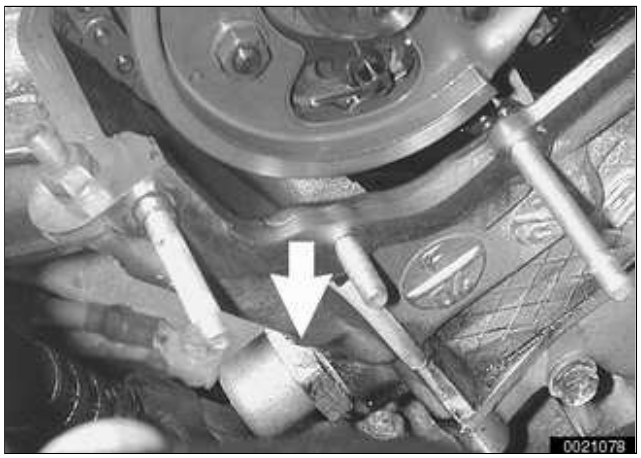
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of removal.

Tightening torques	
Radiator fan (viscous clutch) to coolant pump	40 Nm (30 ft-lb)
Spark plug to cylinder head	25 Nm (18 ft-lb)

Camshaft timing, adjusting

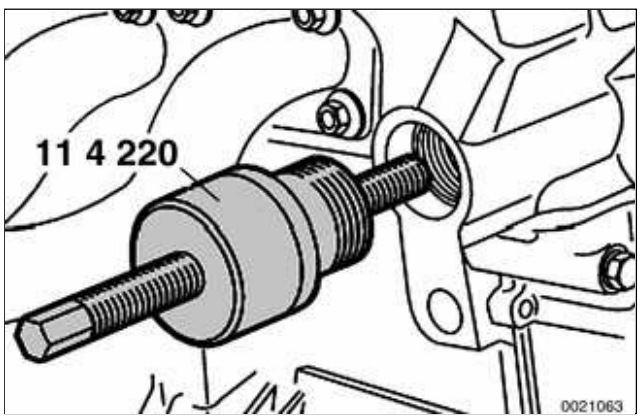
Use this procedure to check and, if necessary, adjust camshaft timing. This procedure assumes that the cylinder head cover and intake camshaft plastic baffle have been removed as described under ⇒ Camshaft Timing Chains, Removing. Also, be sure the cooling fan behind the radiator and the spark plugs have been removed.



- Remove primary camshaft chain tensioner cylinder (**arrow**).

CAUTION!

Primary camshaft chain tensioning piston is under spring pressure.

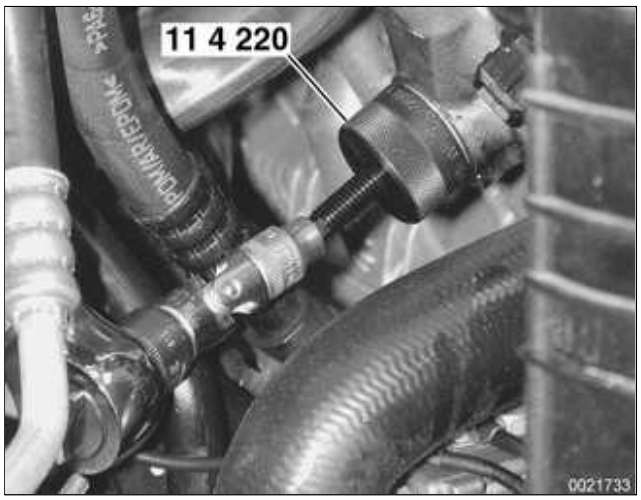


- Insert BMW special tool 11 4 220 in cylinder head and bring adjustment screw into contact with tensioning rail.

Note:

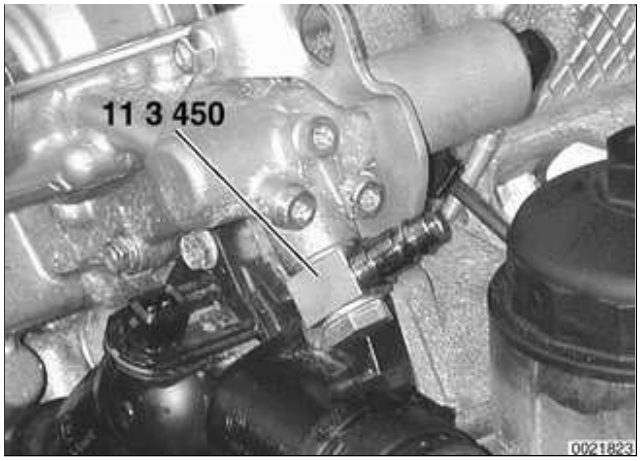
BMW special tool 11 4 220 is a dummy primary chain tensioner and simulates the function of the tensioner.

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- Preload primary chain tensioner rail:
  - Tighten adjusting screw on BMW special tool 11 4 220.

Tightening torque	
Primary chain tensioner preload	0.7 Nm (6 in-lb)

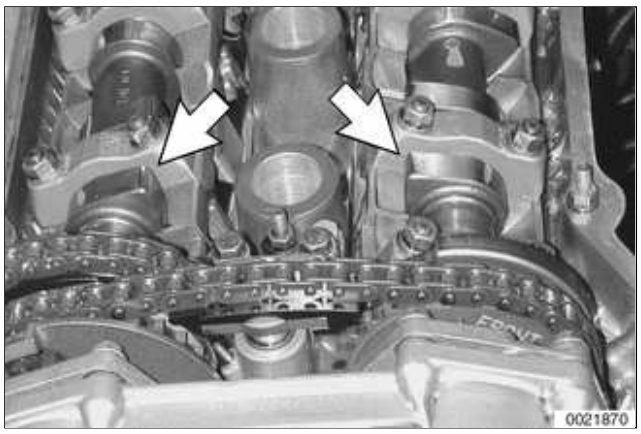


- Unscrew oil pressure pipe from VANOS unit. Remove banjo bolt from oil pressure line and install BMW special tool 11 3 450.

CAUTION!

Cover top of VANOS unit with lint-free shop cloth. Attachment of compressed air line will force oil to spray out of bore.

  - Connect compressed air line to air fitting. Apply air pressure set to 2 - 8 bar (30 - 110 psi).



- With compressed air line connected, turn engine at least twice in direction of rotation until cylinder 1 intake and exhaust camshaft lobes (**arrows**) face each other.

CAUTION!

Do not rotate engine counterclockwise to reach the top dead center position. Instead, complete another two complete rotations.

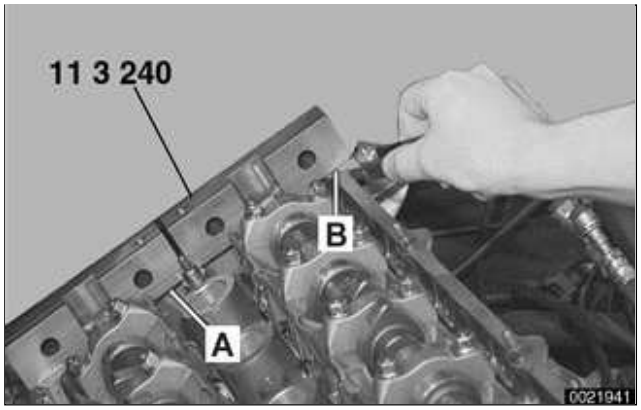


- Remove sealing plug from bore on lower left side of engine block near flywheel. Secure crankshaft in TDC position with BMW special tool 11 2 300 (**arrow**).

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- Unscrew and remove cylinder head cover studs at rear of cylinder head.



➢ Place BMW special tool 11 3 240 over camshafts ends and measure clearance of tool to cylinder head surface.

Note:

- *If the exhaust side of the tool (**A**) is not flush with the head, retime the camshafts as described below.*
- *Due to flexible sprocket design, VANOS unit tolerances and play in the VANOS splines, when the camshaft timing is set correctly, the intake side of special tool 11 3 240 (**B**) may be up to 1 mm (0.04 in) above the surface of the cylinder head. This is normal. Reassemble engine. Otherwise, retime the engine as described below.*

- Remove Double VANOS unit as described earlier.



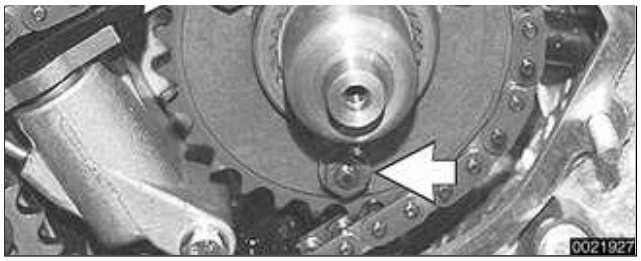
➢ Press down on secondary chain tensioner and lock into place using BMW special tool 11 3 292 or equivalent.

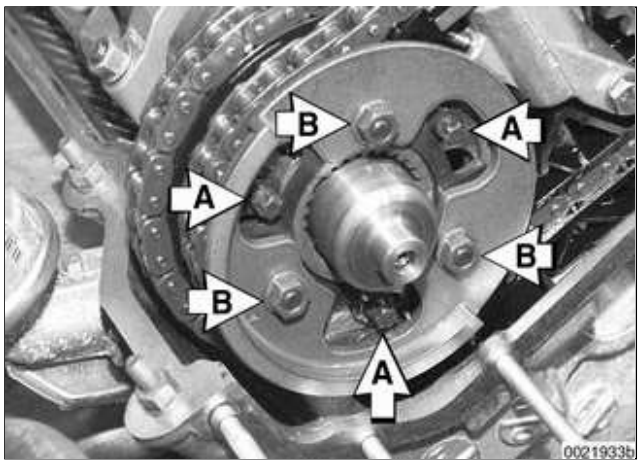
- Make sure primary chain tensioner dummy tool (special tool 11 4 220) is installed in side of cylinder head and just touching tensioning rail. Do not preload chain yet.



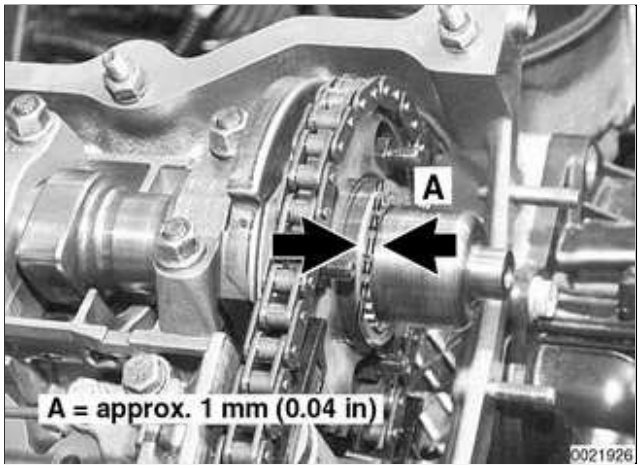
➢ Loosen intake camshaft sprocket mounting nuts (**arrows**) by 1 turn.

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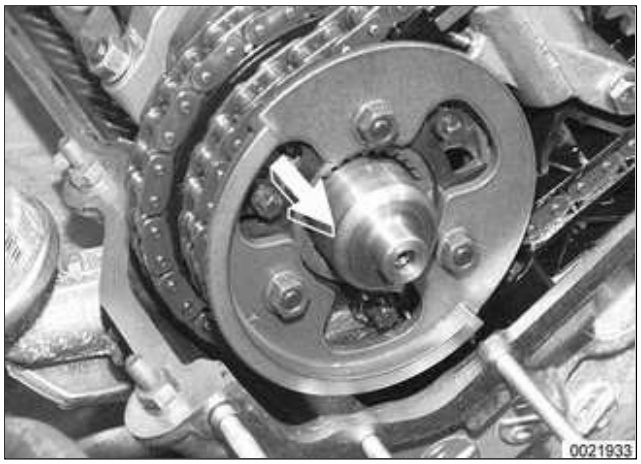




- Loosen exhaust camshaft sprocket mounting bolts (**A**) turn.
  - Loosen exhaust camshaft impulse wheel mounting nuts (**B**) 2 turns.

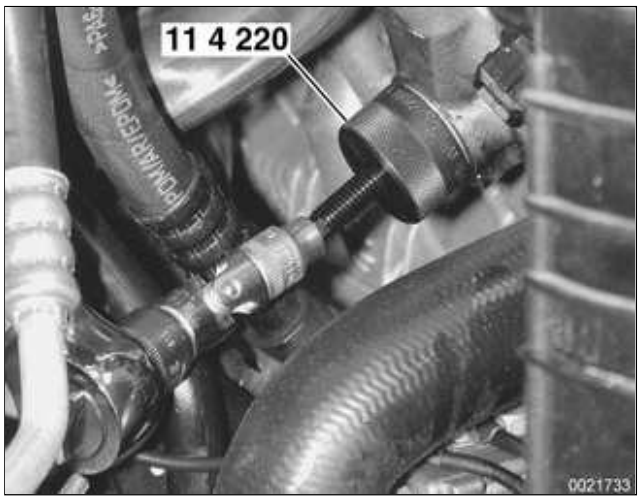


- Slide out intake camshaft splined shaft until approx. 1 mm (0.04 in) of splines (**arrows**) can be seen.



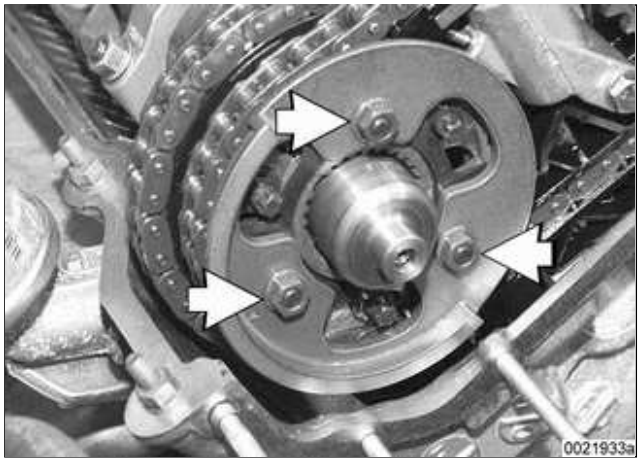
- Pull out exhaust camshaft splined shaft to stop.
  - Make sure camshafts are secured in TDC position using BMW special tools 11 3 240 and 11 3 244.

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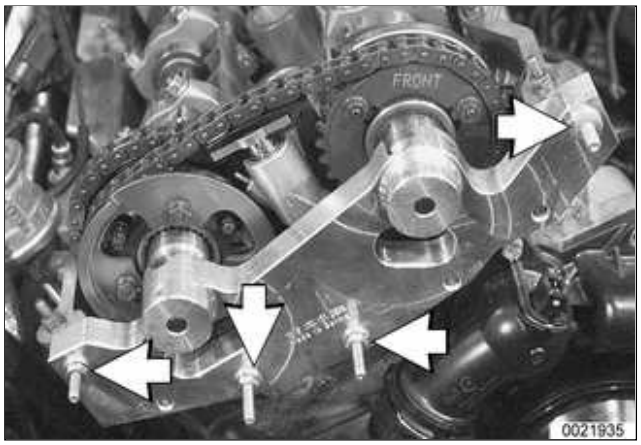


- Preload primary chain tensioning rail:
  - Tighten adjusting screw on BMW special tool 11 4 220.

Tightening torque	
Primary chain tensioner preload	0.7 Nm (6 in-lb)



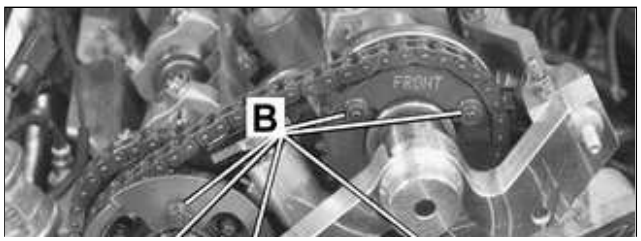
- Preload exhaust camshaft spring plate by pressing on impulse wheel. Tighten mounting nuts (**arrows**) by hand. Do not tighten fully.



- Install BMW special tool 11 6 150 (VANOS setup bracket) to front of cylinder head timing case. Tighten nuts (**arrows**) by hand, and then tighten down uniformly until special tool is in full contact with cylinder head.

CAUTION!

Make sure all gasket material is removed from face of cylinder head. Clean sealing face and keep free of oil. If any foreign material is present on the sealing surface, the camshaft timing will be incorrect.



- Secure camshaft impulse sprockets and wheels:
  - Pretighten Torx screws (**A**) on exhaust camshaft impulse wheel to

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approx. 5 Nm (44 in-lb).

- Pretighten mounting nuts (**B**) on exhaust and intake sprocket assemblies to approx. 5 Nm (44 in-lb).

- Torque down Torx screws (**A**) and nuts (**B**) to final specifications.

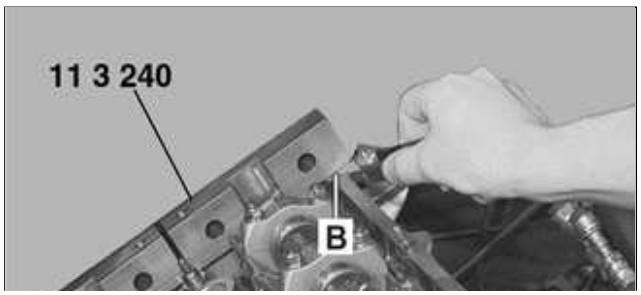
Tightening torques	
Sprocket assembly to camshaft initial torque	5 Nm (44 in-lb)
Sprocket assembly to camshaft	
M7 Torx screw (**A**)	20 Nm (15 ft-lb)
M6 mounting nut (**B**)	10 Nm (89 in-lb)

- Remove flywheel locking tool from transmission bellhousing so that crankshaft is no longer locked.

- Remove camshaft locking tools from rear of cylinder head.

- Crank engine over twice by hand in direction of rotation until cylinder 1 intake and exhaust camshaft lobes face each other again.

- Secure crankshaft with BMW special tool 11 2 300.



Place BMW special tool 11 3 240 over camshaft ends and measure clearance of tool to cylinder head surface.

Note:

- *If the exhaust side of the tool (A) is*

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not flush with the head, camshaft timing is incorrect. Repeat camshaft timing procedure.

- *Due to flexible sprocket design, VANOS unit tolerances and play in the VANOS splines, when the camshaft timing is set correctly, the intake side of special tool 11 3 240 (B) may be up to 1 mm (0.04 in) above the surface of the cylinder head. This is normal. Otherwise, repeat camshaft timing procedure.*

- Remove camshaft locking tools from rear of camshafts.

- Remove BMW special tool 11 4 220 (dummy primary chain tensioner). Reinstall primary chain tensioner.

Tightening torque	
Primary chain tensioner cylinder to cylinder head	70 Nm (52 ft-lb)

- Remove flywheel locking tool from transmission bellhousing Reinstall sealing plug.

- Remove VANOS setup bracket from front of cylinder head.

- Install VANOS control unit as described earlier in this group.

- Remove compressed air fitting (special tool 11 3 450) from VANOS unit.

- Fit VANOS oil line banjo bolt with

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new seals. Attach oil line to VANOS unit.

Tightening torque	
Oil line to VANOS unit (banjo bolt)	32 Nm (24 ft-lb)

- Remainder of engine assembly is reverse of disassembly.

Tightening torques	
Radiator cooling fan (viscous clutch) to coolant pump	40 Nm (30 ft-lb)
Cylinder head cover to cylinder head	10 Nm (89 in-lb)
Spark plug to cylinder head	25 Nm (18 ft-lb)

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General

This repair group covers lubrication system troubleshooting as well as oil pan removal and oil pump replacement.

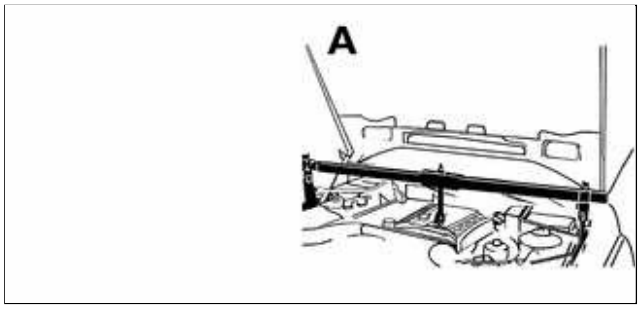
Special tools

The engine needs to be properly supported while the front suspension subframe is removed to access the lubrication system. If BMW special tools 00 0 200 / 00 0 208 are not available, a device to support the weight of the engine from above would be suitable.

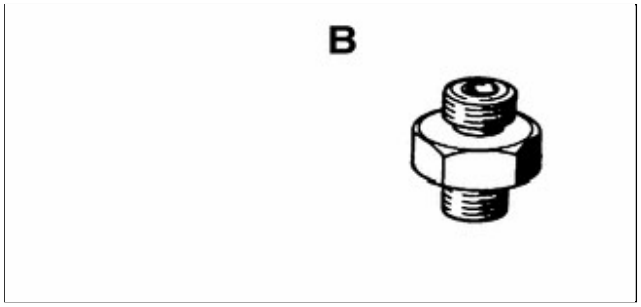
A standard oil pressure gauge may be used for measuring oil pressure. If the BMW DIS tester system is to be used, a special adapter is needed.

Note:

Oil change procedure and oil filter replacement are covered in ⇒ 020 Maintenance



- Engine support bracket BMW 00 0 200/00 0 208



- Adapter for BMW oil pressure gauge BMW 11 4 050

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Engine lubrication

Oil pressure is generated by a gear-type pump bolted to the bottom of the engine block. The oil pump is chain driven off the front of the crankshaft.

Oil passages in the cylinder block and cylinder head connect the oil pump to components such as camshafts, crankshaft and valve lifters.

Engine oil capacity (includes filter replacement)	
Rear wheel drive	6.5 liters (6.9 qt.)
All wheel drive	7.5 liters (7.9 qt.)

Troubleshooting

The oil pressure warning system consists of an oil pressure switch mounted in the oil circuit and an instrument panel warning light. Other safety features include:

- Oil level warning system
- A filter bypass to provide lubrication should the oil filter become clogged
- An oil pump pressure relief valve to prevent excessive system pressure

CAUTION!

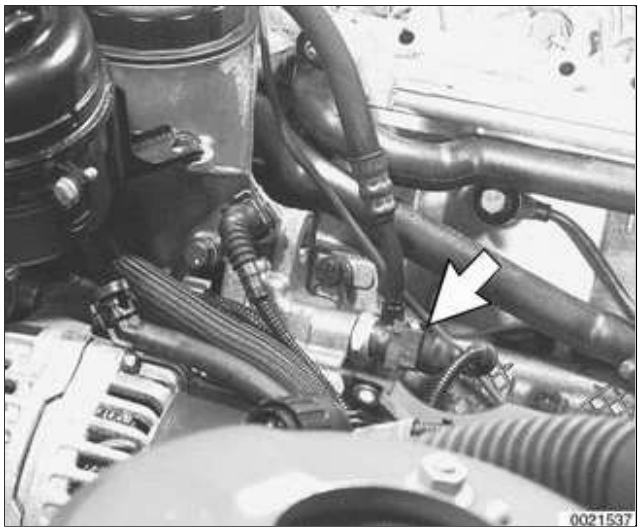
If the red oil pressure warning light comes on or flashes on while driving, always assume that the oil pressure is low.

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Oil pressure, checking

In some engines access to the oil pressure warning switch port may be extremely restricted.

- Unscrew oil filter cap in order to allow engine oil to drain back down into oil pan.



➢ Disconnect harness connector from oil pressure switch (**arrow**) and remove switch.

CAUTION!

Running the engine with the oil pressure switch disconnected may set a fault code (DTC).

Note:

- *Thoroughly clean around the oil pressure switch before removing it.*
- *Be prepared to catch leaking oil with a shop towel.*

Component location	
Oil pressure switch	base of oil filter housing

- Install pressure gauge in place of switch.
- With gauge installed, start engine and allow to reach operating temperature. Check oil pressure both cold and hot.

Note:

For the most accurate test results, the engine oil and filter should be new. The

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oil should be the correct grade.

Oil pressure	
Idle (minimum)	0.5 bar (7 psi)
Regulated pressure (elevated engine speed)	4.0 bar (59 psi)

- Remove pressure gauge and reinstall pressure switch.

Tightening torque	
Oil pressure switch to oil filter housing	27 Nm (20 ft-lb)

If testing shows low oil pressure, one or more of the following conditions may be indicated:

- Worn or faulty oil pump
- Worn or faulty engine bearings
- Severe engine wear

All of these conditions indicate the need for major repairs.

Oil pressure warning system, testing

When the ignition is turned on, the oil pressure warning light comes on. When the engine is started and the oil pressure rises slightly, the oil pressure switch opens and the warning light goes out. Make sure the oil level is correct before making tests.

- Turn ignition switch on.

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- Warning light on instrument panel must light up.

- Remove connector from oil pressure switch.

- Warning light on instrument panel must go out.

CAUTION!

Running the engine with the oil pressure switch disconnected may set a fault code (DTC).

Note:

If the light does not go out, the wiring to the switch is most likely grounded somewhere between the switch terminal and the warning light. See Electrical Wiring Diagrams at rear of manual for electrical schematics.

- If warning light does not light when ignition is on, remove connector from oil pressure switch and use a jumper wire to ground connector terminal to a clean metal surface.

Note:

If the warning light comes on, check the switch as described in the next step. If the warning light does not come on, the wiring to the instrument cluster or to the light itself is faulty.

- To test switch, connect an ohmmeter between terminal in switch body and ground. With engine off, there should be continuity. With engine running, oil pressure should open switch and there should be no continuity.

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Replace a faulty switch.

CAUTION!

Keep in mind that low oil pressure may be preventing the switch from turning the light out. If the light remains on while the engine is running, check the oil pressure as described earlier. Do not drive the car until the problem is corrected. The engine may be severely damaged.

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Oil Pan

The oil pan removal procedure requires that the engine be supported from above and the front suspension subframe be unbolted and lowered from the chassis.

Oil pan, removing and installing (rear wheel drive models)

- Raise car and place securely on jack stands.

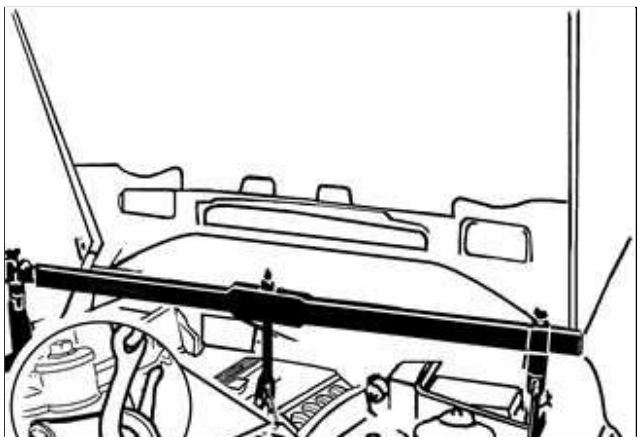
WARNING!

Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

- Remove splash shield from under engine.

- Drain engine oil as described in ⇒ 020 Maintenance

- Remove air filter housing complete with mass air flow sensor.



- Install engine lifting equipment at front engine lifting point and raise approximately 5 mm (inch) until engine weight is supported.

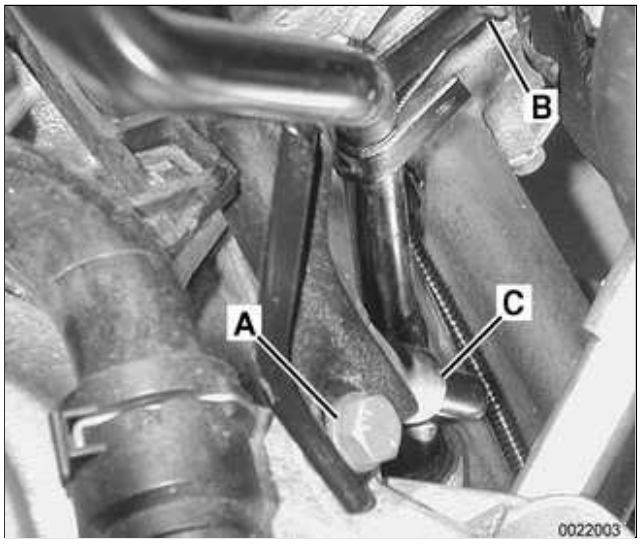
- On cars with automatic transmission, remove ATF cooler line brackets from oil pan and from transmission.

Note:

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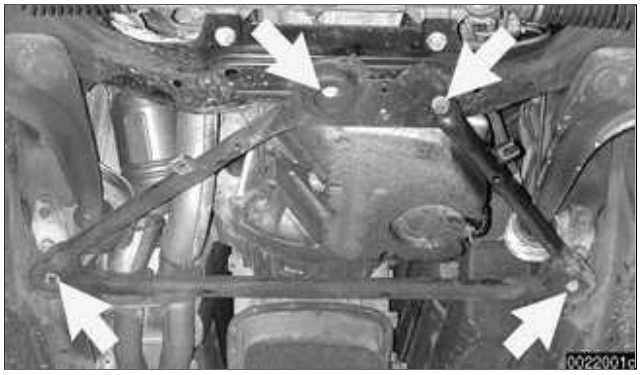
Place drain pan under lines to catch ATF drips.



- Remove oil dipstick guide tube:
  - Detach mounting bolt (**A**) from left engine mounting bracket.
  - Detach fuel lines and wiring harness brackets (**B**).
  - Disconnect oil separator hose (**C**) from base of guide tube and remove tube from oil pan.

Note:

The guide tube is sealed in the block using an O-ring. Check that the O-ring comes out with the tube.



- Working underneath car, remove bolts (**arrow**) and lower reinforcing brace between front suspension subframe and body.

Note:

Reinforcement consists of a triangulated bar for Sedan or Sport Wagon or a reinforced plate for Convertible or Coupe.

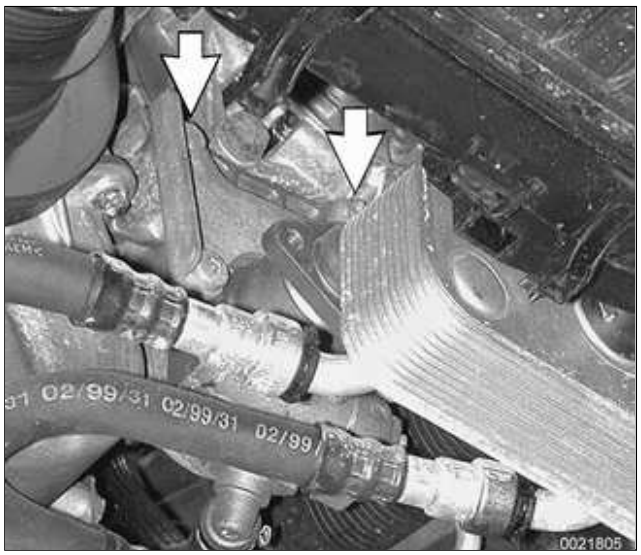


- Separate steering column shaft from steering rack at universal joint.

CAUTION!

In order to avoid the need for front-end realignment, do not unbolt power steering rack from suspension subframe.

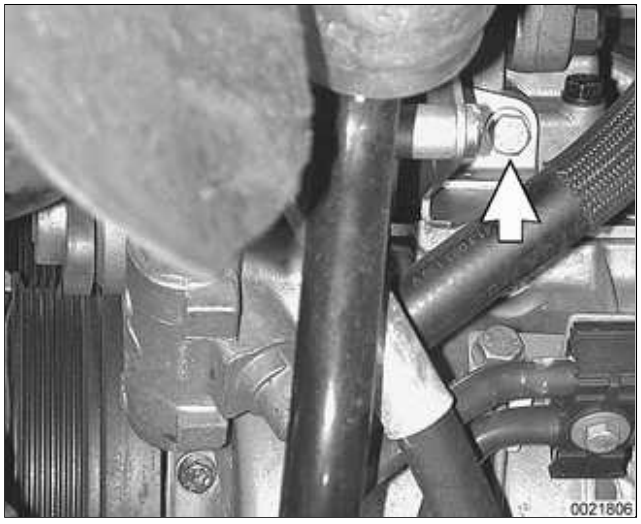
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- Remove power steering pump pulley. Remove two mounting bolts from the front (**arrows**)

  Note:

  Do not detach power steering fluid lines from pump.



- Remove third power steering mounting bolt (**arrow**) and remove pump from its mounting bracket. Use stiff wire to suspend pump from chassis.



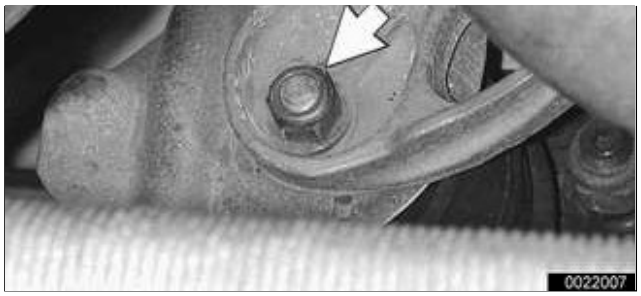
- Detach electrical harness connector (**arrow**) at oil level sensor.



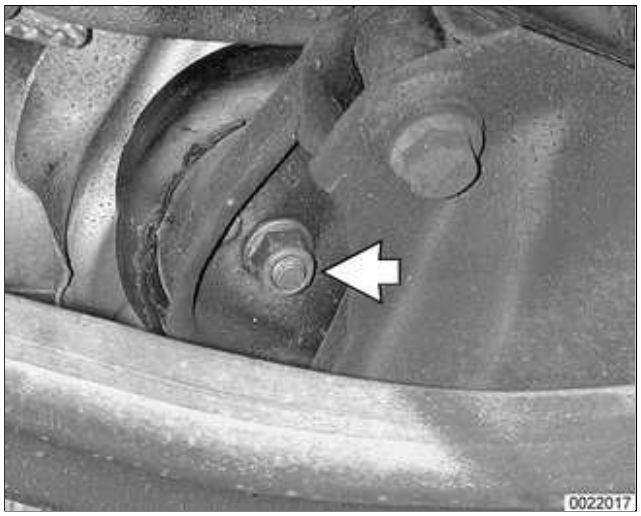
- Loosen top engine mount fasteners (**arrow**).

  Note:

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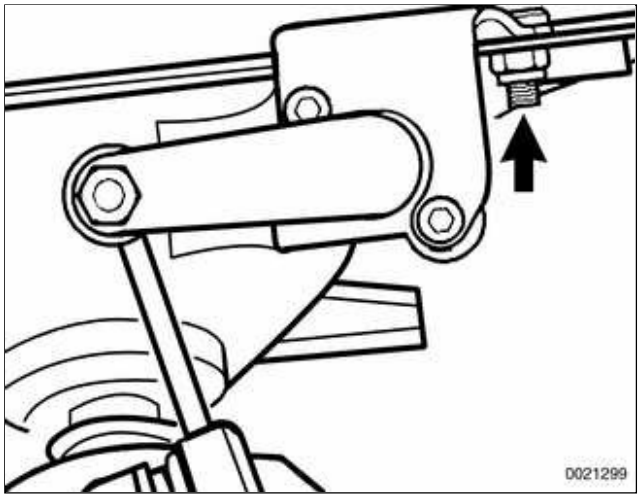
Right side is shown in photo. Left is similar.



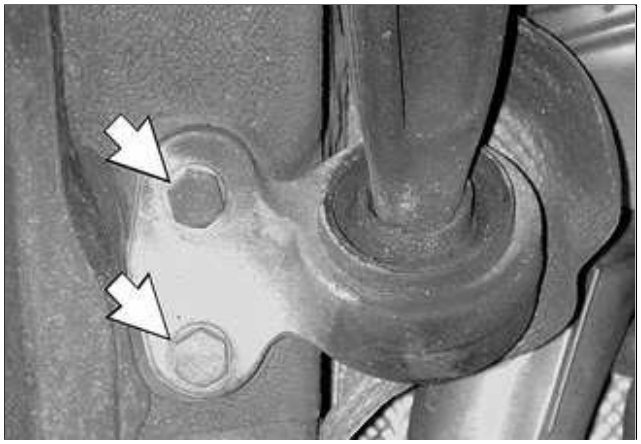
- Loosen lower engine mount fasteners (**arrows**).

Note:

Right side is shown in photo. Left is similar.



- If applicable, remove front ride level sensor mounting bolt (**arrow**) and lay sensor aside.



- Remove left and right front control arm bracket bolts (**arrows**) from frame rails.

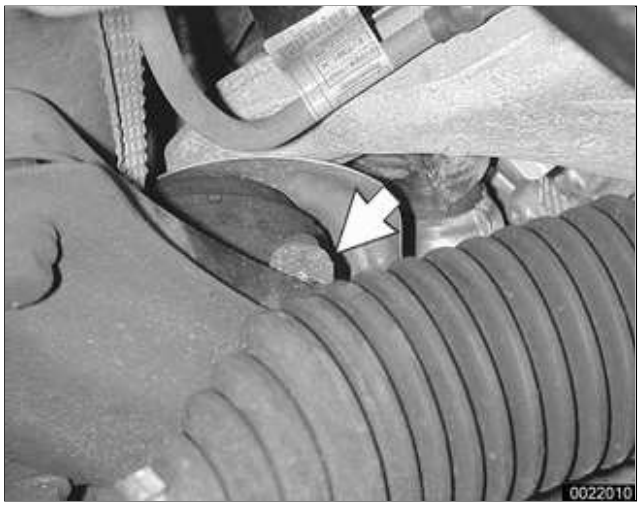
Note:

Right side is shown in photo. Left is similar.

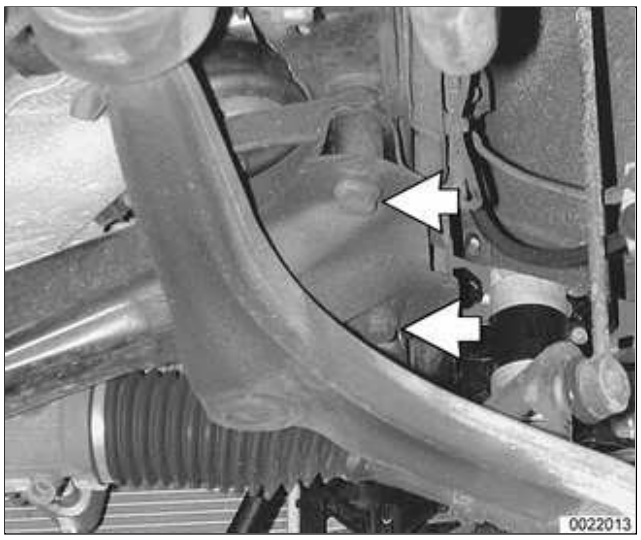
- Detach left and right stabilizer bar anchors from frame rails.

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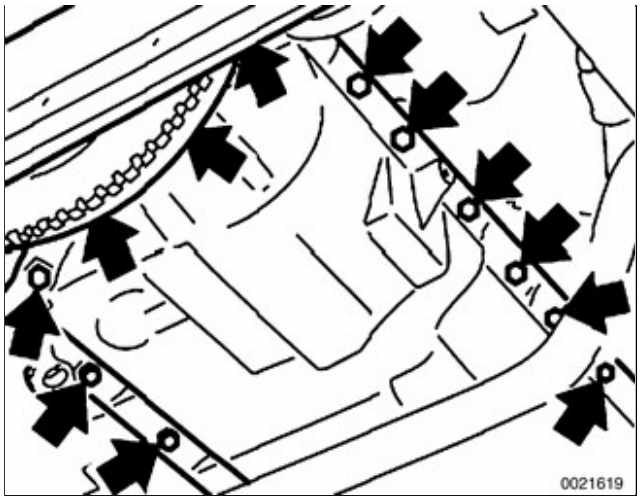
- Remove left control arm ball joint mounting nut (**arrow**) at front suspension subframe.
  - Drive ball joint out from subframe using soft hammer.
  - Push control arm aside.
  - Repeat for left side.



- Support suspension subframe from below using appropriate jacking equipment. Remove subframe mounting bolts (**arrows**) and lower subframe as far as possible.

Note:

Right side is shown in photo. Left is similar.



- Remove oil pan screws (**arrows**) at cylinder block and transmission bellhousing. Lower oil pan forward to remove.

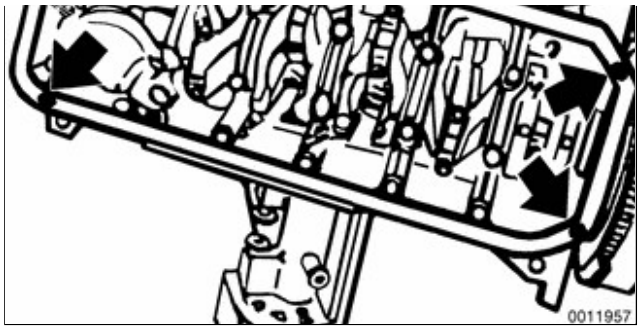
CAUTION!

If the oil pan does not separate easily from the engine cylinder block, a few taps with a rubber mallet should break it free. Do not pry the oil pan loose.



- When installing oil pan:
  - Thoroughly clean all old gasket

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material from mating surfaces and use a new gasket.

- Apply a small amount of non-hardening sealer (3-Bond 1209® or equivalent) to oil pan gasket directly below joints (**arrows**) for end cover and front timing case cover. Apply a bead 3 mm wide by 2 mm high.
- Tighten oil pan bolts to cylinder block evenly all around.
- Tighten transmission bellhousing bolts last.

Tightening torque	
Oil drain plug to oil pan (M12)	25 Nm (18 ft-lb)
Oil pan to engine block	
M6, 8.8 grade	10 Nm (89 in-lb)
M6, 10.9 grade	12 Nm (106 in-lb)
Transmission bellhousing to oil pan	
M8 Allen	24 Nm (17 ft-lb)
M8 Torx	21 Nm (15 ft-lb)

- Remainder of installation is reverse of removal.
- Replace self-locking nuts when reinstalling front suspension components.
- Match up key ways while installing steering column shaft. See ⇒ 320 Steering and Wheel Alignment for more specific procedures.

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- Use new oil dipstick tube sealing O-ring.
- Fill engine with oil as described in ⇒ 020 Maintenance.
- After adding engine oil, start and run engine. Raise engine speed to 2,500 rpm until oil pressure warning lamp goes out (about 5 seconds).

Note:

BMW does not recommend a front end alignment following this procedure.

Tightening torques	
Control arm ball joint to suspension subframe	90 Nm (66 ft-lb)
Front subframe to frame rails (M12, use new bolts)	
8.8 grade	77 Nm (57 ft-lb)
10.9 grade	110 Nm (81 ft-lb)
12.9 grade	105 Nm (77 ft-lb)
Front end reinforcement to frame rails or suspension subframe (M10, use new bolts)	
Initial torque	59 Nm (44 ft-lb)
Torque angle	90° + 30°
Stabilizer bar to frame rail (M8 nut)	22 Nm (16 ft-lb)
Steering column universal joint clamping screw (M8 bolt, use new bolt)	22 Nm (16 ft-lb)

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Oil pan, removing and installing (all wheel drive models)

- Raise car and place securely on jack stands.

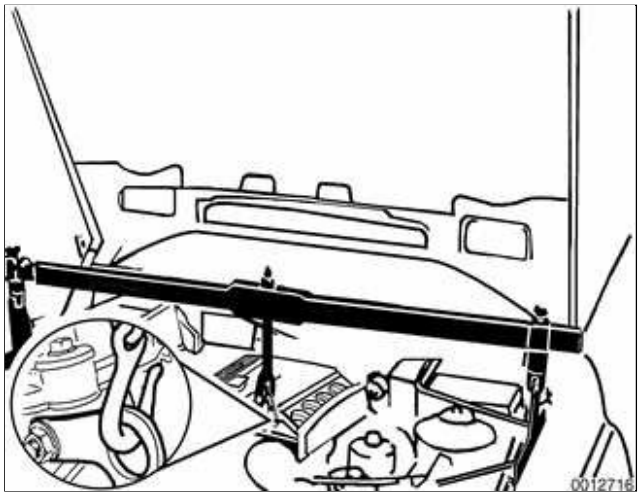
WARNING!

Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

- Remove splash shield from under engine.

- Drain engine oil as described in ⇒ 020 Maintenance

- Remove air filter housing complete with mass air flow sensor.



- Install engine lifting equipment at front engine lifting point and raise approximately 5 mm (inch) until engine weight is supported.

- Remove fuel line clamping brackets from oil pan.

- On cars with automatic transmission, remove ATF cooler line brackets from oil pan and from transmission.

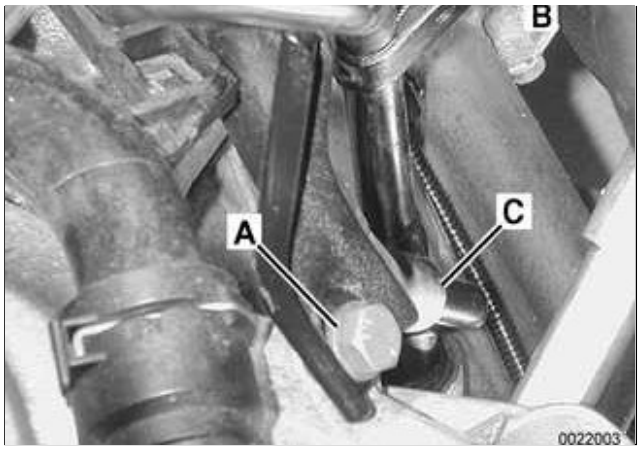
Note:

Place drain pan under lines to catch ATF drips.



- Remove oil dipstick guide tube:

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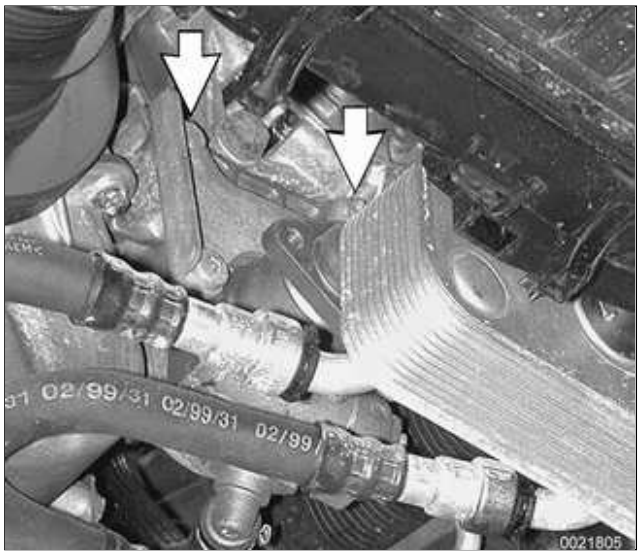
- Detach mounting bolt (**A**) from left engine mounting bracket.
- Detach fuel lines and wiring harness brackets (**B**).
- Disconnect oil separator hose (**C**) from base of guide tube and remove tube from oil pan.

Note:

The guide tube is sealed in the block using an O-ring. Check that the O-ring comes out with the tube.



- Separate steering column shaft from steering rack at universal joint. Point wheels straight ahead before disconnecting shaft from rack. See ⇒ 320 Steering and Wheel Alignment.

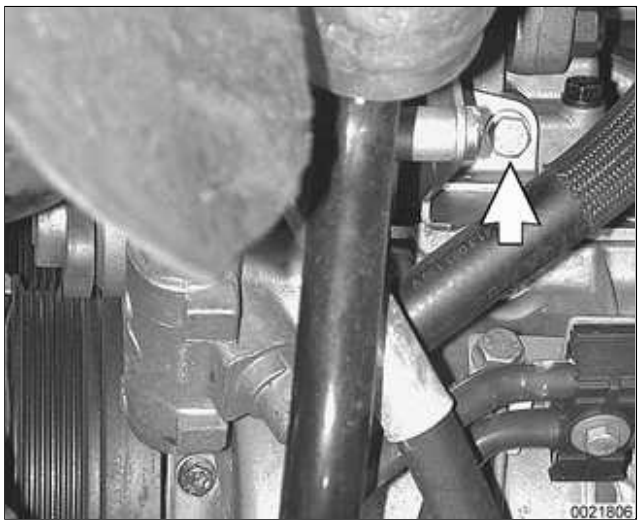


- Remove power steering pump pulley. Remove two mounting bolts from the front (**arrows**).

Note:

Do not detach power steering fluid lines from pump.

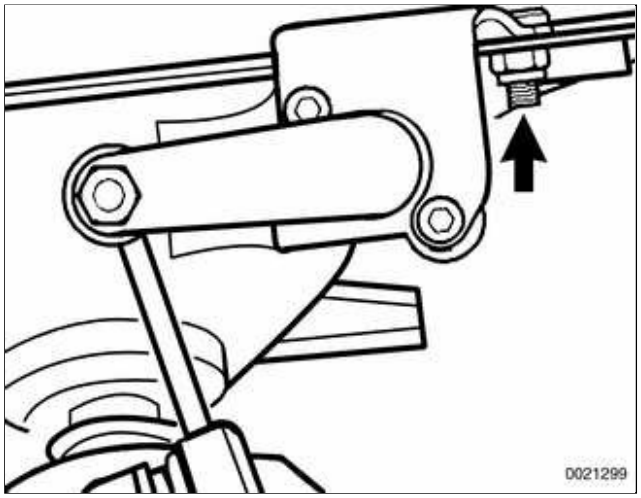
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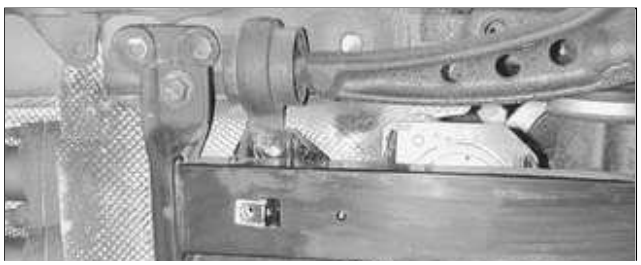
- Remove third power steering mounting bolt (**arrow**) and remove pump from its mounting bracket. Use stiff wire to suspend pump from chassis.



- Detach electrical harness connector at oil level sensor.
  - Remove lower engine mount fasteners.

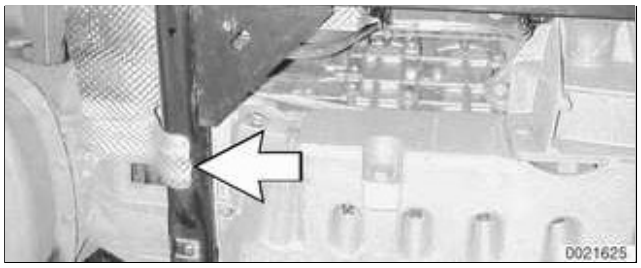


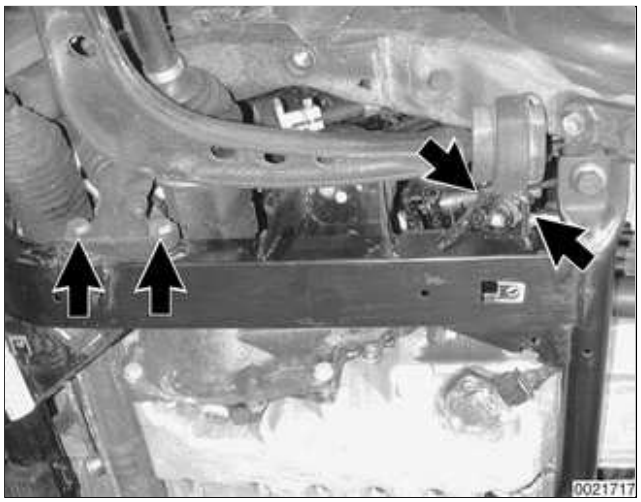
- If applicable, remove front ride level sensor mounting bolt (**arrow**) and lay sensor aside.



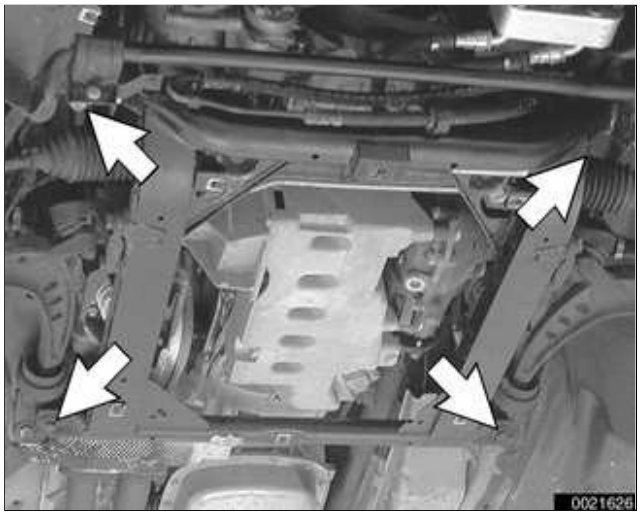
- Working at rear right corner of front subframe, unhook heatshield from subframe (**arrow**).
  - Detach stabilizer bar anchors from frame rails.

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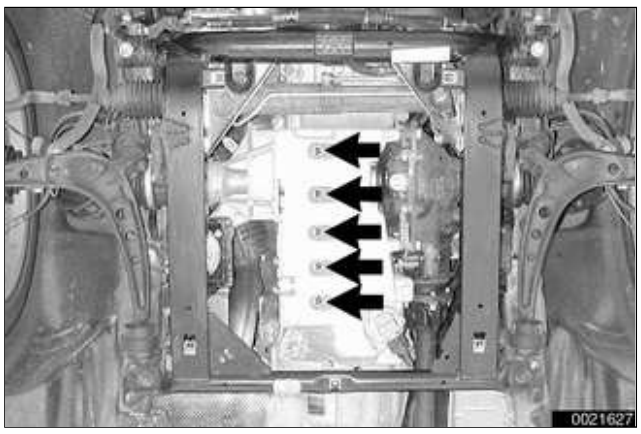
- Remove control arm rear bracket and ball joint mounting bolts (**arrows**) from subframe.
  - Remove control arms and front drive axles as described in ⇒ 310 Front Suspension.
  - Remove front differential and right axle inner bearing pedestal as described in ⇒ 311 Front Axle Final Drive.



- Support subframe while removing four mounting bolts (**arrows**).

CAUTION!

Lower subframe as far as possible without damaging power steering lines. Make sure it is adequately supported throughout the remainder of this procedure.



- Remove oil pan:
  - Remove bellhousing bolts from oil pan.
  - Remove all oil pan periphery bolts.
  - Remove center oil pan bolts (**arrows**).

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- Lower oil pan to remove.

CAUTION!

If the oil pan does not separate easily from the engine cylinder block, a few taps with a rubber mallet should break it free. Do not pry the oil pan loose.

- When reinstalling oil pan:

- Thoroughly clean all old gasket material from mating surfaces and use a new gasket.

- Apply a small amount of non-hardening sealer (3-Bond 1209® or equivalent) to oil pan gasket directly below joints for end cover and front timing case cover. Apply a bead 3 mm wide by 2 mm high.

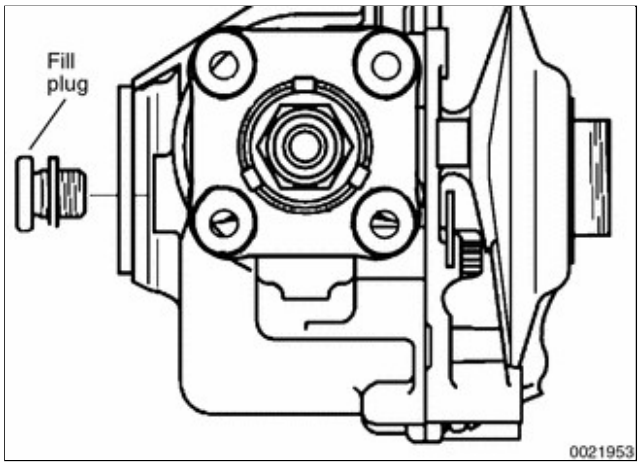
- Tighten oil pan bolts to cylinder block evenly all around.

- Tighten transmission bellhousing bolts last.

Tightening torque	
Oil drain plug to oil pan (M12)	25 Nm (18 ft-lb)
Oil pan to engine block	
M6, 8.8 grade	10 Nm (89 in-lb)
M6, 10.9 grade	12 Nm (106 in-lb)
M8, 8.8 grade	22 Nm (16 ft-lb)
Transmission bellhousing to oil pan	
M8 Allen	24 Nm (17 ft-lb)

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Tightening torque	
M8 Torx	21 Nm (15 ft-lb)



Reinstall front differential and right axle inner bearing pedestal. See ⇒ 311 Front Axle Final Drive.

- Fill differential to lower edge of fill plug.

Tightening torques	
Fill or drain plug to front differential	65 Nm (48 ft-lb)
Front differential to oil pan (M10)	45 Nm (33 ft-lb)

- Reinstall front axles, control arms and front steering arms as described in ⇒ 310 Front Suspension.

Note:

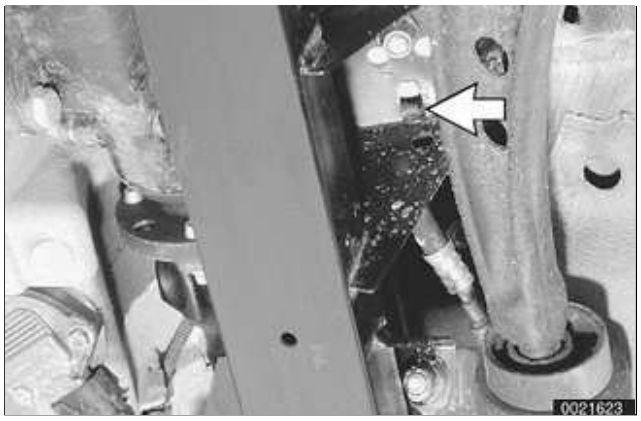
- *Be sure to replace seals on differential output flanges.*
- *Replace self-locking fasteners when reinstalling front suspension components.*

Tightening torques	
Control arm ball joint bracket to subframe	
M12 bolt	77 Nm (57 ft-lb)
Control arm mounting bracket to subframe	
M10 bolt (always replace)	59 Nm (44 ft-lb)



When reattaching engine to subframe, be sure that left engine mount locating

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tab (**arrow**) is seated correctly in subframe slot.

Tightening torques	
Engine mount to subframe	
M10 self-locking nut	45 Nm (33 ft-lb)
Front of subframe to frame rail (M12 bolt, always replace)	
8.8 grade	77 Nm (57 ft-lb)
10.9 grade	110 Nm (81 ft-lb)
12.9 grade	105 Nm (77 ft-lb)
Rear of subframe to mounting adapter	
M12 bolt (always replace)	110 Nm (81 ft-lb)

- Remainder of installation is reverse of removal.

- Match up key ways while installing steering column shaft. See ⇒ 320 Steering and Wheel Alignment for more specific procedures.

- Use new oil dipstick tube sealing O-ring.

- Fill engine with oil as described in ⇒ 020 Maintenance.

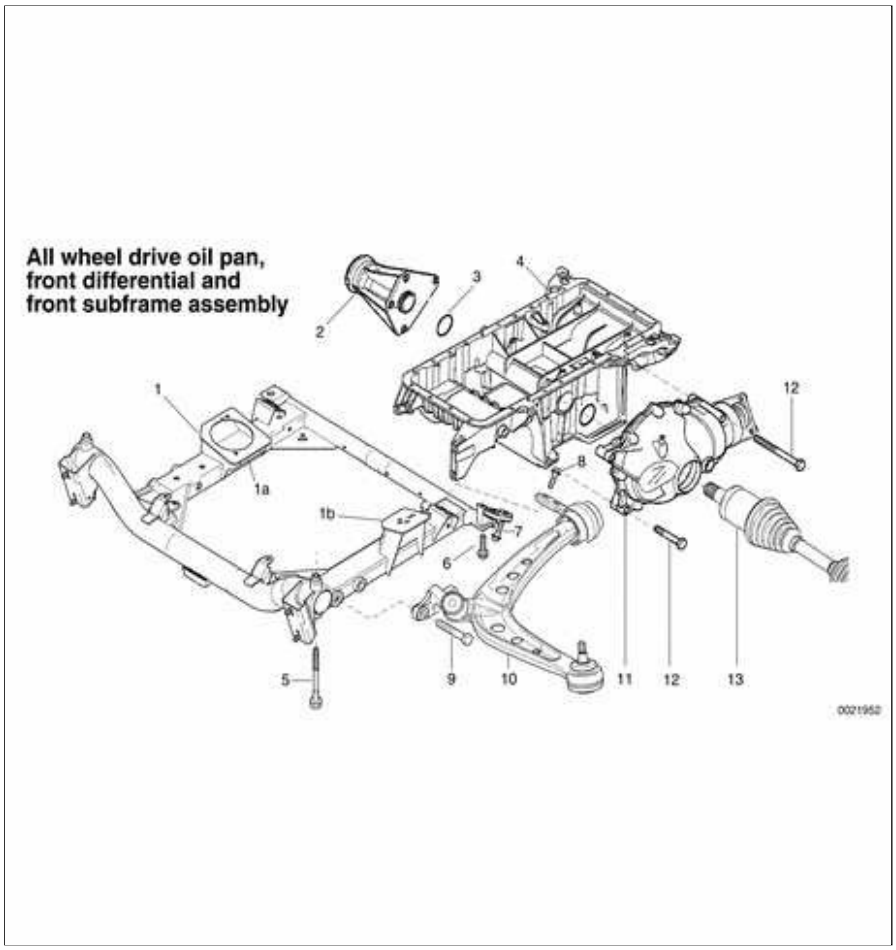
- After adding engine oil, start and run engine. Raise engine speed to 2,500 rpm until oil pressure warning lamp goes out (about 5 seconds).

Note:

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Be sure to align the front end after this procedure.

Tightening torques	
Stabilizer bar to frame rail (M8 nut)	22 Nm (16 ft-lb)
Steering column universal joint clamping screw (M8 bolt, use new bolt)-	22 Nm (16 ft-lb)



All wheel drive oil pan, front differential and front subframe assembly

1 - **Front subframe**

1a - **Right engine mounting point**

1b - **Left engine mounting point**

2 - **Right axle inner bearing pedestal**

3 - **Sealing O-ring**

4 - **Oil pan**

5 - **Bolt M12 (always replace) -**

- 8.8 grade tighten to 77 Nm (57 ft-lb)
- 10.9 grade tighten to 110 Nm (81 ft-lb)

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- 12.9 grade tighten to 105 Nm (77 ft-lb)

6 - **Bolt M12 (always replace)**

- tighten to 110 Nm (81 ft-lb)

7 - **Bolt M10 (always replace)**

- tighten to 59 Nm (44 ft-lb)

8 - **Bolt M10 (always replace)**

- tighten to 59 Nm (44 ft-lb)

9 - **Bolt M12**

- tighten to 77 Nm (57 ft-lb)

10 - **Front control arm with ball joint and rear mounting bracket**

11 - **Front differential**

12 - **Bolt M10**

- tighten to 45 Nm (33 ft-lb)

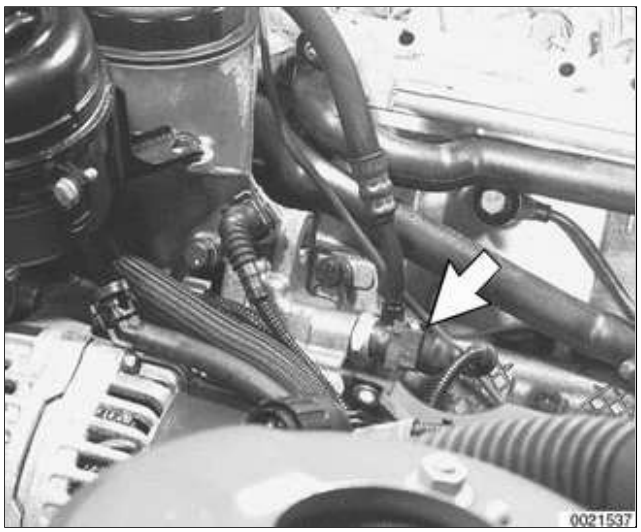
13 - **Left front axle**

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Component Replacement

Oil pressure warning switch



- The pressure warning switch is located under the intake manifold, in the rear of the oil filter housing.

Note:

Switch removal may require intake manifold removal.

Tightening torque	
Oil pressure switch to oil filter housing	27 Nm (20 ft-lb)

Oil level warning switch



- The oil level warning switch is located at the bottom of the engine oil pan.

Note:

Anytime the oil level warning switch is removed, be sure to replace the sealing O-ring between switch and oil pan.

Oil pump, removing and installing

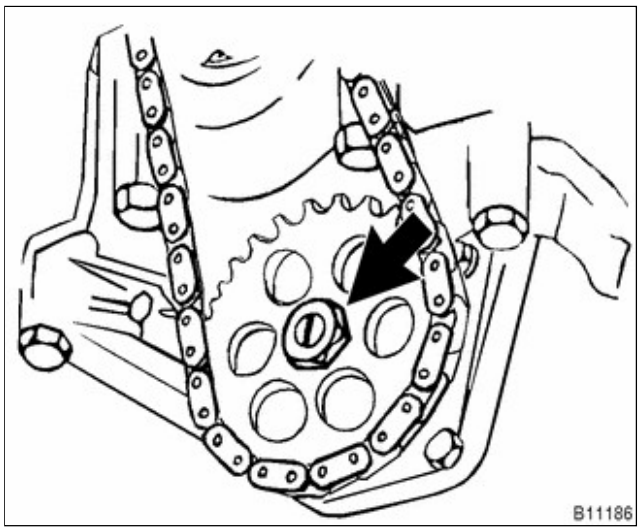
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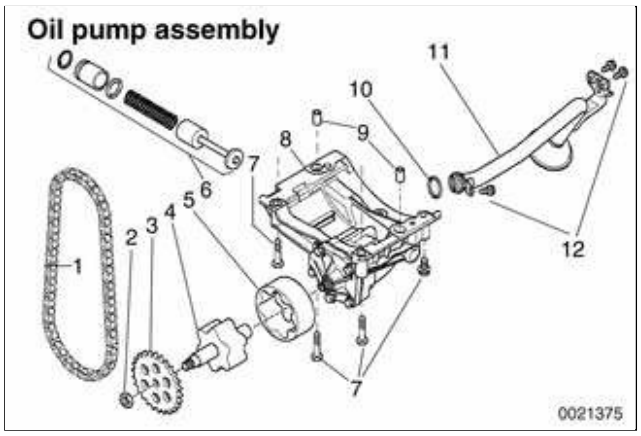
Oil pump removal requires lowering the front suspension subframe to remove the oil pan.

- Drain oil as described in ⇒ 020 Maintenance.

- Remove oil pan as described earlier.



- Remove oil pump sprocket mounting nut (left-hand thread) (**arrow**). Lift sprocket off together with drive chain.



- Remove mounting bolts from oil pump (**7**) and oil pump pickup tube (**12**). Withdraw pump.

1 - Drive chain

2 - Nut M10x1left-hand thread -tighten to 25 Nm (18 ft-lb)

3 - Oil pump sprocket

4 - Inner rotor

5 - Outer rotor

6 - Oil pressure relief valve assembly

7 - Bolt M8 -tighten to 22 Nm (16 ft-lb)

8 - Oil pump housing

9 - Locating dowels

10 - Sealing O-ring

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11 - Oil pick-up pipe

12 - Bolt M6 -tighten to 10 Nm (89 in-lb)

- On engines with integrated oil pump and oil scraper: Remove oil pump with scraper.

- On engines with separate oil pump and scraper:

♦ First remove mounting bolts and withdraw oil pump intake pipe.

♦ Remove oil pump mounting bolts. Remove oil pump assembly.

Note:

♦ *Note any spacers between pump and engine block.*

♦ *Note positions of locating dowels.*

- Remove cover from oil pump and check for wear or scoring. Spin oil pump shaft and check that gears turn smoothly. Replace pump if gears spin with difficulty or any wear is present.

- Installation is reverse of removal, noting the following:

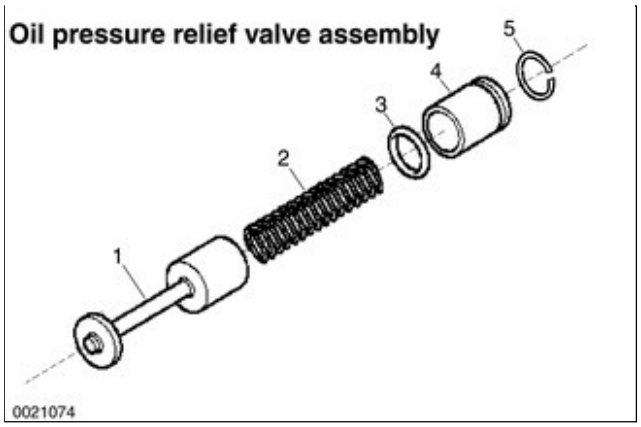
♦ Align sprocket splines to oil pump shaft splines before tightening sprocket nut.

Tightening torques	
Oil drain plug to oil	25 Nm (18 ft-lb)

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Tightening torques	
pan (M12)	
Oil pan to engine block	
M6, 8.8 grade	10 Nm (89 in-lb)
M6, 10.9 grade	12 Nm (106 in-lb)
M8, 8.8 grade	22 Nm (16 ft-lb)
Oil pump to engine block (M8)	22 Nm (16 ft-lb)
Oil pump sprocket to oil pump shaft	
M10x1 left-hand thread	25 Nm (18 ft-lb)
Transmission bellhousing to oil pan	
M8 Allen	24 Nm (17 ft-lb)
M8 Torx	21 Nm (15 ft-lb)

Oil pump pressure relief valve



The oil pump pressure relief valve is held in the side of the oil pump with a circlip.

1 - Control plunger

2 - Spring

3 - Sealing O-ring

4 - Sleeve

5 - Circlip

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General

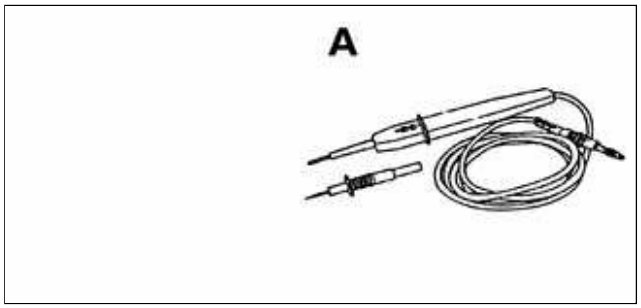
This repair group covers component replacement information for the ignition system.

When diagnosing engine management problems, including on-board diagnostics (OBD II) fault code analysis, also refer to these repair groups:

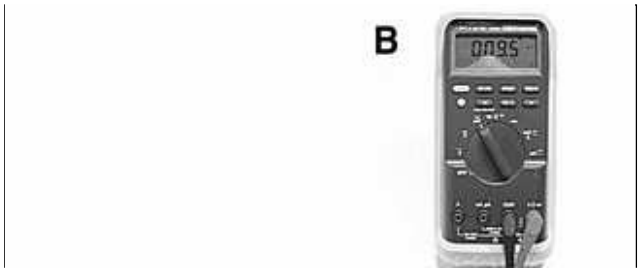
- ⇒ 100 Engine–General
- ⇒ 130 Fuel Injection
- Electrical Wiring Diagrams at the rear of this manual
- ⇒ OBD On Board Diagnostics at the rear of this manual

Special tools

Owing to the coil-per-cylinder configuration, system diagnosis and testing requires special test equipment.



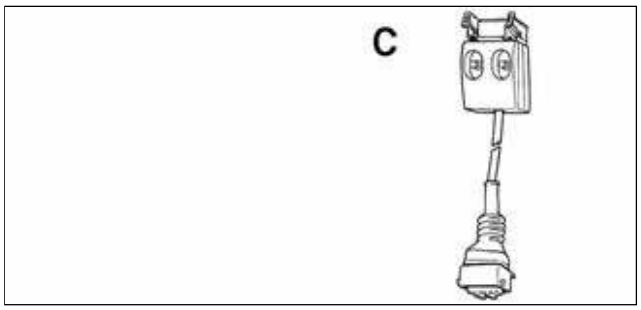
- LED test light Baum 1115 (Source: Baum Tools Unlimited)



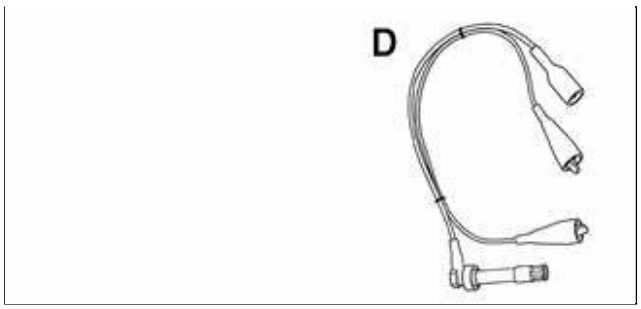
- Automotive digital multimeter Fluke 87

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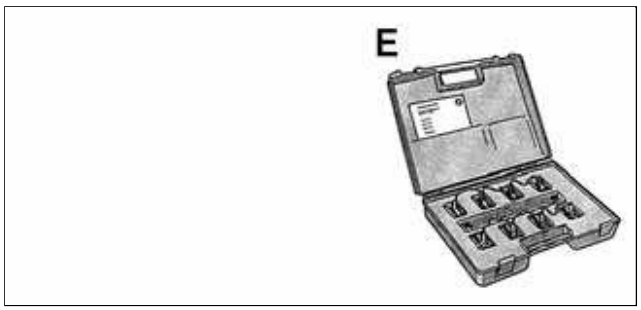




- Primary voltage test harness BMW 12 7 020



- Secondary voltage test harness BMW 12 7 030



- Ignition coil test adapters BMW 12 7 040

Engine management

BMW E46 engines use an advanced engine management system known as Digital Motor Electronics (DME). DME incorporates on-board diagnostics, fuel injection, ignition and other engine control functions. DME variants are listed in ⇒ Table a.

Second generation On-Board Diagnostics (OBD II) is incorporated into the engine management systems used on the cars covered by this manual. Using a BMW-specific electronic scan tool, it is possible to access Diagnostic Trouble Codes (DTCs) that pinpoint ignition and other engine management problems.

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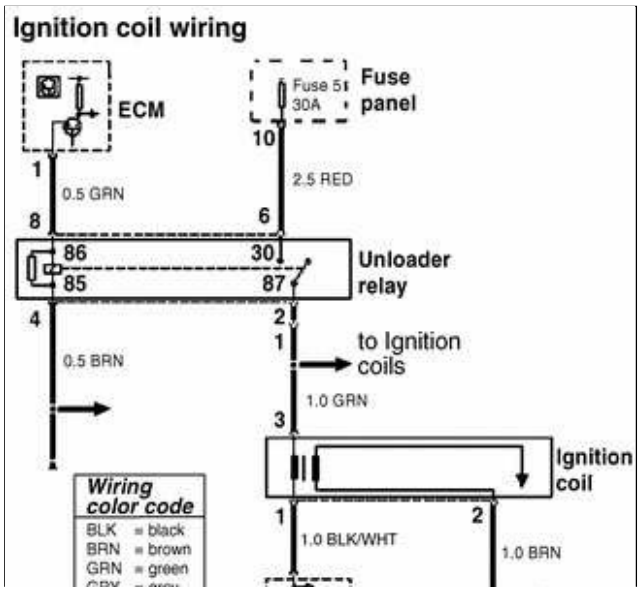
Additional information about DTCs and engine management system electronic system diagnosis is provided in ⇒ OBD On Board Diagnostics at the rear of this manual.

Table a. Engine management systems	
Year: Engine	**DME system**
1999 - 2000: M52 TU B25 M52 TU B28	Siemens MS 42.0
2001: M54 B25 M54 B30	Siemens MS 43.0

Ignition system



- All engines use a distributorless ignition system with individual ignition coils for each cylinder. There is no distributor cap or ignition rotor.



- Each coil can be controlled by the Engine Control Module (ECM) on a cylinder-by-cylinder basis.

Note:

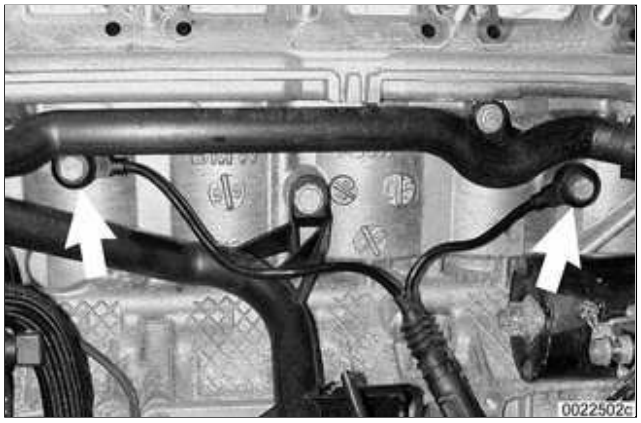
Schematic diagram of ignition coil circuit is for MS 42.0 engine management system. On MS 43.0 system, ignition coil terminal 3 receives power from Fuse 1 (30 amp). See Electrical Wiring Diagrams for specific wiring information.

WARNING!

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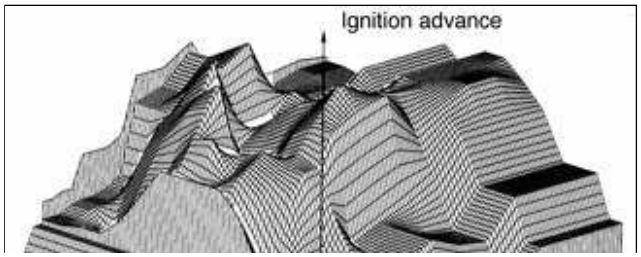
- ***Do not touch or disconnect any cables from the coils while the engine is running or being cranked by the starter.***
- ***The ignition system produces high voltages that can be fatal. Avoid contact with exposed terminals. Use extreme caution when working on a car with the ignition switched on or the engine running.***
- ***Connect and disconnect the DME system wiring and test equipment leads only when the ignition is OFF.***
- ***Before operating the starter without starting the engine (for example when making a compression test) always disable the ignition.***



- Knock sensors (**arrows**) monitor the combustion chamber for engine-damaging knock. Two sensors monitor three cylinders each. If engine knock is detected, the ignition point is retarded by the ECM.

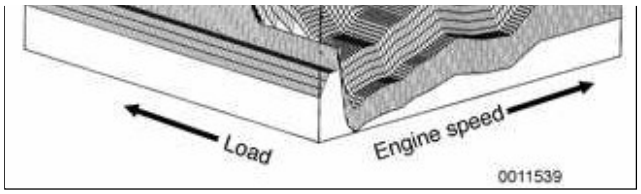
Note:

When knock is detected, ignition timing will be retarded at the selective cylinder(s) by 3° increments. If knock is no longer detected, the timing will be advanced in 1° increments.



- Ignition timing is electronically mapped and not adjustable. The ECM uses engine load, engine speed, coolant temperature, knock detection and intake air temperature as the basic inputs for timing control. A three

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dimensional map similar to the one shown is digitally stored in the ECM.

The initial ignition point is determined by the crankshaft speed sensor during cranking. Once the engine is running, timing is continually adjusted based on operating conditions.

Basic troubleshooting principles

Poor driveability may have a variety of causes. The fault may lie with the ignition system, the fuel system, parts of the emission control system, or a combination of the three. Because of these interrelated functions and their effects on each other, it is often difficult to know where to begin looking for problems.

For this reason, effective troubleshooting should always begin with an interrogation of the On-Board Diagnostics (OBD II) system. The OBD II system detects engine management malfunctions. When faults are detected, the OBD II system stores a Diagnostic Trouble Code (DTC) in the Engine Control Module (ECM) along with other pertinent fault information. In addition, the Malfunction Indicator Light (MIL) will come on if an emissions related fault is detected. Additional OBD II information, including a DTC lookup table can be found in the back of this manual under ⇒ OBD On Board Diagnostics.

Note:

On model year 1999 and 2000 cars, the MIL is labeled Check Engine. On model year 2001 cars, the MIL is labeled Service Engine Soon.

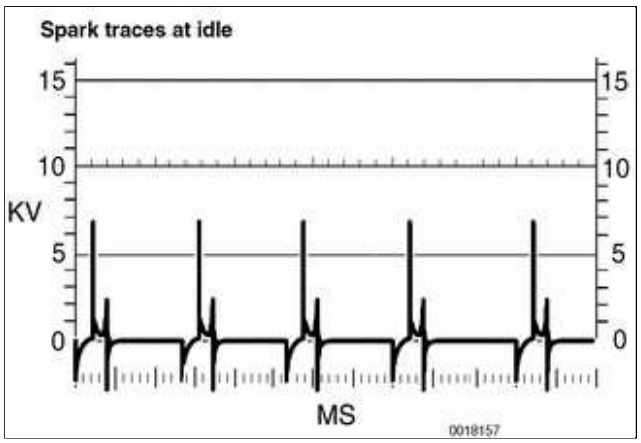
An engine that starts and runs indicates that the ignition system is

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fundamentally working-delivering voltage to the spark plugs. A hard-starting or poor-running engine, however, may indicate a problem with how well the spark is delivered. Faulty or worn ignition components, such as old spark plugs, or an individual coil problem may be the cause.

WARNING!

Inefficient combustion (rich air/fuel mixture) can cause elevated hydrocarbon exhaust emissions and catalytic converter damage. For this reason, if a severe misfire is detected, the fuel injector will be turned off to the specific cylinder and the MIL illuminated.

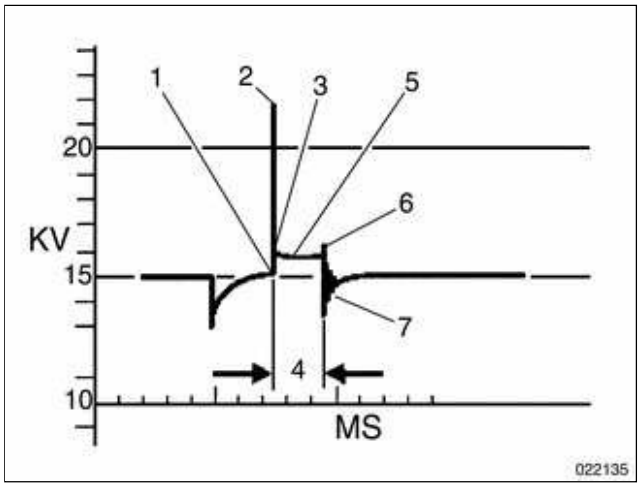


- One way to diagnose a faulty coil on a car that is running is to use an oscilloscope to analyze spark quality. The illustrations show normal scope trace of spark at idle.

⇒ Table b lists common ignition coil voltage faults and related causes.

Note:

Note the length of sparking period and the up-down voltage attenuations. A short sparking period and/or an irregular/low voltage attenuation usually indicates a faulty coil.



- A normal oscilloscope pattern for a six cylinder engine.

1 - Start of ignition voltage peak

2 - Level of ignition voltage

3 - Level of combustion voltage

4 - Period of combustion

5 - Combustion curve characteristics

6 - Start of decay process

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7 - Termination oscillations

Note:

See ⇒ Ignition coil assembly, testing and replacing as described later.

Table b. Ignition trace diagnostics		
Parameter	**Ignition voltage low**	**Ignition voltage high**
Spark plug electrode gap	too small	too big
Spark plug electrode condition	-	worn/burnt
Spark plug electrode temperature	too high	too low
Engine compression	too low	too high
Spark plug wire(s)	-	faulty
Fuel air mixture	-	too lean

Misfire detection

Engine misfire, the result of inefficient combustion in one or more cylinders, may be caused by a variety of malfunctions in various subsystems.

The OBD II system incorporated into the MS 42.0 and MS 43.0 engine management systems is designed to detect and warn of misfire faults during engine operation. Misfire fault codes are listed in ⇒ Table c. Misfire fault codes. For a detailed list of fault codes see ⇒ OBD On Board Diagnostics.

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Once engine misfire has been detected and the fault codes downloaded from the ECM, it is necessary to follow a diagnostic path to correct the problem. The ignition subset of the diagnostic path is shown in ⇒ Table d. Ignition system problems

Table c. Misfire fault codes

P code	BMW fault code	Fault code	Possible cause(s)
P0301	238	Misfire cylinder 1	Ignition fault: Defective or incorrect spark plug(s) or connector(s); defective ignition coil(s) Mechanical fault: Crankshaft pulse wheel loose or damaged; damaged piston(s), valve(s) or camshaft(s); oil pressure low Catalyst fault: Excessive exhaust backpressure due to restricted catalyst Fuel supply fault: Contaminated fuel; fuel delivery fault (blocked filter, low fuel in tank, defective fuel pump); running loss system fault; leaking or blocked fuel injector(s); fuel pressure regulator fault; evaporative system fault ECM/sensor input fault: Implausible sensor signal; oxygen sensor(s) faulty; ECM faulty
P0302	239	Misfire cylinder 2	
P0303	240	Misfire cylinder 3	
P0304	241	Misfire cylinder 4	
P0305	242	Misfire cylinder 5	
P0306	243	Misfire cylinder 6	
P1396	244	Crankshaft sensor adaptation at limit	Misfire detection fault: Varying pulse wheel tolerances or loose pulse wheel

Table d. Ignition system problems

Component	Condition	Test	Repair
Spark plug	Incorrect spark plug Electrode gap too small Electrode(s) missing Oil or fuel fouled spark plug Ceramic insulation cracked	Inspect spark plugs.	Verify correct spark plugs. Replace plugs if defective. Check crankcase ventilation and oil level.

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Component	Condition	Test	Repair
Secondary circuit	Wet coil Corroded coil connections	Secondary circuit	Check for water leak. Check resistance values (see ⇒ Table e).
Ignition coil	Primary or secondary circuit on or shorted Housing cracked, damaged	Primary and secondary circuits (see ⇒ Table e)	Replace coil as necessary.
Ignition coil harness connector	Power supply, primary control circuit or ground (shunt signal) circuits impaired	Primary ignition and terminal 4A feedback preset measurements	Look for open, loose connector, corrosion, crossed or damaged connector pins. Inspect ignition unloader relay. Replace coils as necessary.

Warnings and cautions

The engine management system contains sensitive electronic components. To protect the system and for general safety, the following warnings and cautions should be observed during ignition system troubleshooting, maintenance or repair work.

WARNING!

- ***Do not touch or disconnect any cables from the coils while the engine is running or being cranked by the starter.***

- ***The ignition system produces high voltages that can be fatal. Avoid contact with exposed terminals. Use extreme caution when working on a car with the ignition switched on or the engine running.***

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- ***Connect and disconnect the DME system wiring and test equipment leads only when the ignition is OFF.***

- ***Before operating the starter without starting the engine (for example when making a compression test) always disable the ignition.***

CAUTION!

- ***Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.***

- ***Do not attempt to disable the ignition by removing the coils from the spark plugs.***

- ***Connect or disconnect ignition system wires, multiple wire connectors, and ignition test equipment leads only while the ignition is off. Switch multimeter functions or measurement ranges only with the test probes disconnected.***

- ***Do not disconnect the battery while the engine is running.***

- ***A high impedance digital multimeter should be used for all voltage and resistance tests. An LED test light should be used in place of an incandescent-type test lamp.***

- ***In general, make test connections***

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only as specified by BMW, as described in this manual, or as described by the instrument manufacturer.

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Ignition System Service

Ignition firing order



- Each ignition coil is mounted above the corresponding spark plug. Cylinder 1 is at the front of the engine.

Ignition firing order	
M52 TU/M54 engine	1 - 5 - 3 - 6 - 2 - 4

Disabling ignition system

The ignition system operates in a lethal voltage range and should therefore be disabled any time engine service or repair work is being done that requires the ignition to be switched on.



- The engine management system can be disabled by removing the DME main relay (**arrow**). The relay is located in the electronics box (E-box) in the left rear of the engine compartment.

CAUTION!

Relay locations may vary. Use care when identifying relays. The main relay has a large (4 mm 2) red wire at terminal 30 and a large (4 mm 2) red/white wire at terminal 87. See ⇒ 610 Electrical Component Locations.

Checking for spark

CAUTION!

If a spark test is done incorrectly, damage to the Engine Control Module

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(ECM) or the ignition coils may result.

Note:

Spark plug replacement is covered in ⇒ 020 Maintenance.

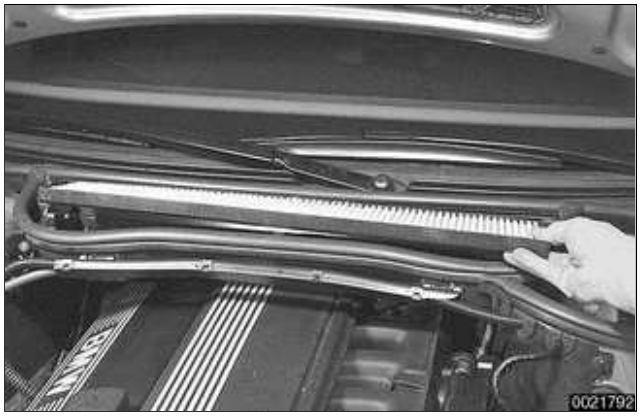
Checking for spark is difficult on engines with distributorless ignition systems.

Try removing the spark plugs and inspecting for differences between them. A poor-firing plug may be wet with fuel and/or black and sooty, but not always. If a coil is not operating, the engine management system will electrically disable the fuel injector to that cylinder. The key is to look for differences between cylinders.

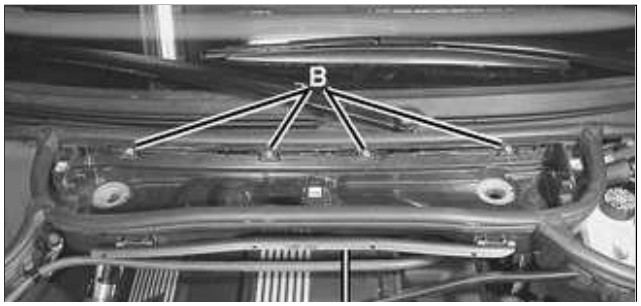
Ignition coil assembly, testing and replacing

CAUTION!

Use a digital multimeter for the following tests.



- Remove interior ventilation microfilter.



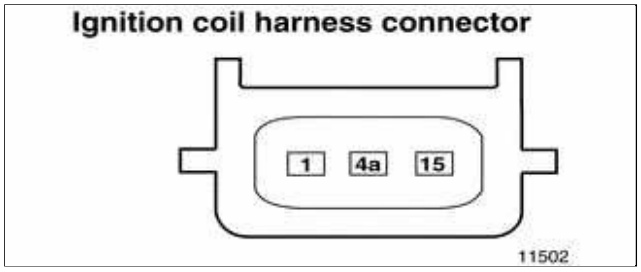
- Remove housing for microfilter for interior ventilation.
  - Open wiring harness loom (**A**) and remove wires.

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- Unfasten screws (**B**) and remove lower microfilter housing.

- Remove plastic engine cover from top of valve cover by prying off bolt covers and removing cover mounting bolts.



Disconnect harness connector from coil. Connect multimeter between terminal **15** (+) in connector and ground.

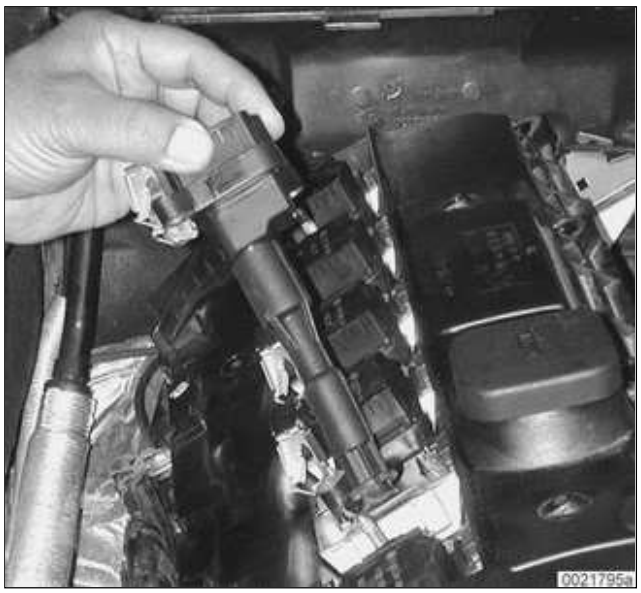
- Turn ignition on and check for battery voltage.

- If battery voltage is not present, check wire between terminal **15** and ignition switch. See Electrical Wiring Diagrams.

CAUTION!

The wiring to terminal 15 (+) of the coil (via the ignition switch) is not fuse protected. Use care when testing this circuit.

- Turn ignition off.



Remove coil and inspect coil housing for hairline cracks or leaking casting material. A leaky ignition coil may indicate a faulty Engine Control Module (ECM). Check ECM before installing a new coil.

CAUTION!

Note location of coil ground straps before coil removal; reinstall in the same location.

- Use a multimeter to test:

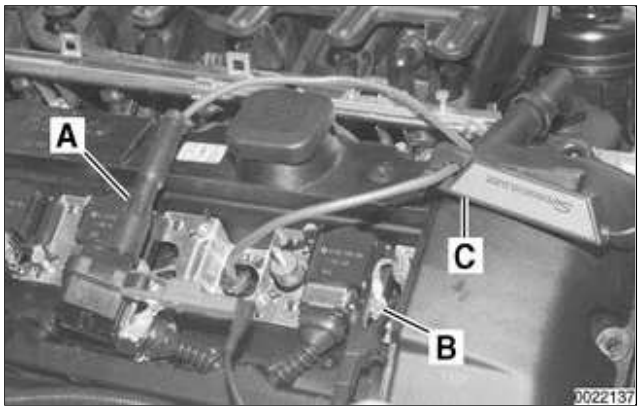
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- Coil primary resistance at coil terminals
- Spark plug connector resistance
- Compare results to specification in ⇒ Table e.

Table e. Ignition coil resistance

Component	Terminals	Resistance
Coil primary	1 (-) and 15 (+)	approx. 0.8 Ω
Coil secondary		N.A.
Spark plug connector		
Bosch		1 kΩ 20%
Beru		1.8 kΩ 20%

- Replace ignition coil or spark plug connector if resistance readings do not meet specifications.



Remove ignition coil to be tested.

- Install BMW special tool 12 7 030 (**A**) on coil to be tested.
- Connect ground jumper between coil mounting point and engine ground point (**B**).
- Clip scope high pick-up lead (**C**) around ignition lead.
- Start engine.

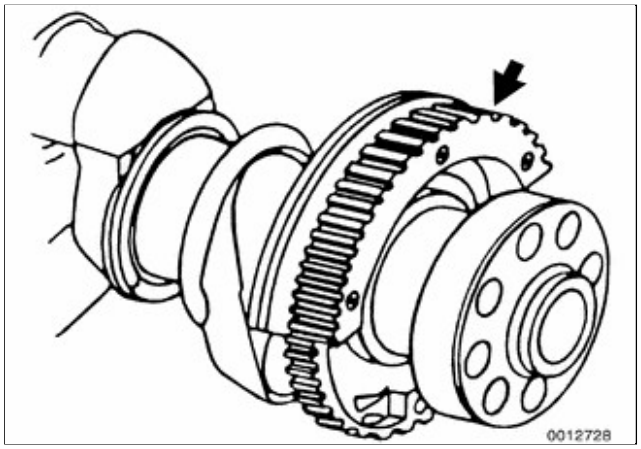
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- Compare scope pattern with diagrams in ⇒ Basic troubleshooting principles.

Note:

When replacing ignition coils, ensure that the replacements are from the same manufacturer with the same part/code numbers. If individual coils with the correct specifications are not available, all coils should be replaced.

Crankshaft speed sensor, replacing



The crankshaft speed sensor is mounted in the left rear side of the cylinder block below the starter. The sensor reads a toothed pulse wheel (**arrow**) mounted to the end of the crankshaft.

If the Engine Control Module (ECM) does not receive a signal from the crankshaft speed sensor during cranking, the engine will not start.

If the OBD II system misfire detection protocol detects a catalyst damaging fault due to a malfunction in crankshaft speed sensor components, the Check Engine light (Malfunction Indicator Light or MIL) will be illuminated.

Note:

If the crankshaft speed sensor pulse wheel is damaged, the engine will have to be disassembled down to the crankshaft to replace the wheel.

- Make certain ignition has been turned off.

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- Raise car and support in a safe manner.

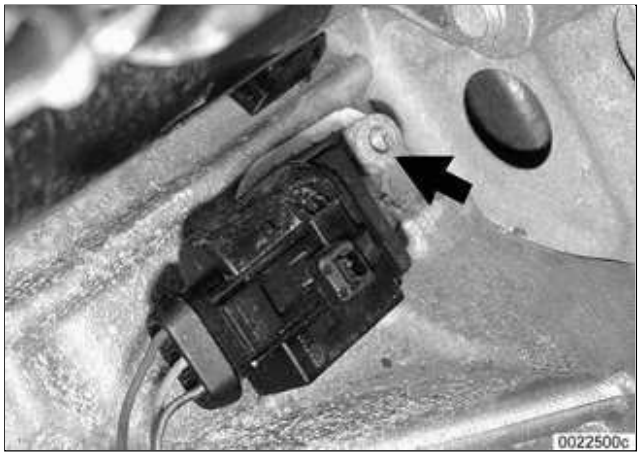
WARNING!

Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

- Remove under-engine splash guards.



- Working just underneath starter:
  - Cut off wire tie securing crankshaft speed sensor harness connector (**arrow**) to sensor.
  - Disconnect harness connector.



- Remove sensor mounting screw (**arrow**) and remove sensor from cylinder block.
  - Installation is reverse of removal, noting the following:
  - Use a new O-ring when installing sensor.
  - Be sure wiring is rerouted in same orientation.
  - Secure sensor using new wire ties.
  - Use scan tool to read out and clear

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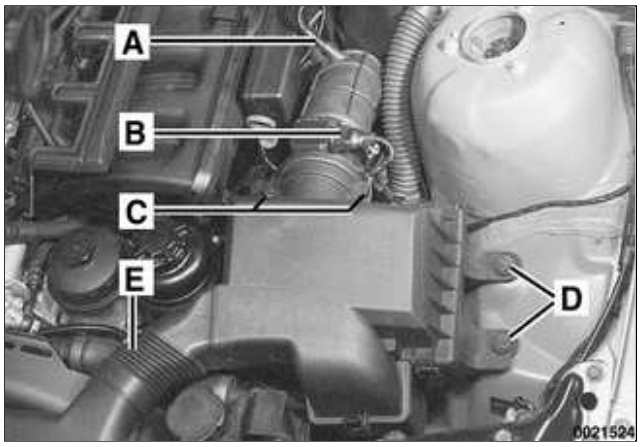
ECM fault memory.

Camshaft position sensors

The camshaft position sensors are used by the engine management system for VANOS control, sequential fuel injection and knock control.

Intake camshaft position sensor, replacing

- Make certain ignition has been turned off.
- Remove housing for the microfilter for interior ventilation as shown earlier.
- Remove plastic cover from above fuel injectors by prying off bolt covers and removing cover mounting bolts.



➢ Remove complete air filter housing:

- Disconnect electrical harness connector on mass air flow sensor (**B**).
- Detach vacuum line at intake boot (**A**).
- Remove filter housing mounting screws (**D**).
- Loosen hose clamp at intake boot and detach air duct connections (**C**).

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- Disconnect cold air duct tube (**E**).

- Disconnect harness connector from VANOS solenoid and unscrew solenoid from VANOS control unit. Be prepared with shop rags to catch oil released from VANOS unit.



- Remove camshaft sensor (**arrow**) from left front of cylinder head, next to top of oil filter housing.

- Disconnect camshaft sensor harness from under intake manifold. Prior to removal, attach a stiff piece of wire to the harness connector end to preserve proper routing of harness for reinstallation.

- Installation is reverse of removal.

- Use new O-rings when installing sensor and solenoid.

- Be sure wiring is rerouted in same orientation.

- Use scan tool to read out and clear ECM fault memory.

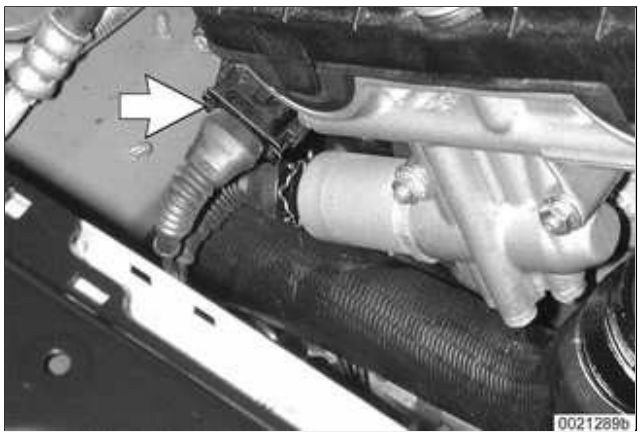
Tightening torques	
Intake camshaft sensor to cylinder head	5 Nm (3.5 ft-lb)
VANOS solenoid to VANOS control unit	30 Nm (22 ft-lb)

Exhaust camshaft position

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sensor, replacing

- Make certain ignition has been turned off.



➢ Working at front of engine on exhaust (**right**) side, detach exhaust camshaft position sensor electrical harness connector (**arrow**).

- Remove camshaft sensor from right front of cylinder head.

- Installation is reverse of removal.

♦ Use a new O-ring when installing sensor.

♦ Be sure wiring is rerouted in same orientation.

♦ Use scan tool to read out and clear ECM fault memory.

Tightening torque	
Exhaust camshaft sensor to cylinder head	5 Nm (3.5 ft-lb)

Knock sensors, replacing

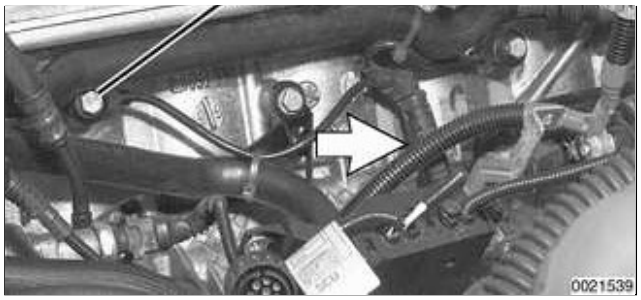
The knock sensors are bolted to the left side of the cylinder block under the intake manifold.

- Remove intake manifold as described in ⇒ 113 Cylinder Head Removal and Installation.



➢ Disconnect knock sensor electrical harness connector (**arrow**) on left side of engine cylinder block.

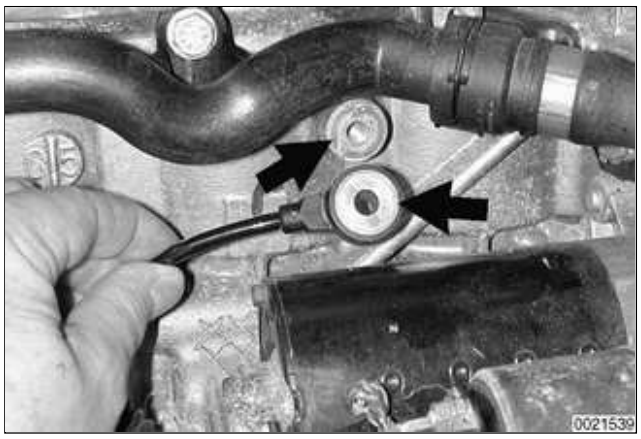
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- Remove knock sensor mounting bolts (**A**) on side of cylinder block. Remove sensors.

CAUTION!

Note the installed angle of the knock sensor on the block before removing it. Reinstall the sensor in the same position. Be sure to use a torque wrench when tightening the sensor mounting bolt.



- Clean knock sensor contact surface on engine block and sensor (**arrows**) before installing knock sensor.

Tightening torque	
Knock sensor to cylinder block	20 Nm (15 ft. lbs.)

- Use scan tool to read out and clear ECM fault memory.

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General

This repair group covers service and repair for the Siemens engine management systems used on the E46 models covered by this manual. Additional engine management information may also be found in the following repair groups:

- ⇒ 100 Engine–General
- ⇒ 120 Ignition System
- ⇒ 160 Fuel Tank and Fuel Pump
- Electrical Wiring Diagrams

Note:

Fuel pressure testing and fuel pump repair information is covered in ⇒ 160 Fuel Tank and Fuel Pump.

Table a. Engine management systems	
Model Year: Engine code	**DME system**
1999 - 2000: M52 TU B25 M52 TU B28	Siemens MS 42.0
2001: M54 B25 M54 B30	Siemens MS 43.0

The Siemens systems are sophisticated self-diagnosing OBD II systems. These systems continuously monitor components and record and store valuable diagnostic information.

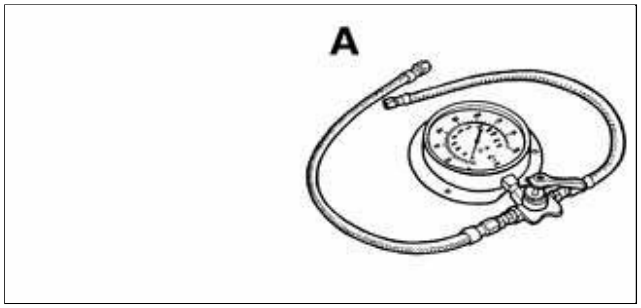
When faults arise, or if the MIL

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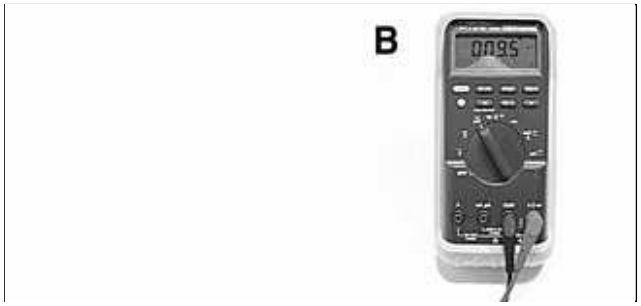
(malfunction indicator lamp) in the instrument cluster is illuminated, begin troubleshooting by hooking up a BMW-compatible scan tool. The rich diagnostic capabilities of these systems have the potential to save hours of diagnostic time, incorrect component replacement and possible damage to system components. See ⇒ OBD On Board Diagnostics at the back of this manual.

Tools and test equipment

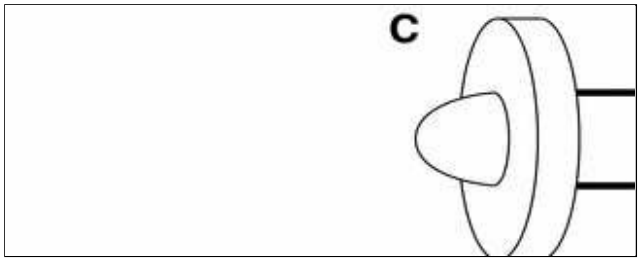
If the equipment required to do the job is unavailable, it is recommended that these repairs be left to an authorized BMW dealer or other qualified BMW repair facility.



- Fuel pressure gauge Baum 1318 (Source: Baum Tools Unlimited)



- Automotive digital multimeter Fluke 87



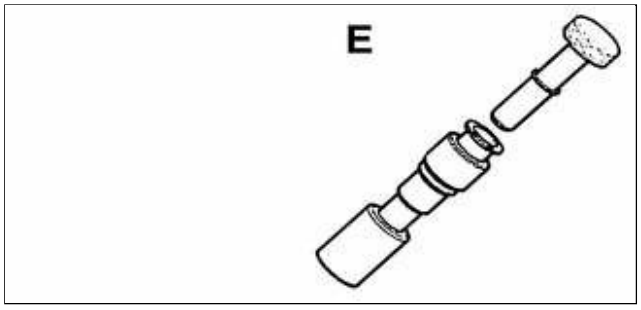
- Low current test light (“noid”) Baum 1115a (Source: Baum Tools Unlimited)



- Factory DTC scan tool BMW DIS/MoDiC

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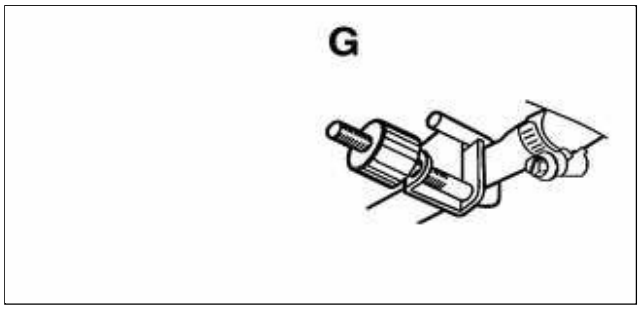




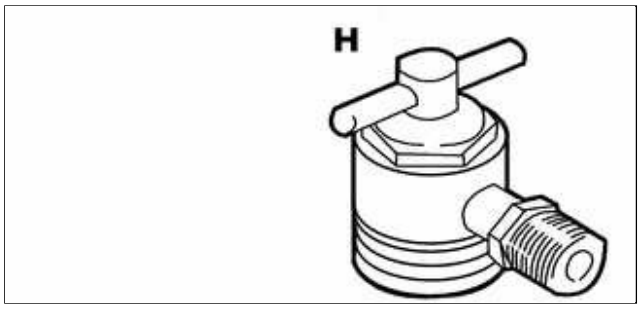
- Fuel line plugs BMW 13 5 281 / 13 5 282



- Aftermarket DTC scan tool Baum CS2000 (Source: Baum Tools Unlimited)



- Fuel line clamp BMW 13 3 010



- Fuel rail to pressure gauge fitting BMW 13 5 220

Note:

- *Professional diagnostic scan tools available at the time of this printing include the BMW factory tools (DISplus and MoDiC) and a small number of aftermarket BMW-specific tools. The `CS2000' from Baum Tools Unlimited, the `Retriever' from Assenmacher Specialty Tools, and the MT2500 from Snap-on are three examples*

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of quality OBD scan tools.

- *In addition to the BMW professional line of scan tools, there are many inexpensive `generic' OBD II scan tool software programs and handheld units available. Although these tools have limited capabilities as compared to the dedicated tools, they are powerful diagnostic tools. These tools read live data streams, freeze frame information for DTCs (diagnostic trouble codes) and impending DTCs, as well as a host of other valuable diagnostic data.*

- *For the DIY owner, simple aftermarket DTC readers are also available. These inexpensive BMW-only tools are capable of checking for DTCs as well as turning off the illuminated MIL, and resetting the service indicator lights.*

- *See ⇒ 020 Maintenance for specialty tool manufacturer contact information.*

Principle of operation

The DME fuel injection system is completely electronic in operation. Intake air, engine coolant temperature, crank and camshaft positions, engine speed and many other engine operating parameters are measured electronically and the information is supplied to the engine control module (ECM).

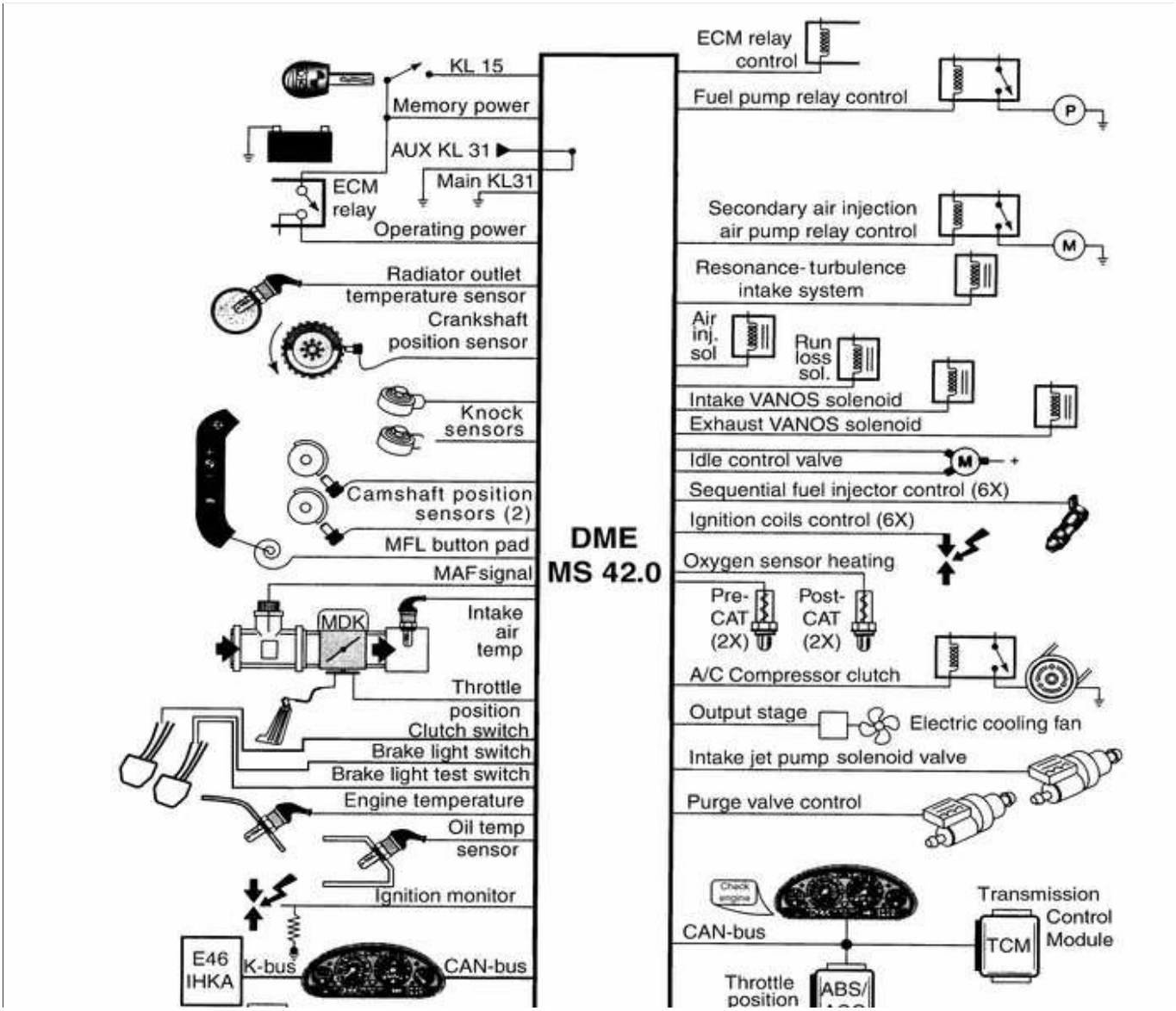
Based on input information, the ECM controls the ignition coils, fuel injectors,

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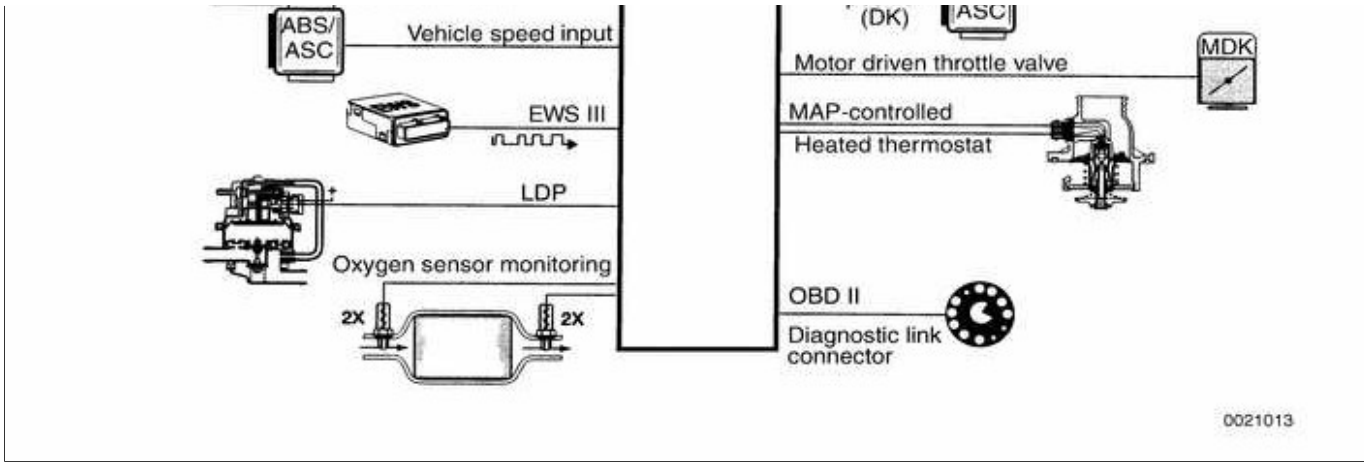
motor driven throttle valve, double VANOS system, radiator cooling fan, electrically heated thermostat, as well as other outputs.

The illustration on the following page shows the MS 42.0 ECM inputs and outputs. The MS 43.0 system is similar in operation, with the main difference being the fully electronic `drive-by-wire' throttle valve. Additional system operational information can be found in ⇒ 100 Engine–General.

DME MS 42.0



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Warnings and cautions

For personal safety, as well as the protection of sensitive electronic components, adhere to the warnings and cautions on the following pages.

WARNING!

- ***Gasoline is highly flammable and its vapors are explosive. Do not smoke or work on a car near heaters or other fire hazards when diagnosing and repairing fuel system problems. Have a fire extinguisher available in case of an emergency.***

- ***When working on an open fuel system, wear suitable hand protection, as prolonged contact with fuel can cause illnesses and skin disorders.***

- ***The ignition system produces high voltages that can be fatal. Avoid contact with exposed terminals. Use extreme caution when working on a car with the ignition switched on or the engine***

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running.

- ***Do not touch or disconnect any cables from the coils while the engine is running or being cranked by the starter.***
- ***Connect and disconnect the DME system wiring and test equipment leads only when the ignition is switched off.***
- ***Renew fuel system hoses, clamps and O-rings any time they are removed.***
- ***Before making any electrical tests that require the engine to be cranked using the starter, disable the ignition system as described in ⇒ 120 Ignition System.***

CAUTION!

- ***Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.***
- ***Do not connect any test equipment that delivers a 12-volt power supply to terminal 15 (+) of the ignition coil. The current flow may damage the ECM. In general, connect test equipment only as specified by BMW, or the equipment maker.***
- ***Only use a digital multimeter for electrical tests.***
- ***Only use an LED test light for***

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quick tests.

- ***Disconnecting the battery may erase fault code(s) stored in memory. Check for fault codes prior to disconnecting the battery cables.***

- ***Wait at least 40 seconds after turning off the ignition before removing the engine control module (ECM) connector. If the connector is removed before this time, residual power in the system relay may damage the control module.***

- ***Cleanliness is essential when working on an open fuel system. Thoroughly clean fuel line connections and surrounding areas before loosening. Avoid moving the car. Only install clean parts.***

- ***Fuel system cleaners and other chemical additives other than those specifically recommended by BMW may damage the catalytic converter, the oxygen sensor or other fuel supply components.***

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Electrical Checks and Component Testing

Troubleshooting and fault diagnosis on OBD II cars is best performed using an electronic scan tool. However, it may be necessary to perform basic tests of the engine management main components, fuel system or wiring.

CAUTION!

- ***The tests in this section may set fault codes (DTCs) in the ECM and illuminate the MIL. After all testing tests is completed, access and clear DTC fault memory using a BMW compatible scan tool. See ⇒ OBD On Board Diagnostics at the back of this manual.***

- ***Only use a digital multimeter for electrical tests.***

- ***Relay positions can vary. Be sure to confirm relay position by identifying the wiring in the socket using the wiring diagrams found at the rear of this manual.***

DME main relay, testing

The DME main relay is energized via the engine control module (ECM) and supplies battery positive (B+) power to many of the engine management components and subsystems. If this relay is faulty, the engine will not start.

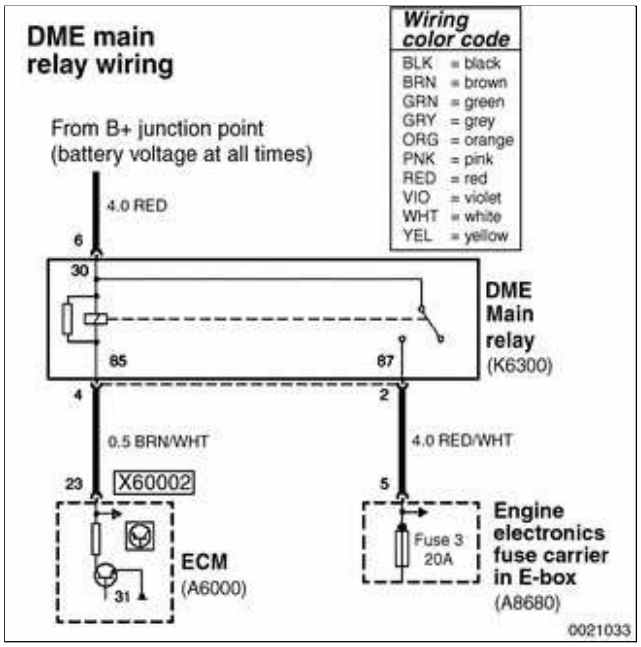


With ignition off, remove main relay (**arrow**) in electronics box (E-box) at

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left rear of engine compartment.



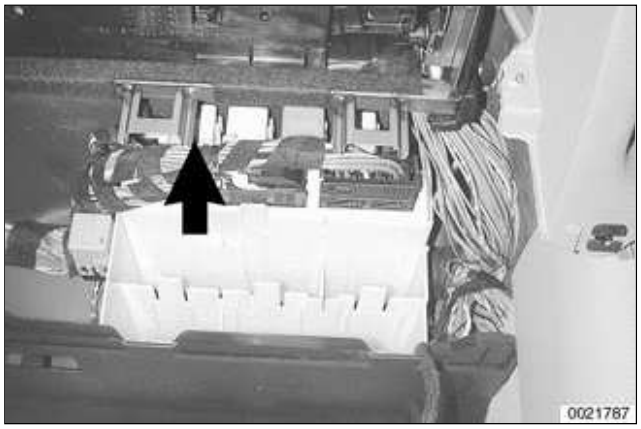
- Check for voltage at terminal **6** of main relay socket (**30**- **red** wire).
  - If battery voltage is present continue testing.
  - If battery voltage is not present, check large red wire in relay socket. See Electrical Wiring Diagrams.
  - Reinstall relay and turn ignition on. Gain access to underside of relay socket and check for ground at terminal **4** (**85**- **brown/white** wire).
  - If ground is present continue testing.
  - If ground is not present, signal from ECM (connector X60002, pin **23**) is missing. Check wire between ECM and relay.
  - With ignition on and relay installed, check for battery voltage at terminal **2** (**87**- **red/white** wire).
  - If battery voltage is present, relay has energized and is functioning correctly.

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- If battery voltage is not present and all earlier tests are OK, relay is faulty and should be replaced.

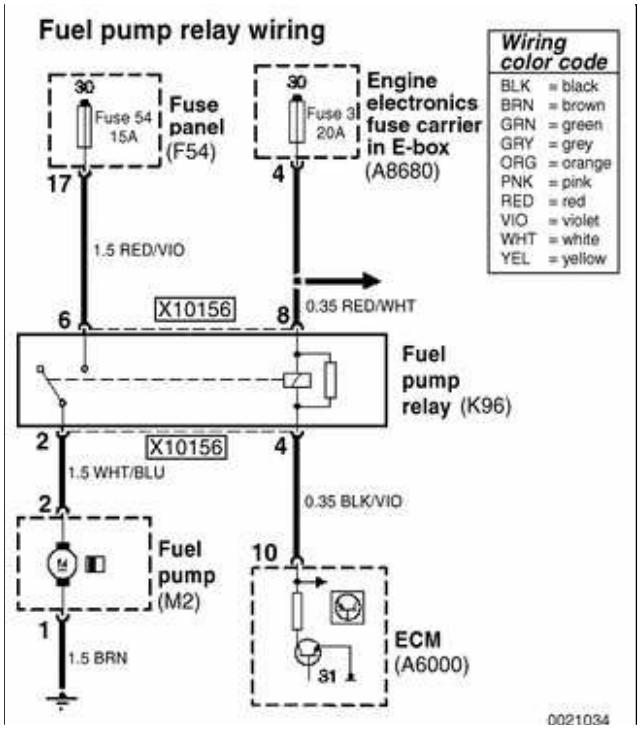
Fuel pump relay, testing

The ECM energizes the fuel pump relay by providing the coil side of the relay with ground. During starting, the fuel pump runs as long as the ignition switch is in the start position and continues to run once the engine starts. If the relay is faulty the fuel pump will not run.



- Fuel pump relay (**arrow**) is located behind glove compartment. Remove glove compartment. See ⇒ 513 Interior Trim.

  - Remove fuel pump relay from socket.



- With ignition in START position, check for battery voltage at relay connector (X10156) terminals **6** and **8** (**red/violet** andred/white wires).

CAUTION!

Ensure that manual transmission vehicles are not in gear, and automatic transmission vehicles are in Park or Neutral prior to operating ignition in START position.

  - With ignition in START position, use digital multimeter to check for ground at terminal **4** (**black/violet** wire).

Note:

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The ground at terminal 4 is switched by the ECM. The ECM harness must be connected to check the switched ground connection.

- If no faults are found up to this point, turn ignition key off. Using a fused (14 gauge) jumper wire, connect relay connector terminal **6** to terminal **2**. The fuel pump should run.

- If pump runs and all other tests are as specified, fuel pump relay is probably faulty.

- If pump does not run, test fuel pump operation as described in ⇒ 160 Fuel Tank and Fuel Pump.

CAUTION!

The jumper wire should be 1.5 mm^2 (14 ga.) and include an in-line fuse holder with a 15 amp fuse. To avoid fuse/relay panel damage from repeated connecting and disconnecting, also include a toggle switch.

Fuel delivery and fuel pressure

Checking fuel delivery volume and fuel pressure is a fundamental part of troubleshooting and diagnosing the engine management system. Fuel pressure directly influences fuel delivery. Procedures for measuring the fuel pressure and fuel volume are given in ⇒ 160 Fuel Tank and Fuel Pump.

Relieving fuel pressure

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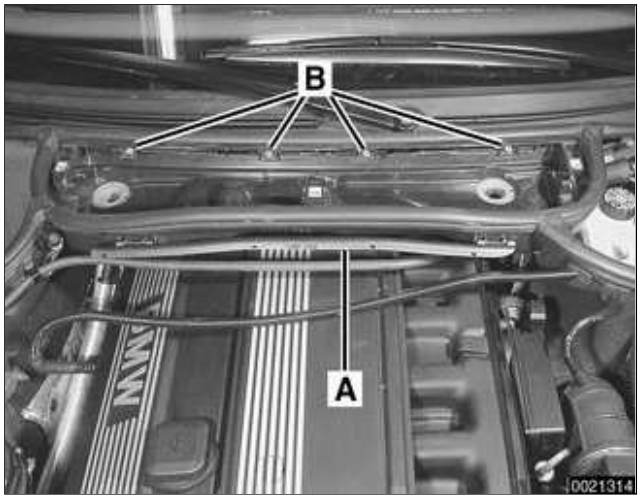
The fuel system retains fuel pressure in the system when the engine is turned off. To prevent fuel from spraying on a hot engine, system fuel pressure should be relieved before disconnecting fuel lines. One method is to tightly wrap a shop towel around a fuel line fitting and loosen or disconnect the fitting.

Cleanliness is essential when working with fuel circuit components. Thoroughly clean the unions before disconnecting fuel lines.

WARNING!

- ***Gasoline is highly flammable and its vapors are explosive. Do not smoke or work on a car near heaters or other fire hazards when diagnosing and repairing fuel system problems. Have a fire extinguisher available in case of an emergency.***

- ***When working on an open fuel system, wear suitable hand protection. Prolonged contact with fuel can cause illnesses and skin disorders.***



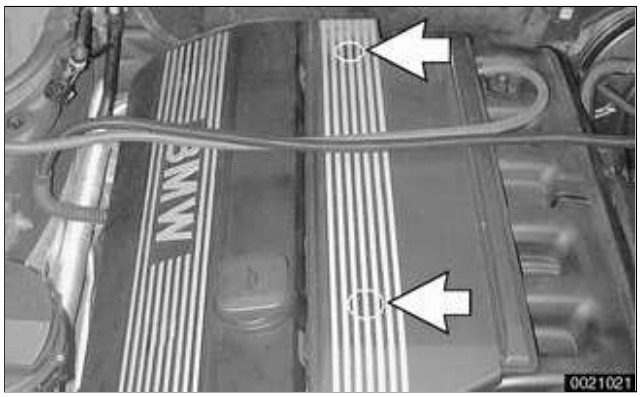
Remove interior ventilation microfilter housing.

- Remove upper cover and microfilter.

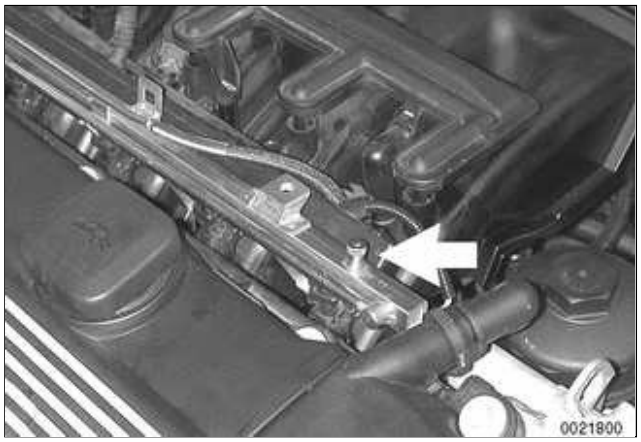
- Open wiring harness loom (**A**) and move wiring out of way.

- Unfasten screws (**B**) and remove lower microfilter housing.

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- Remove fuel rail cover by prying off nut covers (**arrows**) and removing nuts.



- Unscrew schræder valve cap (**arrow**) from fuel rail. Unscrew fuel tank cap to release pressure to vent tank.
  - Using a brief burst of compressed air (maximum of 3 bar or 43.5 psi) blow fuel back through return line into fuel tank.

WARNING!

- ***Fuel in fuel line is under pressure (approx. 3 - 5 bar or 45 -75 psi) and may be expelled under pressure. Do not smoke or work near heaters or other fire hazards. Keep a fire extinguisher handy. Before disconnecting fuel hoses, wrap a cloth around fuel hoses to absorb any leaking fuel. Catch and dispose of escaped fuel. Plug all open fuel lines.***

- ***Always unscrew fuel tank cap to release pressure in the tank before working on the tank or lines.***

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Component Replacement

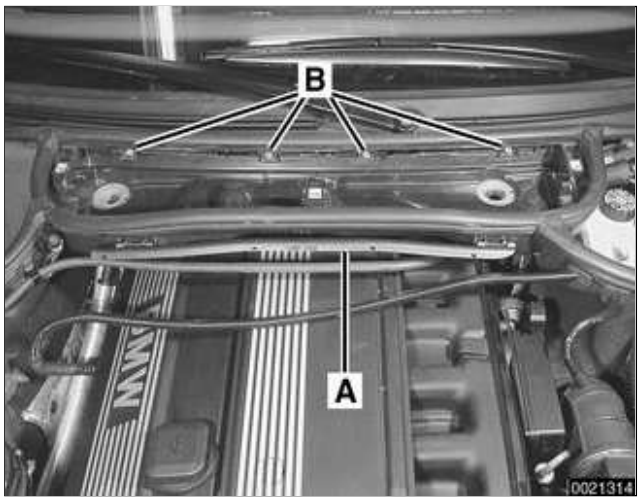
After diagnosing and replacing a faulty engine management component, be sure to use a BMW-compatible scan tool to check and clear the fault memory in the ECM. Diagnostic trouble codes are given in ⇒ OBD On Board Diagnostics at the back of this book.

Fuel rail and injectors, removing and installing

- Disconnect negative (-) battery cable.

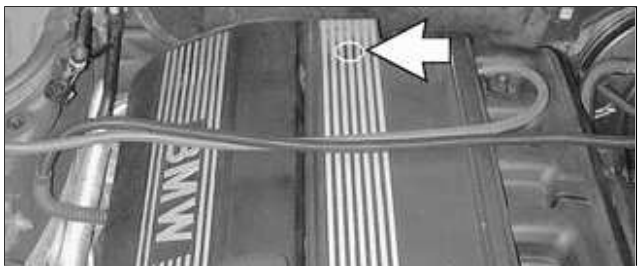
CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.



➢ Remove housing for microfilter for interior ventilation.

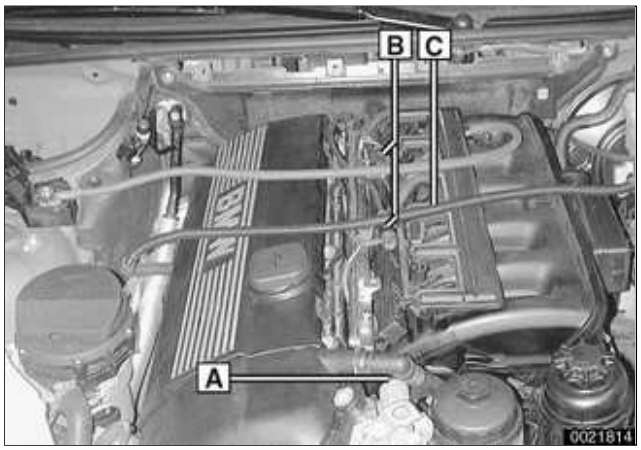
- ♦ Remove upper cover and microfilter.
- ♦ Open wiring harness loom (**A**) and remove wires.
- ♦ Unfasten screws (**B**) and remove lower microfilter housing.



➢ Remove fuel rail cover by prying off nut covers (**arrows**) and removing nuts.

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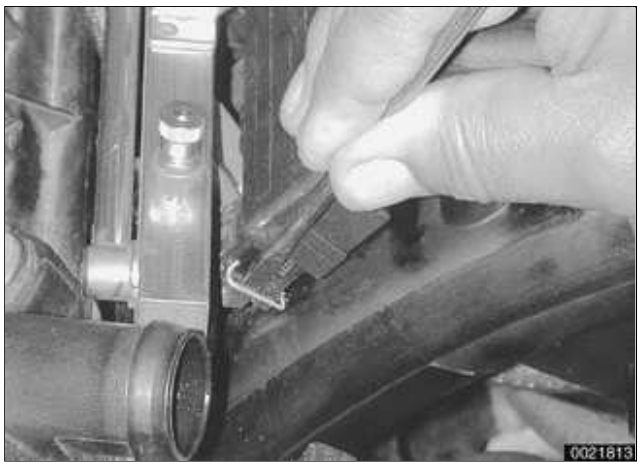




- Working above engine, disconnect electrical harness connectors:
  - VANOS control unit harness connector (**A**)
  - Connectors for oxygen sensors (**B**)
  - Connector for intake air temperature sensor (**C**)

CAUTION!

Mark oxygen sensor harness connectors in order to avoid reversing them during installation. Incorrect reconnection can cause serious engine damage.



- Disconnect fuel injector electrical connectors from injectors:
  - Use small screwdriver to pry one corner of wire lock clip on fuel injector 1 connector.
  - Repeat for all injectors.
  - Lift off connector loom and set aside.



- Unscrew schræder valve cap (**arrow**) from fuel rail. Unscrew fuel tank cap to release pressure to vent tank.
  - Using a brief burst of compressed air (maximum of 3 bar or 43.5 psi) blow fuel back through return line into fuel tank.

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WARNING!

- ***Do not smoke or work near heaters or other fire hazards. Keep a fire extinguisher handy. Before disconnecting fuel hoses, wrap a cloth around fuel hoses to absorb any leaking fuel. Catch and dispose of escaped fuel. Plug all open fuel lines.***

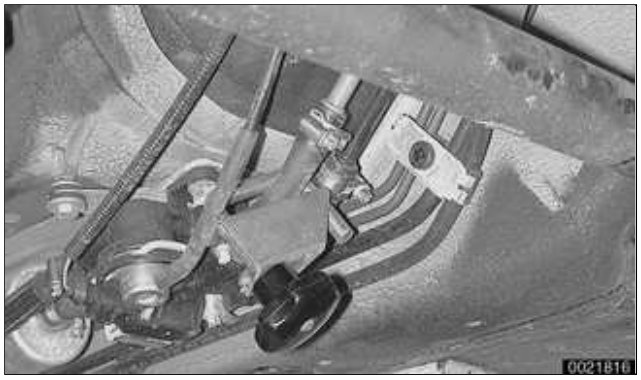
- ***Always unscrew the fuel tank cap to release pressure in the tank before working on the tank or lines.***

- Raise car and support in a safe manner.

CAUTION!

Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

- Remove protective engine splash guard.



➢ Working beneath car (on left side under driver seat), remove fuel filter cover and clamp off fuel hose(s).

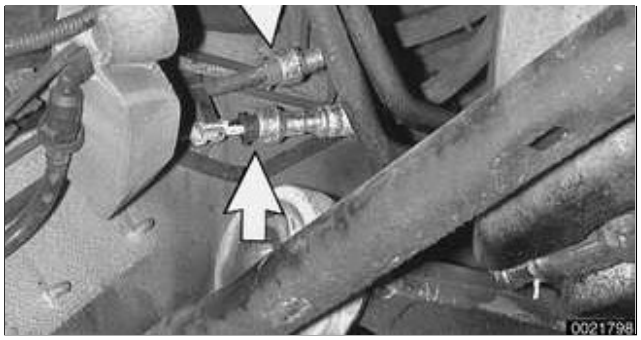
Note:

MS 42.0 vehicle shown. Fuel line arrangement on MS 43.0 vehicles varies from that shown. The MS 43.0 system uses a non-return fuel rail. Only a single fuel line leads to the engine compartment.



➢ Disconnect fuel hose(s) from fuel line(s) (**arrows**) using special fuel line

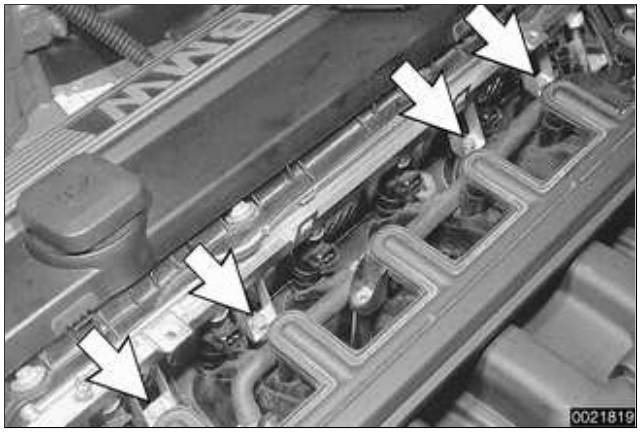
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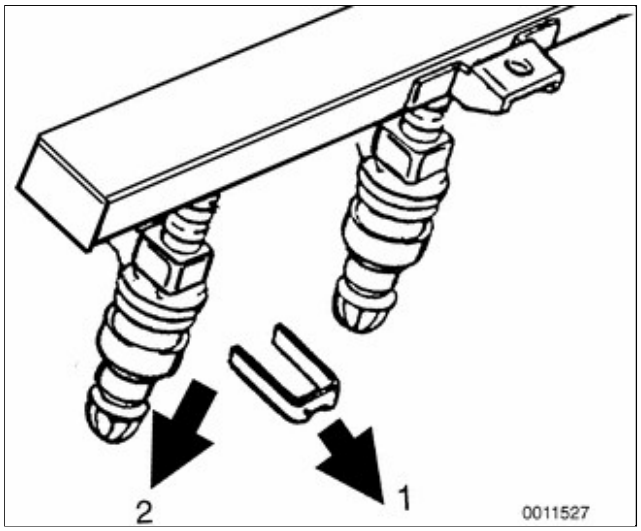
removal tool 16 1 050 or equivalent. Seal off fuel line(s) with BMW special tools 13 5 281/13 5 282.

CAUTION!

Fuel may be expelled under pressure. Do not smoke or work near heaters or other fire hazards. Keep a fire extinguisher handy. Before disconnecting fuel hoses, wrap a cloth around fuel hoses to absorb any leaking fuel. Plug all open fuel lines.



- Remove fuel rail mounting bolts (**arrows**).
  - Carefully pry fuel rail off manifold.
  - Separate fuel line support bracket at rear of intake manifold.
  - Guide fuel line(s) out of rear of engine compartment while lifting fuel rail out.



- Remove individual injectors:
  - Pry retaining clip from injector (**1**).
  - Pull injector from rail (**2**).
  - \- Installation is reverse of removal.
  - Fit new O-rings when installing injectors. For ease of installation, lightly lubricate all fuel system O-rings with assembly lubricant.
  - Check that injector electrical connections are correctly fitted and that injectors are fully seated prior to installing fuel rail mounting

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bolts.

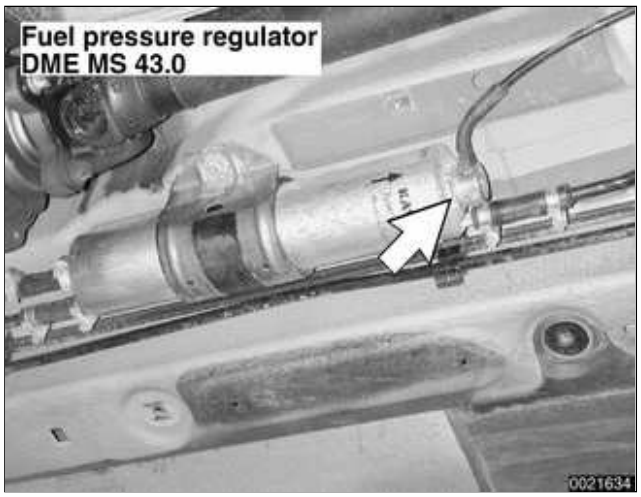
- Replace any wire ties removed during removal procedure.

CAUTION!

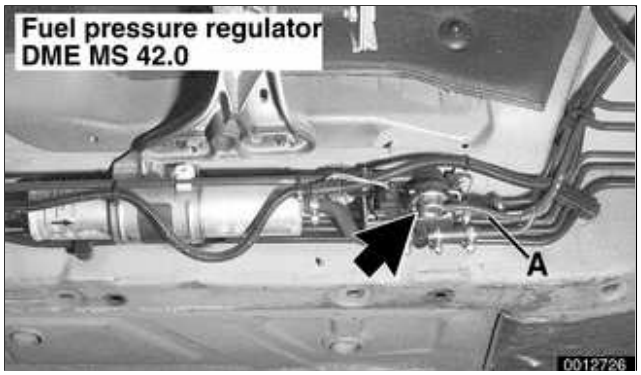
Replace any flexible fuel lines which were pinched shut during testing.

Fuel pressure regulator, replacing

E46 fuel pressure regulator location	
DME MS 42.0	under left side of car, in 3/2-way valve
DME MS 43.0	under left side of car, in fuel filter



- On models with DME MS 43.0, the fuel pressure regulator (arrow) is an integral part of the fuel filter. Fuel filter replacement procedure is covered in ⇒ 020 Maintenance.



- DME MS 42.0: Working under car below driver's seat, remove protective cover from below fuel pressure regulator (**arrow**).

  - Disconnect vacuum hose (**A**) from fuel pressure regulator.

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- Remove locking spring clip retaining fuel pressure regulator.

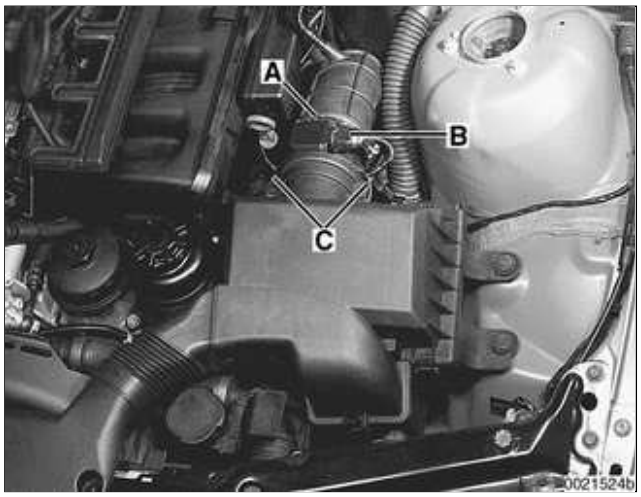
- Wrap a shop rag around regulator, then remove regulator from 3/2 way valve by pulling straight down.

- Installation is reverse of removal. Replace sealing O-rings.

Mass air flow (MAF) sensor, removing and installing

CAUTION!

Be sure the ignition is OFF before replacing DME system components.



➢ Loosen hose clamp (**A**) and pull intake air duct from mass air flow (MAF) sensor.

- Disconnect electrical harness connector (**B**) and unclip fasteners (**C**).

- Remove sensor. Inspect protective screen in sensor housing. Replace sensor if screen is damaged.

- Inspect air intake ducting for damage and cracks. Replace rubber parts as necessary.

- Installation is reverse of removal.

♦ Replace sealing O-ring between sensor and air filter housing.

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No adjustment to air flow sensor is possible.

Engine coolant temperature (ECT) sensor, replacing

The engine coolant temperature (ECT) sensor is located toward the rear of the cylinder head below intake runner no. 6. Intake manifold removal is required to access the ECT sensor.

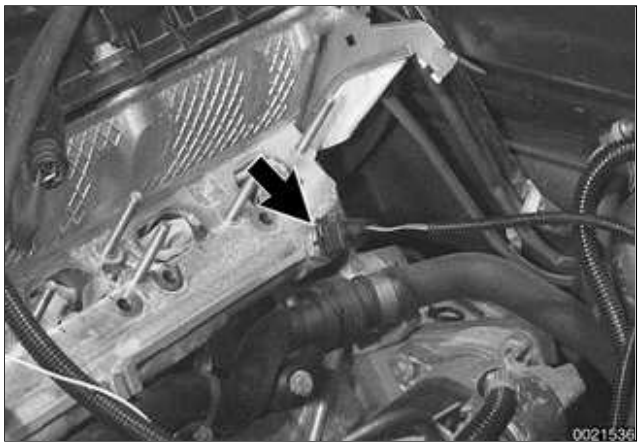
CAUTION!

Be sure the ignition is OFF before replacing DME system components.

- Remove intake manifold as described in ⇒ 110 Engine Removal and Installation.

WARNING!

Due to risk of personal injury, be sure the engine is cold before beginning the removal procedure.



- Working at rear of cylinder head, disconnect harness connector (**arrow**) from ECT sensor.

- Remove sensor. Catch any coolant that leaks out with shop rags.

- Installation is reverse of removal.

- Use a new copper sealing washer when installing new sensor.

- Replace lost coolant.

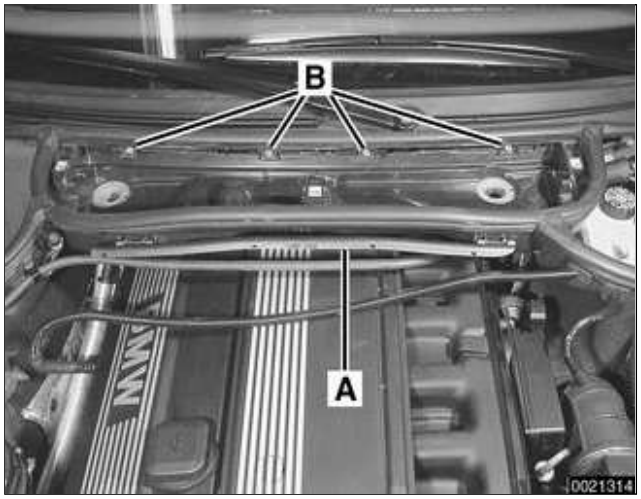
Tightening torque

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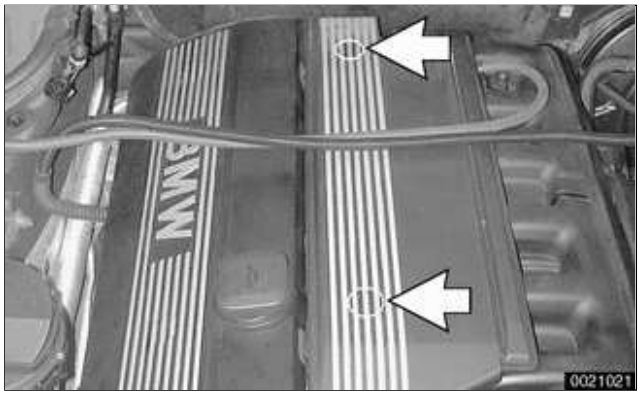
Tightening torque	
ECT sensor to cylinder head	13 Nm (10 ft-lb)

Intake air temperature (IAT) sensor, replacing

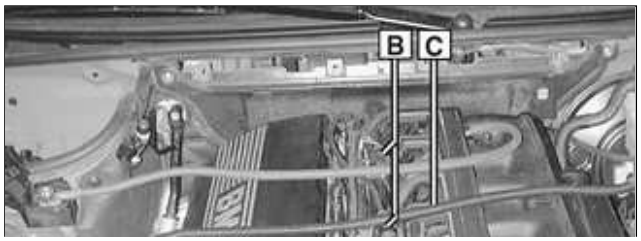
The intake air temperature (IAT) sensor is located at the top center of the intake manifold. The intake air temperature sensor functions to adapt or fine tune the fuel mixture and engine timing based on varying intake air temperatures.



- Remove housing for microfilter for interior ventilation.
  - Remove upper cover and microfilter.
  - Open wiring harness loom (**A**) and remove wires.
  - Unfasten screws (**B**) and remove lower microfilter housing.



- Remove fuel rail cover by prying off plastic covers (**arrows**) and removing nuts.



- Remove electrical harness connector (**arrow**) from IAT sensor.

CAUTION!

Be sure the ignition is OFF.

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- Depress locking clip on side of temperature sensor and pull straight out of intake manifold.

- Installation is reverse of removal.

♦ Use a new sealing O-ring at base of sensor and lubricate with assembly lubricant for ease of installation.

Throttle assembly, removing and installing

Some throttle assembly faults will reset the engine control module (ECM) adaptation values. BMW's diagnostic tool (DIS or MoDiC) or aftermarket equivalent tool is necessary to reset ECM adaptations after throttle assembly replacement.

CAUTION!

After replacement of the throttle valve assembly, and/or on MS 43.0 systems the pedal position sensor, an adaption procedure must be performed using the factory scan tool or equivalent. The vehicle will not start unless this adaption procedure is carried out.

Disconnect battery negative (-) cable in luggage compartment.

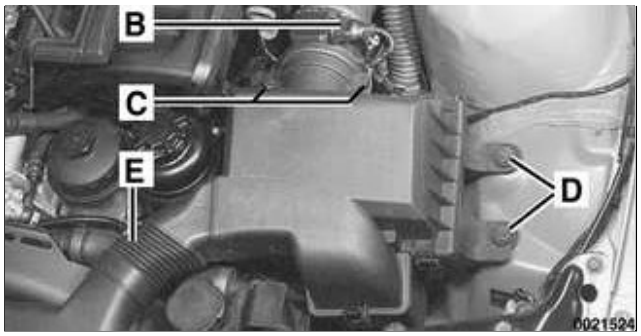
CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.



➢ Remove complete air filter housing:

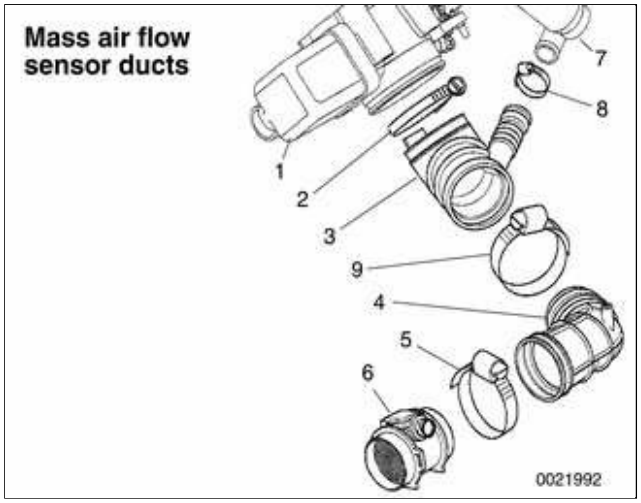
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- Disconnect vacuum line at intake boot (**A**).
- Disconnect electrical harness connector on mass air flow sensor (**B**).
- Release mass air flow sensor clips (**C**).
- Remove filter housing mounting screws (**D**).
- Disconnect air duct connections (**E**) and lift complete air filter housing out of engine compartment, pulling it forward away from mass air flow sensor.

Note:

In this step, mass air flow sensor remains attached to rubber air duct.



- Loosen clamps **2** and **8** and remove mass air flow sensor and air ducts.

1 - Throttle assembly

2 - Hose clamp 77 - 84 mm

3 - Y-duct

4 - Air duct

5 - Hose clamp 83 - 90 mm

6 - Mass air flow sensor

7 - Idle control valve

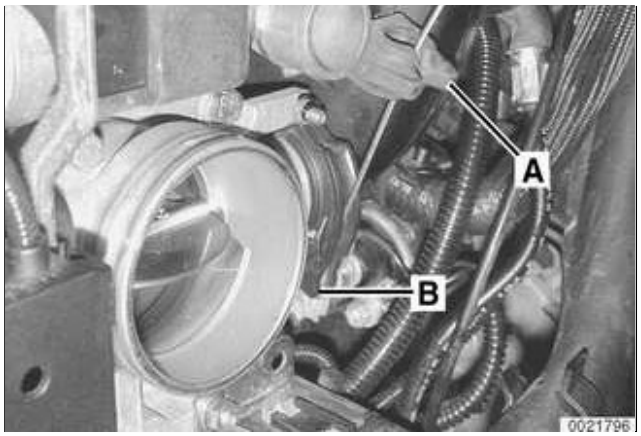
8 - Hose clamp 28 - 33 mm

9 - Hose clamp 77 - 84 mm

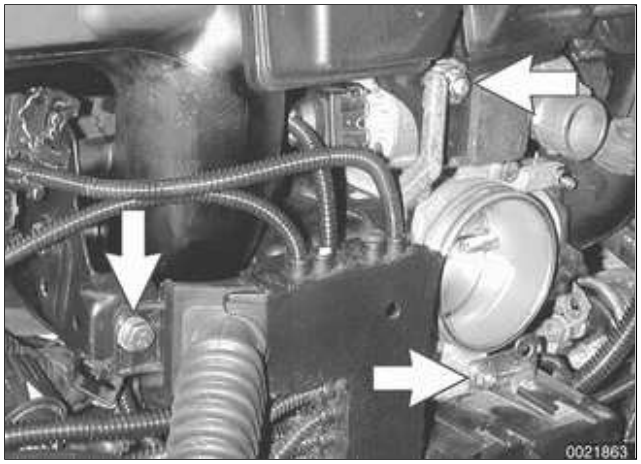


- On MS 42.0 vehicles: Pull throttle cable

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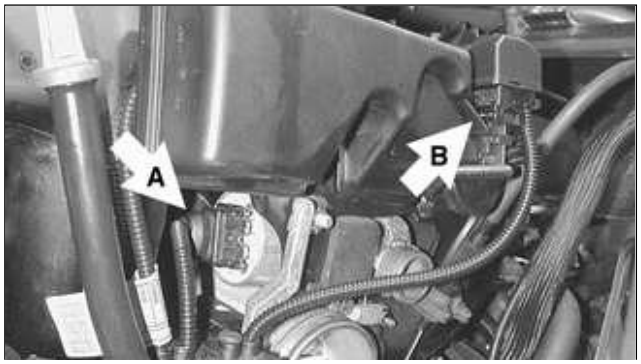
upwards out of rubber retainer (**A**) and unhook ball end of cable (**B**) from throttle actuator.



- Remove nuts and bolt (**arrows**) retaining wiring harness conduit to throttle body.



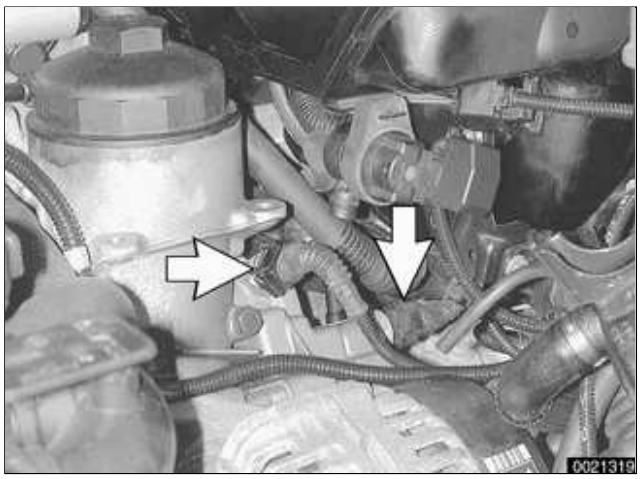
- Working at throttle housing: Turn harness plug (**arrow**) counterclockwise and remove.



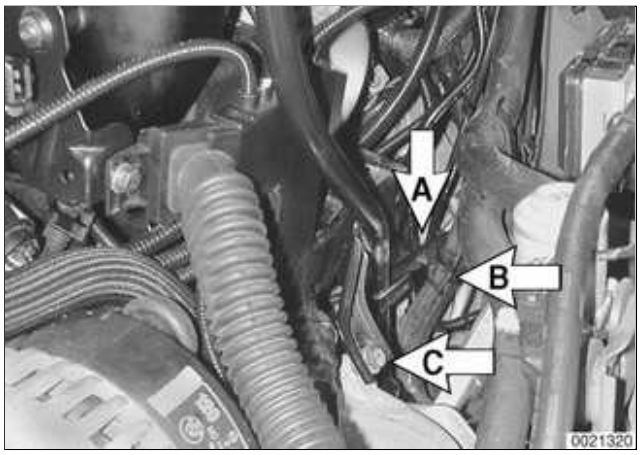
- Working at side of intake manifold, disconnect electrical harness connectors:
  - Idle control valve (**A**)
  - Intake manifold resonance valve (**B**)

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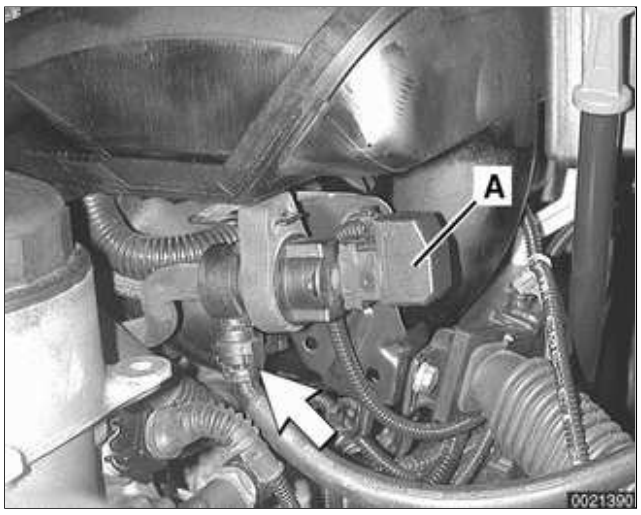




- Disconnect electrical harness connectors (**arrows**) at oil pressure sender and oil temperature sender at base of oil filter housing.



- Remove dipstick guide tube:
  - Disconnect wiring harness brackets from tube (**A**).
  - Unclip fuel lines from tube (**B**).
  - Remove lower guide tube mounting bolt (**C**). Pull out dipstick guide tube.



- If necessary, disconnect electrical harness connector at fuel tank venting valve (**A**). Disconnect hose at quick disconnect fitting (**arrow**).
  - Remove throttle assembly mounting screws at all corners and pull assembly off manifold.
  - Installation is reverse of removal.
  - Replace sealing ring between throttle assembly and intake manifold.

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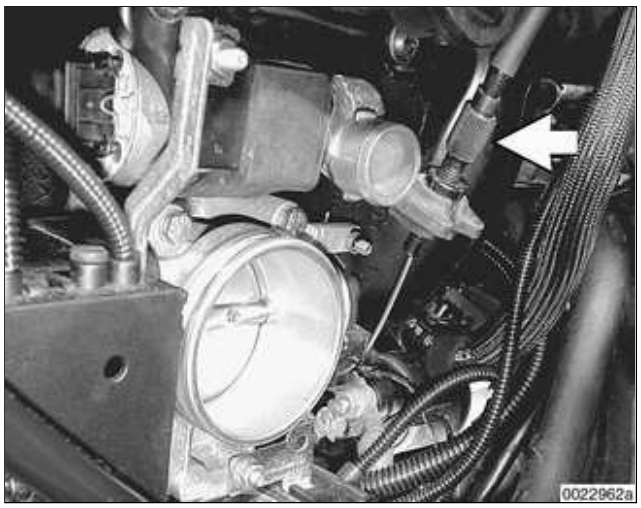
- Reattach throttle assembly harness connector with care. Arrow on fully tightened connector must line up with corresponding arrow on throttle assembly housing.

- On DME MS 42.0: Reattach throttle cable and adjust as described later.

- Use BMW scan tool to reset ECM adaptation values.

Throttle cable, adjusting (MS 42.0)

Models with DME MS 42.0 are equipped with a throttle cable. Cable adjustment should be adjusted any time it is disconnected or replaced. This procedure requires the factory scan tool or an equivalent to read and adjust throttle angle. It is recommended that procedure be done by an authorized BMW dealer service department.



Basic adjustment:

- Ensure that at idle (accelerator pedal in rest position) throttle cable has detectable play at throttle lever attaching point. Play must not exceed maximum allowable.

- Adjust by turning knurled adjustor (**arrow**) on end of throttle cable sheath at throttle housing.

Throttle cable clearance

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Throttle cable clearance	
Max. play at throttle plate lever	3 mm (0.125 in.)

- Full throttle adjustment (manual transmission):

♦ With ignition key on press pedal fully to stop. Check throttle angle using scan tool. Adjust pedal stop if necessary.

Throttle angle specifications	
Manual transmisssion:	
Full throttle	80° - 84°

- Full throttle adjustment (automatic transmission):

♦ With ignition key on, press accelerator until pedal touches kickdown stop. Check throttle angle. Press accelerator pedal down beyond kickdown stop pressure point. Check throttle angle. Adjust kickdown stop if necessary, recheck.

♦ Press accelerator down fully against stop. Check throttle angle.

♦ Use scan tool diagnostic program or road test vehicle to confirm transmission downshifts when kickdown is actuated.

Throttle angle specifications	
Automatic transmission:	

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Throttle angle specifications	
Kickdown stop contacted	76° - 80°
Kickdown pressure point range	84° - 88°
Full-load downshift	100%

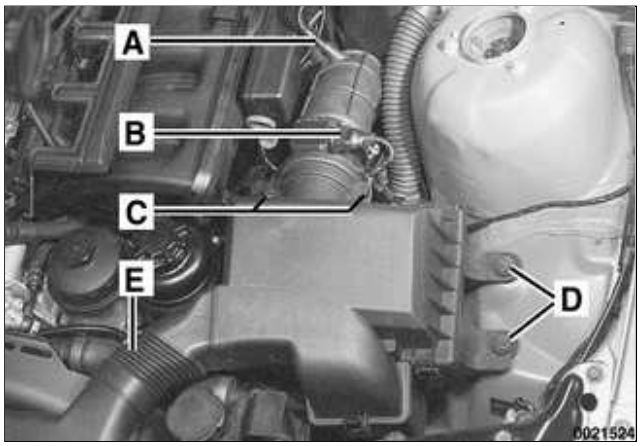
Idle speed control valve, replacing

The idle speed control valve is mounted under the intake manifold adjacent to the dipstick tube bracket. The valve can be removed with the manifold in place, although the job is easier if the manifold is first removed. Intake manifold removal is described in ⇒ 113 Cylinder Head Removal and Installation.

- Disconnect battery negative (-) cable in trunk.

CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.



Remove complete air filter housing:

- Disconnect vacuum line at intake boot (**A**).
- Disconnect electrical harness connector on mass air flow sensor (**B**).
- Release mass air flow sensor clips (**C**).

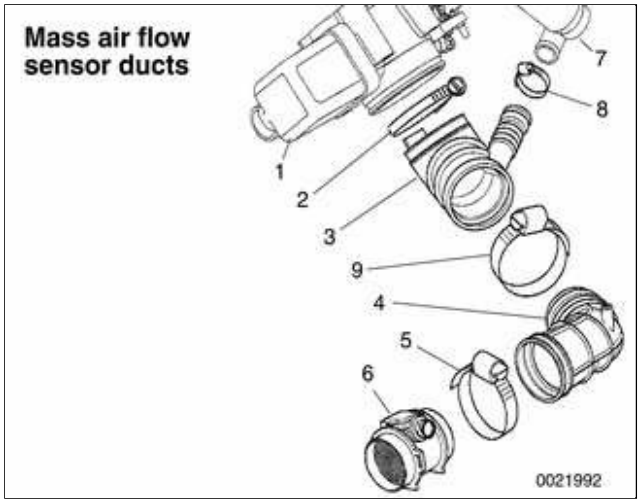
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- Remove filter housing mounting screws (**D**).

- Disconnect air duct connections (**E**) and lift complete air filter housing out of engine compartment, pulling it forward away from mass air flow sensor.

Note:

In this step, mass air flow sensor remains attached to intake duct.



- Loosen clamps **2** and **8** and remove mass air flow sensor and air ducts.

1 - Throttle assembly

2 - Hose clamp 77 - 84 mm

3 - Y-duct

4 - Air duct

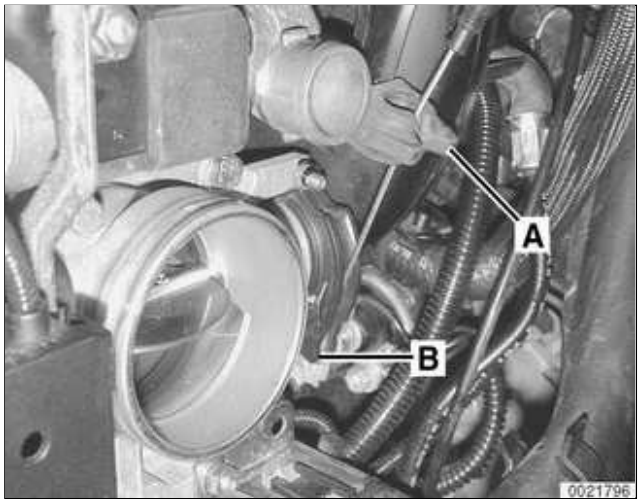
5 - Hose clamp 83 - 90 mm

6 - Mass air flow sensor

7 - Idle control valve

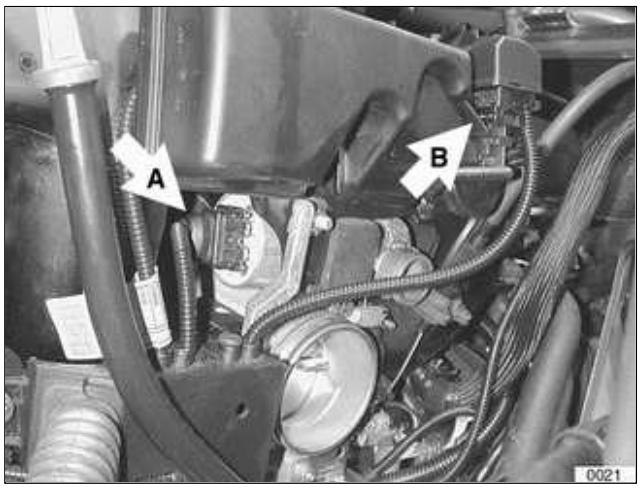
8 - Hose clamp 28 - 33 mm

9 - Hose clamp 77 - 84 mm



- DME MS 42.0: Pull throttle cable upwards out of rubber retainer (**A**) but leave attached to throttle actuator (**B**).

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➢ Working at side of intake manifold, disconnect electrical harness connectors:

- ♦ Idle control valve (**A**)
- ♦ Intake manifold resonance valve (**B**)
- \- Disconnect bypass hose from idle control valve.
- \- Remove idle control valve:
- ♦ Remove idle control valve bracket mounting fasteners.
- ♦ Slide control valve with bracket out from between intake manifold and throttle assembly.
- ♦ Pull control valve from rubber retainer.
- \- Installation is reverse of removal.
- ♦ Use new gaskets and O-ring seals when installing. Use assembly lubricant to facilitate reassembly.
- ♦ Install idle control valve rubber seal in intake manifold first, then insert control valve.
- ♦ Similarly, install mass air flow sensor into intake duct, then install to throttle assembly.

Engine control module (ECM), removing and installing

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Note:

Replacement ECMs must be coded with application information (i.e. engine code, transmission type, etc.) prior to installation. Consult an authorized BMW dealer before replacing the ECM. Alternatively, coded ECMs may be available at an additional cost.

- Disconnect negative (-) battery cable. Wait at least three minutes.

CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

- Remove E-box cover at left rear of engine compartment. Cover is retained with four captive screws.



➢ ECM (**arrow**) is located in right rear of E-box, as identified with five electrical harness connectors.



➢ Disconnect ECM harness connectors by releasing lock on each plug and pivoting lever. Pull all five connector up and off ECM.

- Remove ECM from retaining brackets and pull from its holder.

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- Installation is reverse of removal.

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ECM Pin Assignments

ECM pin assignments are given in ⇒ Table b. ECM pin assignment-DME MS 42.0 and MS 43.0. This information may be helpful when diagnosing faults to or from the ECM. If all inputs and wiring are OK but operational problems still exist, the ECM itself may be faulty.

Generally, absence of voltage or continuity means there is a wiring or connector problem. Test results with incorrect values do not necessarily mean that a component is faulty. Check for loose, broken or corroded connections and wiring before replacing components. If the results are still incorrect, check the component itself.

For engine management system electrical schematics, see Electrical Wiring Diagrams.

CAUTION!

- ***Always wait at least three minutes after turning off the ignition before removing the connector from the engine control module (ECM). If the connector is removed before this time, residual power in the system relay may damage the ECM.***

- ***Always connect or disconnect the control module connector and meter probes with the ignition off.***

When making checks at the ECM itself, a breakout box should be used to allow tests to be made with the connector attached to the ECM. This also prevents damage to the small terminals

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in the connector. As an alternative, the harness connector housing can be separated so that electrical checks can be made from the back of the connector.

Table b. ECM pin assignment-DME MS 42.0 and MS 43.0

Connector X60001 9-pin black			
Pin	**Signal**	**Component/function**	**Notes**
1	Output	Terminal 15	Unloader relay terminal 15
2		not used	
3		not used	
4	Ground	Ground	Ground point
5	Ground	Ground	Ground connector
6	Ground	Ground	Ground connector
7	Input	Terminal 30 (Fuse 80 amp)	B+ Terminal
8	Input	Voltage supply (Fuse 2)	Fuse carrier, engine electronics
9	Input	Voltage supply	Fuse carrier, engine electronics

Connector X60002 24-pin black			
Pin	**Signal**	**Component/function**	**Notes**
1	Input	Heater, precatalyst oxygen sensor 1	Heated oxygen sensor 1 in front of catalytic converter
2		not used	
3	Input/output	CAN bus signal, low	Transmission control module
4	Input/output	CAN bus signal, high	Transmission control module
5		not used	
6	Input/output	Transmit diagnosis line (TXD) data link signal	Transmission control module
7	Input	Heater, post-catalyst oxygen sensor 1	Heated oxygen sensor 1 behind catalytic converter
8		not used	

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Connector X60002 24-pin black			
Pin	**Signal**	**Component/function**	**Notes**
9		not used	
10		not used	
11		not used	
12	Input	Signal, 3/2-way valve, running losses (MS 42.0)	3/2 way valve, running losses (MS 42.0)
13	Input	Heater, precatalyst oxygen sensor 2	Heated oxygen sensor 2 in front of catalytic converter
14	Input	Signal, precatalyst oxygen sensor 1	Heated oxygen sensor 1 in front of catalytic converter
15	Input	Signal, precatalyst oxygen sensor 2	Heated oxygen sensor 2 in front of catalytic converter
16	Input	Signal, post-catalyst oxygen sensor 1	Heated oxygen sensor 1 behind catalytic converter
17		not used	
18	Input	Signal, post-catalyst oxygen sensor 2	Heated oxygen sensor 2 behind catalytic converter
19	Input	Heater, post catalyst oxygen sensor 2	Heated oxygen sensor 2 behind catalytic converter
20	Ground	Ground, precatalyst oxygen sensor 1	Heated oxygen sensor 1 in front of catalytic converter
21	Ground	Ground, precatalyst oxygen sensor 2	Heated oxygen sensor 2 in front of catalytic converter
22	Ground	Ground, post-catalyst oxygen sensor 1	Heated oxygen sensor 1 behind catalytic converter
23	Input	DME main relay signal activation	DME main relay
24	Ground	Ground, post-catalyst oxygen sensor 2	Heated oxygen sensor 2 behind catalytic converter

Connector X60003 52-pin black			
Pin	**Signal**	**Component/function**	**Notes**
1	Input	Signal, mass air flow	Hot film mass air flow sensor

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Connector X60003 52-pin black			
Pin	**Signal**	**Component/function**	**Notes**
		sensor	
2	Input	Signal, exhaust camshaft sensor 1	Camshaft position sensor II
3	Input	Signal, suction jet pump valve (2.8 L, 3.0 L)	Suction jet pump valve
4	Output	Throttle valve supply (MS 42.0)	Throttle valve (MS 42.0)
5	Input	Signal, intake camshaft position sensor	Camshaft position sensor I
6		not used	
7	Output	Throttle valve supply	Throttle valve
8	Input	Signal, crankshaft position sensor	Crankshaft position sensor
9	Input	Signal, pedal position sensor 2 (MS 42.0)	Throttle valve (MS 42.0)
10	Input	Signal, throttle position potentiometer 2	Throttle valve
11		not used	
12	Input	Feedback signal, engine start	Starter
13	Input	Signal, battery charge indicator lamp	Generator (Alternator)
14	Ground	Ground, throttle position sensor (MS 42.0)	Throttle valve (MS 42.0)
15	Ground	Ground, exhaust camshaft sensor 1	Camshaft position sensor II
16	Input	Signal, pedal position sensor 1 (MS 42.0)	Throttle valve (MS 42.0)
17	Ground	Ground, mass air flow sensor	Hot film mass air flow sensor
18	Ground	Ground, intake camshaft sensor 1	Camshaft position sensor I

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Connector X60003 52-pin black			
Pin	**Signal**	**Component/function**	**Notes**
19	Input	Signal, throttle potentiometer 1	Throttle valve
20	Ground	Ground, throttle position sensor	Throttle valve
21	Ground	Ground, crankshaft position sensor	Crankshaft position sensor
22	Output	Signal, intake air temperature	Intake air temperature sensor
23	Ground	Ground, intake air temperature sensor	Intake air temperature sensor
24	Output	Signal, coolant temperature sensor	Coolant temperature sensor
25	Ground	Ground, coolant temperature sensor	Coolant temperature sensor
26	Input	Signal, oil pressure	Oil pressure switch
27	Output	Signal, engine oil temperature	Oil temperature sensor
28	Ground	Ground, engine oil temperature sensor	Oil temperature sensor
29	Output	Signal, knock sensor	Knock sensor
30	Output	Signal, knock sensor	Knock sensor
31	Output	Signal, knock sensor	Knock sensor
32	Output	Signal, knock sensor	Knock sensor
33	Input	Signal, cylinder 1 fuel injector	Cylinder 1 fuel injector
34	Input	Signal, cylinder 2 fuel injector	Cylinder 2 fuel injector
35	Input	Signal, cylinder 3 fuel injector	Cylinder 3 fuel injector
36	Input	Signal, cylinder 4 fuel injector	Cylinder 4 fuel injector
37	Input	Signal, cylinder 5 fuel injector	Cylinder 5 fuel injector

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Connector X60003 52-pin black			
Pin	**Signal**	**Component/function**	**Notes**
38	Input	Signal, cylinder 6 fuel injector	Cylinder 6 fuel injector
39	Input	Signal, oil level sensor	Oil level sensor
40	Input	Signal, VANOS inlet valve	VANOS inlet valve
41	Input	Signal, VANOS outlet valve	VANOS outlet valve
42	Input	Signal, evaporative emissions valve	Evaporative emissions valve
43	Input	Signal, throttle valve drive	Throttle valve
44	Input	Signal, throttle valve drive	Throttle valve
45	Input	Signal, engine coolant thermostat	Engine coolant thermostat (map controlled)
46	Input	Signal, close idle speed control valve	Idle speed control valve
47	Input	Signal, open idle speed control valve	Idle speed control valve
48	Ground	Signal shield, knock sensor	Shield, knock sensor
49	Input	Signal, resonance valve intake system	Resonance valve intake system
50		not used	
51		not used	
52	Input	Signal, secondary air injection pump valve	Secondary air injection valve

Connector X60004 40-pin black			
Pin	**Signal**	**Component/function**	**Notes**
1	Input	Signal, battery charge indicator lamp	Instrument cluster control unit

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Connector X60004 40-pin black			
Pin	**Signal**	**Component/function**	**Notes**
2	Input	Feedback signal, engine start	Instrument cluster control module
3	Input	Signal, secondary air injection pump	Secondary air injection pump relay
4	Input	Signal, electric fan	Auxiliary fan motor
5		not used	
6		not used	
7		Pedal position sensor (PWG) (MS 43.0)	Pedal position sensor (PWG) (MS 43.0)
8		Signal, pedal position sensor (PWG) (MS 43.0)	Pedal position sensor (PWG) (MS 43.0)
9		Pedal position sensor (PWG) (MS 43.0)	Pedal position sensor (PWG) (MS 43.0)
10	Input	Signal, fuel pump relay 1	Fuel pump relay 1
11	Input	Signal, oil pressure switch	Instrument cluster control module
12		Pedal position sensor (PWG) (MS 43.0)	Pedal position sensor (PWG) (MS 43.0)
13		Signal, pedal position sensor (PWG) (MS 43.0)	Pedal position sensor (PWG) (MS 43.0)
14		Pedal position sensor (PWG) (MS 43.0)	Pedal position sensor (PWG) (MS 43.0)
15		not used	
16		not used	
17	Input	Speed signal (MS 42.0 up to 6-00)(MS 42.0 from 6-00 and MS 43.0)	Data link connector OBDII 16 pin connector)
18		not used	
19		not used	

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Connector X60004 40-pin black			
Pin	**Signal**	**Component/function**	**Notes**
20	Output	Diagnostic module tank leak (DMTL) detection (MS 43.0)	Leak detection (DMTL) (MS 43.0)
21	Input	Signal, oil level sensor	Instrument cluster control module
22	Input	Signal, processed wheel speed, right rear	ABS/ASC module, ABS/DSC module
23	Output	Signal, clutch pedal position switch	Clutch pedal position switch
24	Input	Signal, brake light switch	Light switching center control unit
25		not used	
26	Input	Terminal 15	Fuse F29
27	Output	Voltage supply, multifunction steering wheel	Volute spring
28	Input	Signal, brake light switch	Brake light switch
29	Input	Signal, relay, A/C compressor	A/C compressor relay
30		Signal, leakage diagnosis pump (MS 42.0)Signal diagnostic module (MS43.0)	Leakage diagnosis pumpLeak detection (MS 43.0)
31		not used	
32	Input/output	Transmit diagnosis line (TXD) data link signal	Data link connector (MS 42.0)OBD II connector (MS 43.0)
33	Input	Electronic vehicle immobilization	Electronic immobilizer control module
34		Signal, leakage diagnosis pump (LDP) (MS 42.0)	Leakage diagnosis pump (LDP) (MS 42.0)
35		not used	
36	Input/output	CAN bus signal, high	Connector, CAN bus

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Connector X60004 40-pin black			
Pin	**Signal**	**Component/function**	**Notes**
37	Input/output	CAN bus signal, low	Connector, CAN bus
38	Ground	Ground, coolant outlet temperature sensor	Temperature sensor
39	Output	Signal, coolant outlet temperature	Temperature sensor
40		not used	

Connector X60005 9-pin black			
Pin	**Signal**	**Component/function**	**Notes**
1	Input	Signal, ignition coil 3	Ignition coil 3
2	Input	Signal, ignition coil 2	Ignition coil 2
3	Input	Signal, ignition coil 1	Ignition coil 1
4		not used	
5	Ground	Ground	Ground connector
6	Ground	Ground	Ground connector
7	Input	Signal, ignition coil 6	Ignition coil 6
8	Input	Signal, ignition coil 5	Ignition coil 5
9	Input	Signal, ignition coil 4	Ignition coil 4

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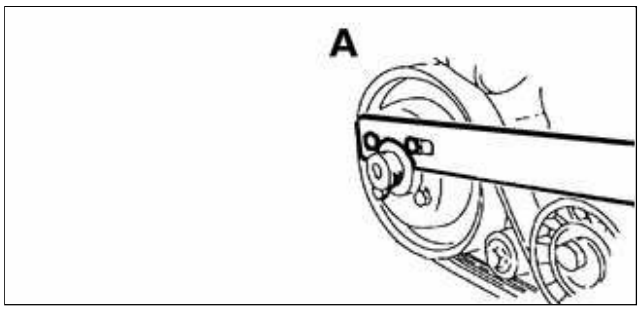
General

This section covers component repair information for the engine cooling system.

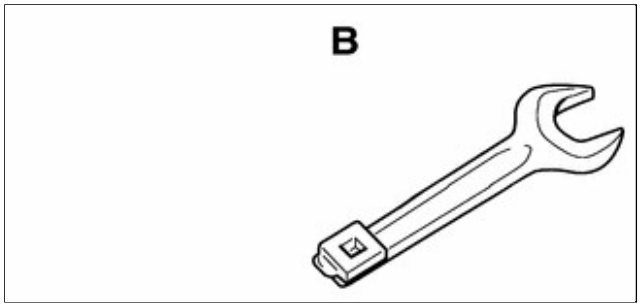
The E46 cooling system uses a centrifugal-type belt-driven coolant pump, an electric primary cooling fan, and an electrically heated thermostat. The cooling system is unique in that the cooling fan and the thermostat are controlled and monitored by the DME engine management system. Therefore, cooling system faults can be diagnosed using an appropriate scan tool.

Special tools

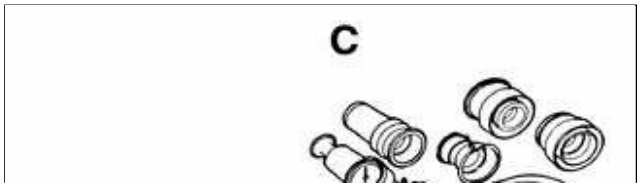
Special tools are necessary for fan clutch removal and pressure testing the cooling system.



- Cooling fan counterhold wrench BMW 11 5 030



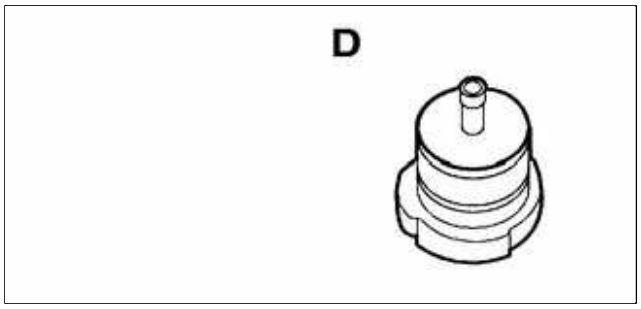
- Cooling fan wrench BMW 11 5 040



- Cooling system pressure tester BMW 17 0 002/17 0 005

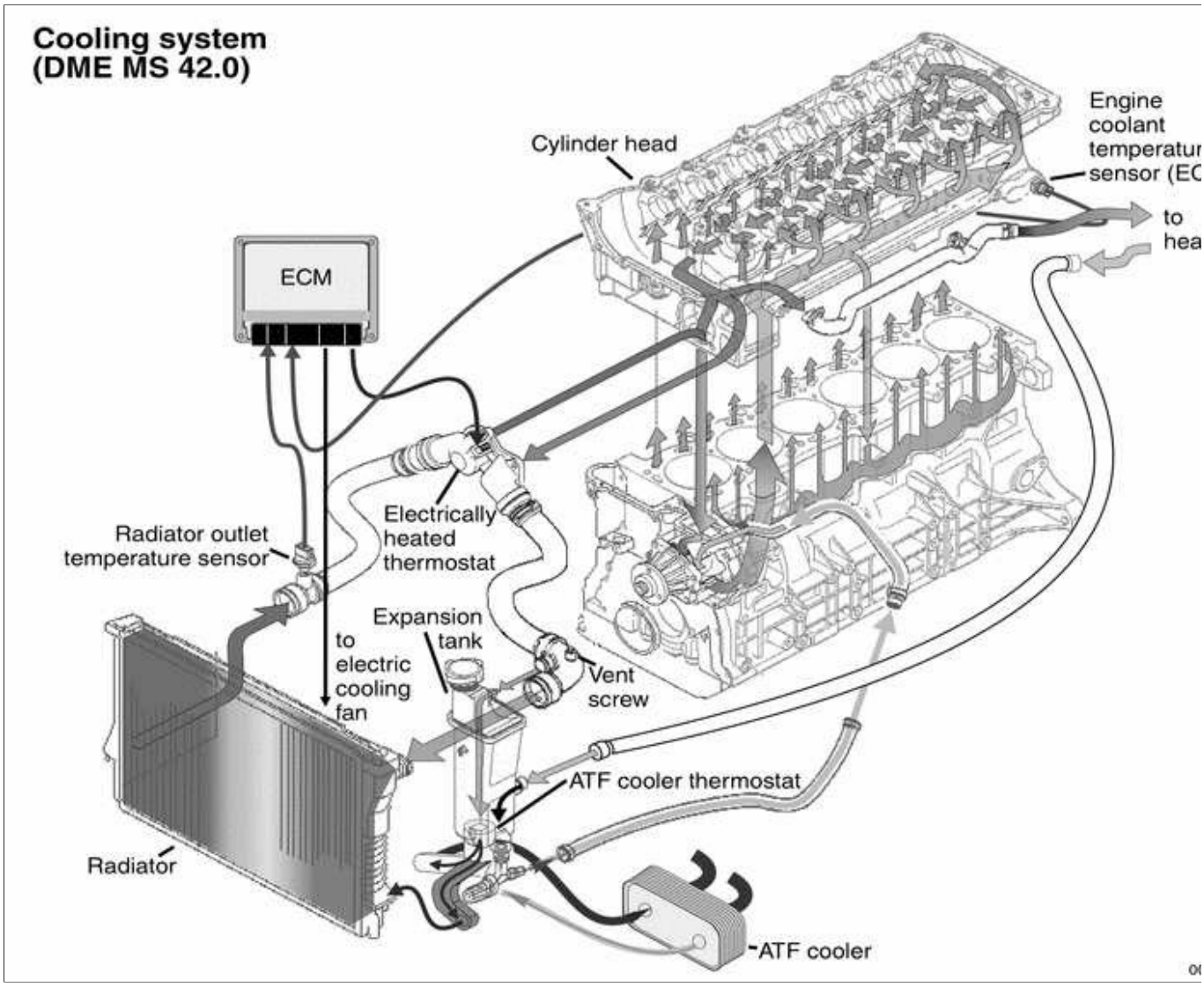
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- Expansion tank cap test adapter BMW 17 0 007

Cooling system (DME MS 42.0)

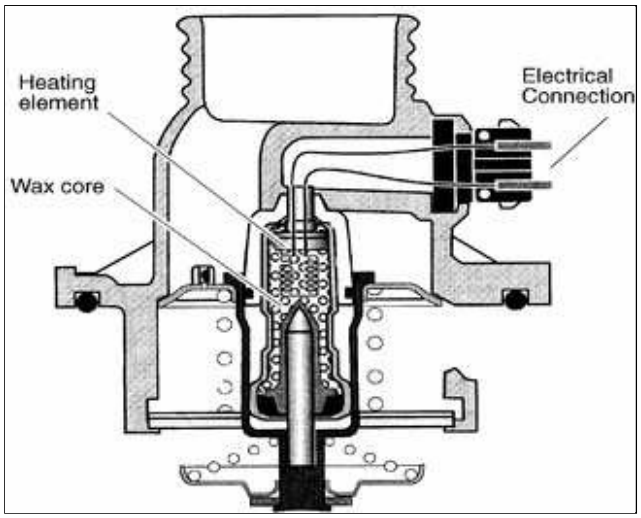


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Coolant pump

A centrifugal-type coolant pump is mounted to the front of the engine. The belt-driven pump circulates coolant through the system whenever the engine is running.

Thermostat



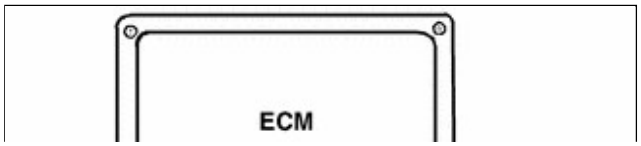
- An electrically heated thermostat regulates the engine coolant temperature and is controlled by the DME control module. The heated thermostat allows the engine to be operated at higher temperatures at idle and at part throttle. Having the ability to control the engine coolant temperature electronically results in improved emissions and performance. Problems with the heated thermostat can be diagnosed using a compatible scan tool.

Radiator and expansion tank

The radiator is a crossflow design. An expansion tank provides for coolant expansion at higher temperatures and easy monitoring of the coolant level.

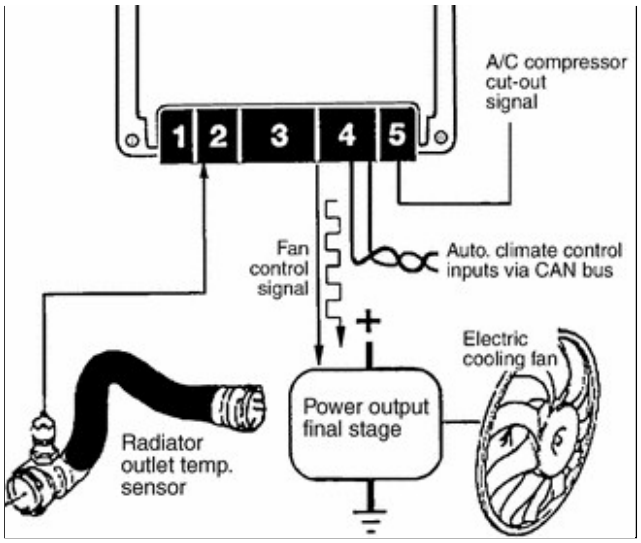
On cars with automatic transmission, ATF is circulated through an additional heat exchanger (ATF cooler).

Cooling fan (primary)



- The are two cooling fan configurations used on the cars covered by this manual, depending on transmission

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application.

On cars with automatic transmissions, the main fan is electric and mounted on the bumper side of the radiator. The fan is controlled by the DME control module via the output final stage. Additionally a belt-driven fan via a viscous fluid coupling (clutch) is attached to the front of the coolant pump. The fan clutch controls the speed of the fan based on engine compartment temperature.

On cars with manual transmissions, a single multi-speed electric cooling fan is used. The fan is mounted on the engine side of the radiator and controlled by the DME control module via the output final stage.

On both configurations, the output final stage is mounted on the fan housing, next to the fan motor. The fan is operated using a pulse width modulated (PWM) signal and is protected by a 50-amp fuse. Electric fan activation is based on the following inputs to the ECM:

- Radiator outlet temperature
- Catalyst temperature (calculated temperature)
- Vehicle speed
- Battery voltage
- A/C pressure (calculated pressure)

When the vehicle is first started, The ECM activates the electric fan briefly at 20% of its maximum speed, then switches off. This is for diagnostic monitoring. The voltage generated by the fan when it slows down (acting as a generator) must match the stored `rpm'

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values in the fan power output stage to confirm that the fan is operating correctly.

Note:

- *If the ECM stored a cooling fan fault, check that the fan is not seized and that is spins freely.*
- *When A/C is switched ON, the electric fan is not immediately turned on.*
- *After the engine is switched OFF, the fan may continue to run at varying speeds for up to 10 minutes, based on calculated catalyst temperature.*

Warnings and cautions

The following warnings and cautions should be observed when working on the cooling system.

WARNING!

- ***At normal operating temperature the cooling system is pressurized. Allow the system to cool as long as possible before opening-a minimum of an hour-then release the cap slowly to allow safe release of pressure.***
- ***Releasing the cooling system pressure lowers the coolant boiling point and the coolant may boil suddenly. Use heavy gloves and wear eye and face protection to guard against scalding.***
- ***Use extreme care when draining***

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and disposing of engine coolant. Coolant is poisonous and lethal to humans and pets. Pets are attracted to coolant because of its sweet smell and taste. Consult a veterinarian immediately if coolant is ingested by an animal.

CAUTION!

- ***Avoid adding cold water to the coolant while the engine is hot or overheated. If it is necessary to add coolant to a hot system, do so only with the engine running and coolant pump turning.***
- ***To avoid excess silicate gel precipitation in the cooling system and loss of cooling capacity, use BMW coolant or equivalent low silicate antifreeze.***
- ***If oil enters the cooling system, the radiator, expansion tank and heating circuit must be flushed with cleaning agent. BMW recommends removal of the radiator and expansion tank to flush.***
- ***When working on the cooling system, cover the alternator to protect it against coolant drips.***
- ***Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.***

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Troubleshooting

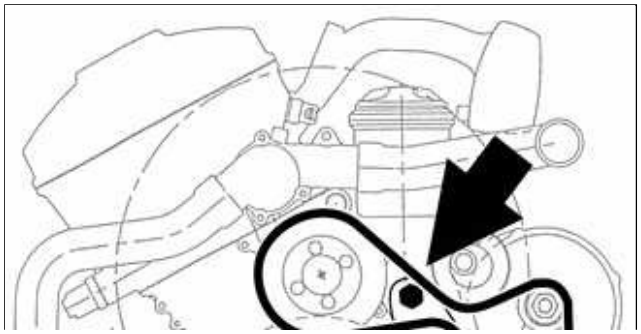
Begin the diagnosis of cooling system problems with a thorough visual inspection. If no visual faults are found, it is recommend that the DME system be checked for stored diagnostic fault codes (DTCs) using BMW scan tools DIS (Diagnostic Information System) or MoDiC (Mobile Diagnostic Computer) or an aftermarket equivalent.

Common cooling system faults can be grouped into one of four categories:

- Cooling system leaks
- Poor coolant circulation
- Radiator cooling fan faults
- Electrical/electronic faults

Be sure to check the condition and tension of the coolant pump drive belt. Check hoses for cracks or softness. Check clamps for looseness. Check the coolant level and check for evidence of coolant leaks from the engine.

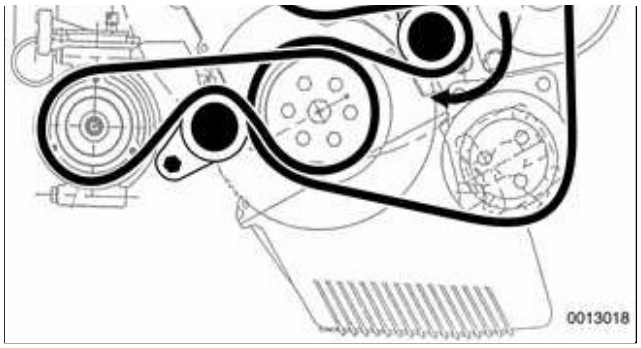
Check that the radiator fins are not blocked with dirt or debris. Clean the radiator using low-pressure water or compressed air. Blow outward, from the engine side out.



To check coolant pump:

- Lever tensioner clockwise using wrench on hex (large arrow) and slip belt off pulley.
- Firmly grasp opposite sides of

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pulley and check for play in all directions.

- Spin pulley and check that shaft runs smoothly without play.

Note:

The coolant provides lubrication for the pump shaft, so an occasional drop of coolant leaking from the pump is acceptable. If coolant drips steadily from the vent hole, the pump should be replaced.

The cooling system becomes pressurized at normal operating temperature, which raises the boiling point of the coolant. Leaks may prevent the system from becoming pressurized, allowing the coolant to boil at a lower temperature. If visual evidence is inconclusive, a cooling system pressure test can help to pinpoint hard-to-find leaks.

If the cooling system is full of coolant and holds pressure, the next most probable causes of overheating are:

- Faulty radiator fan or DME control circuit. Use an appropriate scan tool to interrogate the DME control module for faults.
- Loose or worn drive belt.
- Failed thermostat or coolant pump impeller. Some pumps may be fitted with plastic impellers.
- Clogged/plugged radiator or coolant passages.

Cooling system pressure test

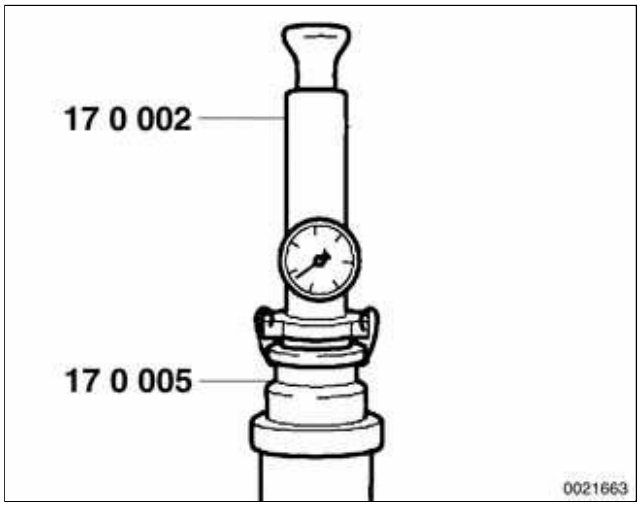
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A cooling system pressure test is used to check for internal leaks. Some of the common sources of internal leaks are a faulty cylinder head gasket, a cracked cylinder head, or a cracked cylinder block.

To do a cooling system pressure test, a special pressure tester is needed.

WARNING!

At normal operating temperature the cooling system is pressurized. Allow the system to cool before opening. Release the cap slowly to allow safe release of pressure.



- With engine cold, install pressure tester (BMW special tools 17 0 002/17 0 005 or equivalent) to expansion tank. Pressurize system to specification listed in ⇒ Table a.
  - Pressure should not drop more than 0.1 bar (1.45 psi) for at least two minutes.
  - If pressure drops rapidly and there is no sign of external leakage, cylinder head gasket may be faulty. Perform compression and leak-down tests as described in ⇒ 100 Engine–General
  - Also test expansion tank cap using pressure tester and correct adapter (BMW special tool 17 0 007 or equivalent). Replace faulty cap or cap gasket.

Table a. Cooling system test pressures

Component	Test pressure
Radiator	1.5 bar (21.75

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Table a. Cooling system test pressures	
Component	**Test pressure**
	psi)
Radiator cap	2 bar (29 psi)

CAUTION!

Exceeding the specified test pressure could damage the radiator or other system components.

Combustion chamber leak test

- If you suspect that combustion chamber pressure is leaking into the cooling system past the cylinder head gasket, use an exhaust gas analyzer to test the vapors rising from the coolant at the expansion tank.

CAUTION!

- ***Use an extension tube above the reservoir neck to maintain distance between the top of the coolant and the gas analyzer nozzle. The gas analyzer is easily damaged if it is allowed to inhale liquid coolant.***

- ***While running engine to check for causes of overheating, observe coolant temperature carefully in order to avoid engine damage.***

Thermostat, checking

If the engine overheats or runs too cool and no other cooling system tests

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indicate trouble, the electrically heated thermostat may be faulty.

Check for thermostat diagnostic fault codes (DTCs) using BMW scan tools DIS or MoDiC or equivalent. DTCs pertaining to cooling system malfunctions are listed in ⇒ Table b. See also ⇒ OBD On Board Diagnostics at the back of this manual.

Table b. Cooling system fault codes

BMW fault code	Explanation	Possible cause(s)
10	Engine coolant temperature out of predefined range	Faulty thermostat or cooling fan. Faulty wiring to cooling fan or thermostat.
222	Insufficient coolant temperature signal to permit closed loop operation	Faulty thermostat. Faulty thermostat electrical circuit.

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Cooling System Service

Coolant, draining and filling

WARNING!

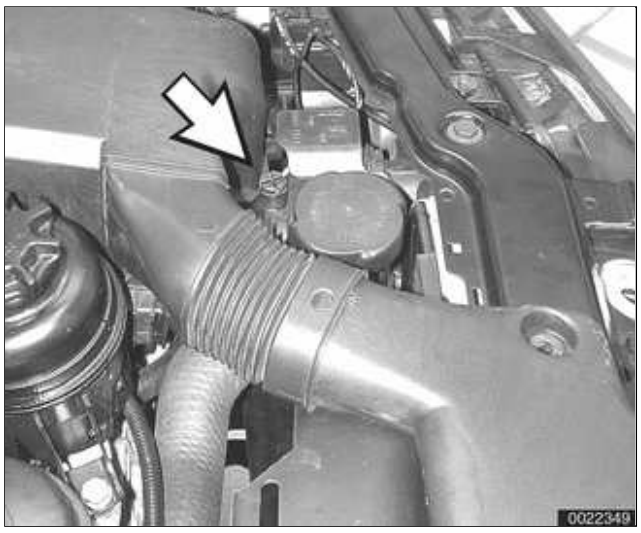
Allow the cooling system to cool before opening or draining the cooling system.

- Raise front of car and support safely.

CAUTION!

Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

- Remove splash shield from under engine.



- Loosen radiator bleed screw at top radiator fitting (**arrow**).

  - Remove cap from radiator expansion tank. Set temperature controls to full warm.

  - Place 3-gallon pail underneath radiator.



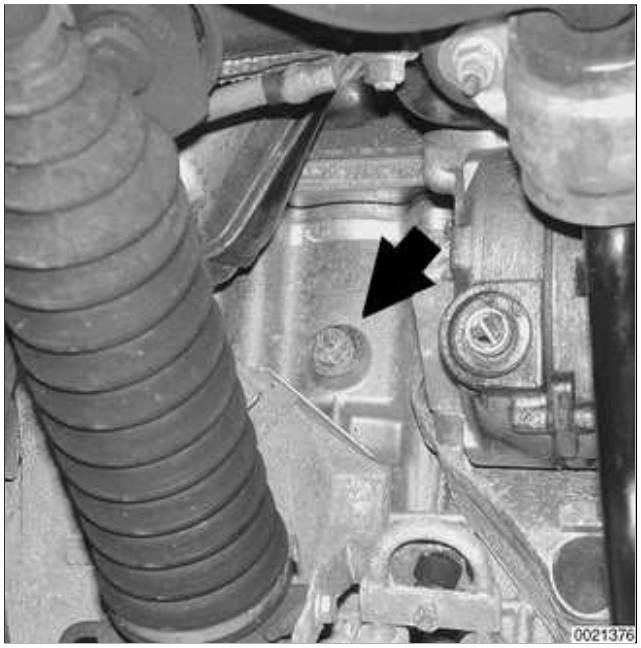
- Remove drain plug (**arrow**) on bottom of radiator.

WARNING!

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Coolant is poisonous. It is especially lethal to pets. Clean up spills immediately and rinse the area with water.



- Place empty 3-gallon pail underneath exhaust side of engine block. Loosen and remove engine block coolant drain plug (**arrow**).

Note:

The block drain plug is located on the exhaust side of the engine block at cylinder 2.

- Reinstall radiator and engine block drain plugs using new sealing washers.
- Before refilling radiator:
  - Switch ignition to ON.
  - Set temperature controls to full warm.
  - Set blower control to low.
- Using a coolant mixture of 50% antifreeze and 50% distilled water, fill expansion tank slowly. Continue until coolant emerges from bleed screw. Cooling system capacity is listed in ⇒ Table c.

Note:

- *Be sure radiator bleed screw is loose when filling cooling system.*

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- *Tap water may cause corrosion of radiator, engine and coolant hoses.*

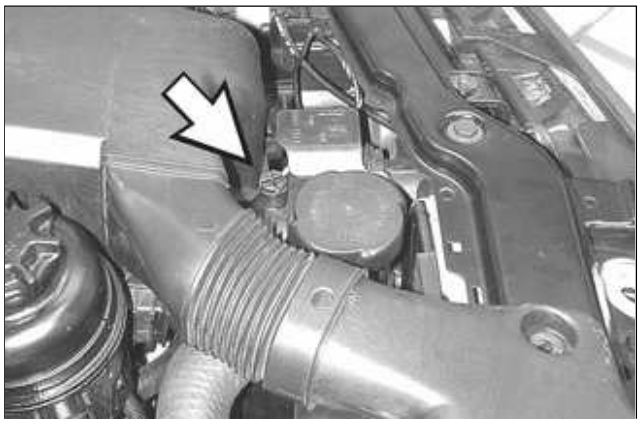
- *Coolant can often be reused provided it is clean and less than two years old. Do not reuse coolant when replacing damaged engine parts. Contaminated coolant may damage the engine or cooling system.*

Table c. Cooling system capacity	
Engine	**Capacity**
M52 TU/M54	8.4 liters (8.8 qt.)

Tightening torques	
Engine block drain plug to block	25 Nm (18 ft-lb)
Radiator drain plug to radiator	2 - 3 Nm (18 - 27 in-lb)

Cooling system, bleeding

Air may become trapped in the system during cooling system service. Trapped air can prevent proper coolant circulation. Whenever the coolant is drained and filled, the system should be bled of trapped air.



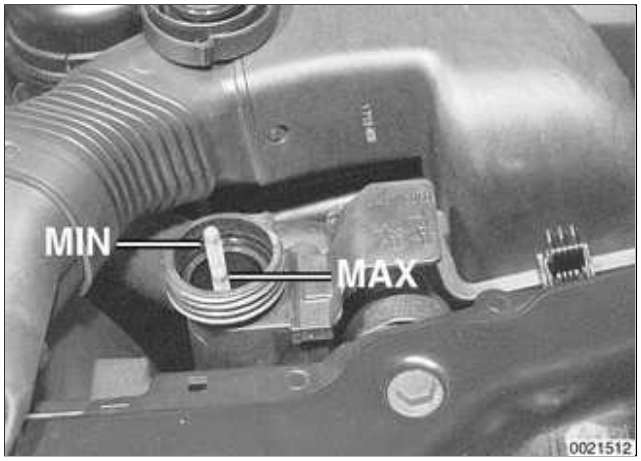
Loosen bleed screw (**arrow**) on radiator expansion tank.

- Set temperature controls in passenger compartment to full warm, set blower to low setting and turn ignition to ON position (do not start engine).

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- Slowly add coolant until it spills from bleed screw. When coolant spilling from bleed screws is free of air bubbles, tighten screw.



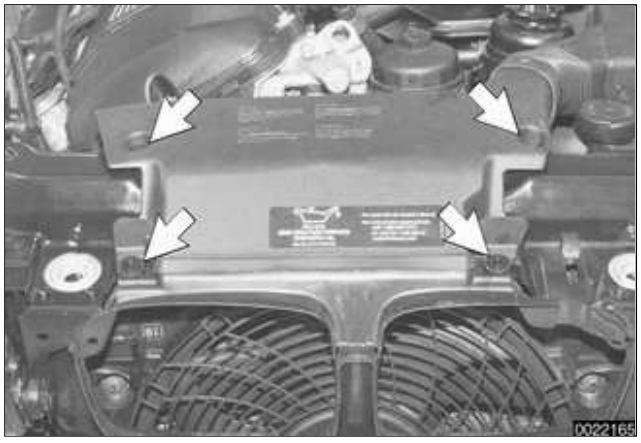
- Run engine until it reaches operating temperature.
  - After engine has cooled, recheck coolant level.
  - Top up so that coolant level indicator is at MAX.

CAUTION!

Always use genuine BMW coolant or its equivalent to avoid the formation of harmful, clogging deposits in the cooling system. Use of other antifreeze solutions may be harmful to the cooling system.

Tightening torque	
Radiator bleed screw	2.5 Nm (22 in-lb)

Viscous clutch cooling fan, replacing (models with automatic transmission)



- To gain access to viscous clutch fan or electric fan at front of the engine:
  - Remove expansion rivets (**arrows**) and remove intake duct.

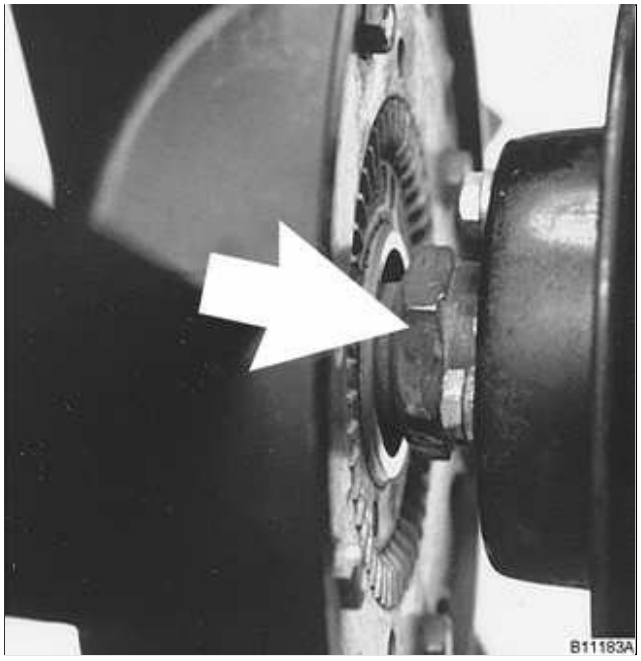
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- Working at top of fan shroud, remove screw and expansion rivet (**arrows**) holding fan shroud to radiator. Unclip or disconnect electrical connector(s) from right side of shroud.

Note:

Shroud is detached from radiator at this point but can only be removed later when fan and clutch assembly is removed.



- Using 32 mm wrench (BMW special tool 11 5 040) on fan clutch nut (**arrow**), turn wrench quickly in a clockwise direction (working from front of car) to loosen. Spin fan off coolant pump.

Note:

- *The radiator cooling fan nut (32 mm wrench) has left-hand threads.*
- *If fan nut is difficult to loosen, use BMW special tool 11 5 030 to counterhold coolant pump pulley.*

- Lift fan and shroud together out of engine compartment.
- To replace fan clutch, remove fan mounting bolts and separate viscous clutch from fan.
- Installation is reverse of removal.

Tightening torques	
Clutch nut to coolant pump (left-hand threads)	
without BMW tool 11 5 040	40 Nm (29 ft-lb)

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Tightening torques	
with BMW tool 11 5 040	30 Nm (22 ft-lb)
Fan to viscous clutch	10 Nm (89 in-lb)

Electric cooling fan, replacing (models with manual transmission)

On models with manual transmission, the primary cooling fan is electrically operated and is mounted on the engine side of the radiator.

- Remove air intake duct as described above.



Working at top of fan shroud, remove screw and expansion rivet (**arrows**) holding fan shroud to radiator. Unclip or disconnect electrical connector(s) from right side of shroud.

- Lift fan assembly straight up and off radiator. If necessary, push center top area of fan shroud toward engine to unhook shroud from radiator crossmember.

- Fan can be separated from shroud on bench.

CAUTION!

Do not carry fan by the blades; it may disturb the balance.

- Installation is reverse of removal.

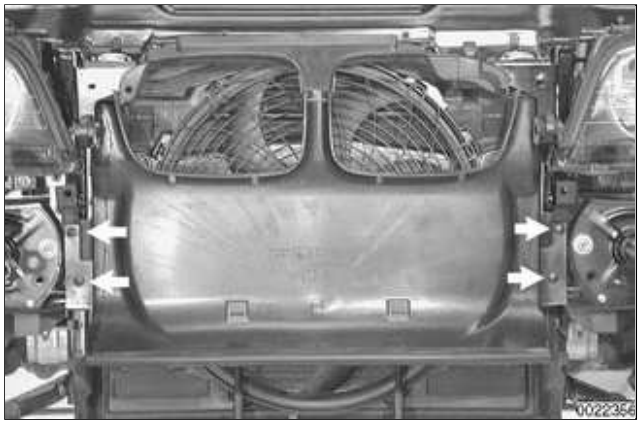
Electric cooling fan, replacing (models with automatic

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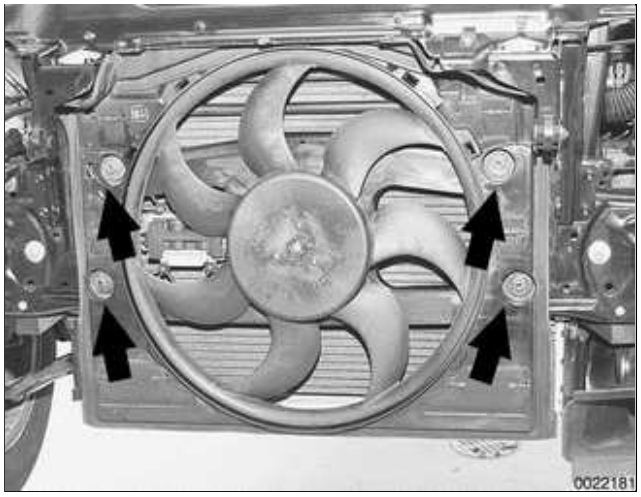
transmission)

The electric cooling fan on cars with automatic transmission is mounted behind the front bumper, in front of the A/C condenser.

- Remove air intake duct as described above.
- Remove front bumper. See ⇒ 510 Exterior Trim, Bumpers.
- Disconnect fan electrical connector (**arrow**) on right side of radiator shroud



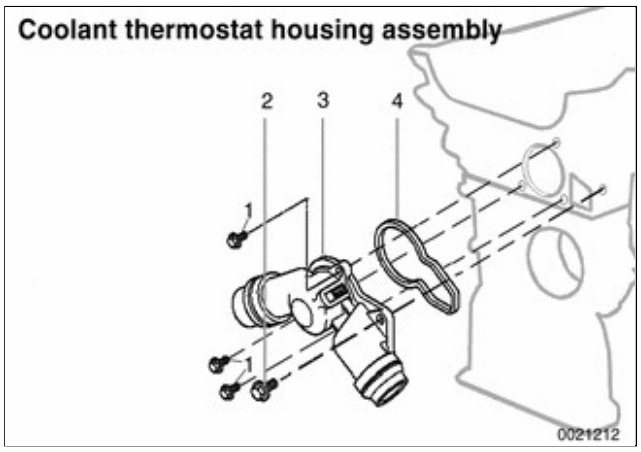
- Pull out plastic expansion rivets (**arrows**) and remove cover from front of fan.



- Remove fan mounting nuts (**arrows**) and lift out fan.
- Installation is reverse of removal. Install front bumper. See ⇒ 510 Exterior Trim, Bumpers.

Thermostat, replacing

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- The electrically-heated thermostat is an integral part of the thermostat housing. The operation of the thermostat is monitored by the DME control module. If a faulty thermostat is suspected, the DME control module should be interrogated for stored fault codes using an appropriate scan tool.

1 - Bolt M6

2 - Bolt M8

3 - Housing with heated thermostat

4 - Gasket

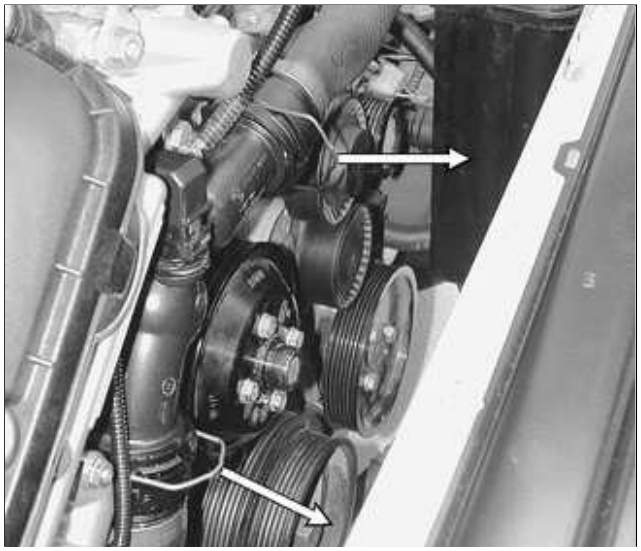
- Drain radiator and engine block as described above under ⇒ Coolant, draining and filling.

WARNING!

Allow cooling system to cool before opening or draining the system.

- Remove air intake duct, cooling fan and fan shroud as described earlier.

- Disconnect electrical harness connector from thermostat housing.



- Lever out retaining clips (**arrows**) and pull hose fittings off housing.

- Unbolt and remove thermostat housing from front of engine. Loosen nut at top of engine lifting eye to facilitate removal.

- Installation is reverse of removal, noting the following:

♦ Keep sealing faces free of oil.

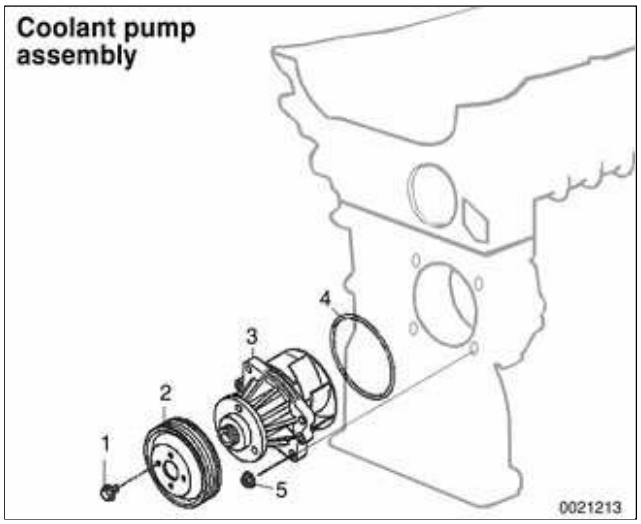
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- Use new sealing gasket.
- Fill system with coolant as described under ⇒ Coolant, draining and filling

Tightening torques	
Engine block drain plug to block	25 Nm (18 ft-lb)
Radiator drain plug to radiator	2 - 3 Nm (18 - 27 in-lb)

Coolant pump, replacing



The engine coolant pump is mounted in the front of the engine in the timing chain cover.

1 - Bolt M6 -tighten to 10 Nm (89 in-lb)

2 - Drive pulley

3 - Coolant pump

4 - O-ring seal

5 - Nut M6 -tighten to 10 Nm (89 in-lb)

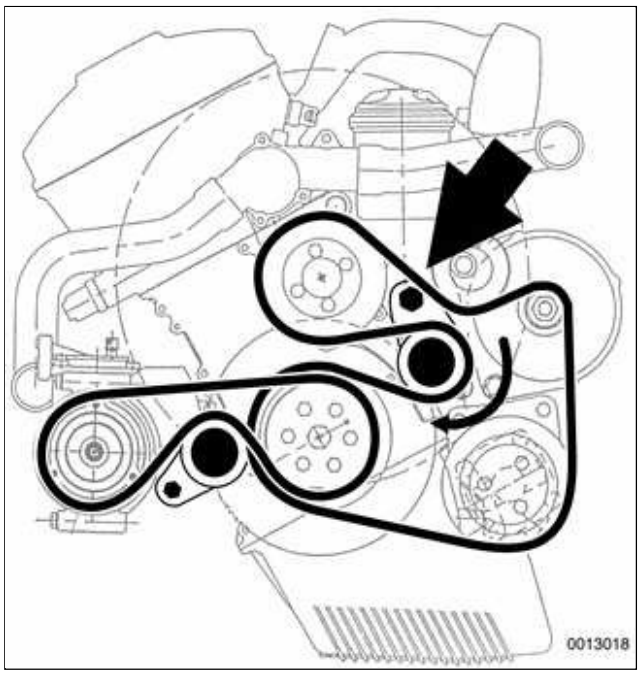
- Drain cooling system as described earlier.

WARNING!

Allow cooling system to cool before opening or draining system.

- Remove air intake duct, cooling fan and fan shroud as described earlier.

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- Remove engine drive belt: Lever tensioner hex (**large arrow**) in clockwise direction (facing engine) and slip belt off coolant pump pulley.

Note:

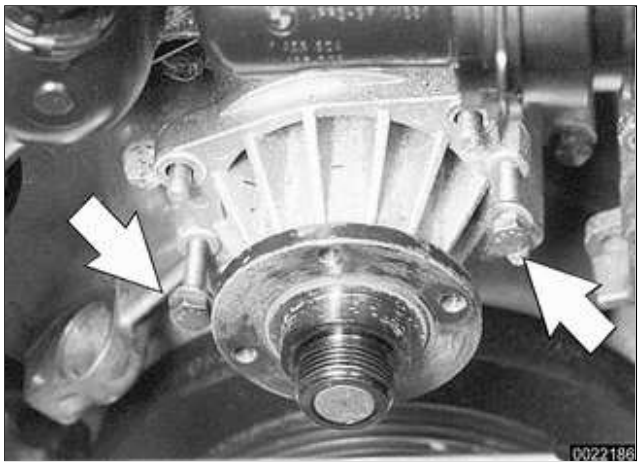
Mark direction of drive belt rotation if reusing belt.

- Remove coolant pump pulley bolts and remove pulley from pump.

- Remove pump mounting nuts (qty. 4).

Note:

The coolant pump is mounted on studs and retained by nuts.



- Insert two M6 screws (**arrows**) in tapped bores and tighten uniformly until pump is free from timing chain cover. (Thermostat and hoses have been removed for visual access.)

- Installation is reverse of removal, noting the following:

- Be sure to replace sealing O-ring and gaskets.

- Coat O-ring with lubricant during installation.

Tightening torques	
Coolant pump to timing chain cover	10 Nm (89 in-lb)
Coolant pump pulley to coolant pump	10 Nm (89 in-lb)
Engine block drain plug to block	25 Nm (18 ft-lb)

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Tightening torques	
Radiator drain plug to radiator	2-3 Nm (18-27 in-lb)

Radiator, removing and installing

- Raise front of car and support safely.

CAUTION!

Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

- Remove splash shield from under engine.

- Drain radiator and engine block as described earlier.

WARNING!

Allow cooling system to cool before opening or draining system.

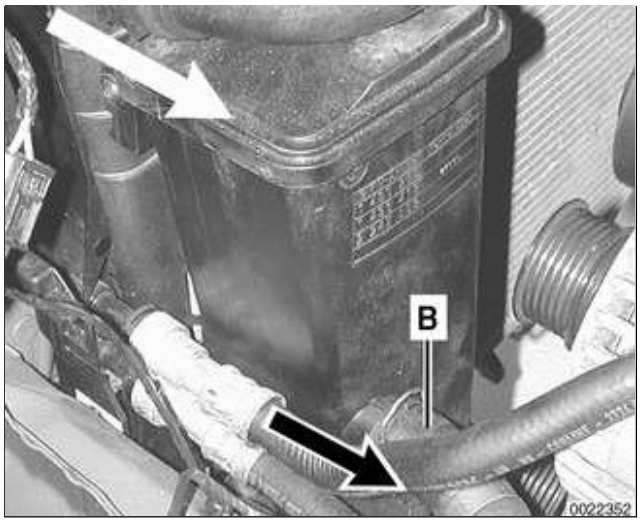
- Remove complete air filter housing.

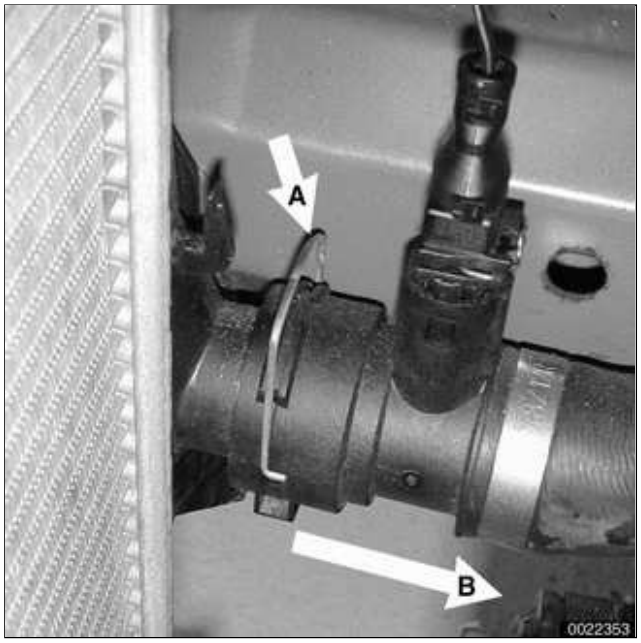
- Remove air intake duct, cooling fan and fan shroud as described earlier.



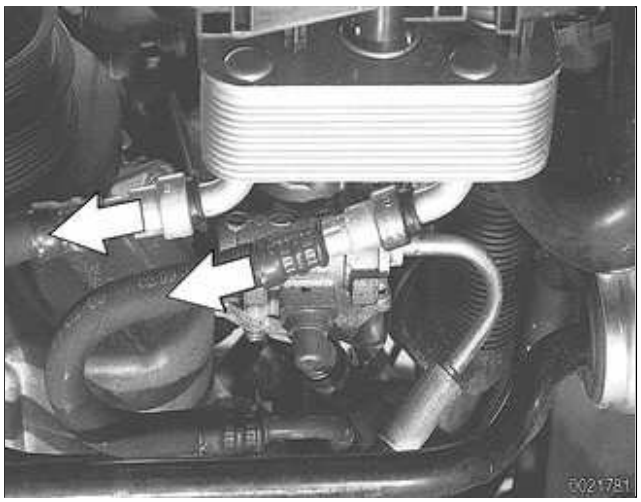
Working on left side of radiator, lever out hose retaining clips and disconnect coolant hose fittings from radiator (**A**) and radiator expansion tank (**B**).

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- Working on ride side of radiator, release hose retaining clips (**A**) and disconnect lower coolant hose fitting from radiator (**B**).
  - Working underneath radiator, disconnect harness connector from coolant level sensor.

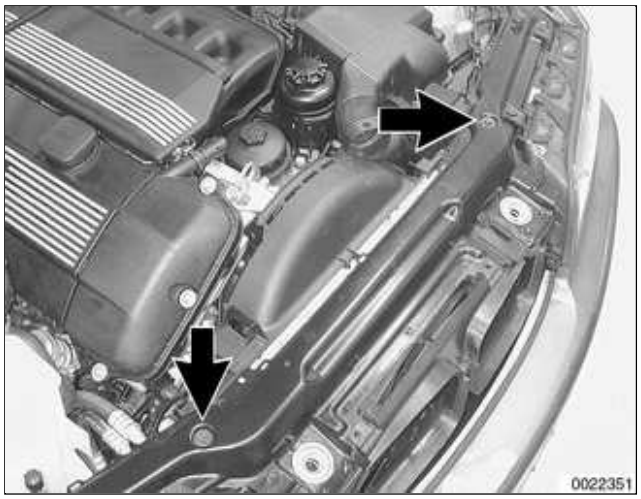


- Where applicable, disconnect automatic transmission fluid (ATF) cooler lines from ATF cooler at quick disconnect unions (**arrows**) as follows:
  - Push hose toward oil cooler.
  - Press black locking ring into hose fitting while pulling hose off cooler.

CAUTION!

Be sure to have a drain pan ready to catch spilled ATF.

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Note:

Alternatively, detach ATF cooler from radiator by pulling up on quick release clips and pulling cooler from radiator tank.

- Remove plastic bolts at top of radiator (**arrows**). Pull radiator up and out of car.

- Installation is reverse of removal, noting the following:

- Do not coat sealing O-rings with anti-seize paste.

- Fill radiator and cooling system as described under ⇒ Coolant, draining and filling

- Check ATF level and, if necessary, top up. See ⇒ 240 Automatic Transmission.

Tightening torques	
Engine block drain plug to block	25 Nm (18 ft-lb)
Radiator drain plug to radiator	2 - 3 Nm (18 - 27 in-lb)

Coolant expansion tank, removing and installing

- Raise front of car and support safely.

CAUTION!

Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack

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stands designed for the purpose. A floor jack is not adequate support.

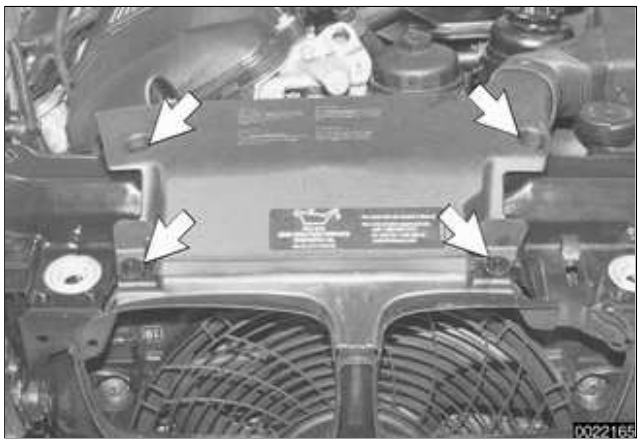
- Remove splash shield from under engine.

- Drain radiator and engine block as described earlier.

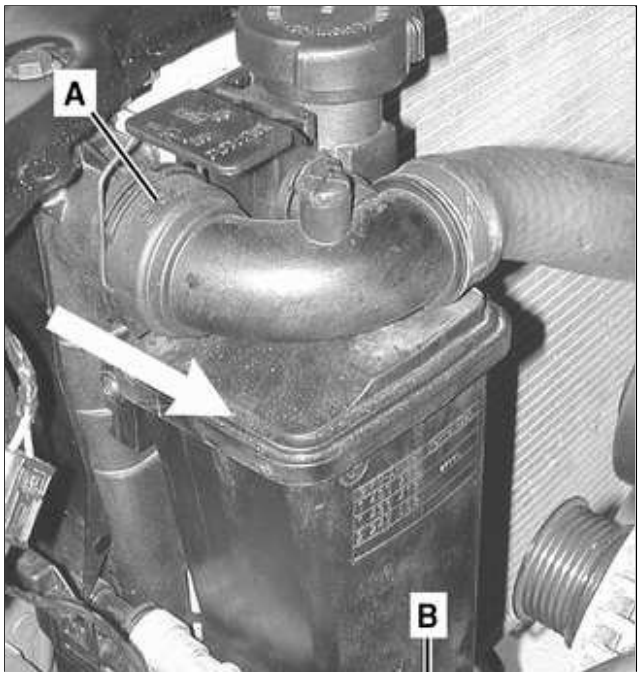
WARNING!

Allow cooling system to cool before opening or draining system.

- Remove complete air intake filter housing.



➢ Working at front of engine compartment, remove expansion rivets (**arrows**) retaining air intake duct to radiator support and remove intake duct.

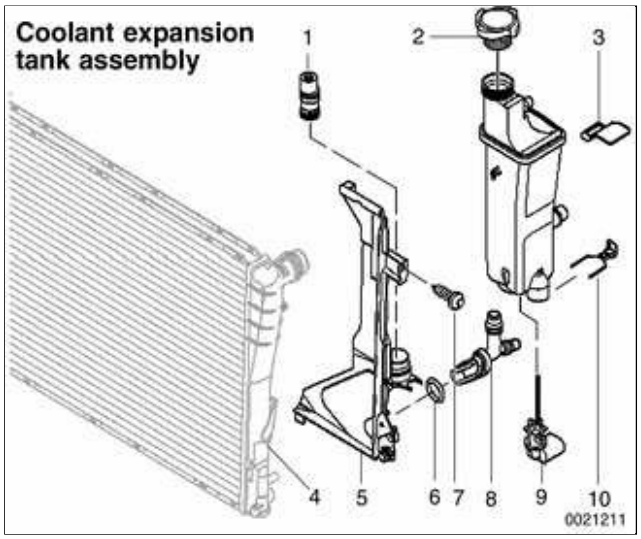


➢ Release hose retaining clips and disconnect coolant hose fittings (**A** and **B**) from expansion tank.

- Working underneath radiator, disconnect harness connector from coolant level sensor.

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- Remove coolant level sensor (**9**) by twisting counterclockwise and pulling out of bottom of tank.

1 - Thermostat (ATF heat exchanger)

2 - Expansion tank cap

3 - Label

4 - Radiator

5 - Mounting bracket

6 - Sealing O-ring

7 - Self-tapping screw

8 - Connector (ATF heat exchanger)

9 - Coolant level sensor

10 - Locking clip

- Pull out expansion tank by detaching from radiator at top. Then pull up from mounting bracket at bottom.

- Installation is reverse of removal.

- Do not coat O-rings with anti-seize paste.

- Fill radiator and cooling system as described under ⇒ Coolant, draining and filling

Tightening torques	
Engine block drain plug to block	25 Nm (18 ft-lb)

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Tightening torques	
Radiator drain plug to radiator	2 - 3 Nm (18 - 27 in-lb)

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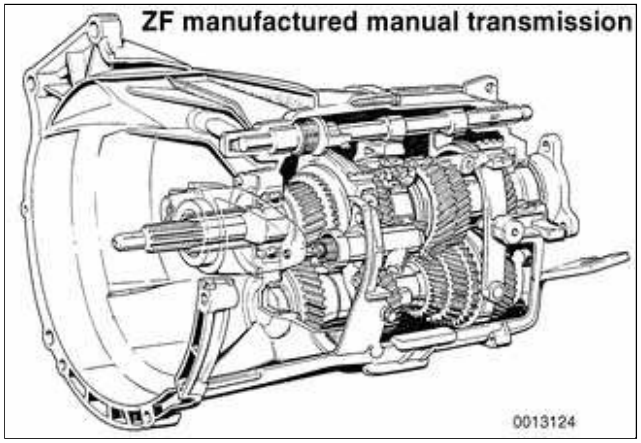
General

This section covers the repairs related to the clutch, manual and automatic transmissions, shift linkages, driveshafts, and transfer case (all wheel drive vehicles only). For repairs related to drive axles and front and rear final drive differentials, see ⇒ 311 Front Axle Final Drive and ⇒ 331 Rear Axle Final Drive.

Drivetrain

E46 models are equipped with a longitudinal drivetrain. The transmission is bolted directly to the rear of the engine. In rear wheel drive models, a driveshaft connects the output shaft of the transmission to the rear final drive. On all wheel drive models, a transfer case is mounted to the rear of the transmission, with drive shafts leading to front and rear final drive assemblies. Individual drive axles with integrated constant velocity joints transfer rotational power from the final drive units to the drive wheels.

Manual transmission



ZF manufactured manual transmission

Due to different power characteristics and performance requirements, three different manual transmissions are used in models covered by this manual. Manual transmission applications are given in ⇒ Table a. Manual transmission applications.

Note:

For transmission gear ratio information and repair information, see ⇒ 230 Manual Transmission.

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The manual transmissions use a single clutch disc with dual-mass flywheel. For further information, see ⇒ 210 Clutch.

Manual transmissions have a metal ID plate mounted on the side of the transmission. Do not rely on numbers cast on the transmission case for identification.

Table a. Manual transmission applications

Model	Year	Engine	Transmission
323i/Ci 325i/Ci	1999 - 2000 2000 - 2001	M52 TU M54	Getrag S5D 250G
328i/Ci 330i/Ci	1999 - 2000 2000 - 2001	M52 TU M54	ZF S5D 320Z
325xi330xi	2000 -2001	M54	ZF S5D 280Z

Automatic transmission

Two different automatic transmissions are used, depending on model and model year and/or production date. All of the automatic transmissions are electrohydraulically controlled with five forward speeds. Automatic transmission applications are given in ⇒ Table b. Automatic transmission applications.

For automatic transmission repair information, see ⇒ 240 Automatic Transmission.

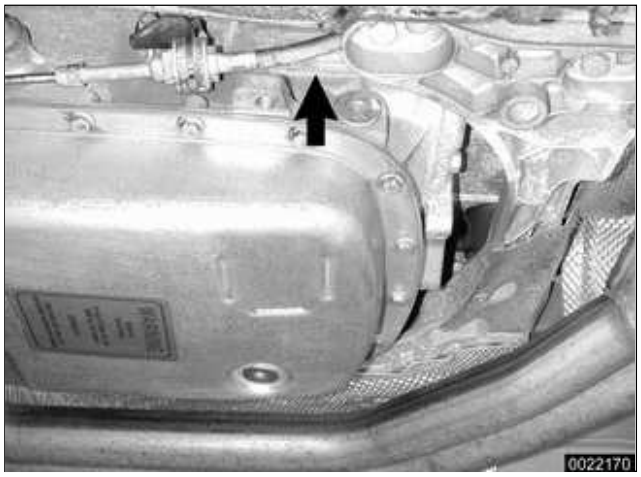
Transmission Identification codes for automatic transmissions are located on metal ID tags mounted to the body of the transmission.

Note:

323 i/Ci and 328 i/Ci models

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manufactured from 08/98 to 03/00 are equipped with the A5S 360R automatic transmission. Vehicles produced after 03/00 use the A5S 325Z transmission.



- GM manufactured transmissions have the ID tag located on the left hand side of the transmission housing, behind the transmission selector cable, just above the transmission pan (**arrow**).



- ZF manufactured transmissions have the ID tags mounted on the left side of the rear of the transmissions, just above the automatic transmission pan (**arrow**).

Table b. Automatic transmission applications

Model	Year	Engine	Transmission
323i/Ci 328i/Ci	1999 - 2000 2000 - 2001	M52TU	GM A5S 360R ZF A5S 325 Z
325i/Ci 330i/Ci	2000 - 2001	M54	ZF A5S 325 Z
325xi 330xi	2000 - 2001	M54	GM A5S 390R

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Transmission lubricants

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General

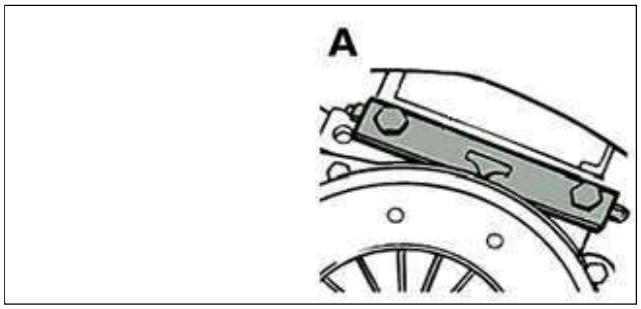
This repair group covers replacement of the clutch mechanical and hydraulic components. Read the procedure through before beginning a job.

Note:

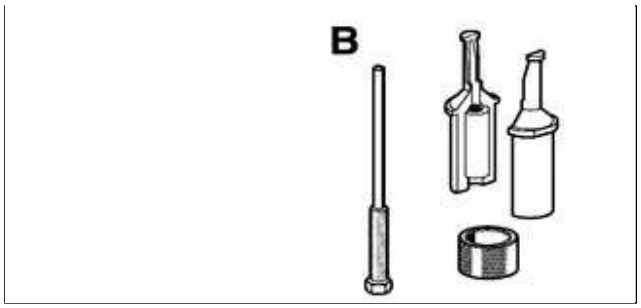
See ⇒ 200 Transmission–General for transmission application information.

Special tools

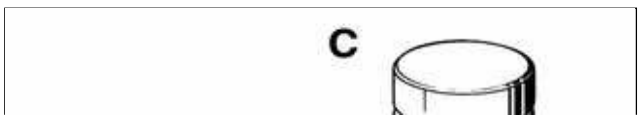
The 3 Series BMW employs a traditional style clutch layout with a self adjusting clutch for manual transmission cars. BMW suggests some specific tools for fitting and removing the self adjusting clutch (SAC) assembly. These tools are required for aligning and assembling the clutch disk, as well as locking the flywheel in place and aligning the SAC assembly to the dual mass flywheel.



- Flywheel locking tool BMW 11 2 170



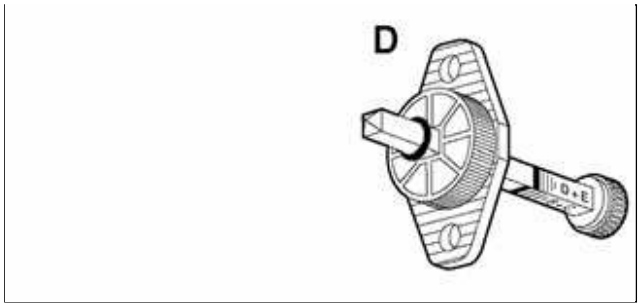
- Pilot bearing removal tool BMW 11 2 340



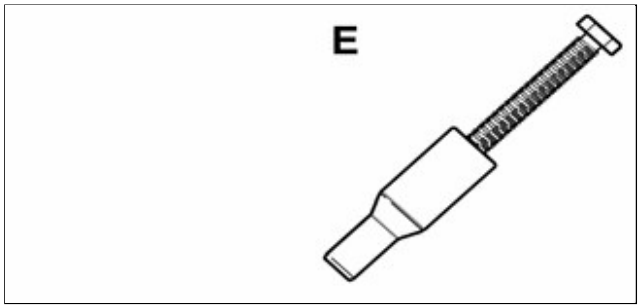
- Pilot bearing installation tool BMW 11 2 350

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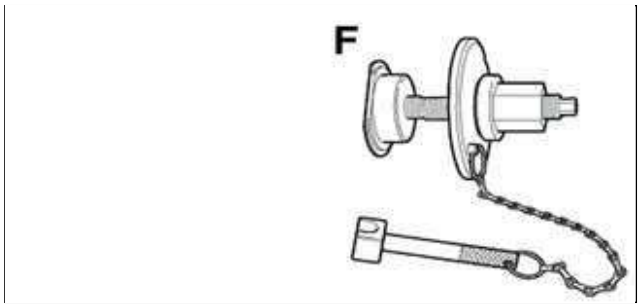




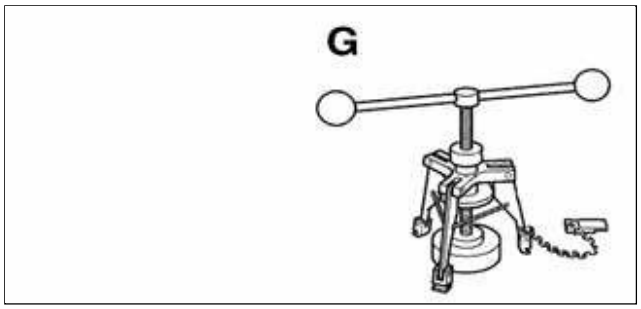
- Clutch lining gauge BMW 21 2 080



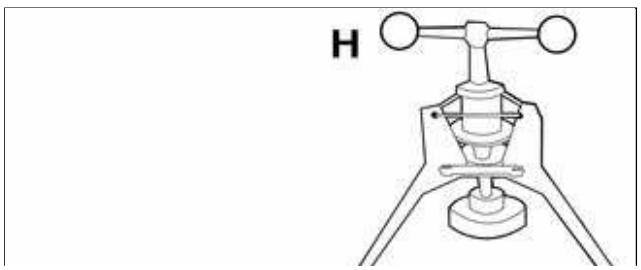
- Clutch centering mandrel BMW 21 2 142



- SAC clutch lock tool BMW 21 2 150

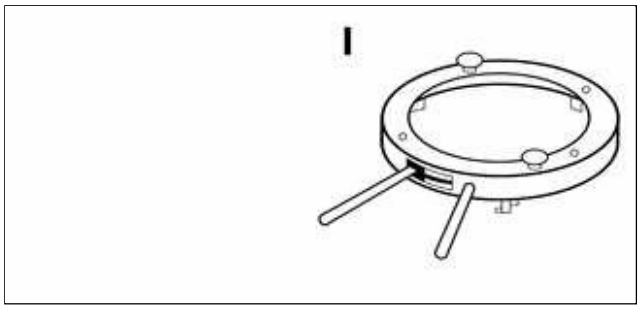


- Clutch diaphragm tensioning too BMW 21 2 160



- SAC tensioning tool BMW 21 2 170

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SAC locating ring BMW 21 2 180

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Clutch Hydraulics

The clutch is hydraulically actuated by the master and slave cylinders. Clutch disc wear is automatically taken up through the self adjusting pressure plate springs, making periodic adjustments unnecessary.

A soft or spongy feel to the clutch pedal, long pedal free-play, or grinding noises from the gears while shifting can all indicate problems with the clutch hydraulics. In these circumstances it is best to start with a clutch fluid flush, followed, if necessary, by replacement of the hydraulic parts.

Note:

The clutch hydraulic system shares the fluid reservoir and fluid with the brake hydraulic system.

Clutch hydraulic system, bleeding and flushing

If the clutch/brake fluid is murky or muddy, or has not been changed within the last two years, the system should be flushed. Flushing the old fluid from the clutch lines is done using a brake system pressure bleeder.

- Raise and safely support vehicle.

- Remove under transmission splash guard if applicable.

- Remove brake fluid reservoir cap. Using a clean syringe, remove brake fluid from reservoir. Refill reservoir with clean DOT 4 brake fluid.

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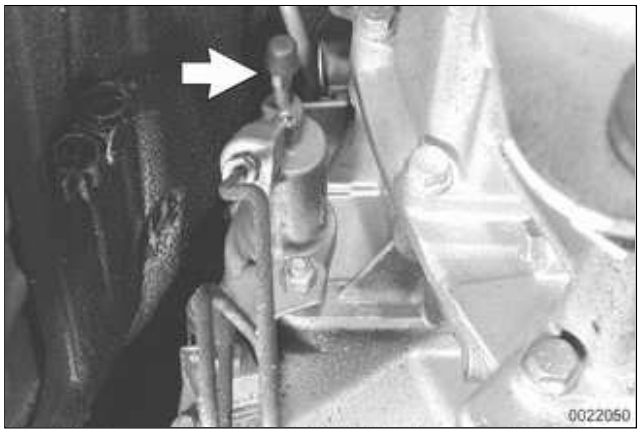
- Attach pressure brake bleeder to fluid reservoir and pump bleeder a few times to pressurize hydraulic fluid system.

CAUTION!

- ***Do not exceed 2 bar (29 psi) pressure at the fluid reservoir when bleeding or flushing the hydraulic system.***

- ***Brake fluid is poisonous, highly corrosive and dangerous to the environment. Wear safety glasses and rubber gloves when working with brake fluid. Do not siphon brake fluid with your mouth. Immediately clean away any fluid spilled on painted surfaces and wash with water, as brake fluid will remove paint.***

- ***Always use new brake fluid from a fresh, unopened container. Brake fluid will absorb moisture from the air. This can lead to corrosion problems in the hydraulic systems, and will also lower the brake fluid's boiling point. Dispose of brake fluid properly.***



- Connect a length of hose from clutch slave cylinder bleeder valve (**arrow**) to a container.

  - Open bleeder valve and allow brake fluid to expel until clean fluid comes out free of air bubbles.

  - Close bleeder valve and disconnect pressure bleeding equipment from fluid reservoir. Hose on bleeder valve remains connected.

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- Slowly operate clutch pedal about 10 times. Fill reservoir with clean fluid as necessary.

- Unbolt slave cylinder from transmission. Fit BMW special tool 21 5 030. Press slave cylinder pushrod completely into slave cylinder.

- Hold slave cylinder so that bleeder valve is at the highest point.

- Open bleeder valve.

- Once brake fluid appears with out air bubbles, withdraw pushrod completely.

- Press slave cylinder pushrod all the way in.

- If brake fluid appears without air bubbles close bleeder valve and slowly release pushrod. Repeat procedure until fluid runs out clear and without bubbles.

- Disconnect bleeder hose. Install slave cylinder to transmission. Add clean brake fluid to reservoir as necessary. Check clutch operation.

Tightening torque	
Clutch slave cylinder to transmission	22 Nm (16 ft-lb)

Clutch master cylinder,

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replacing

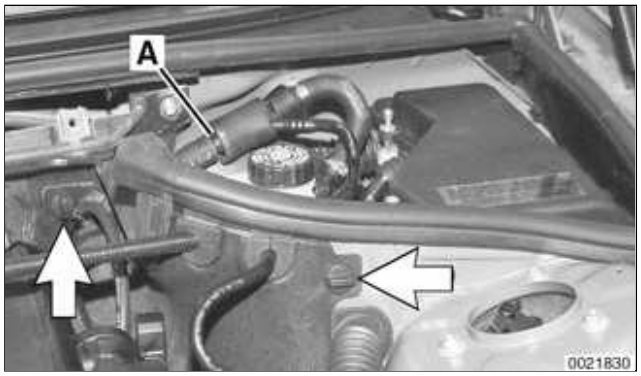
The clutch master cylinder is mounted to the pedal assembly directly above the clutch pedal.

- Disconnect negative (-) cable from battery.

CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

- Raise and safely support vehicle.
- Remove under transmission splash guard if applicable.
- Remove brake fluid reservoir cap. Using a clean syringe, remove brake fluid from reservoir.
- Disconnect fluid supply hose from brake master cylinder. Place a pan under hose to catch any excess fluid.
- Working in engine compartment, disconnect fluid line fitting from master cylinder.



Working at left rear of engine compartment:

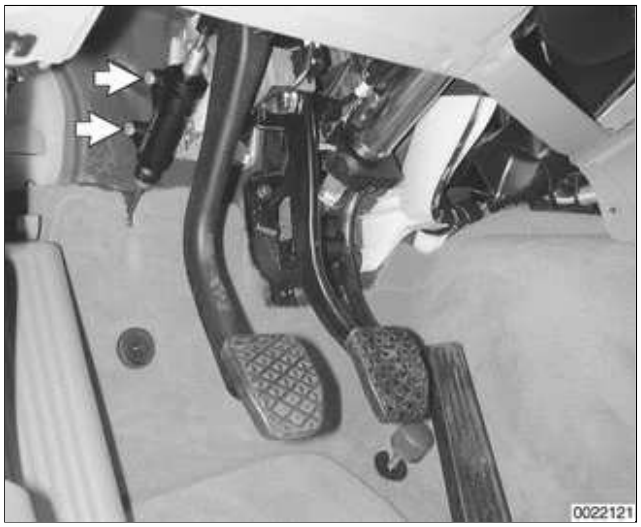
- Peel rubber edge seal off top of panel.
- Twist plastic panel retainers (**arrows**) 90° and pull out to remove.

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- Disengage panel from hoses and wiring harnesses and remove from engine compartment.

- Separate brake booster vacuum hose at one way valve (**A**). Plug hose ends.

- Disconnect clutch pedal from clutch master cylinder push rod by removing securing pin.



➢ Remove master cylinder mounting bolts (**arrows**).



➢ Remove clip (**arrow**) retaining hydraulic line to master cylinder. Be prepared to catch any excess brake fluid remaining in hydraulic line.

Note:

Wrap clutch master cylinder with shop rags when removing hydraulic fluid lines from master cylinder to prevent brake fluid spill.

- Pull hydraulic line from master cylinder. Remove master cylinder with supply hose.

- Installation is reverse of removal. Fill fluid reservoir with clean fluid.

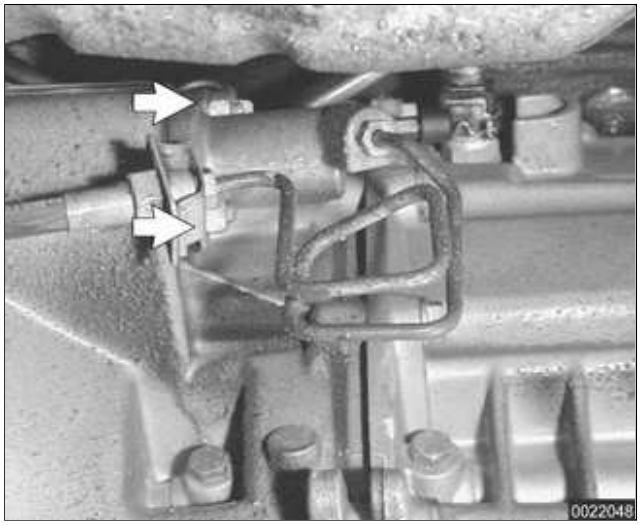
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Bleed clutch hydraulics as described earlier. Connect negative cable to battery last.

Tightening torques	
Clutch master cylinder to pedal cluster	22 Nm (16 ft-lb)
Fluid line to master cylinder or slave cylinder	20 + 5 Nm (15 + 4 ft-lb)

Clutch slave cylinder, replacing

- Pinch off brake fluid supply hose to clutch master cylinder using BMW special tool 13 3 010 or equivalent fuel line clamp tool.
- Remove transmission splash guard if applicable.
- Disconnect fluid hose from slave cylinder. Place a pan under hose to catch any excess fluid.



➢ Remove mounting nuts (**arrows**) from slave cylinder on left side of transmission.

- Installation is reverse of removal, noting the following:

♦ Check for wear on slave cylinder. Any other wear except on tip is caused by misalignment of clutch components.

♦ Lightly coat pushrod tip with molybdenum disulfide grease (Molykote® Longterm 2 or

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equivalent).

- During installation be sure pushrod tip engages recess in clutch release lever.
- Fill fluid reservoir with clean fluid.
- Bleed clutch hydraulics as described earlier.

Tightening torques	
Clutch slave cylinder to transmission	22 Nm (16 ft-lb)
Fluid line to slave cylinder	20 + 5 Nm (15 + 4 ft-lb)

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Clutch Mechanical

The transmission must be removed from the engine to access the clutch mechanical components. It is recommended that the clutch disc, pressure plate and release bearing be replaced during a clutch overhaul. Be sure to check the bottom of the bellhousing for oil. If engine oil is found, check for a faulty rear crankshaft oil seal.

Due to the construction of the self adjusting clutch (SAC) disc special tools must be used when removing the SAC style clutch. The pressure plate of the SAC clutch uses a wedge ring which rotates against the diaphragm springs to accommodate for clutch disc wear. The wedge ring adjusts by means of spring tension, so special tools must be used to apply and relieve spring tension as the clutch pressure plate is removed and installed. For special tools needed for clutch replacement procedures refer to the ⇒ Special tools

Table a. Clutch disc diameter	
Model	**Diameter**
323i/Ci 325i/Ci/xi	228 mm (8.98 in.)
328i/Ci 330i/Ci/xi	240 mm (9.45 in.)

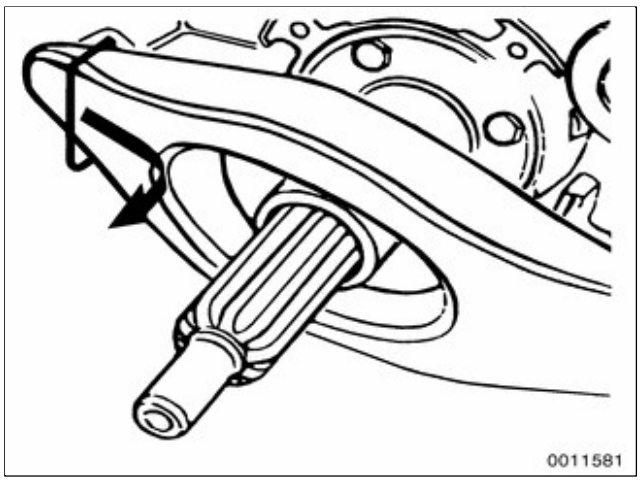
Clutch, removing

- On all wheel drive vehicles: Remove transfer case. See ⇒ 270 Transfer Case.

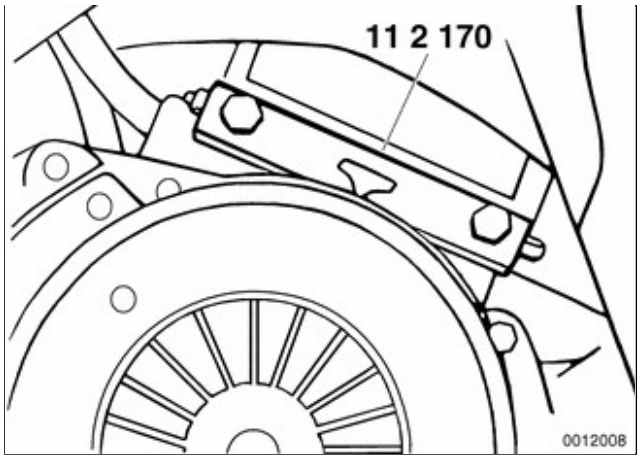
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- Remove transmission from engine. See ⇒ 230 Manual Transmission.

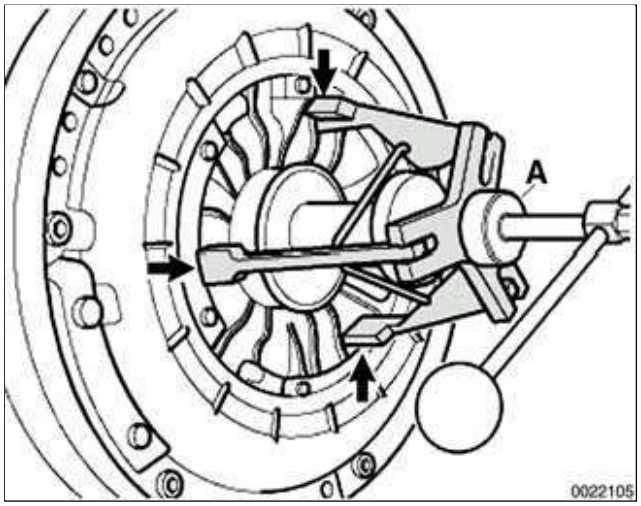
- Remove release bearing from transmission input shaft.



- Remove clutch release lever by pulling away from spring clip in direction of **arrow**.



- Lock flywheel in position using BMW special tool 11 2 170 or equivalent.



- Install BMW special tool 21 2 160 or 21 2 170 with feet (**arrows**) clamping on to pressure plate at openings for self-adjusting springs. Tighten down head nut (**A**) to lock feet into position.

CAUTION!

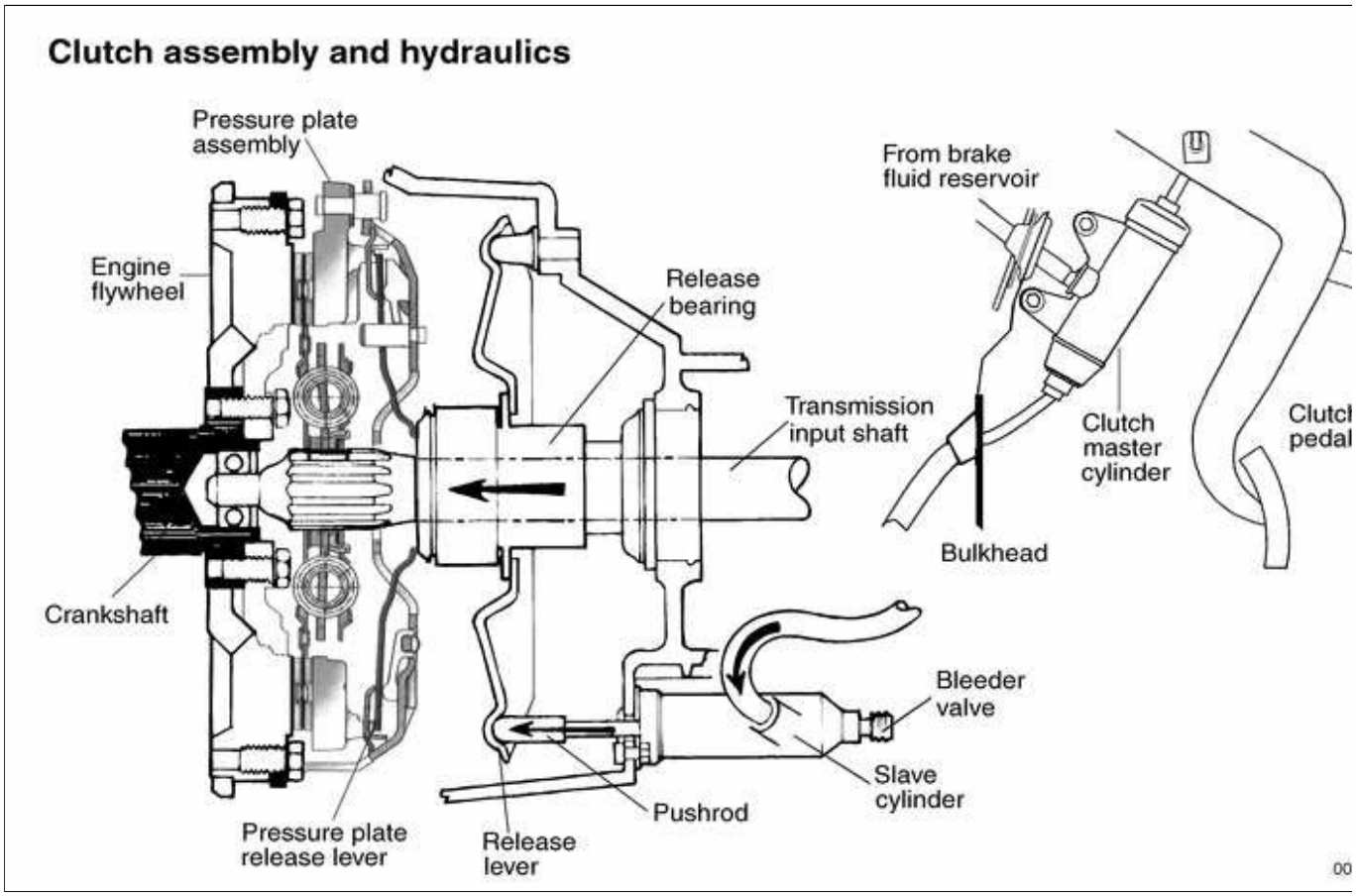
Self adjusting clutch tool feet must engage in the openings for adjusting springs to safely remove the SAC pressure plate.

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- Turn tool handle in until clutch diaphragm spring is fully tensioned.

- Remove six bolts from perimeter of pressure plate. Remove self adjusting clutch unit and clutch disk.

Clutch assembly and hydraulics



Clutch, inspecting

- Inspect clutch disc for wear, cracks, loose rivets, contamination or

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excessive runout (warping). Replace if necessary.

Note:

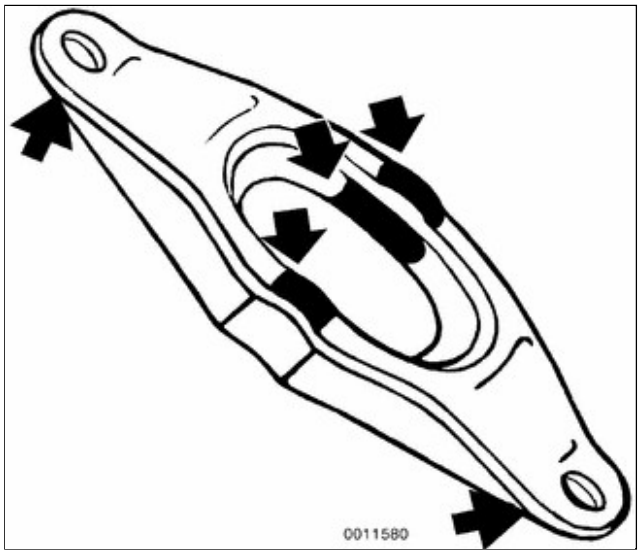
Measure the depth of clutch lining at lining rivets. If shallowest rivet depth is less than 1 mm (0.04 in.), replace clutch disk.

- Inspect flywheel for scoring, hot spots, cracks or loose or worn guide pins. Replace flywheel if any faults are found.

WARNING!

If flywheel is removed from vehicle, use new bolts during installation. The old stretch-type bolts should not be reused.

- Inspect transmission pilot bearing in end of crankshaft. The bearing should rotate smoothly without play. If necessary, replace as described later.

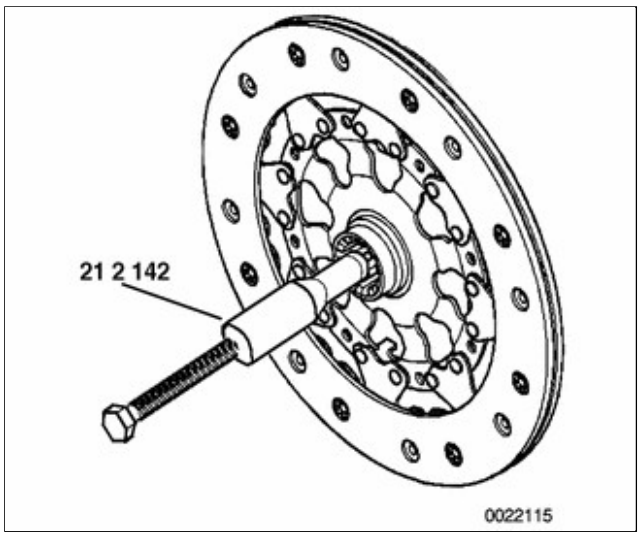


➢ Inspect and clean release bearing lever. Apply a thin coat of grease to release bearing lever lubrication points (**arrows**). Also, lightly lubricate clutch disc splines and transmission input shaft splines.

Clutch, installing new pressure plate

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New self adjusting clutch (SAC) pressure plates come with a locking plate installed that maintains spring tension on the self adjusting springs. This locking ring must not be removed until the pressure plate is securely installed on the flywheel with the clutch disk in place.



- Center clutch disk on flywheel using BMW special tool 21 2 142, or an equivalent clutch alignment tool.

Note:

The sides of a replacement clutch disk are labelled engine side and transmission side. Be sure to install clutch disk orientated in the proper direction.

- Install self adjusting clutch pressure plate onto dowel pins at flywheel. Tighten each bolt one turn at a time until pressure plate is fully seated, and then torque to specification

Tightening torque	
Clutch to flywheel	
M8 (8.8 grade)	24 Nm (18 ft-lb)
M8 (10.9 grade)	34 Nm (25 ft-lb)

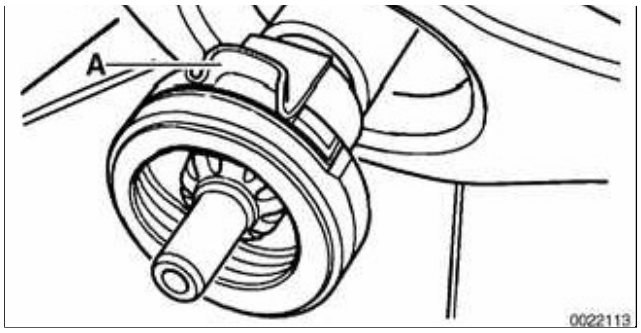
- Using a 14 mm allen wrench, carefully screw out locking plate in a clockwise direction.

- Remove BMW special tool 21 2 142 with bolt or screw enclosed with replacement clutch disk.



- Clean and inspect release bearing guide sleeve on transmission. Install release lever and release bearing. Bearing tabs (**A**) align with contact points (**B**) on

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release lever.

- Install transmission. See ⇒ 230 Manual Transmission.

Tightening torques	
Transmission to engine (Torx bolts)	
M8	22 Nm (16 ft-lb)
M10	43 Nm (32 ft-lb)
M12	72 Nm (53 ft-lb)

Clutch, installing used pressure plate

Note:

- *Before installing a used Self Adjusting Clutch (SAC) pressure plate, be sure to reset self adjusting ring to the new position*

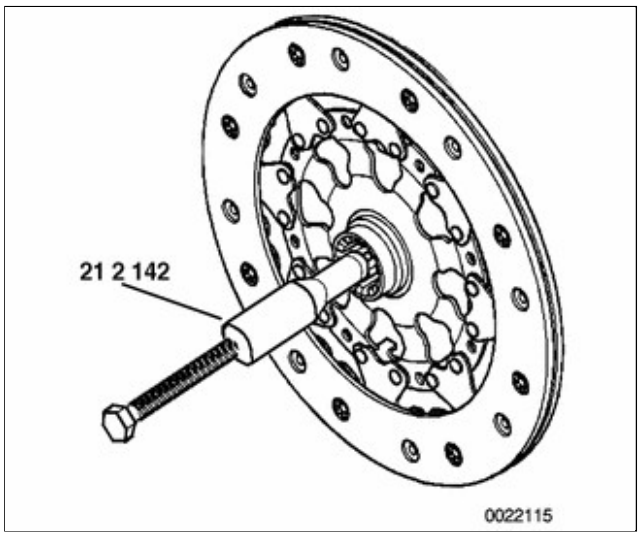
- *Locating hooks of BMW special tool 21 2 180 must engage in openings of SAC pressure plate*

- Place self adjusting clutch pressure plate on clean work surface. Install special tool 21 2 180 onto pressure plate.

- Squeeze handles of 21 2 180 together. Tighten down knurled knobs of 21 2 180. SAC adjustment ring is now in installation position.

- Install special tool 21 2 170 over 2 12 180 on SAC pressure plate. Screw in handle of 21 2 170 until diaphragm spring of SAC pressure plate is pretensioned.

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- Center clutch disk with BMW special tool 21 2 142. A comparable clutch alignment tool may be used. Remove threaded handle of clutch alignment tool

WARNING!

Be sure clutch disc is facing the correct way. The disc should be marked engine side or transmission side.

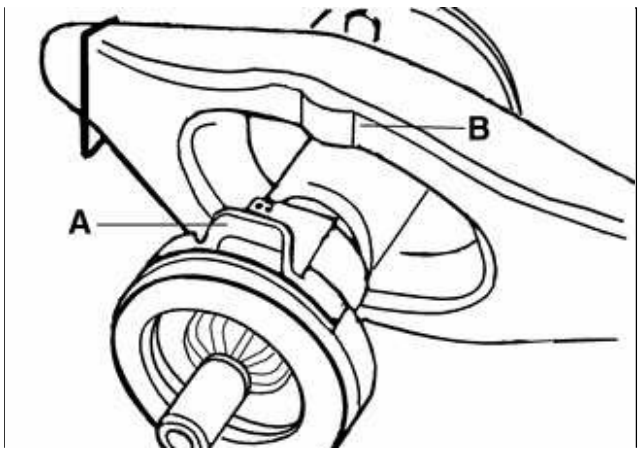
- Mount self adjusting clutch assembly on flywheel, noting location of alignment pins.

- Tighten each bolt one turn at a time until pressure plate is fully seated, and then torque to specification.

Tightening torque	
Clutch to flywheel	
M8 (8.8 grade)	24 Nm (17-ft-lb)
M8 (10.9 grade)	34 Nm (25 ft-lb)

- Unscrew handle of special tool until load is removed from diaphragm. Remove BMW special tool 21 2 180 from pressure plate.

- Remove clutch alignment tool from disk.



- Clean and inspect release bearing guide sleeve on transmission. Install release lever and release bearing. Make sure bearing tabs (**A**) align with contact points (**B**) on release lever.

- Install transmission. See ⇒ 230 Manual Transmission.

Tightening torques

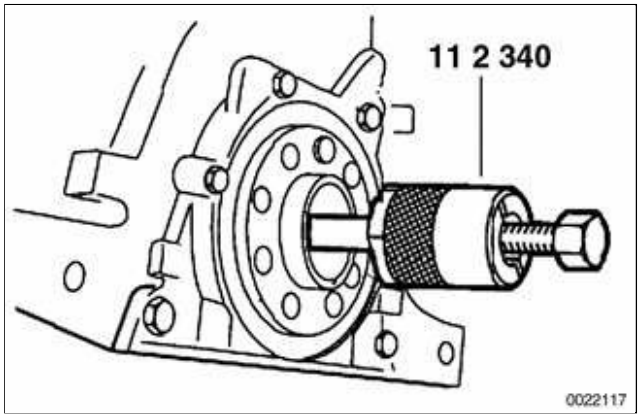
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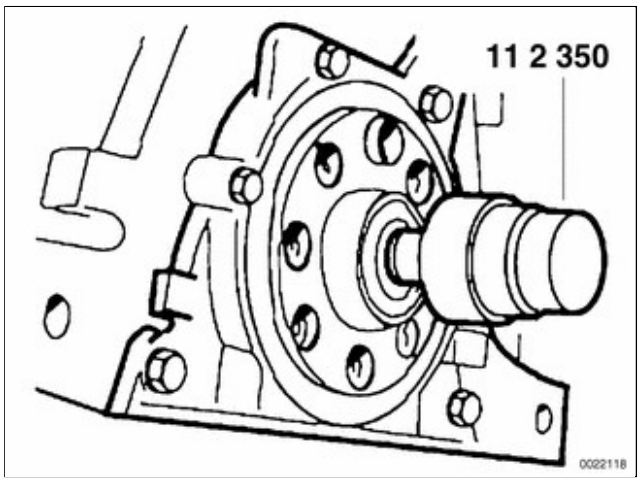
Tightening torques	
Transmission to engine (Torx bolts)	
M8	22 Nm (16 ft-lb)
M10	43 Nm (32 ft-lb)
M12	72 Nm (53 ft-lb)

Transmission pilot bearing, replacing

- Remove clutch as described earlier.



➢ Remove transmission pilot bearing from end of crankshaft using BMW special tool 11 2 340 or equivalent puller.



➢ Press new bearing into place using BMW special tool 11 2 350 or equivalent driver.

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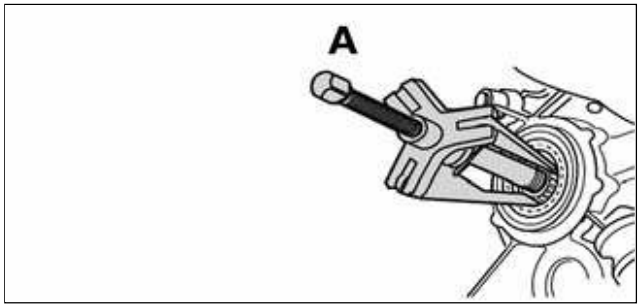
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General

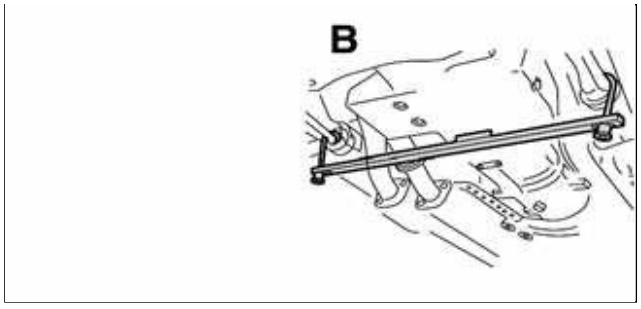
This repair group covers external transmission service, including removal and installation of the transmission unit. Internal transmission repair is not covered. Special press tools and procedures are required to disassemble and service the internal geartrain.

Special tools

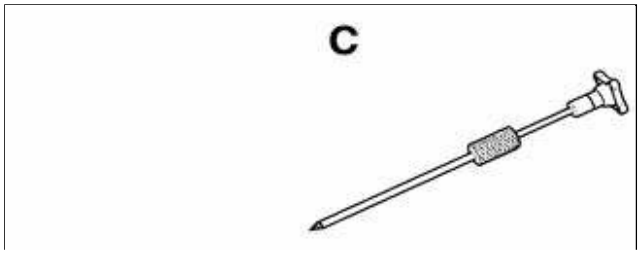
BMW specified tools are required for removal and installation of the manual transmission, as well as the removal and installation of seals at the transmission input, output, and selector shafts. If these tools are unavailable, equivalent tools may be substituted.



- Seal puller BMW 00 5 010

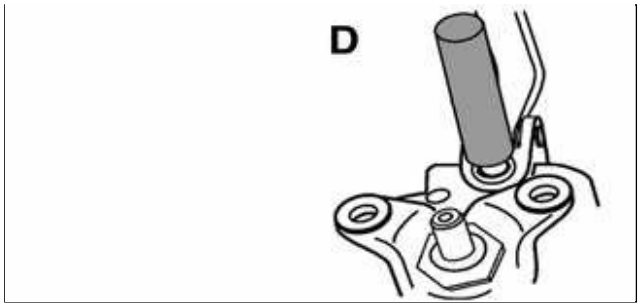


- Engine support bracket (lower) BMW 11 8 022

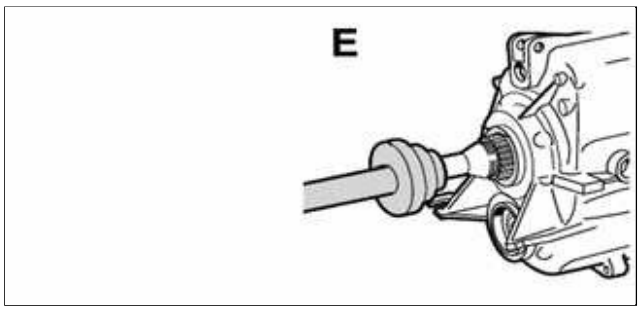


- Input shaft seal puller (slide hammer) BMW 23 0 490

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- Selector seal drift BMW 23 0 22



- Output seal drift BMW 23 2 300

Manual transmissions used are based on engine application. Consult ⇒ 200 Transmission–General for transmission application information. ⇒ Table a. Manual transmission gear ratios lists gear ratio specifications.

Note:

Do not rely on forged casting numbers for transmission code identification.

Table a. Manual transmission gear ratios

Transmission	Getrag S5D 250G	ZF S5D 280Z	ZF S5D 320Z
Gear Ratios:			
1st	4.23	4.21	4.21
2nd	2.52	2.49	2.49
3rd	1.66	1.66	1.66
4th	1.22	1.24	1.24
5th	1.00	1.00	1.00
reverse	4.04	3.85	3.85

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Transmission Fluid Service

Manual transmissions installed in the 3 Series are normally filled with a "Lifetime" manual transmission fluid (BMW MTF LT-1) and do not require periodic fluid changes. Transmissions filled with MTF LT-1 lifetime oil are identified with a yellow label near the transmission fill plug labeled "Lifetime Oil MTF-LT-1".

Transmission fluid level, checking

Checking the transmission fluid level involves simply removing the side fill plug and inserting a finger into the hole to check the fluid level. If the fluid level is up to the bottom of the fill hole (finger is wetted by transmission fluid), the level is correct.

Transmission fluid, replacing

- Drive vehicle for a few miles to warm transmission.

- Raise and safely support vehicle to access drain plug.

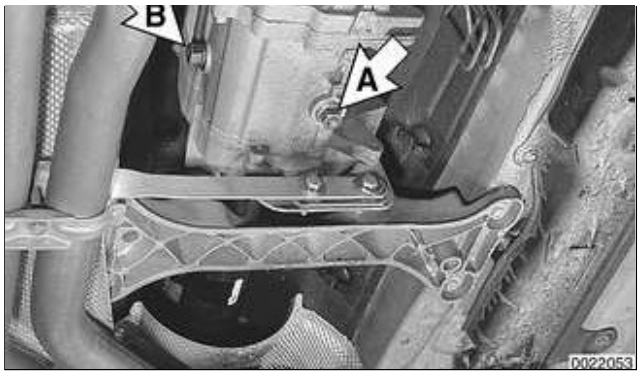
CAUTION!

Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.



Place a drain pan under transmission and remove drain plug (**A**) at bottom of transmission.

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- Install and torque drain plug.
- Remove fill plug (**B**) from side of transmission.
- Slowly fill transmission with fluid until fluid overflows fill hole.
- Install and torque fluid fill plug.nothing

Fluid capacity	
Getrag transmission	1.0 liter (1.1 US qts)
ZF transmission	1.2 liters (1.3 US qts)

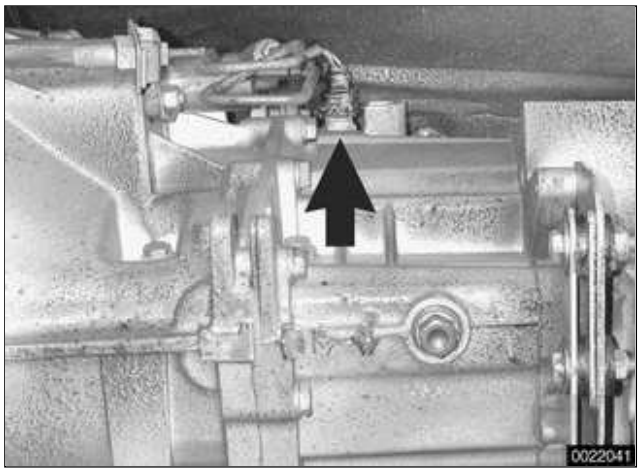
Tightening torque	
Transmission drain or fill plug	50 Nm (37 ft-lb)

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Transmission Service

Back-up light switch, replacing



- Raise and safely support vehicle to access back-up light switch. Unscrew switch from transmission.

Note:

- *The back-up light switch (**arrow**) on Getrag transmissions is in the left side of the transmission.*
- *The back-up light switch on ZF transmission is in the right front of the transmission.*

- Install new switch.

Tightening torque	
Back-up light switch to transmission	20 Nm (15 ft-lb)

- Check transmission fluid level before lowering vehicle.

Selector shaft seal, replacing (transmission installed)

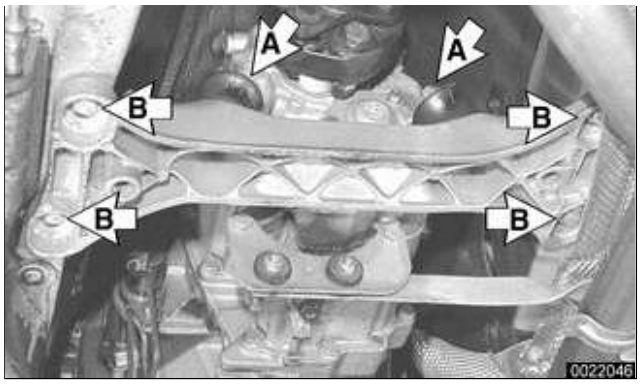
- Raise and safely support vehicle.

- Support transmission with transmission jack.

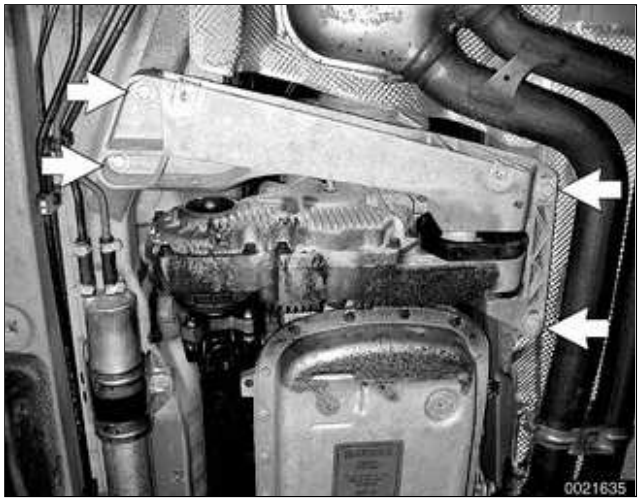


- On rear wheel drive cars:

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- Remove driveshaft. See ⇒ 260 Driveshaft.
- Remove transmission mount bolts (**A**).
- Remove transmission crossmember bolts (**B**) and tilt down rear of transmission.

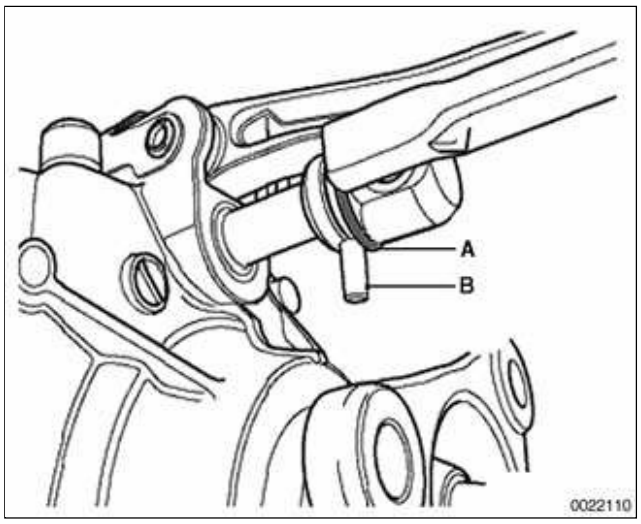


➢ On all wheel drive cars:

- Remove front and rear driveshafts. See ⇒ 260 Driveshaft
- Remove transfer case crossmember bolts (**arrows**) and remove transfer case. See ⇒ 270 Transfer Case.

CAUTION!

Tilting the engine to lower the transmission can lead to damage to various components due to lack of clearance.

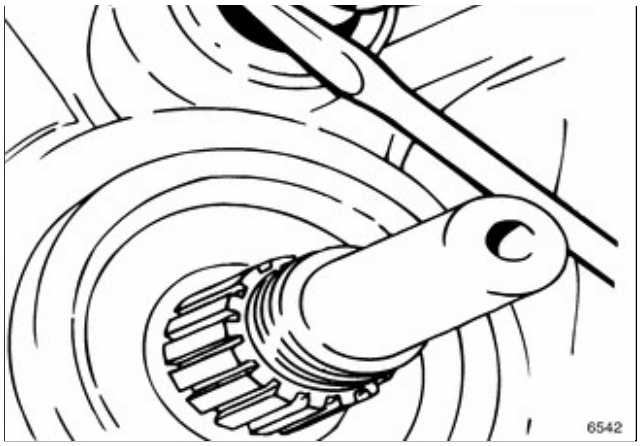


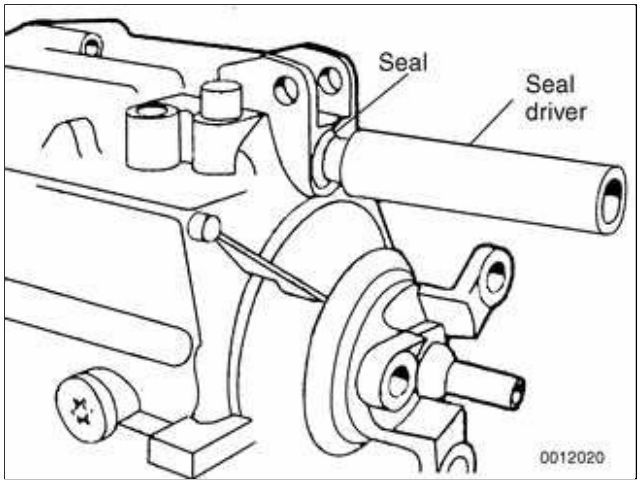
➢ Working at rear of selector shaft, pry snap ring (**A**) out of groove with a small screwdriver. Push snap ring towards gear selector rod joint and drive out pin (**B**).



➢ Carefully pry out selector shaft oil seal with a narrow seal remover or small screwdriver.

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- Coat new selector shaft seal with transmission fluid. Drive new seal in flush with housing. Use BMW special seal installation tool 23 1 140 or equivalent and a soft-faced (plastic) hammer.

- Installation is reverse of removal, noting the following;

- Install driveshaft using new lock nuts.

- Check transmission oil level, topping up as necessary.

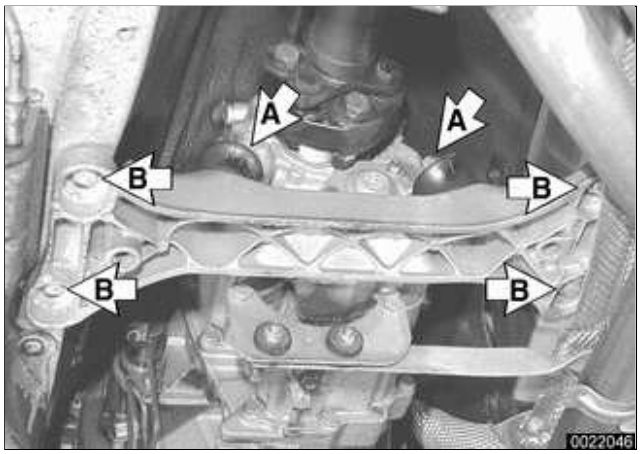
Tightening torques	
Center bearing (driveshaft) to body	21 Nm (15 ft-lb)
Clamping sleeve (driveshaft)	10 Nm (89 in-lb)
Driveshaft to final drive flange	
With U-joint (M10 ribbed nut)	80 Nm (59 ft-lb)
With U-joint (M10 compressed nut)	64 Nm (47 ft-lb)
Flex-disc to driveshaft or transmission flange	
M10 (8.8 grade)	48 Nm (35 ft-lb)

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Tightening torques	
M10 (10.9 grade)	60 Nm (44 ft-lb)
M12 (10.9 grade)	100 Nm (74 ft-lb)
Transmission / transfer case crossmember to chassis (M8)	21 Nm (15 ft-lb)
Transfer case to transmission (M10)	41 Nm (30 ft-lb)

Output shaft seal, replacing (transmission installed)

- Raise and safely support vehicle.
- Support transmission with transmission jack.



➢ On rear wheel drive cars:

- Remove driveshaft. See ⇒ 260 Driveshaft.
- Remove transmission mount bolts (**A**).
- Remove transmission crossmember bolts (**B**) and tilt down rear of transmission.



➢ On all wheel drive cars:

- Remove front and rear driveshafts. See ⇒ 260 Driveshaft
- Remove transfer case crossmember bolts (**arrows**) and remove transfer case. See ⇒ 270 Transfer Case.

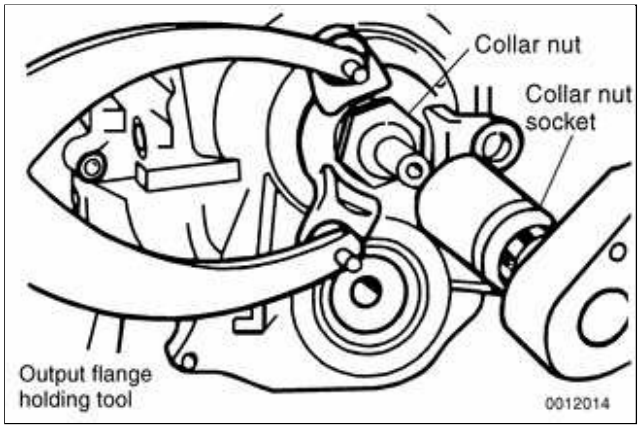
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CAUTION!

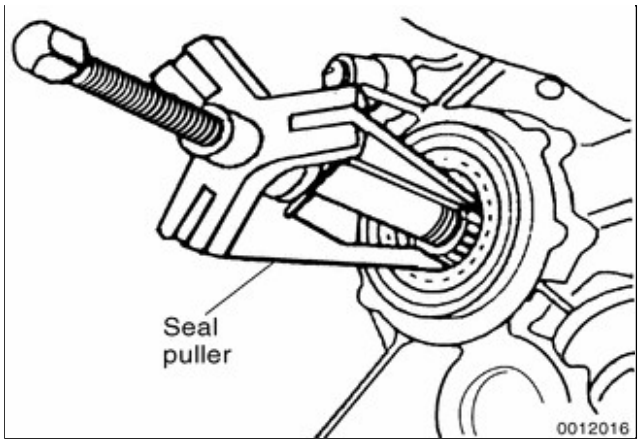
Tilting the engine to lower the transmission can lead to damage to various components due to lack of clearance.

- Bend back and remove transmission output collar nut lockplate.

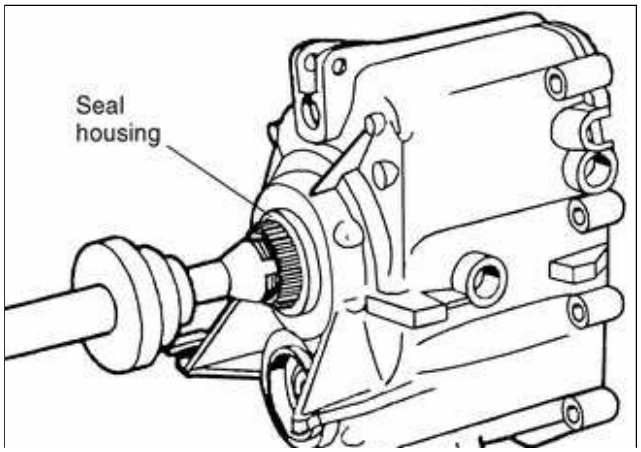


- Remove collar nut with 30 mm thin-walled deep socket. Counterhold output flange to prevent it from turning.

- Remove output flange. If necessary, use a puller.



- Use a seal puller to remove seal from transmission housing



- Coat new seal with transmission fluid and drive into position until it is flush with housing. Use seal driver (BMW special tool 23 2 300) or equivalent.

- Reinstall output flange (and shims, if applicable) to output shaft.

Note:

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On Getrag S5D 250G transmissions BMW recommends heating the output flange to about 176F (80C) to aid in installation. This can be done by placing the flange in hot water.

- Coat bearing surface of collar nut with sealer and install nut. Tighten collar nut in two stages. Install new lockplate. Bend tabs into flange grooves.

Note:

BMW recommends the use of a sealer such as Loctite ® 242 when installing the flange collar nut to prevent oil from leaking past the threads.

- Installation is reverse of removal, noting the following:

- Install driveshaft using new nuts. See ⇒ 260 Driveshaft.

- Check transmission and transfer case fluid level, if applicable, topping up as necessary.

Tightening torque	
Transmission crossmember to chassis	
M8	21 Nm (15 ft-lb)
Transmission output flange to output shaft	
Stage I	190 Nm (140 ft-lb)
Stage II (after loosening)	120 Nm (89 ft-lb)

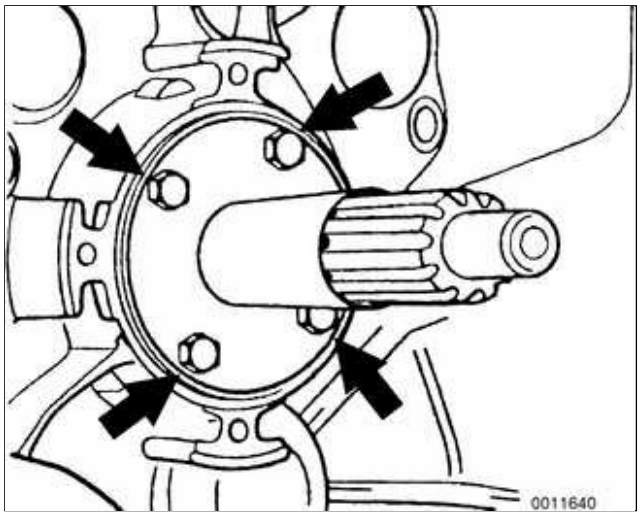
Input shaft seal, replacing

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(transmission removed)

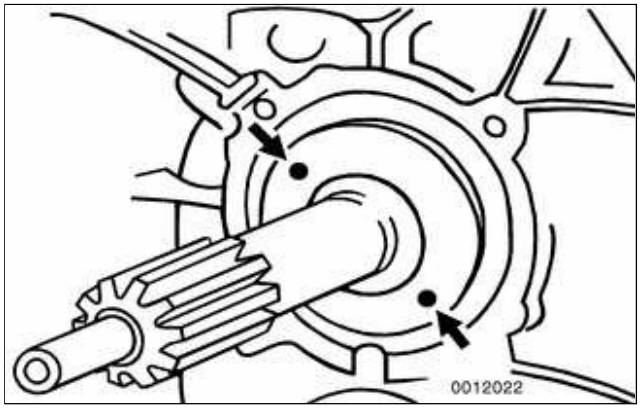
Replacement of the input shaft seal requires the removal of the transmission from the vehicle as describedlater in this repair group.

- Remove clutch release bearing and release lever from inside bellhousing.



➢ Remove bolts (**arrows**) for clutch release-bearing guide sleeve, noting bolt lengths (Getrag transmission shown). Remove sleeve and any spacers (shims) under it.

- With transmission on a workbench, remove input shaft seal cover from inside bell-housing.



➢ Locate two indents (**arrows**) in seal. Thread a slide hammer seal puller at indents, pull seal and remove seal

- Use care not to scratch or damage input shaft. Use a protective sleeve or tape the shaft when removing and installing the seal.

- Lubricate new seal with transmission oil and drive into place using an appropriate drift.

- Thoroughly clean guide sleeve mounting bolts, sealing surfaces, and threads in case. Apply sealer (Loctite® 242 or equivalent) to guide sleeve sealing surface and bolts. Reinstall guide sleeve and spacer(s).

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Tightening torque	
Guide sleeve to transmission	
M6x12 bolt	10 Nm (89 in-lb)

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Transmission Removal and Installation

Removal and installation of the transmission is best accomplished on a lift using a transmission jack. The engine must be supported from above using appropriate support equipment. This allows the engine to pivot on its mounts to access the upper Torx-head bolts at the bellhousing.

WARNING!

- ***Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.***

- ***The removal of the transmission may upset the balance of the vehicle on a lift.***

Transmission, removing and installing

- Disconnect negative (-) cable from battery.

CAUTION!

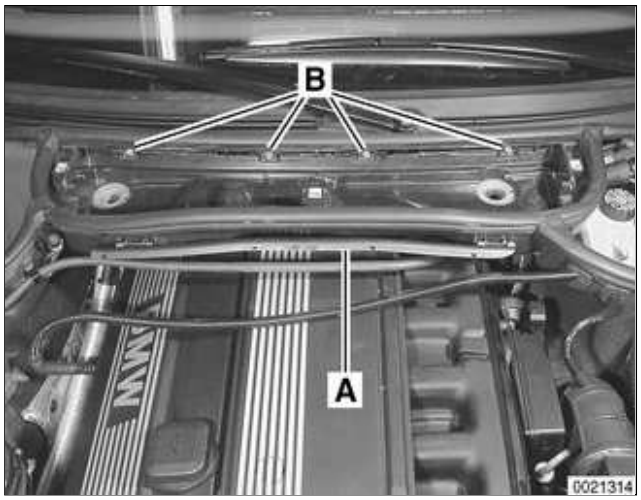
Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.



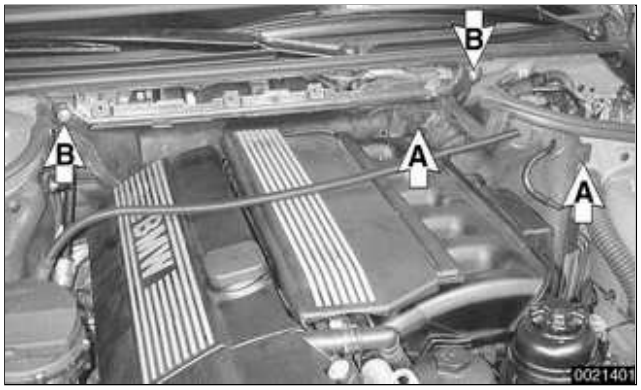
Remove engine cooling intake hood fasteners (**arrows**) at front of engine compartment.

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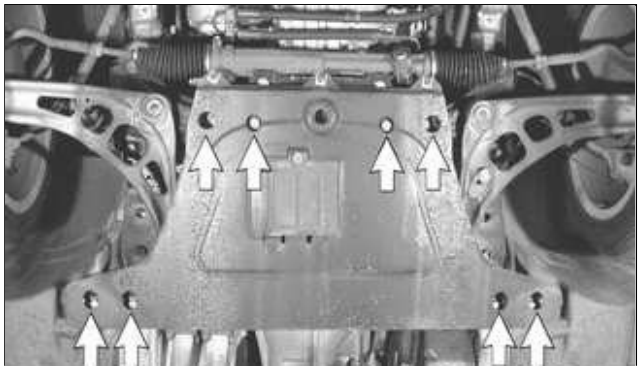




- Remove housing for interior ventilation microfilter.
  - Remove upper cover and microfilter.
  - Open wiring harness loom cover (**A**) and remove wires.
  - Unfasten screws (**B**) and remove lower microfilter housing.



- Remove heater bulkhead cover.
  - Remove engine compartment side trim panel. Turn locking knobs (**A**) and slide trim panel from mounting lip.
  - Remove heater bulkhead cover mounting screws (**B**) and lift cover up and out from firewall.
  - Raise and safely support vehicle.
  - Remove engine splashguard from underside of vehicle.



- Remove front suspension reinforcement bolts (**arrows**). Remove reinforcement (**coupe shown**) and front axle subframe.

Note:

- *Tubular style front end reinforcements are used in rear*

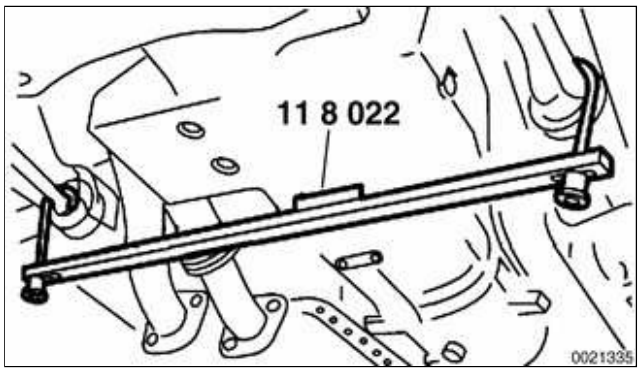
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wheel drive 3 Series sedans and wagons built up to 11/00 and coupes built up to 10/99.

- *Pan style front end reinforcements are used on rear wheel drive sedans and wagons built after 12/00, coupes built after 11/99 and all convertibles.*

- *All wheel drive models require no reinforcement due to the construction of the front subframe.*



- Attach BMW special tool 11 8 022 to left and right lower control arms. Tighten knurled screws until tool makes contact with engine oil pan.

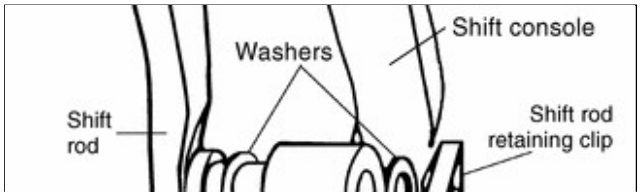
  - Support transmission with transmission jack. Remove reinforcing cross brace from below engine/transmission.

  - Disconnect harness connector from back-up light switch on transmission.

  - Remove exhaust system and heat shield. See ⇒ 180 Exhaust System

  - Remove driveshaft. See ⇒ 260 Driveshaft.

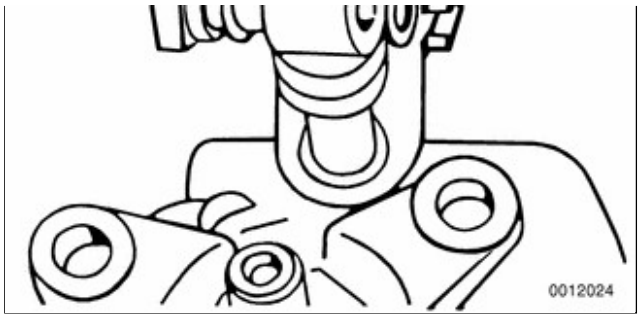
  - On all wheel drive vehicles: Remove transfer case. See ⇒ 270 Transfer Case.



- Disconnect shift rod from selector shaft coupling.

  - Disconnect shift console from top

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of transmission. See ⇒ 250 Gearshift Linkage.

- Unbolt clutch slave cylinder from side of transmission. Do not disconnect fluid hose. Suspend slave cylinder from chassis using stiff wire.

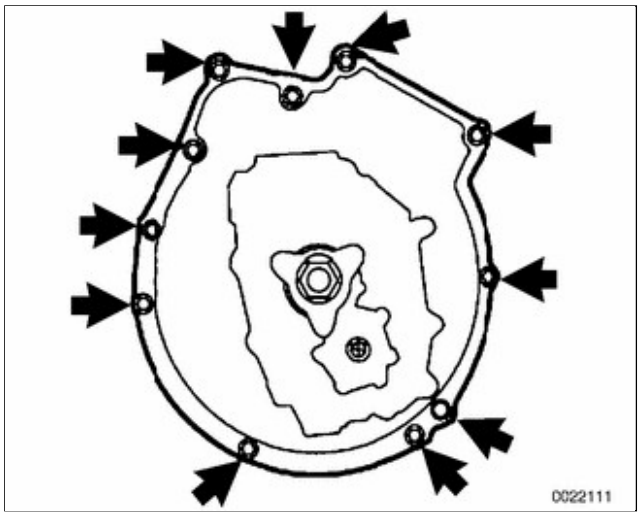
CAUTION!

Do not operate clutch pedal with slave cylinder removed from transmission.

- Loosen knurled screws of BMW special tool 11 8 022 until transmission/engine assembly is just above, but not in contact with fire wall and heater connections.

CAUTION!

Tilting the engine to lower the transmission can lead to damage to various components due to lack of clearance at rear of engine -Remove brake fluid reservoir if necessary.



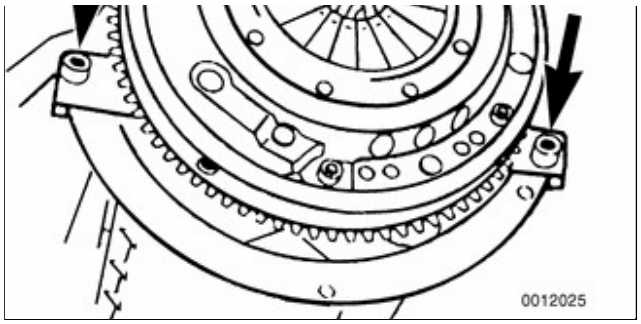
- Remove transmission mounting Torx-head bolts (**arrows**). Note length and location of bolts.

- Remove transmission by pulling backward until the transmission input shaft clears the clutch disc splines, then pull downwards. Lower jack and remove transmission.



- Installation is reverse of removal, keeping in mind the following:

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- When installing a new transmission, be sure to transfer parts from old transmission if applicable.
- Thoroughly clean input shaft and clutch disc splines. Lightly lubricate transmission input shaft before installing.
- Be sure bellhousing dowels (**arrows**) are correctly located.
- Center rear of transmission in driveshaft tunnel before tightening transmission support bracket.
- Always replace front end reinforcement mounting fasteners on vehicles equipped with the plate style reinforcement.

Note:

Torx-head mounting bolts should always be used with washers to prevent difficult removal in the future.

- Install driveshaft and preload center bearing bracket. Use new nuts when mounting driveshaft to transmission/flex disc and final drive. See ⇒ 260 Driveshaft.
- Refill transmission with appropriate lubricant before starting or towing the car. See ⇒ Transmission Fluid Service earlier in this repair group.

Tightening torques
Front end reinforcement to chassis and subframe (M10)

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Tightening torques	
(tubular style)	42 Nm (31 ft-lb)
(pan style)	59 Nm (44 ft-lb) + 90°
Rubber mount to transmission or bracket nut (M8)	21 Nm (15 ft-lb)
Slave cylinder to transmission	22 Nm (16 ft-lb)
Transmission crossmember to chassis	
M8	21 Nm (15 ft-lb)
Transmission to engine (Torx-head)	
M8	22 Nm (16 ft-lb)
M10	43 Nm (32 ft-lb)
M12	72 Nm (53 ft-lb)
Transmission drain/fill plug	50 Nm (37 ft-lb)

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General

This section covers maintenance and replacement of the E46 automatic transmission. Internal repairs to the automatic transmission are not covered. Special tools and procedures are required to disassemble and service internal automatic transmission components.

Automatic transmissions are identified by code letters found on a data plate located on the side or rear of the transmission case. See ⇒ 200 Transmission–Generalfor application information. For gear ratio specifications, see ⇒ Table a. Automatic transmission applications.

CAUTION!

ATF does not circulate unless the engine is running. When towing an automatic transmission vehicle, use a flat-bed truck or raise the rear wheels off the ground. All wheel drive vehicles equipped with automatic transmissions must be towed using a flat-bed truck only.

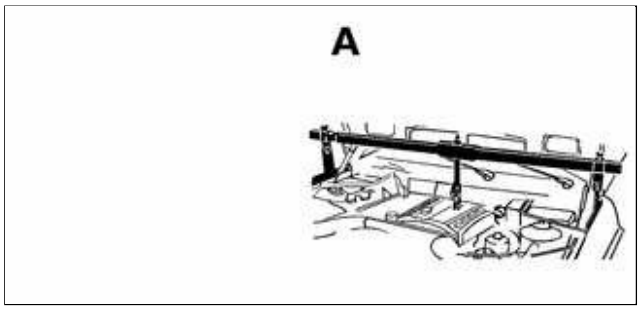
The electronic transmission control module (TCM) monitors transmission operation for faults and alerts the driver by illuminating the transmission fault indicator on the instrument panel. On-board diagnostic codes stored in the TCM must be downloaded and interpreted by trained technicians using special BMW diagnostic equipment.

Special tools

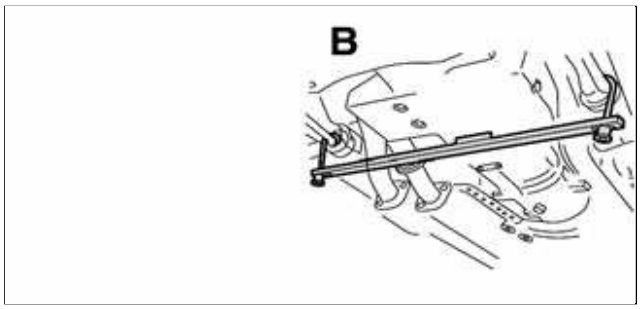
Some special tools are required for the removal and installation of an automatic transmission on the E46 BMW models. While these tools are not

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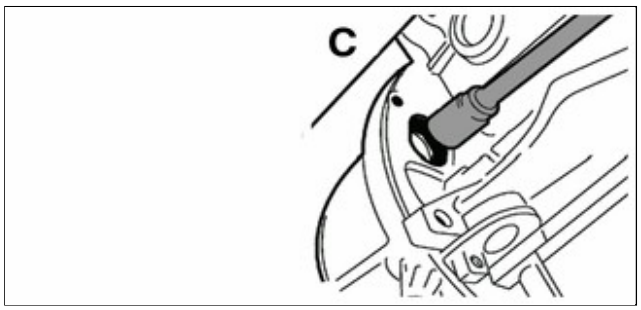
absolutely necessary, they are especially helpful when dealing with the removal and replacement of the torque converter.



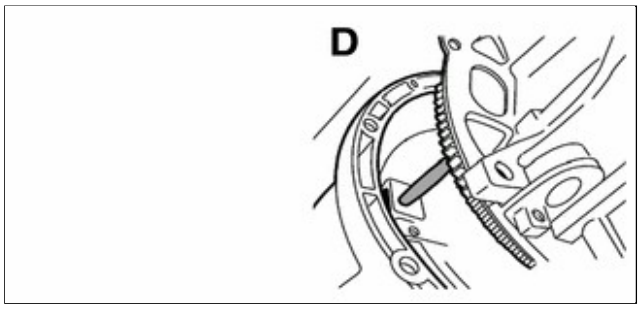
- Engine support bracket BMW 00 0 200 / 208



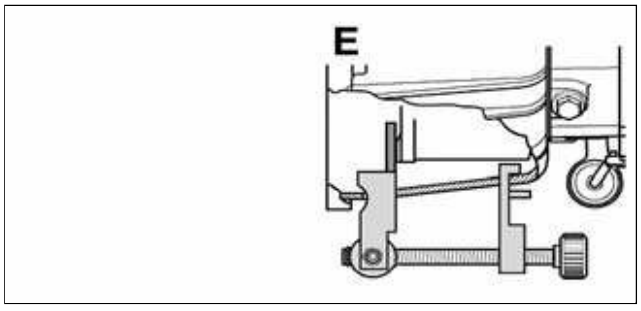
- Oil pan support bracket BMW 11 8 022



- Torque converter socket BMW 24 1 100



- Spline bore alignment tool BMW 24 2 300



- Torque converter clamp BMW 24 4 131 / 135

Internal repairs to the automatic transmission require special service equipment and knowledge. If it is determined that internal service is required, consult an authorized BMW

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dealer about a factory reconditioned unit or a transmission rebuild.

323i/Ci and 328i/Ci models manufactured from 08/98 to 03/00 are equipped with the A5S 360R automatic transmission. Vehicles produced after 03/00 are equipped with the A5S 325Z transmission.

Table a. Automatic transmission applications

Model	Year	Engine	Transmission
323i/Ci 328i/Ci	1999 - 2000 2000 - 2001	M52TU	GM A5S 360R ZF A5S 325 Z
325i/Ci 330i/Ci	2000 - 2001	M54	ZF A5S 325 Z
325xi 330xi	2000 - 2001	M54	GM A5S 390R

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Transmission Service



The automatic transmissions installed in the 3 Series are filled with either Dexron III ATF, or Texaco 8072B a special life-time oil.

CAUTION!

Mixing different types of transmission fluids will lead to transmission failure.

Note:

The transmission lubricant installed can be found on a sticker on the transmission pan. Dexron III ATF (black sticker) reads "ATF-Oil!". Special life-time oil (green sticker) reads "Life-Time Oil". In addition, a sticker may be located on the fluid sump indicating the type of transmission lubricant used. If in doubt, consult an authorized BMW dealer for alternate fluid use and current information regarding transmission operating fluids.

Automatic transmission fluid (ATF) level, checking

The automatic transmission is not equipped with a dipstick. Checking the ATF level requires measuring and maintaining a specified ATF temperature within a narrow range during the checking procedure. The checking temperature is not fully warm or cold (the ATF pan should be approximately warm to the touch).

- Raise and safely support vehicle to access ATF fill plug.

CAUTION!

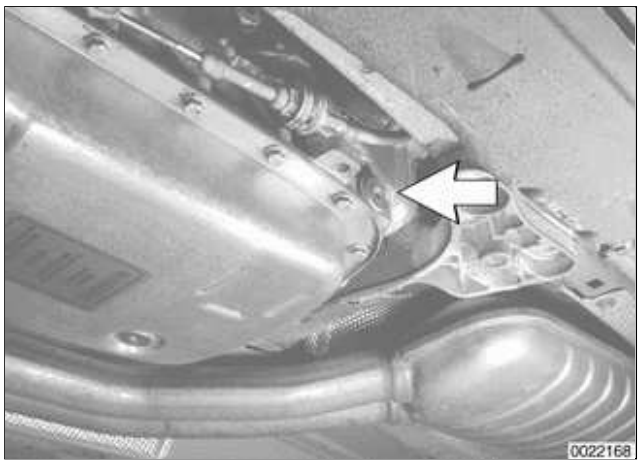
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Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

- Warm up drivetrain by running engine until ATF reaches specified temperature. Apply brake and, while idling engine, shift through all gears several times. Turn engine off.

ATF level checking	
Fluid temperature	30° - 50°C (85° - 120°F)

- Connect vehicle to BMW diagnostic scan tool DIS or MoDiC using the Data Link Connector (DLC) in the engine compartment, or under driver's side of dash (model year 2000 and later cars) in order to read transmission temperature.



➢ Remove ATF fill plug (**arrow**). Place transmission in neutral and restart engine. (A5S 360R transmission shown.)

Note:

Make sure ATF temperature is greater then 30°C, before releasing fill plug.

- With ATF between 30° - 50°C (85° - 120°F), add fluid until it spills from fill hole.

WARNING!

Hot ATF can scald. Wear eye protection and protective clothing and gloves during the check. If the transmission was overfilled, hot ATF

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will spill from the filler hole when the fill plug is removed.

- Reinstall fill plug using new sealing ring.

Tightening torques	
ATF drain plug to ATF sump	
A5S 360R / A5S 390R (M14)	20 Nm (15 ft-lb)
A5S 325Z	35 Nm (26 ft-lb)
ATF fill plug to ATF sump	
A5S 360R / A5S 390R (M14)	20 Nm (15 ft-lb)
A5S 325Z	30 Nm (22 ft-lb)

ATF, draining and filling

The procedure given here includes removal and installation of the ATF fluid strainer (filter).



Remove ATF drain plug (**arrow)**and drain fluid into container. (A5S 360R transmission shown.)

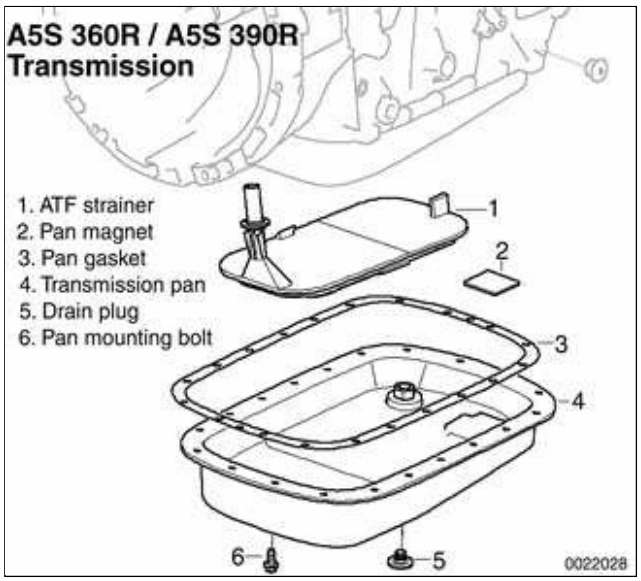
WARNING!

The ATF must not be hot when draining. Do not drain the ATF if the engine and/or transmission is hot. Hot ATF can scald. Wear eye protection, protective clothing and gloves.

- Remove transmission pan mounting bolts and remove pan.

- Remove pan gasket and clean gasket sealing surface.

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- Pull ATF fluid strainer from transmission pump housing. If strainer sealing ring remains in pump housing remove using a seal puller.

- Installation is reverse of removal.

- Always replace seal for drain plug and all gasket(s) and O-rings.

- Clean sump and sump magnet(s) using a lint-free cloth.

- Tighten transmission pan bolts in sequential order.

- Fill transmission with approved fluid.

- Check fluid level as described under ⇒ Automatic transmission fluid (ATF) level, checking

Note:

Use new sump bolts purchased from BMW. Alternatively, clean old bolts and coat with Loctite® thread locking compound or equivalent.

Automatic transmission fluid capacity	
A5S 360R / A5S 390R	
with torque converter	9 liters (9.5 qt)
without torque converter	4 liters (4.2 qt)
A5S 325Z (2.5 liter)	
with torque converter	8.9 liters (9.4 qt)

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Automatic transmission fluid capacity	
without torque converter	6.2 liters (6.5 qt)
A5S 325Z (3.0 liter)	
with torque converter	8.7 liter (9.2 qt)
without torque converter	6.1 liter (6.4 qt)

Tightening torques	
ATF drain plug to ATF sump	
A5S 360R / A5S 390R (M14)	18 Nm (14 ft-lb)
A5S 325Z	35 Nm (26 ft-lb)
ATF fill plug to ATF sump	
A5S 360R / A5S 390R (M14)	18 Nm (14 ft-lb)
A5S 325Z	30 Nm (23 ft-lb)
ATF sump to transmission	
A5S 360R / A5S 390R (M14)	10 Nm (7 ft-lb)
A5S 325Z	6 Nm (4 ft-lb)

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Transmission Removal and Installation

Removal and installation of the transmission is best accomplished on a lift using a transmission jack. Use caution and safe workshop practices when working beneath car and lowering transmission.

CAUTION!

- ***Be sure the vehicle is properly supported. The removal of the transmission may upset the balance of the vehicle on a lift.***
- ***Tilting the engine to remove the transmission can lead to damage to various components due to lack of clearance.***
- ***On cars with AST remove throttle body.***
- ***Remove brake fluid reservoir if necessary.***

Torx-head bolts are used to mount the transmission to the bellhousing. Be sure to have appropriate tools on hand before starting the job.

Transmission, removing and installing

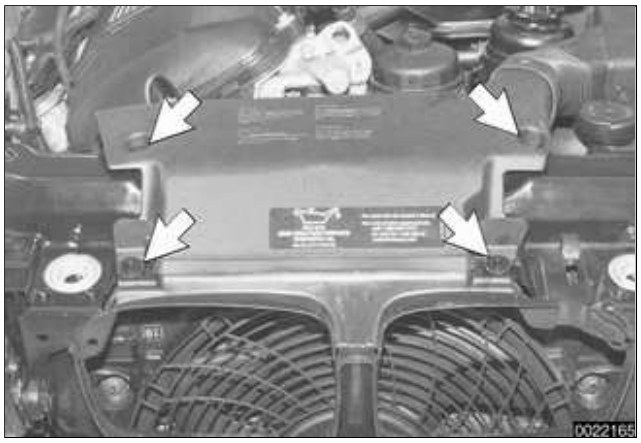
- Disconnect negative (-) cable from battery.

CAUTION!

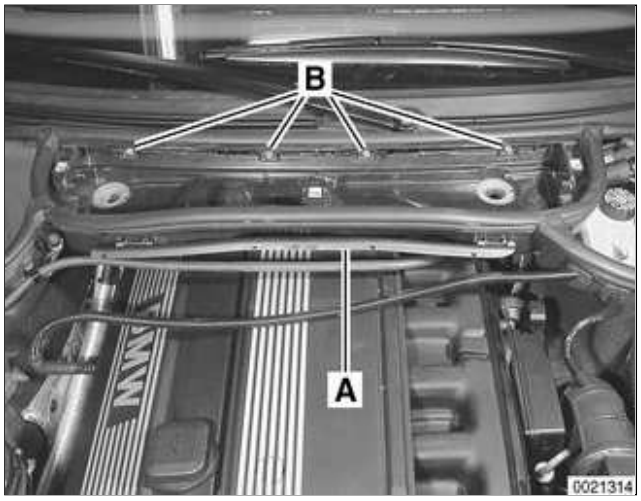
Prior to disconnecting the battery,

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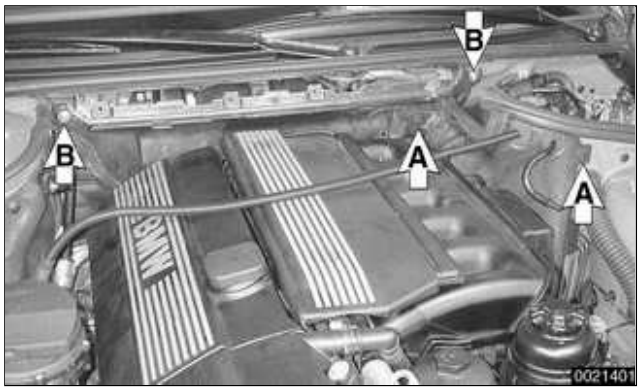
read the battery disconnection cautions given at the front of this manual on page viii.



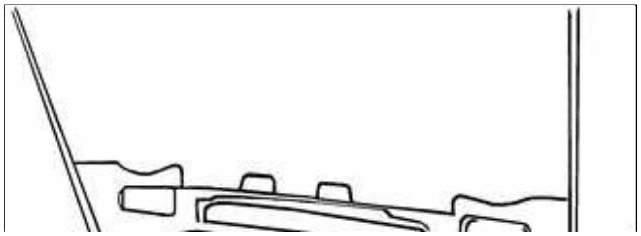
- Remove engine cooling intake hood fasteners (**arrows**) at front of engine compartment.
  - Remove engine driven cooling fan, unfasten cooling fan cowl and pull slightly upwards. See ⇒ 170 Radiator and Cooling System.



- Remove housing for interior ventilation microfilter.
  - Remove upper cover and microfilter.
  - Open wiring harness loom cover (**A**) and remove wires.
  - Unfasten screws (**B**) and remove lower microfilter housing.



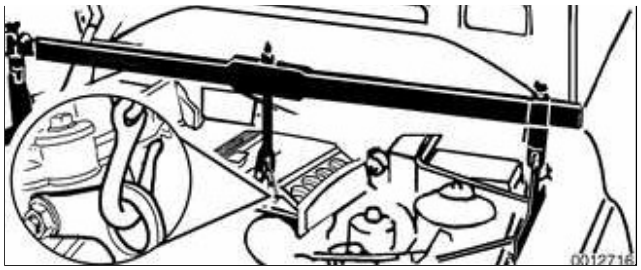
- Remove heater bulkhead cover.
  - Remove engine compartment side trim panel. Turn locking knobs (**A**) and slide trim panel from mounting lip.
  - Remove heater bulkhead cover mounting screws (**B**) and lift cover up and out from firewall.



- Install engine support across engine bay. Raise and safely support vehicle.

CAUTION!

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- ***Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.***

- ***Removal of transmission will cause engine to tip unless engine support is used.***

- Remove engine splash guard from underside of vehicle.

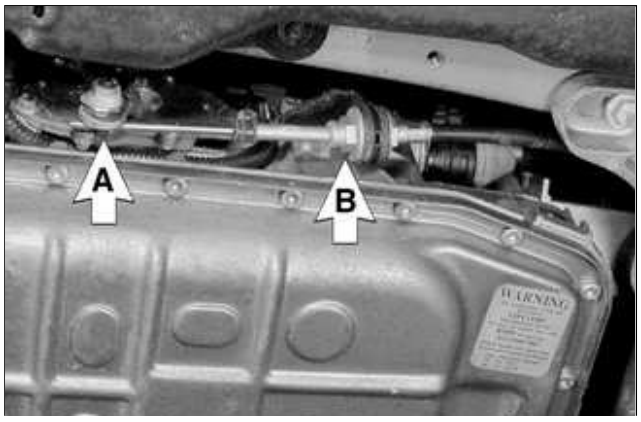
- Remove front suspension reinforcement at lower control arms and front subframe.

- Drain ATF from transmission as described earlier.

- Remove exhaust system and exhaust heat shield. See ⇒ 180 Exhaust System.

- Remove driveshaft(s). See ⇒ 260 Driveshaft.

- On all wheel drive equipped vehicles: Remove transfer case. See ⇒ 270 Transfer Case.



- With selector lever in Park, disconnect shift selector lever cable from lever and remove cable bracket.

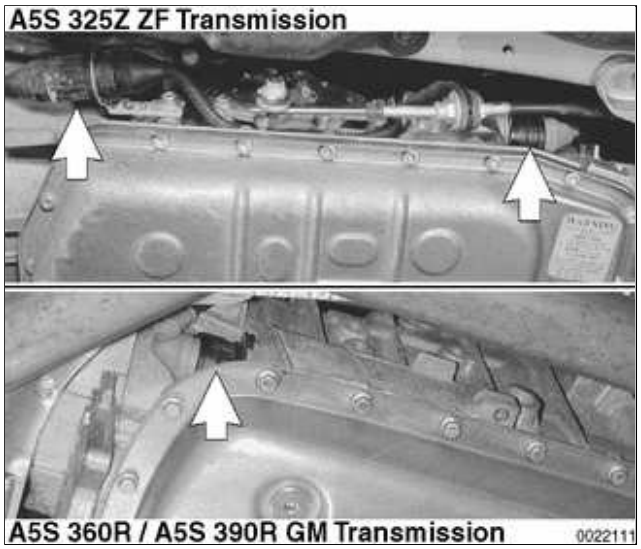
  - Hold linkage clamping bolt (**A**) stationary when loosening selector lever cable clamping nut (**B**).

  - Loosen cable clamping nut and

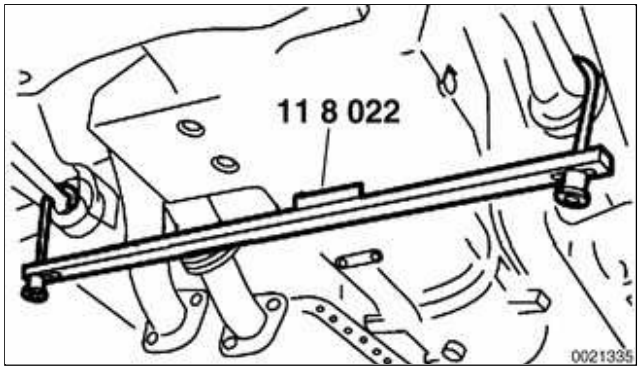
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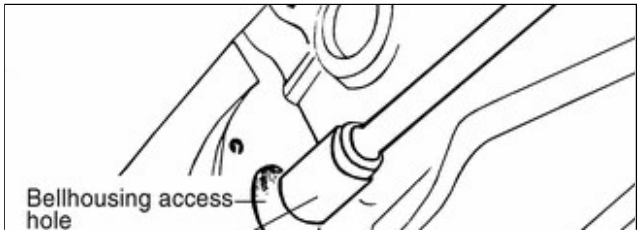
remove cable from bracket. (A5S 325Z transmission shown.)



- Disconnect electrical harness connector(s) from transmission by turning bayonet lock ring(s) (**arrows**) counterclockwise.
  - On A5S 325Z disconnect two connectors on the left side of the transmission.
  - On A5S 360R / A5S 390R disconnect the harness connector at the right rear of the transmission.
  - Remove wiring harness(s) from transmission housing.
  - Disconnect transmission cooler line clamps from engine. Disconnect cooler lines from transmission.

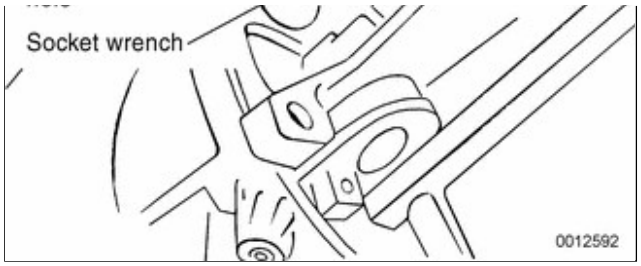


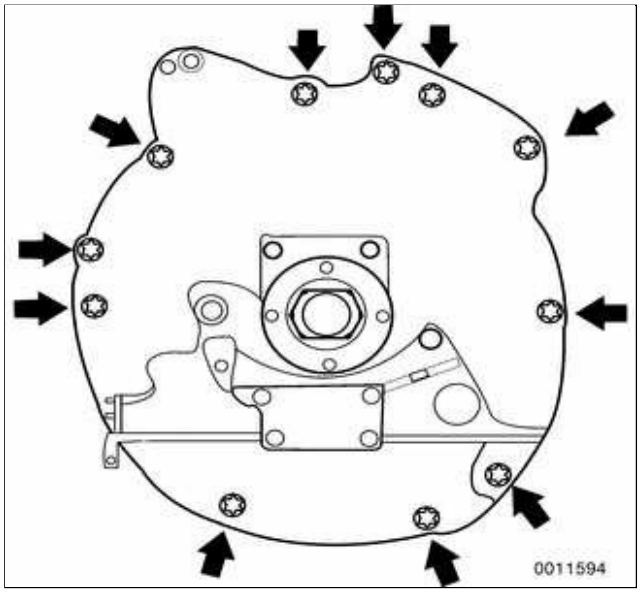
- Attach BMW special tool 11 8 022 to lower control arms.
  - Support transmission with transmission jack. Remove transmission support crossmember.
  - Lower transmission until engine cylinder head touches firewall. Tighten knurled screws of BMW special tool 11 8 022 until tool supports engine oil pan securely.



- Remove access plug in cover plate on right side of engine block and remove torque converter bolts. Turn crankshaft to access bolts.

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- Remove bellhousing-to-engine mounting bolts (**arrows**).
  - Install BMW special tools 24 4 131 and 24 4 135 to secure torque converter in place during transmission removal.

CAUTION!

Do not allow the torque converter to fall off the transmission input shaft.

  - Remove transmission by pulling back and down. Lower jack to allow transmission to clear vehicle.
  - Installation is reverse of removal, noting the following:

- Blow out oil cooler lines with low-pressure compressed air and flush cooler with clean ATF twice before reattaching lines to transmission.

CAUTION!

- ***Wear safety glasses when working with compressed air.***
- ***Do not reuse ATF after flushing.***

- Install new sealing washers on hollow bolts.

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- Install new O-rings on transmission cooler lines, where applicable.
- Inspect engine drive plate for cracks or elongated holes. Replace if necessary.
- Check to be sure torque converter is seated correctly in transmission during final installation.
- When mounting transmission to engine, the three mounting tabs on torque converter must be aligned with indentations on drive plate. Use an alignment dowel to line up bolt holes, if necessary.
- Fill transmission with clean ATF until oil level is even with fill hole. Then check fluid level as described earlier.
- Adjust gearshift mechanism. See ⇒ 270 Transfer Case.

Note:

Torx-head mounting bolts should always be used with washers to prevent difficult removal in the future.

Tightening torques	
ATF drain plug to ATF sump	
A5S 325Z	35 Nm (26 ft-lb)
A5S 360R	20 Nm (15 ft-lb)
ATF fill plug to ATF sump	
A5S 325Z	30 Nm (22 ft-lb)
A5S 360R	20 Nm (15 ft-lb)

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Tightening torques	
Front suspension reinforcement to chassis (M10)	42 Nm (30 ft-lb)
Torque converter to drive plate (M10)	45 Nm (33 ft-lb)
Transmission support crossmember to chassis	23 Nm (17 ft-lb)
Transmission to engine (Torx-head with washer)	
M8	21 Nm (15 ft-lb)
M10	42 Nm (31 ft-lb)
M12	72 Nm (53 ft-lb)

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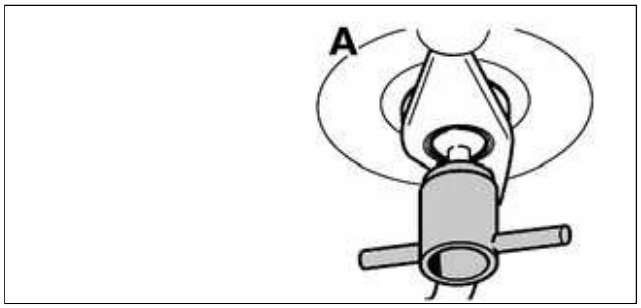
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General

This repair group covers transmission gearshift and linkage service for both manual and automatic transmission equipped vehicles.

Special tools

BMW suggests the use of one special tool in the removal of the gear shift lever for manual transmission equipped vehicles.



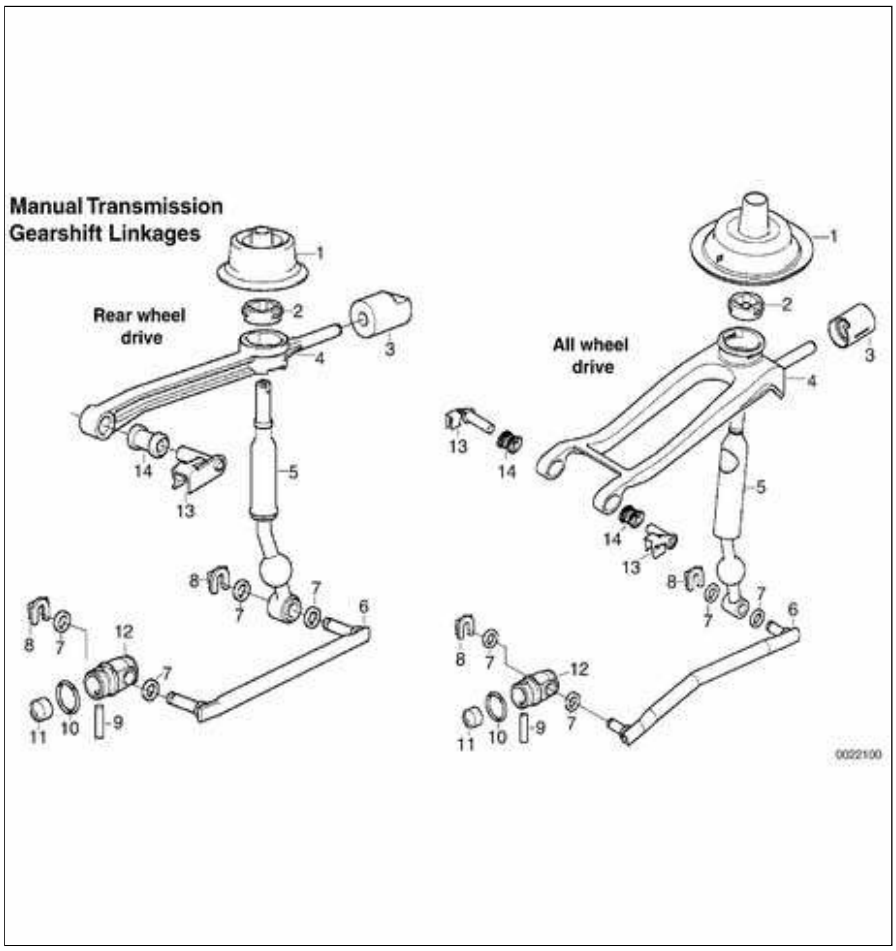
- Pin wrench BMW 25 1 110

To gain access to the complete gearshift mechanism it is necessary to remove the exhaust system and the driveshaft as described in ⇒ 180 Exhaust System and ⇒ 260 Driveshaft.

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Manual Transmission Gearshift



Manual Transmission Gearshift Linkages

1 - Rubber boot

2 - Shift lever bearing

3 - Shift arm bearing

4 - Shift arm

5 - Shift lever

6 - Selector rod

7 - Spacer ring

8 - Circlip

9 - Dowel pin

10 - Lock ring

11 - Washer

12 - Gear selector rod joint

13 - Bearing bolt

14 - Bearing bushing

Gearshift lever, removing (manual transmission)

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Use the above illustration as a guide when removing and installing the linkage.

- Remove shift knob by pulling knob straight off the manual gearshift.

Note:

Removal of the shift knob will require about 90 lbs. of force. Do not twist knob or locating key can be damaged.

- Pry up on rear of shift boot to unclip, then remove boot from front retainers.

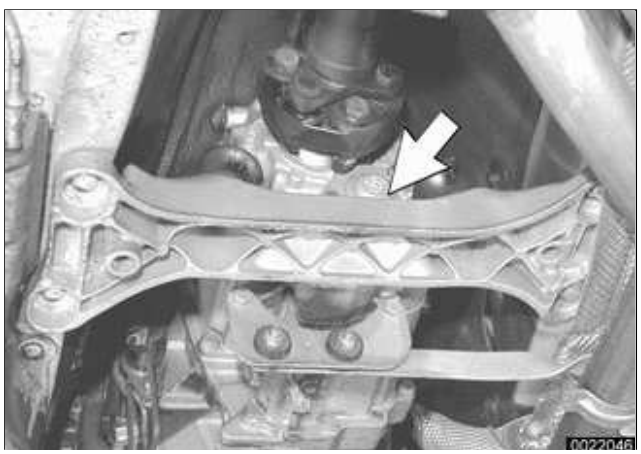
- Raise vehicle to gain access to underside of vehicle.

WARNING!

Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

- Remove complete exhaust system. See ⇒ 180 Exhaust System.

- Remove driveshaft(s). See ⇒ 260 Driveshaft.



Support transmission with transmission jack. Remove crossmember (**arrow**) from rear of transmission.

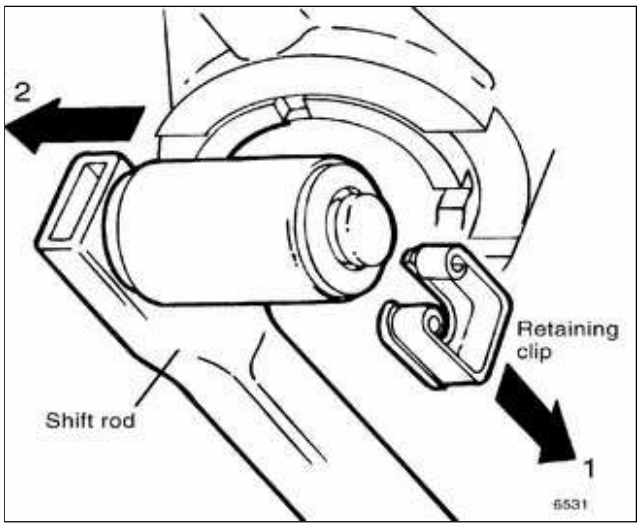
- Lower rear of transmission to access gearshift linkage.

CAUTION!

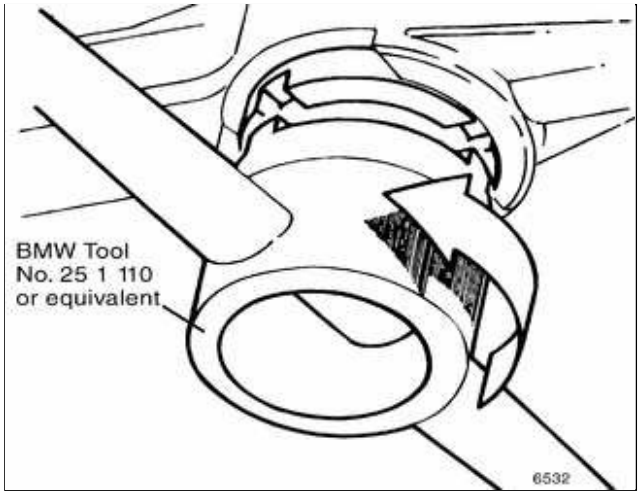
Tilting the engine to lower the transmission can lead to damage to

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various components due to lack of clearance.

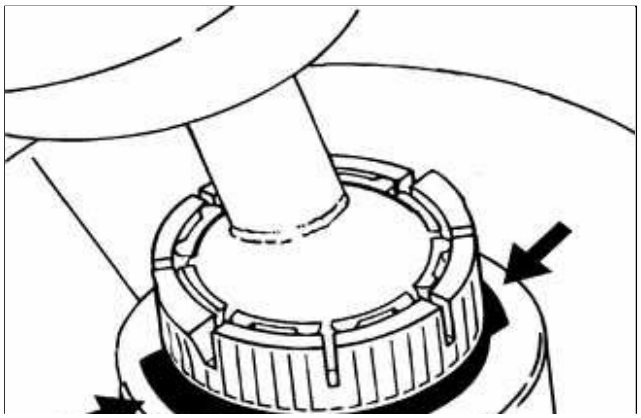


- Working above transmission, disconnect shift rod from gearshift lever by pulling off shift rod retaining clip in direction of arrow (**1**). Disengage shift rod from gearshift lever (**2**). Note washers on either side of shift rod end.



- Release gearshift lever retaining ring from below using BMW special tool 25 1 110. Turn tool 90° (turn) counterclockwise.
  - Raise transmission and temporarily install transmission crossmember.
  - Lower vehicle. Working from inside passenger compartment, pull up on gearshift lever to remove it together with retaining ring and rubber grommet.

Gearshift lever, installing (manual transmission)



- Install shift lever, aligning locking tabs with openings in shift console (**arrows**). Press down on retaining ring until it clicks into place.
  - Install rubber grommet with arrow pointing forward. Install shift rod and shift boot.

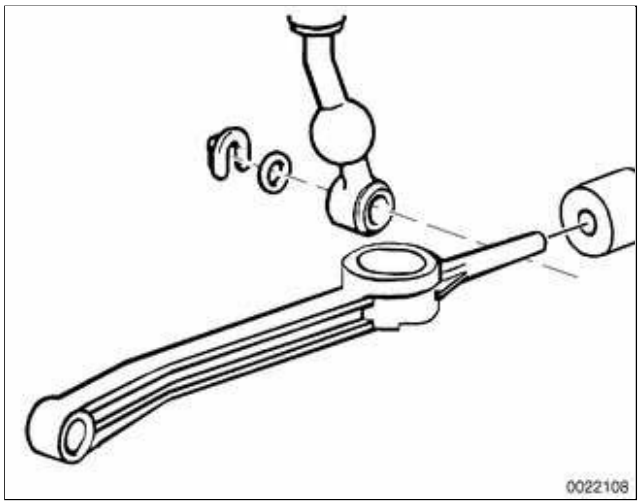
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Install rubber grommet correctly so that it seals out water.

- Connect shift rod to shift lever. Install transmission crossmember. Lift transmission and tighten crossmember bolts.



Before connecting the shift rod to the lever, be sure the gearshift lever is facing the correct way as illustrated.

- Install driveshaft(s) and heat shield. See ⇒ 260 Driveshaft.

- Reinstall exhaust system. See ⇒ 180 Exhaust System

- Lower vehicle. Install shift boot cover. Push shift knob onto lever.

Tightening torques	
Rear driveshaft to final drive flange	
With U-joint (M10 ribbed nut)	80 Nm (59 ft-lb)
With U-joint (M10 compressed nut)	64 Nm (47 ft-lb)
Flex-disc to driveshaft or transmission flange	
M10 (8.8 grade)	48 Nm (35 ft-lb)
M10 (10.9 grade	60 Nm (44 ft-lb)
M12 (10.9 grade)	100 Nm (74 ft-lb)
Front driveshaft to final drive flange (with U-joint) (M10)	70 Nm (52 ft-lb)
Transmission crossmember to body (M8)	21 Nm (15 ft-lb)

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Automatic Transmission Gearshift

In E46 models, the electronic immobilizer (EWS) prevents starter operation unless the gear position is Park or Neutral.

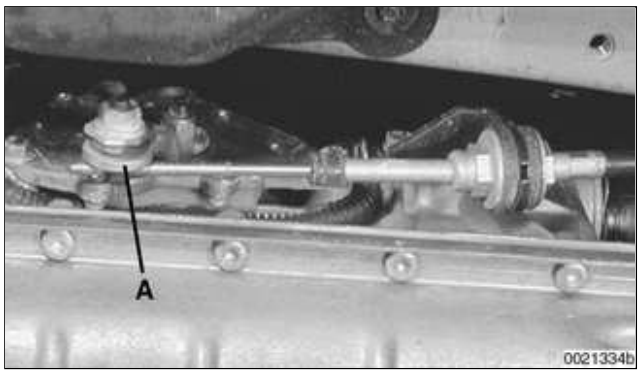
Gearshift mechanism, adjusting (automatic transmission)

- Position gearshift lever in Park.

- Raise vehicle to gain access to shift linkage.

WARNING!

Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose.



Loosen selector clamping nut (**A**). Counterhold clamping bolt when loosening nut.

- Push shift lever of transmission forward toward engine (Park position) while applying light pressure on cable end. Tighten cable clamping nut.

Note:

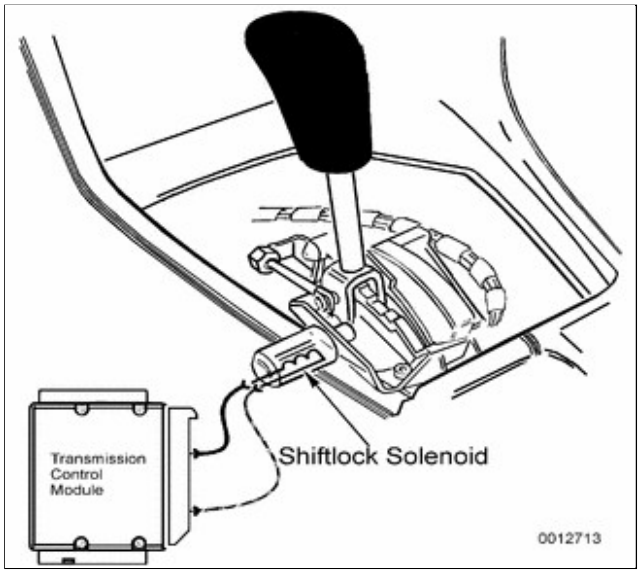
Do not overtighten the nut so that it twists the cable .

Tightening torque	
Shift cable clamping nut	10 - 12 Nm (7.5 - 9 ft-lb)

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Automatic shiftlock, checking function (automatic transmission)

The automatic shiftlock uses an electric solenoid to lock the selector lever in Park or Neutral. Depressing the foot brake with the ignition on energizes the solenoid, allowing the lever to be moved into a drive gear. The solenoid is energized only when the engine speed is below 2,500 rpm and the vehicle speed is below 3 mph. The solenoid is mounted in the right-hand side of the selector lever housing.



- Automatic shiftlock prevents drive gear selection until the brake pedal is depressed.

  - With engine running and car stopped, place selector lever in Park or Neutral.

  - Without depressing brake pedal, check that selector lever is locked in position Park or Neutral.

  - Depress brake pedal firmly. Solenoid should be heard to energize.

  - Check that selector lever can now be moved out of Park or Neutral.

Note:

The next test should be performed in an open area with the parking brake on and with extreme caution.

  - With selector lever in Park or Neutral and brake pedal depressed, raise engine above 2,500 rpm. Check that selector

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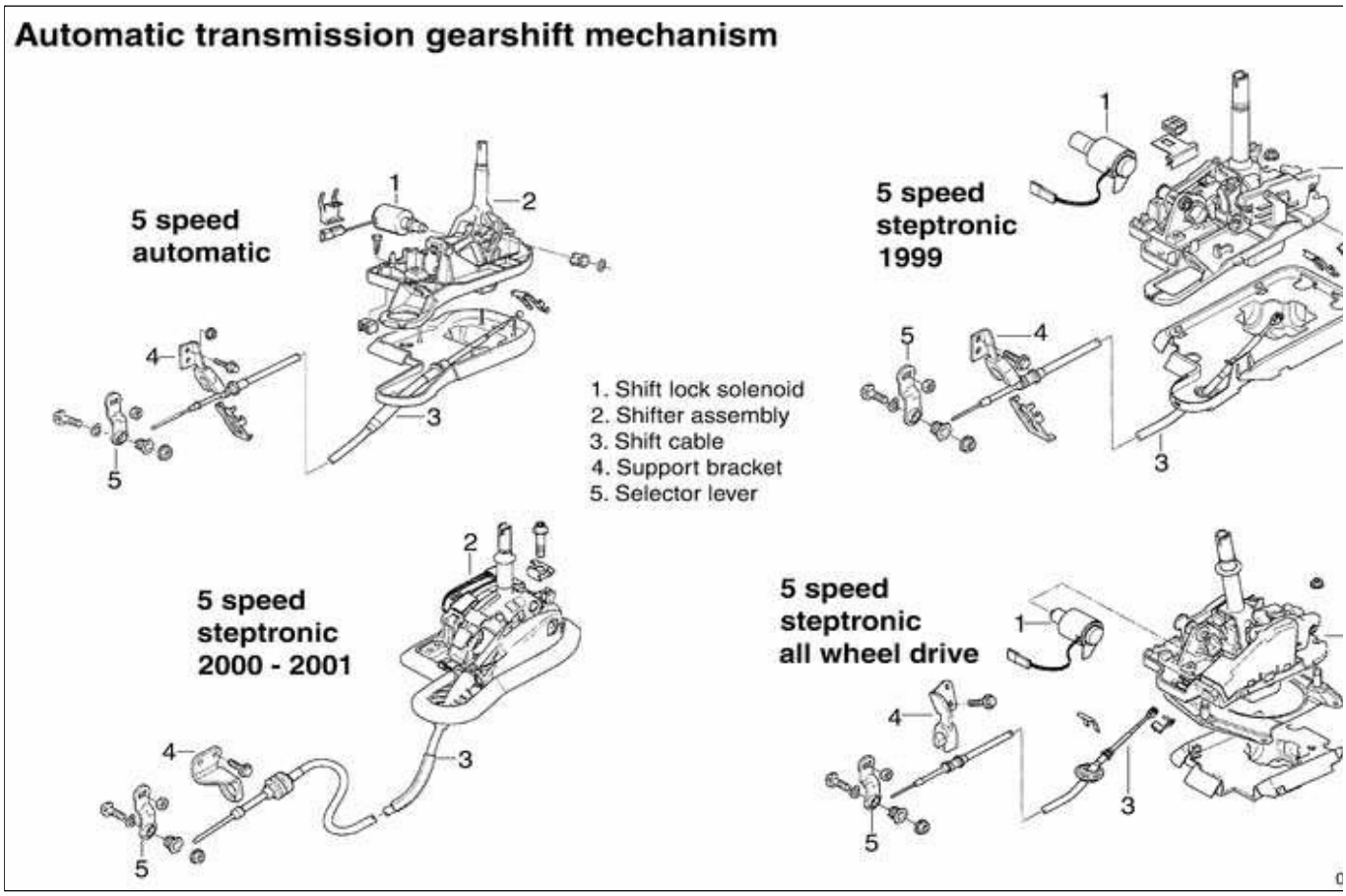
lever cannot be moved out of Park or Neutral.

If any faults are found check the electrical operation of the shiftlock solenoid and check for wiring faults to or from the transmission control module (TCM). See ⇒ 610 Electrical Component Locations and Electrical Wiring Diagrams.

Note:

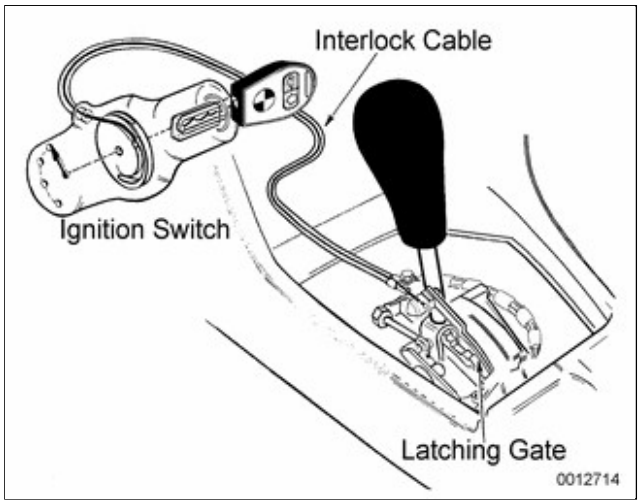
The solenoid is controlled via the TCM, using brake pedal position, engine speed, and road speed as controlling inputs.

Automatic transmission gearshift mechanism



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Shift interlock, checking function (automatic transmission)



The shift interlock uses a cable between the ignition switch and the shift lever to lock the shift lever in the park position when the key is in the off position or removed. This feature also prevents the key from being removed from the ignition lock until the selector lever is in Park.

- Shift selector lever to Park position and turn ignition key to the off position.

- Remove ignition key. Check that selector lever cannot be shifted out of Park position.

Note:

- *It must only be possible to remove ignition key with selector lever in Park position.*

- *Shift interlock cable must not be kinked.*

- Turn ignition key on and depress brake pedal. Check that selector lever moves freely from gear to gear.

- With selector lever in a gear position other than Park, attempt to turn key to off position and remove. Key should not go into off position.

If any faults are found check cable for kinks and check cable attachment points for damage or faults.

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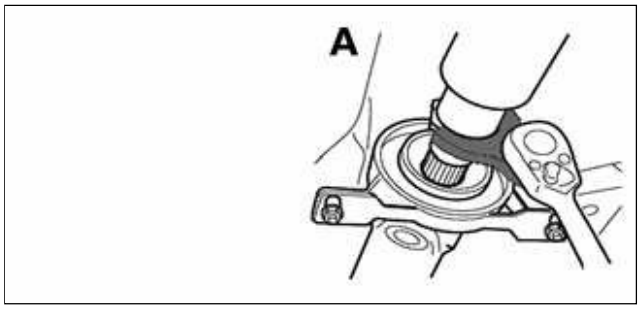
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General

This repair group covers the repair and replacement of driveshafts and driveshaft components. Drive axles are covered in ⇒ 311 Front Axle Final Drive and ⇒ 331 Rear Axle Final Drive.

Special tools

BMW suggests the use of a special tool in the release of the clamping sleeve which acts as a grease seal for the splined shaft to the rear of the driveshaft center bearing.



- Clamping sleeve adjustment tool BMW 26 1 040

Front and rear driveshafts

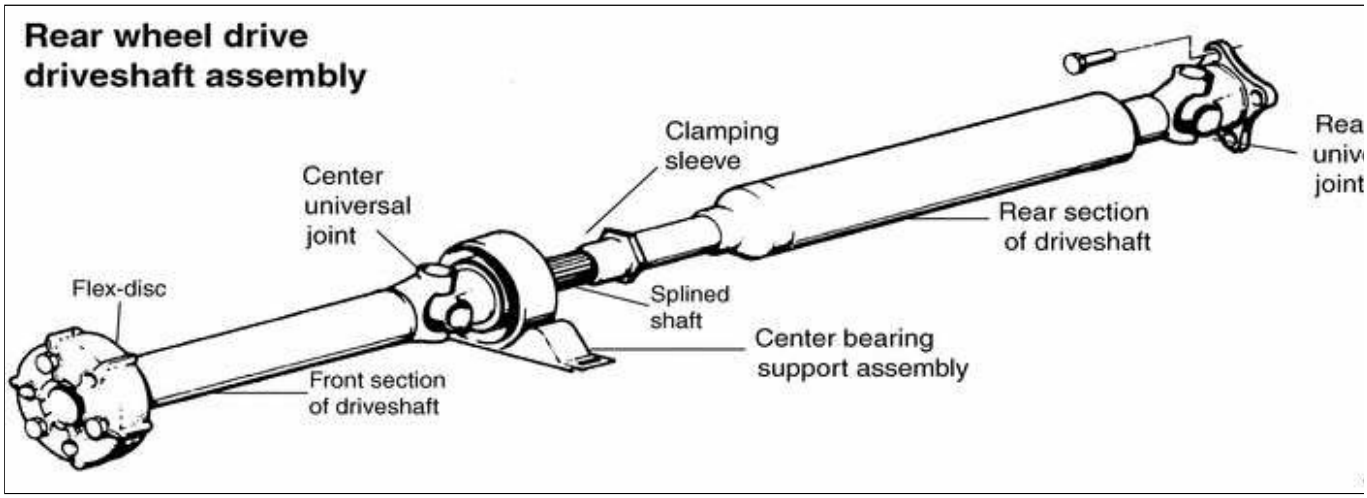
The rear driveshaft is a two-piece unit joined in the center by a sliding splined coupling. This coupling compensates for fore and aft movement of the drive line. The driveshaft is connected to the transmission by a rubber flex-disc and to the rear final drive by a universal joint. It is supported in the middle by a center support bearing. The bearing is mounted in rubber to isolate vibration.

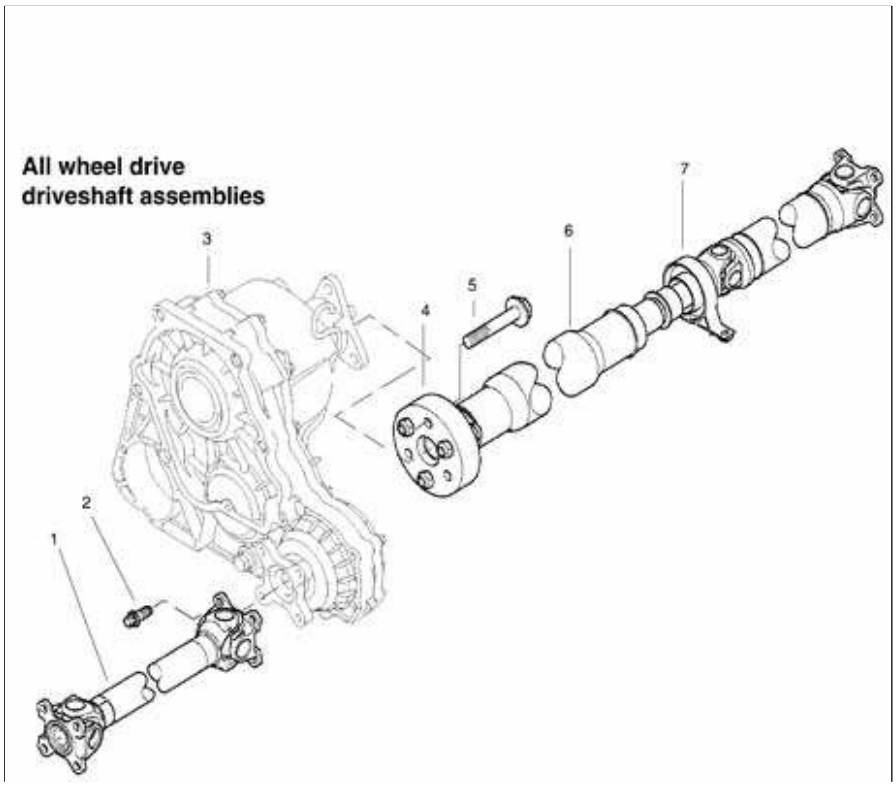
All wheel drive models incorporate two driveshafts. The rear driveshaft is a two-piece unit with splined center coupling much like that of a rear wheel drive model, but it is shorter and connects the transfer case to the rear differential. A short, one-piece

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driveshaft runs from the transfer case to the front differential. The front driveshaft bolts to the transfer case and differential directly, using no flexible rubber disk.

Rear wheel drive driveshaft assembly





All wheel drive driveshaft assemblies

1 - **Front driveshaft assembly**

2 - **Torx screw M10**

- tighten to 70 Nm (52 ft-lb)

3 - **Transfer case**

4 - **Flex disc**

5 - **Bolt M12**

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- tighten to 100 Nm (74 ft-lb)

6 - **Rear driveshaft assembly**

7 - **Driveshaft center bearing mount**

Troubleshooting

The source of driveline vibrations and noise can be difficult to pinpoint. Engine, transmission, front and rear axle, or wheel vibrations can be transmitted through the driveshaft to the car body. Noises from the car may be caused by final drive problems, or by faulty wheel bearings, drive axles, or even worn or improperly inflated tires.

Note:

For drive axle repair information, see ⇒ 311 Front Axle Final Drive or ⇒ 331 Rear Axle Final Drive.

Driveshaft noise or vibration may be caused by worn or damaged components. Check the universal joints for play. With the driveshaft installed, pull and twist the driveshaft while watching the joint. The BMW specification for play is very small, so almost any noticeable play could indicate a problem.

Check the torque of the fasteners at the flange connections. At the rear driveshaft check the rubber of the flex-disc and center bearing for deterioration or tearing and check for preload at the center bearing with a visual inspection. Check the driveshafts for broken or missing balance weights. The weights are welded

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tabs on the driveshaft tubes. In addition to inspecting for faulty driveshaft parts, the installed angles of the driveshaft should also be considered.

Further inspection requires removal of the driveshafts. Check the front centering guide on the transmission output flange for damage or misalignment. Also check runout at the transmission or transfer case output flange and output shaft, and at the final drive input flange. Check the bolt hole bores in the flange for wear and elongation.

Driveshaft flange runout (max. allowable)	
Transmission / transfer case output flange	
axial play	0.10 mm (0.004 in.)
radial play	0.07 mm (0.003 in.)
Final drive input flange radial play (measured at driveshaft centering lip)	0.07 mm (0.003 in.)

Spin the rear driveshaft center bearing and check for smooth operation without play. Check that the splines of the sliding coupling move freely. Clean and lubricate the splines with molybdenum disulfide grease (Molykote® Longterm 2or equivalent).

Check the universal joints for wear or binding. If any joint is difficult to move or binds, the driveshaft section should be replaced.

Universal joint play	
Maximum allowable	0.15 mm (0.006 in.)

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⇒ Table a. Driveshaft troubleshooting lists symptoms of driveshaft problems and their probable causes. Most of the repair information is contained within this repair group.

Note:

With the driveshaft installed, the actual amount that the universal joints pivot is limited. For the most accurate test, check universal joints in their normal range of movement.

If inspection reveals nothing wrong with the driveshaft, it may need to be rebalanced. This can be done by a speciality driveshaft repair shop. Also, check the alignment of the driveshaft as described below.

Note:

Minor driveshaft vibrations can often be corrected simply by disconnecting the driveshaft at the final drive and repositioning it 90, 180 or 270 in relation to the final drive input flange.

Table a. Driveshaft troubleshooting

Symptom	Probable cause	Corrective action
Vibration when starting off (forward or reverse).	Incorrect preload of center bearing.	Check preload of center bearing. Readjust preload.
	Center bearing rubber deteriorated.	Inspect center bearing and rubber. Replace if necessary.
	Flex-disc damaged or worn.	Inspect flex-disc. Replace if necessary.
	Engine or transmission mounts faulty.	Inspect engine and transmission mounts. Align or replace, if necessary.
	Front centering guide worn, or driveshaft mounting flanges out of round.	Check front centering guide and replace if necessary. Check runout of driveshaft flanges.

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Symptom	Probable cause	Corrective action
	Universal joints worn or seized.	Check universal joint play and movement. Replace driveshaft if necessary.
	Sliding coupling seized.	Remove driveshaft and check movement of sliding coupling. Clean coupling splines and replace parts as necessary.
	Driveshaft misaligned.	Check driveshaft alignment.
Noise during on/off throttle or when engaging clutch.	Final drive components worn or damaged (excessive pinion-to-ring-gear clearance).	Remove final drive and repair.
	Drive axle or CV joint faulty.	Inspect drive axles and CV joints. Repair or replace as necessary.
	Sliding coupling seized.	Remove driveshaft and check movement of sliding coupling. Clean coupling splines and replace parts as necessary.
Vibration at 25 to 30 mph (40 to 50 km/h).	Front centering guide worn, or driveshaft mounting flanges out of round or damaged.	Check front centering guide and replace if necessary. Check runout of driveshaft mounting flanges.
	Universal joints worn or seized.	Check universal joint play and movement. Replace driveshaft if necessary.
	Flex-disc damaged or worn.	Inspect flex-disc. Replace if necessary.
	Center bearing rubber deteriorated.	Inspect center bearing. Replace if necessary.
	Sliding coupling seized.	Remove driveshaft and check movement of sliding coupling. Clean coupling splines and replace parts as necessary.
	Misaligned installed position.	Check driveshaft alignment.
Vibration, audible rumble over 35 mph (60 km/h).	Front centering guide worn, or driveshaft mounting flanges out of round or damaged.	Check front centering guide and replace if necessary. Check runout of driveshaft mounting flanges.

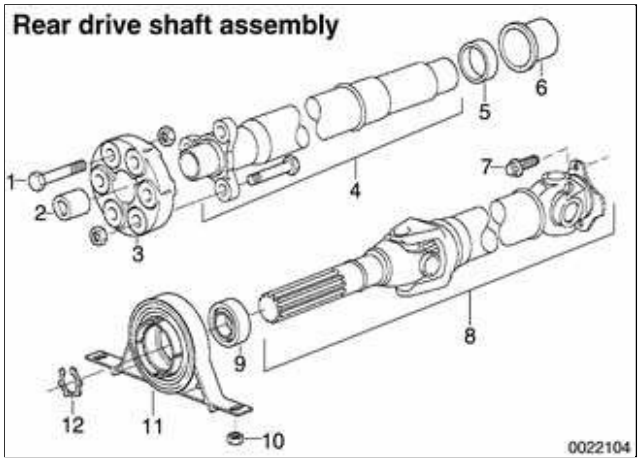
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Symptom	Probable cause	Corrective action
	Mounting flange bolts loose or holes worn.	Remove driveshaft and check transmission output flange and final drive input flange. Replace if necessary.
	Driveshaft unbalanced.	Check driveshaft for loose or missing balance weights. Have driveshaft rebalanced or replace if necessary.
	Universal joints worn or seized.	Check universal joint play and movement. Replace driveshaft if necessary.
	Sliding coupling seized.	Remove driveshaft and check movement of sliding coupling. Clean coupling splines or replace parts as necessary.
	Incorrect preload of center bearing.	Check preload of center bearing. Readjust if necessary.
	Center bearing faulty.	Replace center bearing.
	Final drive rubber mount faulty.	Inspect final drive rubber mount and replace if necessary.
	Driveshaft misaligned.	Check driveshaft alignment.

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Rear Driveshaft Service



Repair kits for the universal joints are not available for BMW driveshafts. Worn or damaged universal joints usually require replacement of the driveshaft.

1 - Hex bolt, M12

2 - Centering sleeve

3 - Flexible disk

4 - Front section of driveshaft

5 - Clamping sleeve

6 - Clamping ring

7 - Torx screw

8 - Rear section of drive shaft

9 - Center bearing

10 - Nut

11 - Center bearing support

12 - Lock ring

The driveshaft is balanced to close tolerances. Whenever it is to be removed or disassembled, the mounting flanges and driveshaft sections should be marked with paint or a punch before proceeding with work. This will ensure that the driveshaft can be reassembled or installed in exactly the original orientation.

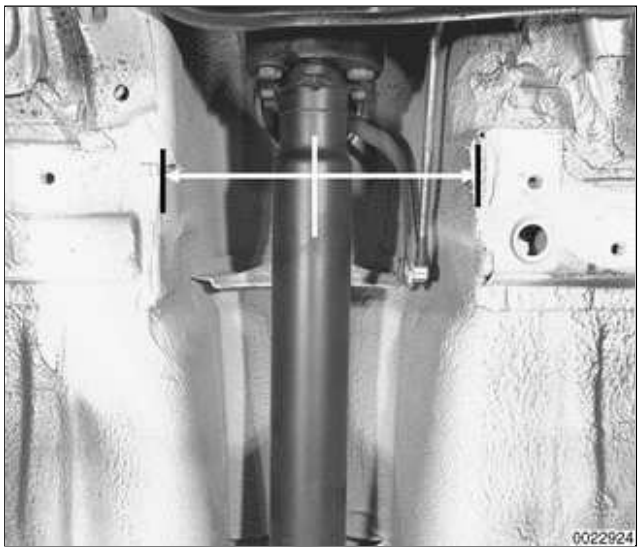
Rear driveshaft, aligning

The alignment of the driveshaft does not normally need to be checked unless the engine/transmission or the

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final drive have been removed and installed. If all other parts of the driveshaft have been inspected and found to be okay, but there is still noise or vibration, driveshaft alignment should be checked.

There are two important driveshaft alignment checks. The first is to make sure that the driveshaft runs straight from the transmission to the final drive, without any variation from side-to-side caused by misalignment of the engine/transmission in its mounts. Make a basic check by sighting along the driveshaft from back to front. Any misalignment should be apparent from the center bearing forward.



- To adjust the side-to-side alignment, loosen transmission or engine mounts to reposition them, then retighten mounts. The driveshaft should be exactly centered in driveshaft tunnel.

The second important driveshaft alignment check is more complicated. It checks the amount the driveshaft is angled vertically at the joints. This angle is known as driveshaft deflection.

In general, there should be little deflection in the driveshaft between the engine, the center bearing, and the final drive. Precise checks require the use of a large protractor or some other means of measuring the angle of the engine and the final drive and comparing these angles to the angle of the driveshaft sections.

To change the deflection angle, shims can be placed between the center bearing and the body or between the transmission and its rear support. When using shims to change a deflection angle, keep in mind that the angle of adjacent joints will also change. Deflection angles should be as small as possible.

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Rear driveshaft, removing

WARNING!

- ***Be sure the wheels are off the ground before removing the driveshaft. Set the parking brake before removing the driveshaft.***

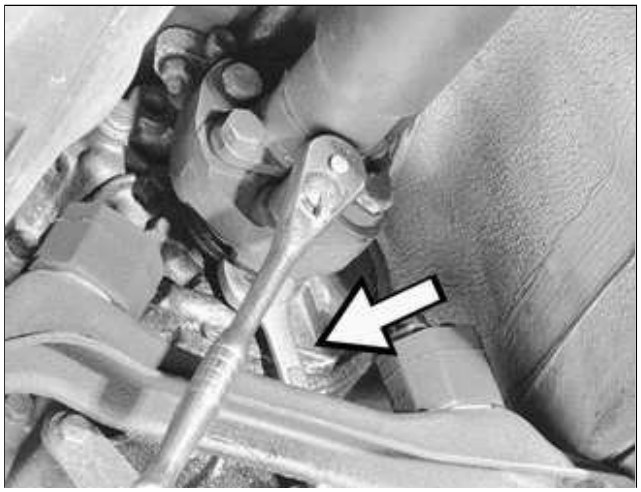
- ***Once the driveshaft has been removed, the vehicle can roll regardless of whether the transmission is in gear or not.***

- ***The driveshaft is mounted to the transmission and final drive with self-locking nuts. These nuts are designed to be used only once and should be replaced during reassembly.***

- Remove complete exhaust system. See ⇒ 180 Exhaust System.

- Remove exhaust heat shields.

- Matchmark front and rear driveshaft connections at transmission and final drive.

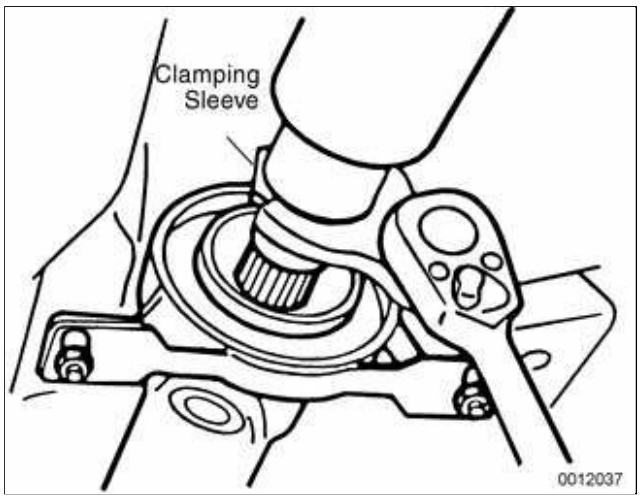


➢ Remove driveshaft mounting bolts. Discard old nuts. Note open-end wrench (**arrow**) being used to counterhold bolt at transmission flex-disc.

- Support driveshaft sections from body using stiff wire.

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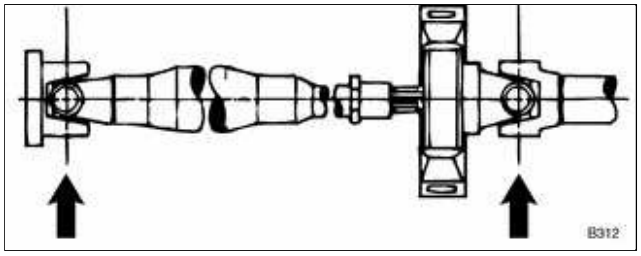


- Using BMW special tool 26 1 040, loosen threaded clamping sleeve on driveshaft a few turns.
  - Remove center support bearing mounting bolts.
  - Remove driveshaft but do not separate two halves. Pull down on center of driveshaft to facilitate removal.

Note:

If driveshaft halves were separate and not matchmarked, see ⇒ Rear driveshaft, installing. If a vibration occurs, disassemble driveshaft and rotate one section 180°.

Rear driveshaft, installing



- Align driveshaft matchmarks at final drive and then at transmission flange. Centerlines of universal joints (**arrows**) must be parallel or at 90° to each other. Position center support bearing and start attaching nuts. Use new self-locking nuts.
  - Tighten flange nuts while preventing bolts from twisting in coupling. Tighten final drive flange first, then tighten coupling at transmission.



- Preload center support bearing by pushing bearing forward (**arrow**) 4-6 mm (0.16-0.24 in.) from center. Tighten attaching bolts.

CAUTION!

The maximum allowable change in

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height of the center bearing or transmission support using shims is 3 mm (0.12 in.).

- Tighten threaded sleeve on driveshaft to proper torque.
- Install heat shields.
- Install exhaust system. See ⇒ 180 Exhaust System. Connect wiring harness to oxygen sensors.
- Road test vehicle to check for noise or vibration.

WARNING!

- ***Do not reuse self-locking nuts. These nuts are designed to be used only once.***
- ***Avoid stressing the flex-disc when torquing the bolts. Do this by holding the bolts steady and turning the nuts on the flange side.***

Tightening torques	
Center bearing to body	21 Nm (15 ft-lb)
Clamping sleeve	10 Nm (89 in-lb)
Drive axle to differential flange	
M10 Torx bolt	83 Nm (61 ft-lb)
M10 with locking teeth (replace bolts)	96 Nm (71 ft-lb)
M10 with ribbed teeth (black)	100 Nm (74 ft-lb)
M10 with ribbed teeth (silver) ZNS	80 Nm (59 ft-lb)

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Tightening torques	
(replace bolts)	
Flex-disc to driveshaft or transmission flangE	
M10 (8.8 grade)	48 Nm (35 ft-lb)
M10 (10.9 grade)	60 Nm (44 ft-lb)
M12 (10.9 grade)	100 Nm (74 ft-lb)
Transmission crossmember to body (M8)	21 Nm (15 ft-lb)

Note:

Bolt grade is marked on the bolt head. When replacing bolts, only use bolts of the same strength and hardness as the originals installed.

Flex-disc, replacing

The flex-disc between the front section of the rear driveshaft and the output flange of the transmission or transfer case should be checked for cracks, tears, missing pieces, or distortion. Check for worn bolt hole bores in the flange.

- Remove driveshaft as described earlier.

Note:

It is possible to only partially remove the driveshaft, leaving it connected to the final drive. The driveshaft can be tilted down in the center and slid off the transmission flange once the clamping sleeve is loosened and the center bearing bracket is unbolted. Suspend the driveshaft using stiff wire in as close to the installed position as possible. If the driveshaft hangs

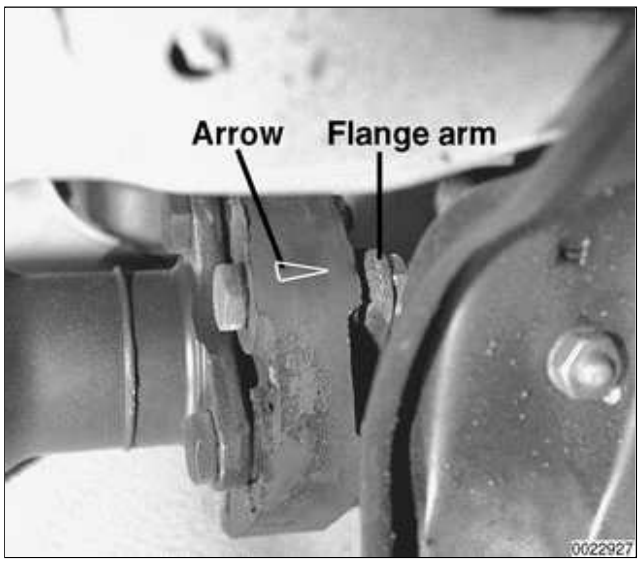
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unsupported, the rear universal joint may be damaged.

- Unbolt flex-disc from driveshaft.

Note:

Removal and installation of the bolts may be made easier by placing a large hose clamp around the flex-disc, and tightening the clamp slightly to compress the coupling.



- Install new flex-disc using new self-locking nuts. Molded arrows on coupling should face flange arms.

- Install driveshaft as described earlier.

Note:

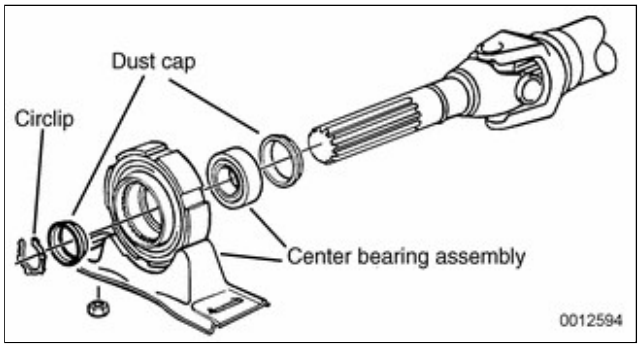
Torque only the nuts while holding the bolt heads. This will prevent damaging or fatiguing the rubber.

Tightening torques	
Center bearing to body	21 Nm (15 ft-lb)
Clamping sleeve	10 Nm (89 in-lb)
Drive axle to differential flange	
M10 Torx bolt	83 Nm (61 ft-lb)
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Tightening torques	
M10 (10.9 grade)	60 Nm (44 ft-lb)
M12 (10.9 grade)	100 Nm (74 ft-lb)
Transmission crossmember to body (M8)	21 Nm (15 ft-lb)

Center bearing assembly, replacing



- To replace the center bearing assembly, the driveshaft must be removed from the car. The center bearing assembly consists of a grooved ball bearing in a rubber mount. The bearing assembly is pressed onto the front section of the driveshaft and secured by a circlip.

  - Remove rear driveshaft. See ⇒ Rear driveshaft, removing.

  - Match mark front and rear driveshaft sections before separating.

  - Loosen clamping sleeve fully and pull driveshaft sections apart. Remove rubber bushing, washer, and clamping sleeve from front section.

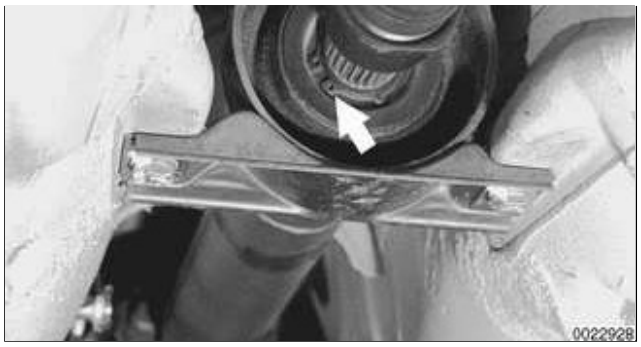
  - Inspect condition of rubber bushing for splined coupling. Replace worn or damaged parts.



- Remove center bearing circlip (**arrow**) and dust guard.

  - Install puller so that it pulls on

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inner hub of bearing. Pulling on outer ring of mount may tear rubber, and entire bearing assembly will need to be replaced.

- Before installation, make sure dust guard is on driveshaft, and then press center mount onto driveshaft flush with dust guard.

- Place clamping sleeve, washer, and rubber bushing on front driveshaft section. Lubricate splines with molybdenum disulfide grease (Molykote® Longterm 2 or equivalent) and then reassemble driveshaft.

Note:

Do not retighten clamping sleeve until driveshaft is installed.

- Install driveshaft as described earlier

- Tighten clamping sleeve.

Tightening torque	
Clamping sleeve	10 Nm (7.5 ft-lb)

Front centering guide, replacing

The front centering guide centers the driveshaft in relation to the transmission or transfer case. The guide is press-fit into a cavity in the front of the driveshaft and slides onto the transmission output shaft.

No specifications are given for wear of the guide, but generally the guide

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should fit snugly on the transmission output shaft.

Note:

Some driveshafts have a dust cap installed on the end of the driveshaft, over the centering guide. The dust cap may become bent or distorted when the driveshaft is removed or installed. Damage to the dust cap should not affect the centering guide and should not be mistaken for guide wear.

- Remove driveshaft as described earlier.

- Pack cavity behind centering guide with heavy grease until grease is flush with bottom edge of guide.

- Insert 14 mm (approximately in.) diameter mandrel or metal rod into guide. Strike guide with hammer to force centering guide out.

Note:

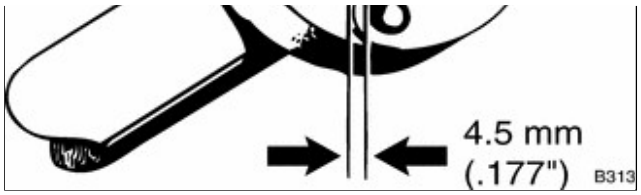
The mandrel should fit snugly in the centering guide so that the grease cannot escape around the sides of the mandrel.

- Remove old grease from driveshaft, lubricate new centering guide with molybdenum disulfide grease (Molykote® Longterm 2 or equivalent) and drive it into driveshaft.



When installing new driveshaft centering guide, the sealing lip of the guide should face outward and it should be driven into the driveshaft to drive guide to a protrusion depth of 4.5 mm (.177 in.).

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- Install driveshaft as described earlier.

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Front Driveshaft Service

Repair kits for the universal joints are not available for BMW driveshafts. Worn or damaged universal joints usually require replacement of the driveshaft.

Front driveshaft, removing and installing

CAUTION!

Do not move vechicle using engine power once front driveshaft has been removed.

- Raise vehicle and safely support to access front driveshaft.

WARNING!

- ***When raising the car using a floor jack or a hydraulic lift, carefully position the jack pad to prevent damaging the car body. A suitable liner (wood, rubber, etc.) should be placed between the jack and the car to prevent body damage.***

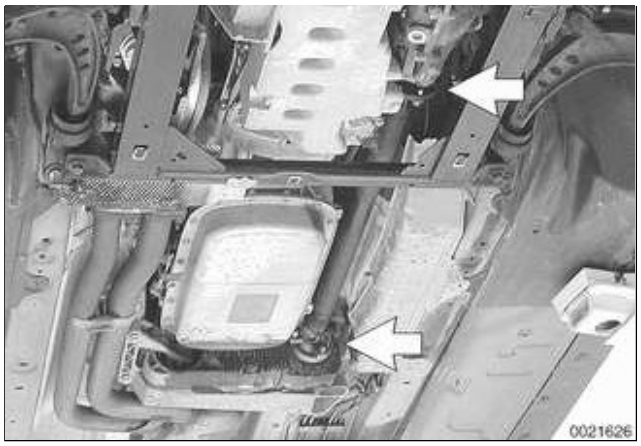
- ***Watch the jack closely. Make sure it stays stable and does not shift or tilt. As the car is raised, the car may roll slightly and the jack may shift.***

- Remove underbody splash guard.



Remove bolts holding driveshaft to transfer case output flange and front differential input flange (**arrows**).

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- Installation is reverse of removal.

Tightening torques	
Driveshaft to drive flange (M10)	70 Nm (52 ft-lb)

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General

This repair group covers removal and installation of the all wheel drive transfer case. Internal transfer case repair is not covered. Special press tools and procedures are required to disassemble and service the internal geartrain.

Some procedures covered in this repair group will require you to refer to the following repair groups:

- ⇒ 180 Exhaust System
- ⇒ 260 Driveshaft

The transfer case is used in all wheel drive models to direct power from the transmission to both the front and rear differentials via driveshafts. This transfer case is unique in that it delivers 38% of the transmission's torque output to the front differential, and 62% of the torque to the rear. Unlike the transfer cases used in many four wheel drive trucks, the transfer case used is a single range unit, permanently engaged to drive all four wheels all of the time.

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Transfer Case

Transfer case, removing and installing

- Raise vehicle and safely support to access transfer case.

WARNING!

- ***When raising the car using a floor jack or a hydraulic lift, carefully position the jack pad to prevent damaging the car body. A suitable liner (wood, rubber, etc.) should be placed between the jack and the car to prevent body damage.***

- ***Watch the jack closely. Make sure it stays stable and does not shift or tilt. As the car is raised, the car may roll slightly and the jack may shift.***

- Remove engine splash guard from underside of vehicle.

- Remove exhaust system. See ⇒ 180 Exhaust System.

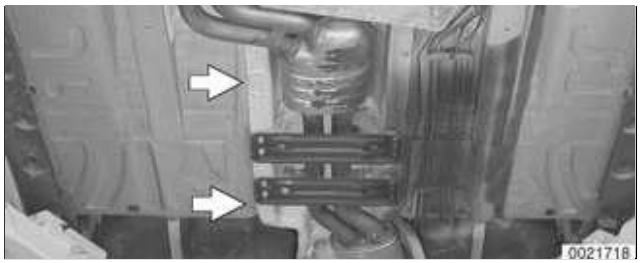


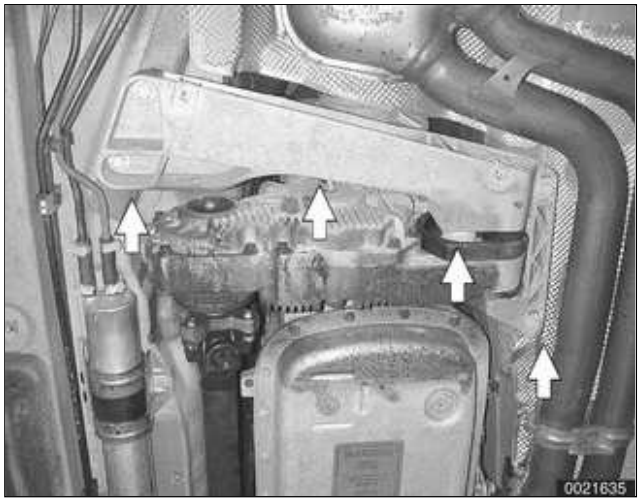
- Remove exhaust system heat shields (**arrows**).

- Remove front drive shaft. See ⇒ 260 Driveshaft.

- Support transmission with transmission jack or suitable shop hoist.

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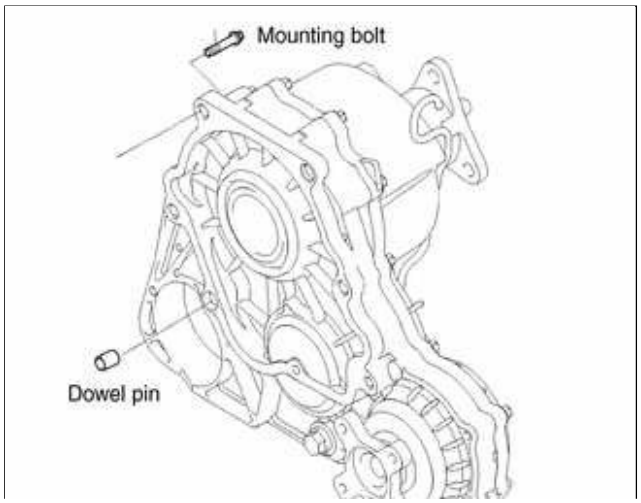


- Remove transmission crossmember (**arrows**).
  - Detach transfer case vent tube.
  - Keeping the driveshaft in place, remove nuts retaining rear driveshaft to transfer case at flexible disc.

CAUTION!

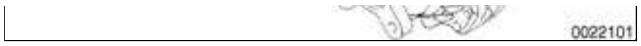
Do not allow the driveshaft to hang down. This may damage universal joints at drive shaft ends.

  - Support rear driveshaft center bearing and release mounting nuts.
  - Lower rear driveshaft at center bearing and remove from transmission output flange at flexible disk. Support from vehicle body using stiff wire.



- Remove bolts retaining transfer case to transmission and remove transfer case.
  - Installation is reverse of removal, noting the following:
    - Replace dowel pins in transfer case mounting surface if damaged.
    - Coat dowel pins with anti-seize

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before installing.

- On manual transmission cars: Replace sealing O-ring between transmission and transfer case.

Note:

When refilling transfer case, recheck oil level again after driving car approximately 200 meters (600 ft).

Tightening torques	
Transmission crossmember to body (M8)	21 Nm (15 ft-lb)
Transfer case to transmission (M10)	41 Nm (30 ft-lb)
Transfer case filler plug (M18)	33 Nm (24 ft-lb)

Fluid capacities	
Transfer case oil change	0.16 liter (0.16 qt.)
New transfer case fill	0.24 liter (0.25 qt.)

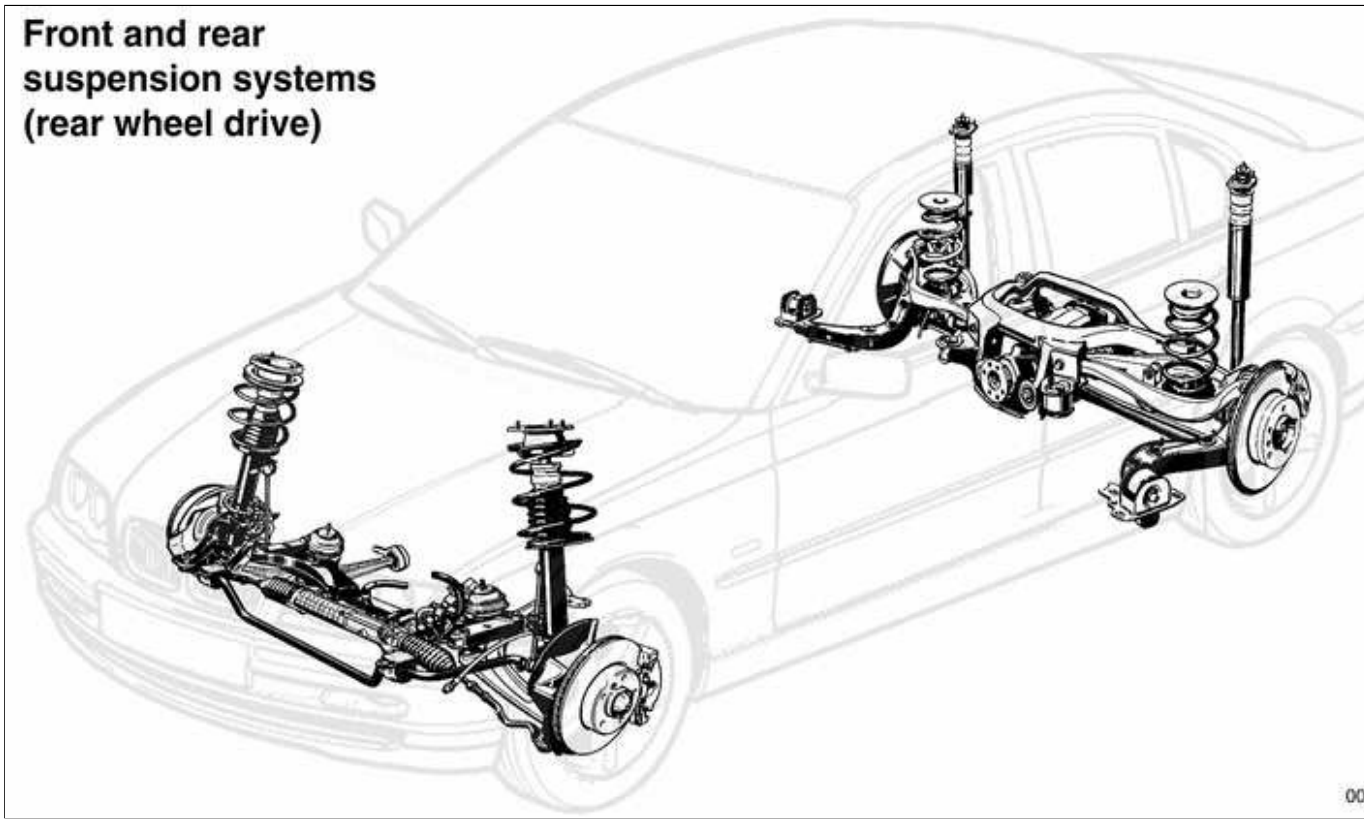
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General

This section covers general information for front and rear suspension, steering system, and the electronic braking and stability control systems.

Front and rear syspension systems (rear wheel drive)

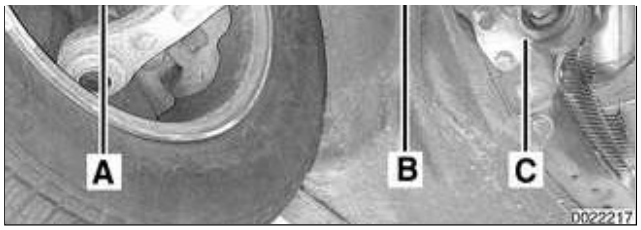


Front suspension



In rear wheel drive cars, the control arm on each side connects the steering arm (**A**) to mounting points on the subframe (**B**) and the body frame rail (**C**). On all wheel drive cars the rear mounting of the control arm is to the subframe.

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Each front strut assembly includes a tubular strut housing with an integrated shock absorber and a large coil spring. The upper strut mount includes a coil spring seat and strut bearing. A rubber bump stop limits suspension travel. The steering arm clamps the lower end of the strut assembly. The strut assembly pivots between the upper strut mount bearing and a ball joint on the control arm.

The front suspension is designed with minimum positive steering offset. This geometry contributes to stability when traction is unequal from side to side.

Front suspension, rear wheel drive cars

The control arms are constructed of forged aluminum. This design lowers the overall weight of the car and reduces the amount of unsprung mass. By reducing unsprung mass, softer, more comfortable springs can be used and accurate handling is maintained.

The three point mounting of each L-shaped control arm precisely controls the front-to-rear and side-to-side position of the strut, while the flexibility of the joints and mounts also allows the movement necessary for suspension travel. The control arm mounting points

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are designed with anti-dive geometry. This design reduces the normal tendency for the front of the vehicle to dive under hard braking.

Control arm position is fixed, with no adjustment provisions on the control arms for altering front wheel alignment.

A stabilizer bar mounted to both strut housings helps to reduce body roll when cornering.

Front suspension, all wheel drive

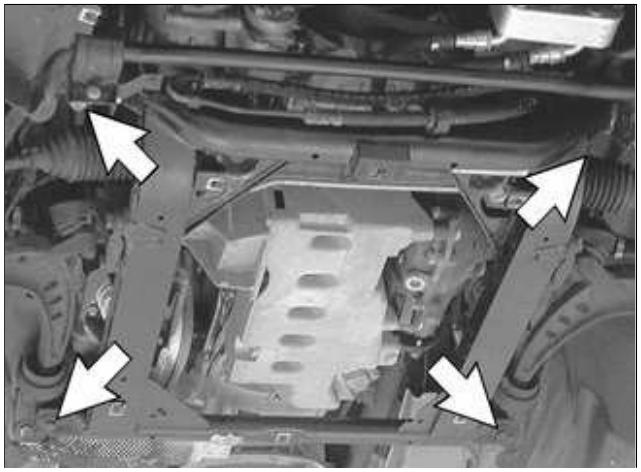
For model year 2001, the E46 Sedan and Sport Wagon are offered with optional all wheel drive. The all wheel drive models are known as 325xi or 330xi.

Note:

The internal BMW designation of these models is E46/16.

The all wheel drive system adds approx. 100 kg (220 lbs.) to the weight of the car. Weight distribution is largely unaffected at 52.7% front, 47.3% rear.

The front suspension for all wheel drive vehicles has been redesigned to provide clearance for the front axle differential and drive shafts. All suspension components are constructed of steel.



The front subframe consists of two square frame sections welded to two tubes to form a box structure. Four bolts (**arrows**) attach it to the undercarriage of the vehicle.

The steel control arms, smaller than the aluminum arms used on rear wheel drive models, attach at the rear to the subframe. The control arm inner ball joints are bolted to the subframe. The hydraulic engine mounts are different

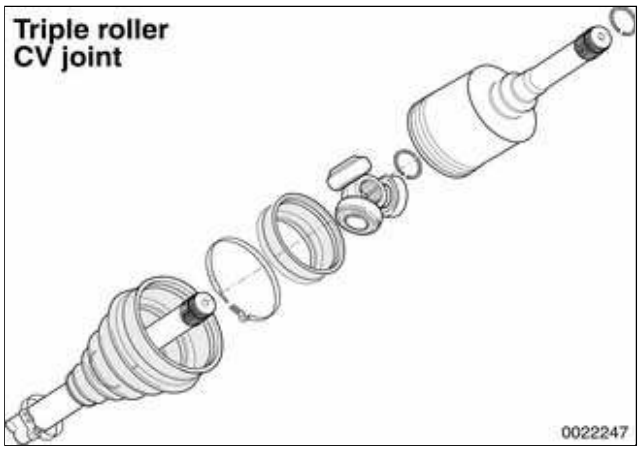
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from the rear wheel drive version and have also been relocated to provide front axle clearance.

The front stabilizer bar has been increased in diameter to accommodate the additional weight. See ⇒ Table a.

The struts are shorter than the rear wheel drive version. Reinforcement plates have been added between the strut upper mounting and the strut towers to prevent sheet metal deformation when traveling on poor road surfaces. The spring travel of the E46 all wheel drive is approximately 20 mm (3/4 in.) less than the rear wheel drive version. The shorter front axle spring travel is due to the limited angle of deflection of the front axle shafts.



Each front drive axle shaft has a conventional constant velocity (CV) joint at the outboard end and a triple roller bearing CV joint at the inboard end. The right inner joint shaft is supported by a bearing pedestal bolted to the oil pan. The shaft extends through the engine oil pan into the front differential.

The front axle differential, bolted to the left side of the engine oil pan, is driven by a 40 mm (1.57 in.) single piece driveshaft. Universal joints are located at both ends of the driveshaft.

The sport suspension option is not available for all wheel drive models.

Steering

The variable-assist power steering system consists of an engine-driven hydraulic pump, a rack-and-pinion type steering gear, and connecting linkage to the road wheels. E46 models utilize an engine-speed dependent variable effort steering system. At low speeds, maximum power assist is provided to

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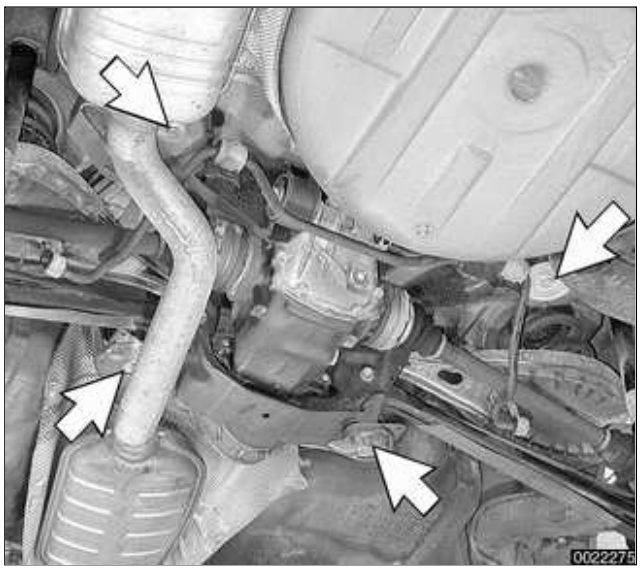
ease parking and city driving. At high speeds, assist is reduced to ensure stability.

The steering linkage connects the rack-and-pinion unit through tie rods to the steering arms. The tie rod ends allow the wheels to pivot and react to suspension travel.

On all wheel drive models, the rack and pinion steering is constructed with a larger diameter piston than the rear wheel drive version. This is necessary to counter the additional drag of the all wheel drive system and the wider standard wheels and tires.

The lower steering column in all wheel drive models connects to the steering rack via a universal joint, whereas there is flexible ("guibo") joint on the rear wheel drive models. The turning radius of the all wheel drive vehicle is 35.8 feet, 1.4 feet greater than the rear wheel drive vehicle.

Rear suspension



The rear suspension subframe (final drive carrier) is the main mounting point for the differential housing and rear suspension components. It is bolted to the vehicle undercarriage using four large rubber bushings (**arrows**).

Trailing arms locate the rear wheels and anchor the springs, shock absorbers and stabilizer bar. Drive axles with constant-velocity (CV) joints at both ends transfer power from the differential to the road wheels. The differential is mounted to the subframe through rubber mounts and bushings to help isolate drivetrain noise and vibration.

In all wheel drive models, the rear suspension and the rear differential have

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the same layout as the rear wheel drive version.

The rear suspension travel of the E46 all wheel drive is approx. 17 mm (0.67 in.) less than the rear wheel drive version. The reason for the reduced travel in the rear is to prevent excessive body roll as a result of the higher body profile.

The rear stabilizer bar diameter has been increased to accommodate the additional vehicle weight. See ⇒ Table a.

Table a. E46 stabilizer bars

Model	Front diameter	Rear diameter
Rear wheel drive	23.0 mm (0.906 in.)	18 mm (0.709 in.)
All wheel drive	23.5 mm (0.925 in.)	20 mm (0.787 in.)
Sport suspension (n/a on awd)	24.0 mm (0.945 in.)	19 mm (0.748 in.)

Brakes

E46 cars are equipped with power disc brakes with integral antilock brakes (ABS). The parking brake is a dual-drum system integrated with the rear brake rotors.

Power assist is provided by a vacuum booster when the engine is running. The brake pedal pushrod is connected directly to the master cylinder, so failure of the vacuum booster does not normally result in total brake failure.

Each disc brake uses a caliper with a single hydraulic cylinder. Brake pads in the left front and right rear contain wear sensors. When the pads need replacement, the sensors illuminate a

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light on the dashboard.

Tires and wheels

Tire size is critical to the proper operation of the anti-lock brake system and traction control system. Several different styles of wheels in 15, 16, and 17 inch diameters are available from an authorized BMW dealer.

On all wheel drive cars, standard wheel size is 17x 7.0 to ensure there is enough room for the front axles and brakes. Tire size is 205/50 R17.

Tire and rim size applications are listed in ⇒ Table b. Rim and tire sizes.

Note:

Aftermarket wheels should be selected with care. Improperly fitted wheels can contact and damage suspension, brake or body components and may adversely affect vehicle stability.

Table b. Rim and tire sizes

Model	Standard		Option	
	Rim size	Tire size	Rim size	Tire size
323i	15 x 6.5	195/65R 15	16 x 7	205/55R 16
323Ci 325i/Ci 328i	16 x 7	205/55R 16	17 x 8	225/45R 17
328Ci	16 x 7	205/55R 16	17 x 7.5/8.5	225/45R 17 245/45R 17
330i/Ci	17 x 7	205/50R 17	17 x 7.5/8.5	225/45R 17 245/45R 17
325xi 330xi	17 x 7	205/50R 17		

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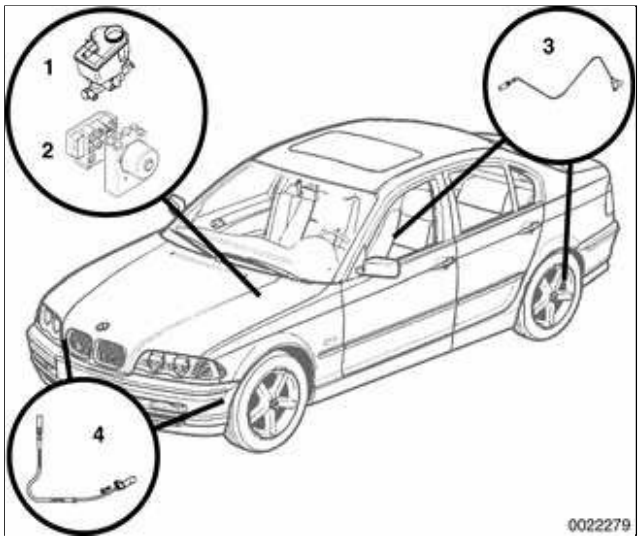
Electronic Brake and Stability Control Systems

All E46 vehicles are equipped with an Antilock Braking System (ABS). Early production models featured ABS with Automatic Stability Control (ABS/ASC). Later models came equipped with ABS and Dynamic Stability Control (ABS/DSC). DSC builds upon the existing ABS/ASC system to provide electronic control of drive and braking systems to insure vehicle stability.

This manual will refer to these systems as ABS. ASC or DSC will be specified when necessary. See the accompanying illustrations for individual system identification.

E46 Electronic braking and stability control systems

ASC



1999 - 2000 Automatic Stability Control Teves MK 20 ASC

1 - Brake master cylinder and fluid reservoir, left rear of engine compartment

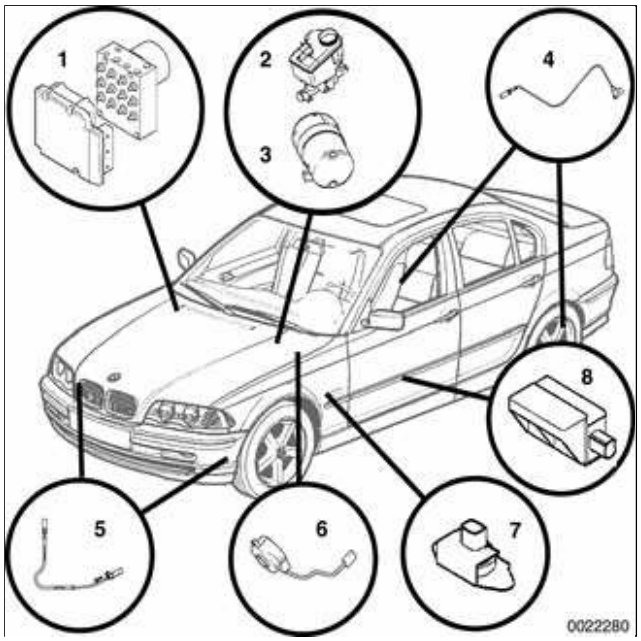
2 - ASC control module and hydraulic unit, left rear of engine compartment under master cylinder

3 - Rear wheel speed sensor, at each rear wheel hub

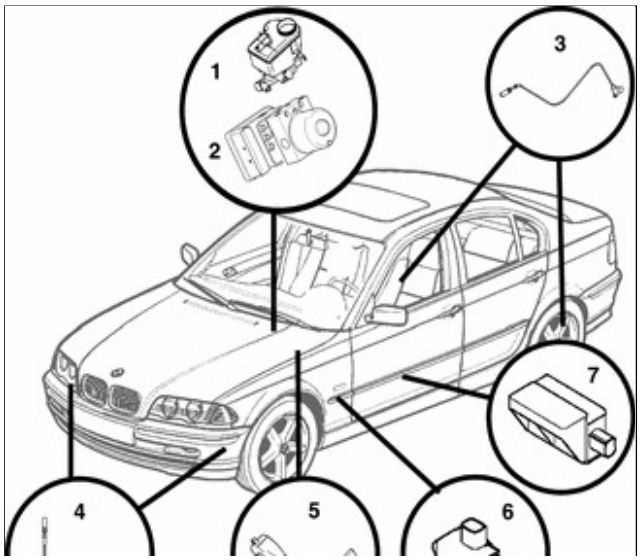
4 - Front wheel speed sensor, at each front steering arm

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DSC



- 1999 - 2000 Dynamic Stability Control Teves MK 20 DSC
  - 1 - DSC control module and hydraulic unit, right rear of engine compartment
  - 2 - Brake fluid reservoir, master cylinder and DSC brake pressure sensors, left rear of engine compartment
  - 3 - DSC precharge pump, left rear of engine compartment, under brake master cylinder
  - 4 - Rear wheel speed sensor, at each rear wheel hub
  - 5 - Front wheel speed sensor, at each front steering arm
  - 6 - Steering angle sensor, at base of upper steering column
  - 7 - Lateral acceleration sensor, behind driver's kickpanel
  - 8 - Rotational acceleration (yaw) sensor, under driver's seat, underneath rug



- 2001 rear wheel drive Dynamic Stability Control Teves MK 60 DSC
  - 1 - Brake fluid reservoir and master cylinder, left rear of engine compartment
  - 2 - DSC control module and hydraulic unit, left rear of engine compartment, under brake master cylinder
  - 3 - Rear wheel speed sensor, at each rear wheel hub

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4 - Front wheel speed sensor, at each front steering arm

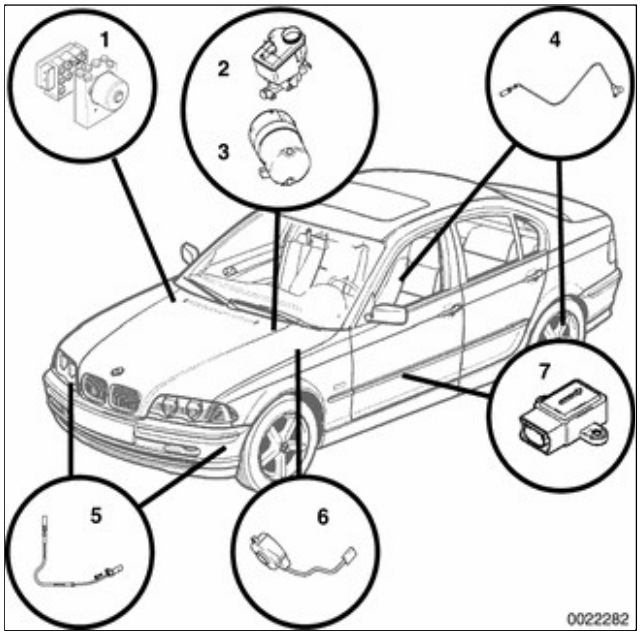
5 - Steering angle sensor, at base of upper steering column

6 - Lateral acceleration sensor, behind driver's kickpanel

7 - Rotational acceleration (yaw) sensor, under driver's seat, underneath rug

Note:

There is no precharge pump in this system.



2001 all wheel drive Dynamic Stability Control Bosch DSC III 5.7

1 - DSC control module, hydraulic unit and DSC brake pressure sensor, right rear of engine compartment

2 - Brake fluid reservoir and master cylinder, left rear of engine compartment

3 - DSC precharge pump, left rear of engine compartment, under brake master cylinder

4 - Rear wheel speed sensor, at each rear wheel hub

5 - Front wheel speed sensor, at each front steering arm

6 - Steering angle sensor, at base of upper steering column

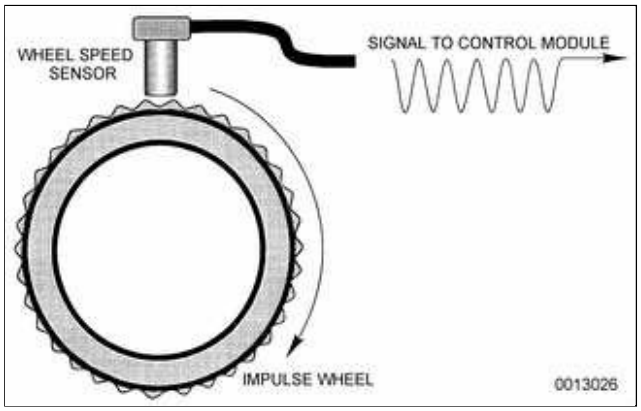
7 - Lateral acceleration sensor and rotational acceleration (yaw) sensor, under driver's seat, underneath rug

ABS system description

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The electronically controlled ABS maintains vehicle stability and control during emergency braking by preventing wheel lock-up. ABS provides optimum deceleration and stability during adverse conditions. It automatically adjusts brake system hydraulic pressure at each wheel to prevent wheel lock-up.

The system's main components are the wheel speed (pulse) sensors, the ABS/ASC or ABS/DSC control module, and the hydraulic control unit.



The wheel speed sensors continuously send wheel speed signals to the control module. The control module compares these signals to determine, in fractions of a second, whether any of the wheels are about to lock. If any wheel is nearing a lock-up condition, the module signals the hydraulic unit to maintain or reduce pressure at the appropriate wheel(s). Pressure is modulated by electrically-operated solenoid valves in the hydraulic unit.

Automatic Stability Control (ASC)

The Automatic Stability Control (ASC) system works in conjunction with the Antilock Brake System (ABS) and the engine management system to enhance vehicle control. The main function of the ASC system is to maintain the rolling contact between the tires and the road surface under all driving conditions. This is achieved through exact application and management of braking and drivetrain forces.

Note:

The traction control system referred to as ASC (Automatic Stability Control)

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may also be referred to as ASC+T (Automatic Stability Control+Traction).

The ASC system improves traction by electronically applying the rear brakes when the rear drive wheels are spinning at a faster rate than the front wheels. The combined ABS/ASC control module, operating through the ABS hydraulic control unit, modulates braking force at the rear wheels.

In addition, ASC will deactivate individual fuel injectors and override the motor driven throttle to reduce engine torque and maintain vehicle traction. Because the throttle is controlled electronically the driver cannot increase the engine power output during ASC intervention regardless of how far the accelerator pedal is pushed.

The components that comprise the ASC system also function to replace the limited slip differential available in previous models. Even with the ASC system turned off, if the ASC control module senses a difference in wheel speed (one wheel spinning) the control module will apply modulated braking force to the slipping wheel until traction is regained, but will not override fuel injection function.

Traction control also comes into operation during deceleration. Decelerating on snowy or icy road surfaces can lead to rear wheel slip. If a rear wheel starts to drag or lock up, the ASC system can limit the problem by adjusting throttle, fuel injection and ignition timing.



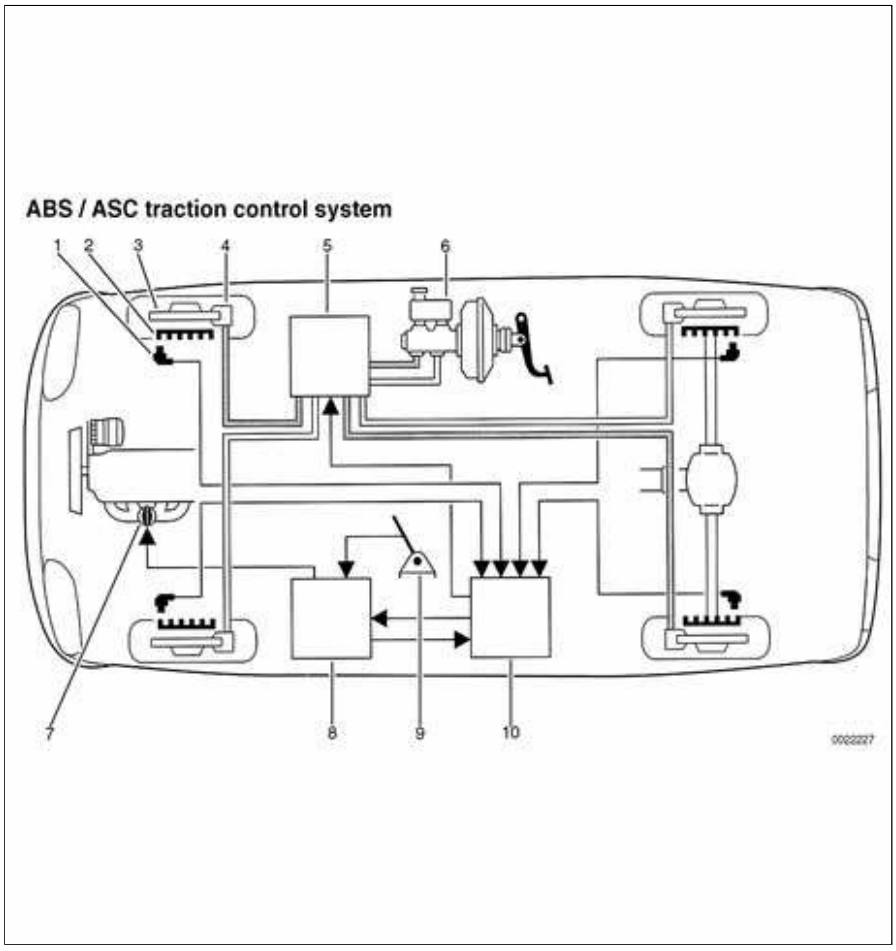
A switch on the center console is used to toggle the ASC on or off.

The ASC system is designed to be maintenance free. There are no adjustments that can be made. Repair and troubleshooting of the ASC system

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requires special test equipment and knowledge and should be performed only by an authorized BMW dealer. ⇒ Table c. ASC indicator lamp function lists the conditions indicated by the ASC indicator light in the instrument cluster.



ABS/ASC traction control system

1 - Wheel speed sensor

2 - Wheel speed pulse wheel

3 - Brake disk

4 - Brake caliper

5 - ABS/ASC hydraulic unit

6 - Brake master cylinder

7 - Throttle valve

8 - Engine control module

9 - Accelerator pedal

10 - ABS/ASC control module

Table c. ASC indicator lamp function

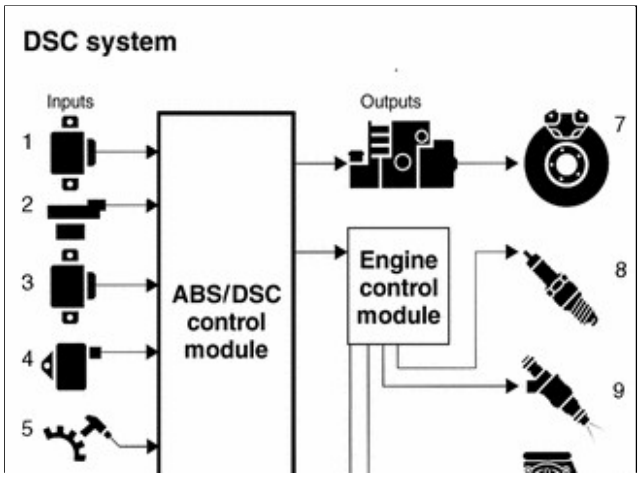
Indicator lamp	Condition	Action / Use
Light on	Normal ASC start-up	Automatic ASC self-test

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Indicator lamp	Condition	Action / Use
Light off	ASC monitoring mode	Automatic ASC operation
Press ASC button, light comes on	ASC off (disabled)	Rocking the car to get out of snow or other loose surface Driving with snow chains
Press ASC button, light goes out	ASC monitoring mode	Automatic ASC operation
Light flashes	ASC active mode	Normal ASC operation as it controls wheel speed
Light stays on after start up or comes on while driving	Defect in ASC	Consult BMW dealer for diagnosis/repair (vehicle operation remains normal)

Dynamic Stability Control (DSC)

Dynamic Stability Control (DSC), standard in 2000 and later E46 models, utilizes many principles and components of the ASC traction control system. DSC is active throughout the driving experience, unlike ASC which is only active during acceleration and braking. DSC helps stabilize the vehicle in cornering and avoidance maneuvers by adjusting engine controls such as throttle, ignition, fuel injection and the application of brake pressure to the wheels individually.



The DSC control module uses various inputs to determine vehicle instability during braking, cornering, or reduced traction situations. Based upon these inputs the ABS/DSC control module sends outputs to the engine control module and the ABS/DSC hydraulic unit to activate torque reduction protocols and braking intervention.

Inputs

1 - Lateral acceleration sensor

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2 - Steering angle sensor

3 - Rotational rate (yaw) sensor

4 - Brake pressure sensor

5 - ABS wheel speed sensors

6 - Engine control module

Outputs

7 - ABS/DSC hydraulic system

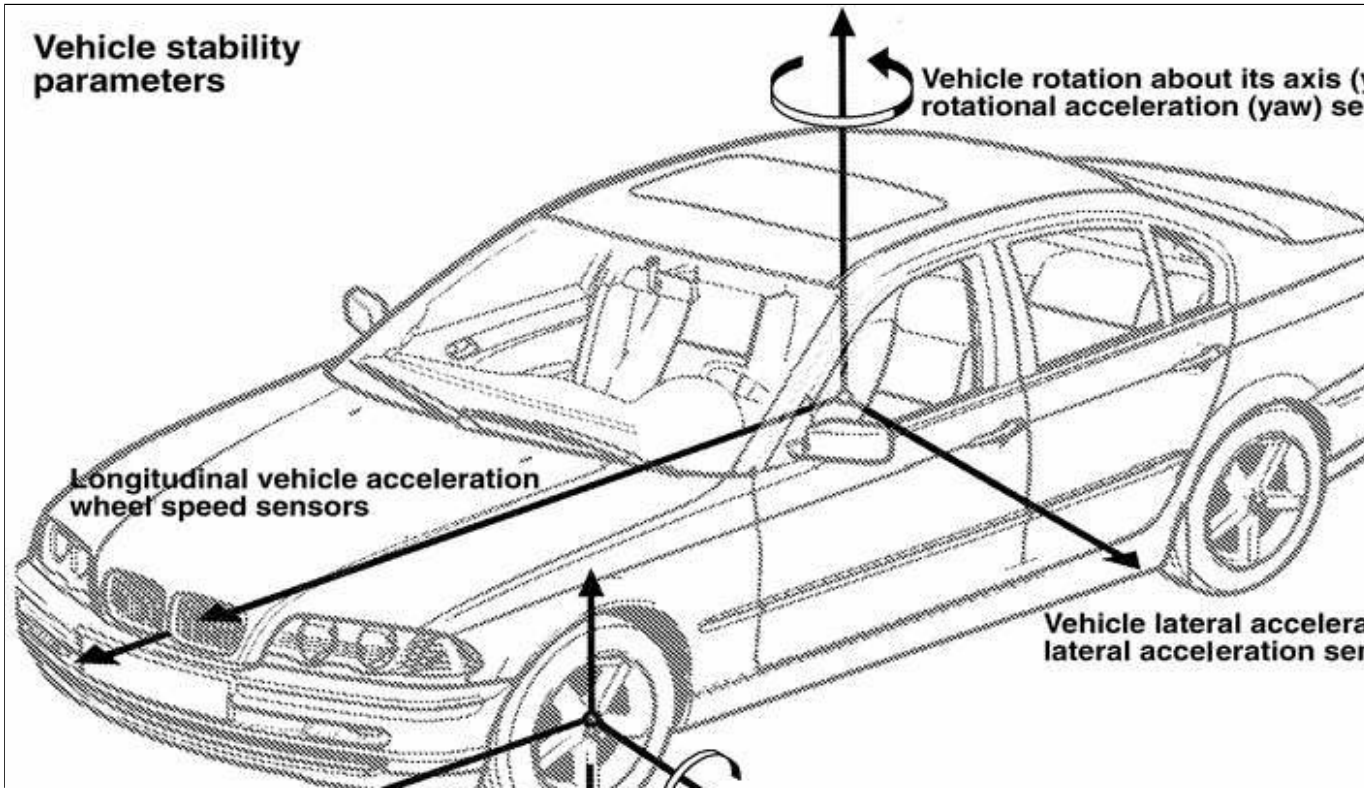
8 - Ignition (spark)

9 - Fuel injection

10 - Throttle valve

The DSC system can be toggled on and off by a switch mounted on the center console. Turning off the DSC system does not disable ABS or ASC functions.

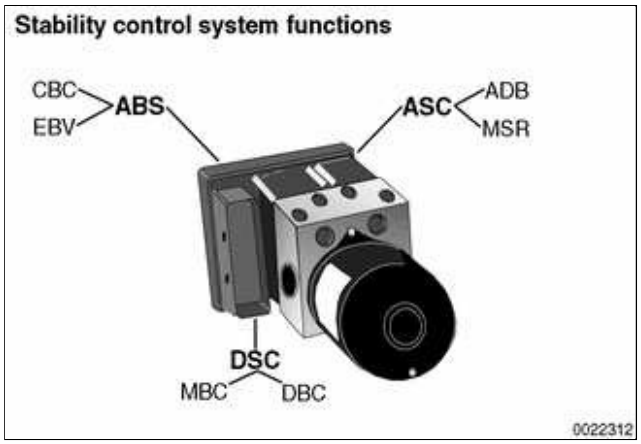
Vehicle stability parameters



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System functions



Each of the electronic braking and stability control systems include sub-systems which use the hydraulic unit/control module and sensors to carry out additional system functions. The foundation of the stability control systems is Antilock Braking System (ABS) with the following basic functions:

- Cornering brake control (CBC)
- Electronic brake proportioning (EBV)

The Teves MK 20 ASC system functions as a basic ABS system, but adds additional system functions:

- Brake intervention (ADB)
- Drag torque reduction (MSR)

All of the dynamic stability control systems are based on the ABS/ASC system, but add DSC system functions

- Dynamic brake control (DBC)
- Maximum brake control (MBC)

Cornering brake control (CBC)

Cornering brake control reduces brake pressure build up on the inside rear

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wheel brake circuit during cornering if activation threshold values are exceeded.

Electronic brake proportioning (EBV)

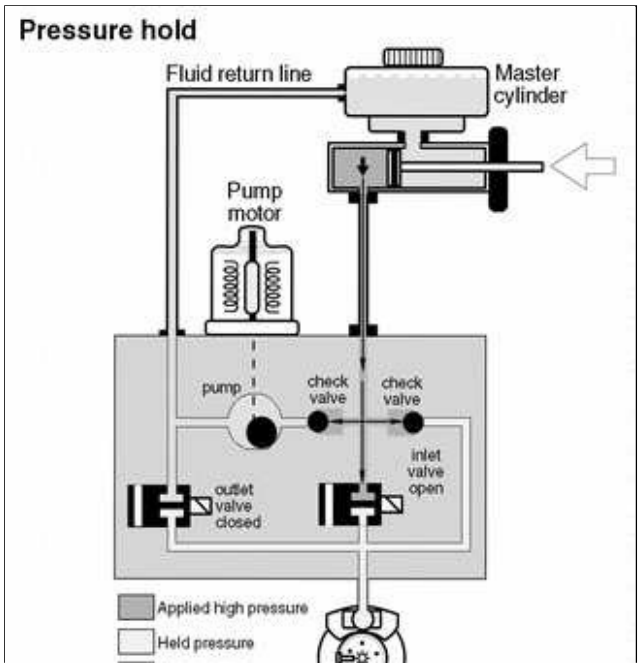
Electronic brake proportioning adjusts braking force to the rear wheels based upon the vehicle's loading, front to rear, to maximize the vehicle's braking power.

Using wheel speed sensors, the control module compares individual wheel deceleration rates as the brakes are applied. If the difference in wheel speeds exceeds the programmed threshold values, EBV is activated. EBV activation modulates inlet valves to the rear wheels to regulate braking force.

Brake intervention (ADB)

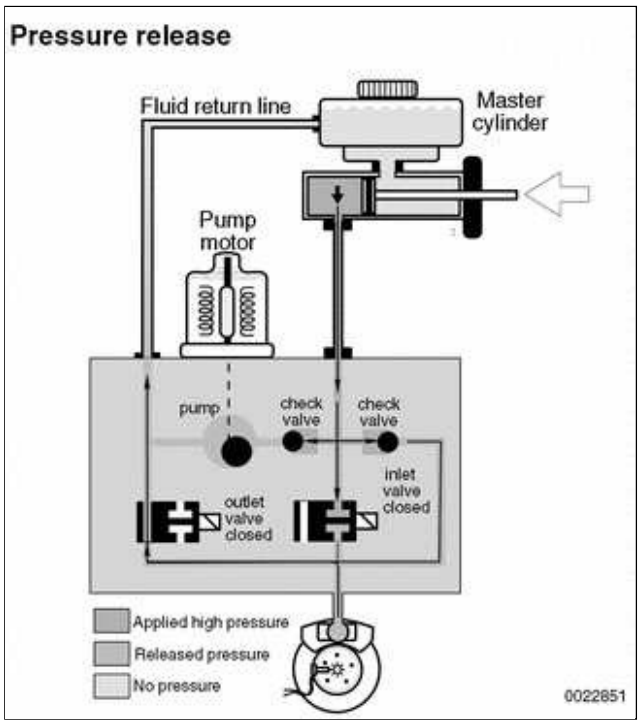
Brake intervention is applied to the individual drive wheel which is losing traction by activating the rear brake calipers in three phases:

- Pressure build
- Pressure hold



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- Pressure release

When intervention is necessary:

- The changeover valve in the hydraulic unit energizes and closes inlet valves for the two front wheels and the rear wheel with traction.
- The rear brake circuit intake valve is energized and opened to rear wheel without traction.
- Return/pressure pump is activated and draws in brake fluid from the master cylinder and delivers pressurized brake fluid to wheel without traction.
- Pressure hold and pressure release cycles are run by cycling inlet and outlet valve to rear brake caliper without traction.

Drive torque reduction

In low traction conditions, the ABS control module request is sent to the engine control module (ECM) via the CAN-bus. The ECM accomplishes torque reduction by implementing the following measures:

- Reducing throttle opening angle
- Retarding ignition
- Cutting off individual cylinder fuel injectors

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Drag torque reduction (MSR)

During deceleration and engine braking conditions engine drag torque can cause the rear wheels of a vehicle to lock on low traction surfaces, especially in high speed, low gear driving. This can lead to loss of traction in the rear. When drive wheel speed is slower than front wheel speed the ECM will suspend vehicle coasting by increasing throttle opening angle and engine torque.

Dynamic brake control (DBC)

The DBC function provides increased braking pressure, up to ABS threshold, during emergency braking situations. The DSC control unit will implement DBC function when brake pressure builds rapidly with application of the brake pedal.

DBC triggering conditions:

- Brake light switch on
- Brake pressure in master cylinder above ABS threshold
- Brake pressure build up speed above threshold
- Vehicle road speed above 3 mph
- Pressure sensor self test completed and sensors OK
- Vehicle travelling forward
- Not all wheels in ABS regulation range

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When DBC function is activated, braking pressure will increase at all wheels up to the ABS regulation point. DBC will continue until the driver releases the brake pedal, brake pressure drops, or the vehicle slows to under 3 mph.

Maximum brake control (MBC)

Maximum brake control is designed to assist in stability control by increasing rear brake pressure when the front wheels are under ABS regulation. MBC intervention is triggered when the brakes are applied too slowly to reach DBC threshold.

MBC triggering conditions:

- Both front wheels in ABS regulation
- Vehicle speed above 3 mph
- DBC and pressure sensor self test completed and OK
- Vehicle travelling forward
- Rear wheels not under ABS regulation

MBC will activate the return pump to increase rear wheel pressure build up. The function will be terminated under the following conditions:

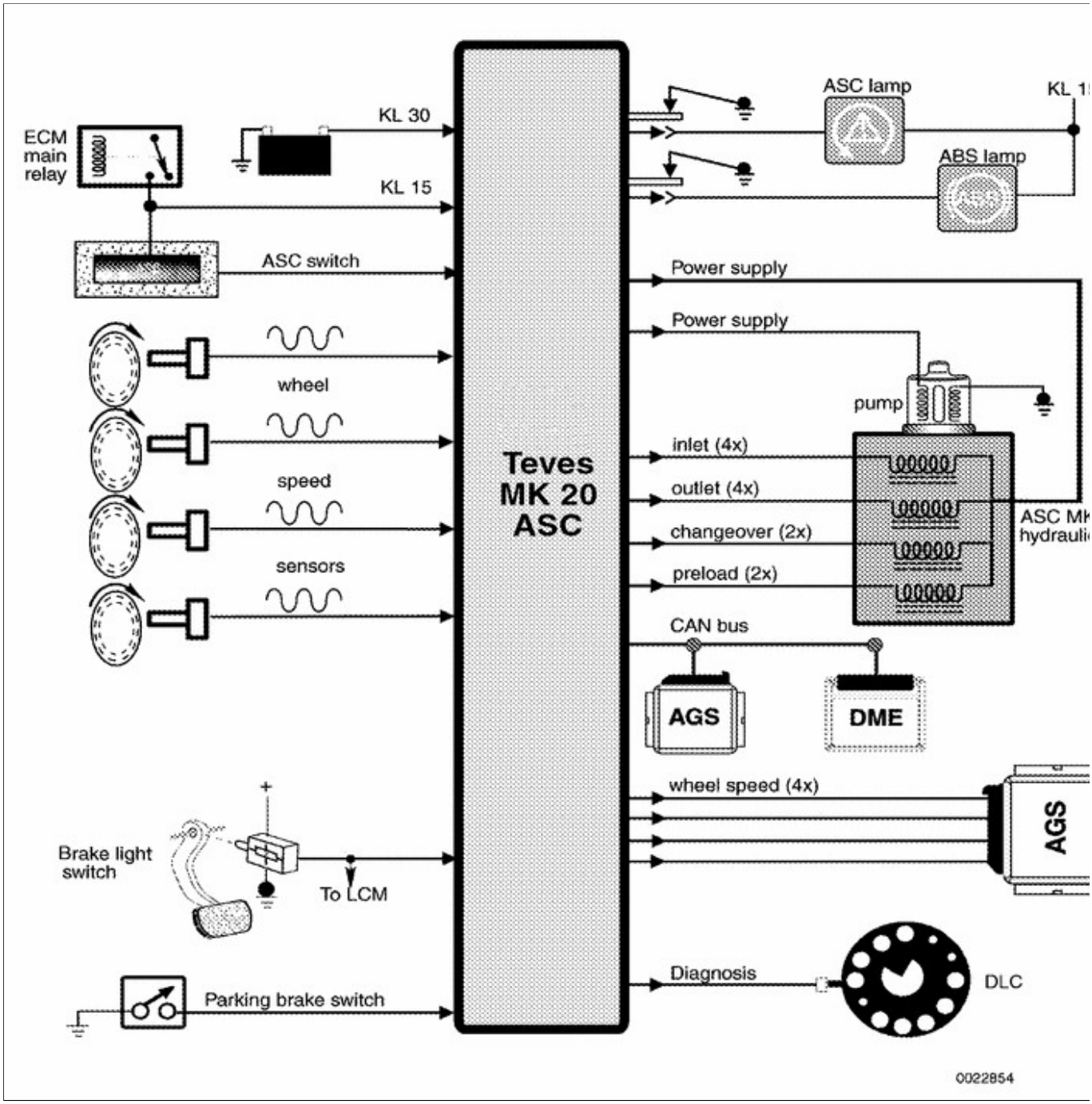
- Front wheels drop out of ABS regulation
- Driver releases brake pedal
- Brake pressure falls below

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threshold

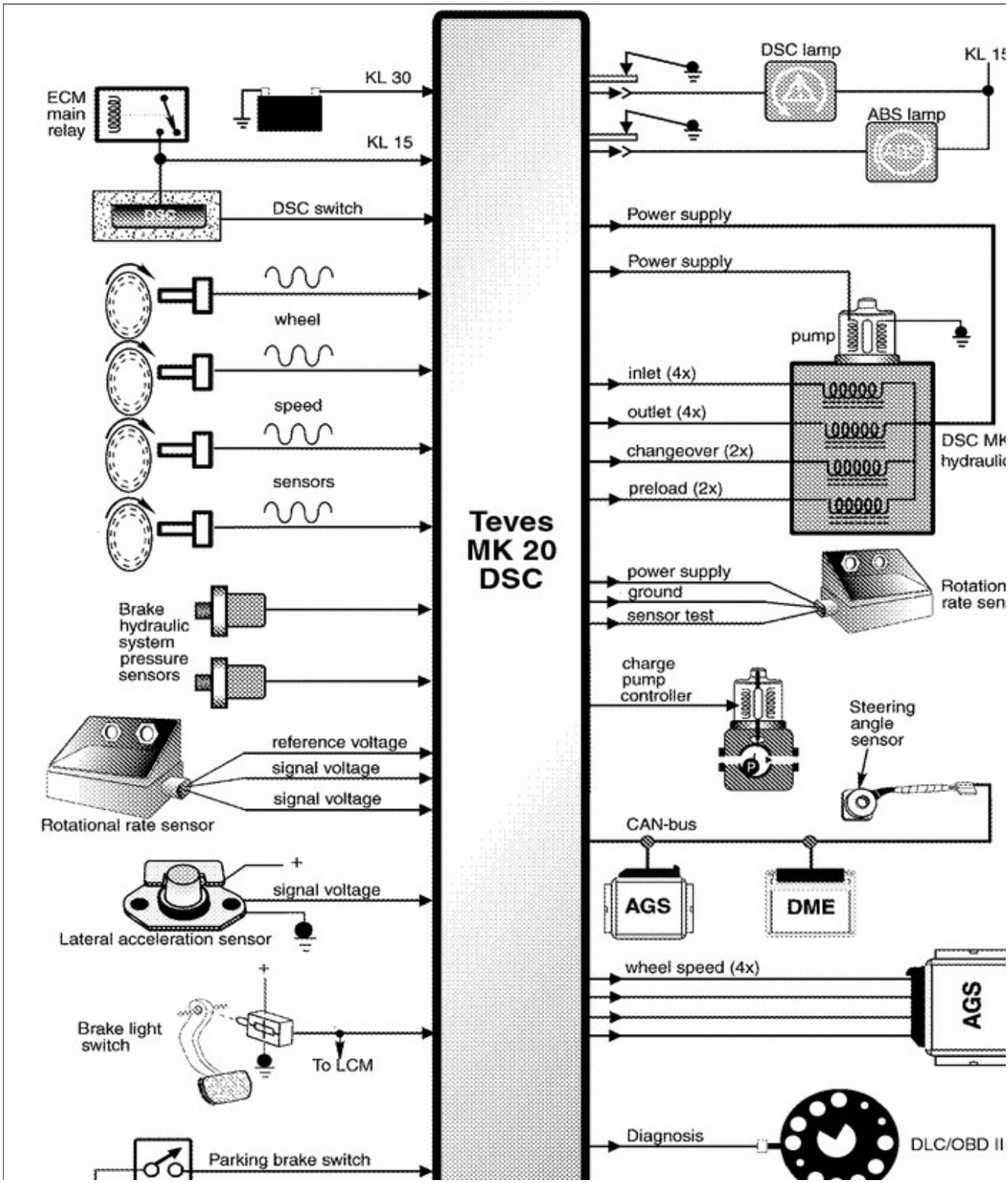
- Vehicle road speed drops below 3 mph

Teves MK 20 ASC diagram



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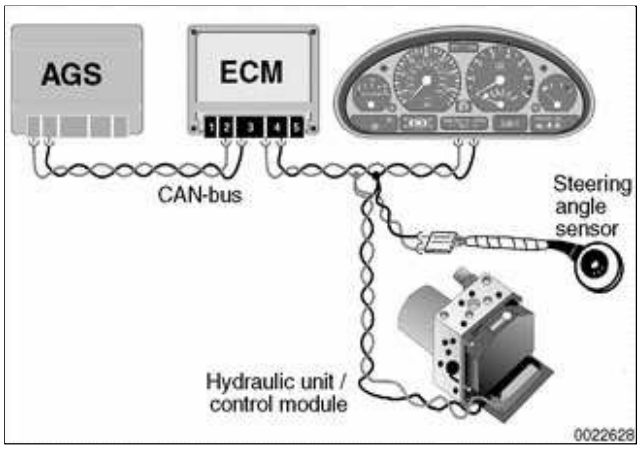
Teves MK 20 DSC Diagram



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Vehicle network



The hydraulic unit/control module communicates with some sensors and many other control modules over the CAN-bus. The CAN-bus is a system of wiring that functions like a computer network, allowing different components to communicate over the same data line, at the same time, by varying electronic signals.

Component communication dialogs take place between multiple control units and sensors over the CAN-bus:

- Engine control module (ECM) provides current engine torque to ABS control module.
- ABS control module provides wheel speed sensor signals (vehicle speed) to other modules
- ABS control module signals ECM to increase/reduce torque, ECM adjusts motor driven throttle (MDK/EDK)
- ABS control module commands transmission control module (AGS) to suppress shifts during ASC/DSC regulation
- DSC receives yaw, lateral acceleration & steering angle sensor information
- ABS control module receives signal

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from ASC/DSC switch on dash.

- ABS control module signals turn instrument cluster warning lamps on during ASC/DSC regulation.

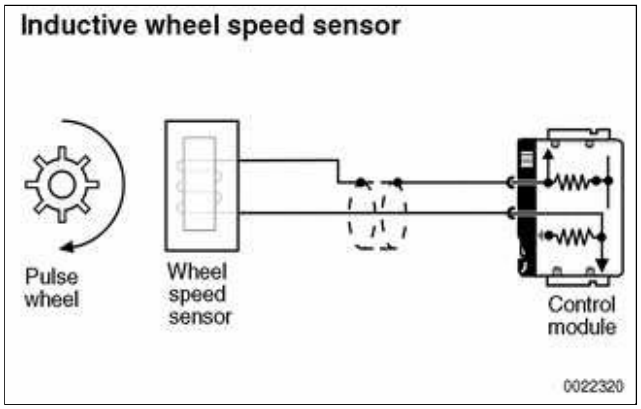
Hydraulic unit/control module

The hydraulic unit is mounted in conjunction with the control module. While the hydraulic unit and control module function as one unit, they are replaceable individually. All ABS/ASC or ABS/DSC processing functions are performed by the control module. The control module is linked to the vehicle's engine control module (ECM) and transmission control module (AGS) (if applicable) by the CAN-bus network.

Wheel speed sensors

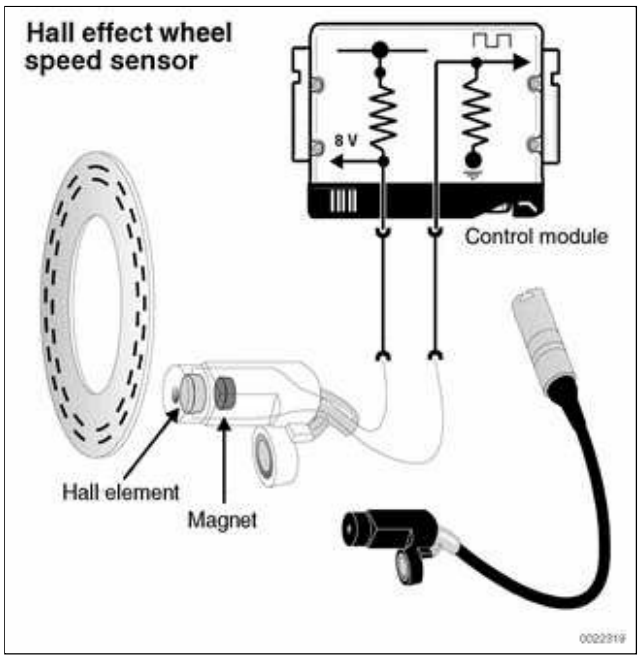
Wheel speed sensors are a crucial component in every ABS system. Control modules use these sensor inputs to determine overall vehicle speed and individual wheel speed for both ABS braking and stability control functions.

Three different types of wheel speed sensor are used in the E46 electronic braking and stability control systems:

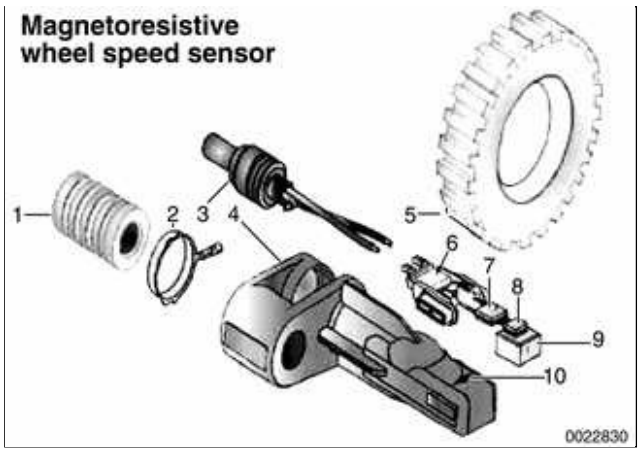


- 1999 - 2000 Teves MK 20 ASC / DSC: Inductive

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- 2001 Bosch DSC III 5.7: Hall effect



- 2001 Teves MK 60 DSC: Magnetoresistive

1 - Fastening element

2 - Ground contact

3 - Sensor wiring

4 - Sensor housing

5 - Metal pulse wheel

6 - Sensor element support

7 - Evaluation module

8 - Sensor element

9 - Magnet

10 - Pick-up surface

CAUTION!

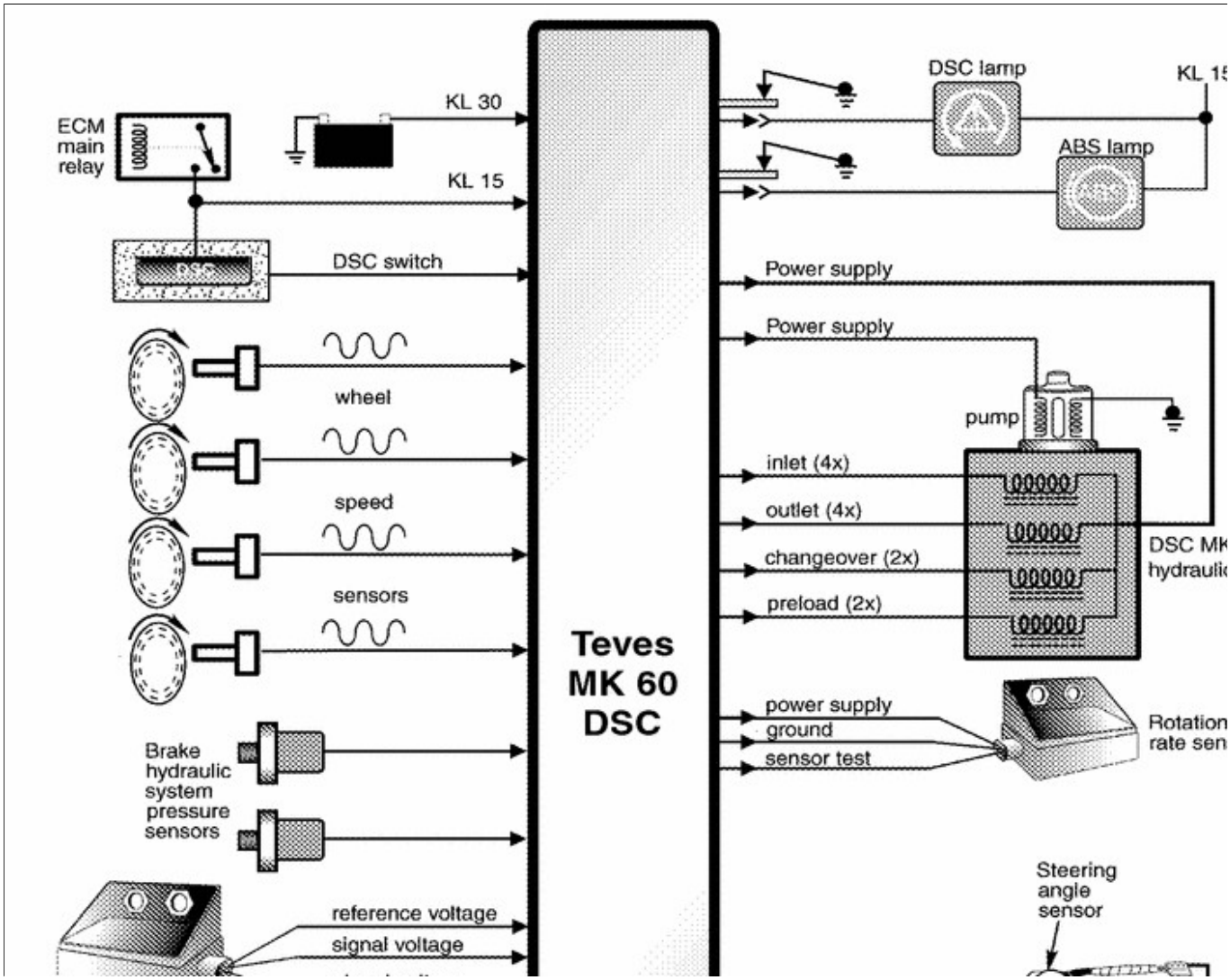
The magnetoresistive and the Hall effect sensor for the rear wheel are physically interchangeable. However, the electronic properties are not the same and they must not be interchanged.

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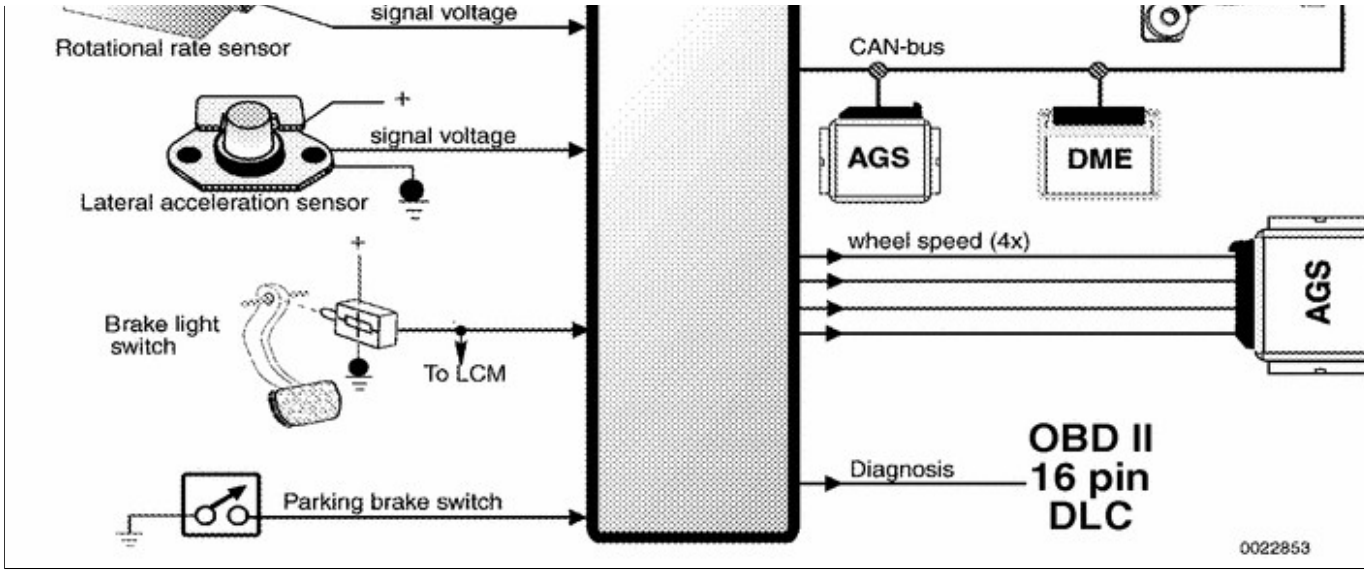
DSC lateral acceleration sensor

The lateral acceleration sensor provides the DSC control module with an input signal based on the degree of lateral acceleration (g forces) that the vehicle experiences. Based on a 5 volt reference voltage, the sensor will return an output voltage that ranges between 0.5 and 4.5 volts to the DSC control module, with 1.8 volts as a standing voltage. This input, along with other DSC inputs, determines the amount of DSC regulation needed to maintain vehicle stability.

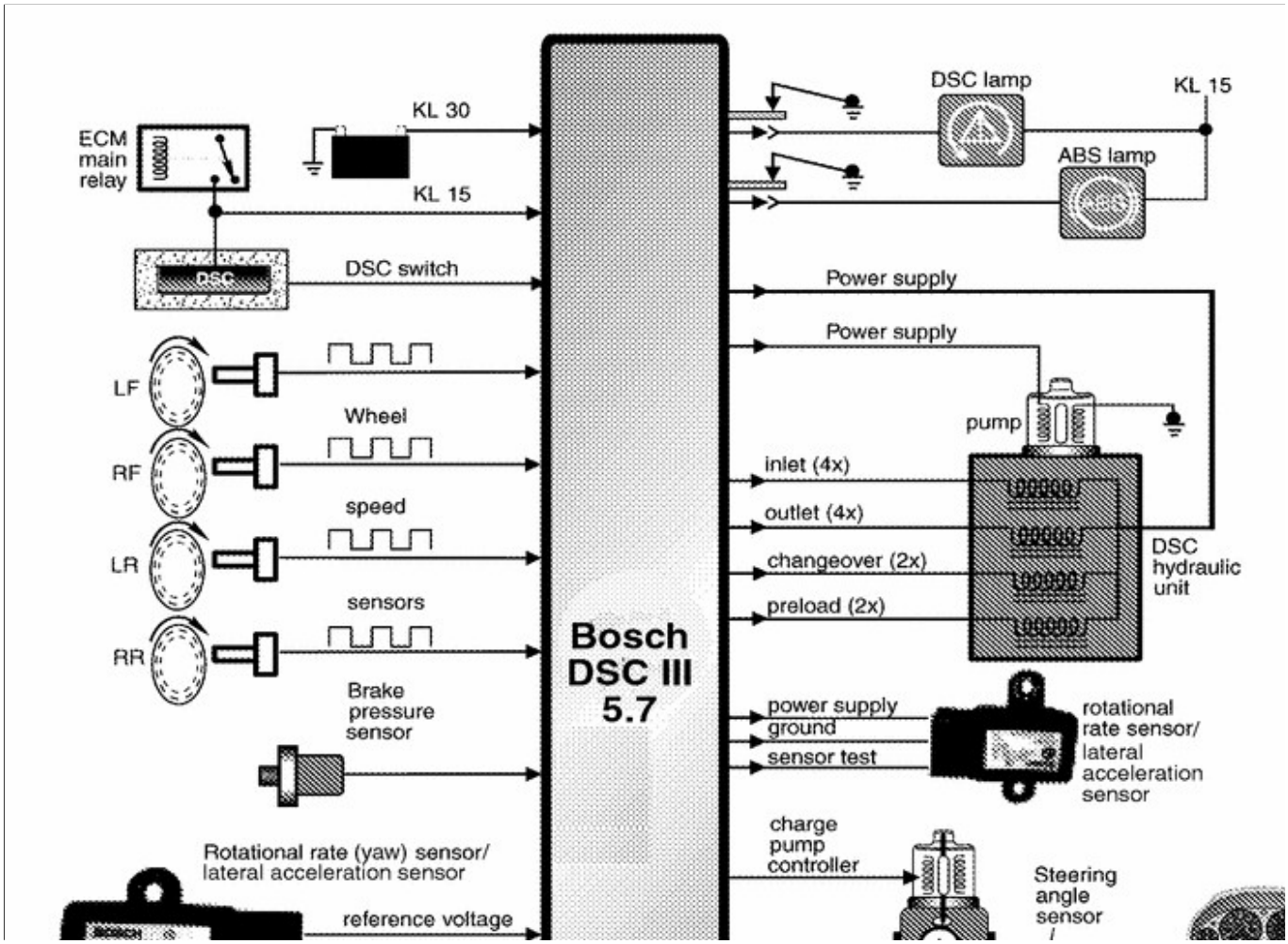
Teves MK 60 DSC diagram



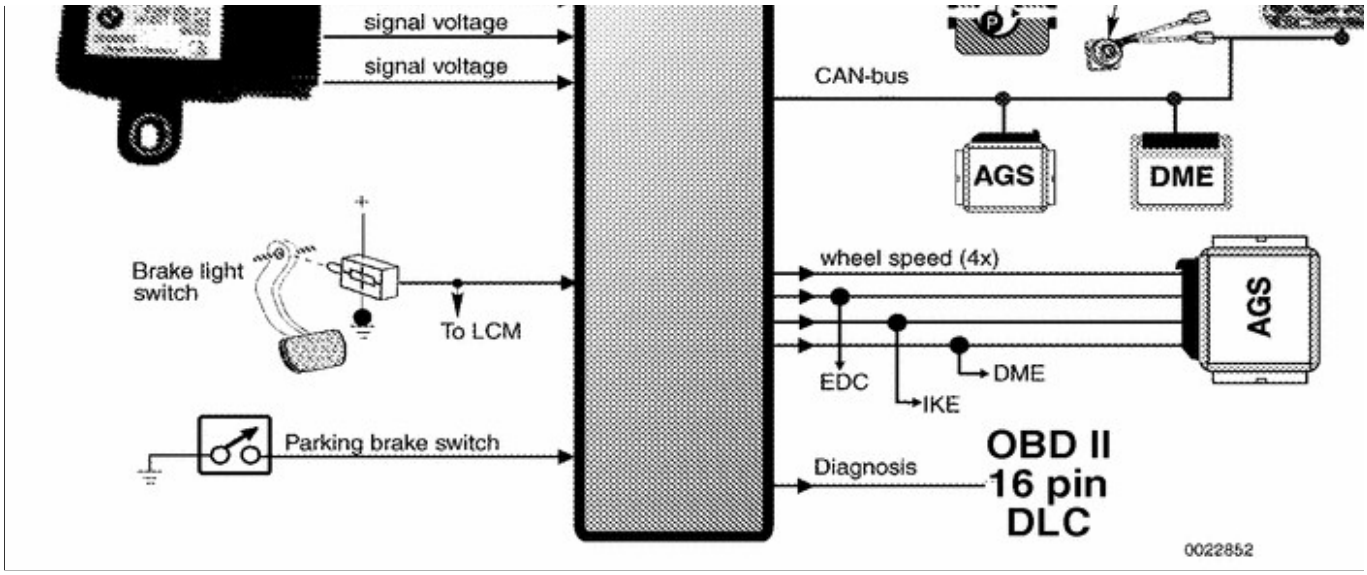
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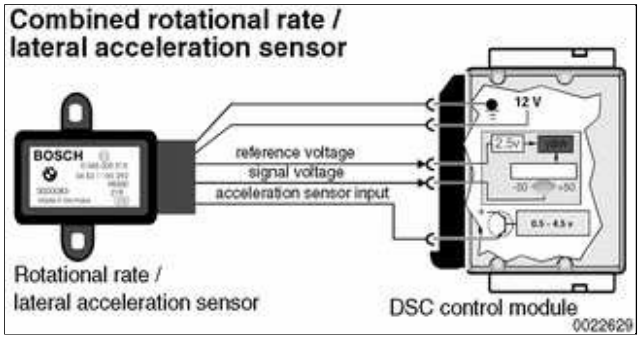
Bosch DSC III 5.7 diagram



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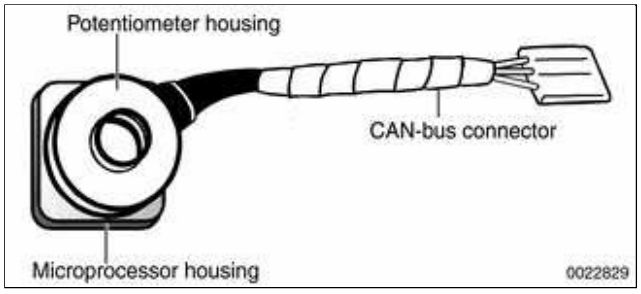


DSC rotational rate (yaw) sensor



- The rotational rate sensor provides a analog voltage signal to the DSC control module to indicate the rotational speed (yaw) of the vehicle on its vertical axis. The control module supplies a 5 volt reference voltage to the sensor. The sensor returns a voltage between 0.25 and 4.65 volts based on the amount of yaw. If the vehicle's yaw exceeds preset parameters, the DSC control module will activate a DSC regulation cycle to increase vehicle stability while cornering. In case of failure the sensor will send a constant voltage to the DSC control unit.

DSC steering angle sensor

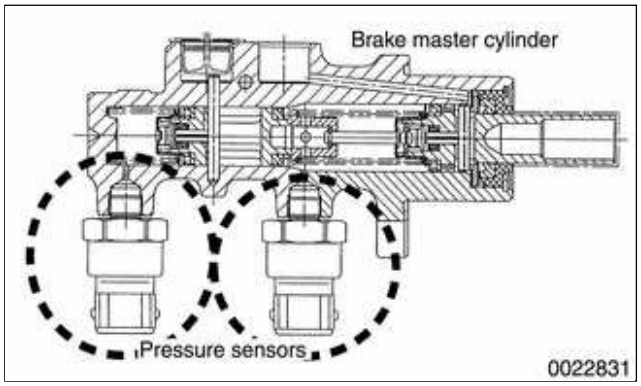


- Using two potentiometers, the steering angle sensor determines the steering angle and the rate of steering change. The sensor processes the two potentiometer outputs and provides a digital signal to the DSC control unit via the vehicle's CAN-bus network. Sensor recalibration is required after steering

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angle sensor replacement or repairs to the steering column. This recalibration is performed using either the DIS or MoDiC BMW scan tools.

DSC pressure sensor



- The DSC pressure sensor(s) provides the ABS/DSC control module an analog voltage signal in proportion to brake pressure in the master cylinder.

The DSC MK 20 and MK 60 systems use two switches installed at the brake master cylinder.

The Bosch DSC III 5.7 system uses one switch installed at the DSC hydraulic unit.

DSC precharge pump

The DSC precharge pump is used in the Teves MK 20 DSC and Bosch DSC III 5.7 systems (1999 - 2000 DSC and 2001 all wheel drive equipped vehicles).

The DSC precharge pump provides the hydraulic unit with the necessary supply of hydraulic brake fluid. When the DSC system is activated, the precharge pump delivers brake fluid from the reservoir to the hydraulic unit at 10 bar (150 psi).

Switches and indicators

ASC/DSC control button



- The control button is used to deactivate the stability control functions of either the ASC system or the DSC system.

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Brake light switch

The brake light switch input signal is used by the control module to determine which stability control routine is necessary. The control module will interrupt Automatic Stability Control (ASC) functions if the brake pedal is depressed during ASC operation. On vehicles equipped with DSC, DSC operation is not cancelled during braking situations.

Note:

Bosch DSC III 5.7 control module compares input from the brake light switch with pressure sensor value. The pressure sensor must not detect more than 5 bar when the brake light switch is not actuated.

Parking brake switch

The switch for the parking brake warning lamp is used to signal the control module if the parking brake is engaged. This signal is used in stability control system logic to cancel system functions.

Brake fluid level switch

The reed-type brake fluid level switch monitors the level of brake fluid available in the brake fluid reservoir. When an adequate amount of fluid is present, the switch completes a ground circuit for the

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control module. When fluid level is too low, the circuit is broken and the ASC/DSC functions are turned off. Normal braking and ABS remains unaffected.

Warning lamps



Braking and stability control warning lights

1 - ASC/DSC warning light. Illuminates solidly when ASC/DSC system has been turned off, or blinks when ASC/DSC system is activate.

2 - Brake warning light. Indicates when the parking brake is engaged, or when brake system hydraulic fluid level is low.

3 - Antilock brake system (ABS) warning light. Indicates that the ABS system has been deactivated, or when there is an ABS system malfunction.

4 - Brake pad wear warning light. Indicates worn brake pads.

WARNING!

If the brake warning lamp, ABS warning lamp, and ASC/DSC warning lamp are all illuminated at the same time, there is an ABS and stability control system failure. Do not drive vehicle without diagnosing the problem.

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Troubleshooting

Stable handling and ride comfort both depend on the integrity of the suspension and steering components. Any symptom of instability or imprecise road feel may be caused by worn or damaged suspension components.

When troubleshooting suspension and steering problems, also consider the condition of tires, wheels and their alignment. Tire wear and incorrect inflation pressures can dramatically affect handling. Subtle irregularities in wheel alignment angles also affect stability. Mixing different types or sizes of tires, particularly on the same axle, can affect alignment and may unbalance a car's handling.

⇒ Table d. Suspension and steering troubleshootinglists the symptoms of common suspension and steering problems and their probable causes, and suggests corrective actions. Bold type indicates the repair groups where applicable test and repair procedures can be found.

Table d. Suspension and steering troubleshooting

Symptom	Probable cause	Repairs
Breaking away while braking	Worn struts or shock absorbers	Replace struts or shock absorbers. ⇒ 310, ⇒ 330
Car pulls to one side, wanders	Incorrect tire pressure	Check and correct tire pressures. ⇒ 020
	Incorrect wheel alignment	Check and adjust wheel alignment. ⇒ 320
	Faulty brakes (pulls only when braking)	Check for sticking/damaged front caliper. ⇒ 340
Front end or rear end	Worn struts or shock absorbers	Replace struts or shock absorbers. ⇒ 310, ⇒ 330

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Symptom	Probable cause	Repairs
vibration or shimmy		
	Worn suspension bushings (control arm or trailing arm)	Replace worn bushings. ⇒ 310, ⇒ 330
	Worn front suspension ball joints (control arm, steering arm or steering tie-rod end)	Replace worn ball joints. ⇒ 310
	Unbalanced or bent wheels/tires Loose wheel lug bolts	Balance tires. Check tires for uneven wear patterns. Check wheels for damage. .
	Loose wheel lug bolts	Tighten lug bolts to proper torque.
Poor handling, poor directional stability	Rear control arm or rear subframe bushings worn or damaged	Replace rear suspension bushings as necessary. ⇒ 330
	Rear alignment incorrect	Check and adjust wheel alignment. ⇒ 320
Poor stability, repeated bouncing after bumps, suspension bottoms out easily	Worn struts or shock absorbers	Replace struts or shock absorbers. ⇒ 310, ⇒ 330
Rear end hop with hard braking	Rear trailing arm busing worn or damaged	Replace trailing arm bushing. ⇒ 330
Steering heavy, poor return-to-center	Worn upper strut mounts	Replace strut mounts. ⇒ 310
	Incorrect tire pressure	Check and correct tire pressures. ⇒ 020
	steering system faulty	Check power steering fluid level. ⇒ 320
Steering loose, imprecise	Incorrect tire pressure	Check and correct tire pressures. ⇒ 020
	Loose steering rack mounting bolt(s)	Inspect and tighten bolts. ⇒ 320
	Worn tie rod end(s)	Replace tie rod(s) and align wheels. ⇒ 320
	Faulty front wheel bearing	Replace wheel bearing. ⇒ 310
	Worn or damaged steering rack	Adjust or replace steering rack. ⇒ 320 .
	Worn tires	Replace tires.

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Symptom	Probable cause	Repairs
Suspension noise, especially over bumps (drumming, rattling)	Worn front upper strut mounts	Replace upper strut mounts. ⇒ 310
	Worn suspension bushings (control arm or trailing arm)	Replace worn bushings. ⇒ 310, ⇒ 330
	Worn stabilizer bar rubber mounts	Replace stabilizer bar rubber mounts. ⇒ 310 , ⇒ 330
	Loose suspension subframe	Check subframe for damage. Tighten mounting bolts.
Tail skid when braking	Rear trailing arm front bushing worn or damaged	Replace trailing arm bushing. ⇒ 330
Tire flat spots	Worn struts or shock absorbers	Replace struts or shock absorbers. ⇒ 310 , ⇒ 330
Uneven ride height	Incorrect coil springs	Measure ride height. ⇒ 300
	Bent or damaged suspension components	Inspect, repair/replace as necessary. ⇒ 310 , ⇒ 330
	Sagging coil springs	Replace springs as necessary. ⇒ 310 , ⇒ 330
Unsteady in curves, self-steering, poor rear end stability	Rear subframe bushings worn or damaged	Replace rear suspension bushings as necessary. ⇒ 330
	Differential bushings worn or damaged	Replace rear suspension bushings as necessary. ⇒ 330
	Rear shock absorbers worn	Replace rear shock absorbers. ⇒ 330
Wheel noise, continuous growling, may be more noticeable when turning	Worn wheel bearing	Replace wheel bearing. ⇒ 310 , ⇒ 330
Wheel-hop on normal road surface	Worn struts or shock absorbers	Replace struts or shock absorbers. ⇒ 310 , ⇒ 330

ABS troubleshooting

ABS is designed to be maintenance free. There are no adjustments that can be made to the system. Repair and

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troubleshooting of major ABS components requires special test equipment and knowledge and should be performed by an authorized BMW dealer.

ABS is self-tested by the control module each time the car is started. Once the test is complete, the ABS dashboard warning light turns off. If the light remains lit or comes on at any time during driving, a system fault has occurred and ABS is electronically disabled. The conventional braking system remains fully functioning.

When a system or component failure occurs in the electronic braking and stability control systems, either the brake warning light, ABS warning light, or the ASC / DSC warning light will illuminate.Troubleshooting and diagnosis for the electronic braking and stability control systems must be made using an electronic scan tool.

Brake bleeding functions, as well as component coding and initialization must be completed using BMW scan tools DIS or MoDiC.

ABS system inspection

A visual inspection of the ABS system components may help to locate system faults. If no visual faults can be found and the ABS light remains on, have the system diagnosed by an authorized BMW dealer.

Carefully inspect the entire ABS wiring harness, particularly the pulse sensor harnesses and connectors near each wheel. Look for chafing or damage due to incorrectly routed wires.

Carefully remove the wheel speed sensors. Clean the sensor tips. Inspect toothed wheel on wheel hub. Check for

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missing, clogged or corroded teeth, or other damage that could alter the clearance between the sensor tip and toothed wheel.

Ride height



Ride height measurement (**A**) at either axle is taken from center of wheel arch to bottom of wheel rim.

If the ride height is outside the specification listed, new springs should be installed. Be sure to have the old spring code number on hand when ordering new spring.

⇒ Table e. Front ride height specifications (measurement A) lists front suspension ride height specifications, ⇒ Table f. Rear ride height specifications (measurement A) lists rear suspension ride height specifications. These specifications apply to a car in a normally loaded position. When checking ride height or installing suspension components that require the car to be "normally loaded," load the car as follows:

Normal loaded position	
Each front seat	68 Kg (150 lbs)
Rear seat (center)	68 Kg (150 lbs)
Trunk	21 Kg (46 lbs)
Fuel tank	full

Table e. Front ride height specifications (measurement A)

Wheel size	Standard suspension	Sport suspension	Rough road suspension	All wheel drive suspension
15 inch	576 mm (22.67 in.)	561 mm (22.08 in.)	593 mm (23.35 in.)	

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Wheel size	Standard suspension	Sport suspension	Rough road suspension	All wheel drive suspension
16 inch	589 mm (23.19 in.)	574 mm (22.59 in.)	606 mm (23.86 in.)	606 mm (23.85 in.)
17 inch	604 mm (23.77 in.)	589 mm (23.19 in.)	621 mm (24.44 in.)	621 mm (24.44 in.)
18 inch	617 mm (24.29 in.)	602 mm (23.71 in.)	634 mm (24.96 in.)	634 mm (24.96 in.)
Maximum variation between sides: 10 mm (0.4 in)				
Maximum deviation from specifications: 10 mm (0.4 in)				

Table f. Rear ride height specifications (measurement A)

Wheel size	Standard suspension	Sport suspension	Rough road suspension	All wheel drive suspension
15 inch	542 mm (21.33 in.)	526 mm (20.70 in.)	562 mm (22.12 in.)	
16 inch	555 mm (21.85 in.)	539 mm (21.22 in).	575 mm (22.64 in.)	572 mm (22.52 in.)
17 inch	570 mm (22.44 in.)	554 mm (21.81 in.)	590 mm (23.22 in).	587 mm (23.11 in.)
18 inch	583 mm (22.95 in.)	567 mm (22.32 in.)	603 mm (23.74 in.)	600 mm (23.62 in.)
Maximum variation between sides: 10 mm (0.4 in)				
Maximum deviation from specifications: 10 mm (0.4 in)				

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General

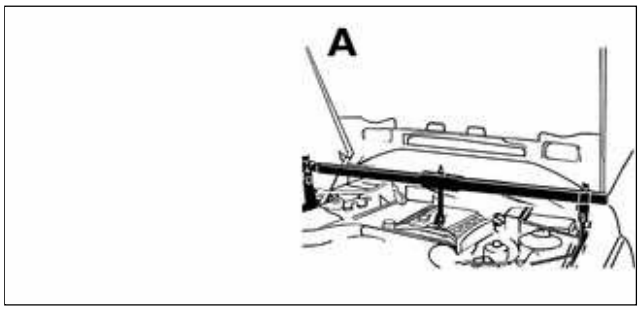
This repair group covers the repair and replacement of components that make up the front suspension of E46 cars.

See ⇒ 300 Suspension, Steering and Brakes-General for a description of the front suspension and components, as well as specification for setting ride height.

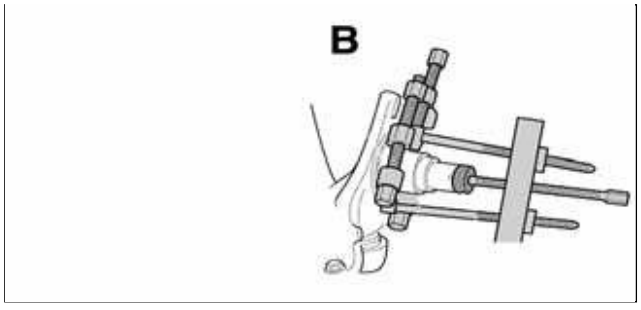
Special tools

Special service tools are required for most of the work described in this repair group. In addition to the tools depicted in the illustrations, a variety of press tools are necessary for control arm bushing replacement.

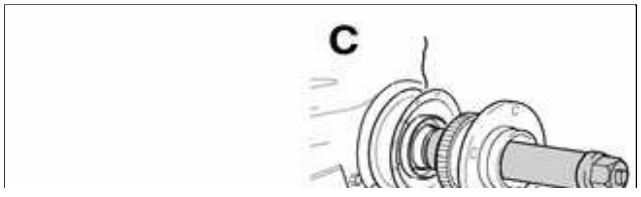
Read the procedures through before beginning any job.



- Engine support bracket BMW 00 0 200/00 0 205



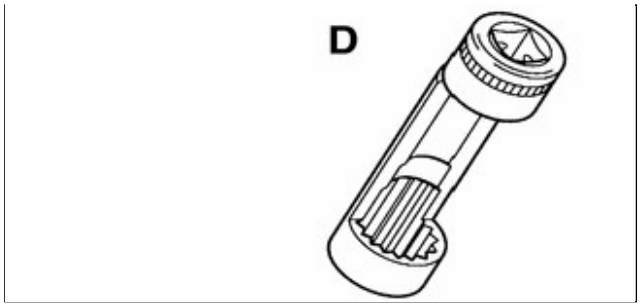
- Bearing puller BMW 00 7 500/31 2 106



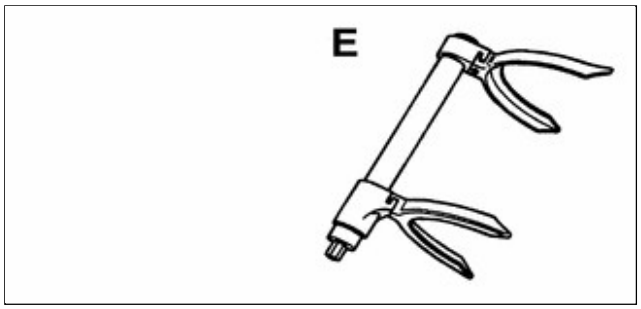
- Wheel bearing installation tool BMW 31 2 110

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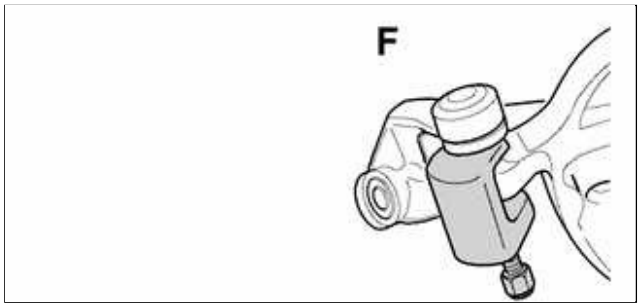




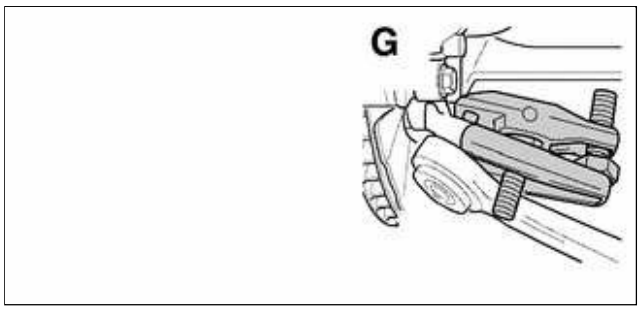
- Upper strut nut removal socket BMW 31 2 210



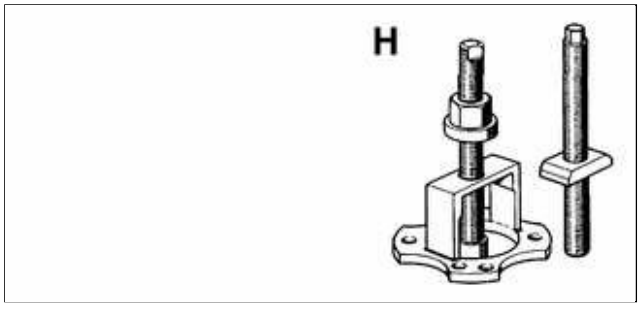
- Front coil spring compressor BMW 31 3 120



- Ball joint puller (all wheel drive BMW 32 2 040

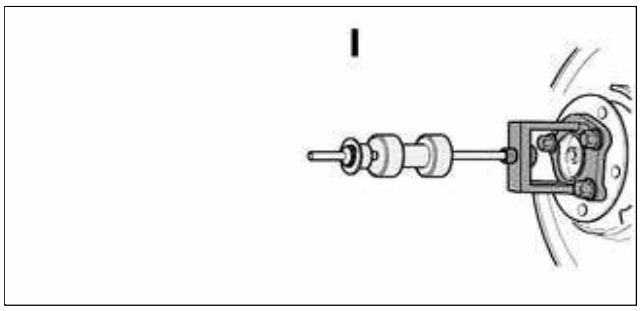


- Ball joint puller BMW 32 3 090

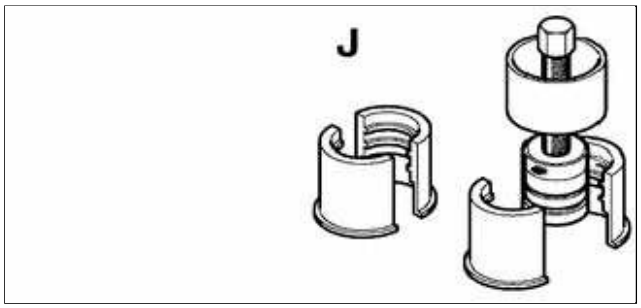


- Outer CV joint removal tool BMW 33 2 111/116/117

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- Slide hammer with adapter BMW 33 4 201/202/203 33 2 116



- Inner bearing race puller set BMW 33 4 400

Front suspension construction

Some front suspension components are constructed of weight saving materials. For example, the control arms (in rear wheel drive models) are forged aluminum. This allows for weight reduction in the car, as well as a lower unsprung mass for better handling. However, the aluminum construction prevents removal or replacement of the pressed-in ball joints.

WARNING!

- ***Physical safety could be impaired if procedures described here are undertaken without the proper service tools and equipment. Be sure to have the right tools on hand before beginning any job.***

- ***Do not reuse self-locking nuts or bolts. They are designed to be used only once and may fail if reused. Always replace***

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self-locking fasteners any time they are loosened or removed.

- ***Do not install bolts and nuts coated with undercoating wax, as the correct tightening torque cannot be assured. Always clean the threads with solvent before installation, or install new parts.***

- ***Do not attempt to weld or straighten any suspension components. Replace damaged parts.***

CAUTION!

- ***Due to the aluminum construction of the control arms, great care must be taken when working on and around the front suspension:***

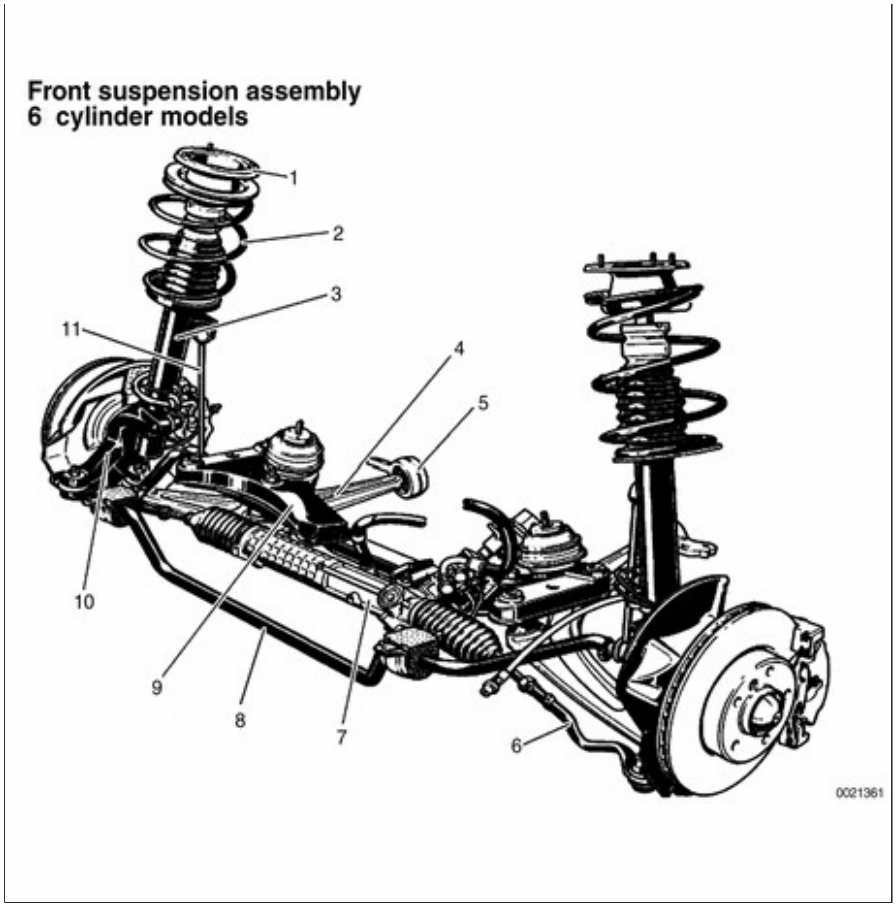
- ***When replacing any damaged front end components, always check the condition of the control arms***

- ***Do not clean control arms with wire brushes made of brass or iron. Only use brushes made of stainless steel.***

- ***Do not expose control arms to temperatures exceeding 80°C (176°F); sparks created by grinding; battery acid or other highly corrosive materials; or steel welding splashes.***

Front suspension

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assembly (6 cylinder models)

- **1 - Upper strut mount**
- **2 - Coil spring**
- **3 - Strut assembly**
- **4 - Control arm**
- **5 - Control arm bushing and mount**
- **6 - Tie rod**
- **7 - Steering rack**
- **8 - Front stabilizer bar**
- **9 - Front suspension subframe**
- **10 - Steering arm**
- **11 - Stabilizer bar link**

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Shock Absorbers and Springs

Note:

Setting the ride height is covered in ⇒ 300 Suspension, Steering and Brakes-General.

The front suspension shock absorbers in E46 cars are McPherson struts. The strut is a major component of the suspension and supports the spring. Most strut assembly components are available as replacement parts. Struts and/or springs should always be replaced in pairs.

Front strut, upper strut mount or spring replacement is a two-step procedure:

- Removal of strut assembly from vehicle
- Disassembly and replacement of components on workbench

Strut assembly, removing and installing

- Raise car and remove front wheel.

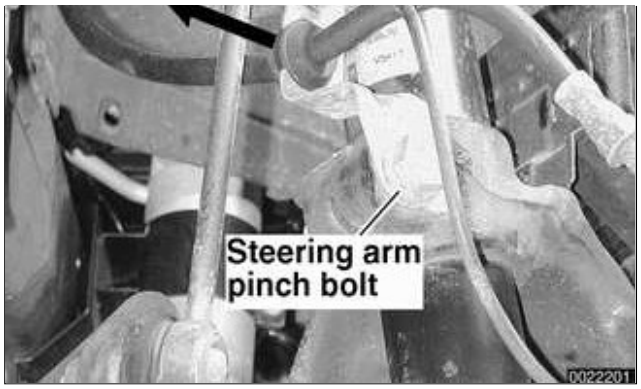
WARNING!

Make sure that the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.



➢ Pull brake fluid hose and ABS sensor wire harness off bracket at steering arm pinch bolt.

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Note:

Right side shown is in illustration. Left side bracket also holds brake pad wear sensor wire.

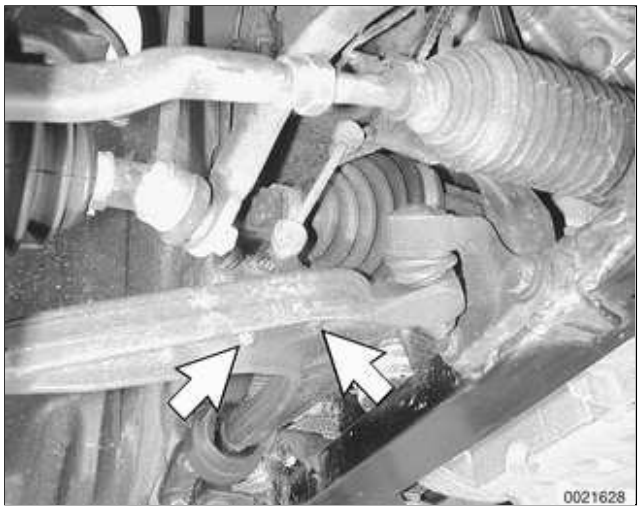
- Unbolt brake caliper assembly, keeping brake hose connected. Suspend brake caliper from chassis using stiff wire. See ⇒ 340 Brakes.



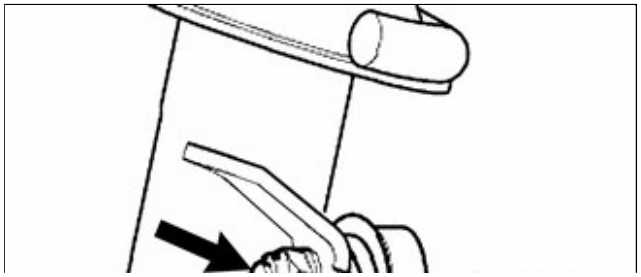
- Remove ABS wheel speed sensor mounting bolt (**arrow**). Slide sensor out of steering arm and lay aside.

Note:

Rear wheel drive vehicle shown in illustration.



- On cars equipped with xenon headlights: Remove headlight vertical aim sensor link bracket mounting nuts (**arrows**) from right control arm.

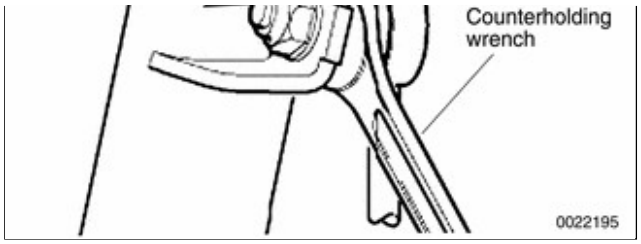


- Loosen and remove stabilizer bar link mounting nut (**arrow**) from strut. Detach link from strut housing.

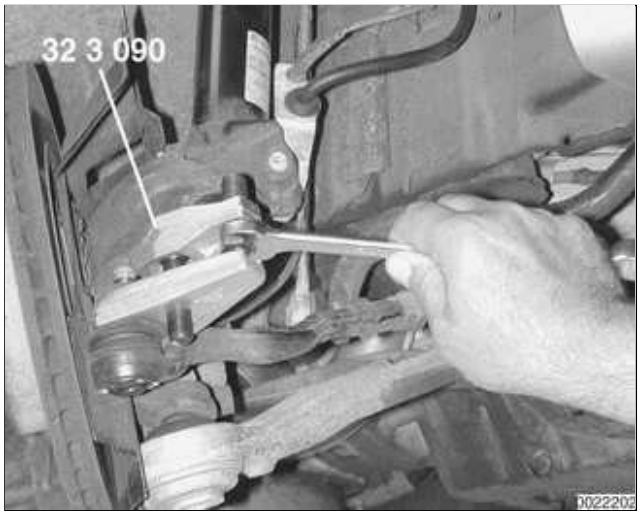
Note:

Use a thin wrench to counterhold shaft

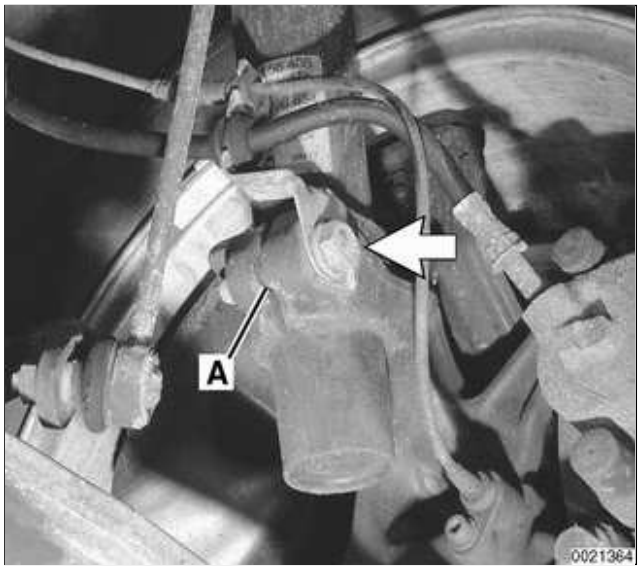
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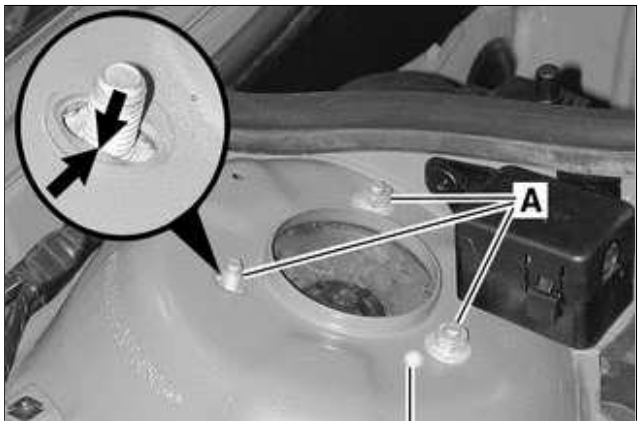
of stabilizer bar link ball joint while removing mounting nut.



- Remove tie rod outer end nut. Use BMW special tool 32 3 090 or equivalent to press tie rod end off steering arm.
  - Remove lower ball joint nut. Use BMW special tool 32 3 090 or equivalent to separate steering arm from control arm.

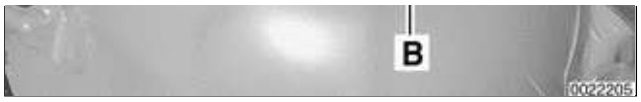


- Support steering arm from below. Loosen pinch bolt (**arrow**) at top of steering arm. Spread clamping collar at slot **A**, if necessary, to slide steering arm off strut assembly.



- Support strut assembly from below.
  - Working in engine compartment at strut tower, remove three strut mounting nuts (**A**) on strut tower.
  - If factory alignment locating pin (**B**) is missing, be sure to mark location of strut mounting studs in

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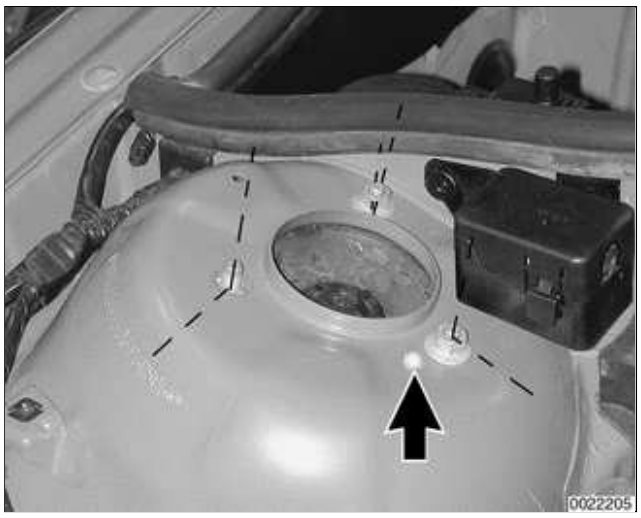


strut tower slots (**arrows**).

CAUTION!

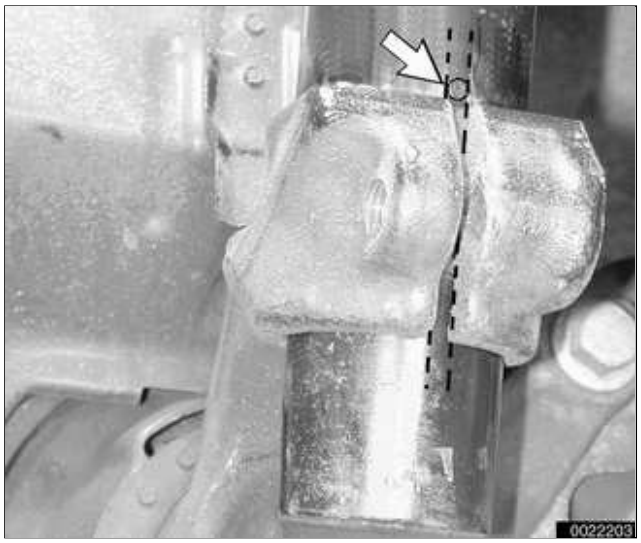
Do not remove center strut retaining nut.

- Lower strut assembly from car.



When installing strut assembly into car:

- Make sure locating pin (**arrow**) of strut bearing is positioned correctly in strut tower.
- If factory alignment locating pin is missing, make sure three upper mounting studs are positioned correctly in slotted holes according to marks made previously.



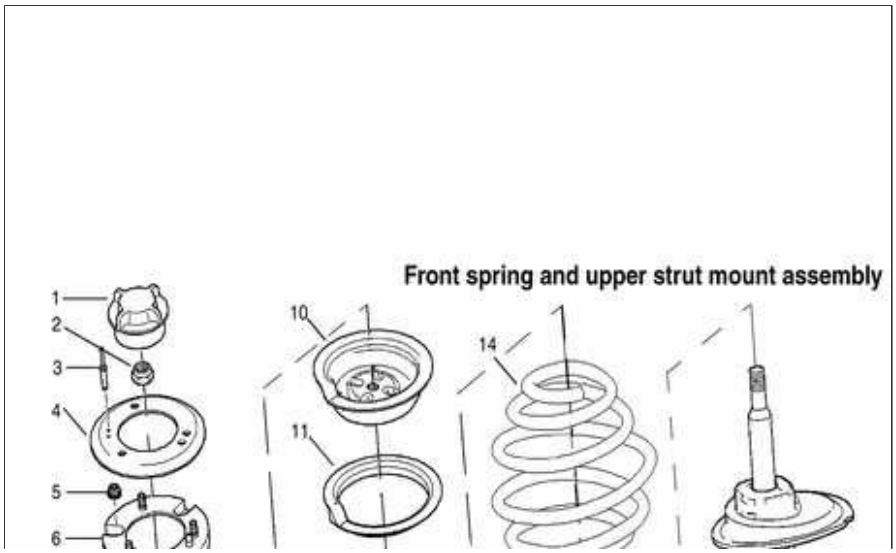
When installing steering arm to strut assembly, insert positioning pin (**arrow**) of strut into slot of steering arm clamping collar. To ensure proper alignment specifications, slide steering arm up on strut until stop is reached.

- Remainder of installation is reverse of removal.
- Be sure to use new self-locking nuts and bolts.
- Use new steering arm mounting bolts, or clean bolts and use Loctite® 270 or equivalent thread-locking compound.
- When attaching stabilizer link to strut, use a thin wrench to counterhold hold link ball joint while tightening nut.

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- Have car professionally aligned when job is complete.

Tightening torques	
Brake caliper to steering arm	110 Nm (81 ft-lb)
Road wheel to hub	100 ± 10 Nm (74 ± 7 ft-lb)
Stabilizer bar link to strut	59 Nm (44 ft-lb)
Steering tie rod to steering arm	65 Nm (48 ft-lb)
Steering arm to control arm	65 Nm (48 ft-lb)
Steering arm pinch bolt at strut housing	81 Nm (60 ft-lb)
Strut assembly to strut tower (self-locking nuts)	24 Nm (18 ft-lb)
Upper strut mount to strut tower, self-locking M8 flanged nut:	
18 mm flange	24 Nm (18 ft-lb)
21 mm flange	34 Nm (25 ft-lb)



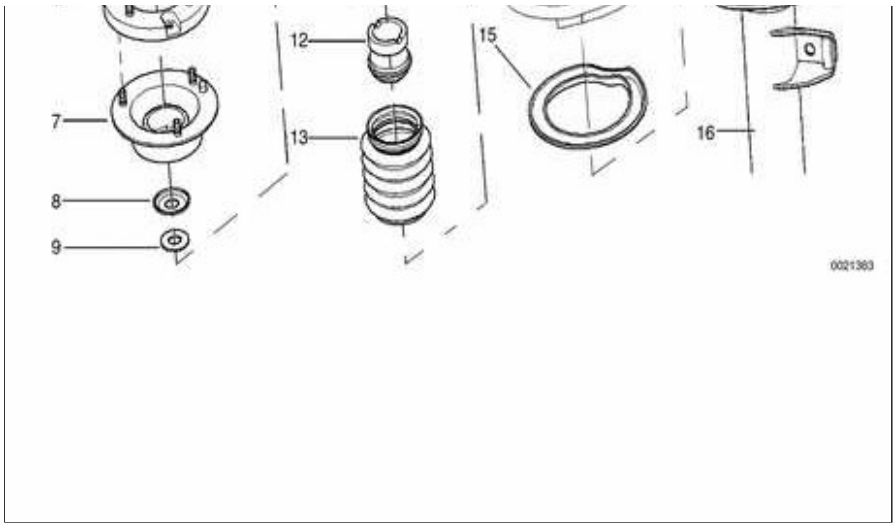
Front spring and upper strut mount assembly

1 - Cap

2 - Upper strut self locking nut M14

- tighten to 64 Nm (47 ft-lb)

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3 - **Rivet (all wheel drive or rough road package only)**

4 - **Strut bearing reinforcement (all wheel drive or rough road package only)**

5 - **Self locking flanged nut M8**

- tighten to:
- 24 Nm (18 ft-lb) (18 mm flange)
- 34 Nm (25 ft-lb) (21 mm flange)

6 - **Spacer plate (all wheel drive or rough road package only)**

7 - **Upper strut bearing**

8 - **Sealing ring**

9 - **Flat washer**

10 - **Upper spring seat**

11 - **Upper spring pad**

12 - **Rubber stop**

13 - **Dust seal**

14 - **Spring**

15 - **Lower spring**

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pad

16 - Strut

Strut assembly, disassembling and assembling

Replacing the strut, upper strut mount or spring requires that the strut assembly first be removed from the car and disassembled. For a guide to parts used during component replacement, see the accompanying diagram.

- Remove strut assembly as described earlier. Place in shop vice, or support securely.

- Using spring compressor, compress spring until spring force on upper mount is relieved.

WARNING!

- ***Do not attempt to disassemble the struts without a spring compressor designed specifically for this job.***

- ***Make sure the spring compressor grabs the spring fully and securely before compressing it.***

- Pry protective cover off top of strut assembly. Use BMW special tool 31 2 210 or equivalent socket to remove strut top (center) nut. Counterhold strut shaft using 6 mm Allen wrench.

- Remove upper strut bearing and

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related components.

- Replace strut, upper strut mount or spring, as needed.

Note:

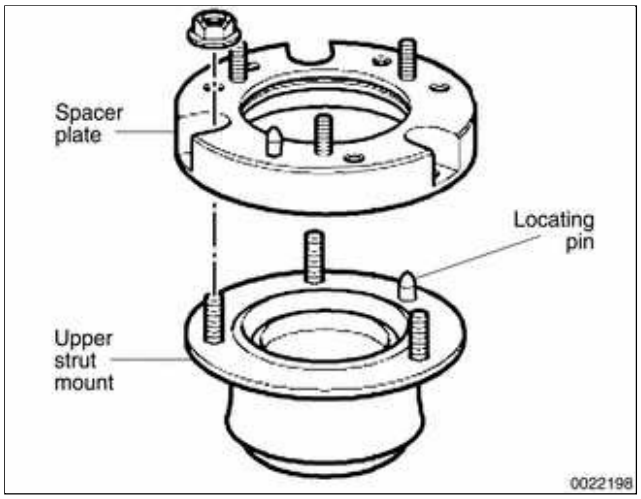
Springs and/or struts should always be replaced in pairs.



- Be sure that replacement struts are marked with the same code as the ones being removed.

Note:

Aftermarket struts are not marked.



- Vehicles with "rough road" package are equipped with a spacer plate above the upper strut mount. Make sure the strut mount locating pin fits in the corresponding bore of the spacer plate.

Note:

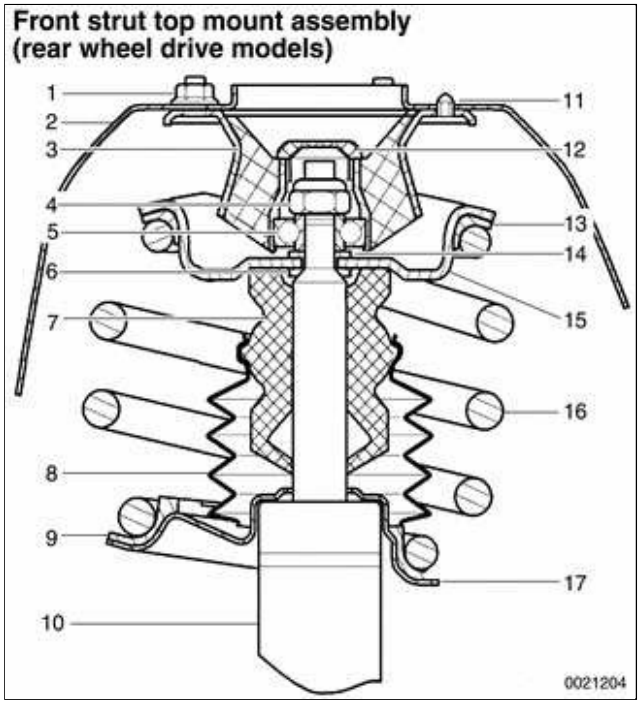
If there is no locating bore in the strut tower for the pin in the replacement upper strut mount to fit, drive out the pin before installing the new mount.



- Replace springs in pairs only. The part number (**A**) is stamped near the large end of the spring.

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Assembly is reverse of disassembly, noting the following:

- Line up slot in spring pad with corresponding slot in lower spring seat.
- Use a new upper strut self locking nut. Tighten nut fully before releasing spring compressor.
- Be sure upper spring pad is correctly installed to upper spring seat and spring end is correctly seated in upper and lower spring seats.
- Release spring compressor carefully and evenly, allowing spring to expand slowly.
- Have car professionally aligned when job is complete.

1 - Self locking nut M8 -tighten to: 24 Nm (18 ft-lb) (18 mm flange) 34 Nm (25 ft-lb) (21 mm flange)

2 - Strut tower

3 - Upper strut mount

4 - Upper strut self locking nut M14 -tighten to 64 Nm (47 ft-lb)

5 - Upper strut bearing

6 - Sealing ring

7 - Rubber bump-stop

8 - Dust shield

9 - Lower spring pad

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10 - Strut housing

11 - Locating pin

12 - Protective cap

13 - Upper spring pad

14 - Washer

15 - Upper spring seat

16 - Spring

17 - Lower spring seat

Tightening torque	
Upper strut mount to strut shaft M14 self-locking nut	64 Nm (47 ft-lb)

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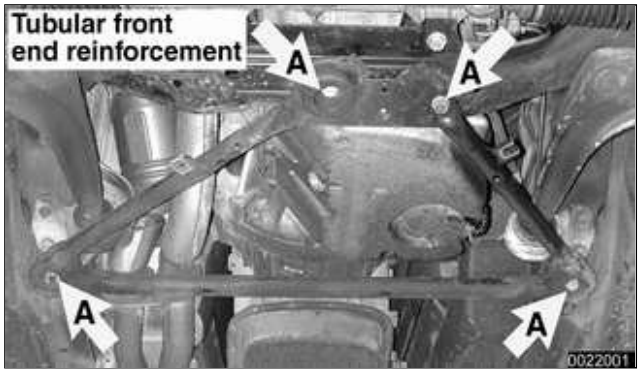
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Front End Reinforcement

In rear wheel drive models, a front end reinforcement is bolted to the rear of the subframe and attached to the frame rails.

CAUTION!

Do not drive vehicle without the front end reinforcement in place. Damage to the front suspension may result.



The tubular front end reinforcement is installed with 4 bolts (**A**) in the following cars:

- Rear wheel drive Sedan and Sport Wagon models manufactured until production date 12/2000.
- Coupe models manufactured until production date 11/1999.

- The aluminum plate type front end reinforcement is installed in the following cars:

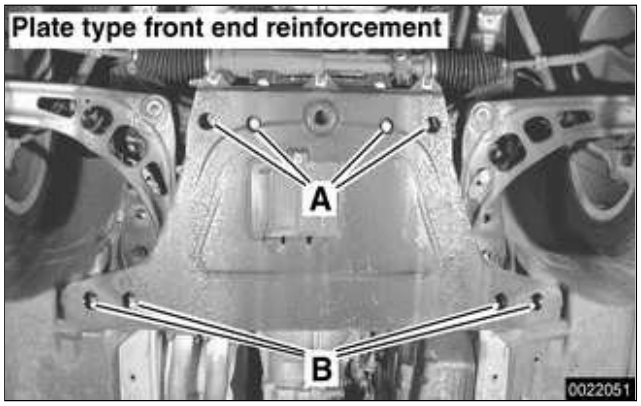
- All Convertible models
- Coupe models manufactured from production date 11/1999.
- Rear wheel drive Sedan and Sport Wagon models manufactured from production date 12/2000.

CAUTION!

After 2/2001, the front reinforcement plate was produced with larger cast depressions to accommodate the

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larger (66 mm) front control arm bushings. The difference in the early production and later plates can only be discerned by removing the plate.



- In order to safely use an early production plate in a car with larger bushings, insert appropriate sized washers between frame rails and reinforcement plate at bolts **B**.

- When reinstalling front end reinforcement:

- Replace mounting bolts.

- Torque bolts in 2 stages, as shown below. Use BMW special tool 00 9 120 or equivalent torque angle protractor.

Tightening torque	
Front end reinforcement to front subframe or body frame rails: M10 bolt (**A**or **B**) (always replace)	
Stage 1	59 Nm (43 ft-lb)
Stage 2	torque angle 90° + 30°

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Front Subframe

The front subframe provides rigid mounting points for the engine, suspension, and steering components. The subframe is not normally subject to wear and should only be replaced if structurally damaged.

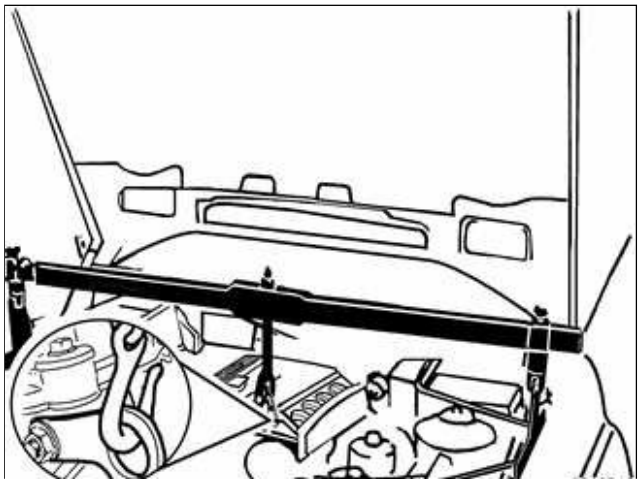
Rear wheel drive and all wheel drive models differ significantly in the design of the front subframe.

Removing the front subframe requires engine lifting equipment to support the weight of the engine from above so that the subframe can be removed from below.

CAUTION!

Removal or replacement of the subframe may affect suspension and steering geometry, including front wheel alignment. Make appropriate matching marks during removal and have the front end aligned once repairs are complete.

Front subframe, removing and installing (rear wheel drive models)



- Using engine support equipment, raise engine until weight of engine is supported.

  - Raise car and remove front wheels.

WARNING!

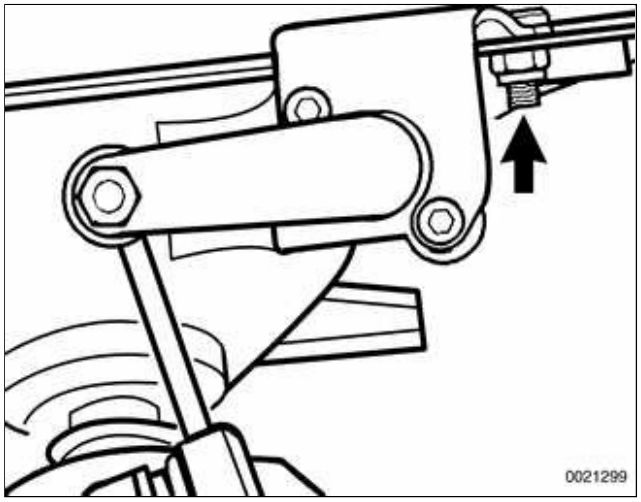
Make sure that the car is firmly supported on jack stands designed for the purpose. Place the jack

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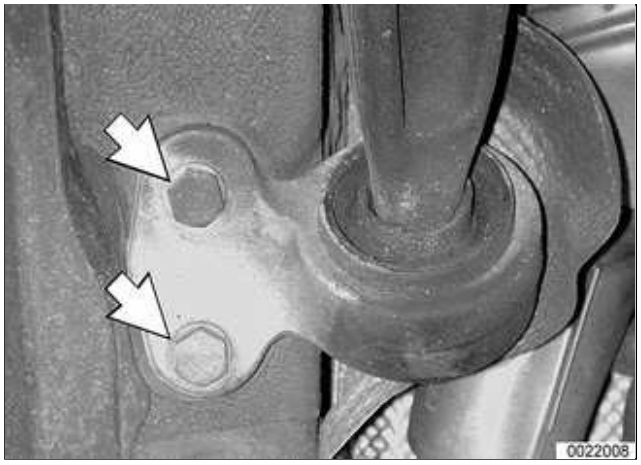
stands beneath a structural chassis point. Do not place jack stands under suspension parts.

- Remove splash shield under engine compartment.

- Remove front end reinforcement. See ⇒ Front End Reinforcement earlier in this group.

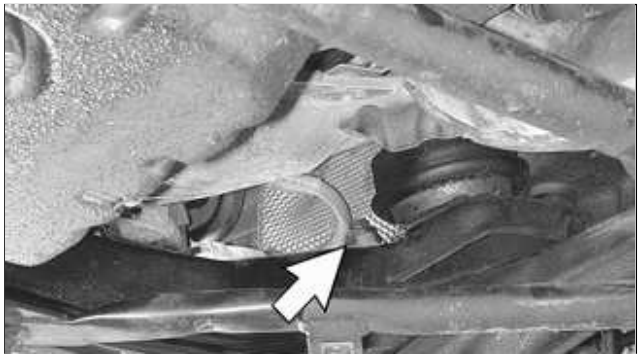


- On cars equipped with xenon headlights: Remove front ride level sensor mounting fastener (**arrow**) and lay sensor aside.



- Remove right front control arm bracket bolts (**arrows**) from frame rail.

  - Repeat for left side.



- Remove right inner control arm ball joint mounting nut (**arrow**) at subframe.

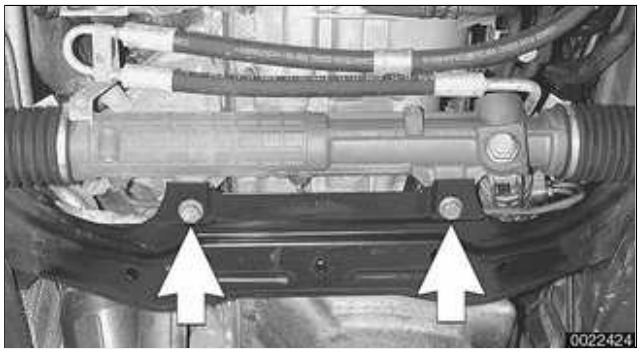
  - Drive ball joint shaft out of subframe using soft hammer.

  - Push control arm aside.

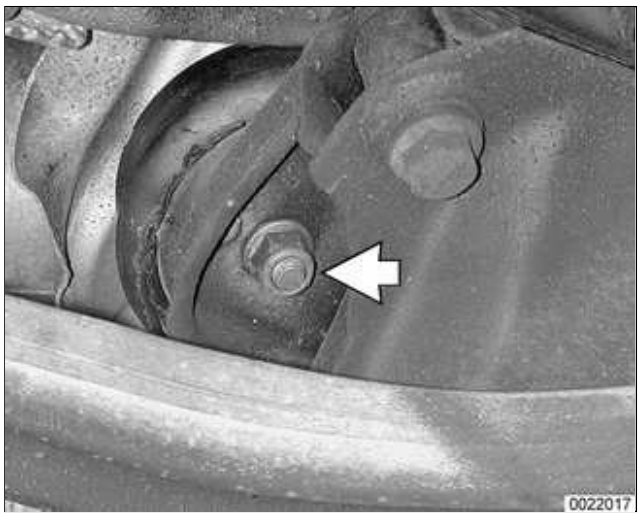
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- Repeat for left side.

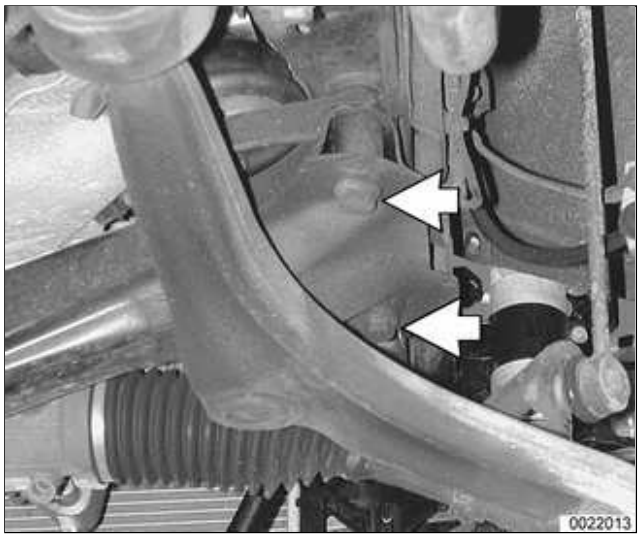


- Remove steering rack mounting bolts (**arrows**) at front of subframe. Suspend rack out of the way with stiff wire.



- Remove right lower engine mount fastener (**arrow**).

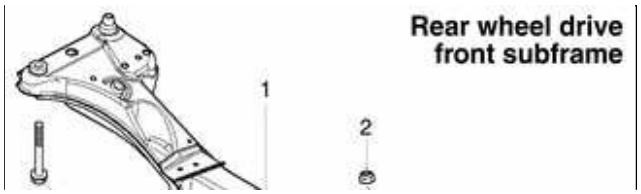
  - Repeat on left side



- Support suspension subframe from below using appropriate jacking equipment. Remove subframe mounting bolts (**arrows**). Remove subframe.

  Note:

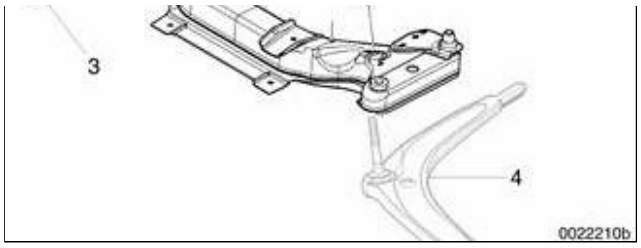
  Right side is shown in photo. Left is similar.



- Installation is reverse of removal, noting the following:

  - Make sure all bolts, bolt holes,

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and mating surfaces are clean to ensure proper tightening and alignment. Use new self-locking nuts or bolts, where applicable.

- Lower engine onto engine mounts, allowing it to settle fully before tightening engine mount bolts.

- When the job is completed, have front end professionally aligned.

1 - Front subframe

2 - inner ball joint nut -tighten to 90 Nm (66 ft-lb)

3 - Subframe mounting bolt (See torque table.)

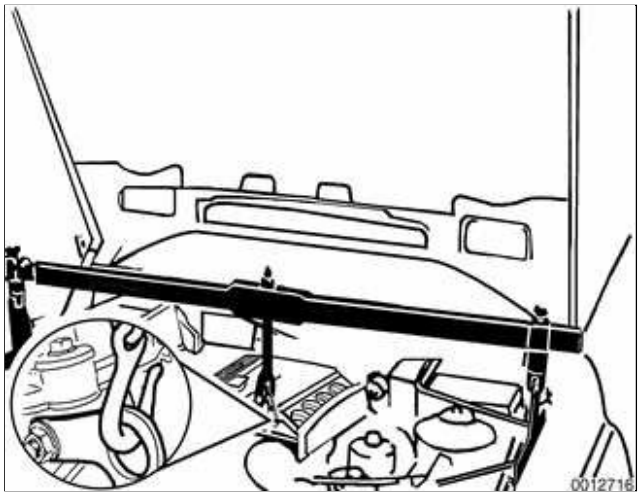
4 - Control arm

Tightening torques	
Control arm ball joint to subframe M14 self-locking nut (always replace)	90 Nm (66 ft-lb)
Control arm bushing carrier to body M10 bolt (always replace)	59 Nm (43 ft-lb)
Front end reinforcement to front subframe or body frame rails: M10 bolt (always replace)	
Stage 1	59 Nm (43 ft-lb)
Stage 2	torque angle 90° + 30°
Steering rack to subframe (M10 bolt)	42 Nm (31 ft-lb)
Subframe to body	
M12-8.8 bolts	77 Nm (57 ft-lb)

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Tightening torques	
M12-10.9 bolts	110 Nm (81 ft-lb)
M12-12.9 bolts	105 Nm (77 ft-lb)

Front subframe, removing and installing (all wheel drive models)

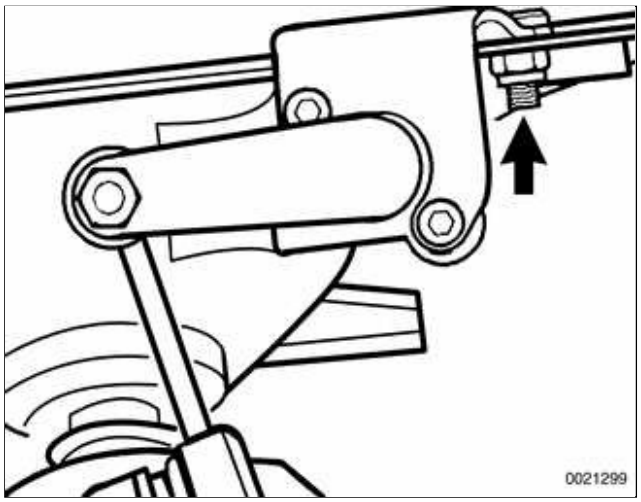


- Using engine support equipment, raise engine until weight of engine is supported.
  - Raise car and remove front wheels.

WARNING!

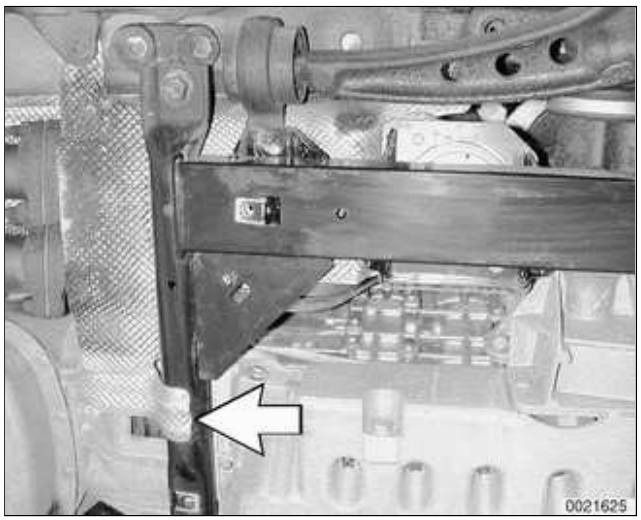
Make sure that the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.

  - Remove splash shield under engine compartment.

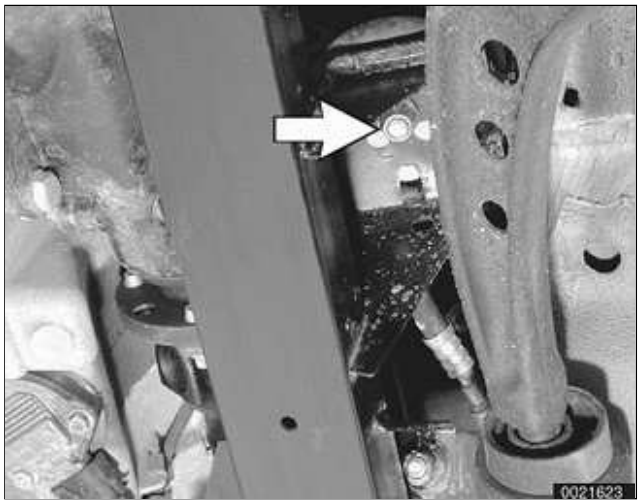


- On cars equipped with xenon headlights: Remove front ride level sensor mounting fastener (**arrow**) and lay sensor aside.

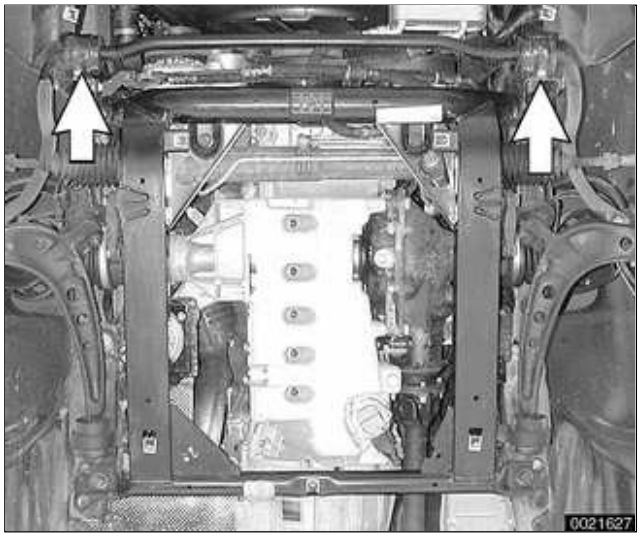
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- Working at rear right corner of front subframe, unhook heatshield from subframe (**arrow**).



- Remove left engine mount fastener (**arrow**).
  - Repeat for right side.
  - Working at right front of subframe, detach power steering lines.



- Remove stabilizer bar anchor fasteners (**arrows**) from front corners of subframe. Suspend stabilizer bar from chassis using stiff wire.

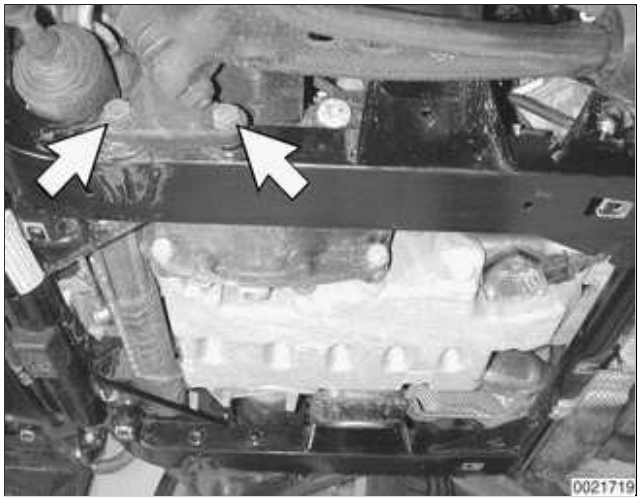


- Working at left rear corner of subframe, remove control arm rear bracket mounting bolts (**arrows**).

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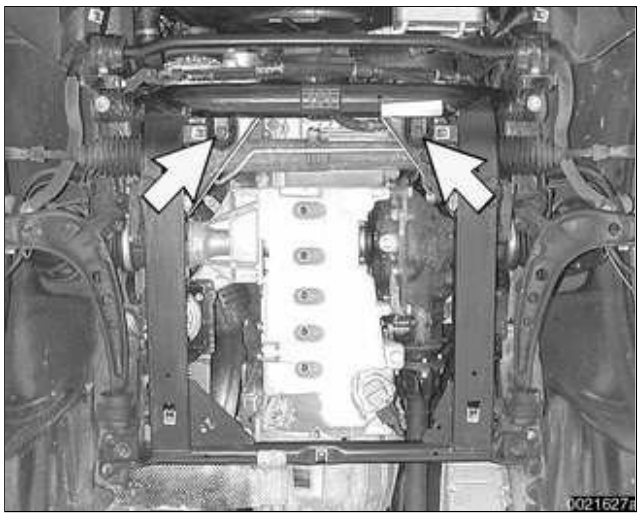
- Repeat for right side.



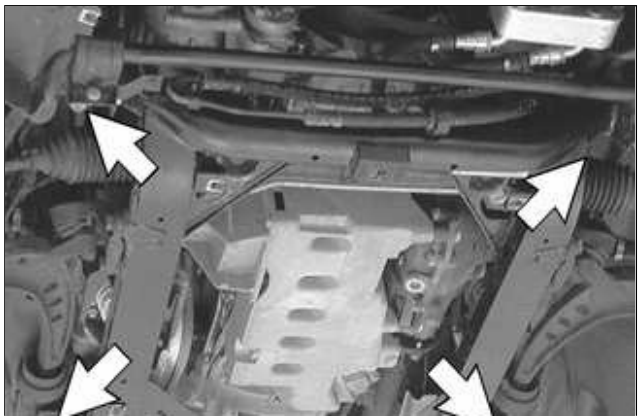
- Working at left side of subframe, remove inner control arm ball joint mounting bracket bolts (**arrows**) from subframe. Hang control arm using stiff wire.

WARNING!

Do not allow the control arm to hang from the outer (steering arm) ball joint. This can damage the ball joint.



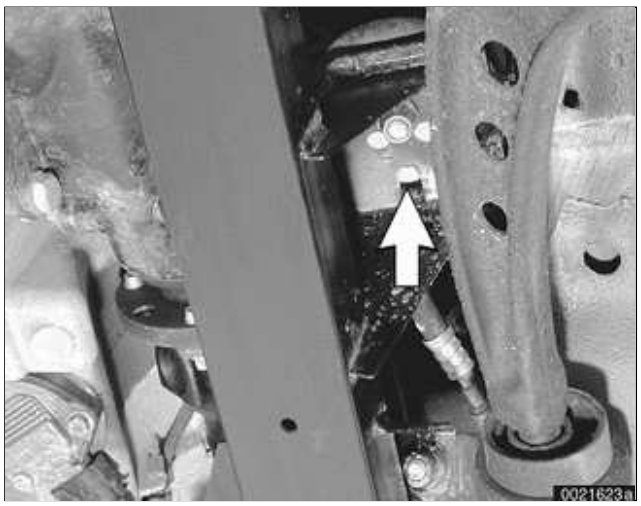
- Working underneath subframe, remove steering rack mounting bolts (**arrows**). Suspend rack with stiff wire.



- Support subframe from below. Remove subframe mounting bolts (**arrows**).
  - Slowly lower subframe, making sure heat shields, wiring harnesses and other underbody components are clear during removal.

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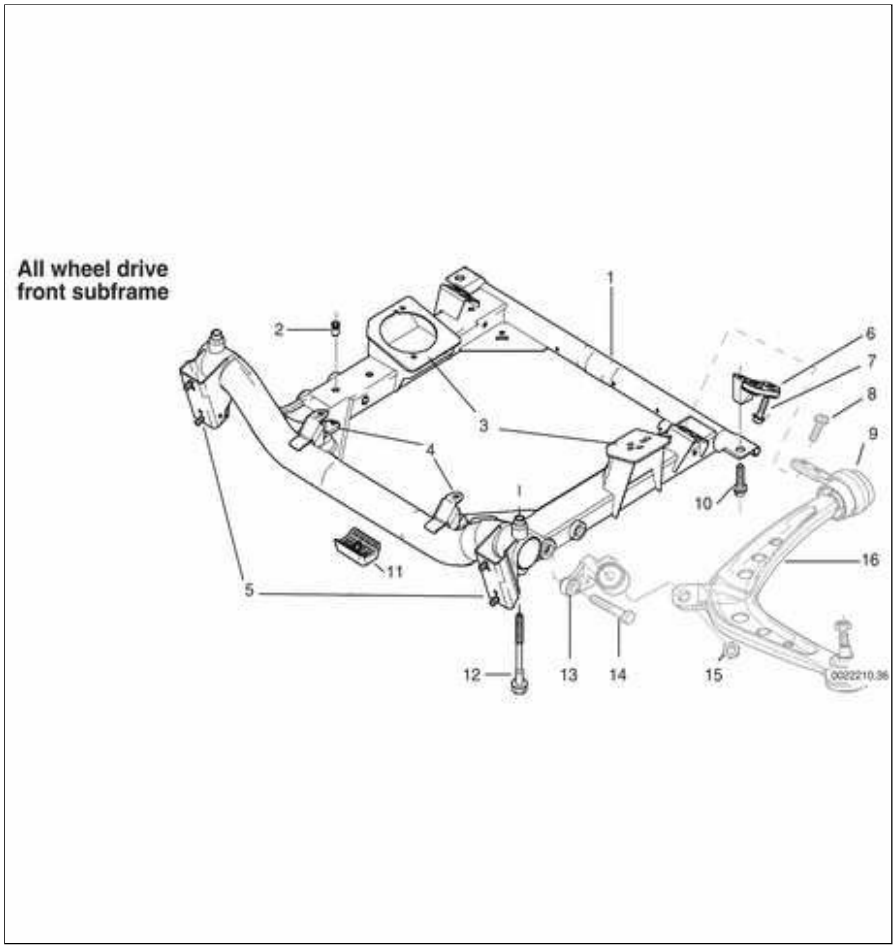
Installation is reverse of removal, noting the following:

- Make sure all bolts, bolt holes, and mating surfaces are clean to ensure proper tightening and alignment. Use new self-locking nuts or bolts, where applicable.
- Lower engine onto engine mounts, making sure locating pin on left mount (**arrow**) seats correctly in slot of subframe boss.
- Allowing engine to settle fully on mounts before tightening engine mount fasteners.
- When the job is completed have front end professionally aligned.

Tightening torques	
Control arm rear bracket to subframe M10 bolt (always replace)	59 Nm (44 ft-lb)
Engine mount to subframe M10 self locking nut	45 Nm (33 ft-lb)
Inner ball joint to control arm M14 self-locking nut (always replace)	80 Nm (59 ft-lb)
Inner ball joint mount to subframe M12 bolt	77 Nm (57 ft-lb)
Stabilizer anchor to subframe (M8)	22 Nm (16 ft-lb)

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Tightening torques	
Steering rack to subframe (M10 bolt)	42 Nm (31 ft-lb)
Subframe adapter to body M10 bolt (always replace)	59 Nm (44 ft-lb)
Subframe front to body	
M12-8.8 bolt	77 Nm (57 ft-lb)
M12-10.9 bolt	110 Nm (81 ft-lb)
M12-12.9 bolt	105 Nm (77 ft-lb)
Subframe rear to adapter M12 bolt (always replace)	110 Nm (81 ft-lb)



All wheel drive front subframe

1 - Front subframe

2 - Blind rivet nut

3 - Engine mounting flange

4 - Steering rack mounting flange

5 - Stabilizer bar mounting

6 - Subframe to body adapter

7 - Bolt M10 (always replace)

♦ tighten to 59 Nm (44-ft-lb)

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8 - **Bolt M10 (always replace)**

- tighten to 59 Nm (44 ft-lb)

9 - **Control arm rear bracket**

10 - **Bolt M12 (always replace)**

- tighten to 110 Nm (81 ft-lb)

11 - **Jack point**

12 - **Subframe mounting bolt M12 (see torque table)**

13 - **Control arm inner ball joint**

14 - **Bolt M12**

- tighten to 77 Nm (57 ft-lb)

15 - **Self locking nut M14 (always replace)**

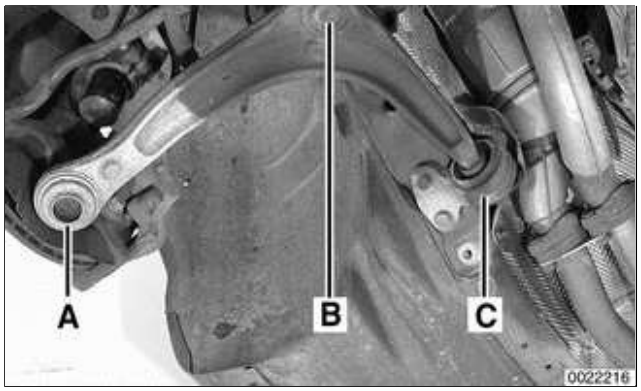
- tighten to 80 Nm (59 ft-lb)

Control Arms



In all models each front control arm has three attachment points:

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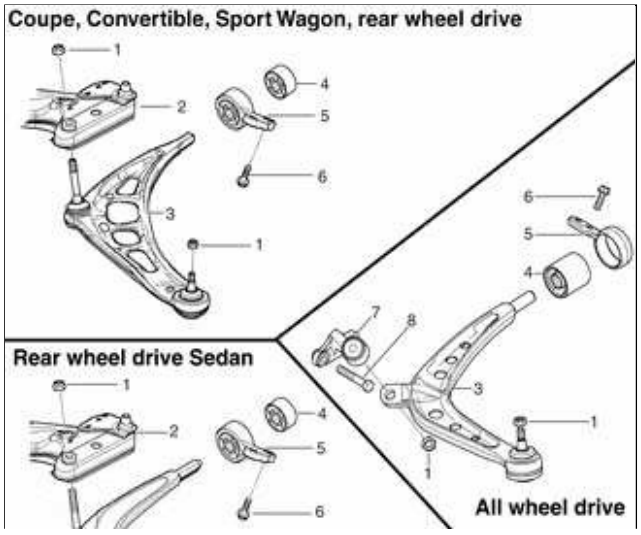
- **A** Outer ball joint attached to steering arm
- **B** Inner ball joint attached to front subframe
- **C** Bushing and bracket attached to the frame rail (rear wheel drive models) or front subframe (all wheel drive models)

Note:

Rear wheel drive front control arm is shown in the illustration.

On all models the rear bushing of the control arm is available as a replacement part.

On rear wheel drive models, both ball joints are pressed into the control arm at the factory. On all wheel drive models, the outer (steering arm) ball joint is pressed in. Because of the aluminum construction of the control arm, pressed-in ball joints are not removable. In case of pressed-in ball joint wear or damage, the complete control arm must be replaced. The control arm with ball joint(s) is available as a replacement unit from BMW.



E46 cars have been equipped with three different styles of control arm. Make sure a replacement control arm is identical to the original.

1 - Ball joint nut

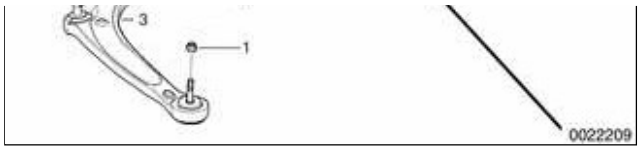
2 - Front subframe

3 - Control arm

4 - Bushing

5 - Bushing bracket

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6 - Bracket mounting bolt

7 - Inner ball joint (all wheel drive only)

8 - Ball joint mounting bolt

Control arm, removing and installing (rear wheel drive models)

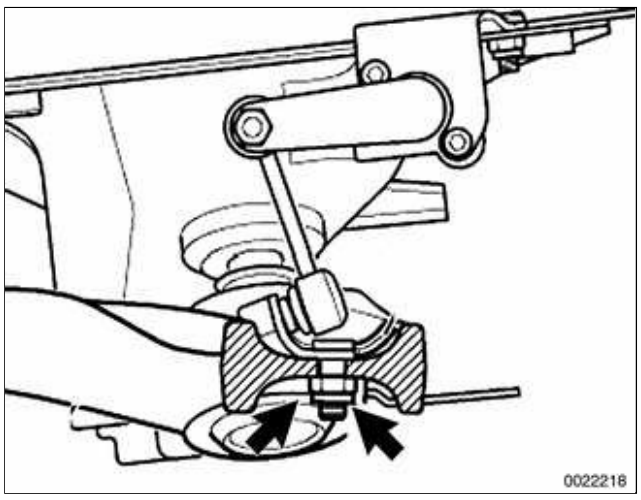
- Raise car and remove wheel.

WARNING!

Make sure that the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.

- Remove splash shield under engine compartment.

- Remove front end reinforcement.

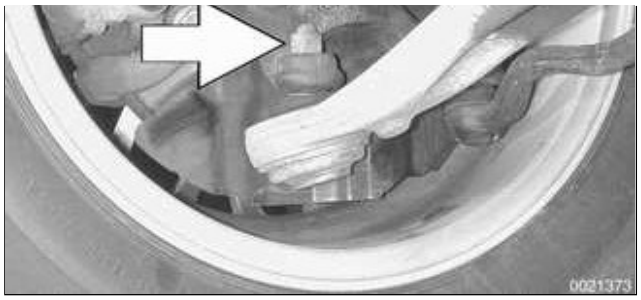


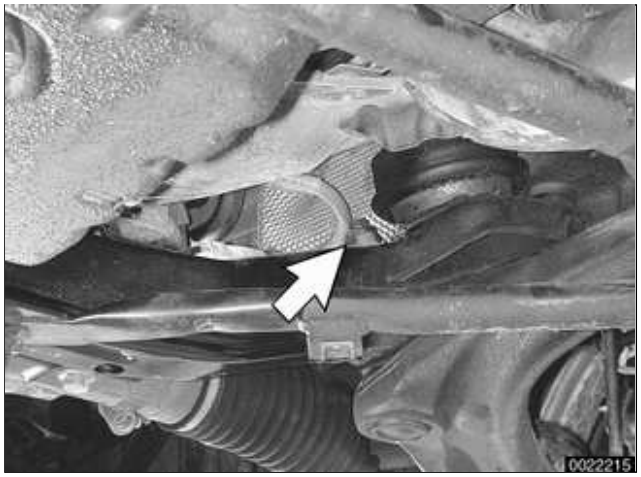
➢ On cars equipped with xenon headlights: Remove self levelling headlight sensor mounting nuts (**arrows**) from right control arm.



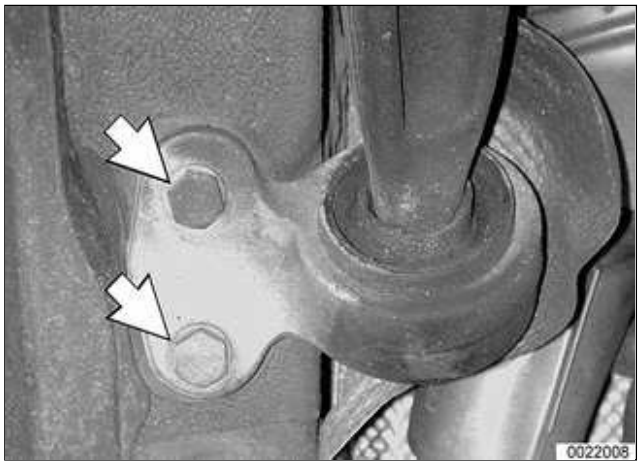
➢ Working at steering arm, remove outer ball joint nut (**arrow**). Use BMW special tool 32 3 090 or equivalent to separate steering arm from control arm.

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- Remove control arm inner ball joint mounting nut (**arrow**) at subframe.
  - Drive ball joint shaft out of subframe using soft faced hammer.



- Support control arm while removing control arm bracket bolts (**arrows**) from frame rail.
  - Remove control arm.
  - Inspect rear bracket rubber bushing for wear.
  - Check ball joints for damage, looseness, or torn boots.
  - Replace control arm if ball joints are damaged.

CAUTION!

- ***If a control arm is deformed due to an accident, inspect the inner ball joint mounting bore in the subframe for damage or eccentricity.***

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- ***If one control arm rear rubber bushing is damaged, bushings on both sides must be replaced.***

Note:

Control arm rear bushing replacement is covered later in this group.

- Installation is reverse of removal, noting the following:

- Make sure all thread bores, bolts, nuts and mating surfaces are clean.

- Use new self-locking nuts or bolts, where applicable.

- Have vehicle alignment checked after assembly. nothing

WARNING!

Do not reuse self-locking nuts or bolts. They are designed to be used only once and may fail if reused.

Tightening torques	
Control arm rear bracket to frame rails M10 bolt (always replace)	59 Nm (44 ft-lb)
Front end reinforcement to front subframe or body frame rails: M10 bolt (always replace)	
Stage 1	59 Nm (44 ft-lb)
Stage 2	torque angle 90° + 30°
Inner ball joint to subframe M14 self-locking nut (always replace)	90 Nm (66 ft-lb)

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Tightening torques	
Outer ball joint to steering arm M12 self-locking nut (always replace)	65 Nm (48 ft-lb)
Road wheel to hub	100 ± 10 Nm (74 ± 7 ft-lb)

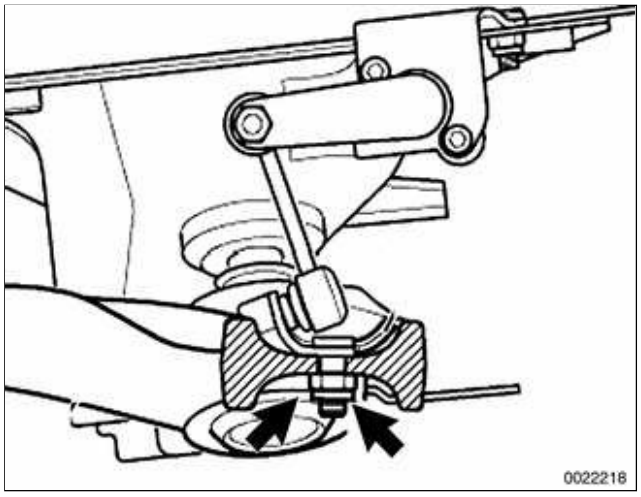
Control arm, removing and installing (all wheel drive models)

- Raise car and remove wheel.

WARNING!

Make sure that the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.

- Remove splash shield under engine compartment.



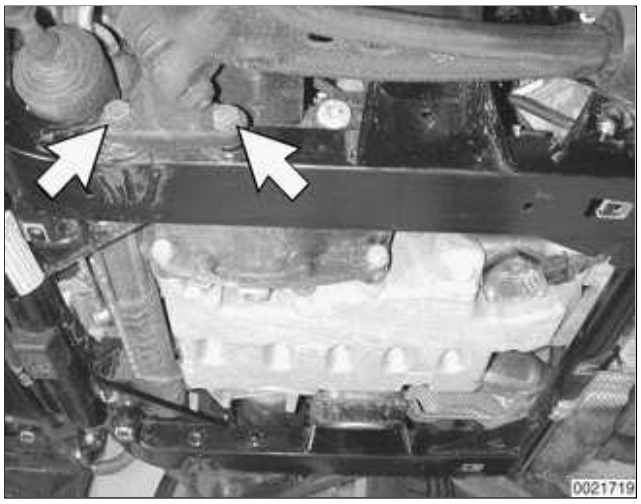
➢ On cars equipped with xenon headlights: Remove headlight vertical aim sensor mounting nuts (**arrows**) from right control arm.



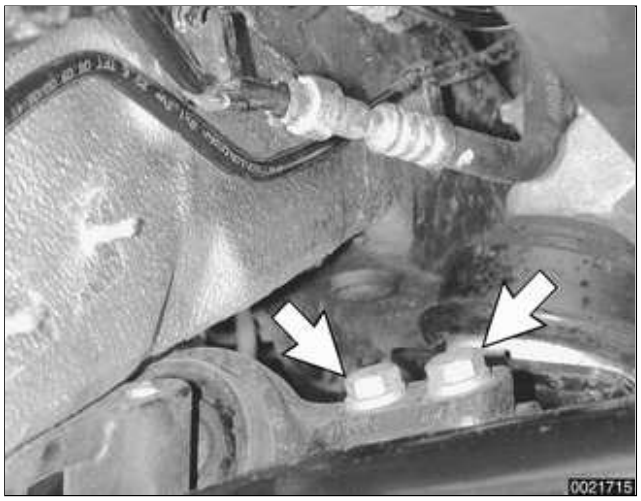
➢ Working at steering arm, remove outer ball joint nut (**arrow**). Use BMW special tool 32 3 090 or equivalent to separate steering arm from control arm.

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- Remove inner ball joint mounting bracket bolts (**arrows**) from subframe.



- Support control arm. Working at rear of subframe, remove control arm rear bracket mounting bolts (**arrows**).

  - Remove control arm.

  - Inspect rear bracket rubber bushing for wear.

  - Check ball joints for damage, looseness, or torn boots.

  - Replace control arm if outer (steering arm) ball joint is damaged.

CAUTION!

If a control arm rear rubber bushing is damaged, both bushings must be replaced.

Note:

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Inner ball joint and control arm rear bushing replacement is covered later in this group.

- Installation is reverse of removal, noting the following:

- Make sure all thread bores, bolts, nuts and mating surfaces are clean.
- Use new self-locking nuts or bolts, where applicable.
- Have vehicle alignment checked after assembly. nothing

WARNING!

Do not reuse self-locking nuts or bolts. They are designed to be used only once and may fail if reused.

Tightening torques	
Control arm rear bracket to subframe M10 bolt (always replace)	59 Nm (44 ft-lb)
Inner ball joint mount to subframe M12 bolt	77 Nm (57 ft-lb)
Outer ball joint to steering arm M12 self-locking nut (always replace)	65 Nm (48 ft-lb)
Road wheel to hub	100 ± 10 N (74 ± 7 ft-lb)

Inner ball joint, replacing (all wheel drive models)

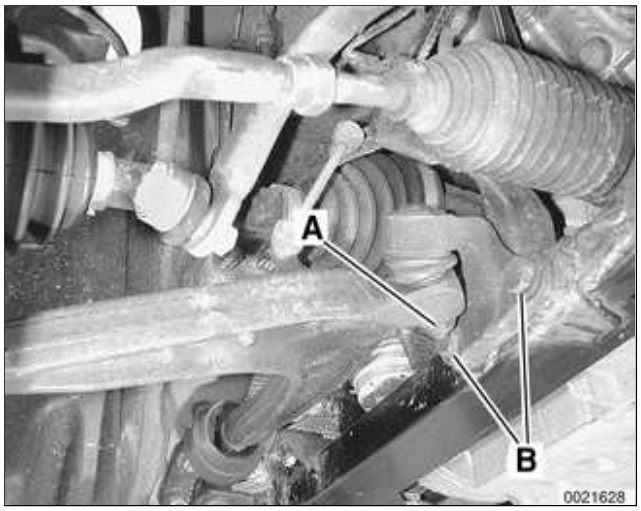
- Raise car and support safely

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WARNING!

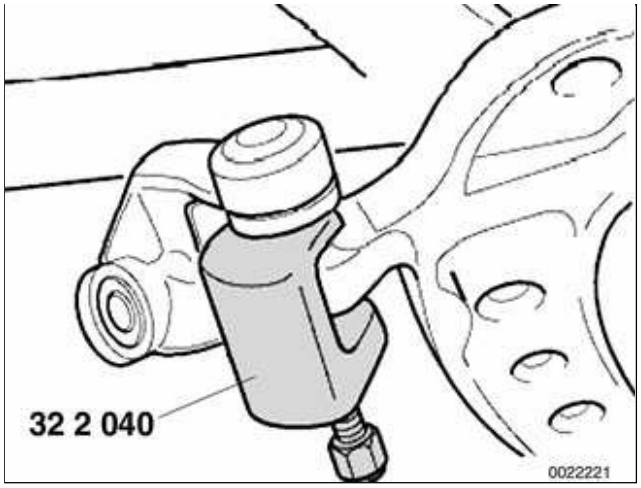
Make sure that the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.

- Remove splash shield under engine compartment.



➢ Remove inner ball joint fasteners from control arm and subframe.

- ♦ Remove nut (**A**) from ball joint shaft.
- ♦ Remove bolts (**B**) from subframe.



➢ Use BMW special tool 32 2 040 or equivalent to separate ball joint from control arm.

- Installation is reverse of removal, noting the following:
- ♦ Make sure thread bores, bolts, nuts and mating surfaces are clean.
- ♦ Use new self-locking nuts or bolts.

Tightening torques	
Inner ball joint mount to subframe M12 bolt	77 Nm (57 ft-lb)

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Tightening torques	
Inner ball joint to control arm M14 self-locking nut (always replace)	80 Nm (59 ft-lb)

Control arm bushings, rear wheel drive

CAUTION!

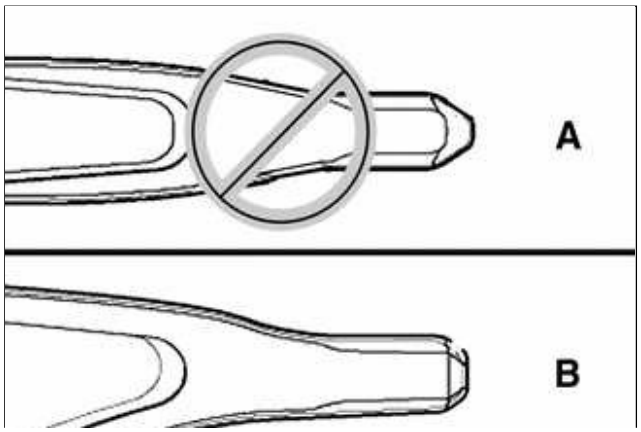
- ***Never reuse a rubber bushing that has been pulled off the control arm. The rubber coated inner sleeve is destroyed when it is pulled off dry.***

- ***Check with an authorized BMW parts dealer for the latest information about control arm bushing applications on E46 cars.***

Control arm bushings should always be replaced in pairs. The two bushings and bushing carriers should have the same markings, indicating same manufacturer.

- To gain access to bushing, remove control arm as described earlier.

- Use puller to remove rear bracket and bushing from control arm.



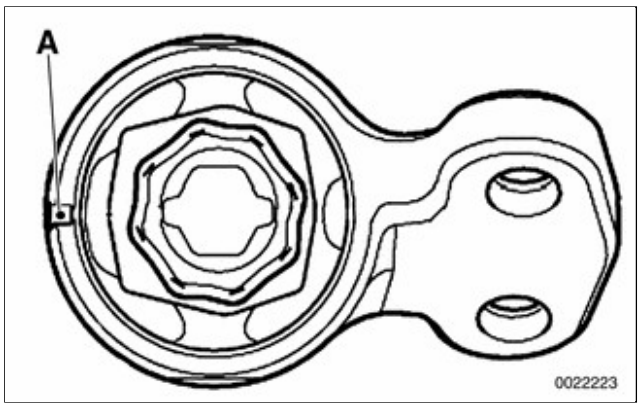
Inspect pin (rubber bushing) end of control arm. Replace control arm with end **A**.

Note:

*Control arms with pin shape **A** have been superseded by parts with pin shape **B**.*

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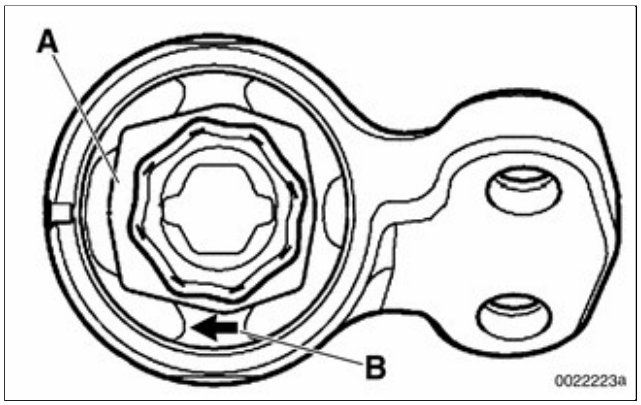




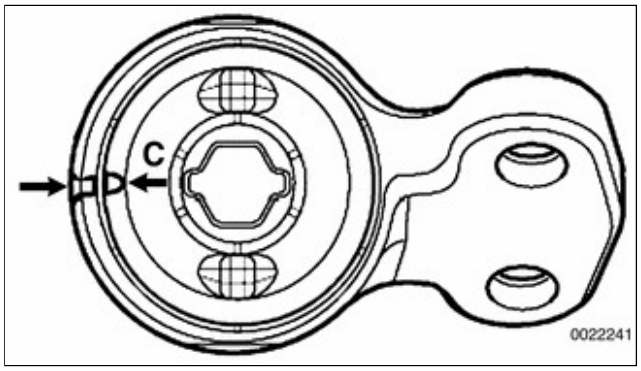
- Inspect bushing bracket. Replace bracket if there is a center punch mark at boss **A**.

WARNING!

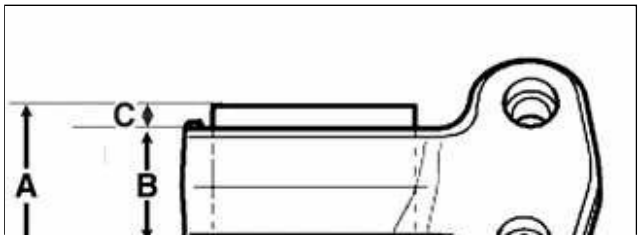
If a bushing bracket with the center punch mark is reused with a new bushing, the bushing may fall out.



-



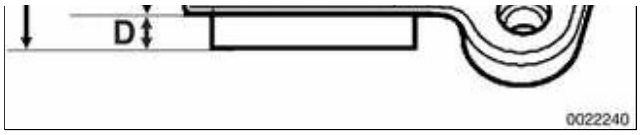
- Use press tools to remove old bushing and press in new. Be sure to line up marks on new bushing with boss on bracket. Depending on manufacturer, mark on bushing may consist of:
  - Extra buffer on inner part of bushing (**A**)
  - Arrow on rubber webbing of bushing (**B**)
  - Indent on outer casing of bushing (**C**)



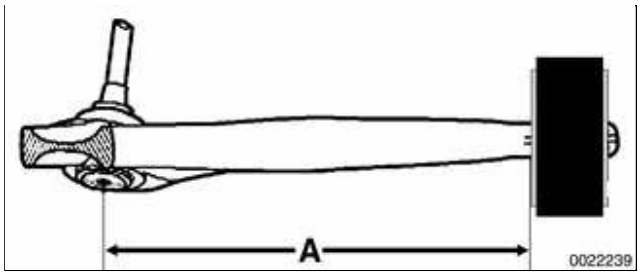
- New bushing must be pressed in so that it protrudes the correct distance from edges of bracket. See ⇒ Table a.

Table a. Control arm bushing

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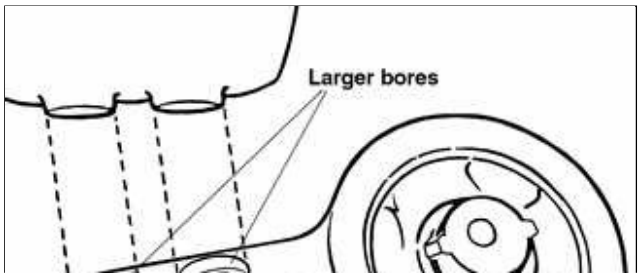


protrusion (rear wheel drive models)		
Dimension	**60 mm bushing**	**66 mm bushing**
A = Total bushing length (nominal)	50.5 mm (1.99 in.)	53.5 mm (2.11 in.)
B = Bracket width (nominal)	34.0 mm (1.36 in.)	
C = Fixed measurement	8.5 mm (0.33 in.)	12.0 mm (0.47 in.)
D = Protrusion	8.0 mm (0.31 in)	7.5 mm (0.29 in.)



- When installing bushing on control arm:
  - Use soapy water on control pin and rubber bushing to facilitate assembly.
  - Make sure dimension **A**(distance from inner ball joint to edge of control arm bushing) is correct after assembly. See ⇒ Table b.

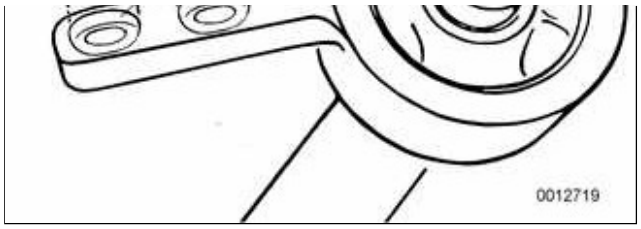
Table b. rear wheel drive models)	
Bushing diameter or model	**Bushing distance A**
60 mm	289 ± 1 mm (11.38 ± 0.04 in.)
66 mm	290.9 ± 1 mm (11.45 ± 0.04 in.)



- Be sure to reinstall bushing bracket to frame rail correctly, with larger centering bores facing up toward body.

Tightening torque	
Control arm rear	59 Nm (44 ft-lb)

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Tightening torque	
bracket to frame rail M10 bolt (always replace)	

Control arm bushings, all wheel drive

CAUTION!

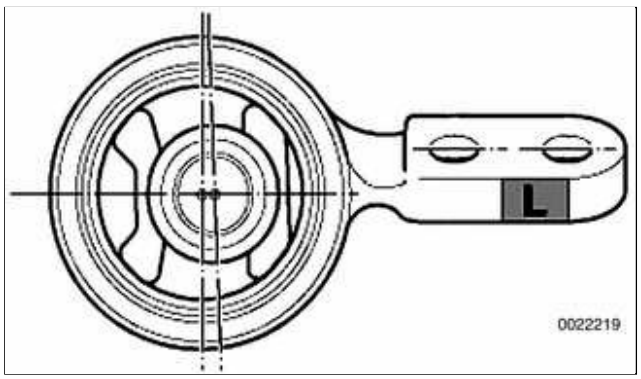
- ***Never reuse a rubber bushing that has been pulled off the control arm. The rubber coated inner sleeve is destroyed when it is pulled off dry.***

- ***Check with an authorized BMW parts dealer for the latest information about control arm bushing applications on E46 cars.***

Control arm bushings should always be replaced in pairs. The two bushings and bushing carriers should have the same markings, indicating same manufacturer.

- To gain access to bushing, remove control arm as described earlier.

- Use puller to remove rear bracket and bushing from control arm.



➢ Use press tools to remove old bushing and press in new.

- Align bushing with bracket as shown in accompanying illustration.

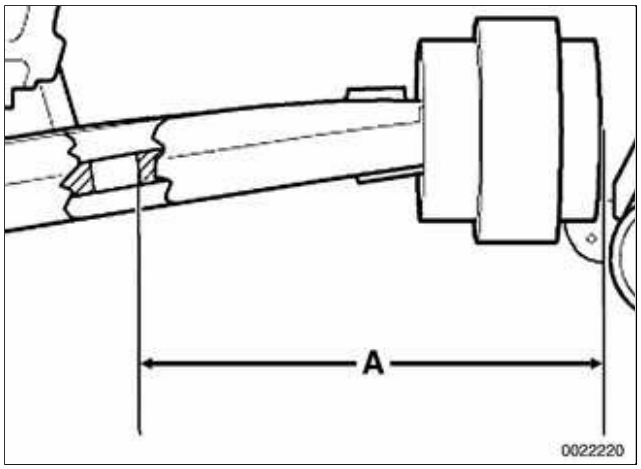
Note:

Brackets are marked L or R for left or right.

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CAUTION!

Never reuse a rubber bushing that has been pulled off the control arm. The rubber coated inner sleeve is destroyed when it is pulled off dry.

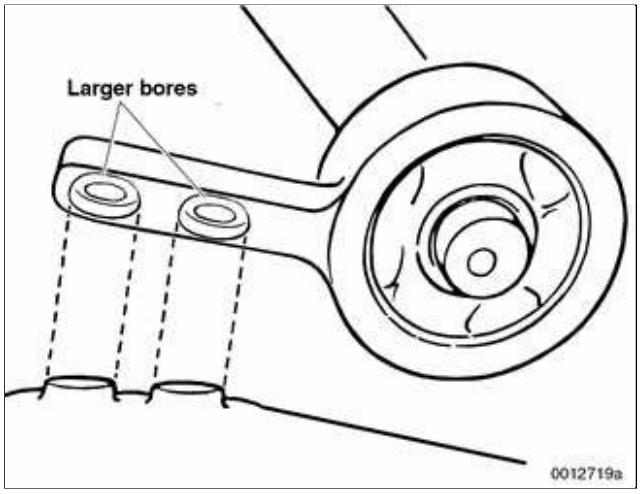


- When installing bushing on control arm:
  - Coat control arm pin and rubber mount with appropriate lubricant to facilitate installation.
  - Make sure dimension **A**(distance from first bore in control arm to outer edge of control arm bushing) is correct after assembly. See ⇒ Table c.

Note:

Slacken pressing tool when measuring installation distance. Rubber bushing must be allowed to relax for measurement to be accurate,.

Table c. Control arm bracket installation distance (all wheel drive models)	
Measurement A	170 ± 1 mm (6.69 ± 0.04 in.)



- Bolt bracket and control arm to front subframe and steering arm immediately after pressing on bushing. Be sure to reinstall bushing bracket to subframe correctly, with larger centering bores facing subframe surface.

Tightening torque	
Control arm rear bracket to subframe M10 bolt (always replace)	59 Nm (44 ft-lb)

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WARNING!

- ***After installation, the car must be left undisturbed for a minimum of 30 minutes. Leave car on the ground but avoid major movement.***
- ***After approx. 30 minutes, the lubricant used to slide on the bushing will have evaporated and the control arm will be correctly seated in the rubber.***
- ***Serious handling problems could result if these instructions are not carried out.***

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Stabilizer Bar

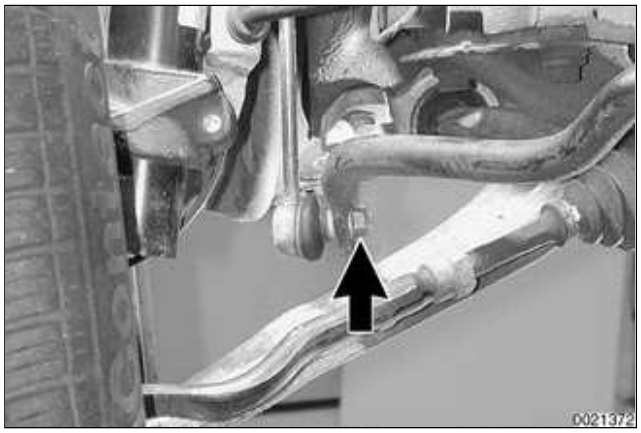
Stabilizer bar, removing and installing

On E46 models the stabilizer bar links attach to the strut assemblies.

- Raise car and support safely.

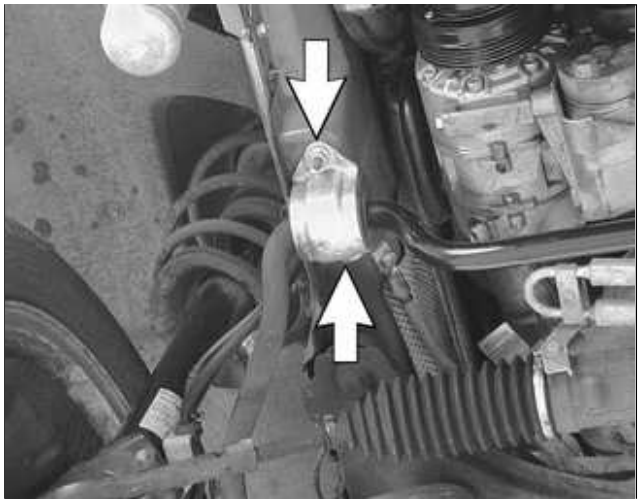
WARNING!

Make sure that the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.



- Remove stabilizer bar connecting link mounting nut (**arrow**) from stabilizer bar on right side. Counterhold ball joint with flat wrench. (Rear wheel drive model shown.)

- Repeat on left side.



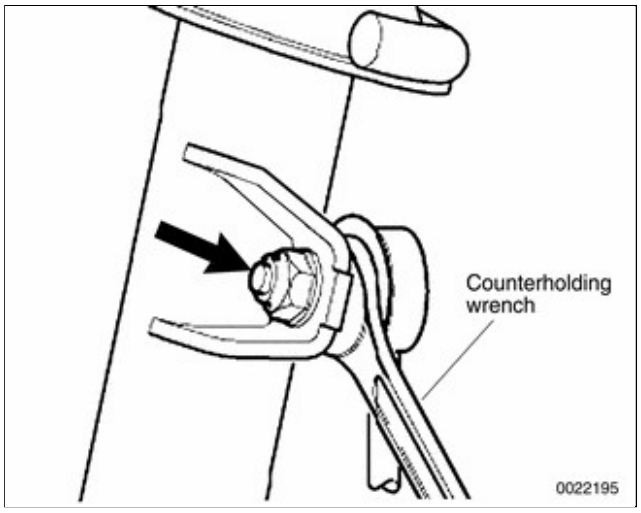
- Remove stabilizer bar bushing anchor nuts (**arrows**) on right side.

- Repeat on left side.

- Remove bar.

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- If necessary, loosen and remove stabilizer bar link mounting nut (**arrow**) from strut. Detach link from strut housing.

Note:

Use a thin wrench to counterhold shaft of stabilizer bar link ball joint while removing mounting nut.

- Installation is reverse of removal, noting the following

- Use new self-locking nuts on connecting links.

- When attaching stabilizer link to strut or bar, use a thin wrench to counterhold ball joints on link while tightening nut.

- Installation of stabilizer bar is easiest with car level (front wheels at the same height) and as near to normal ride height as possible.

Tightening torques	
Stabilizer bar bushing brackets to subframe	22 Nm (16 ft-lb)
Stabilizer bar link to stabilizer bar M10 self locking nut (always replace)	65 Nm (48 ft-lb)
Stabilizer bar link to strut M10 self locking nut (always replace)	65 Nm (48 ft-lb)

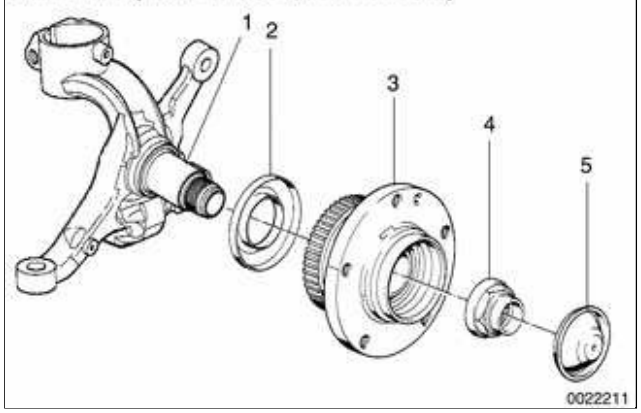
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Front Wheel Bearings

The front wheel bearings are permanently sealed and require no maintenance.

Front wheel bearing and stub axle (rear wheel drive models)



On rear wheel drive models, the bearing is integral with the wheel hub and ABS pulse wheel and pressed on the steering arm stub axle.

1 - Steering arm and stub axle

2 - Dust guard

3 - Wheel hub, bearing and ABS pulse wheel

4 - Stub axle collar nut -tighten to 290 Nm (214 ft-lb)

5 - Dust cap

On all wheel drive models, the front wheel bearing is pressed into the steering arm. The wheel hub is pressed into the bearing and the outer CV joint stub axle is pressed into the hub.

The ABS front pulse wheel in all wheel drive models is the inner (ridged) seal of the front wheel bearing.

Special press tools are required to replace the front wheel bearings. Read the procedures through before beginning the job.

Front wheel bearing, replacing (rear wheel drive models)

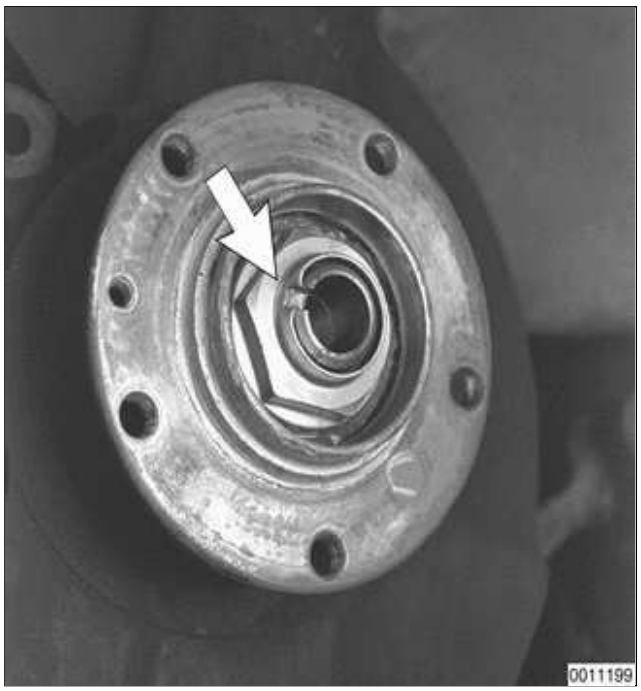
- Raise car and remove front wheel.

WARNING!

Make sure that the car is firmly

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supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.



- Pry off dust cap from center of wheel hub. Bend back staked part (**arrow**) of wheel hub (axle) collar nut.

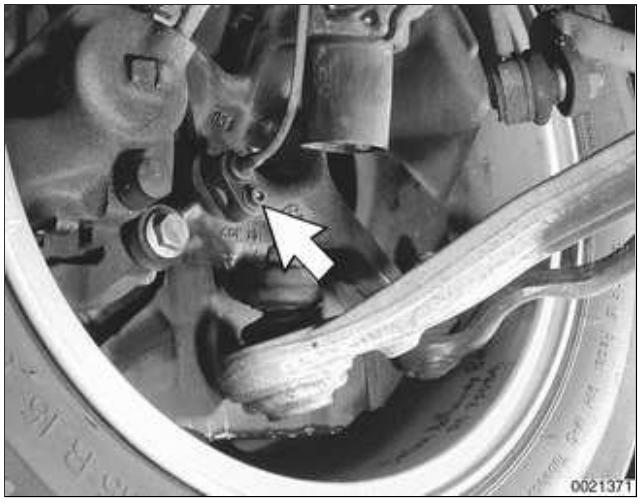
  - Remount wheel and lug bolts.

  - Lower car to ground. With an assistant applying brakes, loosen collar nut. Do not remove completely.

CAUTION!

The wheel hub collar nut is tightened to a torque of 290 Nm (214 ft-lb). Make sure the car is firmly on the ground.

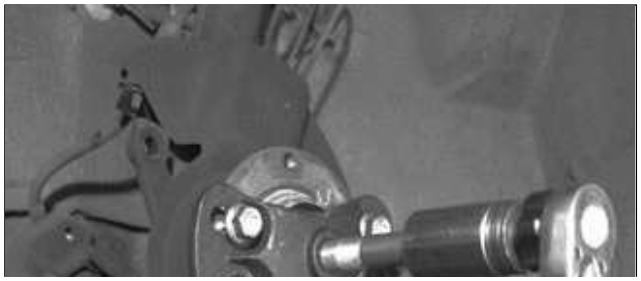
  - Raise car and remove wheel.



- Remove ABS wheel speed sensor (**arrow**).

  - Remove brake caliper assembly and brake rotor as described in ⇒ 340 Brakes. Leave brake hose connected to caliper. Suspend caliper assembly from chassis using stiff wire.

  - Remove wheel hub collar nut.



- Remove wheel hub with integral wheel bearing from steering arm using a slide hammer puller (BMW special tools 33 4 201, 33 4 202, 33 4 203 and 33 2 116) or conventional puller as illustrated.

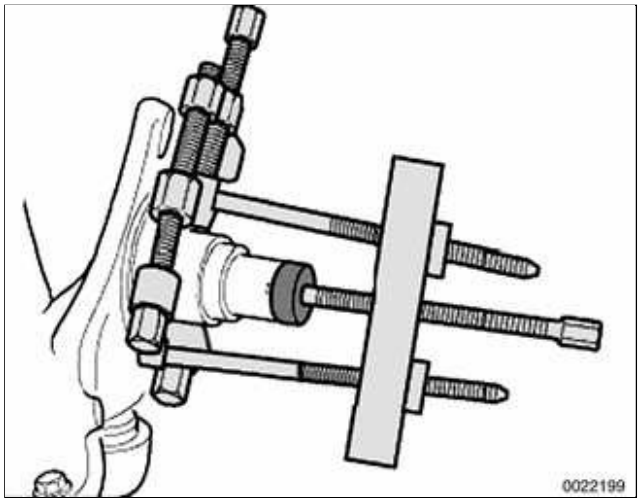
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- If outermost bearing inner race stays on steering arm stub axle, use BMW special tool set 33 4 400 or two-jaw puller to remove race.

CAUTION!

Do not reuse a wheel bearing assembly once it has been removed. The removal process destroys the bearing.



➢ To remove innermost inner race:

- ♦ Unbolt brake rotor dust shield.
- ♦ Bend back wheel bearing dust guard.
- ♦ Use BMW special tools 00 7 500 and 31 2 106 to pull race off stub axle.
- Install splash guard and new dust shield behind bearing. Press new wheel hub/bearing assembly on stub axle using BMW special tool 31 2 110 or equivalent.

CAUTION!

The BMW special tool insures that only the inner bearing race is used to press on the hub and bearing assembly. The bearing is damaged if it is not pressed on using the inner race.

- Install new collar nut. Do not tighten nut to its final torque at this time.
- ♦ Install brake rotor and brake caliper. See ⇒ 340 Brakes.

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- Mount wheel and lug bolts. Lower car to ground to gain leverage.

Tightening torques	
Brake caliper to steering arm	110 Nm (81 ft-lb
Brake rotor to wheel hub	16 Nm (12 ft-lb)
Road wheel to hub	100 ± 10 Nm (74 ± 7 ft-lb)

- With an assistant applying brakes, tighten collar nut.

Tightening torque	
Collar nut to stub axle	290 Nm (214 ft-lb)

- Raise car and remove wheel.

- Stake axle nut and caulk threads of stub axle.

- Install a new grease cap, using Loctite® 638 sealant or equivalent. Install wheel and lower car.

- Install ABS pulse sensor.

Tightening torques	
ABS pulse sensor to steering arm	8 Nm (71 in-lb)

Front wheel bearing, replacing (all wheel drive models)

Removal and installation of the all wheel drive front wheel bearing is best

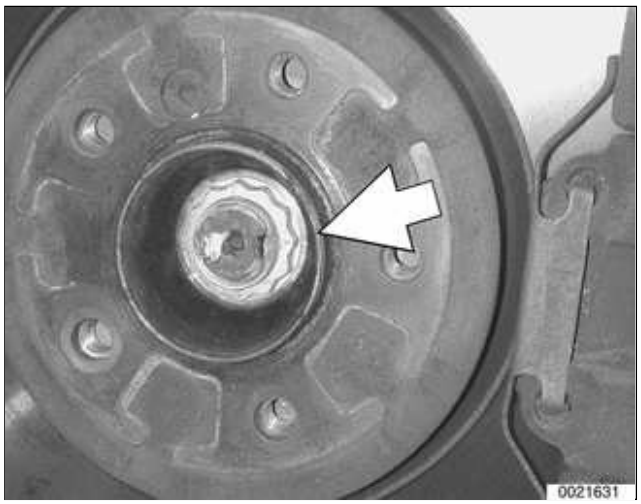
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accomplished by removing the steering arm and wheel hub from the car and separating the components on the bench.

- Raise car and remove front wheel.

WARNING!

Make sure that the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.



- Bend back staked part of wheel hub (axle) collar nut (**arrow**).

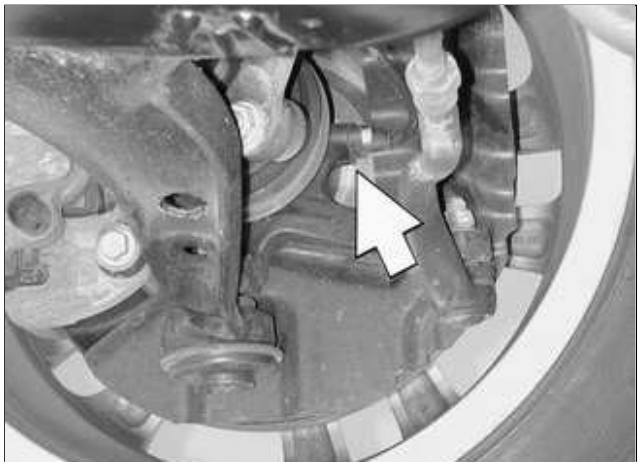
- Remount wheel and lug bolts.

- Lower car to ground. With an assistant applying brakes, loosen collar nut. Do not remove completely.

CAUTION!

The wheel hub collar nut is tightened to a torque of 420 Nm (310 ft-lb). Make sure the car is firmly on the ground.

- Raise car and remove front wheel.

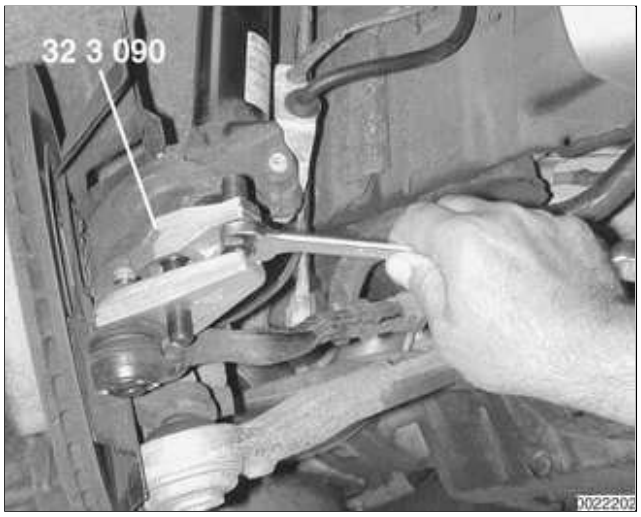


- Remove ABS wheel speed sensor (**arrow**).

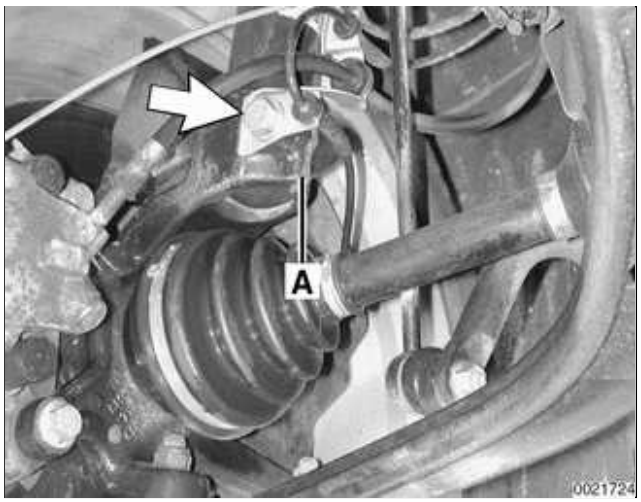
- Remove brake caliper assembly and brake rotor as described in ⇒ 340 Brakes. Leave brake hose connected to caliper. Suspend caliper assembly from chassis using stiff wire.

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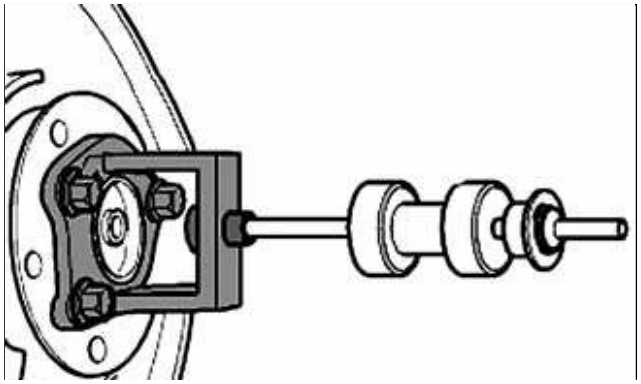
- Remove tie rod outer end nut. Use BMW special tool 32 3 090 or equivalent to press tie rod end off steering arm.
  - Detach control arm from front axle subframe as described earlier.
  - Remove outer ball joint nut. Use BMW special tool 32 3 090 or equivalent to separate steering arm and strut assembly from control arm.
  - Attach BMW special tool 33 2 111 /116 /117, or equivalent puller, to steering arm using five lug bolts and press outer CV joint stub axle inward, out of steering arm.



- Support steering arm from below. Loosen pinch bolt (**arrow**) at top of steering arm. Spread clamping collar at slot **A**, if necessary, to slide steering arm off strut assembly.
  - Working at bench, clamp steering arm in a vise.

CAUTION!

Use a vise with aluminum jaws, or protect steering arm from damage when clamping in vise.

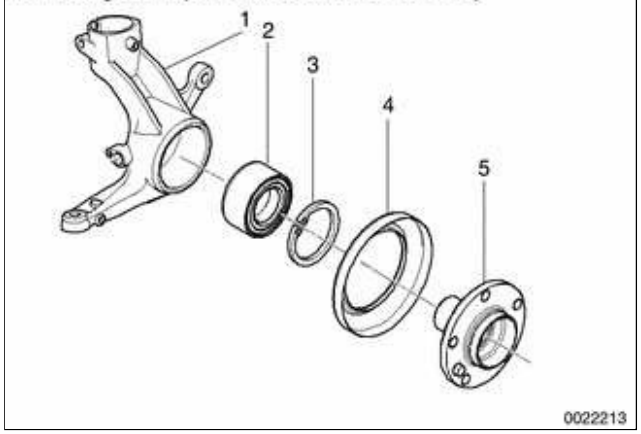


- Remove wheel hub with integral wheel bearing from steering arm using a slide hammer puller (BMW special tools 33 4 201, 33 4 202, 33 4 203 and 33 2 116).
  - If bearing inner race stays on wheel hub, use BMW special tool set 33 4 400 or two-jaw puller to remove race.

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Front wheel bearing and steering arm (all wheel drive models)



- Remove circlip (**3**) from steering arm.

1 - Steering arm

2 - Wheel bearing

3 - Circlip (always replace)

4 - Dust guard

5 - Wheel hub

- Drive wheel bearing out of steering arm using a press with appropriate adapters.

CAUTION!

Do not reuse a wheel bearing assembly once it has been removed. The removal process destroys the bearing.

- Press in bearing using a press with appropriate adapters.

Note:

- *When installing the front wheel bearing into the steering arm, be sure that the ridged bearing seal (ABS impulse wheel) is facing inboard. Start the bevelled edge of the bearing into the bore first.*
- *Coat bearing seat in steering arm over 50% of its length with Loctite® 648.*
- *Make sure press fit surfaces are clean and free of grease.*

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- Replace circlip, making sure ring is correctly seated.

- Place dust guard over steering arm hub.

- Drive wheel hub into bearing using a shop press.

CAUTION!

Press only on the inner race. The bearing is damaged if it is not pressed on using the inner race.

- Installation of steering arm to car is reverse of removal, noting the following:

- Replace control arm bracket bolts.

- Torque stub axle collar nut with vehicle on the ground. Stake nut and caulk stub axle threads.

- Have vehicle professionally aligned.

Tightening torques	
Ball joint to steering arm	65 Nm (48 ft-lb)
Brake caliper to steering arm	110 Nm (81 ft-lb)
Brake rotor to wheel hub	16 Nm (12 ft-lb)
Collar nut to wheel hub	420 Nm (310 ft-lb)
Control arm bracket to subframe	59 Nm (44 ft-lb)

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Tightening torques	
Steering arm pinch bolt at strut housing	81 Nm (60 ft-lb)
Road wheel to hub	100 ± 10 Nm (74 ± 7 ft-lb)
Tie rod to steering arm	65 Nm (48 ft-lb)

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311-1

General

This repair group covers the service and replacement of components that make up the front drive axle for vehicles equipped with all wheel drive. This drive system is integrated into the front suspension of these models.

For a general description of the front suspension and components, see ⇒ 300 Suspension, Steering and Brakes-General.

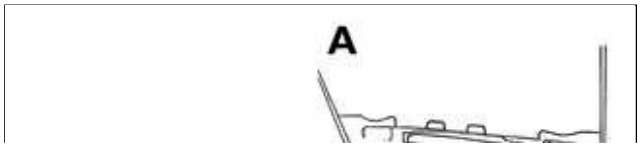
Some procedures will require you to also refer to the following repair groups:

- ⇒ 260 Driveshaft
- ⇒ 270 Transfer Case
- ⇒ 310 Front Suspension
- ⇒ 340 Brakes

Procedures involving the internal repairs of the front differential are not included in this manual.

Special tools

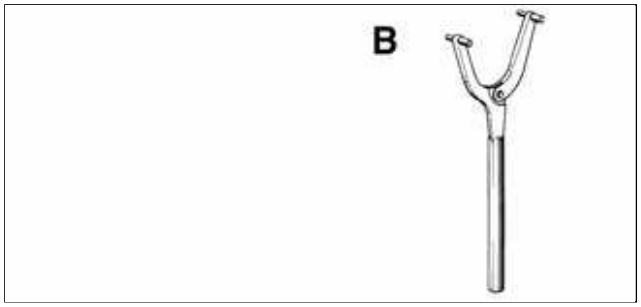
BMW recommends special tools for the removal of the drive axles as well as the installation of the front differential input drive flange seal. Commonly available pullers and drifts can often be substituted for the specified tools. Read the procedures through before beginning any job.



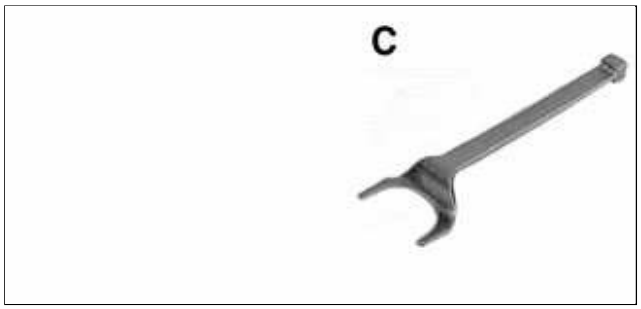
Engine support bracket BMW 00 0 200

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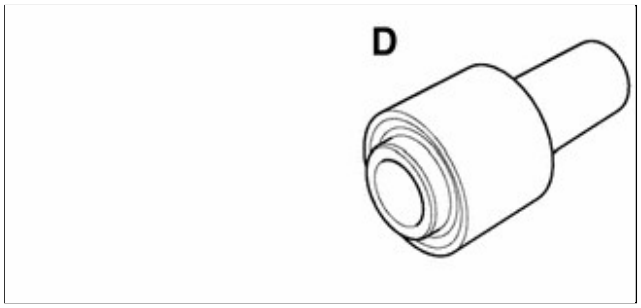




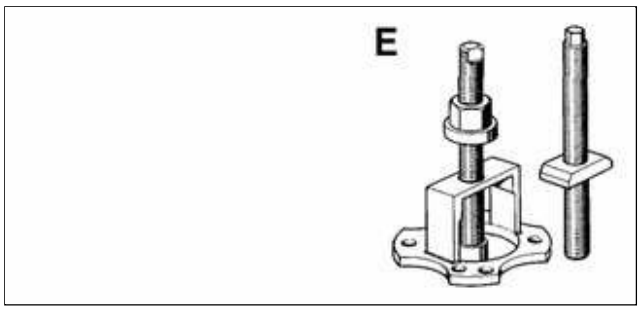
- Transmission flange holder BMW 23 0 020



- Inner CV joint puller BMW 31 1 170



- Impact drift BMW 31 5 130



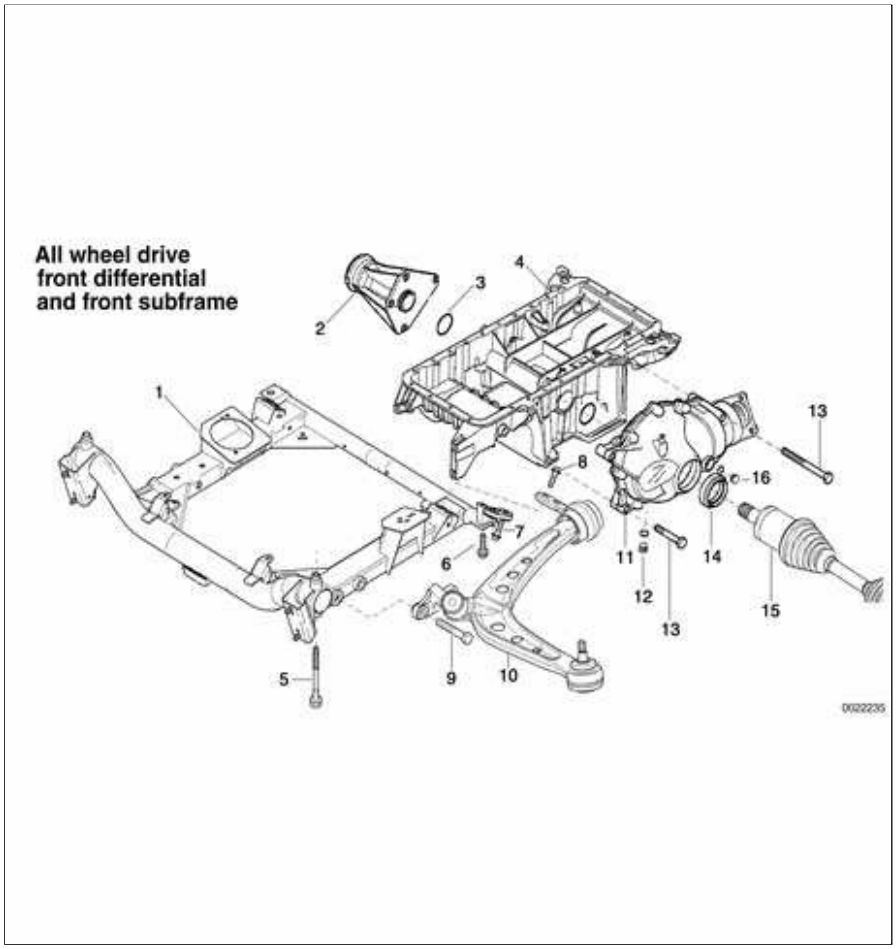
- Outer CV joint removal tool BMW 33 2 111/116/117

System description

The front axle final drive unit is integrated into the engine oil pan on all wheel drive equipped models. The front differential and the right side

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bearing pedestal bolt to each side of a modified oil pan. Power is transmitted to the front differential from the transfer case via a driveshaft, and out to front drive hubs through two drive axles.



All wheel drive front differential and front subframe

1 - **Front subframe**

2 - **Right axle bearing pedestal**

3 - **Sealing O-ring**

4 - **Oil pan**

5 - **Bolt M12 (always replace)**

- 8.8 grade tighten to 77 Nm (57 ft-lb)
- 10.9 grade tighten to 110 Nm (81 ft-lb)
- 12.9 grade tighten to 105 Nm (77 ft-lb)

6 - **Bolt M12 (always replace)**

- tighten to 110 Nm (81 ft-lb)

7 - **Bolt M10 (always replace)**

- tighten to 59 Nm (44 ft-lb)

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8 - **Bolt M10 (always replace)**

- tighten to 59 Nm (44 ft-lb)

9 - **Bolt M12**

- tighten to 77 Nm (57 ft-lb)

10 - **Front control arm with ball joint and rear mounting bracket**

11 - **Front differential**

12 - **Front differential drain plug**

- tighten to 65 Nm (48 ft-lb)

13 - **Bolt M10**

- tighten to 45 Nm (33 ft-lb)

14 - **Drive axle radial seal**

15 - **Drive axle**

16 - **Front differential fill plug**

- tighten to 65 Nm (48 ft-lb)

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Drive Axles

The front drive axles for all wheel drive equipped models use two different types of constant-velocity (CV) joint.

The outer CV joints are a traditional design that allows power to be delivered from the axle to the joint continuously through rotation.

The inner CV joints are triple roller bearing joints. This design minimizes the amount of vibration and noise transmitted back through the vehicle drivetrain, while also allowing the axle to move in and out to compensate for suspension travel.

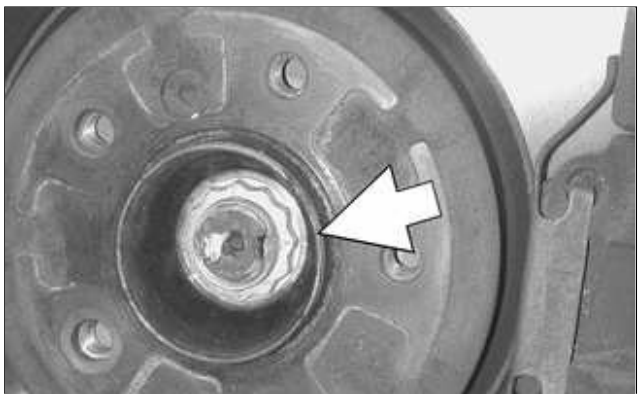
To replace a CV joint or dust boot, the drive axle must be removed from the car.

Drive axle, removing and installing

Note:

If removing the drive axle for service, it is a good idea to replace the drive axle radial seal while the axle is removed from the vehicle.

- Carefully remove center cap from wheel.



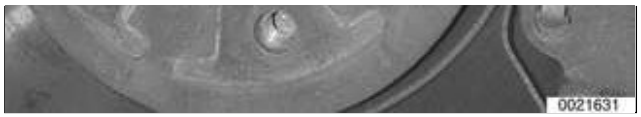
Break free staked collar nut (**arrow**) at steering arm.

- Lift vehicle and support safely.

WARNING!

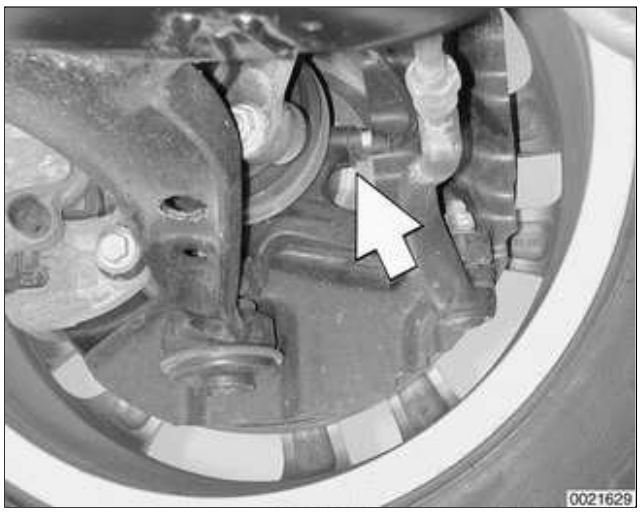
Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack

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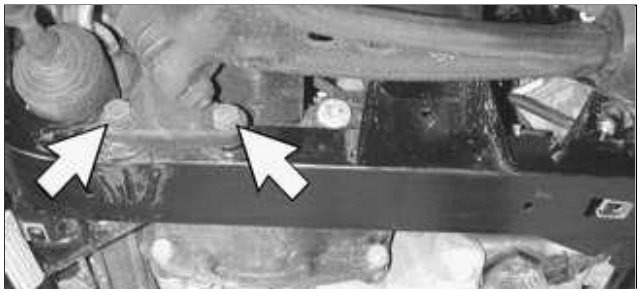
stands designed for the purpose. A floor jack is not adequate support.

- Remove front wheel.
- Remove splash shield from below engine compartment.
- If working on right side, remove right side heat shield from front axle support.



➢ Remove ABS sensor (**arrow**) from steering arm.

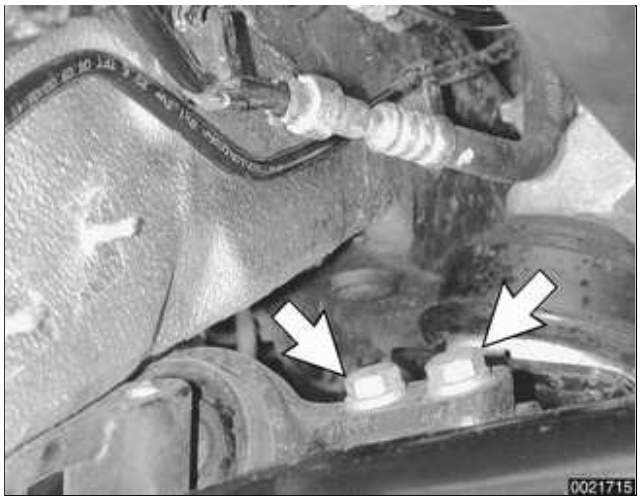
- Unclip brake hose from mounting bracket.
- Unbolt brake caliper and suspend from body using stiff wire.
- On vehicles equipped with Xenon lighting, detach headlight vertical aim sensor from control arm.
- Unfasten stabilizer link from stabilizer bar.
- Remove collar nut from drive axle at steering arm.
- Using BMW special tool 33 2 111/116/117, or similar tool, press outboard end of axle out from drive flange at steering arm.



➢ Remove inner ball joint mounting bracket bolts (**arrows**) from subframe.

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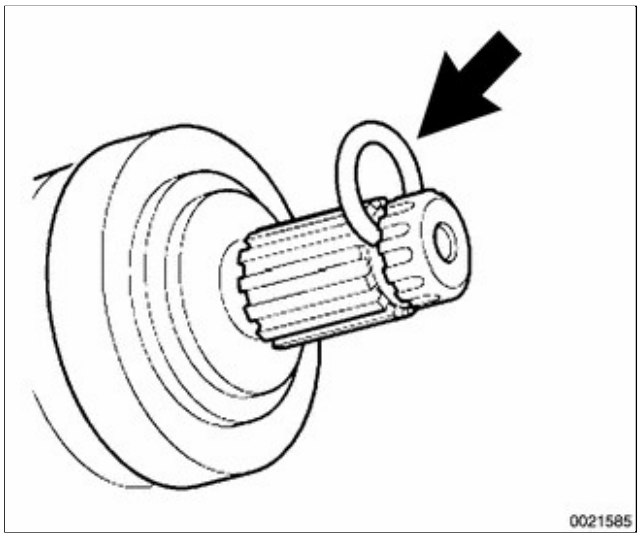




- Support control arm. Working at rear of subframe, remove control arm rear bracket mounting bolts (**arrows**).
  - Tilt steering arm to one side, out of the way.
  - Using BMW special tool 31 1 170 or equivalent pry bar, pry inboard CV joint out of front differential or bearing pedestal.

Note:

Be prepared to catch oil drips from differential or right side bearing pedestal.



- Installation is reverse of removal, noting the following:
  - Replace drive axle radial seal before replacing drive axle.
  - Before installing drive axle, replace inboard CV joint spring clip (**arrow**).
  - When pressing drive axle into front axle differential or bearing pedestal, be sure to press axle beyond resistance of spring clip. Spring clip must snap audibly into place.
  - Replace bolts holding control arm bushing bracket to front axle subframe.

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- Be sure to restake new collar nut at outboard end of drive axle after tightening to correct torque specifications. Caulk axle threads.

- Top up differential fluid. See ⇒ Front differential oil, checking and filling

Tightening torques	
Brake caliper to steering arm	110 Nm (81 ft-lb)
Control arm bushing bracket to front axle subframe (replace bolts)	59 Nm (44 ft-lb)
Drive flange collar nut to front hub	420 Nm (310 ft-lb)
Inner ball joint bracket to front axle subframe	77 Nm (57 ft-lb)
Road wheel to hub	100 ± 10 Nm (74 ± 7 ft-lb)
Stabilizer link to stabilizer bar	65 Nm (48 ft-lb)

Drive axle radial seal, replacing

Note:

If only replacing drive axle radial seal, the axle does not need to be completely removed from the vehicle. Only the inboard CV joint needs to be removed from either the front axle differential or the right axle bearing pedestal. The front suspension may be partially disassembled for radial seal replacement.

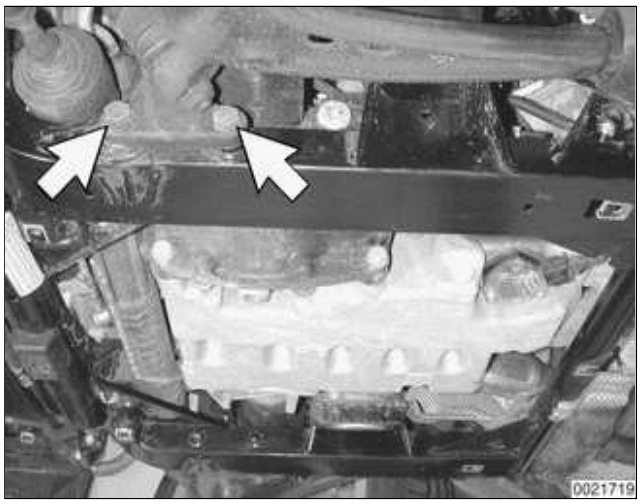
- Lift vehicle and support safely.

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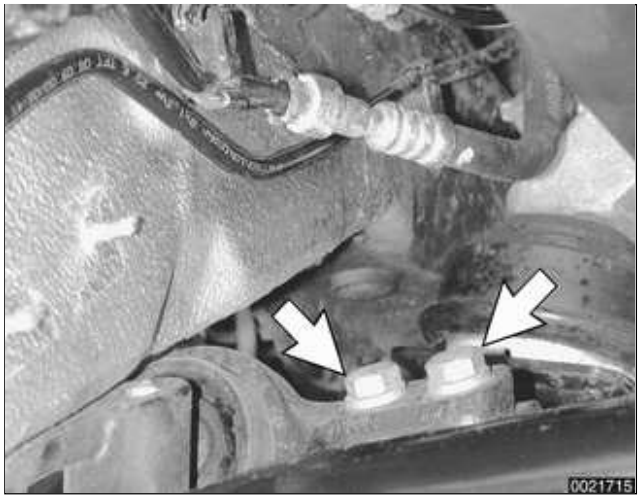
WARNING!

Make sure car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

- Remove splash shield from below engine compartment.



➢ Remove inner ball joint mounting bracket bolts (**arrow**s) from subframe.



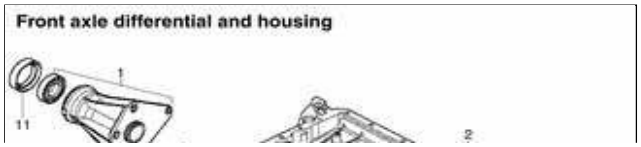
➢ Support control arm. Working at rear of subframe, remove control arm rear bracket mounting bolts (**arrows**).

- Tilt steering arm to one side, out of the way.

- Using BMW special tool 31 1 170 or equivalent pry bar, pry inboard CV joint out of front differential or bearing pedestal.

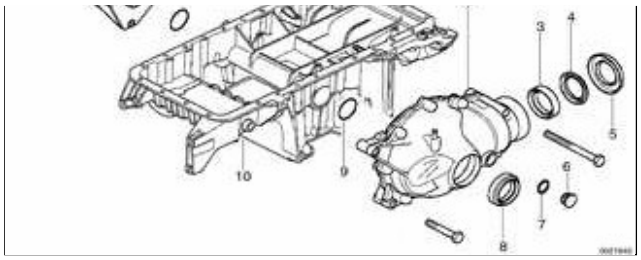
Note:

Be prepared to catch oil drips from differential or right side bearing pedestal.



➢ Pry radial seal out of differential housing or bearing pedestal using a flat screwdriver.

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1 - Right axle bearing pedestal

2 - Front differential

3 - Input shaft seal

4 - Small dustcover

5 - Large dustcover

6 - Differential plug

7 - Plug sealing ring

8 - Drive axle radial seal with lock ring, left

9 - O-ring

10 - Engine oil pan

11 - Drive axle radial seal with lock ring, right

Note:

Remove protective sleeve from new drive axle radial seal before installing seal and save for use during drive axle installation. Drive axle radial seal is equipped with protective covering to prevent sealing lip from damage during installation.

- Using BMW special tool 31 5 130 or equivalent drift, drive radial seal into differential housing or bearing pedestal.

- Coat sealing lip of radial seal with transmission fluid.

- Drive radial seal into differential or bearing pedestal.

- Insert protective sleeve into radial seal.

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- Insert inboard end of drive axle partially into differential housing or bearing pedestal.
- Withdraw protective sleeve from sealing lip, cut protective sleeve and remove sleeve.
- Continue installing drive axle until spring clip snaps audibly into place.

Note:

Always replace spring clip on inboard end of drive axle before reinstalling into differential housing or bearing pedestal.

- Installation is reverse of removal, noting the following:
- Make sure inboard end of drive axle audibly snaps into place.
- Replace control arm bracket bolts.
- Top up differential fluid. See ⇒ Front differential oil, checking and filling

Tightening torques	
Inner ball joint bracket to front axle subframe	77 Nm (57 ft-lb)
Brake caliper to steering arm	110 Nm (81 ft-lb)
Control arm bracket to front axle subframe (replace bolts)	59 Nm (44 ft-lb)

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Outer CV joint boot, replacing

Note:

When replacing CV boots, use complete boot repair kits. A kit will include a new boot, clamping bands, special lubricant, and a new outer CV joint axle circlip. A kit is available from an authorized BMW dealer parts department.

- Remove drive axle from vehicle as described earlier.
- Release retaining clamps from both ends of outer CV boot.
- Using a hammer, pound outer CV joint off drive axle.
- Using a flat blade screw driver, pry spring clip off drive axle splines.
- Clean all old lubricant off axle splines.

Note:

To inspect a CV joint, clean away grease and look for galling, pitting and other signs of wear or physical damage. Polished surfaces or visible ball tracks alone are not necessarily cause for replacement. Discoloration due to overheating indicates lack of lubrication.

- Place new clamping bands and CV boot over drive axle.
- Replace spring clip on splined end of drive axle.

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- Apply Loctite® 270 or an equivalent heavy-duty locking compound to drive axle splines.

WARNING!

Do not let locking compound contact balls in joint. Apply only a thin coat to cover splines.

- Pack outer CV joint with fresh grease. Tap CV joint onto splined end of drive axle until spring clip snaps audibly into place.

CV joint lubricant capacity	
Outer CV joint	80 gram (2.8 oz.)

- Using clamp pliers, secure retaining clamp into position tightly sealing large end of boot against CV joint.

Note:

Before installing each small boot clamp be sure to "burp" boot by flexing CV joint as far over as it will go. A small screw-driver inserted between boot and axle-shaft will help the process.

- With outer CV boot full of grease, and any air eliminated from boot, secure small end of CV boot onto CV joint by securing clamp with pliers.

- Installation is reverse of removal, noting the following:

♦ Make sure inboard end of drive axle audibly snaps into place.

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- Replace control arm bracket bolts.
- Be sure to restake new collar nut at outboard end of drive axle after tightening to correct torque specifications. Caulk axle threads.
- Top up differential fluid. See ⇒ Front differential oil, checking and filling

Tightening torques	
Ball joint bracket to front axle subframe	77 Nm (57 ft-lb)
Brake caliper to steering arm	110 Nm (81 ft-lb)
Control arm bushing bracket to front axle subframe	59 Nm (44 ft-lb)
Drive flange collar nut to front hub	420 Nm (310 ft-lb)

Inner CV joint boot, replacing

Note:

When replacing CV joint boots, use complete boot repair kits. A kit will include a new boot, clamps, special lubricant, and a new inner universal joint circlip. A kit is available from an authorized BMW dealer parts department.

- Remove drive axle from vehicle as described earlier.
- Release retaining clamp on both ends of inner CV boot. Pull back inner boot and detach inner CV joint housing.

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- Remove circlip retaining triple roller bearing to drive axle and remove triple roller bearing.

- Slide boot off drive axle. Separate inner CV joint boot adapter from boot.

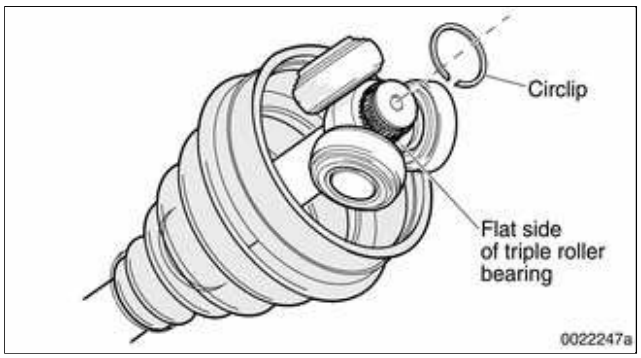
- Clean all old lubricant off axle splines and triple roller bearing splines.

- Install new inner CV joint boot:

♦ Attach boot to boot adapter.

♦ Slide retaining clamps and boot over drive axle.

♦ Secure retaining clamp using clamp pliers, tightly sealing small end of boot against drive axle.



Install triple roller bearing with flat edge of joint facing retaining circlip.

- Replace inner CV joint housing shaft circlip.

- Pack triple roller bearing and inner CV joint boot with fresh grease.

CV joint lubricant capacity	
Inner CV joint	85 gram (3.0 oz.)

- Insert triple roller bearing into inner CV joint housing.

- Secure boot connection to boot adapter using clamp supplied with

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boot kit.

- Installation is reverse of removal, noting the following:

- Make sure inboard end of drive axle audibly snaps into place.
- Replace control arm bracket bolts.
- Be sure to restake new collar nut at outboard end of drive axle after tightening to correct torque specifications. Caulk axle threads.
- Top up differential fluid. See ⇒ Front differential oil, checking and filling

Tightening torques	
Ball joint bracket to front axle subframe	77 Nm (57 ft-lb)
Brake caliper to steering arm	110 Nm (81 ft-lb)
Control arm bracket to front axle subframe (replace bolts)	59 Nm (44 ft-lb)
Drive flange collar nut to front hub	420 Nm (310 ft-lb)

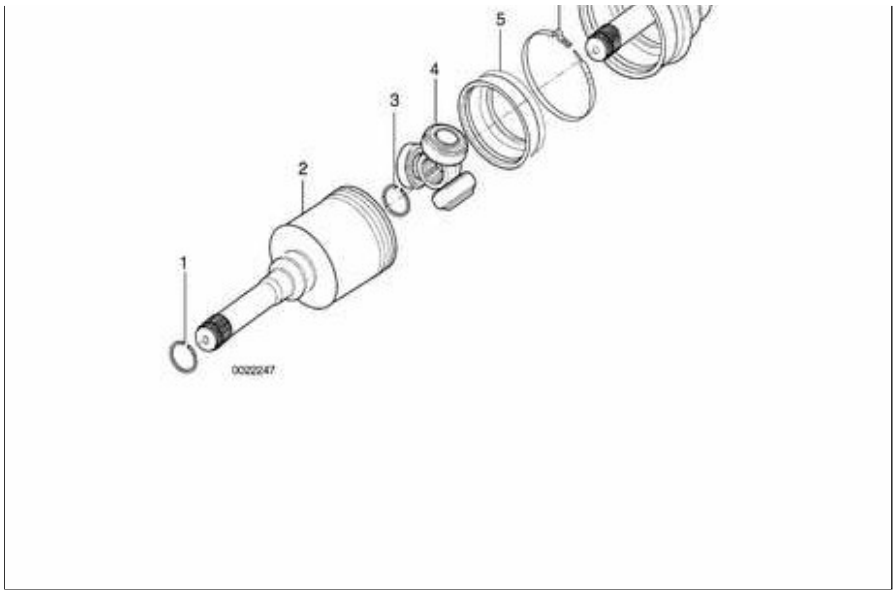


Inner CV joint assembly

1 - Spring clip

2 - Inner CV joint housing

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3 - **Circlip**

4 - **Triple roller bearing**

5 - **Inner CV joint boot adapter**

6 - **Clamp**

7 - **Inner CV joint boot**

8 - **Drive axle shaft**

9 - **Clamp**

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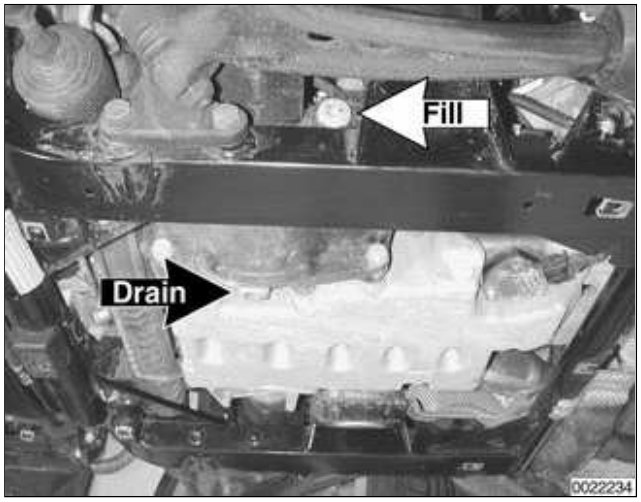
Front Differential

Procedures for replacement of O-ring seal between the engine oil pan and the front differential or right side bearing pedestal are covered in ⇒ Front axle differential, removing and installing and ⇒ Right axle bearing pedestal, removing and installing.

Front differential oil, checking and filling

Note:

BMW supplies the E46 all wheel drive models with lifetime lubrication in the front differential.



Front differential drain plug and fill plug (**arrows**).

Note:

Use an Allen bit socket to remove drain plug. Alternatively, cut approximately 30 mm (1.2 in) from an Allen key and use a box end wrench on key stub.

- Remove oil filler plug.

Note:

Differential fluid level is correct when fluid begins to spill from fill plug.

- Fill differential with appropriate type and quantity of lubricant to bottom of fill plug bore.

- Install and tighten fill plug.

Final drive drain and fill

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Final drive drain and fill	
Oil specifications	BMW SAF-XO synthetic oil
Front axle differential oil capacity	0.7 liters (0.74 US qts.)

Tightening torque	
Front axle differential drain / fill plug	65 Nm (48 ft-lb)

Front axle differential, removing and installing

- Disconnect battery negative (-) ground at battery.

CAUTION!

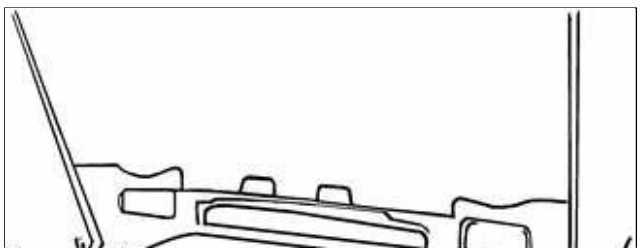
Prior to disconnecting battery, read battery disconnection cautions given at front of this manual on page viii.

- Lift vehicle and support safely.

WARNING!

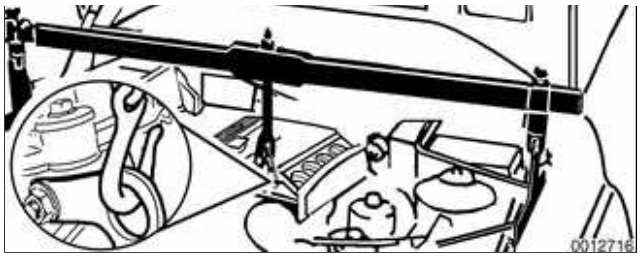
Make sure car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for purpose. A floor jack is not adequate support.

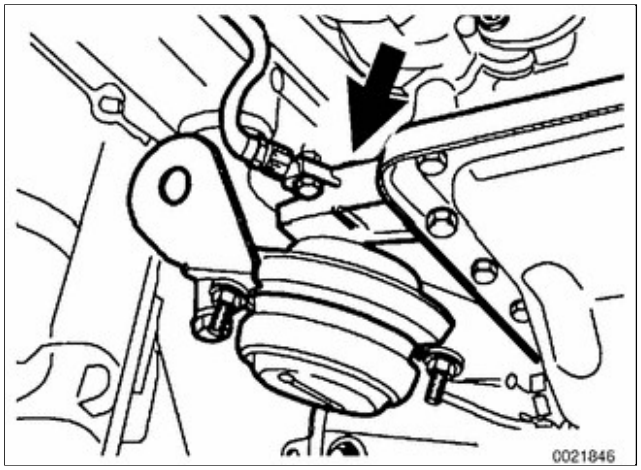
- Remove splash shield from below engine compartment.



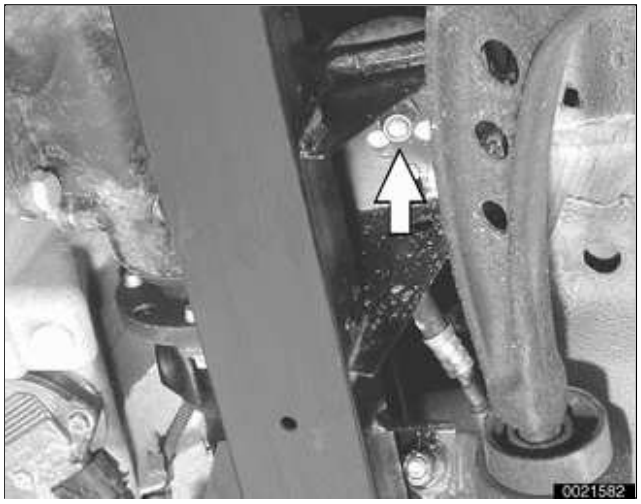
- Support engine using appropriate lifting device.

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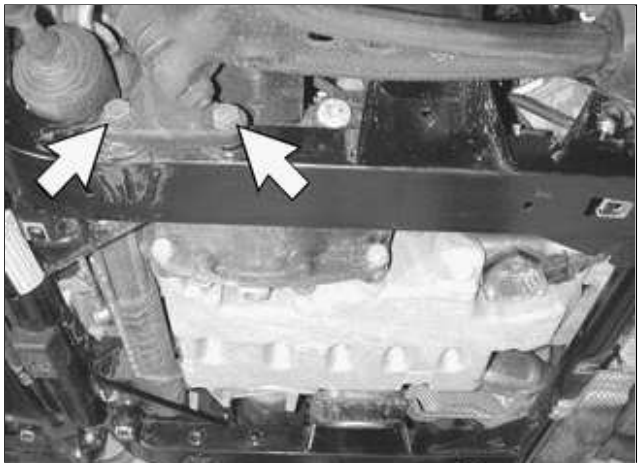




- Release nut at top on right engine mount (**arrow**).



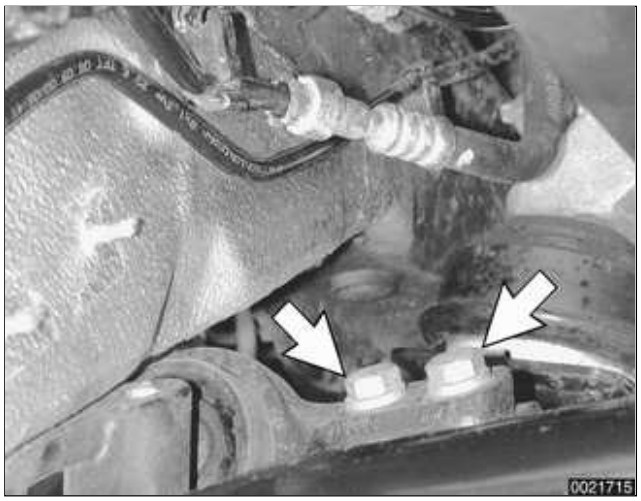
- Remove nut (**arrow**) at bottom on left engine mount.
  - Raise engine approximately 10 mm (0.4 in.).
  - Remove front wheels. Unbolt brake calipers and suspend from body using stiff wire. See ⇒ 340 Brakes.
  - Remove front driveshaft. See ⇒ 260 Driveshaft.



- Remove left inner ball joint mounting bracket bolts (**arrows**) from subframe.
  - Repeat for right side.

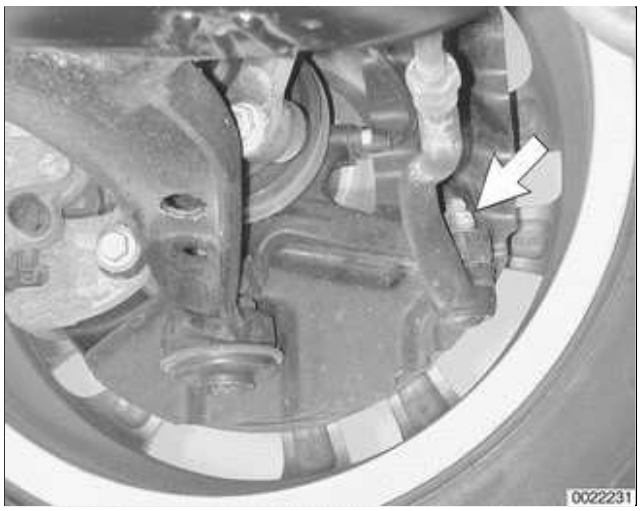
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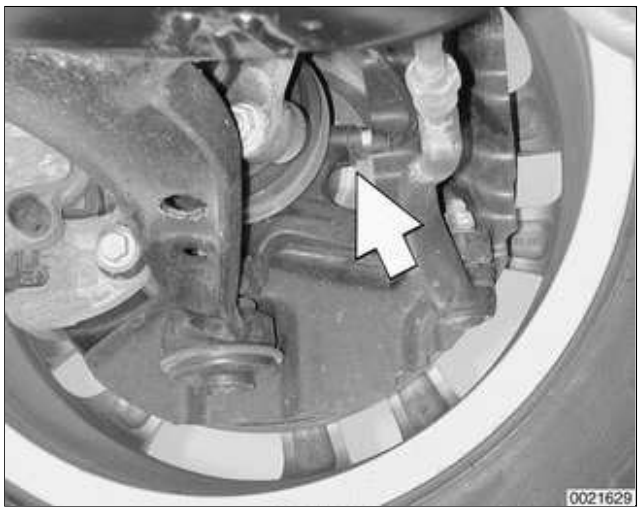
- Support left control arm. Working at rear of subframe, remove control arm rear bracket mounting bolts (**arrows**).

  - Repeat for right side.



- Remove left tie rod outer end nut (**arrow**). Use BMW special tool 32 3 090 or equivalent to press tie rod end off steering are.

  - Repeat for right side.



- Remove left ABS sensor (**arrow**) from steering arm.

  - Repeat for right side.

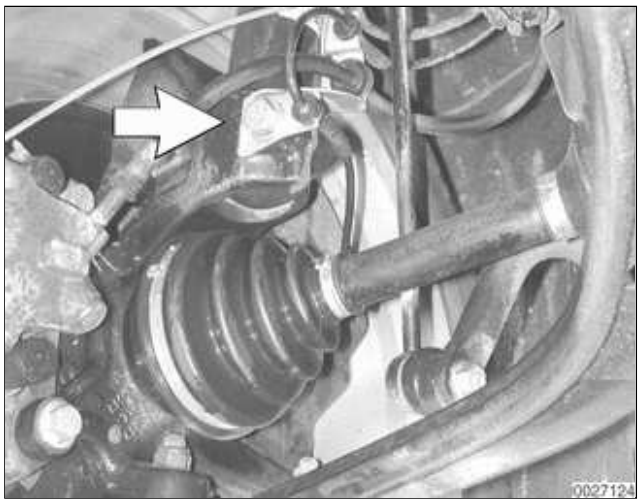
  - Unclip brake hoses and electrical harness wires from mounting brackets.

  - Swing control arms and steering arms out of the way. Using BMW special tool 31 1 170 or equivalent pry bar, pry inner CV joints out of front differential and bearing pedestal.

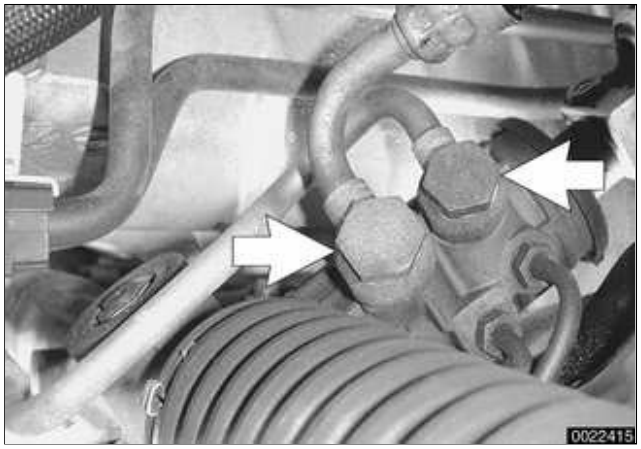
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Note:

Be prepared to catch oil drips from differential or right side bearing pedestal.



- Working on left side of car:
  - Release pinch bolt (**arrow**) at top of steering arm.
  - Pull steering arm down from strut assembly.
  - Remove steering arm, drive axle, and control arm assembly as one unit.
  - Repeat for right side.
  - Remove lower steering column. See ⇒ 320 Steering and Wheel Alignment.
  - Remove stabilizer bar anchors from front subframe.



- Working underneath car, remove fluid line banjo bolts (**arrows**) from steering rack.

CAUTION!

Plug off power steering lines and connections to keep out contamination.

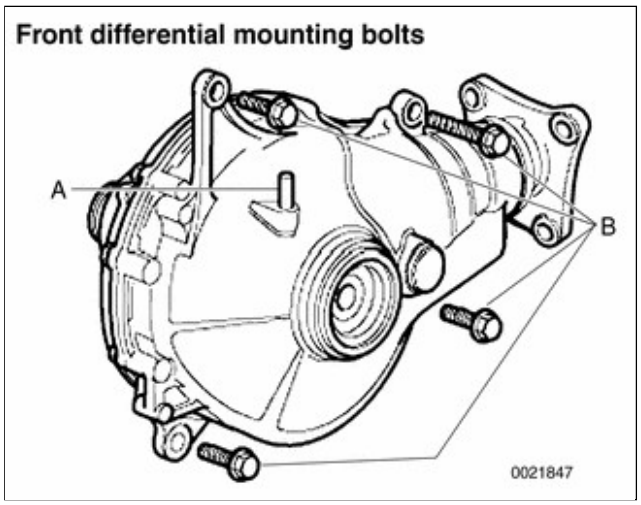
  - Remove front axle subframe and steering rack from frame rails. See ⇒ 310 Front Suspension

Note:

Make sure heat shields, wiring

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harnesses and other under body components are clear during removal.



- Detach vent tube from port (**A**) on front axle differential. Remove mounting bolts (**B**) and remove front axle differential.

  - Install new sealing ring, coating inside edge with assembly lubricant. Push assembly ring up to sealing ring.

Note:

- *Sealing and assembly rings between oil pan and differential must be replaced before differential is installed.*
- *Assembly ring prevents damage when front axle differential is installed.*
- *When front axle differential is installed on oil pan, the assembly ring is forced over sealing ring and remains in place.*

  - Installation is reverse of removal, noting the following:

- Always replace drive axle radial seal of differential before installing drive axles.
- Top up differential fluid. See ⇒ Front differential oil, checking and filling
- Replace sealing rings when reinstalling banjo bolts to steering rack.

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Tightening torques	
Brake caliper to steering arm	110 Nm (81 ft-lb)
Control arm bracket to front suspension subframe (replace bolts)	59 Nm (44 ft-lb)
Engine mount to subframe M10 self locking nut	45 Nm (33 ft-lb)
Front axle differential to oil pan	45 Nm (33 ft-lb)
Front axle differential fill plug	65 Nm (48 ft-lb)
Hydraulic hoses to power steering pump	
M14 banjo bolt	35 Nm (26 ft-lb)
M16 banjo bolt	40 Nm (30 ft-lb
Inner ball joint to front suspension subframe	77 Nm (57 ft-lb)
Stabilizer bar bushing brackets to subframe	22 Nm (16 ft-lb)
Steering arm to lower ball joint	65 Nm (48 ft-lb)
Steering arm clamping bolt at strut housing	81 Nm (60 ft-lb)
Steering column to steering rack	22 Nm (16 ft-lb)
Steering tie rod to steering arm	65 Nm (48 ft-lb)
Subframe front to body	
M12-8.8 bolt	77 Nm (56 ft-lb)

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Tightening torques	
M12-10.9 bolt	110 Nm (81 ft-lb)
M12-12.9 bolt	105 Nm (77 ft-lb)
Subframe rear to adapter M12 bolt (always replace)	110 Nm (81 ft-lb)

Right axle bearing pedestal, removing and installing

- Lift vehicle and support safely.

WARNING!

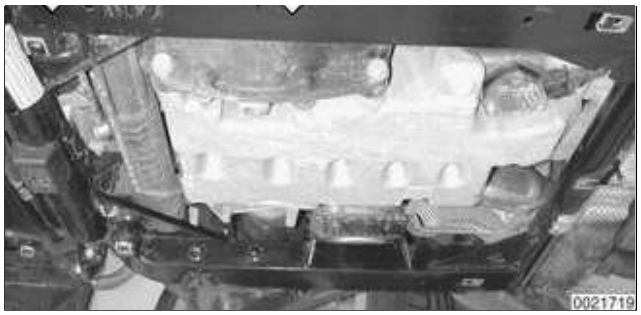
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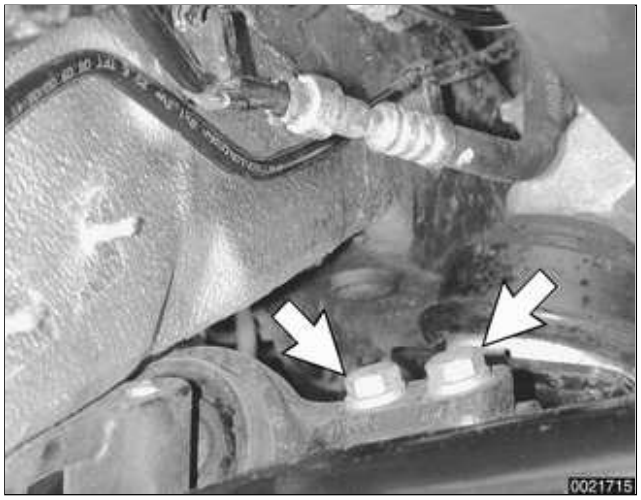
- Remove right front wheel.
- Release nut and remove tie rod end from right steering arm assembly.
- Remove ABS sensor from steering arm.
- Unclip brake hose from mounting bracket.
- Unbolt brake caliper and suspend from body using stiff wire.



➢ Remove inner ball joint mounting bracket bolts (**arrows**) from subframe.

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- Support control arm. Working at rear of subframe, remove control arm rear bracket mounting bolts (**arrows**).
  - Using BMW special tool 31 1 170 or equivalent pry bar, pry inner CV joint out of bearing pedestal.
  - Release pinch bolt at top of steering arm. Pull steering arm down from strut assembly and remove steering arm, drive axle, and control arm assembly.
  - Remove grounding strap on bearing pedestal. Remove four bolts retaining bearing pedestal to oil pan, and remove pedestal.
  - Install new sealing ring, coating inside edge with assembly lubricant. Push assembly ring up to sealing ring.

Note:

- *Sealing and assembly rings between oil pan and differential must be replaced before differential is installed.*
- *Assembly ring prevents damage when bearing pedestal is installed.*
- *When bearing pedestal is installed*

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on oil pan, the assembly ring is forced over sealing ring and remains in place.

- Installation is reverse of removal, noting the following:

- Always replace drive axle radial seal before installing drive axle.

- Top up differential fluid. See ⇒ Front differential oil, checking and filling

Tightening torques	
Bearing pedestal to oil pan	45 Nm (33 ft-lb)
Brake caliper to steering arm	110 Nm (81 ft-lb)
Control arm bracket to front suspension subframe (replace bolts)	59 Nm (44 ft-lb)
Inner ball joint to front suspension subframe	77 Nm (57 ft-lb)
Steering arm to lower ball joint	65 Nm (48 ft-lb)
Steering arm clamping bolt at strut housing	81 Nm (60 ft-lb)
Steering tie rod to steering arm	65 Nm (48 ft-lb)

Input flange radial seal, replacing

- Lift vehicle and support safely.

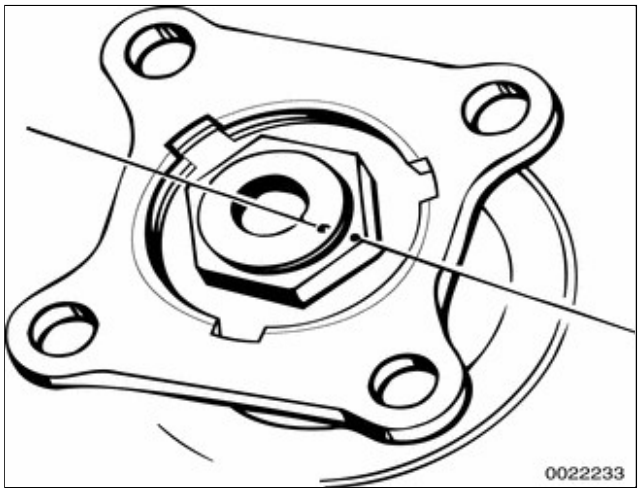
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WARNING!

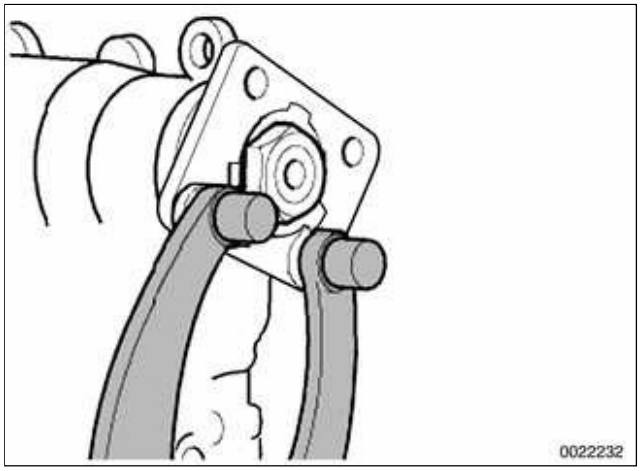
Make sure car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for purpose. A floor jack is not adequate support.

- Remove front driveshaft. See ⇒ 260 Driveshaft

- Pry out input flange retaining nut lock plate.



- Using a centerpunch, mark relation of input flange retaining nut to output shaft.



- Counterhold input flange in place using BMW special tool 23 0 020 and remove nut.

- Pull input flange out from differential using a hub puller.

- Remove input seal dust shields.

- Using a seal puller or flat screwdriver, pry radial seal out of differential housing.

- Coat sealing edges of radial seal with transmission fluid and drive into differential housing using

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BMW special tool 31 5 130 or equivalent drift.

- Replace dust shields.

- Clean input flange and install into differential housing.

- Tighten down nut until punch marks align.

- Install new input flange retaining nut locking plate.

CAUTION!

- ***Do not torque input flange retaining nut beyond matchmarks. Over-torquing can damage differential internals.***

- ***Do not replace input flange or input flange locking nut.***

- Installation is reverse of removal.

Tightening torque	
Input flange collar nut to differential	until matchmarks align

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General

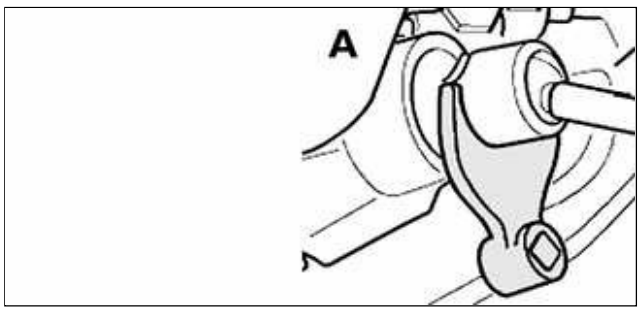
This repair group covers steering wheel and column removal and steering system service, including wheel alignment information.

Note:

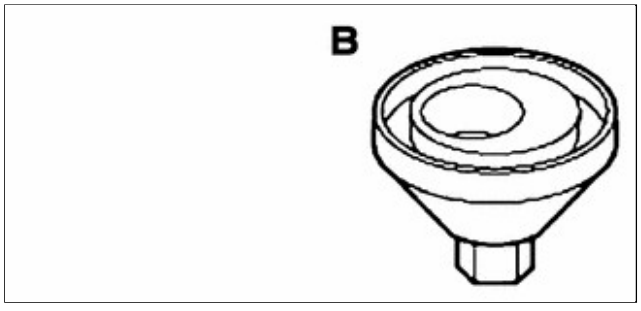
- *Ignition lock cylinder replacement is covered in this section.*
- *For information on steering column mounted switches including the ignition switch, see* ⇒ *612 Switches*

Special tools

Some special tools are necessary to carry out the repairs and adjustments required for steering service and wheel alignment. Be sure to read the procedures through before starting work on the vehicle.

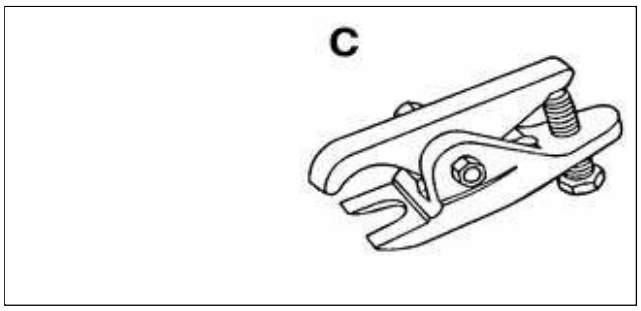


- Inner tie rod removal tool BMW 32 2 110

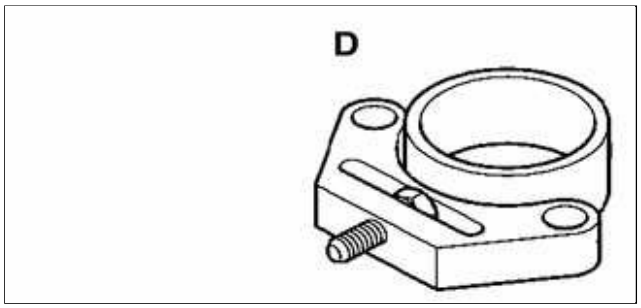


- Rear toe adjusting tool BMW 32 3 030

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- Tie rod end removal tool BMW 32 3 090



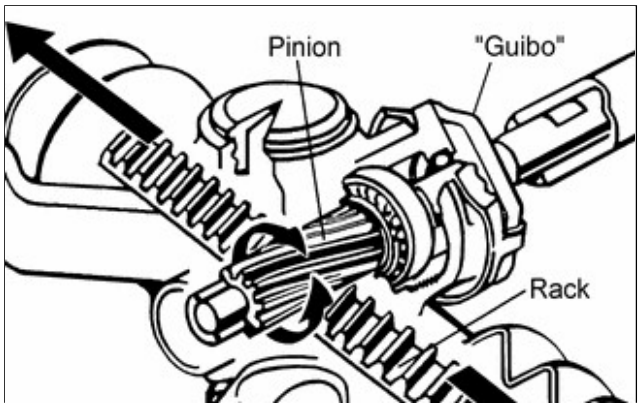
- Front camber adjusting tool BMW 32 3 140

Steering system

The variable-assist power steering system consists of an engine-driven hydraulic pump, a rack-and-pinion steering rack assembly with an integral hydraulic control valve, and connecting linkage to the road wheels.

At low speeds, maximum power assist is provided to ease parking and city driving. At high speeds, assist is reduced to ensure stability. The power steering system varies assist based on engine speed.

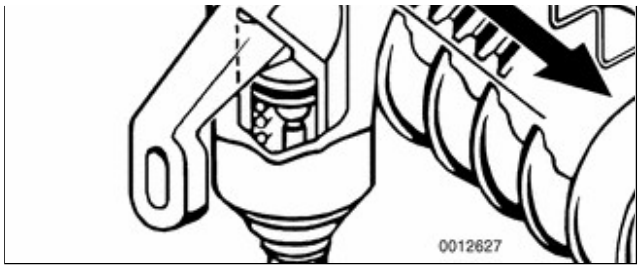
Power assist is provided by a belt-driven pump on the lower left front of the engine, just below the alternator.



- The steering rack is bolted to the front subframe underneath the engine. The steering wheel connects to the rack via a telescoping column which incorporates a rubber coupling ("guibo") to dampen vibration and noise.

The power steering fluid is fed from the fluid reservoir to the pump and to the rack via rubber/metal hoses. The return

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line from the steering rack to the reservoir loops into the airstream in front of the vehicle and is used as a steering fluid cooler.

The steering rack and linkage require no maintenance other than alignment and periodic inspection for worn components. The rubber rack boots and tie-rod end boots should be inspected periodically for tears or damage and replaced if necessary.

WARNING!

- ***The BMW airbag system (MRS II) is complex. Special precautions must be observed when servicing the system. Serious injury may result if system service is attempted by persons unfamiliar with the BMW airbag system and its approved service procedures. BMW specifies that all inspection and service should be performed by an authorized BMW dealer.***

- ***The BMW E46 is equipped with an airbag mounted in the steering wheel. The airbag is an explosive device and should be treated with extreme caution. Always follow the airbag removal procedure as outlined in ⇒ 721 Airbag System (SRS).***

- ***BMW airbags are equipped with a back-up power supply inside the MRS II control module. A 5 second waiting period should be observed after the battery cable has been disconnected. This will allow the reserve power supply to discharge.***

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- ***Do not reuse self-locking nuts. They are designed to be used only once and may fail if reused. Always replace them with new locking nuts.***

- ***Do not install bolts and nuts coated with undercoating wax, as correct tightening torque cannot be assured. Always clean the threads with solvent before installation, or install new parts.***

- ***Do not attempt to weld or straighten any steering components. Always replace damaged parts.***

Note:

The airbag system is traditionally referred to as Supplemental Restraint System (SRS). The BMW version of SRS used in 1999 to 2001 E46 models is known as the Multiple Restraint System (MRS II).

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320-2

Steering Wheel

Steering wheel, removing and installing

- Center steering wheel. Make sure front wheels are pointed straight ahead.

- Disconnect negative (-) cable from battery.

CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

- Carefully remove airbag from front of steering wheel. See ⇒ 721 Airbag System (SRS). Store airbag unit in a safe place.

WARNING!

Improper handling of the airbag could cause serious injury. Store the airbag with the horn pad facing up. If stored facing down, accidental deployment could propel it violently into the air, causing injury.

CAUTION!

Avoid damaging the variety of convenience switches, such as radio and cruise controls, installed in the steering wheel of some models.



- Remove steering wheel center bolt.

Note:

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*The steering column and steering wheel are matchmarked (**arrow**) at the factory. Confirm these marks before removing wheel from column.*

- Remove steering wheel.
- When reinstalling steering wheel:

- Align steering wheel and column match marks.
- Align steering wheel to alignment pins located on steering column switch block.
- Install steering column center bolt. Do not over-torque.

Tightening torque	
Steering wheel to steering shaft	63 Nm (46 ft-lb)

- Carefully install airbag. See ⇒ 721 Airbag System (SRS)

Tightening torque	
Airbag to steering wheel	8 Nm (71 in-lb)

Note:

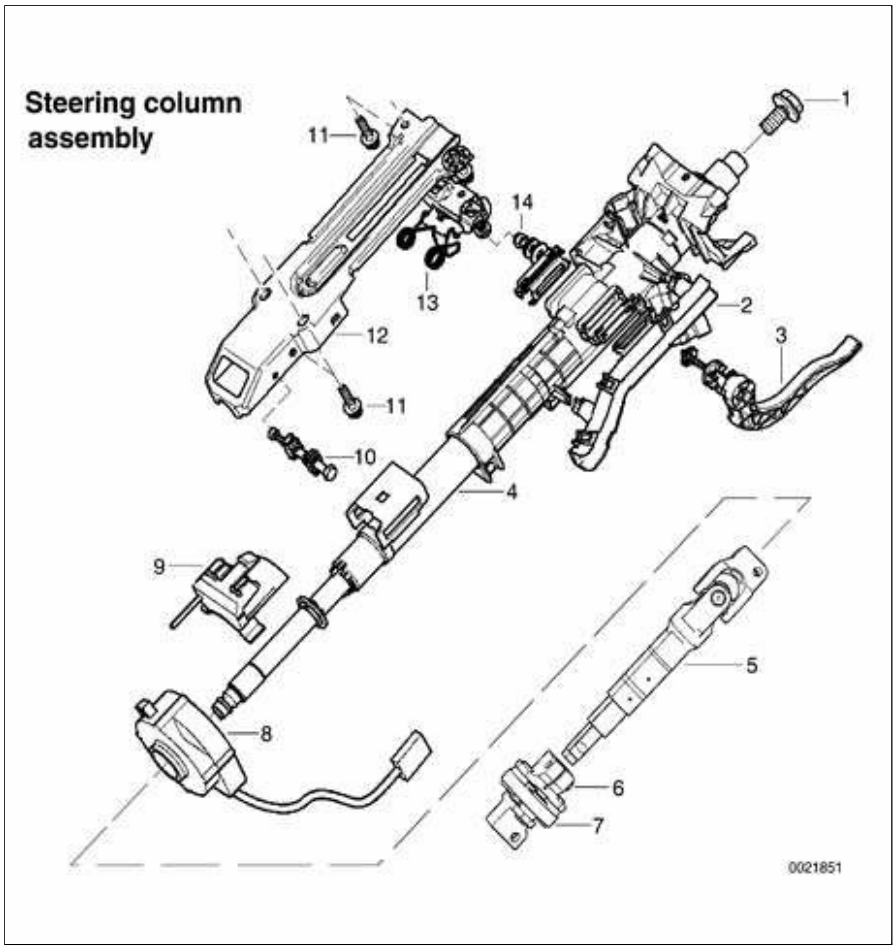
The airbag in some models is attached to the steering wheel using spring clips instead of mounting screws.

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320-3

Steering Column



Steering column assembly

1 - **Hex bolt (M14 x 1.5)**

♦ tighten to 63 Nm (46 ft-lb)

2 - **Cable duct**

3 - **Steering column adjustment lever**

4 - **Upper steering column**

5 - **Lower steering column with universal joint**

6 - **Torx bolt (M8 x 33)**

♦ tighten to 22 Nm (16 ft-lb)

7 - **Flexible joint (guibo)**

8 - **Steering angle sensor**

9 - **Steering angle sensor bracket**

10 - **Column pivot bushing**

11 - **Bolt (M8 x 36)**

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- tighten to 22 Nm (16 ft-lb)

12 - **Steering column mounting bracket**

13 - **Column return spring**

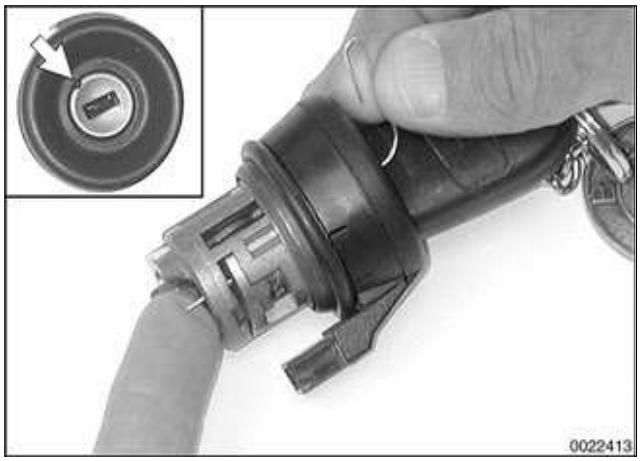
14 - **Nut (M8)**

- tighten to 4.8 Nm (3.5 ft-lb)

- recheck as necessary

Ignition lock cylinder, removing and installing

To remove the ring antenna prior to removing ignition lock cylinder, it is necessary to remove the upper and lower steering column trim. Use BMW special tool 61 3 300 to force off the ring antenna. Alternatively, remove the ignition switch key cylinder first.



With ignition key in ON position (60° from LOCKED):

- Insert a thin piece of stiff wire into opening (**arrow**) in lock cylinder and pull lock cylinder out.

- Detach ring antenna harness connector.

- Gently work ring antenna off key cylinder.

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- Reinstallation is reverse of removal.

Lower steering column, removing and installing

Note:

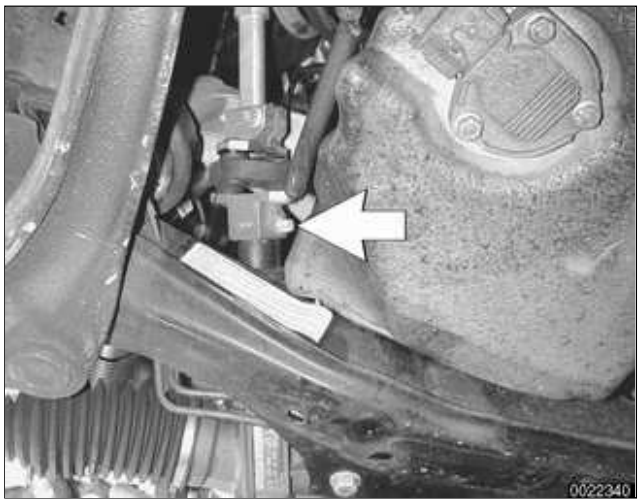
Once the lower steering column has been removed there will be no end stop for the steering wheel. In order to prevent damage to contact ring in steering column, follow procedural steps as listed. 1. Unlock steering wheel. 2. Move steering wheel to straight ahead position. 3. Lock steering wheel and remove ignition key.

- Lift vehicle and support safely.

WARNING!

Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

- Remove splash guard under engine.



Remove lower steering column flexible joint pinch bolt (**arrow**). Slide lower column up and pull flexible joint off steering rack shaft.

Note:

Do not remove alignment flange from steering rack.

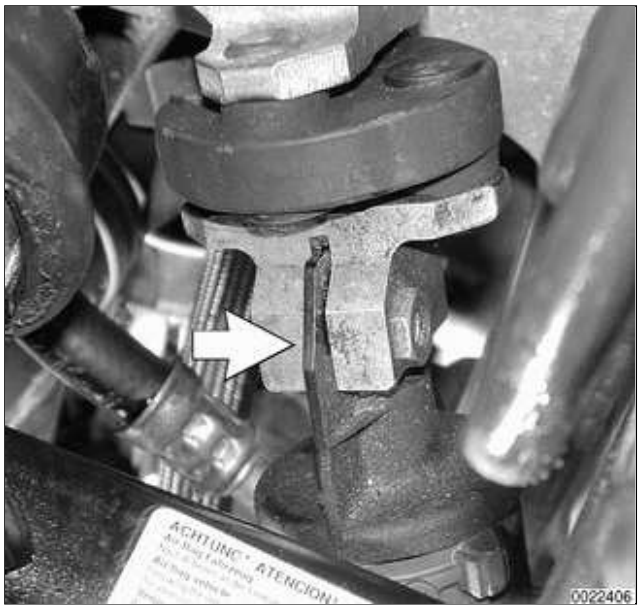
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- Working near firewall, remove pinch bolt at universal joint and remove lower steering column.

Note:

Upper steering column is keyed to lower steering column universal joint. It can only be installed in one position.



- Installation is reverse of removal, noting the following:

  - Replace flexible and universal joint pinch bolts.
  - Align lower steering column to keyed upper steering column.
  - Align tab (**arrow**) on steering rack flange with lower steering column flexible joint.

Tightening torque	
Pinch bolts at steering columns joints	22 Nm (16 ft-lb)

Upper steering column, removing and installing

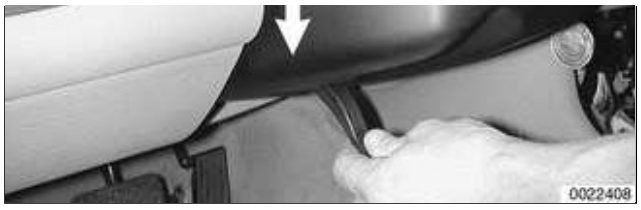
- Remove steering wheel as described earlier.



- Fully lower and extend (**arrows**) adjustable steering column.

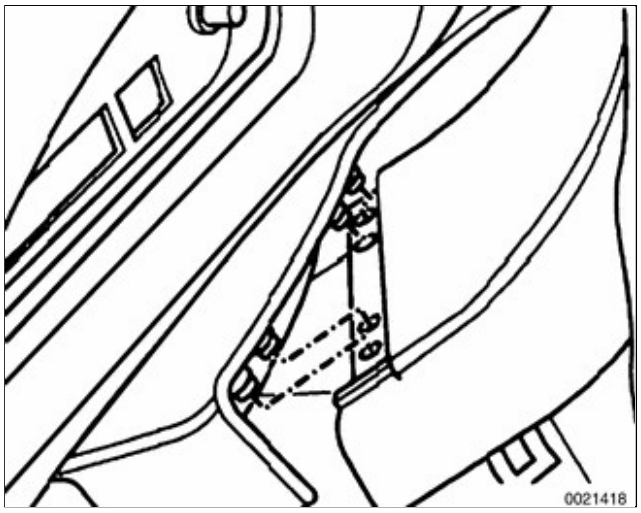
- Remove retaining screw from top of steering column upper trim cover.

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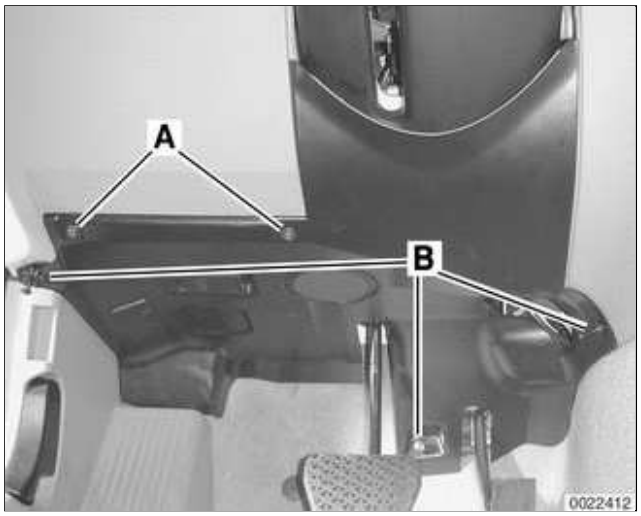




- Push in sides of upper trim cover (**arrows**) to release from lower trim. Pull back and up on upper trim.



- Pry gently to detach flexible cover from upper trim. Lift off trim.

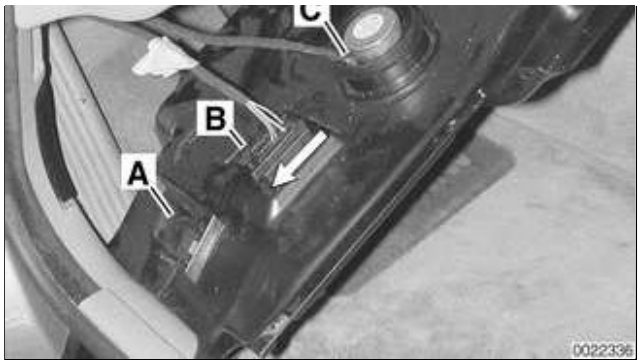


- Remove left footwell (pedal cluster) trim panel.
  - Remove screws (**A**).
  - Remove fasteners (**B**).



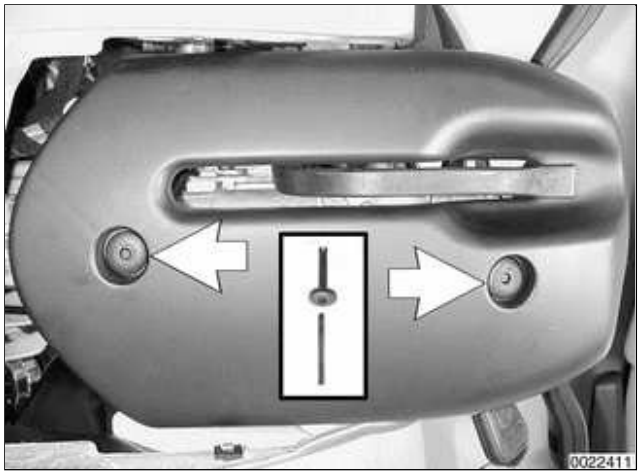
- Disconnect electrical harness connectors at left footwell trim panel and remove panel:

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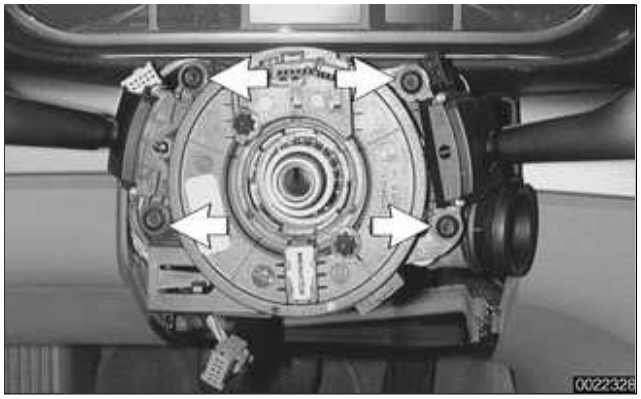


- Unplug connector at footwell interior light (**A**), if equipped.
- Slide lock at OBD II connector (**B**) in direction of **arrow**.
- Unplug connector at cellular phone speaker (**C**) if equipped.

- Remove lower steering column as described earlier.



To remove steering column lower trim, drive pins into expansion rivets (**arrows**) to release. Pull down on trim.



Working at steering column:

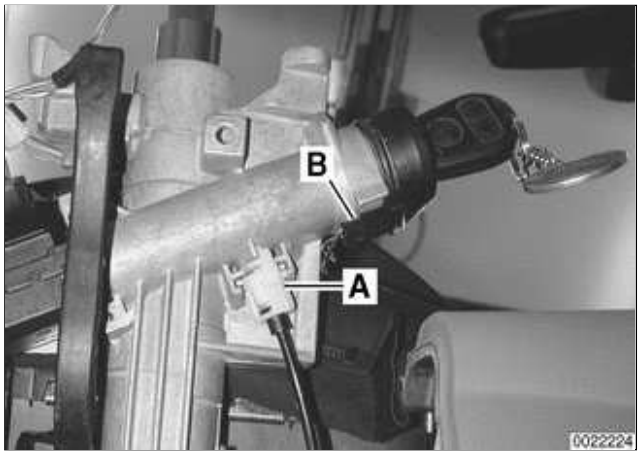
- Remove screws (**arrows**).
- Slide switch block out from steering column.
- Disconnect electrical harness connectors at ignition switch, wiper switch, turn signal / high beam switch, and steering wheel functions / airbag connector.
- Remove switch block.



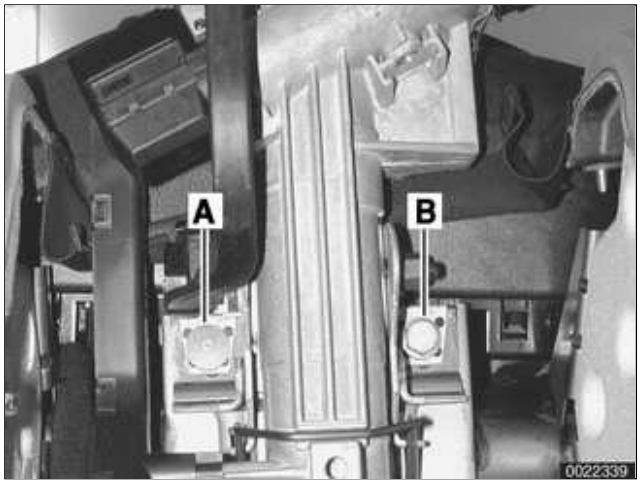
Slide lower section of upper steering column into upper section (**arrow**).

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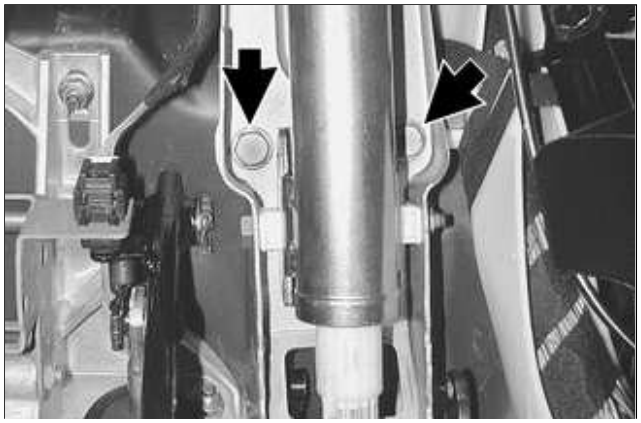




- Remove shift interlock cable (**A**) if necessary.
  - Disconnect electrical harness connector at EWS 3.3 ring antenna (**B**).
  - Working at steering column, detach wiring harness from cable duct.



- Drill out steering column mounting shear bolt (**A**), and remove mounting bolt (**B**).



- Remove lower steering column mounting bolts (**arrows**). Remove upper steering column.
  - Installation is reverse of removal, noting the following:
    - Replace shear bolt at steering column mounting bracket. Tighten

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until bolt head shears off.

- Make sure lock of interlock cable snaps into place.
- When installing column top trim panel, replace expansion nut for trim retaining screw.
- When installing lower trim panel, push expansion rivet pin into rivet until pin head is flush with rivet head.

Tightening torques	
Universal joint pinch bolt at steering column	22 Nm (16 ft-lb)
Steering column to dashboard carrier	22 Nm (16 ft-lb)

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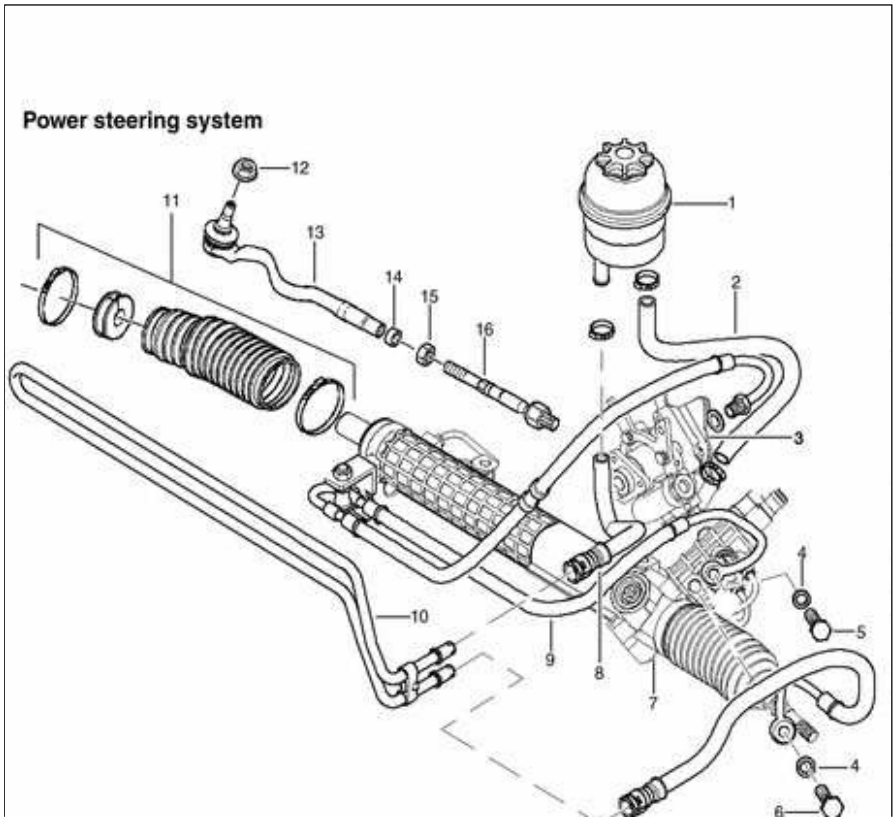
Power Steering System

The power steering fluid reservoir is located on the lower left front of the engine.

CAUTION!

- ***Maintain clean conditions when working with open power steering fluid lines.***
- ***Plug off power steering lines and connections to keep out contamination.***

Power steering fluid	
Recommended fluid	ATF (automatic transmission fluid)



Power steering system

1 - **Power steering fluid reservoir**

2 - **Fluid supply line**

3 - **Power steering pump**

4 - **Copper sealing ring**

5 - **Banjo bolt M14**

♦ tighten to 35 Nm (26 ft-lb)

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6 - Banjo bolt M16

- tighten to 40 Nm (30 ft-lb)

7 - Power steering rack

8 - Pressurized fluid line

9 - Fluid return line

10 - Fluid cooler

11 - Rack boot kit

12 - Tie rod nut

- tighten to 65 Nm (48 ft-lb)

13 - Outer tie rod end

14 - Clamp ring

15 - Outer tie rod end lock nut

- tighten to 45 Nm (33 ft-lb)

16 - Inner tie rod

- tighten to 100 + 10 Nm (74 + 7 ft-lb)

Power steering system, bleeding and filling

- With engine off, fill power steering

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fluid reservoir with clean fluid. Fill level to MAX mark on dip stick.

- Start engine. Slowly turn steering wheel from lock to lock a minimum of two times.

- Turn engine off and check fluid level, adding more if necessary.

Power steering pump, removing and installing

- Empty power steering fluid reservoir using clean syringe. Do not reuse fluid.

- Raise front of car. Remove splash shield from under engine.

- Remove drive belt from power steering pump. See ⇒ 020 Maintenance.

WARNING!

Make sure the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.

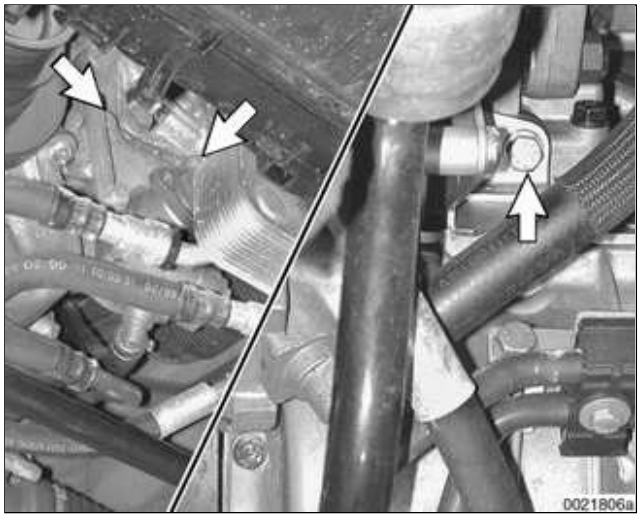
- Remove power steering pump drive pulley.

- Remove fluid hoses from pump. Plug openings in pump and hose ends.

- Remove brake cooling ducts on left side.

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- Remove front stabilizer bar anchors and swing stabilizer bar down out of the way. See ⇒ 310 Front Suspension.



➢ Remove pump mounting bolts (**arrows**) and remove pump. Rear wheel drive model shown.

- Installation is reverse of removal, noting the following:

♦ Make sure all thread bores, bolts, nuts, fluid couplings and mating surfaces are clean, and inside surface of multi-ribbed-belt is free of grease and dirt.

♦ Use new sealing washers when reattaching power steering pressure lines.

♦ Make sure hoses have adequate clearance from chassis. Do not over-torque banjo bolts.

♦ Fill and bleed power steering system as described earlier.

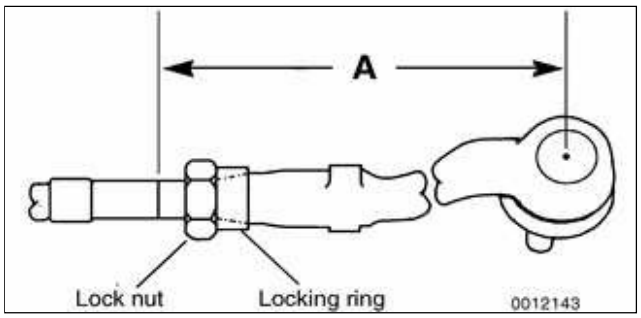
Tightening torques	
Hydraulic hoses to power steering pump	
M14 banjo bolt	35 Nm (26 ft-lb)
M16 banjo bolt	40 Nm (30 ft-lb)
Power steering pump to bracket M8 self-locking nuts	22 Nm (16 ft-lb)
Power steering pump bracket to engine block M8 self-locking nuts	22 Nm (16 ft-lb)

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Steering rack, removing and installing

- Empty power steering fluid reservoir using clean syringe. Do not reuse fluid.

- Raise front of car, and remove wheels. Remove splash shield from under engine.



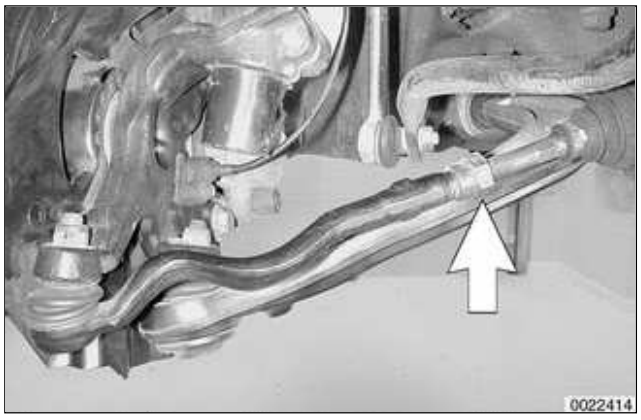
➢ Make reference measurement (**A**) of left outer tie rod end to tie rod. Record measurement.

Note:

- *Accurate measurement of the tie rod end with reference to the tie rod will help approximate correct wheel alignment when new parts are installed.*

- *Note correct placement of inner taper on locking ring*

- Repeat for right side.



➢ Loosen left outer tie rod end lock nut (**arrow**).

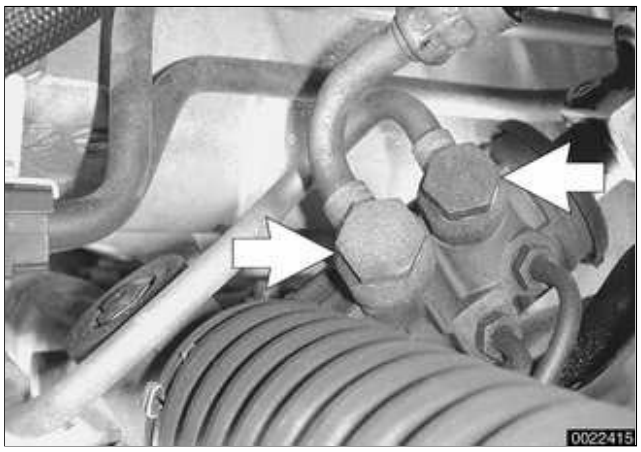
- Unscrew left tie rod end from steering rack by turning inner tie rod shaft.

CAUTION!

Grip end of rack boot to keep it from twisting as the tie rod shaft is unscrewed.

- Repeat for right tie rod.

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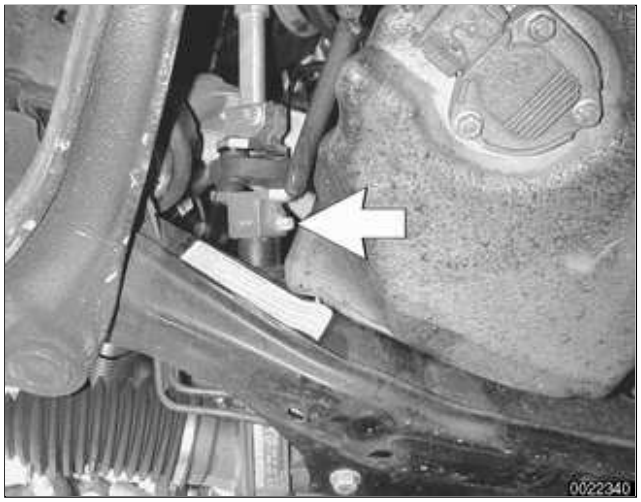
- Working underneath car, remove fluid line banjo bolts (**arrows**) from steering rack.

CAUTION!

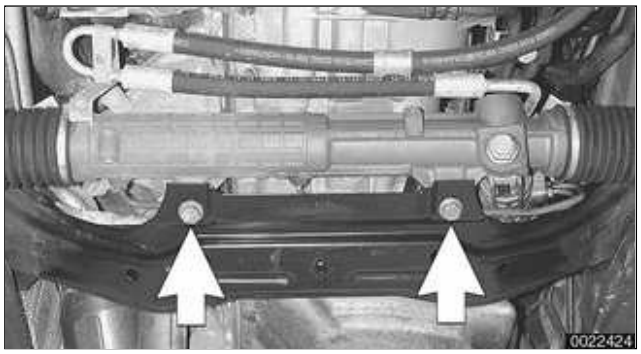
Plug off power steering lines and connections to keep out contamination.

Note:

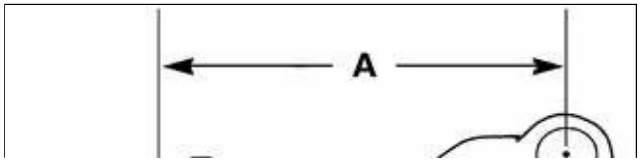
It may be necessary to remove other components to gain access to steering rack.



- Remove lower steering column flexible joint pinch bolt (**arrow**). Pull flexible joint off steering rack shaft.
  - Move steering wheel to straight ahead position and remove ignition key to lock steering.
  - On all wheel drive vehicles:
    - Support front subframe with a shop hoist or appropriate jack.
    - Detach subframe from engine and lower approx. 20 mm (in.). See ⇒ 310 Front Suspension

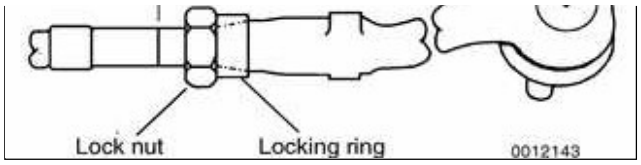


- Remove steering rack mounting bolts (**arrows**). Remove steering rack from subframe by pulling it forward.



- Installation is reverse of removal, noting the following:

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- Make sure all thread bores, bolts, nuts, splines and mating surfaces are clean. Use anti-seize paste on inner tie rod threads.
- Use new self-locking nuts wherever applicable.
- Use keyed components to reassemble steering column flexible joint to steering rack shaft. Make sure wheels are straight ahead.
- Use new sealing rings on banjo fittings. Do not over-torque banjo bolts.
- Use tie rod measurement previously made (measurement **A**) to temporarily set toe.
- Fill and bleed power steering system as described earlier.
- Have car professionally aligned.

Tightening torques	
Outer tie rod end to steering arm replace self-locking nut	65 Nm (48 ft-lb)
Outer tie rod end lock nut	45 Nm (33 ft-lb)
Steering column flexible joint to steering rack shaft	22 Nm (16 ft-lb)
Steering rack to subframe	
M10 bolt	42 Nm (32 ft-lb)
Steering fluid lines	

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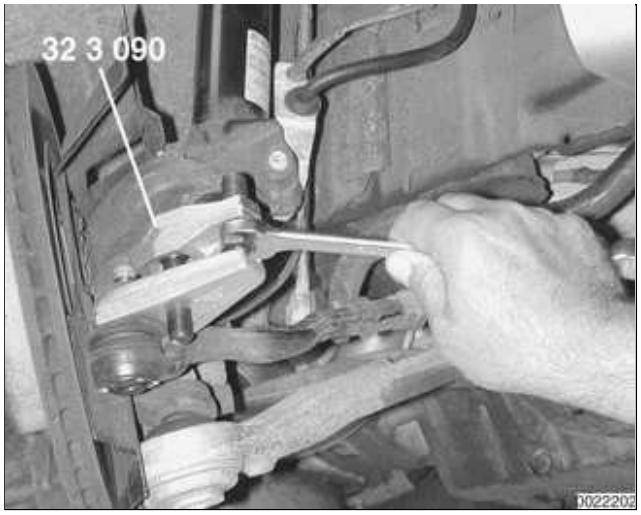
Tightening torques	
M14 banjo bolt	35 Nm (26 ft-lb)
M16 banjo bolt	40 Nm (30 ft-lb)

Outer tie rod end, replacing

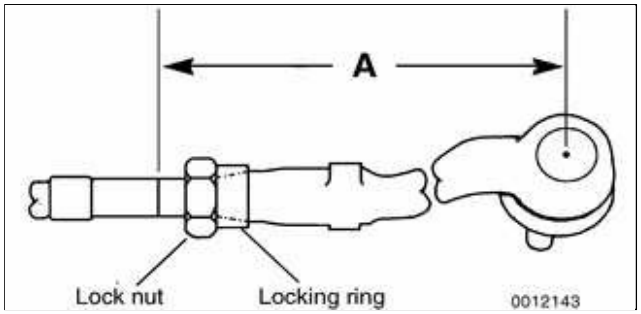
- Raise front of car. Remove road wheel.

WARNING!

Make sure the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.



- Remove outer tie rod ball joint nut. Separate outer tie rod end from steering arm using BMW special tool 32 3 090 or equivalent.



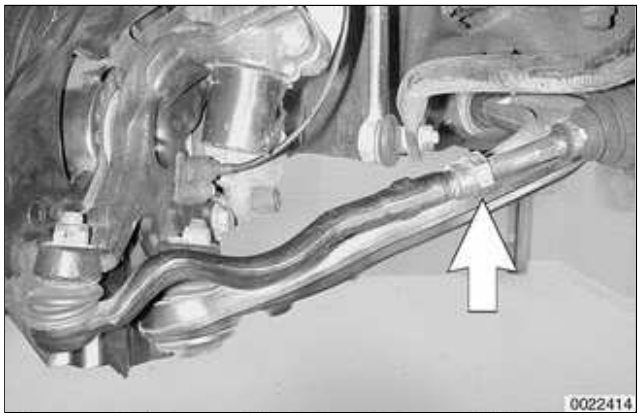
- Make reference measurement (**A**) of outer tie rod end to tie rod. Record measurement.

Note:

- *Accurate measurement of the tie rod end with reference to the tie rod will help approximate correct wheel alignment when new parts are installed.*

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- *Note correct placement of inner taper on locking ring*



➢ Loosen outer tie rod end lock nut (**arrow**).

- Unscrew tie rod end from tie rod shaft.

- Installation is reverse of removal.

- Make sure all threaded parts are clean. Use antiseize paste on inner tie rod threads.

- Use new self-locking nuts, where applicable.

- Use tie rod measurement (**A**) to set toe.

- Have car professionally aligned.

Tightening torques	
Outer tie rod end to steering arm replace self locking nut	65 Nm (48 ft-lb)
Outer tie rod end lock nut	45 Nm (33 ft-lb)

Tie rod or rack boot, replacing

- Raise front of car. Remove splash shield from under engine.

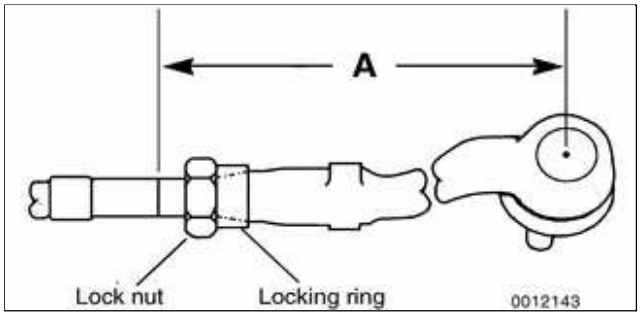
WARNING!

Make sure the car is firmly supported on jack stands designed for the

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purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.

- Remove outer tie rod end self-locking nut, and separate outer tie rod end ball joint as described above.



- Make a reference measurement of outer tie rod end to tie rod. Record measurement.

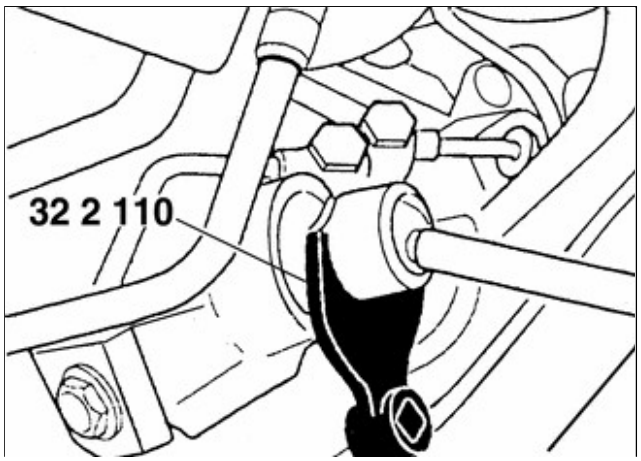
Note:

- *Accurate measurement of the tie rod end with reference to the tie rod will help approximate correct wheel alignment when new parts are installed.*
- *Note correct placement of inner taper on locking ring*

- Cut rack boot band clamp and slide bellows back. Inspect boot for any sign of damage. Replace if necessary.

Note:

New rack boot kit comes with new band clamp.



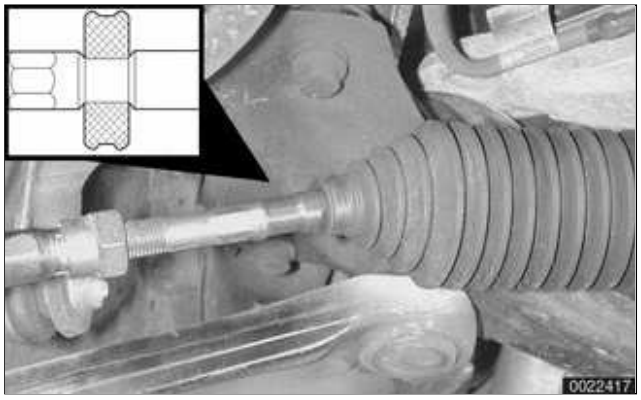
- Using BMW special tool 32 2 110 remove inner tie rod shaft from steering rack.

CAUTION!

To avoid damage to steering rack while removing tie rod, turn steering until end of rack is as far as possible in housing

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- When reassembling, grease tie rod taper so that rack boot support buffer or small end of rack boot (**inset**) slides on tie rod when tie rod is tightened, preventing rack boot from twisting.

- Installation is reverse of removal, noting the following:

- Make sure all threaded parts are clean. Replace self-locking nuts.

- Install outer tie rod end to new tie rod using reference measurement (**A**) recorded earlier.

- Have car professionally aligned.

Tightening torques	
Outer tie rod end to steering arm	65 Nm (48 ft-lb)
Outer tie rod end lock nut	45 Nm (33 ft-lb)
Inner tie rod to steering rack	100 + 10 Nm (74 + 7 ft-lb)

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Wheel Alignment

Proper handling, stability, tire wear and driving ease depend upon the correct alignment of all four wheels. The front axle is aligned in relation to the rear axle, then the front wheels are aligned in relation to one another. This is known as a four-wheel or thrust-axis alignment.

The BMW E46 uses a sophisticated multi-link suspension at the front and rear of the car. Proper alignment requires computerized alignment equipment.

Alignment specifications only apply under the following conditions:

- Correct wheels and tires are installed, in good condition, and are at the correct inflation pressures.
- All steering and suspension parts and bushings are undamaged and show no signs of abnormal wear.
- Wheel bearings are in good condition.
- Ride height is in accordance with specifications. See ⇒ 300 Suspension, Steering and Brakes-General
- Car is in normal loaded position.

See ⇒ Table a. Front wheel alignment specifications for front wheel alignment specifications, ⇒ Table b. Rear wheel alignment specifications for rear wheel alignment specifications.

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WARNING!

While performing alignment procedures, make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

Normal loaded position	
Each front seat	68 Kg (150 lb)
Rear seat (center)	68 Kg (150 lb)
Trunk	21 Kg (46 lb)
Fuel tank	full

Table a. Front wheel alignment specifications

Parameter	**Standard suspension**	**All wheel drive suspension**	**Sport suspension**	**Rough road suspension**
Toe angle (total)	0° 14' ± 8'			
Camber (difference between left/right max. 30') track differential angle with 20° lock on inside wheel	-20' ± 20' -1° 34' ± 30'	20' ± 20' -53' ± 30'	43' ± 20' -1° 34' ± 30'	+8' ± 20' -1° 34' ± 30'
Caster (difference between left/right max. 30') with 10 wheel lock with 20 wheel lock	5° 26' ± 30' 5° 37' ± 30'	5° 27' ± 30' 5° 37' ± 30'	5° 36' ± 30' 5° 47' ± 30'	5° 17' ± 30' 5° 27' ± 30'
Front wheel displacement	0° ± 15'			

Table b. Rear wheel alignment specifications

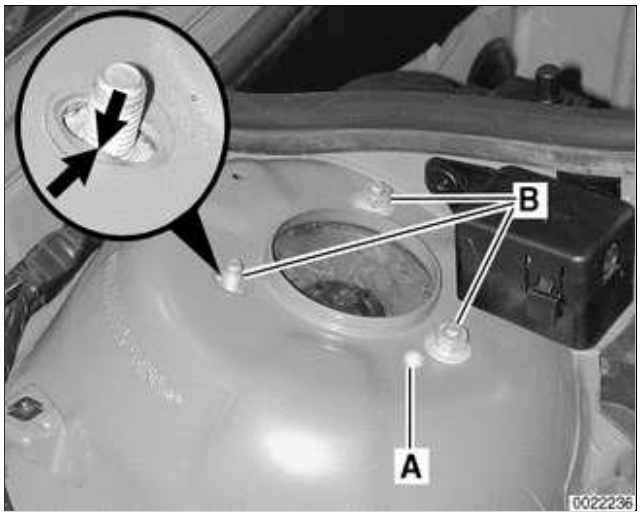
Parameter	**Standard suspension**	**All wheel drive suspension**	**Sport suspension**	**Rough road suspension**
Toe angle (total)	0° 16' ± 6'			

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Parameter	Standard suspension	All wheel drive suspension	Sport suspension	Rough road suspension
Camber (difference between left/right max. 15') maximum allowable deviation between sides	-1° 30' ± 15'	-1° 15' ± 15'	-2° 04' ± 15'	-46' ± 15'
Geometrical axis deviation	0° ± 6'			

Front wheel camber

Any change to the camber will also change the toe setting. Always adjust camber prior to adjusting toe.

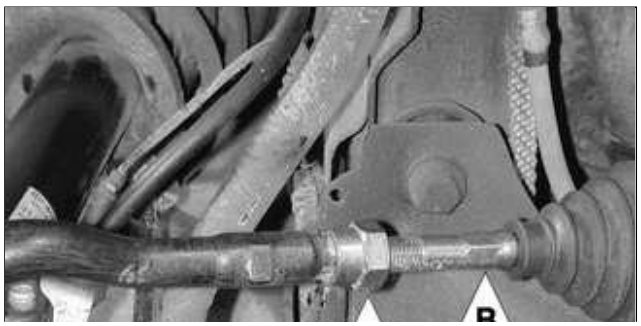


➢ Front wheel camber adjustment can be made by driving out factory strut alignment pin (**A**) in upper strut housing.

- Loosen upper strut mount nuts (**B**).
- Use BMW special tool 32 3 140 to adjust position of upper strut mount studs in slotted holes (**arrows**).

Tightening torque	
Upper strut mount to body	24 Nm (17 ft-lb)

Front wheel toe



➢ Front wheel toe is adjusted at tie rod ends:

- Loosen tie rod lock nut (**A**).
- Adjust tie rod by turning inner tie rod (**B**) to change length.

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Note:

- *Steering rack can be centered by aligning centering mark on steering shaft with lug on steering rack.*
- *To keep steering wheel centered, adjust both tie rods equal amounts.*
- *Make sure the rubber boot on the rack moves freely on the tie rod and does not become twisted.*

Tightening torque	
Tie rod lock nut	45 Nm (33 ft-lb)

Rear wheel camber



➢ Rear wheel camber is adjusted at outer end of rear lower control arm using camber adjusting bolt.

- Make sure bolt remains between two alignment lugs (**arrows**) on end of control arm.
- Check toe setting as described below.

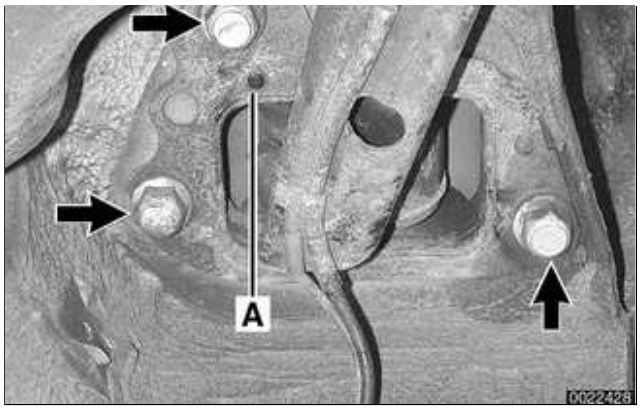
Tightening torque	
Rear lower control arm to rear trailing arm	77 Nm (57 ft-lb)

Rear wheel toe



➢ Loosen trailing arm bracket mounting bolts (**arrows**).

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- Install BMW special tool 32 3 030 over alignment lug (**A**) and adjacent bolt.

- Use tool to adjust position of bracket.

- Remove tool and tighten trailing arm bracket mounting bolts.

Tightening torque	
Rear trailing arm bracket to body	77 Nm (57 ft-lb)

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330-1

General

This repair group covers removal and replacement of E46 rear suspension components.

A general description of the rear suspension, ride height specifications and a troubleshooting guide can be found in ⇒ 300 Suspension, Steering and Brakes-General.

Additional component replacement information specific to all wheel drive models can be found in the following repair groups:

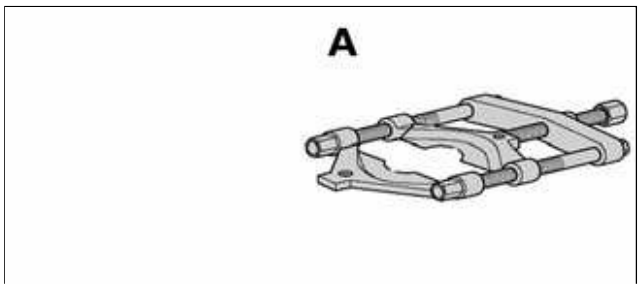
- ⇒ 310 Front Suspension
- ⇒ 311 Front Axle Final Drive
- ⇒ 331 Rear Axle Final Drive

Alignment information can be found in ⇒ 320 Steering and Wheel Alignment.

Special tools

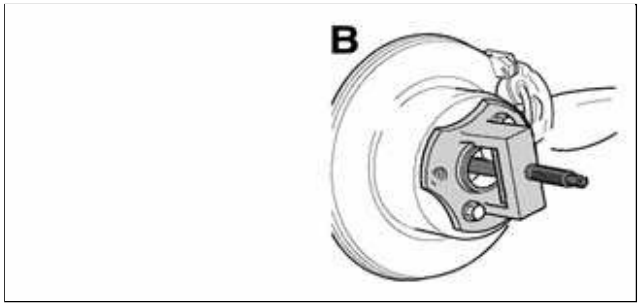
Special service tools are required for some of the work described in this repair group. Most of these tools are specialized presses and pullers that might be replaced by standard pullers of various sizes.

Read the procedures through before beginning any job.

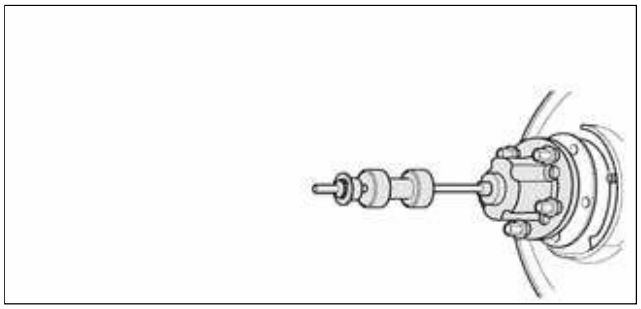


Bearing splitter BMW I 00 7 500

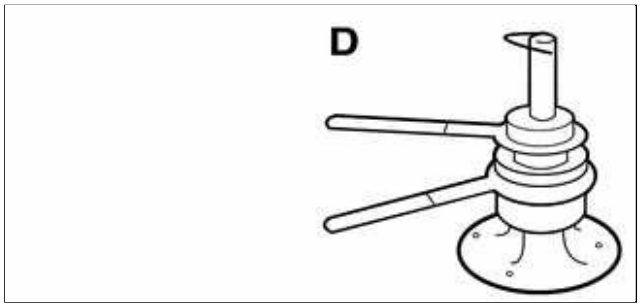
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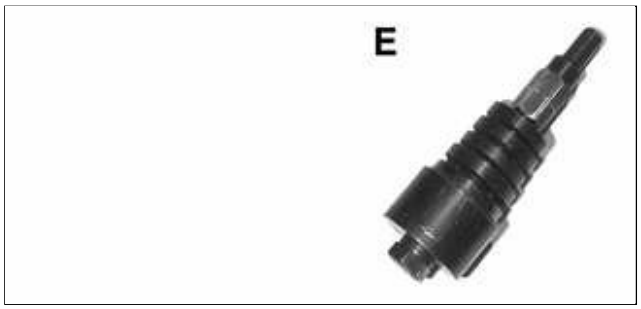
- Drive axle press BMW set 33 2 115/116/119



- Flange puller BMW set 33 2 116/4 201/4 202/4 203



- Inner bearing race puller BMW set 33 4 400



- Wheel bearing extractor B90 (Source: Baum Tools Unlimited)

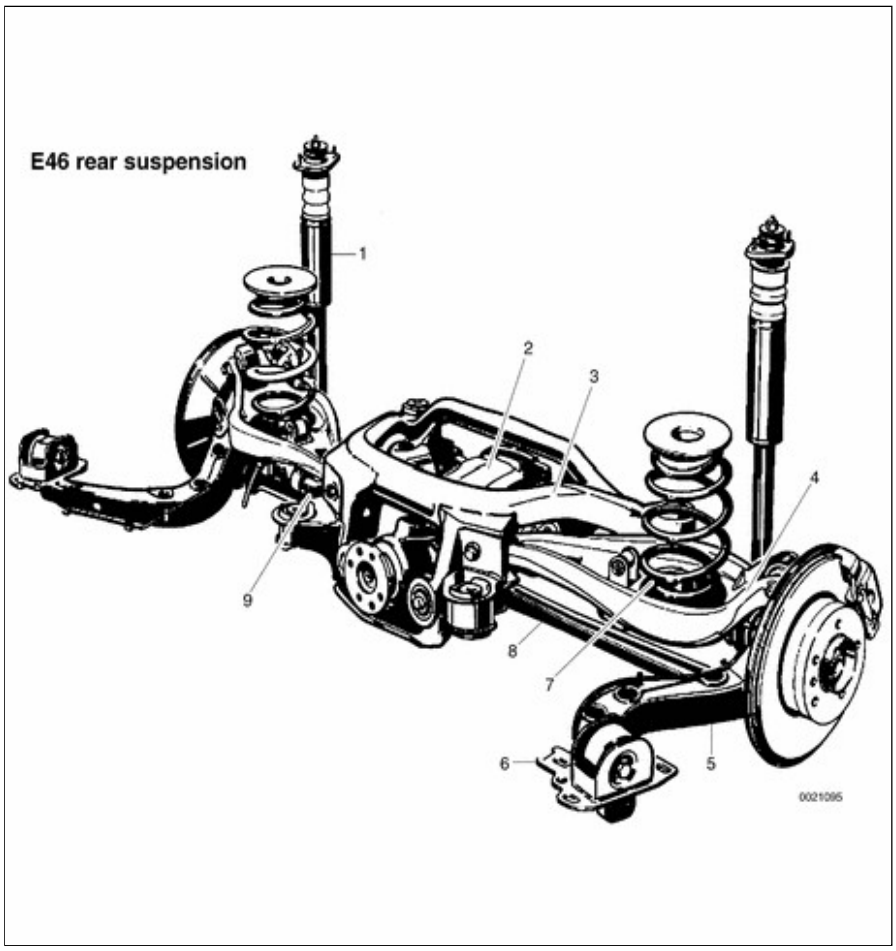
Rear suspension description

BMW uses an independent rear suspension consisting of an upper and a lower control arm and a trailing arm on each side. The weight of the car is supported by coil springs. There is a rear stabilizer bar attached to the upper control arms. Gas-pressure shock absorbers round out the rear

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suspension.

The rear subframe (final drive carrier) supports the rear differential and provides mounting points for the upper and lower control arms. The upper control arm on each side provide the lower spring perch for the coil spring. The upper and lower control arm on each side are attached to the trailing arm. The trailing arms contain the wheel bearings for the rear drive hubs. The rear brake calipers are bolted to the trailing arms.



E46 Rear suspension

1 - Shock absorber

2 - Differential housing

3 - Rear subframe (final drive carrier)

4 - Upper control arm

5 - Trailing arm

6 - Trailing arm bracket

7 - Coil spring

8 - Lower control arm

9 - Stabilizer bar

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Rear Shock Absorbers and Springs

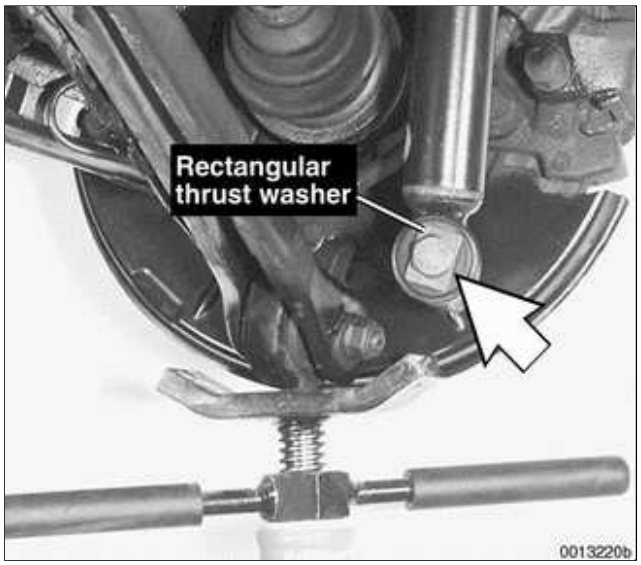
Replace shock absorbers and springs in pairs only.

Rear shock absorber, removing and installing

- Raise car and remove rear wheels.

WARNING!

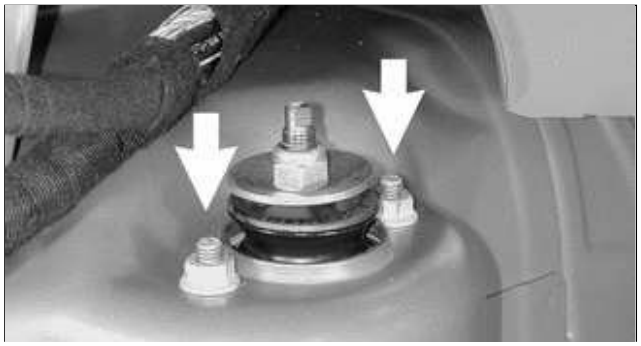
Make sure that the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.



- Support trailing arm from below using an adjustable jackstand. Remove shock absorber lower mounting bolt (**arrow**).

CAUTION!

The shock absorber prevents the drive axle from dropping too far. Support the trailing arm before removing the lower shock absorber bolt to avoid damage to drive axle CV joints.



- On Sedan or Coupe models: Working in trunk, pry out luggage compartment liner retaining clips. Peel back liner to gain access to upper shock absorber mounting nuts (**arrows**).

- On Convertible models: Open convertible top storage

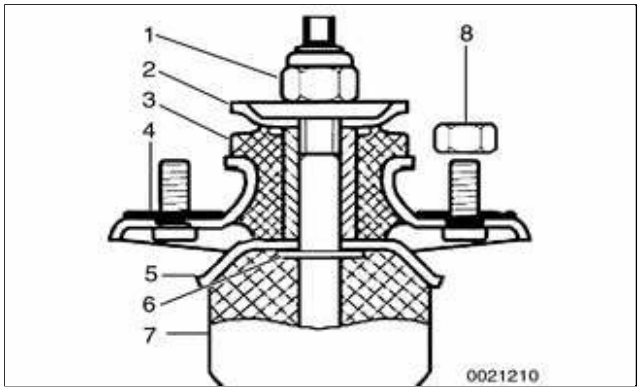
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compartment to access upper shock absorber mount.

- On Sport Wagon models: Working in cargo compartment, remove side trim next to rear seat backrests.

- Support shock absorber from below while removing upper mounting nuts. Lower shock absorber out of wheel housing.



Transfer shock top mounting plate, dust cover (if applicable) and related components to new shock absorber.

1 - Self-locking nut M10 -tighten to 14 Nm (10 ft-lb)

2 - Upper support plate

3 - Top mount

4 - Body seal

5 - Lower support plate

6 - Spacer ring

7 - Rubber bump stop

8 - Self-locking nut M8 -tighten to 24 Nm (17 ft-lb)

- Installation on car is reverse of removal, noting the following:

- Make sure all threaded bolts, nuts and mating surfaces are clean.

- Install shock absorber into shock tower using a new upper mounting seal and new self-locking nuts.

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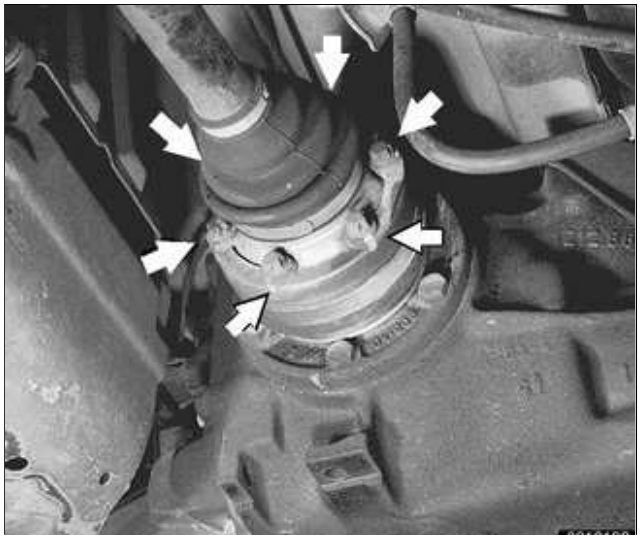
- Make sure rectangular thrust washer on lower mounting bolt is between bolt head and shock absorber rubber.

- Tighten lower shock absorber bolt to its final torque once car is on ground.

Tightening torques	
Road wheel to hub	100 ± 10 Nm (74 ± 7 ft-lb)
Shock absorber to trailing arm (car in normal loaded position)	100 Nm (74 ft-lb)
Shock absorber to upper mount	14 Nm (10 ft-lb)
Shock absorber upper mount to body M8 self-locking nuts	28 Nm (21 ft-lb)

Coil spring, removing and installing

- Raise car and remove rear wheel.



Remove drive axle to final drive mounting bolts (**arrows**).

- Detach drive axle from final drive.

- Suspend drive axle from chassis using stiff wire.

- Remove fuel tank protective panel.

- Detach stabilizer bar from rear

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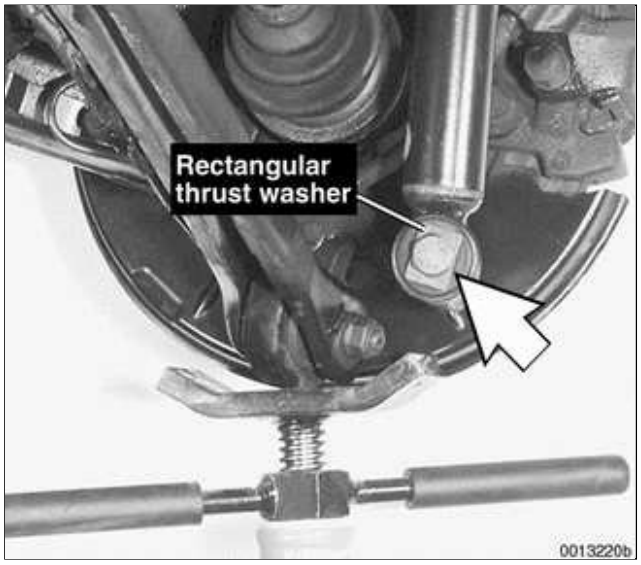
subframe.



- Remove rear brake line bracket mounting bolt (**arrow**). Detach bracket from trailing arm.

CAUTION!

Avoid damaging the brake hose by stretching when the trailing arm is lowered.



- Support trailing arm from below using an adjustable jackstand. Remove shock absorber lower mounting bolt (**arrow**).

  - Lower trailing arm slowly and carefully until the compressed coil spring is fully unloaded. Remove spring.

  - If spring is to be reused:

    - Inspect spring for any surface damage or corrosion.

    - Inspect top and bottom spring seat rubber pads for signs of damage.

    - Replace any parts showing evidence of wear or damage.

Note:

In the "rough road package", the top spring seat pad is 14.5 mm (0.57 in.) thick.

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- To install spring:

- Coat top spring pad with anti-friction paste (e.g., tire mounting paste).

- Slowly lift suspension back into position, making sure coil spring is correctly seated in upper and lower spring seats.

- When suspension has been lifted sufficiently, reattach shock absorber to trailing arm. Make sure rectangular thrust washer on lower shock absorber mounting bolt is between bolt head and shock absorber rubber.

- Tighten lower shock absorber bolt to its final torque once car is on ground.

- Remainder of installation is reverse of removal.

Tightening torques	
Drive axle to final drive flange	
M10x20 mm Torx bolt	83 Nm (61 ft-lb)
M10x46 mm bolt (black)	100 Nm (74 ft-lb)
M10x46 mm bolt (silver) (always replace)	80 Nm (59 ft-lb)
Road wheel to hub	100 ± 10 Nm (74 ± 7 ft-lb)
Shock absorber to trailing arm (car in normal loaded	100 Nm (74 ft-lb)

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Tightening torques
position)

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Rear Suspension Arms, Subframe and Bushings

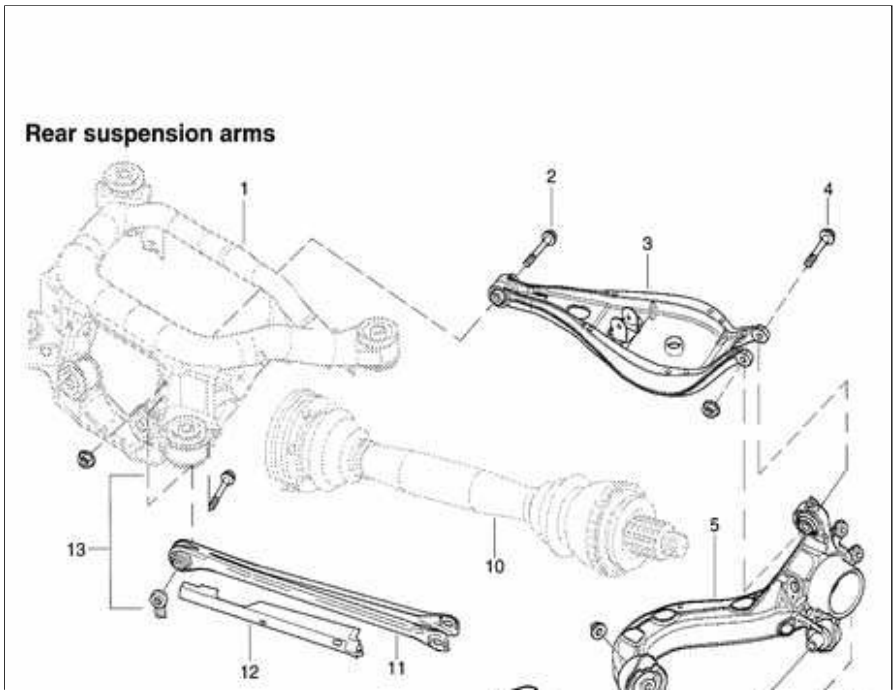
The trailing arms, control arms and their mounting bushings control the position of the rear wheels. A damaged suspension arm or worn bushings will change the rear wheel alignment and may adversely affect handling and stability.

WARNING!

Do not attempt to straighten a damaged suspension arm. Bending or heating may weaken the original part. If the suspension arm shows any signs of damage or excessive corrosion, it must be replaced.

Note:

If a rear brake line is disconnected to remove a trailing arm, the complete braking system must be bled as part of the reinstallation procedure.



Rear suspension arms, assembly

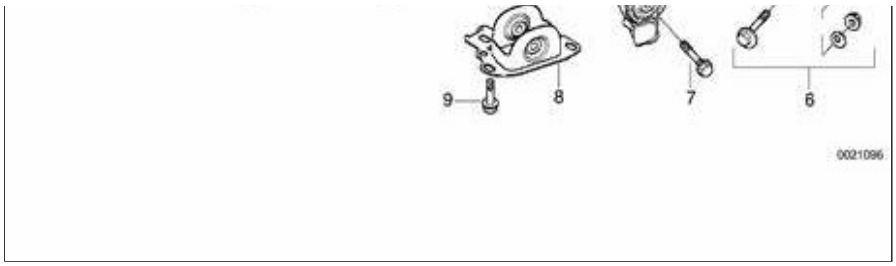
1 - Rear subframe

2 - Upper control arm inner bolt self-locking M12 nut

- tighten to 77 Nm (57 ft-lb)

3 - Upper control arm

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4 - **Upper control arm outer bolt self-locking M12 nut**

- tighten to 110 Nm (81 ft-lb)

5 - **Trailing arm**

6 - **Lower control arm eccentric bolt eccentric flat M12 washer self locking M12 nut**

- tighten to 110 Nm (81 ft-lb)

7 - **Trailing arm front bolt self-locking M12 nut**

- tighten to 110 Nm (81 ft-lb)

8 - **Trailing arm front bracket**

9 - **Bracket mounting bolt**

- tighten to 77 Nm (57 ft-lb)

10 - **Drive axle**

11 - **Lower control arm**

12 - **Lower control arm plastic shield**

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13 - **Lower control arm inner M12 bolt lock plate**

♦ tighten to 110 Nm (81 ft lb)

Trailing arm, removing and installing

- Raise rear end of car and remove wheel.

WARNING!

Make sure that the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.

- Remove drive axle as described in ⇒ 331 Rear Axle Final Drive.

- Right side: Detach brake pad sensor connector at brake caliper.

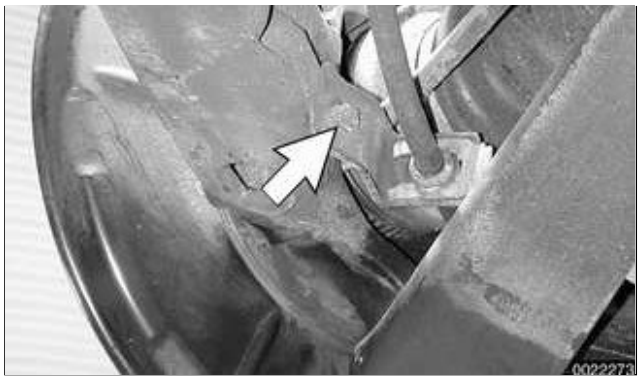
- Remove brake rotor and caliper as described in ⇒ 340 Brakes. Do not remove brake line from caliper. Suspend caliper from body using stiff wire.

- Remove parking brake cable from brake shoe expander. See ⇒ 340 Brakes.



➢ Remove rear brake line bracket mounting bolt (**arrow**). Detach bracket from trailing arm.

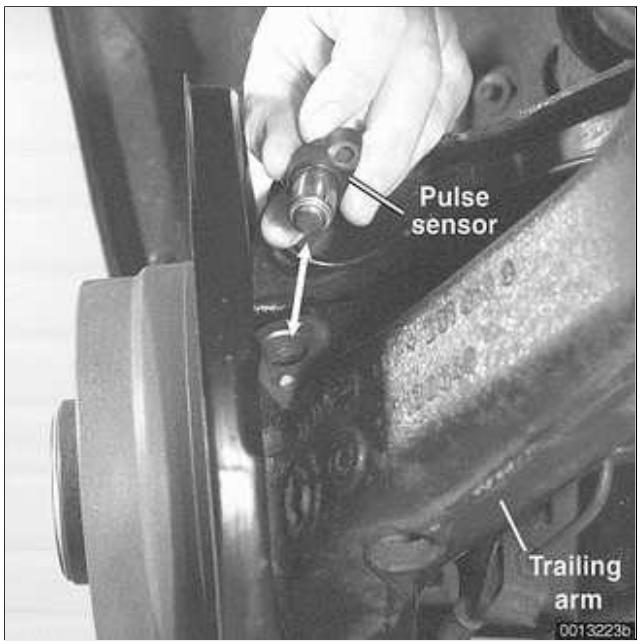
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CAUTION!

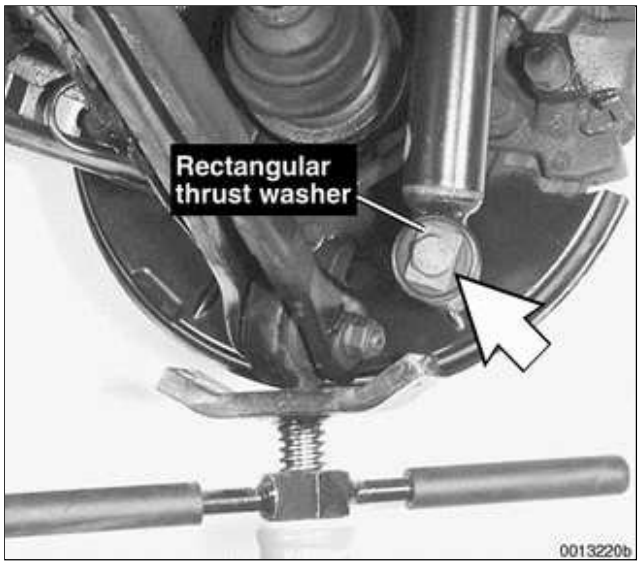
Avoid damaging the brake hose by stretching when the trailing arm is lowered.

- Remove fuel tank protective panel, if equipped.



➢ Remove ABS pulse sensor from trailing arm.

- Unclip pulse sensor and pad sensor (if applicable) harnesses from control arm and lay aside.



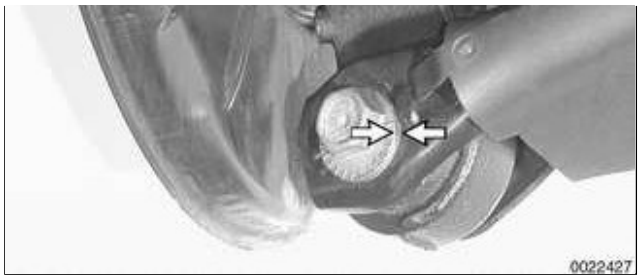
➢ Support trailing arm from below using an adjustable jackstand. Remove shock absorber lower mounting bolt (**arrow**).

- Slowly lower suspension until coil spring can be safely removed.

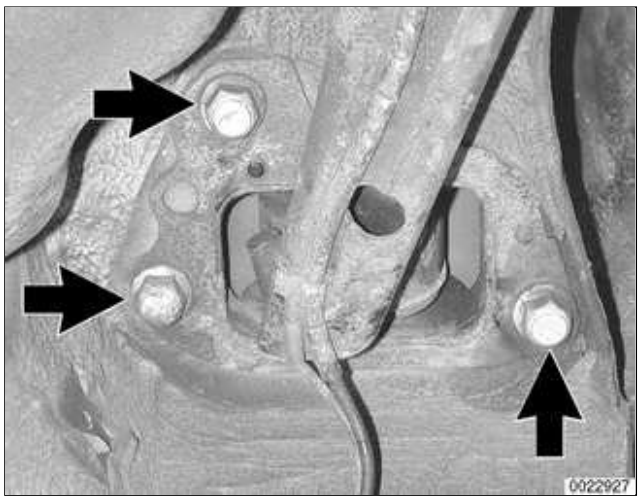


➢ Mark position (**arrows**) of lower control arm eccentric mounting bolt.

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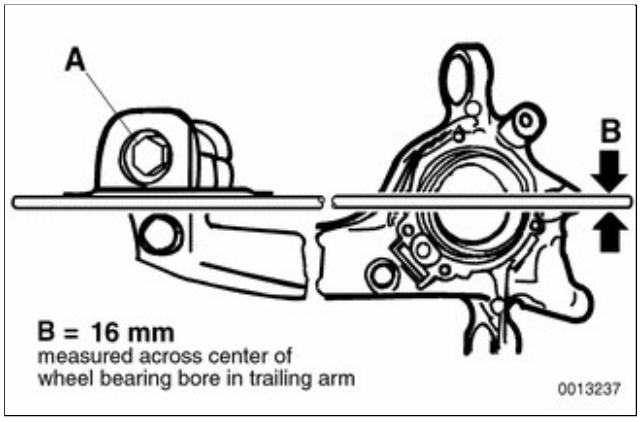


- Unbolt upper and lower control arms from trailing arm. Note direction of bolt insertion in both arms.



➢ To remove trailing arm:

- ♦ Make reference marks to locate trailing arm bracket to body in order to maintain alignment specifications.
- ♦ Remove trailing arm front bracket mounting bolts (**arrows**).
- ♦ Working with trailing arm on workbench, detach front bracket from arm.



➢ When reinstalling, preload trailing arm front bracket bushing:

- ♦ Install bolt (**A**) through bracket and arm and install nut finger tight.
- ♦ Using 16 mm bar stock as shown in illustration, align base of bracket so that it is parallel with center of wheel bearing bore on trailing arm.
- ♦ Torque bracket bolt (**A**).

Tightening torque	
Trailing arm to front bracket	110 Nm (81 ft-lb)

- Remainder of installation is reverse of removal, noting the following:

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- Install new rear wheel bearings.
- Insert control arm mounting bolts in direction previously marked.
- Always use new self-locking nuts.
- Transfer brake system components to new arm as described in ⇒ 340 Brakes.
- Have car professionally aligned when job is complete.

Note:

BMW-supplied replacement trailing arms come with control arm bushings installed. A new wheel bearing will have to be installed.

Tightening torques	
Drive axle collar nut to drive flange	
M24	250 Nm (184 ft-lb)
M27	300 Nm (221 ft-lb)
Drive axle to final drive flange	
M10x20 mm Torx bolt	83 Nm (61 ft-lb)
M10x46 mm bolt (black)	100 Nm (74 ft-lb)
M10x46 mm bolt (silver) (always replace)	80 Nm (59 ft-lb)
Road wheel to hub	100 ± 10 Nm (74 ± 7 ft-lb)
Shock absorber to trailing arm (car in	100 Nm (74 ft-lb)

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Tightening torques	
normal loaded position)	
Trailing arm bracket to body (M12 bolt)	77 Nm (57 ft-lb)
Trailing arm to upper or lower control arm (M12 bolt)	110 Nm (81 ft-lb)

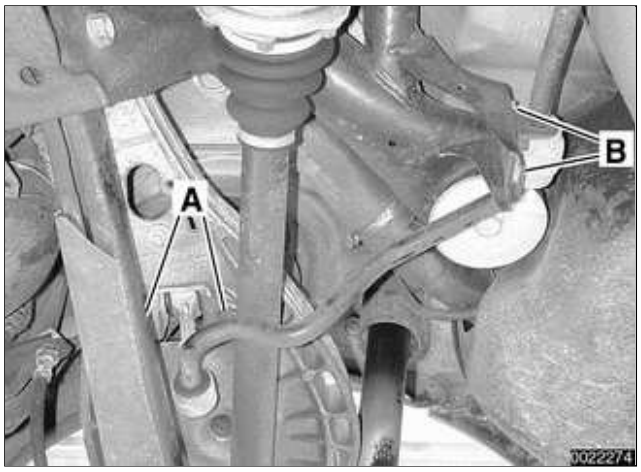
Upper control arm, removing and installing

- Remove drive axle as described in ⇒ 331 Rear Axle Final Drive.

WARNING!

Make sure that the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.

- Remove coil spring as described earlier.



➢ Remove stabilizer bar link bolts (**A**) at upper control arm.

- ♦ Remove stabilizer bar anchor bolts (**B**).
- ♦ Carefully push stabilizer bar aside.

Note:

Do not twist stabilizer bar link bushing on end of bar. See ⇒ Rear Stabilizer Bar later in this repair group.

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- If necessary, remove ride level sensor from upper control arm.

- Unbolt upper control arm from both trailing arm and rear subframe. Note direction of bolt insertion.

Note:

For clearance reasons, it may be necessary to unbolt the differential from the subframe and push it toward the rear of the car in order to remove the control arm mounting bolt from the subframe.

- Installation is reverse of removal, noting the following;

- Insert mounting bolts in direction previously marked
- Always use new self-locking nuts.
- Have car professionally aligned when job is complete.

Tightening torques	
Drive axle collar nut to drive flange	
M24	250 Nm (184 ft-lb)
M27	300 Nm (221 ft-lb)
Drive axle to final drive flange	
M10x20 mm Torx bolt	83 Nm (61 ft-lb)
M10x46 mm bolt (black)	100 Nm (74 ft-lb)
M10x46 mm bolt (silver) (always replace)	80 Nm (59 ft-lb)

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Tightening torques	
Road wheel to hub	100 ± 10 Nm (74 ± 7 ft-lb)
Shock absorber to trailing arm car in normal loaded position	100 Nm (74 ft-lb)
Upper control arm to rear subframe M12 bolt	77 Nm (57 ft-lb)
Upper control arm to trailing arm M12 bolt	110 Nm (81 ft-lb)

Lower control arm, removing and installing

- Raise rear end of car and support it securely on jackstands. Remove rear wheel.

- Support trailing arm from below using an adjustable jackstand.



Mark position (**arrows**) of lower control arm eccentric mounting bolt.

- Remove lower control arm plastic shield.

- Remove both lower control arm mounting bolts. Note direction of bolt insertion.

Note:

For clearance reasons, it may be necessary to unbolt the differential from the subframe and push it toward the rear of the car in order to remove the control arm mounting bolt from the subframe.

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- Use a soft hammer to tap control arm out of its mounting points.

- Installation is reverse of removal.

♦ Welded seam of control arm faces upward.

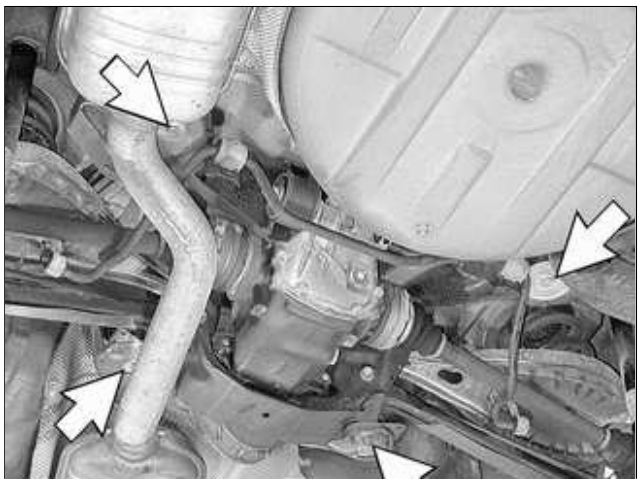
♦ To install mounting hardware at subframe, insert lock plate into opening in subframe from below.

♦ Line up eccentric bolt head with marks made previously.

♦ Have car professionally aligned when job is complete.

Tightening torque	
Lower control arm to rear subframe M12 bolt	110 Nm (81 ft-lb)
Lower control arm to trailing arm M12 eccentric bolt	110 Nm (81 ft-lb)

Rear subframe



In case of damage to the subframe, or if a pressed-in bushing is worn, remove subframe.

♦ Convertible models: Remove rear body reinforcing brace.

♦ Remove exhaust system. See ⇒ 180 Exhaust System.

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- Detach rear driveshaft from rear differential. See ⇒ 260 Driveshaft.
- Detach rear drive axles from rear differential. Remove rear differential. See ⇒ 331 Rear Axle Final Drive.
- Detach rear control arms as described earlier
- Remove rear subframe mounting fasteners (**arrows**) while supporting subframe securely.

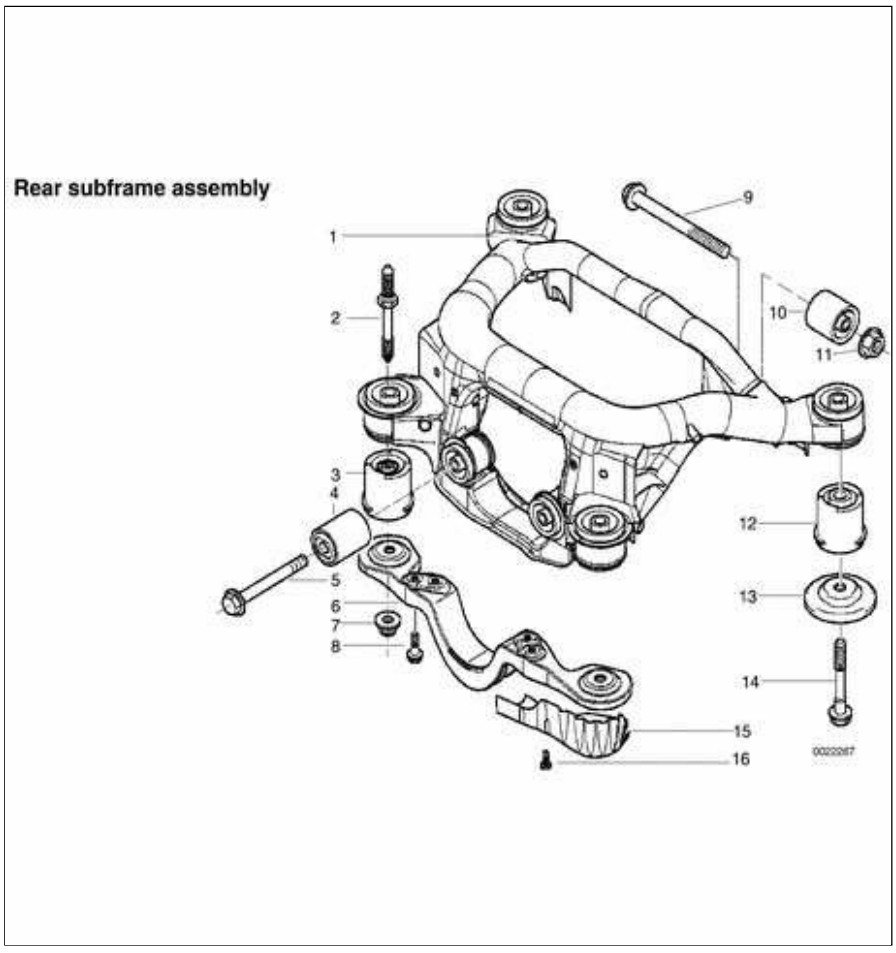
- In case of damage to subframe mounting stud threads, replace stud.

- In case of damage to subframe mounting stud threads in body, repair using Helicoil thread insert M12 x 1.5 x 18.

Tightening torques	
Differential to subframe front bolt (M12)	110 Nm (81 ft-lb)
Differential to subframe rear bolt (M14)	174 Nm (128 ft-lb)
Drive axle to final drive flange	
M10x20 mm Torx bolt	83 Nm (61 ft-lb)
M10x46 mm bolt (black)	100 Nm (74 ft-lb)
M10x46 mm bolt (silver) (always replace)	80 Nm (59 ft-lb)
Driveshaft to differential flange	

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Tightening torques	
M10 compression nut	64 Nm (47 ft-lb)
M10 Torx bolt	85 Nm (63 ft-lb)
Lower control arm to subframe (M12)	110 Nm (81 ft-lb)
Subframe to body (M12)	77 Nm (57 ft-lb)
Upper control arm to subframe (M12)	77 Nm (57 ft-lb)



Rear subframe assembly

1 - Rear subframe (final drive carrier)

2 - M12 mounting stud

♦ tighten to 90 Nm (66 ft-lb)

3 - Bushing

4 - Bushing

5 - M12 bolt with washer

♦ tighten to 110 Nm (81 ft-lb)

6 - Rear suspension reinforcement

7 - M12 self-locking collar nut

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- tighten to 77 Nm (57 ft-lb)

8 - **M8 bolt**

- 8.8 grade tighten to 21 Nm (15 ft-lb)
- 10.9 grade tighten to 30 Nm (22 ft-lb)

9 - **M14 bolt**

- tighten to 174 Nm (128 ft-lb)

10 - **Bushing**

11 - **M14 self-locking collar nut**

12 - **Bushing**

13 - **Stop washer**

14 - **M12 reduced shaft bolt**

- tighten to 77 Nm (57 ft-lb)

15 - **Heat shield**

16 - **M6 self-tapping screw**

Rear suspension bushings

When replacing any bushing in a rear suspension component, be sure to measure and record orientation and protrusion of old bushing from its boss.

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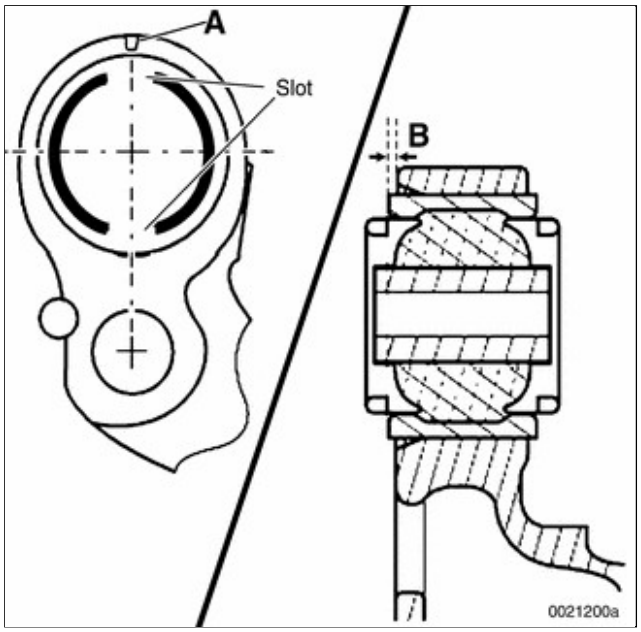
Support car securely before starting work underneath rear suspension.

WARNING!

Make sure that the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.

Trailing arm front bushing

- Before removing trailing arm, be sure to mark position of trailing arm front bracket on body to facilitate resetting of rear toe.



➢ Using appropriate press tools:

- Press bushing out of trailing arm.
- Clean all grease from eye of trailing arm.
- Draw new bushing into trailing arm:
- Line up slot in bushing with mark (**A**) on eye of trailing arm.
- Fully pressed in, cylindrical bushing must protrude from trailing arm eye by measurement **B** = 2.5 mm (0.1 in.)

- Have car professionally aligned when job is complete.

Tightening torques	
Trailing arm to front	110 Nm (81 ft-lb)

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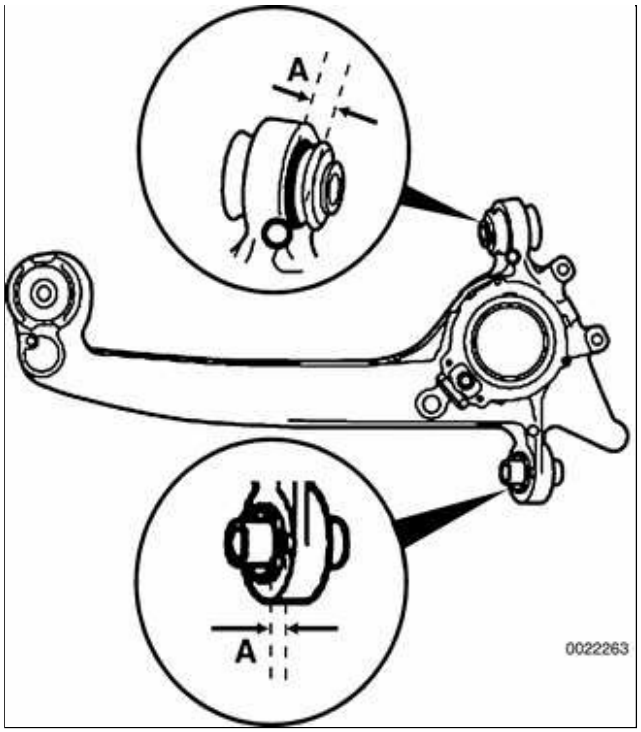
Tightening torques	
bracket	
Trailing arm bracket to body	77 Nm (57 ft-lb)

Upper or lower control arm outer bushing (in trailing arm)

- Upper control arm bushing: Remove trailing arm from car as described earlier. Note direction of bolt insertion.

- Lower control arm bushing: Detach lower control arm from trailing arm. There is no need to remove trailing arm.

- Before detaching lower control arm from trailing arm, be sure to mark position of eccentric mounting bolt to facilitate resetting of rear camber. Note direction of bolt insertion.



➢ To replace bushing:

- Measure and record protrusion (**A**) of old bushing from trailing arm boss.

- Press old bushing out and install new bushing, using protrusion **A** as a reference.

- Have car professionally aligned when job is complete.

Tightening torques
Drive axle collar nut to drive flange

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Tightening torques	
M24	250 Nm (184 ft-lb)
M27	300 Nm (221 ft-lb)
Drive axle to final drive flange	
M10x20 mm Torx bolt	83 Nm (61 ft-lb)
M10x46 mm bolt (black)	100 Nm (74 ft-lb)
M10x46 mm bolt (silver) (always replace)	80 Nm (59 ft-lb)
Lower control arm to trailing arm M12 eccentric bolt	110 Nm (81 ft-lb)
Road wheel to hub	100 ± 10 Nm (74 ± 7 ft-lb)
Shock absorber to trailing arm car in normal loaded position	100 Nm (74 ft-lb)
Upper control arm to rear subframe M12 bolt	77 Nm (57 ft-lb)
Upper control arm to trailing arm M12 bolt	110 Nm (81 ft-lb)

Upper control arm inner bushing

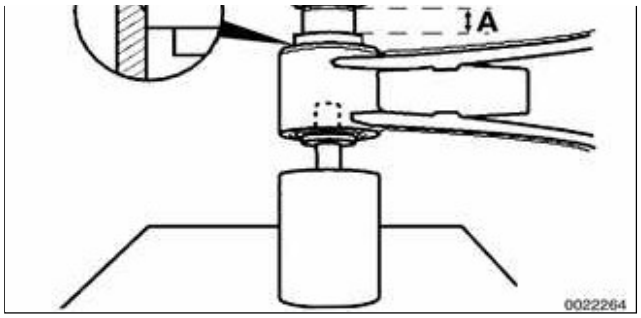
- Remove upper control arm as described earlier.

- Press old bushing out using appropriate press tools.



Press new bushing starting at inner bevelled end (**arrow**) of control arm bore.

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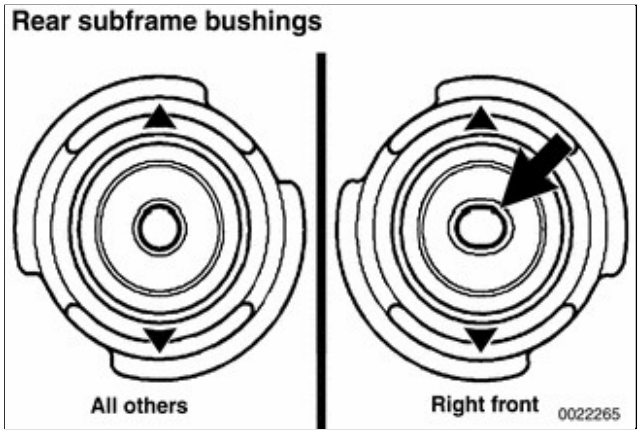
- Be sure that longer collar of bushing (**A**) is on same side as bevel in control arm.
- Outer bushing housing must be flush with control arm bore when fully pressed in.
- Have car professionally aligned when job is complete.

Tightening torque	
Drive axle collar nut to drive flange	
M24	250 Nm (184 ft-lb)
M27	300 Nm (221 ft-lb)
Drive axle to final drive flange	
M10x20 mm Torx bolt	83 Nm (61 ft-lb)
M10x46 mm bolt (black)	100 Nm (74 ft-lb)
M10x46 mm bolt (silver) (always replace)	80 Nm (59 ft-lb)
Road wheel to hub	100 ± 10 Nm (74 ± 7 ft-lb)
Shock absorber to trailing arm (car in normal loaded position)	100 Nm (74 ft-lb)
Upper control arm to rear subframe M12 bolt	77 Nm (57 ft-lb)
Upper control arm to trailing arm M12 bolt	110 Nm (81 ft-lb)

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Rear subframe bushing

- Remove subframe as described earlier.
- In case of damage to subframe mounting stud threads, replace stud.
- In case of damage to subframe mounting stud threads in body, repair using Helicoil thread insert M12 x 1.5 x18.
- Press old bushing out and install new bushing using appropriate press tools. Coat new bushing with Circolight® or equivalent rubber bonding agent.



Bushing position and orientation:

- Right front bushing has elongated hole (**arrow**).
- Orient all bushings with triangular arrow heads pointing front/aft on car.
- Have car professionally aligned when job is complete.

Tightening torque	
Drive axle collar nut to drive flange	
M24	250 Nm (184 ft-lb)
M27	300 Nm (221 ft-lb)
Drive axle to final drive flange	

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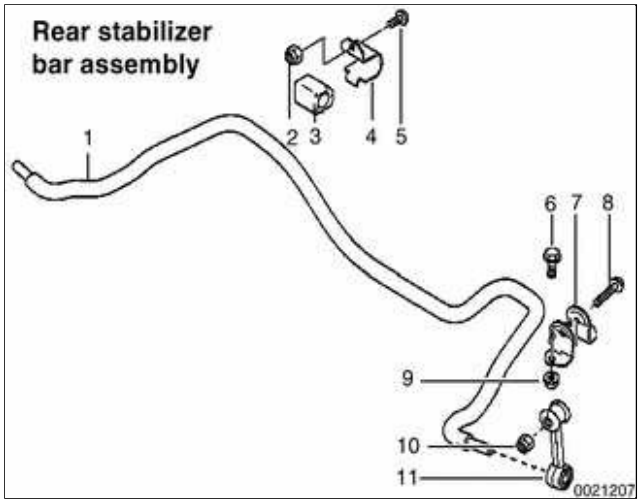
Tightening torque	
M10x20 mm Torx bolt	83 Nm (61 ft-lb)
M10x46 mm bolt (black)	100 Nm (74 ft-lb)
M10x46 mm bolt (silver) (always replace)	80 Nm (59 ft-lb)
Road wheel to hub	100 ± 10 Nm (74 ± 7 ft-lb)
Shock absorber to trailing arm (car in normal loaded position)	100 Nm (74 ft-lb)
Subframe to body (M12)	77 Nm (57 ft-lb)
Upper control arm to rear subframe M12 bolt	77 Nm (57 ft-lb)
Upper control arm to trailing arm M12 bolt	110 Nm (81 ft-lb)

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Rear Stabilizer Bar



The rear stabilizer bar is mounted to the rear subframe and attached via stabilizer bar links to the rear upper control arms.

1 - Stabilizer bar

2 - Self-locking nut M8

3 - Rubber mounting

4 - Clamping support

5 - Bolt M8

6 - Bolt M

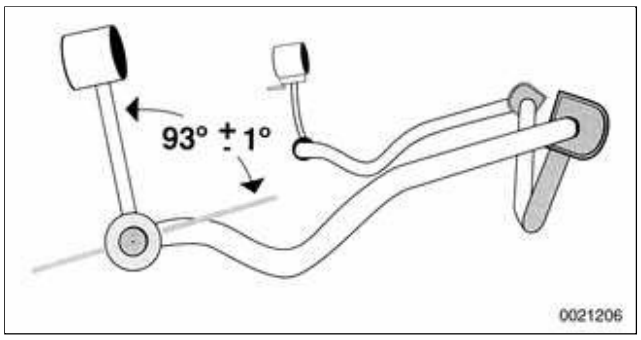
7 - Stabilizer link support bracket

8 - Bolt M8

9 - Self-locking nut

10 - M8 Self-locking nut

11 - M8 Stabilizer link



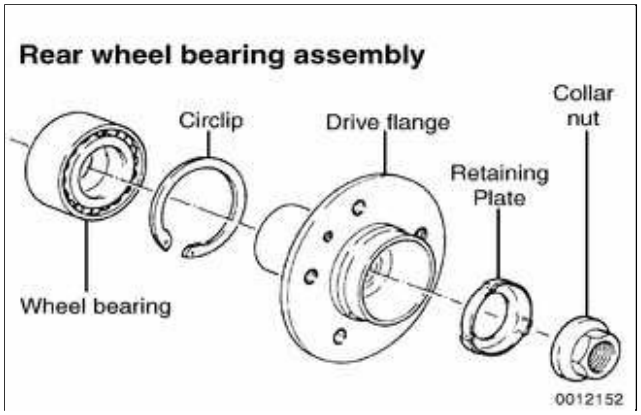
When installing new stabilizer link:

- Clean rubber seating surface at end of stabilizer bar.
- Moisten end of bar and inside rubber mount (in link end). with Circolight® or equivalent rubber bonding agent.
- Push bar into rubber mount and position as shown in illustration. Once rubber bond has set stabilizer link can no longer be rotated

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Rear Wheel Bearings



- The rear wheel bearing is a unitized assembly and is not repairable separately.

Special press tools, to be used with the trailing arm attached to the car, are required to replace a wheel bearing. Read the procedure through before beginning the job.

Rear wheel bearing, replacing

- Remove drive axle as described in ⇒ 331 Rear Axle Final Drive.

WARNING!

Make sure that the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.

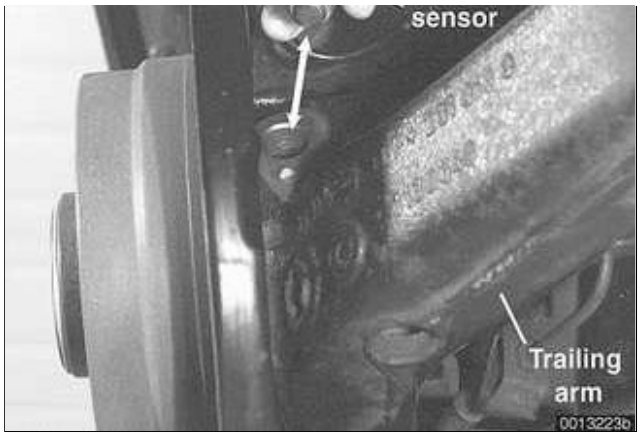
- Right side: Detach brake pad sensor connector at brake caliper.

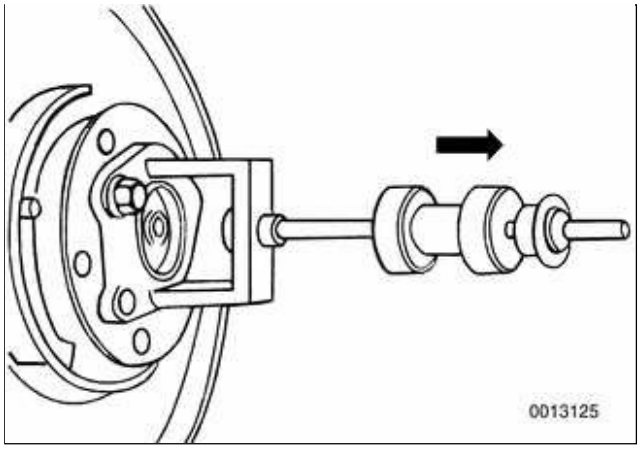
- Remove brake caliper assembly and rotor as described in ⇒ 340 Brakes. Leave brake hose connected to caliper. Suspend caliper assembly from chassis using stiff wire.



- Remove ABS pulse sensor at trailing arm.

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- Remove drive flange from bearing assembly using impact style puller (BMW special tools 33 2 116, 33 4 201/202/203 or equivalent).

CAUTION!

The wheel bearing is destroyed when the drive flange is removed. Do not attempt to reuse bearing.

Note:

Use BMW special tool set 33 4 400 or equivalent to separate inner bearing race from drive flange.

- Remove bearing retaining circlip from bearing housing in trailing arm.

- Using appropriate bearing extraction tools (BMW special tools 33 3 261/262/263 or equivalent), pull bearing assembly out of trailing arm bearing housing.

- Inspect bearing housing for any damage or contamination.

- Clean housing bore thoroughly before installing new bearing.

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- Make sure all mating surfaces are clean

- Install new bearing assembly using press tools (BMW special tools 33 3 261/264/265 or equivalent.

- Install new circlip.

CAUTION!

- ***Apply force only to outer race when installing bearing.***

- ***Make sure that the bearing is pressed in far enough to contact the shoulder at the back side of the housing and that the circlip is fully seated in its groove.***

- ***Always use a new retaining circlip.***

- Draw drive flange into bearing using appropriate press tools (BMW special tools 33 3 261/262/263 or equivalent).

CAUTION!

BMW specifies special tools to pull the drive flange through the wheel bearing into position. If using alternative tools, be sure to support the bearing inner race when pressing or pulling the drive flange into place.

- Install brake caliper assembly and rotor as described in ⇒ 340 Brakes.

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- Reinstall drive axle.

Tightening torques	
Brake rotor to drive flange (M8)	16 Nm (12 ft-lb)
Brake caliper to trailing arm (M12)	67 Nm (50 ft-lb)
Drive axle collar nut to drive flange	
M24	250 Nm (184 ft-lb)
M27	300 Nm (221 ft-lb)
Drive axle to final drive flange	
M10x20 mm Torx bolt	83 Nm (61 ft-lb)
M10x46 mm bolt (black)	100 Nm (74 ft-lb)
M10x46 mm bolt (silver) (always replace)	80 Nm (59 ft-lb)
Road wheel to hub	100 ± 10 Nm (74 ± 7 ft-lb)

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331-1

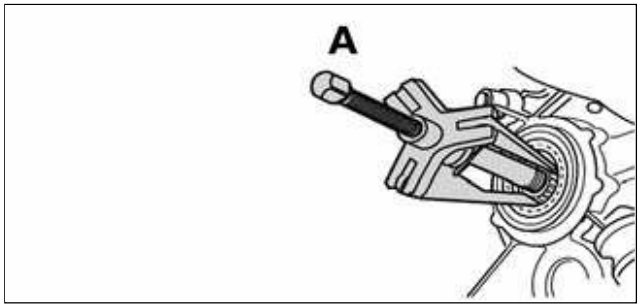
General

This repair group cover removal and repair information for the rear drive axle shafts, CV joints and CV joint boots. Also covered is rear differential (final drive) removal procedures and seal replacement information.

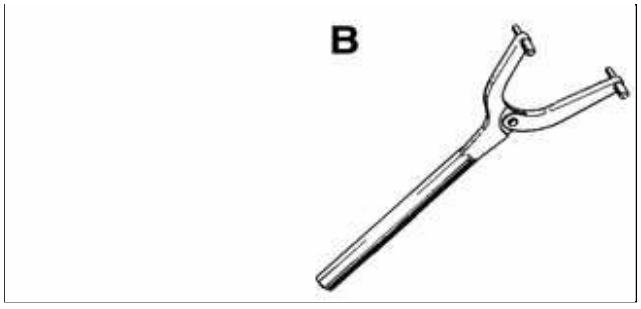
Internal repairs of the differential assembly are not covered in this manual.

Special tools

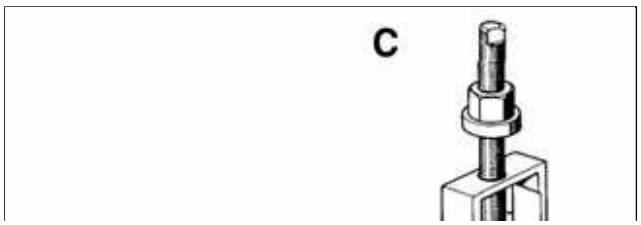
BMW recommends some special tools for the removal of the drive axles as well as the installation of rear differential input and output drive flange seals. Some common pullers and drifts can often be substituted for these tools.



- Radial seal puller BMW 00 5 010



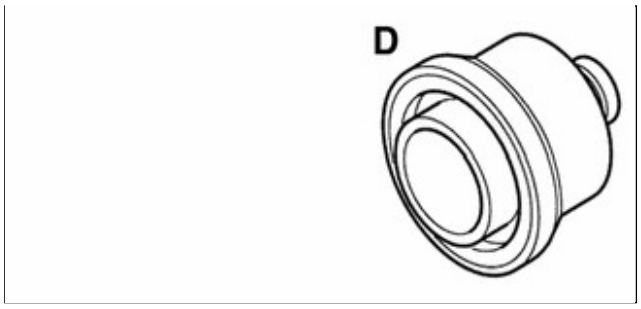
- Flange counterhold tool BMW 23 0 020



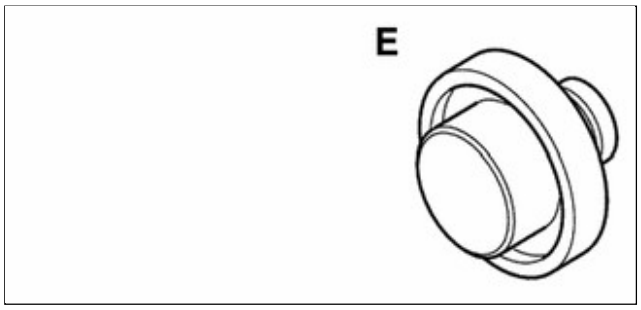
- Drive axle puller BMW 33 2 110

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- Output flange seal drift BMW 33 3 400

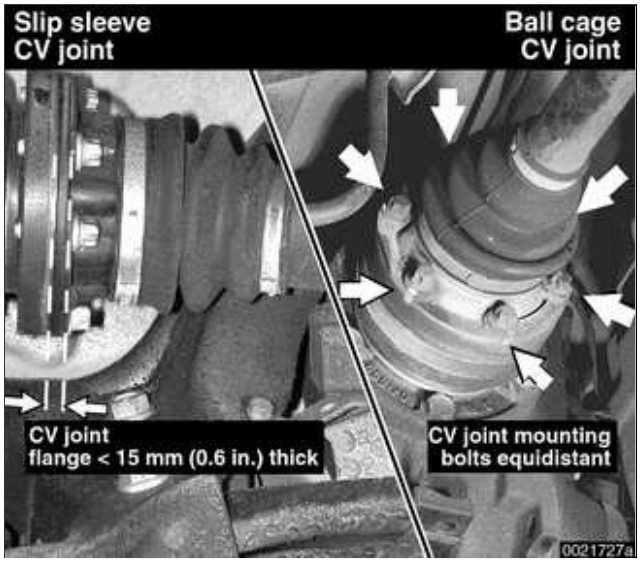


- Input flange seal drift BMW 33 3 430

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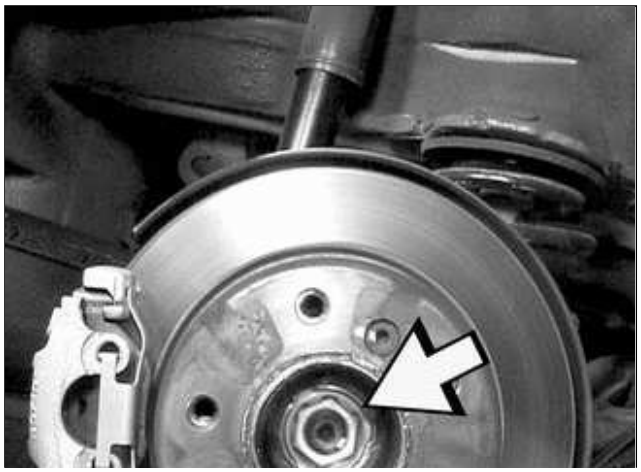
Drive Axles



- The drive axles use constant-velocity (CV) joints on both ends. Two different styles of CV joints have been supplied with E46 vehicles. Refer to the accompanying illustration:
  - Ball cage CV joint. Traditional design CV joint with thick metal housing (approx. 40 mm/1.6 in. thick). Balls slide in non-parallel grooves.
  - Slip sleeve CV joint. Thin bolt-on flange (approx. 15 mm/0.6 in. thick). CV joint has splined shaft that slides into end of axle.

For replacement parts, only CV joints boots or complete axles are offered by BMW. To replace a CV joint boot, the drive axle must be removed from the car. The rear axle shafts are different in length. The shorter of the two shafts is located on the left side, the longer shaft on the right.

Rear drive axle, removing and installing



- With an assistant applying brakes, break free staked collar nut (**arrow**) at center of rear wheel hub. Do not remove completely.

Note:

The drive flange collar nut is tightened to a torque of over 250 Nm (184 ft-lb). Make sure the car is firmly on the ground.

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- Raise rear of car. Remove rear wheel.

WARNING!

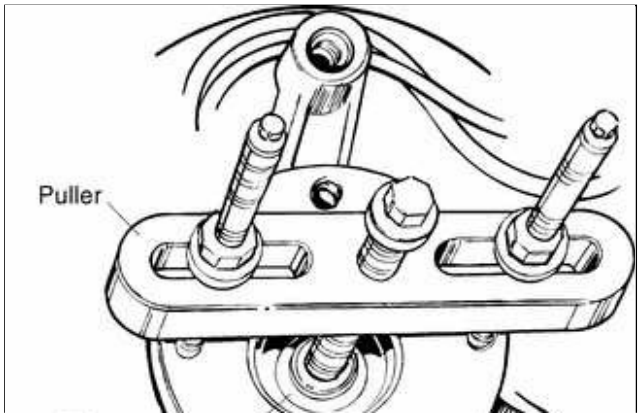
Make sure that the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.

- Detach rear stabilizer bar anchor bolts from rear subframe and tilt stabilizer down.

- Working on left axle: Detach rear of exhaust system and tilt down. Support rear muffler securely.



➢ Remove drive axle to differential mounting bolts (**arrows**). Detach drive axle from drive flange. Suspend drive axle from chassis using stiff wire.



➢ Press drive axle from wheel bearing housing using an appropriate puller.

- Installation is reverse of removal.

◆ Apply a light coating of oil to contact face of collar nut and install it loosely.

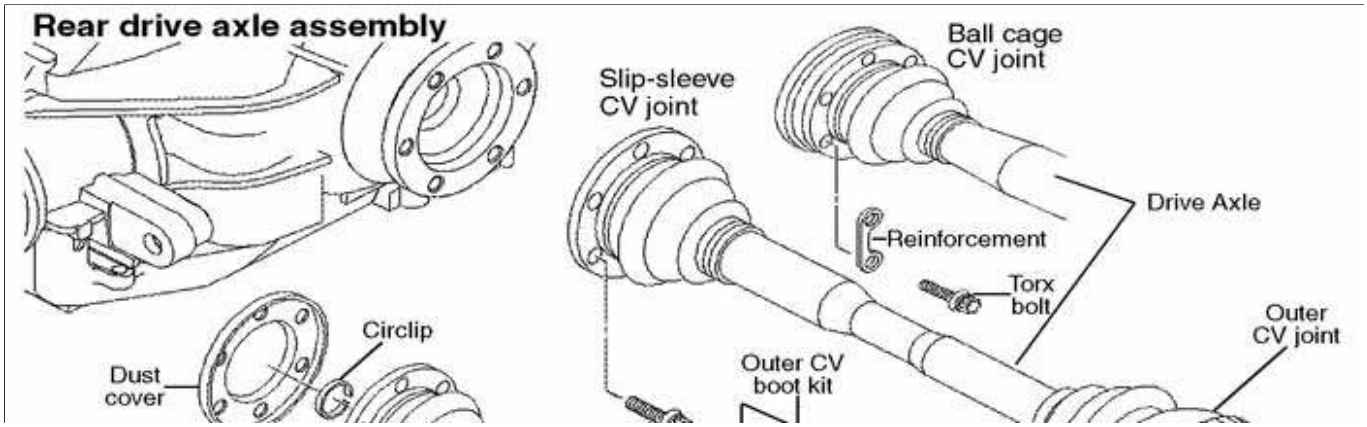
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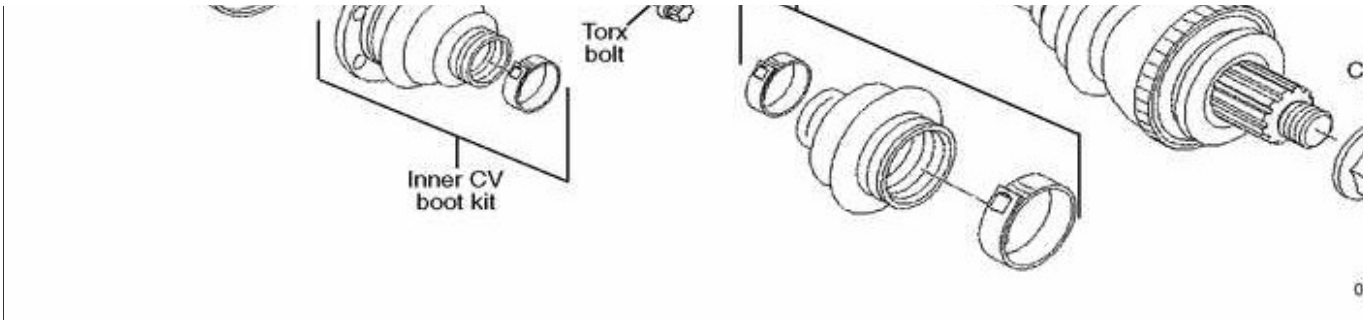
- Install road wheel and lower car to ground.
- With an assistant applying brakes, tighten drive axle collar nut to its final torque.
- Stake and caulk collar nut.

Tightening torques	
Drive axle collar nut to drive flange	
M24	250 Nm (184 ft-lb)
M27	300 Nm (221 ft-lb)
Drive axle to differential flange	
M10x20 mm Torx bolt	83 Nm (61 ft-lb)
M10x46 mm bolt (black)	100 Nm (74 ft-lb)
M10x46 mm bolt (silver) (always replace)	80 Nm (59 ft-lb)
Road wheel to hub	100 ± 10 Nm (74 ± 7 ft-lb)

Rear drive axle assembly



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CV joint boots

Note:

- *When replacing a CV joint boot, use a complete CV joint boot repair kit. The kit will include a new boot, clamping bands, special lubricant, and a new inner CV joint circlip. The kit is available from an authorized BMW dealer parts department.*
- *The outer CV joint cannot be removed from the axle shaft. In order to replace the outer CV boot, it is necessary to remove the inner joint and boot first.*
- *If the CV joints are worn or defective, a complete rebuilt axle shaft is available from an authorized BMW dealer parts department.*

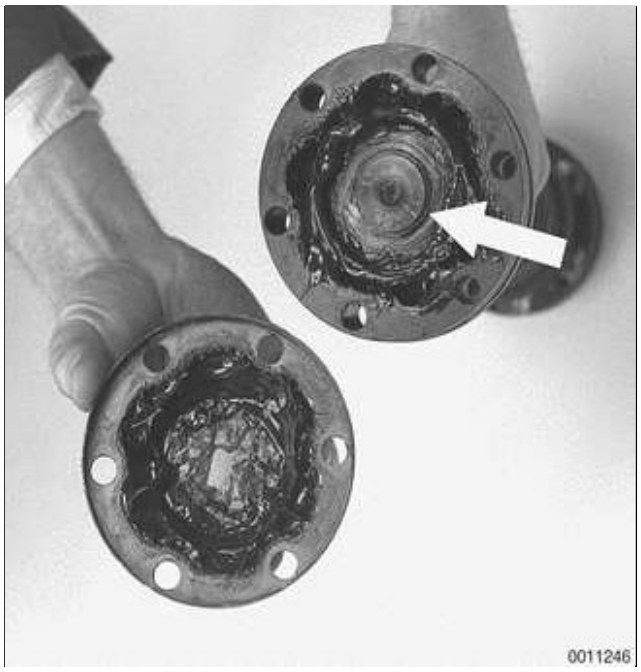
Working with axle shaft at bench, cut off old boot clamps and remove boots. Clean old grease off joints and shafts. Use new grease from CV joint boot kit.

Ball cage CV joint boot

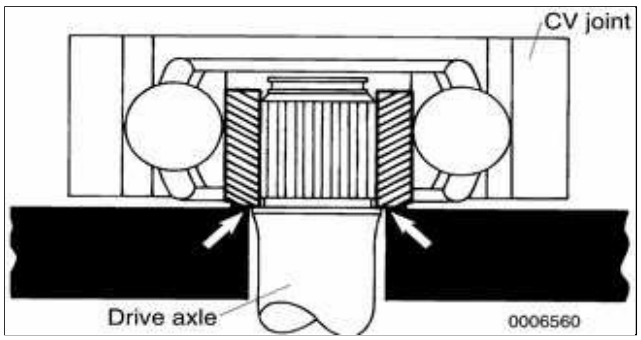


Lift off dust cover from inner CV joint and remove circlip (**arrow**) retaining joint

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inner hub to axle shaft.



- Support inner hub at **arrows**when pressing axle shaft out of joint.

  - Clean all old lubricant off shaft splines and inner joint's splines.

CAUTION!

If the CV joint must be disassembled for cleaning and inspection, be sure to matchmark inner and outer race and intermediate ball cage. This allows reassembly of parts in their original positions.

Note:

To inspect a CV joint, clean away the grease and look for galling, pitting and other signs of wear or physical damage. Polished surfaces or visible ball tracks alone are not necessarily cause for replacement. Discoloration due to overheating indicates lack of lubrication.

  - Apply Loctite® 270 or an equivalent heavy-duty locking compound to drive axle splines. Position new CV joint on shaft so that raised or taller

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side of hub is facing shaft.

WARNING!

Do not let the locking compound contact the balls in the joint. Apply only a thin coat to cover the splines.

- While supporting axle shaft, press inner hub of CV joint onto shaft. Install new circlip.

Note:

- *Do not let the ball hub pivot more than 20 in the outer ring of the joint. The balls will fall out if the hub is pivoted too far.*
- *Before installing each small boot clamp be sure to "burp" the boot by flexing the CV joint as far over as it will go. A small screwdriver inserted between the boot and the axle shaft will help the process.*
- *BMW recommends Bostik®1513 or Epple®4851 adhesive, and Epple®39 or Curil®T sealer.*

CV joint lubricant capacity	
Wheel hub end	80 gram (2.8 oz.)
Differential end	85 gram (3.0 oz.)

- Use sealing gel to seal dust cover to CV joint prior to reinstallation.

Slip sleeve CV joint boot

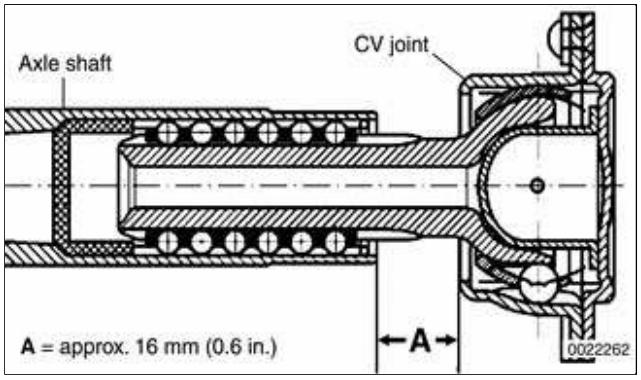
- Pull CV joint partially out of axle shaft. Matchmark relative position of

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joint to shaft.

CAUTION!

If the joint and shaft are not reassembled in their original position the assembly may be out of balance and vibrate during operation.



- When reinstalling joint, push joint into shaft as far as it will go, then pull it out to measurement **A**(16 mm / 0.6 in.).

Note:

This step insures uniform lubrication of the CV joint.

- Keep joint in position while installing inner (small) boot clamp.

- Make sure sealing lip of joint and boot are free of grease. The boot could otherwise slide off when boot clamp is tightened.

Slip sleeve joint boot lengths	
Inner boot	65 mm (2.6 in.)
Outer boot	55 mm (2.2 in.)

Note:

- *On the differential end CV joint, position large boot clamp so that crimp in clamp faces rivet on CV joint flange.*

- *Install large clamps of inner and outer CV joints so that the crimps are offset by 180°.*

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Rear Differential

All rear differential work requires some method of raising the car and supporting it securely while the work is performed. Jack stands and a floor jack can easily be used, but use extreme caution when working beneath the car. See ⇒ 010 General.

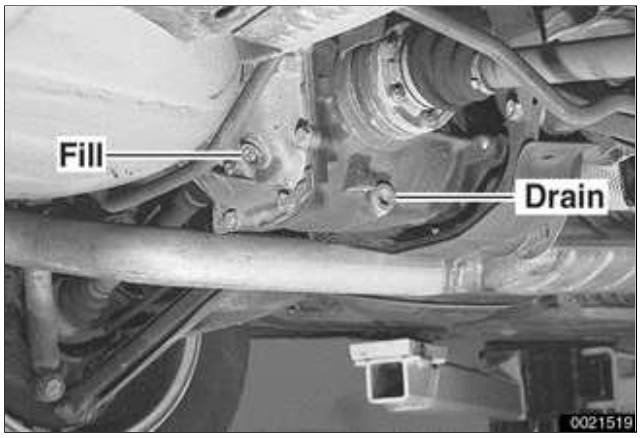
Note:

Removal of rear subframe (differential carrier) is covered in ⇒ 330 Rear Suspension.

Rear differential oil, checking and filling

Note:

BMW supplies the E46 rear differential with lifetime lubricant.



To check rear differential oil level:

- Remove oil filler plug.
- Insert finger into fill hole. If finger is wetted from oil, level is correct.

Note:

Use a 14 mm Allen socket to remove the fill or drain plug. Alternatively, cut approximately 30 mm (1.2 in) from an Allen key and use a box end wrench on the key stub.

- If necessary, fill differential with appropriate type and quantity of lubricant.

Note:

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The differential fluid level is correct when the fluid begins to spill from the fill plug.

- Install and tighten fill plug.

Differential oil	
Differential oil capacity	
Rear wheel drive	0.9 liter (0.95 US qt.)
All wheel drive	1.0 liter (1.06 US qt.)
Oil specification	BMW SAF-XO synthetic oil

Tightening torques	
Differential drain or fill plug	70 Nm (52 ft-lb)

Rear differential, removing and installing

- Raise rear end of car and support it securely on jack stands.

WARNING!

Make sure that the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.

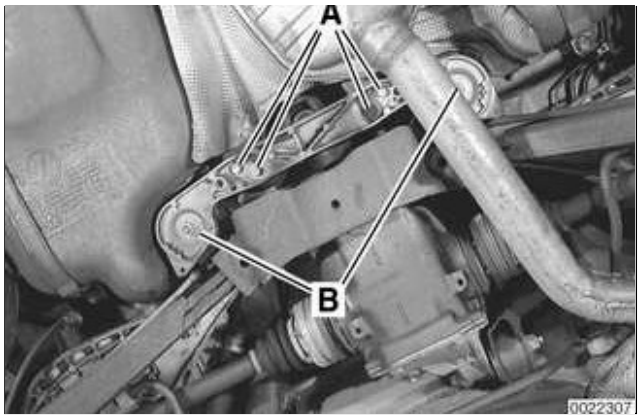
- Remove rear drive axles.

- If necessary, drain differential oil.



- Remove rear suspension reinforcement brace:

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- Remove heat shield between reinforcement brace and exhaust pipe.
- Remove bolts (**A**) mounting brace to undercarriage.
- Remove nuts (**B**) mounting brace and front of rear subframe to undercarriage.
- Lower and remove reinforcement.

Note:

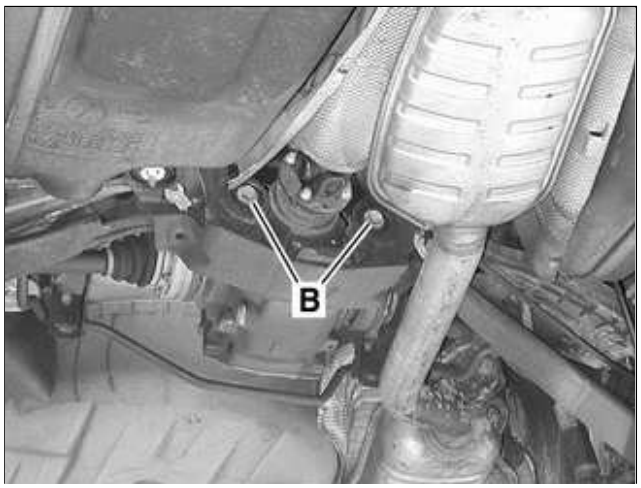
If necessary, tilt rear half of exhaust system down. Support exhaust system securely.

- Detach driveshaft from differential input shaft flange and suspend. See ⇒ 260 Driveshaft.

CAUTION!

Suspend the detached drive axle from the car body with a stiff wire hook to prevent damage to the outer CV joint.

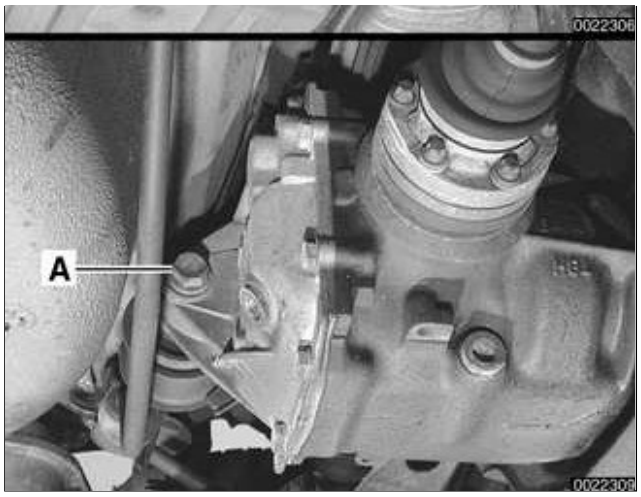
- Remove rear stabilizer bar.



Support differential with transmission jack. Remove rear (**A**) and front (**B**) mounting bolts at subframe.

- Slowly lower differential unit and remove toward rear.
- Installation is reverse of removal. In order to prevent excess vibration and noise, follow sequence for tightening

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differential mounting bolts:

- Install bolts finger tight.
- Tighten front bolts (**B**).
- Tighten rear bolt (**A**).

Tightening torques	
Differential drain or fill plug	70 Nm (52 ft-lb)
Differential to rear subframe	
Front mount (M12 bolts)	95 Nm (70 ft-lb)
Rear mount (M14 bolt)	174 Nm (128 ft-lb)
Drive axle to differential flange	
M10x20 mm Torx bolt	83 Nm (61 ft-lb)
M10x46 mm bolt (black)	100 Nm (74 ft-lb)
M10x46 mm bolt (silver) (always replace)	80 Nm (59 ft-lb)
Driveshaft to differential flange	
M10 compression nut	64 Nm (47 ft-lb)
M10 Torx bolt	85 Nm (63 ft-lb)
Rear suspension reinforcement to undercarriage	
M12 self-locking nut	77 Nm (57 ft-lb)
M8 bolt 8.8 grade	21 Nm (15 ft-lb)
M8 bolt 10.9 grade	30 Nm (22 ft-lb)

- Be sure to refill differential.

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Differential oil	
Differential oil capacity	
Rear wheel drive	0.9 liter (0.95 US qt)
All wheel drive	1.0 liter (1.06 US qt.)
Oil specification	BMW SAF-XO synthetic oil

Differential mounting bushings

- If rear differential mounting bushing are worn, damaged or oil soaked:

- Remove differential from rear subframe.

- Working at subframe, use bushing press tools to remove old bushings and install new ones.

- Carefully note installation marks (arrows) on new bushings.

Note:

BMW uses bushings from different manufacturers in the course of production. Always check with an authorized BMW dealer for the latest information on suspension bushings.

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Rear Differential Oil Seals

Low oil level caused by faulty oil seals may be the cause of noisy differential operation. The drive flange (side) and input shaft (front) oil seals can be replaced while the differential is installed.

Note:

Do not mistake leaking CV joints for flange seal leaks. It may be helpful to degrease the differential to pinpoint the source of the leak prior to replacing seals.

Output drive flange oil seal, replacing

- Raise car and support safely.

WARNING!

Make sure that the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.

- If working on left side: Detach rear of exhaust system and tilt down. Support rear muffler securely.

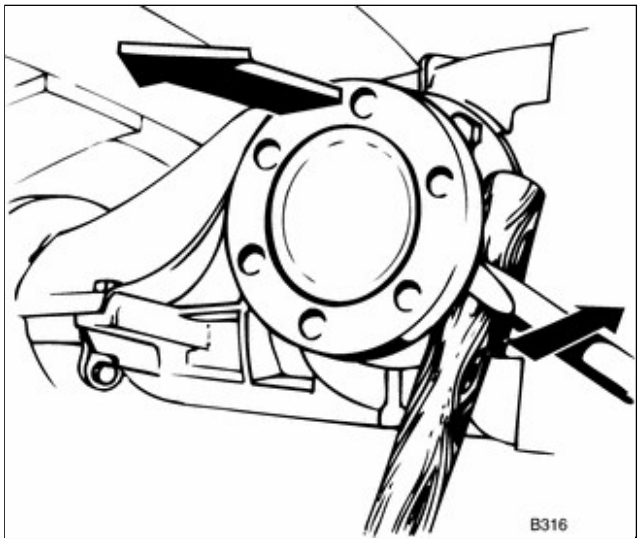
- Detach stabilizer bar from rear subframe.

- Detach drive axle from differential as described earlier.

CAUTION!

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Suspend the detached drive axle from the car body with a stiff wire hook to prevent damage to the outer CV joint.



- Pry output flange from differential. For leverage, use a wooden dowel as shown.

Note:

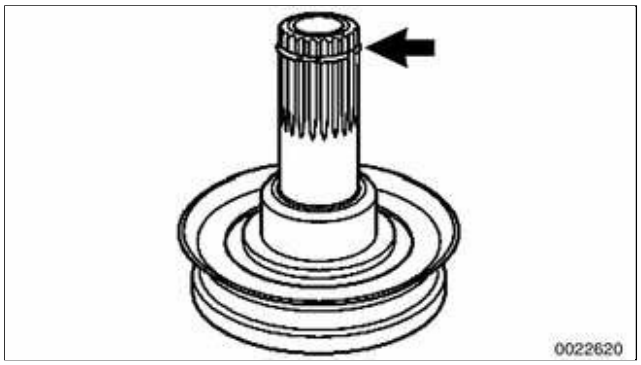
- *Be prepared to catch dripping oil in a pan.*
- *Inspect flange at the point where the oil seal rides on the shaft. Replace the flange if there is a groove worn in the shaft.*

- Pry old oil seal from its recess using BMW special tool 00 5 010 or equivalent seal puller.

CAUTION!

Be careful not to mar the differential housing when removing the seal.

- Dip new seal in differential lubricant and drive into place until fully seated.



- Replace locking circlip (**arrow**) on output flange.

- Install flange by pressing it in by hand until snap ring engages. It may be necessary to turn flange slightly while pushing.

- Attach drive axle and tighten bolts.

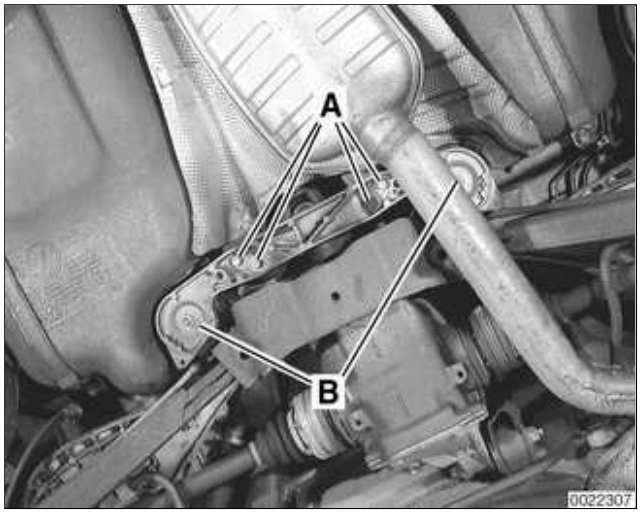
- Top off differential with oil.

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Tightening torque	
Drive axle to differential flange	
M10x20 mm Torx bolt	83 Nm (61 ft-lb)
M10x46 mm bolt (black)	100 Nm (74 ft-lb)
M10x46 mm bolt (silver) (always replace)	80 Nm (59 ft-lb)

Input drive flange oil seal, replacing

- Raise car and support safely.



Remove rear suspension reinforcement brace:

- Remove heat shield between reinforcement brace and exhaust pipe.
- Remove bolts (**A**) mounting brace to undercarriage.
- Remove nuts (**B**) mounting brace and front of rear subframe to undercarriage.
- Lower and remove reinforcement.

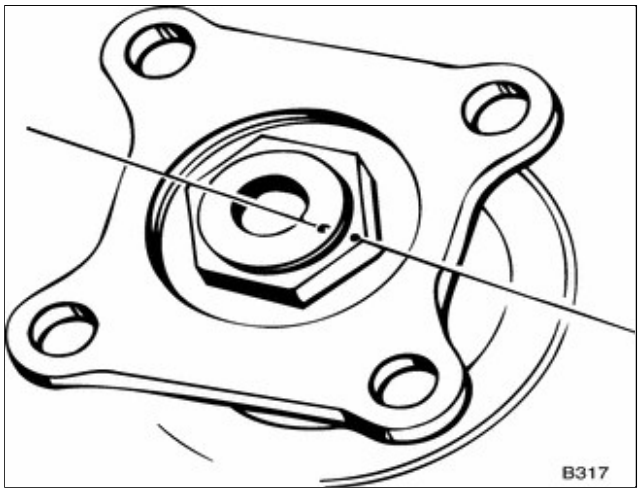
Note:

If necessary, tilt rear half of exhaust system down. Support exhaust system securely.

- Remove driveshaft from differential input shaft flange. See ⇒ 260 Driveshaft. Tie end of driveshaft to

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side.



- Make matching marks on differential input shaft, collar nut and driveshaft flange.

  - Pry lock plate from nut. Counterhold input flange with BMW special tool 23 0 020 or equivalent and remove collar nut.

  - If necessary, use puller to remove input flange.

Note:

Be prepared to catch dripping oil in a pan.

  - Pry old oil seal from its recess using BMW special tool 00 5 010 or equivalent seal puller.

CAUTION!

Be careful not to mar the differential housing when removing the seal.

  - Dip new seal in differential lubricant and drive it into position.

  - Lightly lubricate input shaft and press input flange back on. Install collar nut and slowly tighten until matching marks line up.

  - Install a new lock plate and refill differential with lubricant.

CAUTION!

If the flange collar nut is tightened past the marks, interior components of the differential will be damaged.

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Differential oil	
Differential oil capacity	
Rear wheel drive	0.9 liter (0.95 US qt)
All wheel drive	1.0 liter (1.06 US qt.)
Oil specification	BMW SAF-XO synthetic oil

- Remainder of assembly is reverse of disassembly.

Tightening torques	
Driveshaft to differential flange	
M10 compression nut	64 Nm (47 ft-lb
M10 Torx bolt	85 Nm (63 ft-lb)
Differential drain or fill plug	70 Nm (52 ft-lb)

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General

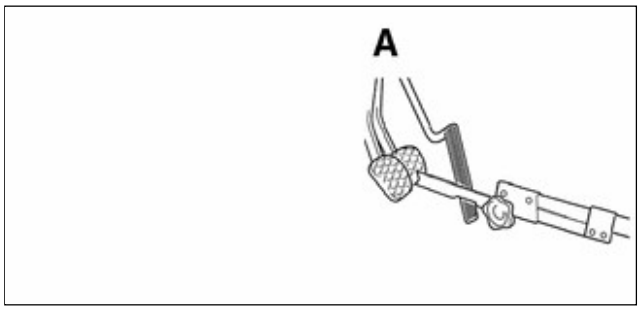
This repair group covers brake service:

- Brake pads, calipers, and disks
- Master cylinder, brake booster, and parking brake
- ABS/ASC and ABS/DSC component replacement

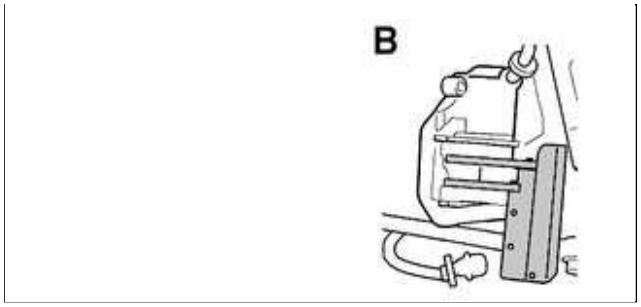
ABS/ASC and ABS/DSC system descriptions are covered in ⇒ 300 Suspension, Steering and Brakes-General.

Special tools

BMW requires the use of either the DIS or the MoDiC diagnostic tool to safely and completely bleed the braking and traction control systems. Read all procedures through before beginning a job.

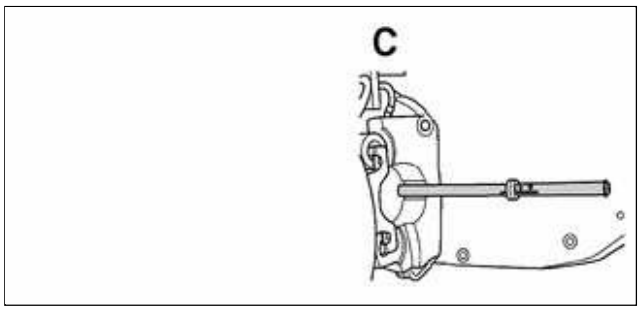


- Pedal prop

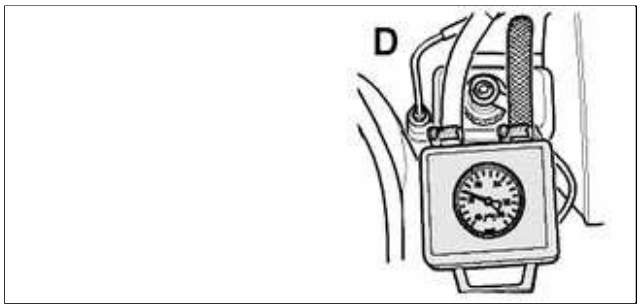


- Brake caliper piston tool BMW 34 1 050

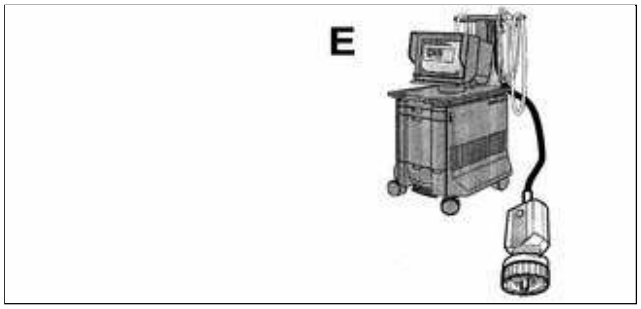
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- Brake pad lining gauge BMW 34 1 260



- Vacuum tester BMW 34 3 100



- Factory diagnostic tool DISplus or MoDiC

E46 brake system

BMW E46 models are equipped with vacuum power-assisted four-wheel disc brakes with an integral Antilock Brake System (ABS). Single-piston calipers act on vented front and rear rotors. A brake pad wear sensor for each axle indicates when brake pads need replacement. The dual drum-type parking brake system is integrated with the rear brake rotors.

Electronic braking and stability control

E46 models were introduced with Automatic Stability Control (ASC). ASC is a computer controlled traction control system that uses the ABS system in

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conjunction with engine management controls to control wheel spin and maintain vehicle stability while braking.

Added midway through the 1999 model year was Dynamic Stability Control (DSC). This system uses ASC technology, but implements wheel speed modulation throughout all stages of driving. DSC is able to reduce understeer by applying differing amounts of braking force to each wheel, as well as overriding the engine management system during hard cornering.

A summary of distinguishing characteristics of the various systems is shown in ⇒ Table a. E46 Electronic braking and stability control systems.

For ABS system and component descriptions, see ⇒ 300 Suspension, Steering and Brakes-General.

WARNING!

A car with electronic stability control is still subject to normal physical laws. Avoid excessive speeds for the road conditions encountered.

Table a. E46 Electronic braking and stability control systems

	Year (model)	**System (manufacturer)**	**Identifiers**
ASC	1999 - 2000	Automatic Stability Control (Teves MK 20)	Control module/hydraulic unit under master cylinder No precharge pump
DCS	1999 - 2000	Dynamic Stability Control (Teves MK 20 DSC)	Control module/hydraulic unit in right rear compartment of engine bay Precharge pump under master cylinder

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	Year (model)	System (manufacturer)	Identifiers
DSC	2001 (rear wheel drive)	Dynamic Stability Control (Teves MK 60 DSC)	Control module/hydraulic unit mounted under master cylinder. No precharge pump
DSC	2001 (all wheel drive)	Dynamic Stability Control (Bosch DSC III 5.7)	Control module/hydraulic unit in right rear compartment of engine bay Precharge pump under master cylinder

Troubleshooting

Brake performance is mainly affected by three things:

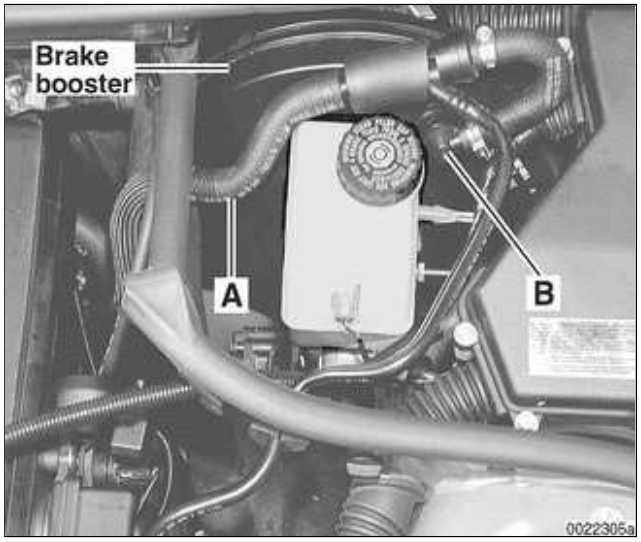
- Level and condition of brake fluid
- The system's ability to create and maintain hydraulic pressure
- Condition of friction components

Air in the brake fluid will make the brake pedal feel spongy during braking or will increase the brake pedal force required to stop. Fluid contaminated by moisture or dirt can corrode the system. Inspect the brake fluid inside the reservoir. If it is dirty or murky, or is more then two years old, the fluid should be replaced.

Visually check the hydraulic system starting at the master cylinder. To check the function of the master cylinder hold the brake pedal down hard with the engine running. The pedal should feel solid and stay solid. If the pedal slowly falls to the floor, either the master

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cylinder is leaking internally, or fluid is leaking externally. Check all brake fluid lines and couplings for leaks, kinks, chafing and corrosion. If no leaks can be found, the master cylinder is faulty and should be replaced.



➢ Check brake booster:

- Remove vacuum hose (**A**) from brake booster and install BMW special tool 34 3 100 between connection and hose on non-return valve (**B**).
- Start engine and check build-up of partial vacuum. Switch engine off.
- Press brake pedal to set partial vacuum of no more than 0.8 bar (11.6 psi). Wait for vacuum value to stabilize.
- When pedal is released, partial vacuum should not drop by more then 0.06 bar (0.8 psi) over 1 hour.

- If vacuum values are not reached:

- Check connections of vacuum hoses.
- Replace vacuum non-return valve (**B**).
- Check seal between brake booster and master cylinder.
- If values still cannot be reached, brake booster must be replaced.

Worn or contaminated brake pads will cause poor braking performance.

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Oil-contaminated or glazed pads will cause stopping distances to increase. Inspect the rotors for glazing, discoloration and scoring. Steering wheel vibration while braking at speed is often caused by warped rotors, but can also be caused by worn suspension components.

When troubleshooting, keep in mind that tire inflation, wear and temperature can all have an affect on braking. See ⇒ 300 Suspension, Steering and Brakes-General for additional suspension and brake system troubleshooting.

⇒ Table b. Brake system troubleshooting lists symptoms of brake problems, probable causes, and suggested corrective actions. Unless it is noted otherwise, relevant repairs are described later in this repair group

WARNING!

- ***All E46 cars require special BMW service equipment to properly bleed either the ABS/ASC or the ABS/DSC system. For safety reasons, the brake system on these cars must not be bled without the use of a factory diagnostic computer.***

- ***Semi-metallic and metallic brake friction materials in brake pads or shoes may produce dangerous dust.***

- ***Brake fluid is poisonous, corrosive and dangerous to the environment. Wear safety glasses and rubber gloves when working with brake fluid. Do not siphon brake fluid with your mouth. Immediately clean fluid spilled on painted surfaces and wash with***

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water, as brake fluid will remove paint.

- ***Always use new brake fluid from a fresh, unopened container. Brake fluid will absorb moisture from the air. This can lead to corrosion problems in the braking system, and will also lower the brake fluid's boiling point. Dispose of brake fluid properly.***

- ***Do not reuse self-locking nuts, bolts or fasteners. They are designed to be used only once and may fail if reused. Always replace them with new self-locking fasteners.***

Table b. Brake system troubleshooting

Symptom	Probable cause	Repairs
Brake squeal	Incorrectly installed brake pads or parking brake shoes, or brake parts.	Check component installation. Check/replace anti-rattle springs.
	Brake pad carriers dirty or corroded	Remove brake pads and clean calipers.
	Brake pads heat-glazed or oil-soaked	Replace brake pads. Clean rotors. Replace leaking calipers as required.
	Wheel bearings worn (noise most pronounced when turning)	Replace worn bearings. See ⇒ 310 Front Suspension or ⇒ 330 Rear Suspension.
Pedal goes to floor when braking	Brake fluid loss due to system leaks	Check fluid level and inspect for signs of leakage.
	Master cylinder or electronic control system faulty	Replace master cylinder. Diagnose electronic control system using factory or compatible diagnostic tool.

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Symptom	Probable cause	Repairs
Low pedal after system bleeding	Master cylinder faulty	Replace master cylinder.
Pedal spongy or brakes work only when pedal is pumped	Air in brake fluid	Bleed system using factory or compatible diagnostic tool
	Master cylinder or electronic control system faulty	Replace master cylinder. Diagnose system using factory or compatible diagnostic tool.
Excessive braking effort	Brake pads wet	Use light pedal pressure to dry pads while driving.
	Brake pads heat-glazed or fluid-soaked	Replace brake pads and rotors. Replace leaking calipers.
	Vacuum booster or vacuum hose connections to booster faulty	Inspect vacuum lines. Test vacuum booster and replace as required. Test vacuum non-return valve for one-way flow.
Brakes pulsate, chatter or grab	Warped brake rotors	Resurface or replace rotors.
	Brake pads worn	Replace brake pads.
	Brake pads heat-glazed or oil-soaked	Replace brake pads. Clean rotors. Replace leaking calipers.
Uneven braking, car pulls to one side, rear brakes lock	Incorrect tire pressures or worn tires	Inspect tire condition. Check and correct tire pressures.
	Brake pads on one side of car heat-glazed or fluid-soaked	Replace brake pads. Clean rotors. Replace leaking calipers. .
	Caliper or brake pads binding	Clean and recondition brakes.
	Worn suspension components	Inspect for worn or damaged suspension components. See ⇒ 310 Front Suspension or ⇒ 330 Rear Suspension.
Brakes drag, bind or overheat	Brake caliper or brake pads binding	Clean or replace caliper.
	Master cylinder or electronic control system faulty	Replace master cylinder. Diagnose electronic control system using factory or compatible diagnostic tool.

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Bleeding brakes

Brake bleeding is usually done for one of two reasons: Either to replace old brake fluid as part of routine maintenance or to expel trapped air in the system that resulted from opening the brake hydraulic system during repairs.

Always use new brake fluid from an unopened container. It is important to bleed the entire system when any part of the hydraulic system has been opened. Be sure to have the special equipment needed before beginning the job.

WARNING!

E46 cars require special BMW service equipment to properly bleed either the ABS/ASC or the ABS/DSC system. For safety reasons, the brake system on these cars must not be bled without the use of a factory diagnostic computer.

When bleeding the brakes, start at the wheel farthest from the master cylinder and progress in the following order:

- right rear brake
- left rear brake
- right front brake
- left front brake

Pressure bleeding brakes

- Top off brake fluid in reservoir and

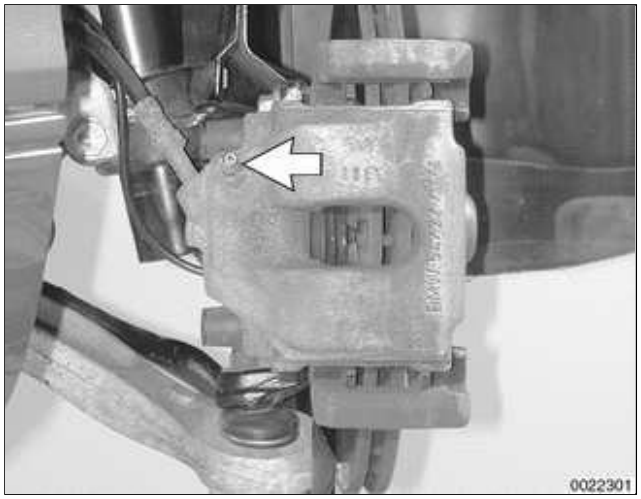
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connect BMW Diagnosis and Information System (DIS) to 20 pin Data Link Connector (DLC) under hood (1999 models), or 16 pin DLC/OBD II connector under dash (2000- 2001 models). Call up service function Bleeding ABS/ASC or service function Bleeding ABS/DSC, depending on which system the vehicle is equipped with.

- Connect pressure bleeding device to brake fluid expansion tank and pressurize.

CAUTION!

Do not exceed a pressure of 2 bar (29 psi) when pressure bleeding the brake system. Excessive pressure will damage the brake fluid reservoir.



Attach bleed hose and fluid receptacle to bleeder screw (**arrow**). Open bleeder screw. Allow DIS bleeding procedure to cycle hydraulic control module valves with bleed screw open.

- After bleeding procedure is completed, slowly depress brake pedal (12 times on ABS/ASC vehicles, 5 times on ABS/DSC vehicles) with bleeder screw open, holding pedal down on the last pump. When escaping fluid is free of air bubbles, close bleeder screw and release brake pedal.

CAUTION!

Bleeder hose must always remain submersed in clean brake fluid whenever the bleeder valve is open.

- Refill brake fluid reservoir and proceed to rear left wheel.

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- Proceed with remaining wheels in order as listed earlier.

Tightening torques	
Bleeder screws (wrench size):	
7 mm screw	3.5 - 5 Nm (2.5 - 3.7 ft-lb)
11 mm screw	12 - 16 Nm (9 - 12 ft-lb)

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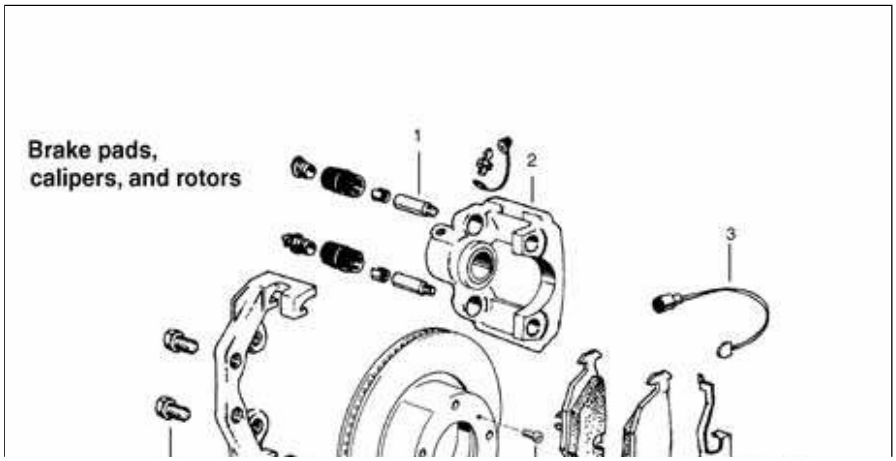
Brake Pads, Calipers, and Rotors

Brake pads can be replaced without disconnecting the brake fluid hose from the caliper or having to bleed the brakes. The rotors can be replaced without disassembling wheel hub and bearing. Always machine or replace rotors in pairs. Replace pads in sets.

Refer to the accompanying illustration (previous page) and the detail notes below during replacement procedures.

WARNING!

- ***Although semi-metallic and metallic brake friction materials in brake pads or shoes no longer contain asbestos, they produce dangerous dust.***
- ***Treat all brake dust as a hazardous material.***
- ***Do not create dust by grinding, sanding, or cleaning brake friction surfaces with compressed air.***

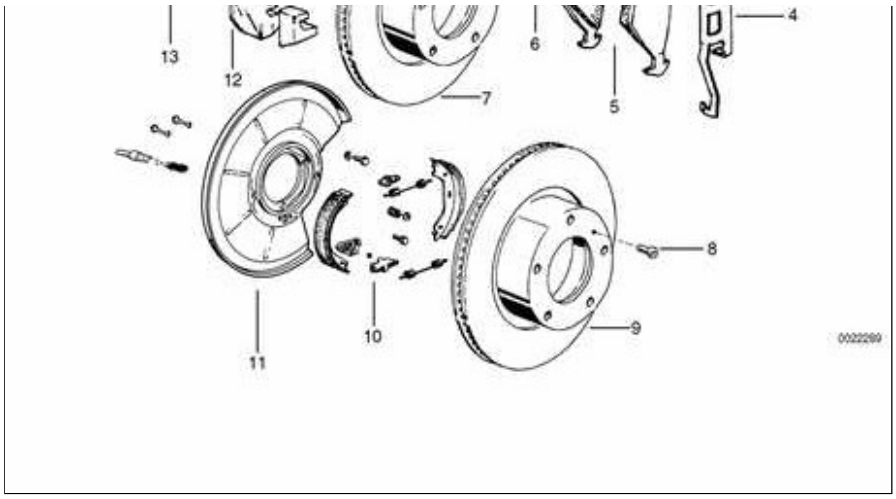


Brake pads, calipers and rotors, assembly

1 - **Brake caliper guide bolts**

♦ 7 mm Allen head

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- Torque to 30 Nm (22 ft-lb)

2 - **Brake caliper**

- Brake line: torque to 18 Nm (13 ft-lb)

- See ⇒ Caliper removal

3 - **Brake pad wear sensor**

- See ⇒ Brake pad wear sensor

4 - **Brake pad anti-rattle clip**

- See ⇒ Brake pad anti-rattle clip

5 - **Brake pads**

- Replacement warning at 3.0 mm (0.11 in.)

- See Brake pads

6 - **Front brake rotor retaining screw**

- Torque to 16 Nm (12 ft-lb)

7 - **Front brake rotor**

- Make sure contact surfaces are clean

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and free from grease

- See Front brake rotor

8 - **Rear brake rotor retaining screw**

- Torque to 16 Nm (12 ft-lb)

9 - **Rear brake rotor**

- Make sure contact surfaces are clean and free from grease.

- Parking brake drum dia. 160 mm (6.3 in.)

- See Rear brake rotor

- For brake rotor specifications see ⇒ Table c and ⇒ Table d

10 - **Parking brake shoes with hardware**

- Min. lining thickness 1.5 mm (0.06 in.)

11 - **Rear brake dust shield**

12 - **Brake pad carrier**

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- Make sure contact surfaces are clean and free from grease

- See Brake pad carrier

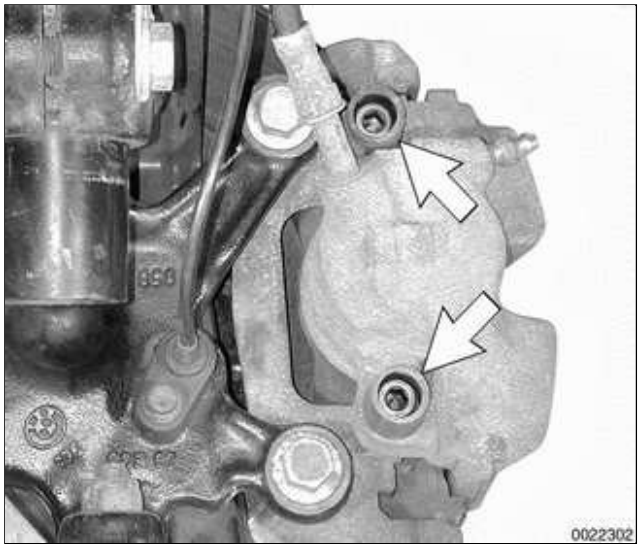
13 - **Brake pad carrier retaining bolts**

- Front: torque to 110 Nm (81 ft-lb)

- Rear: torque to 65 Nm (48 ft-lb)

- Oil bolts lightly. Make sure contact surfaces are clean and free from grease.

Caliper removal



- Remove plastic caps from caliper mounting bolts and remove caliper mounting bolts (**arrows**). Remove caliper from pad carrier.

- Brake caliper hydraulic line only needs to be removed when replacing brake caliper with a new unit. If removing brake caliper to service brake pads or rotors, leave hydraulic line connected.

- If there is a ridge on rotor edge,

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caliper piston will have to be pressed back into caliper before caliper can be removed.

CAUTION!

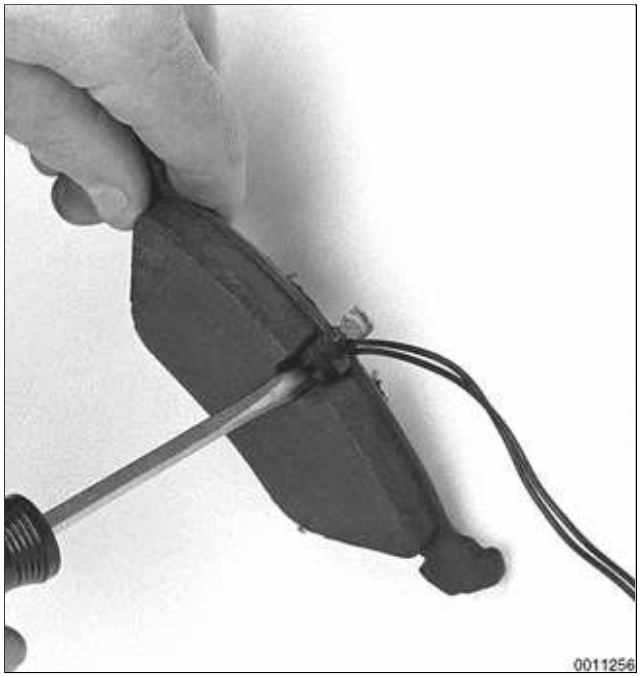
Pressing caliper piston in may cause brake fluid reservoir to overflow. To prevent this, use a clean syringe to first remove some fluid from reservoir.

- Open caliper bleeder screw only when applying force to the piston. Do not allow air to be drawn in through bleeder screw. Catch expelled fluid in appropriate container.
- Do not let brake caliper hang from brake hose. Suspend it from chassis using stiff wire.
- Inspect brake caliper for signs of leakage. Check that caliper piston slides smoothly into caliper. Replace caliper if any faults are found.
- Thoroughly clean all contact points on caliper and brake pad carrier. Clean guide bolts and make sure they slide freely.
- Do not lubricate guide bolts.
- Bleed brake system if hydraulic line to caliper has been removed or replaced. See ⇒ Bleeding brakes.

Tightening torque	
Caliper to brake pad carrier mounting bolts	30 Nm (22 ft-lb)

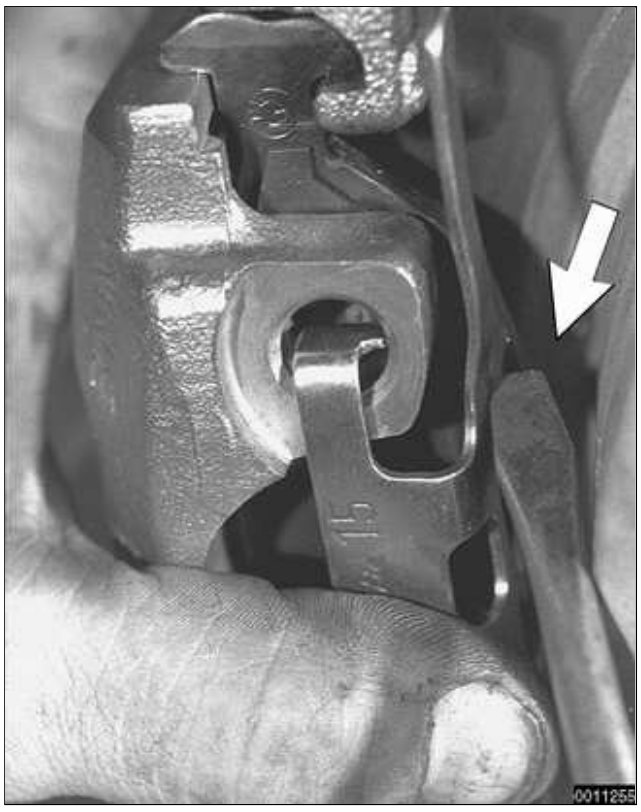
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Brake pad wear sensor



- Carefully pry pad wear sensor from brake pad.
- Insert brake pad wear sensor into cutout in new pad where applicable.
- If brake lining indicator light illuminated prior to brake pad replacement, replace wear sensor.
- Route pad wear sensor wiring through caliper opening and bleeder dust cap.

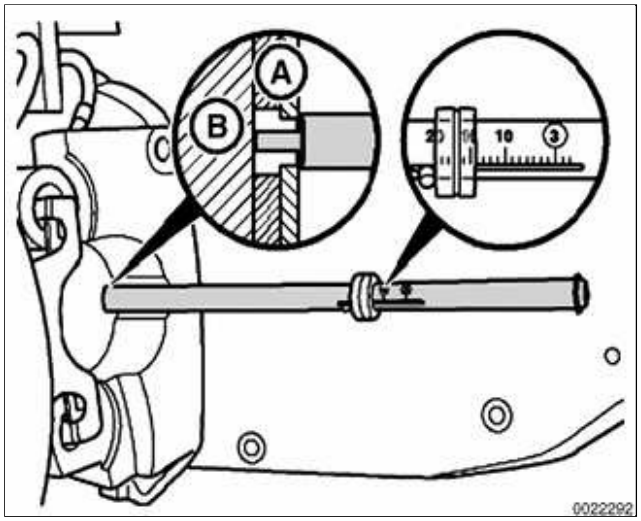
Brake pad anti-rattle clip



Remove anti-rattle clip by unhooking at top and bottom. Use screwdriver as an aid (**arrow**).

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Brake pad lining thickness



To measure brake pad lining thickness:

- Insert BMW special tool 34 1 260 at either front right wheel or left rear wheel
- Move wheel until notch for brake wear indicator can be seen through wheel opening.
- Insert tip of tool into notch so that the body of tool rests on brake pad backing plate (**A**), and tip touches brake disc (**B**).
- Replace pads if thickness is 3.0 mm (0.12 in.) or less.

Brake rotor removal



- Remove brake rotor mounting screw (**arrow**).
- Inspect rotor for cracksm signs of overheating and scoring.
- On original equipment rotors, the minimum allowable thickness is stamped on rotor hub. Measure rotor braking surface with a micrometer at eight to ten different points and use the smallest measurement recorded ⇒ Table c.
- If rotor does not pass minimum thickness requirements or is damaged replace rotor.nothing

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Table c. Brake rotor reconditioning specifications		
	Front	**Rear**
Vented rotor wear limit (min. thickness)	20.4 mm (0.80 in.)	17.4 mm (0.68 in.)
Max. machine limit per friction ring side	0.8 mm (0.03 in.)	0.8 mm (0.03 in.)

WARNING!

Confirm rotor wear limit specifications given in ⇒ Table c with specifications stamped on rotor shell and identified with `MIN TH"

Table d. Brake rotor sizes		
Model	**Front brake rotor**	**Rear brake rotor**
323 i / Ci	286 x 22 mm (11.3 x 0.9 in.)	276 x 19 mm (10.8 x 0.7 in.)
325 i / Ci / xi 328 i / Ci	300 x 22 mm (11.8 x 0.9 in.)	294 x 19 mm (11.6 x 0.7 in.)
330 i / Ci / xi	325 x 25 mm (12.8 x 1.0 in.)	320 x 22 mm (12.6 x 0.9 in.)

- Brake rotors should always be replaced in pairs.
- Clean rotor with brake cleaner

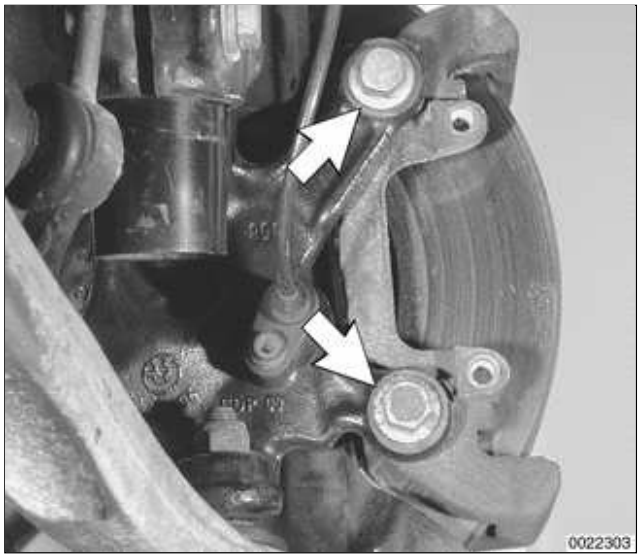
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before installing.

- When installing new rear brake rotors, the parking brake should be adjusted. See ⇒ Parking brake.

Tightening torque	
Brake rotor to hub mounting screw	16 Nm (12 ft-lb)

Brake pad carrier removal



- Remove brake pad carrier mounting bolts (**arrows**) and remove pad carrier from steering arm or trailing arm.

Tightening torques	
Pad carrier to front steering arm	110 Nm (81 ft-lb)
Pad carrier to rear trailing arm	65 Nm (48 ft-lb)

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Master cylinder

The brake master cylinder is mounted to the front of the vacuum booster on the driver side bulkhead.

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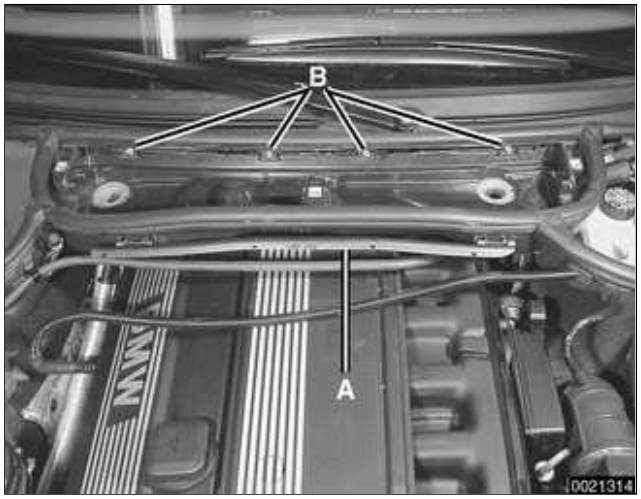
All U.S. market E46 vehicles are equipped with Antilock Braking System (ABS) and either Automatic Stability Control (ASC) or Dynamic Stability Control (DSC). Replacing the master cylinder requires that the braking system be properly bled by an authorized BMW repair facility. This procedure is necessary for the braking and stability controls to function properly.

Master cylinder, removing and installing

- Using a clean syringe, empty brake fluid reservoir.

WARNING!

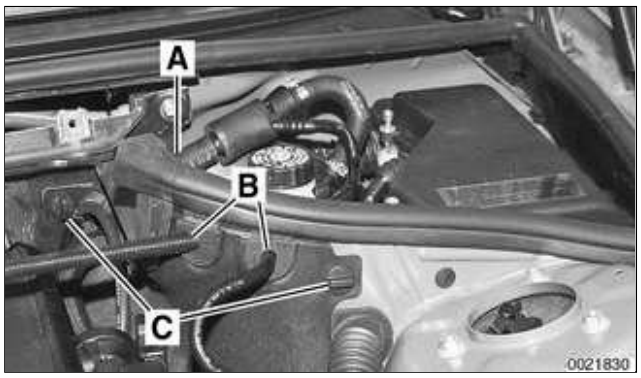
Brake fluid is highly corrosive and dangerous to the environment. Dispose of it properly.



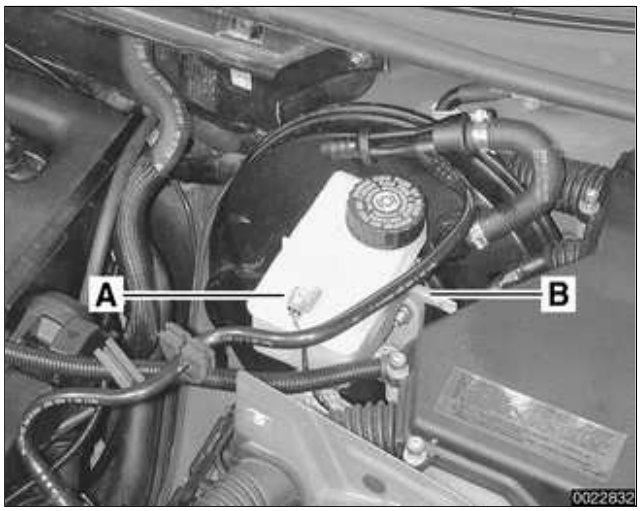
Remove interior ventilation microfilter housing:

- Remove upper cover and microfilter.
- Open wiring harness loom (**A**) and remove wires.
- Unfasten screws (**B**) and remove lower microfilter housing.

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- Remove side trim panel from left rear of engine compartment:
  - Remove rubber strip from top of trim panel at brake booster.
  - Detach vacuum line (**A**) from brake booster Y-connector, unhook from trim panel and push to side.
  - Unhook plastic vacuum line and positive starter cable (**B**) from trim panel and pull forward off trim panel.
  - Release locking clips (**C**) on edges of trim panel and remove panel by pulling upwards.



- Working at brake master cylinder:
  - Disconnect brake fluid level sensor connector (**A**) from fluid reservoir.
  - Disconnect hydraulic clutch system supply line (**B**) if applicable. Plug open brake fluid ducts to prevent fluid leakage or contamination.

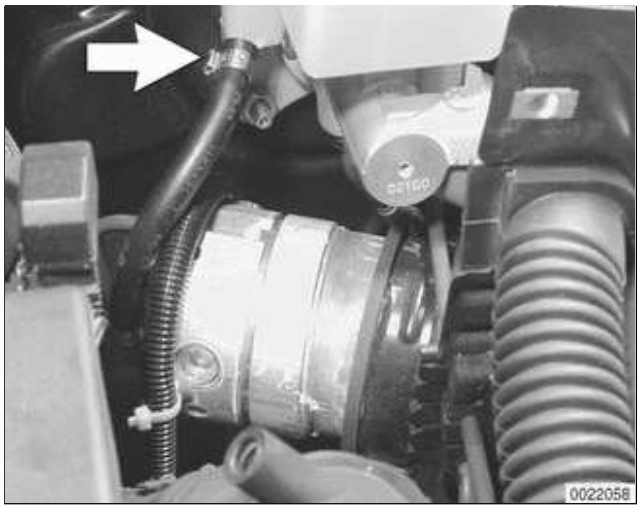
CAUTION!

Keep clutch supply line supported and above clutch master cylinder to prevent any air bubbles from reaching the clutch hydraulic system.



- If DSC precharge pump is installed below brake master cylinder:
  - Release hose clamp (**arrow**) at brake fluid reservoir and remove

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precharge pump supply hose.

- Plug hose and reservoir to prevent fluid leakage or contamination.

- Remove brake fluid reservoir.

- Working at master cylinder:

- Disconnect brake fluid lines and electrical harness connectors from master cylinder as needed.

- On vehicles equipped with Teves DSC: remove brake system pressure sensors if replacing master cylinder.

- Unscrew mounting nuts and remove master cylinder from brake booster.

- Plug open brake lines to prevent contamination.

- Make sure all nuts, fluid couplings, thread bores, and mating surfaces are clean.

- Mount master cylinder to brake booster using a new O-ring and new self-locking nuts.

Tightening torque	
Brake master cylinder to brake booster	26 Nm (19 ft-lb)

CAUTION!

- ***Be sure to align master cylinder***

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pushrod and booster pushrod.

- ***Use care not to over-torque master cylinder mounting nuts. This could damage brake booster and prevent proper vacuum build-up.***

- Connect brake fluid lines to master cylinder.

Tightening torque	
Brake fluid lines to master cylinder	18 Nm (13 ft-lb)

Note:

On Teves MK 20 ASC equipped vehicles: Be sure to leave flex in flexible brake lines between master cylinder and hydraulic unit.

- Carefully reinstall fluid reservoir using new sealing grommets.

- Reconnect supply hose of brake system precharge pump to brake fluid reservoir, if applicable

- Connect hydraulic clutch hose to brake fluid reservoir, if applicable.

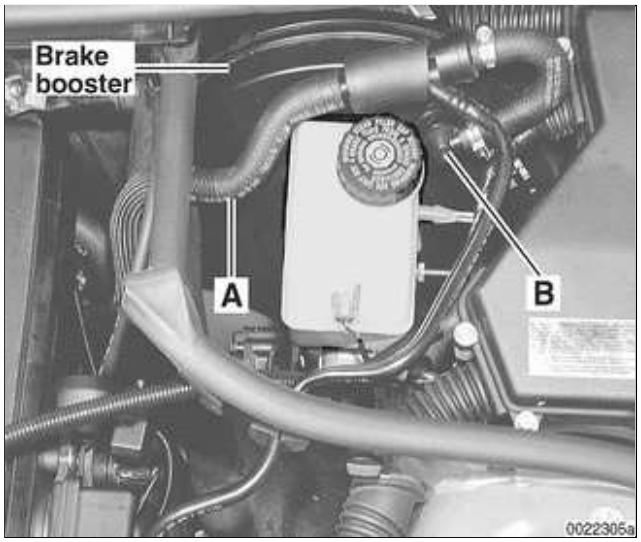
- Remainder of installation is reverse of removal. Bleed entire brake system as described earlier.

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Brake booster

The brake booster is mounted to the bulkhead on driver's side of engine compartment, directly behind brake master cylinder.



A is vacuum hose from intake manifold. **B** is one-way valve. Intake manifold vacuum acts on a large diaphragm in brake booster to reduce brake pedal effort.

Brake booster, removing and installing

CAUTION!

- ***On cars with Automatic Stability Control (ASC) or Dynamic Stability Control (DSC), special BMW service equipment is required to properly bleed the brakes. Removal of the hydraulic unit is not recommended unless this equipment is available. For safety reasons, the brake system on cars with electronic stability control must be bled using the procedures described in this repair group.***

- ***Do not mix up the fluid lines at the hydraulic unit. Label all***

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connections before disconnecting.

- Disconnect negative (-) cable from battery.

CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at front of this manual on page viii.

- Using a clean syringe, empty brake fluid reservoir.

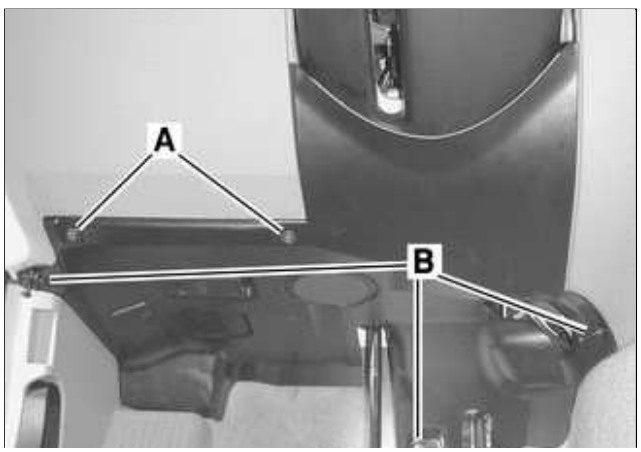
WARNING!

Brake fluid is highly corrosive and dangerous to the environment. Dispose of it properly.

- Remove brake master cylinder as described earlier. Make sure to plug openings at brake fluid lines.

- Disconnect engine vacuum hose from brake booster.

- Remove hydraulic unit or precharge pump below master cylinder as described later in this repair group.



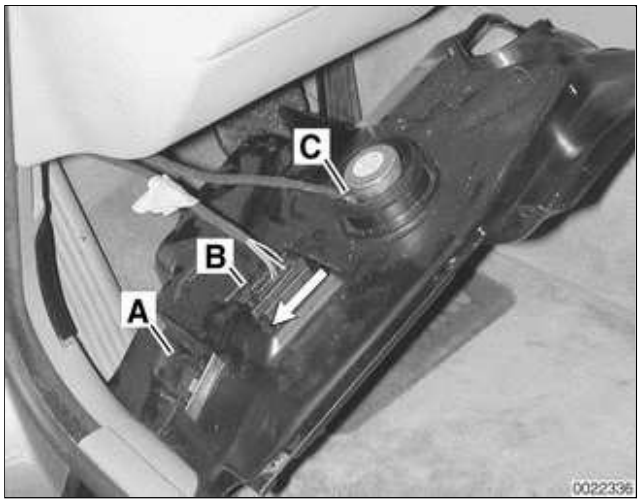
Working in interior, remove left footwell (pedal cluster) trim panel.

- Remove screws (**A**).

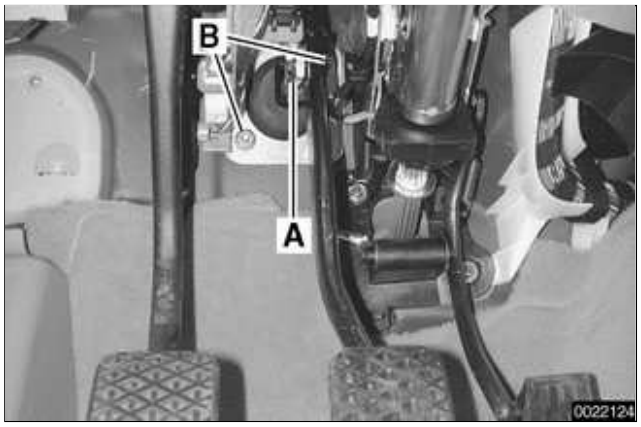
- Remove fasteners (**B**).

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- Disconnect electrical harness connectors at left footwell trim panel and remove panel:
  - Unplug connector at footwell interior light (**A**), if equipped.
  - Slide lock at OBD II connector (**B**) in direction of **arrow**.
  - Unplug connector at speaker (**C**).



- Remove clip (**A**) and slide brake booster pushrod off brake pedal pin. Remove brake booster mounting nuts (**B**).
  - Working in engine compartment, carefully separate brake booster from engine compartment bulkhead.

CAUTION!

Do not use force on booster when separating from bulkhead. This can damage booster and pushrod.

  - Remove booster by tilting brake booster out in direction of engine. Lift booster up and out from engine compartment.
  - Installation is reverse of removal noting the following:
    - Make sure all nuts, fluid couplings, thread bores and mating surfaces are clean.
    - Replace brake booster self-locking

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mounting nuts.

- Replace sealing O-ring between master cylinder and brake booster.

- Bleed brake system as described earlier.

CAUTION!

Do not over-torque the master cylinder mounting bolts. This could damage the brake booster and prevent proper vacuum build-up.

Tightening torques	
Brake master cylinder to brake booster	26 Nm (19 ft-lb)
Brake booster to bulkhead	22 Nm (16 ft-lb)
Brake fluid line to master cylinder or hydraulic unit	18 Nm (13 ft-lb)

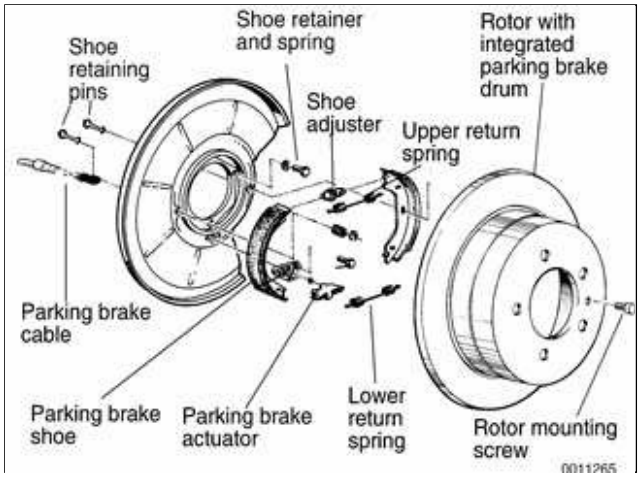
Note:

When replacing the brake booster one-way valve or vacuum hose, install the valve so that the molded arrow is pointing toward the intake manifold. Use new hose clamps.

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Parking brake



The parking brake is a brake drum system integrated into the rear brake rotors.

The parking brake can be adjusted with the wheels installed, although the rear wheels will have to be raised off the ground.

Adjusting the parking brake becomes necessary under the following circumstances:

- Replacing parking brake shoes
- Replacing rear brake rotors
- Excessive stroke of parking brake handle required for actuation (more then 10 notches)
- Replacement of adjustment unit or parking brake cables

Parking brake shoes, adjusting



Lift parking brake lever boot out of console. While holding cables stationary, loosen parking brake cable nuts (**A**) until cables are completely slack.

- Raise rear of car.

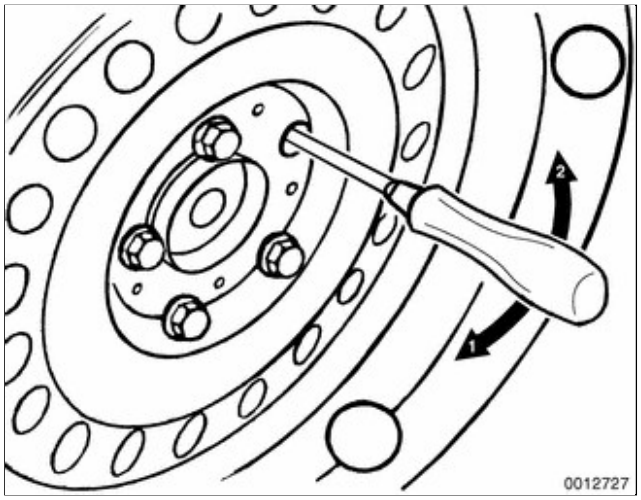
WARNING!

Make sure the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point.

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Do not place jack stands under suspension parts.

- Remove one lug bolt from each rear wheel. Turn road wheel until lug bolt hole lines up with parking brake adjuster (approximately 65° to rear of wheel centerline).



Use flat-bladed screwdriver to turn adjuster. On left wheel, turn adjuster in direction **1** to expand shoes. On right wheel, turn adjuster in direction **2** to expand shoes.

- Using a screwdriver, turn adjuster to expand brake shoes until road wheel can no longer turn, then back adjuster off. Repeat procedure on other rear wheel.

Parking brake adjusting (initial)	
Back off adjuster through wheel lug bolt hole	10 notches

- Working inside car, set parking brake several times to seat cable. Then pull parking brake lever up two notches. Tighten cable adjusting nuts until it is just possible to turn rear wheels with slight resistance.

- Release lever and make sure rear wheels turn freely.

- Turn on ignition. Pull up parking brake lever 1 notch and make sure that light comes.

- Pull parking brake lever up one more notch and check that rear wheels do not move and parking

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brake warning light stays lit. If parking brake light goes out, contact switch must be adjusted.

- Install parking brake lever boot. Install road wheel lug bolts.

Tightening torque	
Road wheel to hub	100 ± 10 Nm (74 ± 7 ft-lb)

Parking brake shoes, removing and installing

- Raise rear of car and remove road wheels.

- Without disconnecting brake fluid hose, remove rear brake calipers from trailing arms. Remove rear brake rotors. See ⇒ Brake Pads, Calipers, and Rotors.

CAUTION!

Do not let the brake caliper assembly hang from the brake hose. Support caliper from chassis with strong wire.

- Unhook upper return spring from brake shoes. Remove shoe retainers by pushing them in and rotating turn. BMW special tool 34 4 000 can be used to remove retainers, if needed.

- Spread shoes apart and lift them out.

- Inspect shoe expander to make sure it functions properly. Apply a

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thin coat of grease to sliding parts and pins.

- Installation is reverse of removal. Be sure to adjust parking brake cables as described earlier.

Parking brake cable, replacing

The parking brake is actuated by two separate Bowden cables between the parking brake handle and the parking brake shoe actuators at the rear brake backing plates. Each cable can be replaced separately.

To replace a cable it is not necessary to remove the rear wheel or to disassemble the brakes. However, it is necessary to remove the complete exhaust system and lower the exhaust system heat shield to access the front end of the parking brake cable housing.

- Working inside car, gain access to base of parking brake handle by removing center console storage tray and center armrest, as necessary.



➢ Use BMW special tool 34 1 030 or equivalent deep 10 mm socket to remove parking brake cable lock nuts (**A**) at base of parking brake handle.

- Raise rear of car.

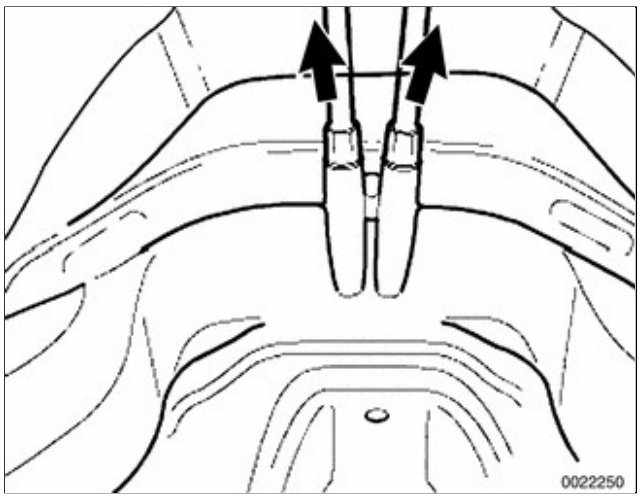
WARNING!

Make sure the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.

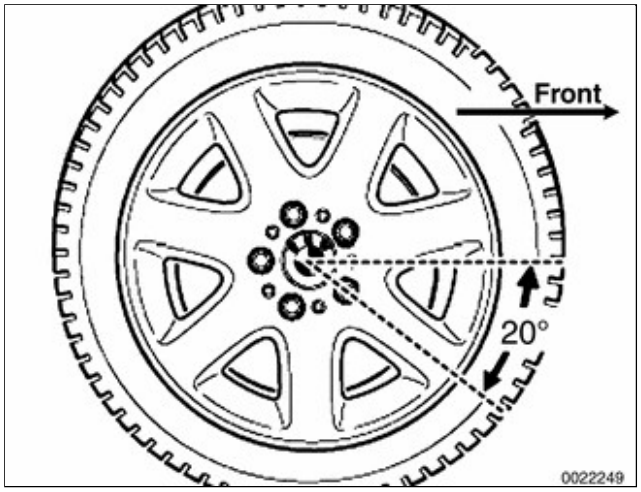
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- Remove complete exhaust system as described in ⇒ 180 Exhaust System.

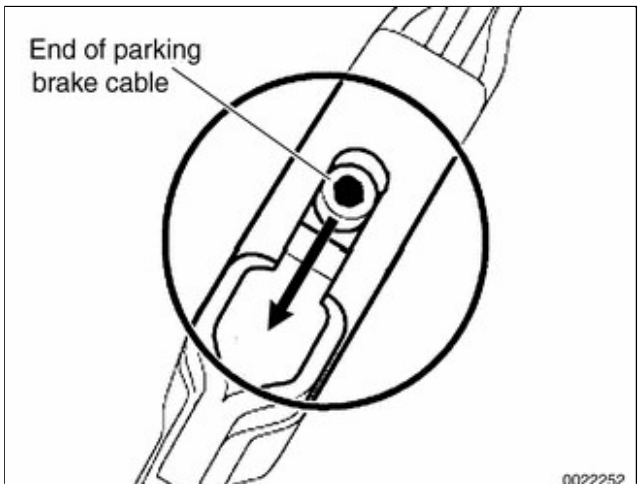
- Remove center tunnel heat shield.



➢ Pull parking brake cable out of body guide tube (**arrows**) and detach from routing brackets, noting correct routing for reinstallation.



➢ Remove one lug bolt from rear wheel. Turn wheel until lug bolt hole is approx. 20° below horizontal to access end of parking brake cable.



➢ Disconnect cable from parking brake actuator:

- Push free (parking brake handle) end of cable into housing to create slack inside brake drum.

- Poke thin screwdriver through lug bolt hole and pry end of parking brake cable downward (**arrow**).

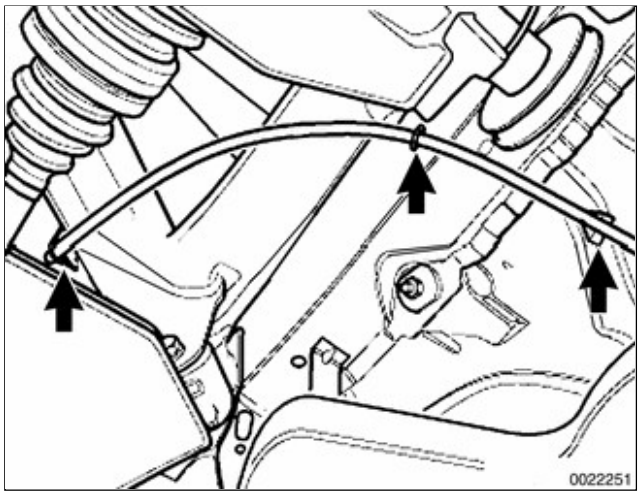
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- Pull cable out of back of backing plate.

- To reinstall:

- Push new cable housing into hole in back of backing plate.

- Push free (parking brake handle) end of cable into housing until end of cable snaps audibly into holder inside brake drum.



- Reroute new cable under car, attaching to brackets (**arrows**).

- Remainder of installation is reverse of removal noting the following:

- Adjust parking brake as described earlier.

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ABS Component Replacement

CAUTION!

- ***If the tires on the car are of different makes, the ASC system may over-react. Only fit tires of the same make and tread pattern.***

- ***In adverse conditions, such as trying to rock the car out of deep snow or another soft surface, or when snow chains are fitted, it is advisable to switch off ASC and allow the car's driveline to operate conventionally.***

All E46 vehicles are equipped with an Antilock Braking System (ABS). Early production models featured ABS with Automatic Stability Control (ABS/ASC). Later models came equipped with ABS and Dynamic Stability Control (ABS/DSC). This manual will refer to these systems as ABS. ASC or DSC will be specified when necessary.

For ABS system and component descriptions, see ⇒ 300 Suspension, Steering and Brakes-General.

Wheel speed sensor, replacing

CAUTION!

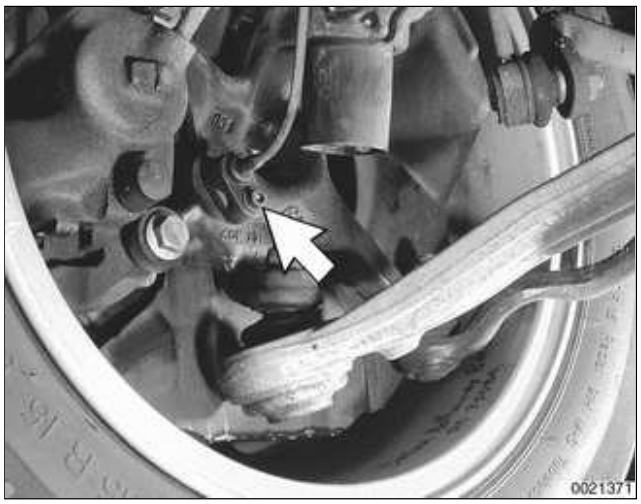
Magnetoresistive & Hall effect wheel speed sensors can be interchanged physically in the rear wheels, but function is not similar.

- Raise applicable end of car.

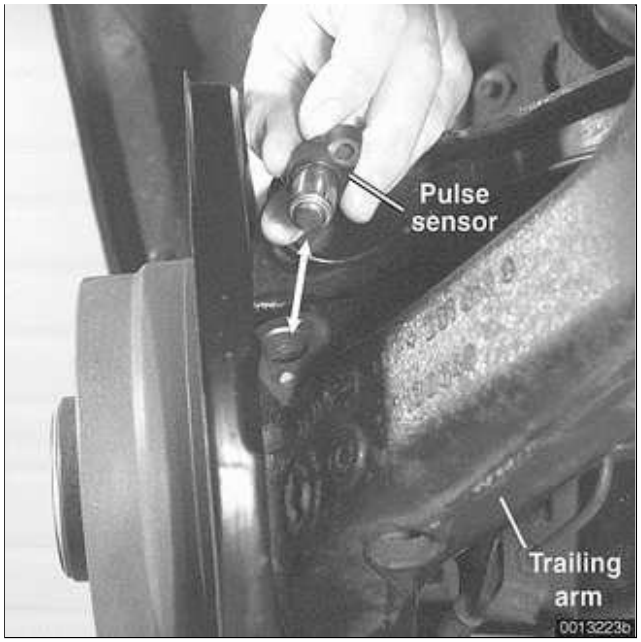
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WARNING!

Make sure the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.



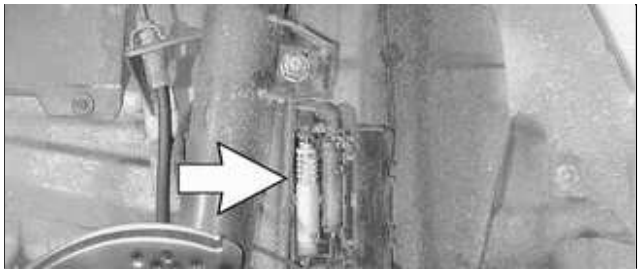
- Front sensor: Unscrew mounting bolt at steering arm (**arrow**).



- Rear sensor: Remove sensor from its bore (**arrow**) in the rear trailing arm.

Note:

ABS wheel speed sensor application may vary depending on traction control system installed.



- Disconnect and remove impulse sensor electrical harness (**arrow**) from retaining mounts. (Left front wheel shown).

  - During installation, apply thin coat

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of Molykote® Longterm 2 or an equivalent grease to impulse sensor and housing.

- Installation is reverse of removal.

Tightening torque	
ABS wheel speed sensor to steering arm / trailing arm	8 Nm (6 ft-lb)

ABS impulse wheel

ABS impulse wheel replacement may be needed in case of damage or impulse teeth corrosion.

Front impulse wheel

- Rear wheel drive models: Impulse wheel is integral with front wheel bearing hub.

- All wheel drive models: Impulse wheel is integral with inner seal of front wheel bearing.

See ⇒ 310 Front Suspension for front wheel bearing replacement procedure.

Note:

When installing the front wheel bearing on an all wheel drive car, be sure that the ridged bearing seal (ABS impulse wheel) is facing inboard.

Rear impulse wheel

- All models: Impulse wheel is pressed on outer CV joint, but it is

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not replaceable separately.

See ⇒ 331 Rear Axle Final Drive for CV joint and drive axle replacement procedures.

DSC lateral acceleration sensor, replacing

Rear wheel drive cars: The lateral accleration sensor is located on the left side driver's footwell, under the panel trim on rear wheel drive vehicles.

All wheel drive cars: The lateral acceleration sensor is combined into one unit with the rotational rate (yaw) sensor. It is mounted under the driver's seat, in front of the left seat rail. See ⇒ DSC rotational rate (yaw) sensor, replacing.

CAUTION!

After replacing the lateral accleration sensor, perform sensor adjustment using either DiS or MoDiC under menu "Service Functions".

- Remove footwell trim on left side A-pillar. Fold foot trim panel and insulating mat to one side.

- Disconnect electrical harness connector. Remove mounting screw and nut. Remove lateral accleration sensor.

- Installation is reverse of removal.

DSC rotational rate (yaw) sensor, replacing

Rear wheel drive cars: The DSC

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rotational rate sensor is located on the left side of the car, under the driver's seat.

All wheel drive cars: The rotational rate sensor is combined into one unit with the lateral acceleration sensor. It is mounted under the driver's seat, in front of the left seat rail.

- Remove driver's seat. See ⇒ 520 Seats.
- Remove plastic trim as necessary. Lift carpet for driver's footwell and fold toward center console. Move insulation forward to gain access to sensor.
- Remove sensor bracket mounting screws.
- Disconnect electrical harness connector at sensor.
- Remove sensor to bracket mounting screws. Lift sensor away from bracket.
- Installation is reverse of removal.

CAUTION!

Be sure to tighten rotational rate sensor and mounting bracket to specified torques. The sensor is vibration sensitive and subject to cause DSC malfunctions if installed improperly.

Tightening torques	
Rotational rate sensor to bracket	8 Nm (6 ft-lb)

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Tightening torques	
Sensor bracket to body	8 Nm (6 ft-lb)

DSC steering angle sensor



Vehicles equipped with DSC have a steering angle sensor (**arrow**) mounted to the steering column right above the pedal cluster. Replacement of this component requires special tools to properly align the steering column and sensor.

After removal or replacement the steering angle sensor requires calibration using BMW scan tools DIS or MoDiC. Once calibrated, the sensor sends a confirmation ID code to the DSC control module to indicate proper calibration.

For steering column removal see ⇒ 320 Steering and Wheel Alignment.

DSC pressure sensor

Rear wheel drive cars: Two DSC pressure sensors are used, mounted in the brake master cylinder.

All wheel drive cars: One DSC pressure sensor is used, mounted on the hydraulic unit.

Tightening torques	
Pressure sensor to hydraulic unit	19 Nm (14 ft-lb)
Pressure sensor to master cylinder	15 + 4 Nm (11 + 3 ft-lb)

Hydraulic unit/control module,

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removing and installing

CAUTION!

E46 cars require special BMW service equipment to properly bleed the brakes. Removal of the hydraulic unit is not recommended unless this equipment is available. For safety reasons, the brake system on cars with ABS must be bled using the procedures described in this repair group.

Note:

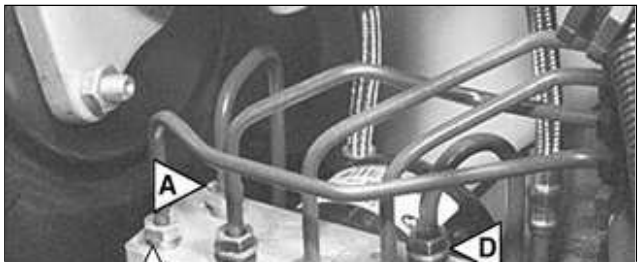
- *Before starting this procedure, read any fault codes from control module memory and print out diagnostic record.*

- *After completing work, perform the function test on control module using either DIS or MoDiC.*

The procedure for removing the ABS/ASC or ABS/DSC hydraulic unit/control module is similar for all models. The location of the units varies.

- On vehicles with hydraulic unit mounted beneath master cylinder, remove master cylinder as described earlier.

- Disconnect electrical harness connector at hydraulic unit/control module.

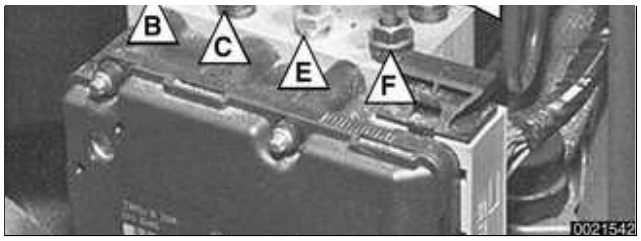


Mark brake lines in relation to their placement on hydraulic unit. (Teves MK 20 ASC hydraulic unit shown.)

A - Front from master cylinder

B - Left front

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C - Right front

D - Rear from master cylinder

E - Right rear

F - Left rear

♦ Remove brake fluid input and output lines.

♦ Seal open brake fluid lines and bores with suitable plugs to prevent contamination.

- Carefully remove brake lines from any retainers or grommets that may be in the way of hydraulic unit/control module removal.

CAUTION!

Make sure not to bend or kink brake lines while separating rubber grommet from retainer.

- Remove mounting screws of hydraulic unit housing and remove hydraulic unit/control module from engine bay.

- If necessary, separate hydraulic unit from control module.

- Installation is reverse of removal, noting the following:

♦ Check rubber mount for hydraulic unit/control module. Replace if damaged.

♦ Make sure all nuts, fluid couplings, thread bores and mating surfaces are clean.

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- Make sure brake lines are securely seated in grommets before installing brake lines in hydraulic unit bores.

- Bleed brakes as described earlier.

Tightening torques	
Brake lines to hydraulic unit	18 Nm (13 ft-lb)
Brake master cylinder to brake booster	26 Nm (19 ft-lb)
Hydraulic unit to body	8 Nm (6 ft-lb)
Mounting bracket to hydraulic unit	8 Nm (6 ft-lb)

DSC precharge pump, removing and installing

CAUTION!

E46 cars require special BMW service equipment to properly bleed the brakes. Removal of hydraulic components is not recommended unless this equipment is available. For safety reasons, the brake system on cars with ABS must be bled using the procedures described in this repair group.

Note:

Before starting this procedure, read any fault codes from control module memory and print out the diagnostic record.

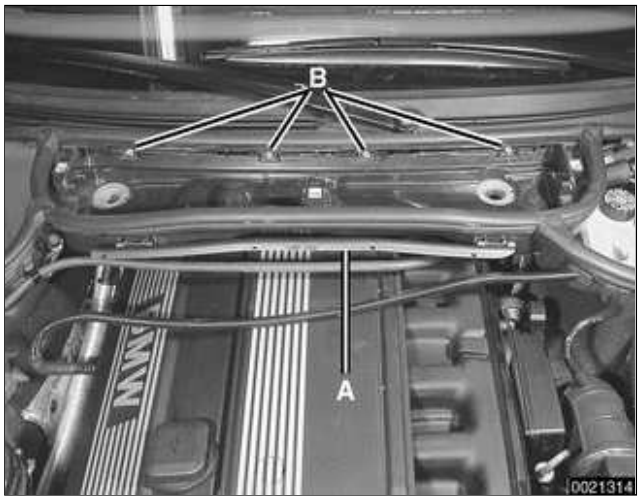
The precharge pump is mounted below the brake master cylinder on the left side of the engine compartment.

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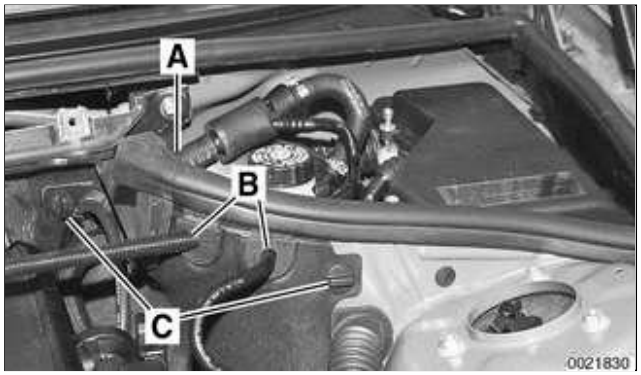
- Using a clean syringe, empty brake fluid reservoir.

WARNING!

Brake fluid is highly corrosive and dangerous to the environment. Dispose of it properly.



- Remove interior ventilation microfilter housing.
  - Remove upper cover and microfilter.
  - Open wiring harness loom (**A**) and remove wires.
  - Unfasten screws (**B**) and remove lower microfilter housing.

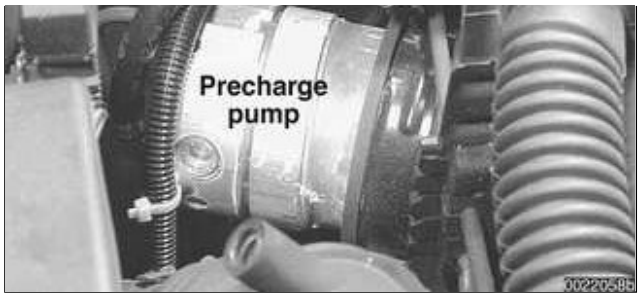


- Remove side trim panel from left rear of engine compartment:
  - Remove rubber strip (**A**) from top of trim panel at brake booster.
  - Remove vacuum line and positive battery cable with grommets (**B**) from trim panel.
  - Release locking clips (**C**) on edges of trim panel and remove panel by pulling upwards.



- Working at precharge pump beneath brake master cylinder:
  - Remove brake fluid feed line (**arrow**) from brake fluid reservoir.
  - Remove brake fluid intake and

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output lines from pump.

- Remove electrical harness connector.
- Lift pump to release from lower mounting pad.
- Slide pump out of retaining ring.

- Installation is reverse of removal, noting the following:

- Be sure to replace rubber pump mounts if damaged or worn.
- When installing vacuum hose and battery cable at trim panel, make sure isolating grommets are securely seated.
- Bleed brakes as described earlier.

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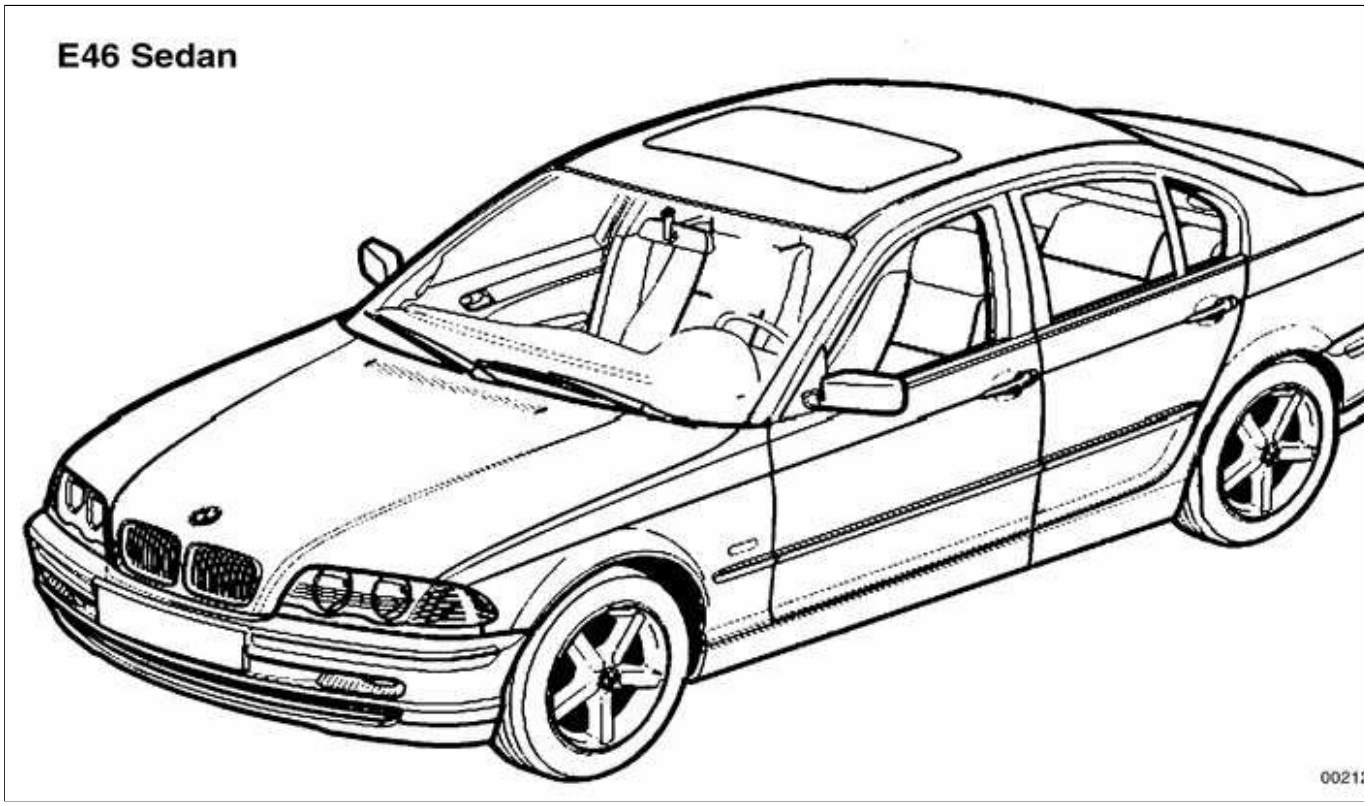
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400-1

General

This section covers system descriptions and general information for the repair groups found in 4 Body and 5 Body Equipment.

E46 Sedan



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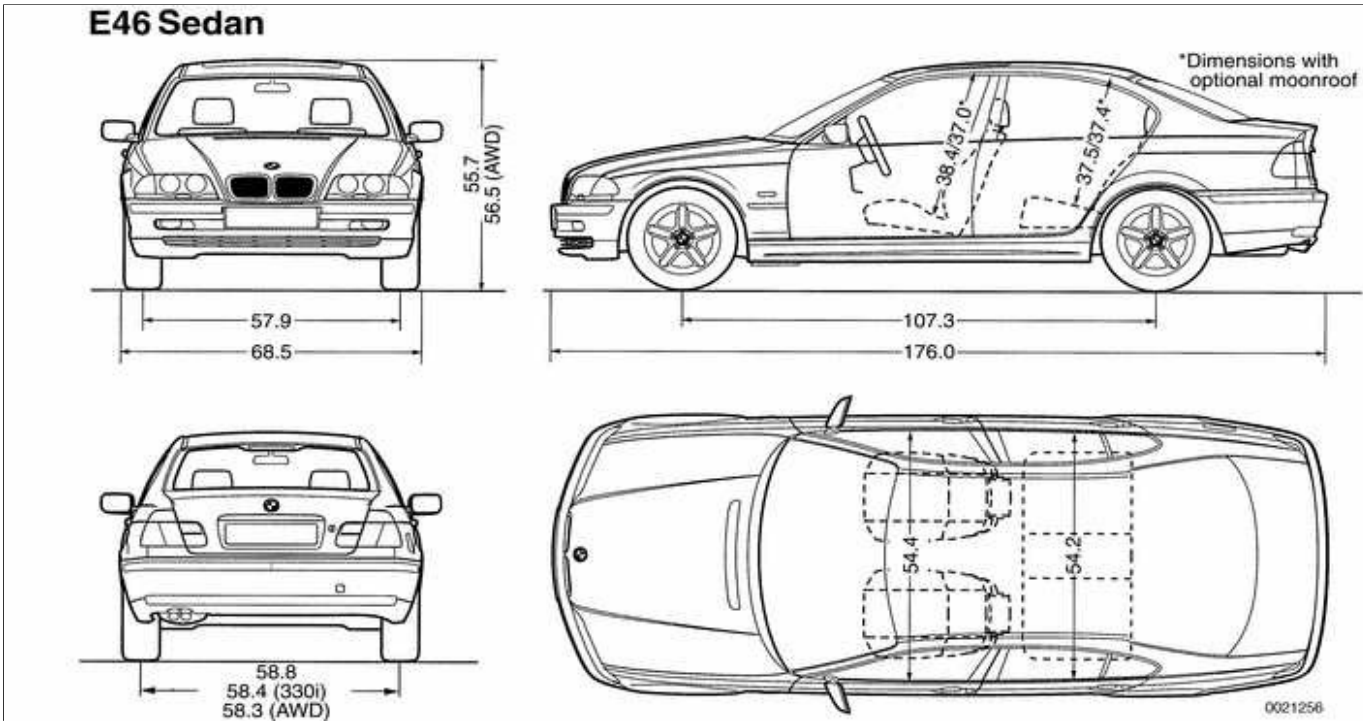
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400-2

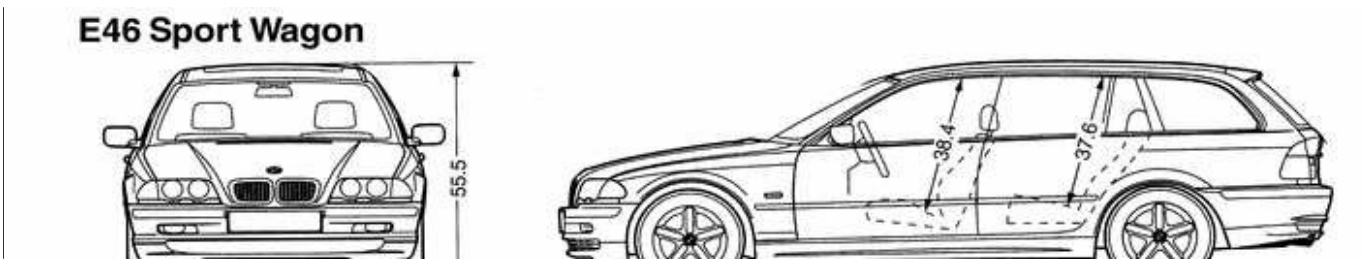
Body Assembly

The body styles of E46 cars covered by this manual are the 4-door Sedan, 4-door Sport Wagon, 2-door Coupe and 2-door Convertible. Body dimensions vary slightly among models. Dimensions are given in inches.

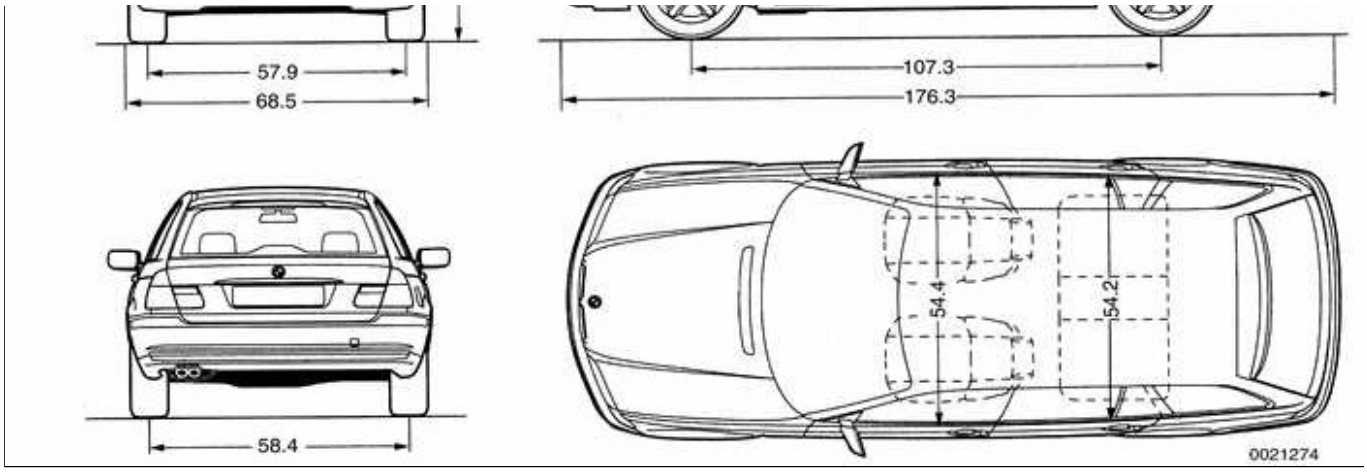
E46 Sedan



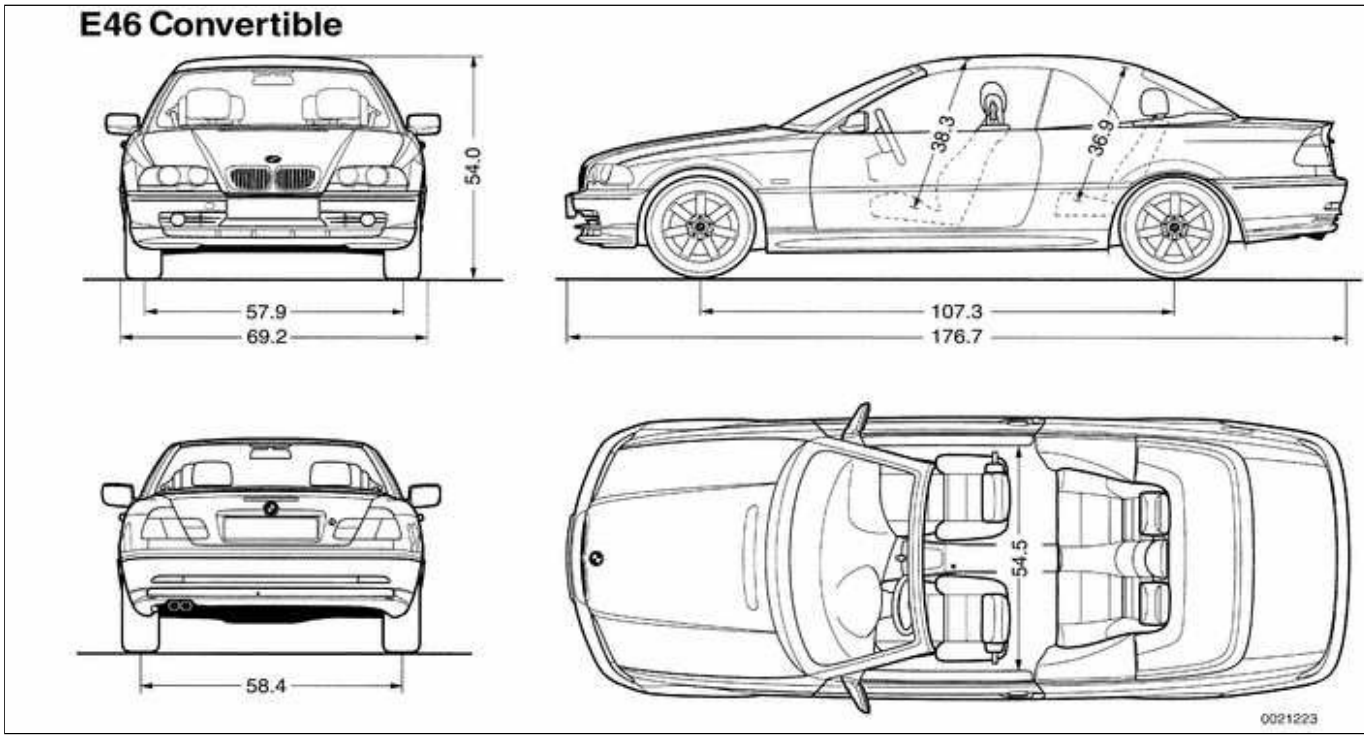
E46 Sport Wagon



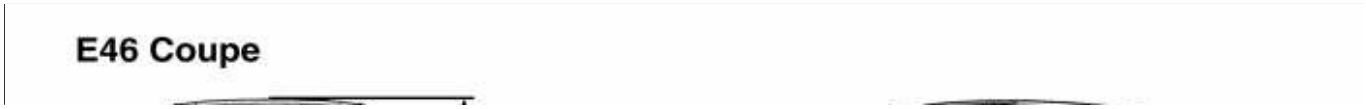
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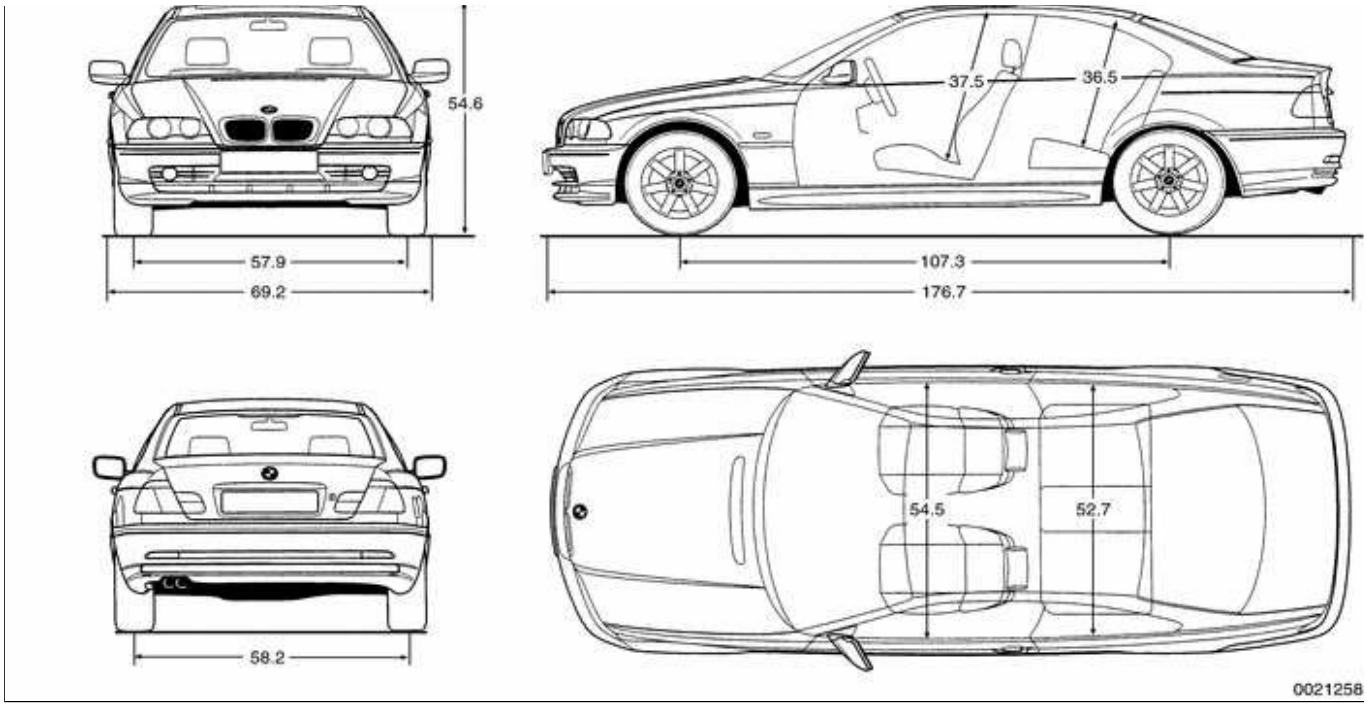
E46 convertible



E46 Coupe

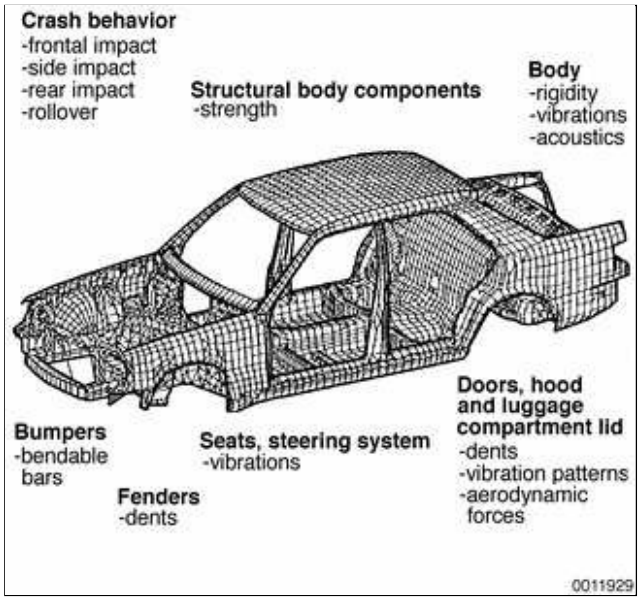


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Body shell

The BMW 3 Series chassis is a unibody design constructed of high strength steel. Attaching parts, such as the front fenders, rear quarter panels, doors, trunk lid and hood are also constructed of steel.



Computer aided design (CAD) techniques have been used in refining E46 body models to reduce vehicle weight while retaining strength and increasing torsional rigidity. For good handling purposes, the more rigid the structure the more precisely the suspension can operate. High strength steels now account for 50% of the body shell weight. The body shell's resistance to twisting forces has been almost doubled over the previous 3 series models. To help insure long-lasting strength, 85% of the body (in surface area) is made of galvanized steel. This resists corrosion and maintains body strength over time.

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The E46 body shell was designed so that the vibrations of torsional twisting and bending are separated into discrete components and in the inaudible range. The current Sedan design ensures that the body twists at 29 hertz and bends at 26 hertz.

Exterior and aerodynamics

With its traditional styling features, such as the kidney grille, circular headlights behind a glass cover (for reasons of streamlining), and the "kick" in the rearmost roof pillar (C-pillar), the E46 can be immediately recognized as a BMW.

Wind resistance. Windows bonded flush to the body and the guided flow of cooling air into the engine compartment provide a good coefficient of drag (C_d).



E46 cars have been designed for balanced aerodynamics but not necessarily an extremely low C_d.

- A low coefficient of lift (C_l) promotes stability at high speeds. The current design has a front C_l of 0.08 and a rear C_l of 0.10.
- Windshield wipers are designed for effectiveness at speeds up to and beyond 200 kph (124 mph).
- Body, window and exterior mirror shapes have been refined for lower wind noise and reduced soiling of mirrors and windows. The Coupe's side mirrors are specially shaped and include five ribs (**arrows**) on the top edge for further wind noise reduction.

All this has resulted in a C_d of

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approximately 0.31 for the Sedan and 0.32 for the Coupe models.

Fenders. The exterior panels are corrosion-resistant zinc coated (galvanized) steel. The front fenders are bolted on. For front fender replacement information, see ⇒ 410 Fenders, Engine Hood.

Bumpers. The front and rear bumpers are clad in high quality deformable plastic and provide protection with virtually no damage to the bumper or the vehicle at solid barrier impact speeds of 4 kph (2.5 mph). In addition to hydraulic dampeners, which absorb the initial impact energy, these bumpers are backed by compressible tubes. These deform in a controlled manner at impact speeds greater than that for which bumpers and hydraulic dampeners are designed. This helps avoid expensive damage to the body at impact speeds up to 14 kph (9 mph).

Coupe models

The E46 Coupe is similar to the 4-door Sedan, but has a more stretched and sleeker appearance. Thus, with the same wheelbase and identical length, it looks different but still familiar.

The 2-door Coupe differs from the 4-door (2-wheel drive) Sedan by a longer front end, a flatter hood line with air slits, and a roof 2.7 cm (1.1 in.) lower. Additional differences include wider doors with frameless windows, glass-covered door-posts (B pillars) and a shorter and lower trunk lid in the Coupe.

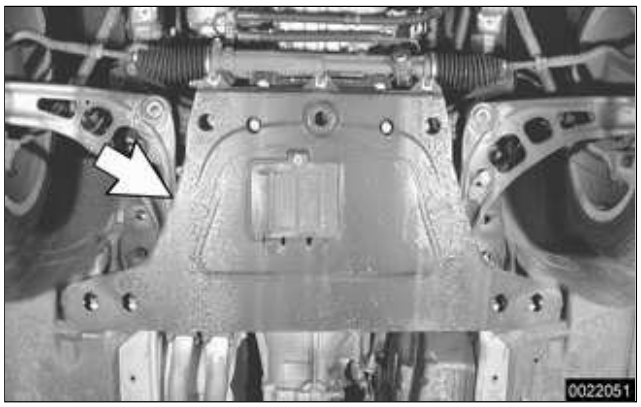
Convertible models

The E46 Convertible is an all-season vehicle with a high level of functionality, excellent interior comfort and acoustic

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refinement. Interior materials and colors, the soft top and the light-alloy wheels have been carefully matched.

Although the automatic Convertible roof is standard, a hard-top in body color with heated rear window is available as an option for the cold season.



The Convertible body structure includes many passive safety refinements over its fixed-top counterparts.

- To achieve a more rigid underbody, an aluminum reinforcement plate (**arrow**) is bolted to the front undercarriage and reinforcing struts are bolted to the rear undercarriage.

Note:

The aluminum reinforcement plate is used in all rear wheel drive E46 models produced from December 2000.

- Transverse seat support reinforcements in the floor pan accommodates the new seat-integrated seat belts (SGS).

- The windshield frame is reinforced with stepped reinforcing tubes which allow it to act as roll-over protection.

- The windshield is bonded into its frame.

- There are tubular door reinforcements.

- The rollover protection system is tripped into position in a fraction of second. With this feature, two bars fully independent of each other come up behind each rear-seat

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backrest when the vehicle is in danger of turning over.

A Convertible body normally flexes and vibrates, transferring oscillations to the passenger compartment. In the E46 Convertible, BMW utilizes a unique battery tray in the trunk as a vibration dampening system to counteract this oscillation.

CAUTION!

The E46 Convertible requires a special battery which is designed for constant vibration.

Information for the Convertible top and its related mechanisms can be found ⇒ 541 Convertible Top .

Sport Wagon

Introduced in 2000, the E46 Sport Wagon is identical to the E46 Sedan from the front bumper to the B pillar (middle door-post). From the B pillar back the Sport Wagon features:

- Remodelled rear doors
- Tail gate and hinge mechanism
- Rear (tail gate) window that flips up to open, independent from the tailgate, held open by compact torsional coil springs
- New rear bumper
- Roof rails (optional equipment)

Structural, safety and comfort features in the Sport Wagon are comparable to the E46 Sedan and Coupe.

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Sport Wagon capacities	
Cargo capacity:	
Rear seat backrest up	435 liters (15.4 cu. ft.)
Rear seat backrest folded down	1345 liters (47.5 cu. ft.)
Load capacity:	
In cargo compartment	540 Kg (1191 lb.)
On roof	75 Kg (165 lb.)

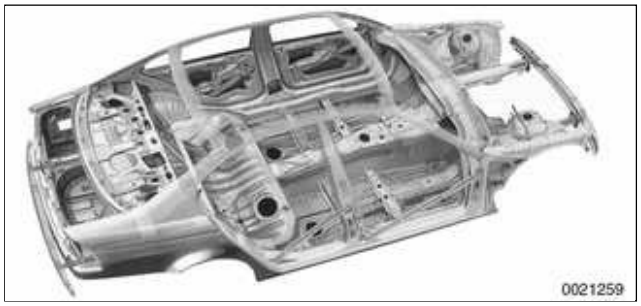
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Safety and Security Features

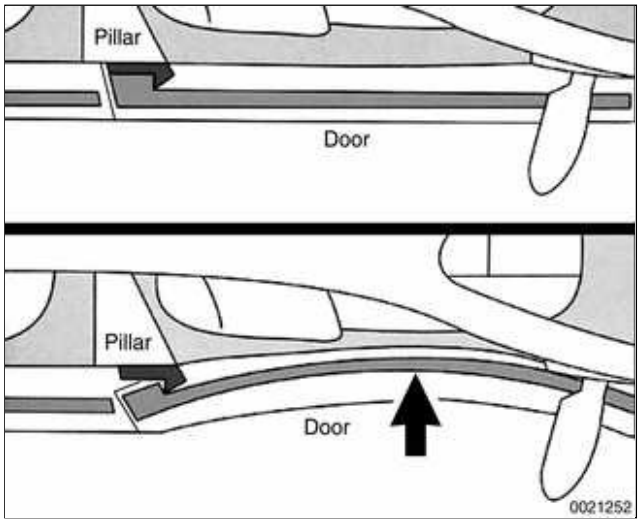
A large number of new or improved safety and security features are incorporated in E46 cars.

Safety cage



- The body safety cage is a continuation of an established BMW concept for passenger protection. Tubular impact structures built into the body provide protection against passenger injury during front or rear impacts.

Door anchoring system



- Each door is reinforced with a diagonal aluminum bar with a metal hook at the rear edge.

  Upon severe side impact, the hook locks into a recessed notch in the B or C pillar, thus providing unitized protection against buckling of the door. The body side holds together as a unit, offering significantly greater strength.

  After most impacts, the door springs back and unhooks from the notch. It can then be opened again.

Door locks and door handles



- The bow type door handles allow easy door opening, but are secure in accidents.

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Electrical components in the locks are fully encapsulated and cannot be picked easily. The new door handles, latches and lock assemblies offer improved reliability and security against theft.

Door position and lock condition are detected by hall sensors.

Roof padding

In addition to the side and head protection airbags, there is supplementary padding at the roof pillars and along the roof above the doors. This is positioned to present energy absorbing surfaces to passengers thrown around by side impact forces.

Seat belts

In the Sedan, Coupe and Sport Wagon models, each front seat belt assembly has a height-adjustable anchor at the B pillar.

An automatic pyrotechnic (explosive charge) tensioner tightens the front belt at the buckle upon impact, snugging up lap and shoulder segments of the belt. The tensioners are designed to automatically tension the belts by about 2 inches (55 mm) in the event of a collision.

A force limiter puts an upper limit on the amount of force each belt can exert on the passenger.

The Convertible seat belts are integrated into the seat, but otherwise have features similar to the other models.

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Airbags



As many as 8 airbags are installed in E46 cars, depending on model.

The front airbags operate without sodium azide propellant, widely considered an irritant when an airbag is deployed.

Starting with 2000 models, "smart" front passenger and driver airbags were installed. These are of the dual-threshold, dual stage design, including a sensor to help prevent the unnecessary deployment of the passenger side airbag if the seat is unoccupied.

Depending on options chosen, one airbag may be installed in each door of the Sedan and Sport Wagon models, protecting passengers against side impacts. Coupe and Convertible models are equipped with door-installed airbags as well.

Head Protection System (HPS) airbags stretch diagonally across the tops of the front doors.

Airbag deployment automatically triggers fuel shut-off, turns on the hazard and interior lights, and unlocks the doors.

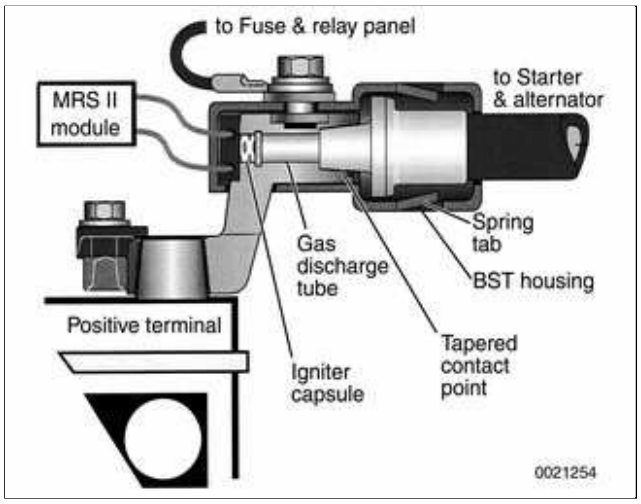
WARNING!

- ***Airbags are inflated by an explosive device. Handled improperly or without adequate safeguards, airbag units can be very dangerous. Special precautions must be observed prior to any work at or near any of the airbags. See ⇒ 721 Airbag System (SRS).***

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- ***Always disconnect the battery and cover the negative (-) battery terminal with an insulator before starting diagnostic, troubleshooting or service work on cars fitted with SRS, and before doing any welding on the car.***

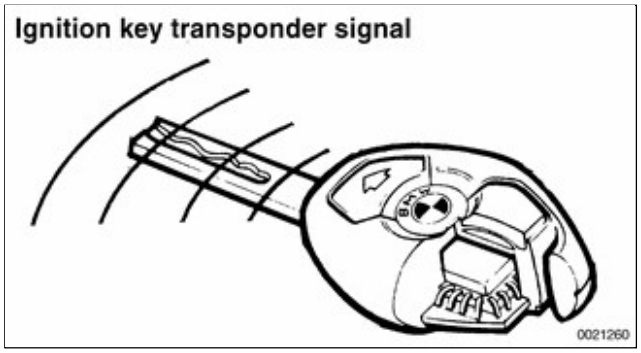
Battery safety terminal (BST)



- A pyrotechnic (explosive charge) device automatically disconnects the battery positive terminal during impacts or collisions.

  The seatbelt system, airbag system and battery safety terminal are controlled by the Multiple Restraint System (MRS II) control module.

Security



- Electronic immobilization (EWS 3.3). All E46 vehicles incorporate an electronic immobilization system known as EWS 3.3. This system uses a wireless communication link between a transponder chip in the ignition key and the ring antenna surrounding the ignition switch. The EWS control module blocks the starting of the vehicle unless the correct coded ignition key is used.

  Note:

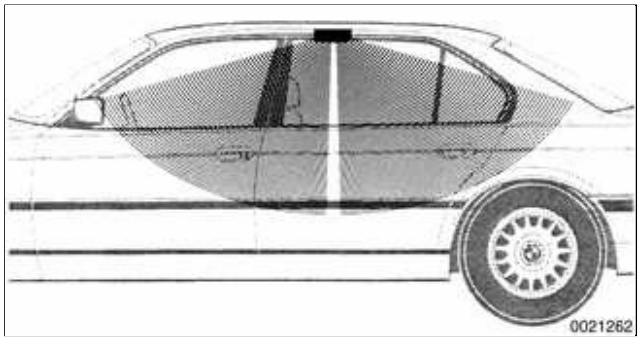
  Electronic immobilization is sometimes referred to as the driveaway protection

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system.

Anti-theft alarm (DWA). This is a dealer-installed option for which the E46 vehicles are factory-wired. When armed, the system monitors door lock contacts and trunk and engine hood locks and sounds a siren if it detects tampering.

Tilt sensor. Located in the right side of the trunk above the battery, the tilt sensor monitors the vehicle parked angle when DWA is armed. The siren is activated if the vehicle angle is changed. This helps prevent theft of the car using a ramp truck.



- Ultrasonic interior protection (UIS). An interior ultrasonic emitter/detector is installed in the center of the headliner of Sedan, Coupe and Sport Wagon models. The DWA alarm is triggered if motion is detected inside the car.

Short distance radar (SDR) is the interior motion detector system used in Convertible models. The SDR emitter is located on the driveshaft tunnel under the center console next to the parking brake.

For further information about anti-theft systems, see ⇒ 515 Central Locking and Anti-theft.

Emergency location

If emergency assistance is needed, the on-board navigation system (if equipped) uses GPS technology to pinpoint the location of the vehicle.

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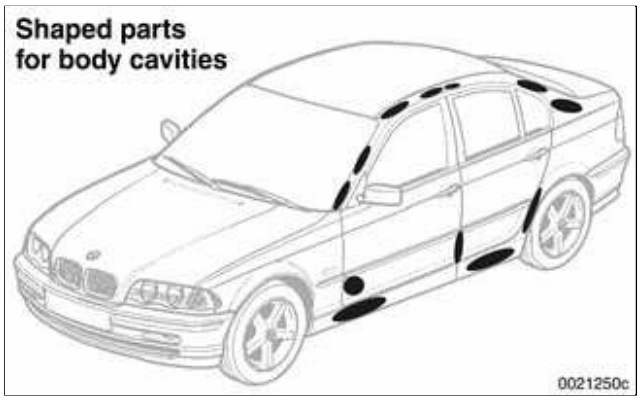
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Interior Features

E46 interiors have a unique character, with a combination of sporty features and innovative design. All body versions were made in a wide choice of interior and exterior colors. New colors with matching leather or leatherette upholstery were introduced for each model year, including light-alloy wheels in new designs.

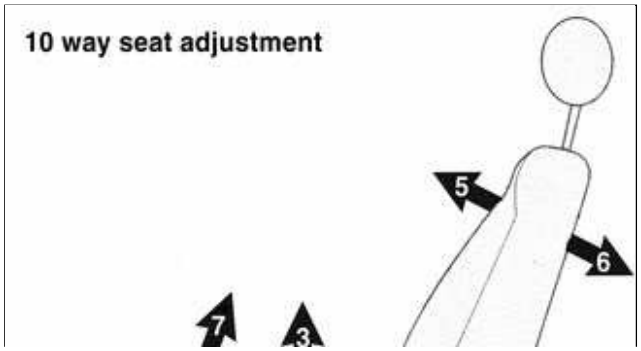
Driving comfort is enhanced by power steering, tilt steering wheel, height-adjustable front seats, and electrically adjustable and heated rear-view mirrors. Inside the car there are reading lights at four seating positions.

Noise reduction



To reduce interior noise, certain body cavities are sealed with shaped parts installed during the manufacturing process. The body is heated to approx 180°C (356°F) and kept at that temperature for approx. 20 minutes, during which interval the shaped parts expand to fit the shapes of the cavities.

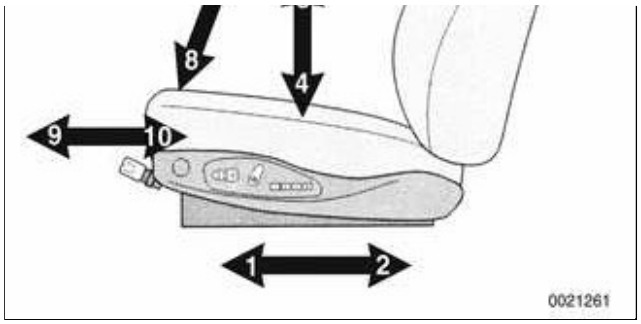
Seats



Anatomically correct seats are constructed from polyurethane foam containing areas or "zones" of different firmness. They offer good lateral support without constricting the occupant.

Driving comfort is enhanced by power steering, tilt steering wheel, height-

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adjustable front seats, and electrically adjustable and heated rear-view mirrors. Inside the car there are reading lights at four seating positions.

The seats have a passive internal ventilation system: Cylindrical cavities within the cushions and backrests generate a pumping effect as the car's ride motions cause occupant motion. This helps remove moisture and feeds fresh air into the seats.

Other features of the seating system:

- The seat bases have steel springs for added support and strength.
- The seat control switches are along the outside edge of the seat.
- Heated seats are an option in all models.
- In cars equipped with seat position memory, three different seat configurations can be memorized by the seat control module(s).
- Seat memory coordinates with outside mirror memory.
- In Convertible models: When a rear passenger presses the seat back switch forward, the comfort entry aid system moves the seat forward and lowers the headrest to prevent it from contacting the sun visor. The seat and headrest are then returned to memorized positions. These functions are controlled by the seat memory module(s).

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- For security reasons, the release lever to fold the rear seat backrest forward is installed in the trunk.

- In Sport Wagon models: Rear seat backs are split 60/40 with the center arm rest on the left seat back. The center arm rest incorporates a non adjustable headrest. When folded down, the arm rest opens out with cup-holders and a storage compartment.

- See ⇒ 520 Seats for more details.

Instruments and controls

Everything in the interior passenger compartment essential to the driver is logically grouped and easy to reach. All instruments and controls have been arranged ergonomically and are fully integrated into the overall design of the vehicle. The following features are optional in some models.

Tilt-telescopic steering wheel has 30 mm (1.2 in.) of vertical and longitudinal adjustment.

Multi-function steering wheel contains two key pads containing controls for the sound system, telephone and cruise control.

Padded dashboard houses the instrument cluster and the ventilation and heating system.



Instrument cluster uses large easy-to-read analog instruments and is removable as a unit without removing the dashboard. On-board computer and Check Control functions are integrated into the instrument cluster

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displays.

Service Interval Display calculates vehicle service needs, based on current driving patterns, and indicates to the driver when the car requires service.

Integrated on-board navigation system, based on Global Positioning System (GPS) technology, is optionally available on E46 cars. When installed, a multi-function monitor is included in the center of the dash above the radio. In addition to displaying navigation system information, this monitor accesses to On-Board Computer functions, audio system controls, mobile phone dialling and memory, and automatic ventilation.

Park Distance Control (PDC) is an optional system which uses ultra-sonic sensors in the rear bumper trim to warn the driver of approaching too close to obstacles when parking.

Central Body Electronics (ZKE V)

E46 cars are equipped with a sophisticated centralized body electric/electronics plan. Central Body Electronics (ZKE V) is self-diagnostic and incorporates many functions into a single control module. The consolidation of several systems into a single control module minimizes power requirements and the incorporation of the diagnostic link results in more efficient and accurate troubleshooting.

ZKE V directly controls the following functions:

- Windshield wiper/washer system, with optional Rain Sensor Interface. See ⇒ 611 Wipers and

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Washers.

- Central locking with power trunk release. See ⇒ 515 Central Locking and Anti-theft.
- Keyless entry (FZV)
- Power window control. See ⇒ 512 Door Windows.
- Car/key memory
- Interior lighting
- Alarm system (DWA)
- Electronic consumer sleep mode. See ⇒ 600 Electrical System–General.

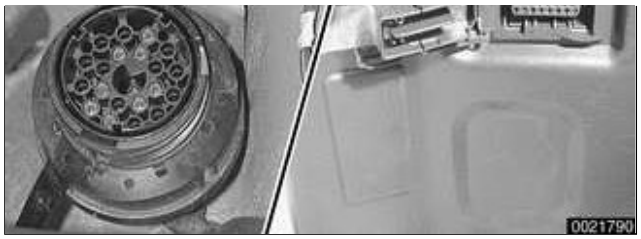
Other functions not directly controlled by ZKE V but interconnected:

- Rain sensor (AIC)
- Sunroof operation. See ⇒ 540 Sunroof.
- Seat memory. See ⇒ 520 Seats.
- Outside rear-view mirror control and heating
- Windshield washer jet heating



ZKE V Diagnostic Trouble Codes (DTCs) are accessible electronically through the data-link connector (DLC). See ⇒ 610 Electrical Component Locations.

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Note:

- *All 1999 models and cars produced through June 2000 are equipped with the DLC socket in the rear right corner of the engine compartment.*

- *In cars produced after June 2000, the DLC socket in the engine compartment has been discontinued. All scan tool codes can now be accessed through the OBD II interface socket on the driver's side of the dashboard, left and below the instrument cluster, under a cover.*

Heating and air conditioning (IHKA)

The integrated heating and air conditioning (IHKA) system uses an extra large, infinitely variable radial blower motor for good distribution of air. Fresh air enters through the grille below the engine hood and into the passenger compartment via the dashboard and footwell vents.

Repair information for the heating and air conditioning system is covered in ⇒ 640 Heating and Air Conditioning.

Heating and air conditioning vent diagram



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Sport Wagon interior features

Child seats. There are three child seat hold down anchors behind the rear seat back rest. Plastic trim covers are used to hide the anchors.

Cargo area. There is a spring-loaded blind and a cargo safety net installed behind the rear seat.

Storage. There are extra storage compartments on the left and right sides in the rear. These house the rear window washer fluid reservoir and sound system components.

Power socket. A 12 volt power socket is in the left side of the cargo area behind the rear seat backrest.

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General

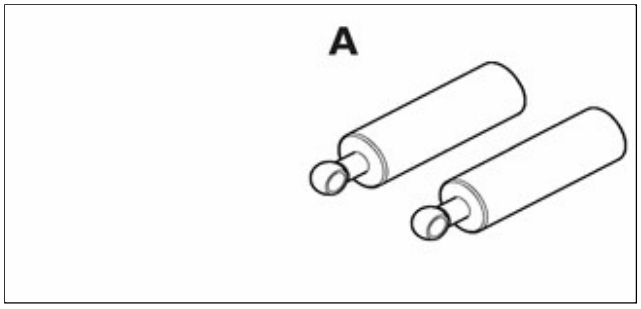
This repair group covers replacement of the front fenders and removal and installation of the engine hood.

Note:

The body is painted at the factory after assembly. Realignment of body panels may expose unpainted metal. Paint all exposed metal once the work is complete.

Special tools

Most body repairs can be performed using regular automotive service tools. Some BMW special tools are required to set body pieces into the service positions.



- Service position hood props BMW 51 2 160

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Front Fenders

Front fender, removing and installing

- Raise hood. Raise and safely support front of vehicle.

WARNING!

- ***When raising the car using a floor jack or a hydraulic lift, carefully position the jack pad to prevent damaging the car body. A suitable liner (wood, rubber, etc.) should be placed between the jack and the car to prevent body damage.***

- ***Watch the jack closely. Make sure it stays stable and does not shift or tilt. As the car is raised, the car may roll slightly and the jack may shift.***

- Remove front wheel. Remove inner plastic liner from wheel housing.

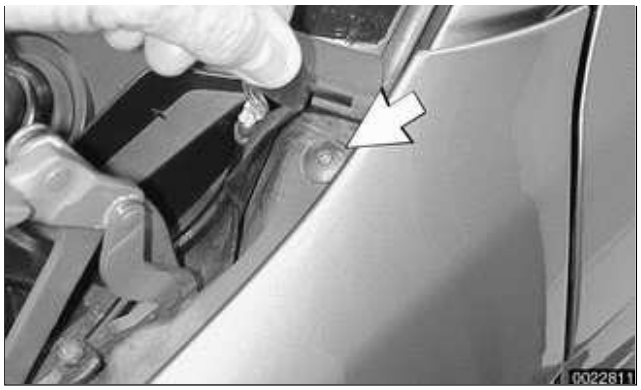
- Remove front turn signal/lens assembly from applicable front corner. Carefully pry out side directional from fender and disconnect. See ⇒ 630 Lights.

- Remove body colored trim panel underneath headlight assembly.

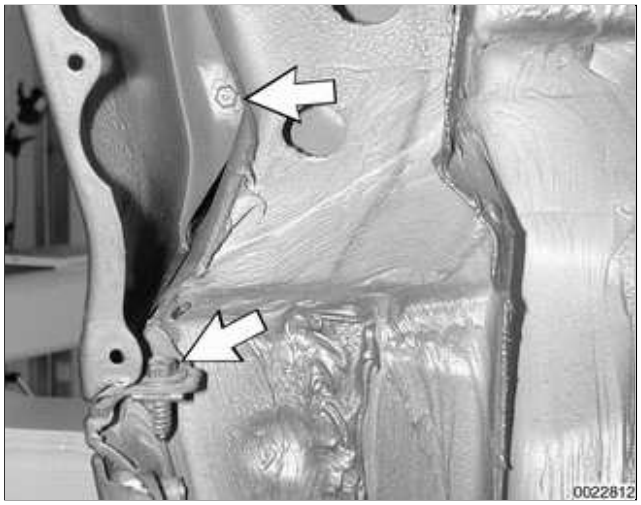


Working at cowl, feed corner of side trim panel cover out from side of fender. Gently lift panel cover upwards

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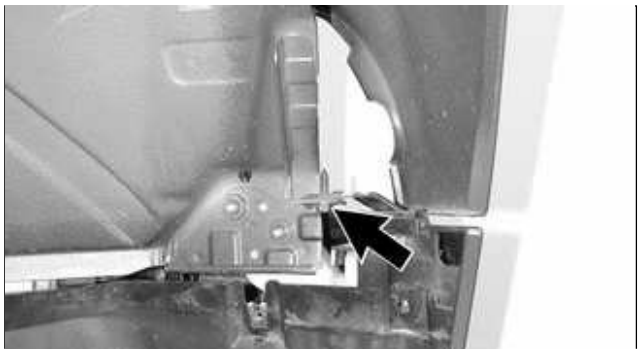
and remove retaining screw (**arrow**).



- Remove lower fender attaching bolts (**arrows**) at rear of wheel housing.



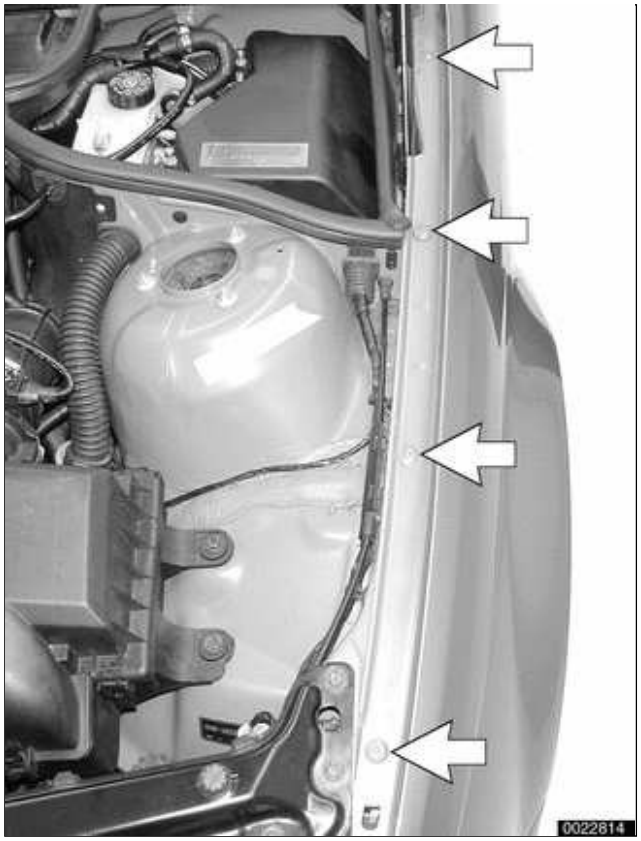
- With door open remove upper fender to door post attaching bolt (arrow).



- Remove screw (**arrow**) at front of fender.

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- Remove bolts (**arrows**) along top edge of fender.

  - Carefully remove fender from body.

  - Installation is reverse of removal, noting the following:

- ♦ Before installing new fender, clean old sealant and protective coating from mounting surfaces.

- ♦ Position new fender and loosely install all mounting bolts. Align fender with door pillar and inner fender, then tighten bolts.

- ♦ Repair any paint damage and paint any exposed metal.

- ♦ Reseal and apply protective coating to mounting surfaces.

Clearance specification	
Fender to front hood or to door	4.25 ± 0.75 mm (0.167 ± 0.03 in.)

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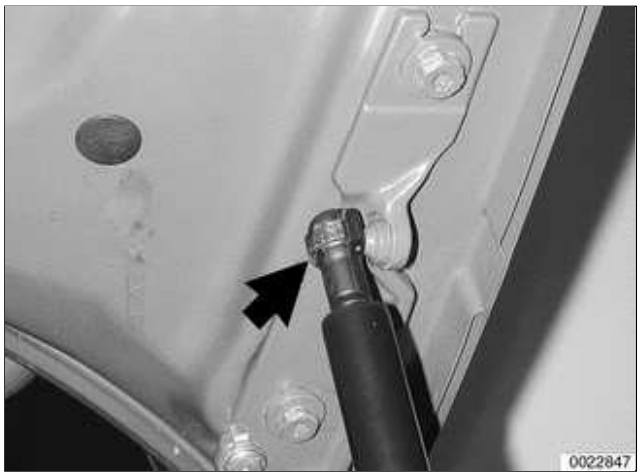
Engine Hood

Hood, raising to service position

CAUTION!

- ***Do not switch on the windshield wipers with the engine hood raised. As a precaution, remove the wiper motor fuse. See ⇒ 610 Electrical Component Locations.***

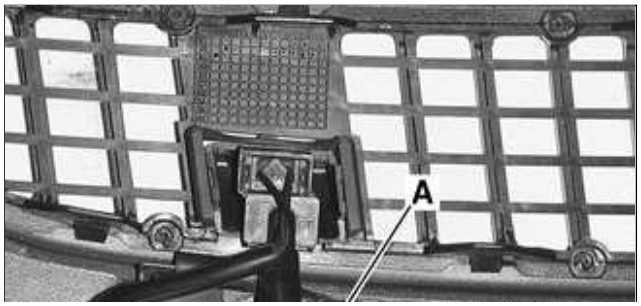
- ***The hood is heavy. Before removing the hood supports, be sure to have an assistant help support the hood.***



- Open hood fully. With the help of a partner, support hood and remove retaining clips (**arrow**) on upper end of pressurized lifting struts. Pull struts off hood.

  - Raise hood higher and install BMW special tool 51 2 160 in between hood lift struts and hood brackets to hold hood in service position.

Hood, removing and installing



- Raise hood:

  - Disconnect washer fluid hose (**A**) from washer nozzles.

  - Where applicable, disconnect

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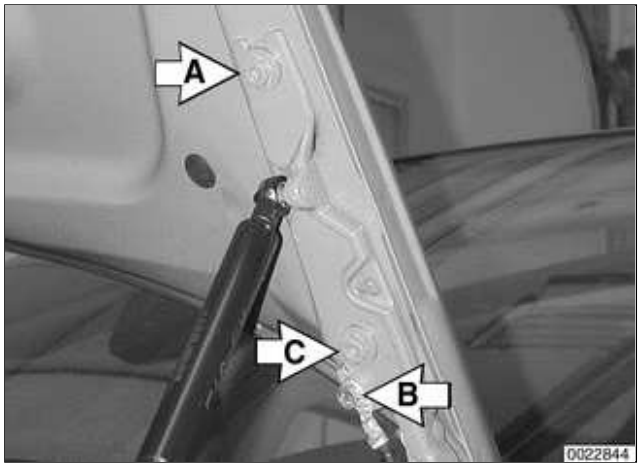


electrical harness connector (**B**) from heated nozzles.

- Detach gas-charged hood supports from hood.

CAUTION!

The hood is heavy. Before removing the hood supports or hood retaining bolts, be sure to have an assistant help support the hood.



➢ Loosen upper hood hinge bolts (**A**). Remove ground strap (**B**) and remove lower hinge bolts (**C**). Lift hood off carefully.

- Installation is reverse of removal.

♦ Repair any paint damage and paint any exposed metal.

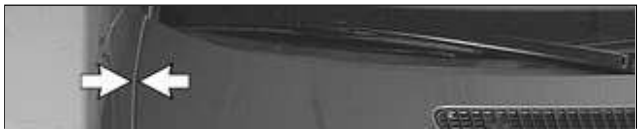
♦ Check hood alignment as described next.

Note:

The hood was fitted and attached to an unfinished body at the factory. Unfinished surfaces exposed by this procedure must be touched up with paint.

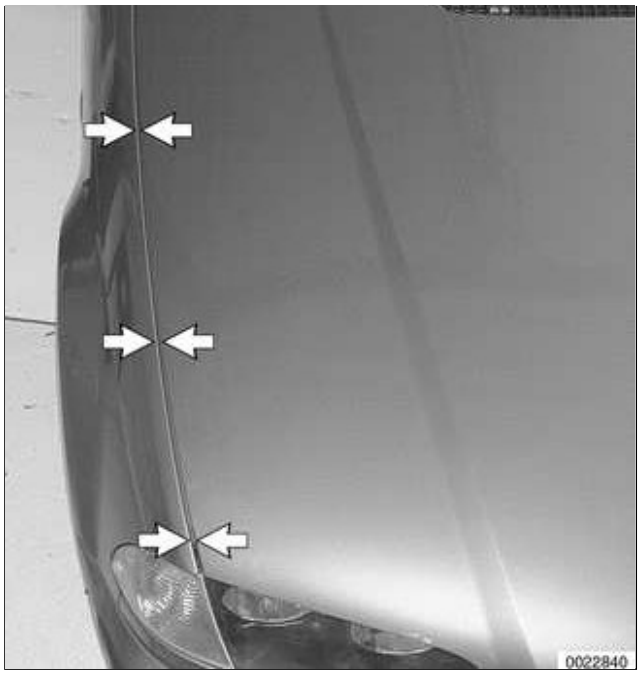
Hood, aligning

When installing the hood, align the hinges as close to the original painted surface as possible. Movement of the hood on its attaching hardware may require touch-up paint.

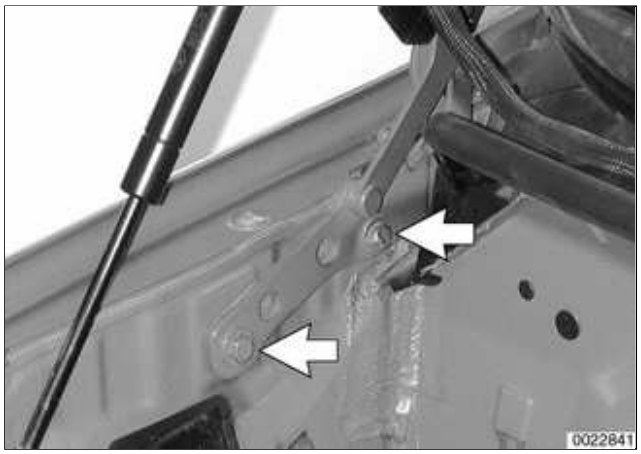


➢ The hood should be aligned so that gap (**arrows**) to fender is as even as possible.

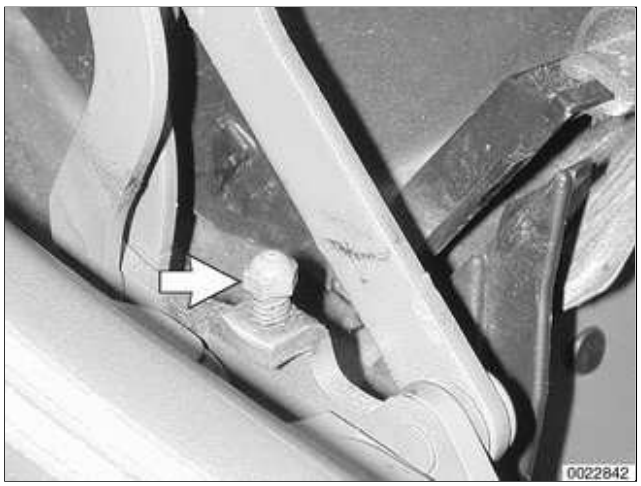
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Clearance specification	
Hood edges to adjoining body panel (gap)	5.5 mm (0.216 in.)



- If height adjustment at rear of hood cannot be completed using upper hinge, loosen lower hinge bolts (**arrows**) and reposition as necessary.

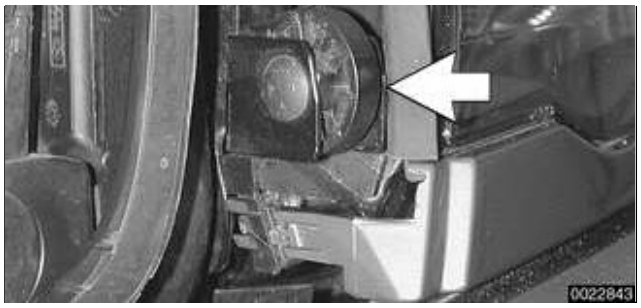


- Plastic coating on top of hinge stop screw must not be damaged or missing.



- Stop disk for front of hood (**arrow**) is eccentric, and is marked 0-10. Initial setting is with the 0 setting forward, for

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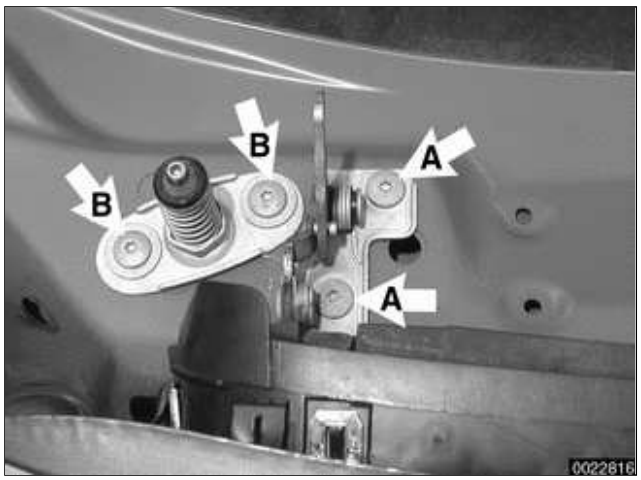
minimal clearance. Turn stop disk to move hood front stop further out.

- Height at front of hood is set using spring pins and rubber stop buffers.

Hood release cable and spring pins, adjusting

Before adjusting hood pins, be sure the hood is aligned evenly to fenders and front panel.

- Make sure bowden cable, which connects both hood locks together, is seated in lock guide on both left and right locks.



Loosen hood spring pin bolts (**A**) and retaining hook bolts (**B**) at hood on left and right sides only enough to allow movement.

- Turn rubber stop buffers over headlights inwards to provide clearance.

- Lower (but do not fully latch) hood several times so pins on hood center themselves in lower locks.

CAUTION!

Do not let hood lock with latch bolts loose.

- Tighten hood spring pin bolts and latch bolts when alignment is correct.

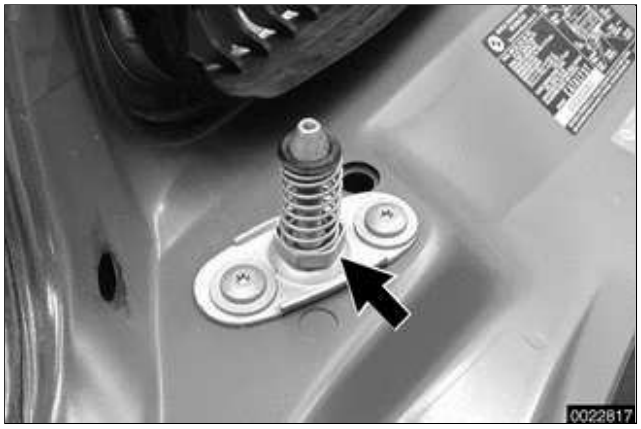
- Remove one screw from each side, clean and coat with

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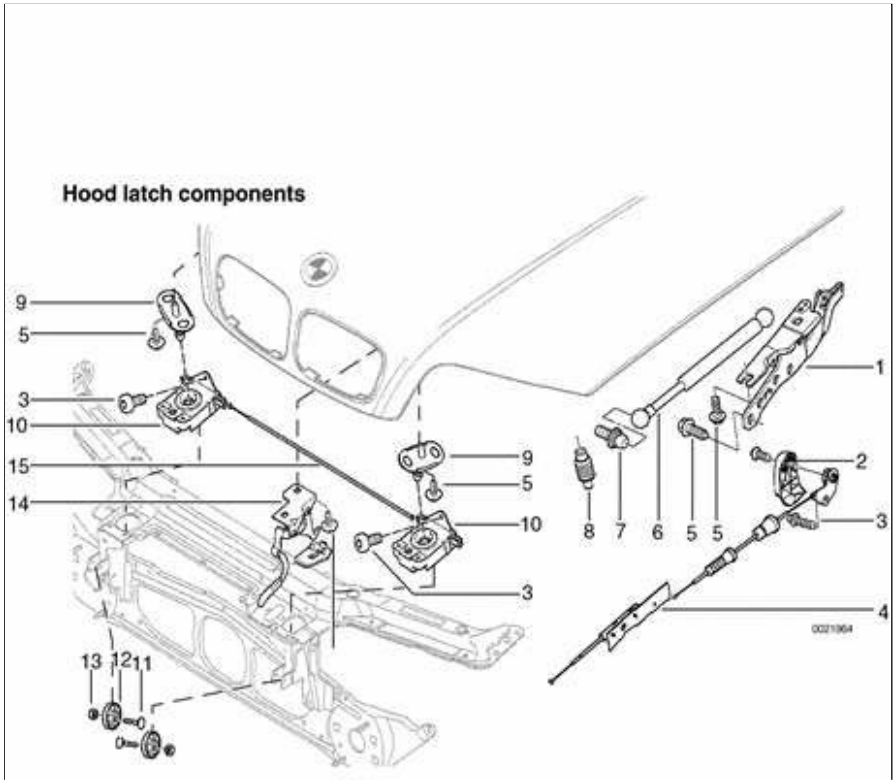
Loctite®270 or equivalent, and reinstall.

- Unscrew rubber stop buffers above headlight assemblies until they support hood when closed without movement.

- Test hood for correct closure and opening. If hood does not spring open, lengthen spring pins.



To lengthen spring pin, loosen locknut (**arrow**) with wrench inserted through spring, then turn pin counterclockwise.



Hood latch components, assembly

1 - Hood hinge

2 - Hood release lever

3 - Torx bolt

4 - Bowden cable, main

5 - Hex bolt

6 - Gas pressurized strut

7 - Ball pin

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8 - Stop buffer

9 - Spring pin

10 - Lower hood lock

11 - Saucer head screw

12 - Eccentric wheel

13 - Hex nut with plate

14 - Hood catch

15 - Bowden cable, center

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BMW > 328 > 2000 > 2.5L L6 (M52)

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Vehicle | Tech Info | Search

Enter Vehicle Indentification Number (VIN):

Decode

Choose vehicle:

BMW

328

2000

2.5L L6 (M52)

DTC Xpress ™

Choose Diagnostic Trouble Code (DTC):

First Select Make/Model/Yr/Eng

Reset | Go to Tech Info

411-1

General

This repair group covers front and rear door repair information. It includes removal and installation of interior front door trim panels, rear door trim panels of Sedans and Sport Wagons and rear trim panels of Coupes and Convertibles.

For information on the power door windows and door glass replacement, see ⇒ 512 Door Windows.

For information on the power door locking system, see ⇒ 515 Central Locking and Anti-theft.

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Doors

WARNING!

E46 cars are fitted with side-impact airbags in the front doors. When servicing doors on cars with front side-impact airbags, always disconnect the negative (-) battery terminal. See ⇒ 721 Airbag System (SRS) for cautions and procedures relating to the airbag system.

Front or rear door, removing and installing

- If working on a door with side-impact airbag, disconnect negative (-) battery cable.

CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.



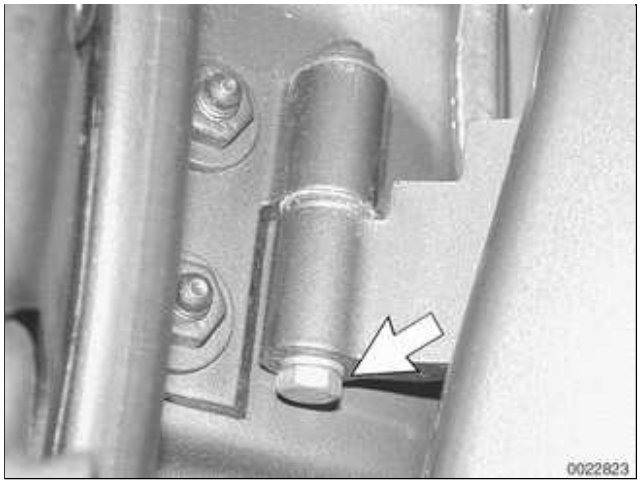
➢ Remove harness connector mounting bolt (arrow) at door pillar.



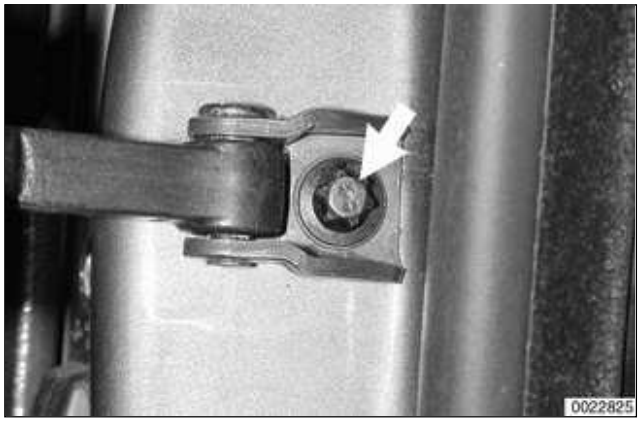
➢ Pull up on locking clip and separate connector.

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➢ With door fully open, remove pin bolts (**arrow**) from top and bottom door hinges.



➢ Remove door check mounting bolt (**arrow**).

- Remove door by lifting up off lower hinge halves.

CAUTION!

Be careful not to damage door or other painted body surfaces. Make sure no load is placed on wiring harness.

- Installation is reverse of removal. Keep in mind the following:

♦ On 4-door models, mount and align rear doors first, followed by the front doors.

♦ Align door so that panel gaps are equal on either side, as described later. If necessary, adjust door hinges as described later.

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- Adjust door striker so that trailing edge of front door is slightly higher (1 mm / 0.04 in.) than leading edge of rear door. See ⇒ 515 Central Locking and Anti-theft.

- Repair any paint damage and paint any exposed metal.

CAUTION!

In 2-door models, removing and installing the door may upset the adjustment and alignment of the window. Window adjustment, as described in ⇒ 512 Door Windows, must be carried out after installation to prevent damaging the glass.

Door adjustment	
Front fender to front door gap approx.	4.25 mm ± 0.25 mm (0.17 ± 0.01 in.)
Front door to rear door gap approx.	4.5 mm ± 0.25 mm (0.18 ± 0.01 in.)
Rear door to rear fender approx.	4.0 mm ± 0.25 mm (0.16 ± 0.01 in.)
Permissible deviation from parallel	1.0 mm (0.04 in.)

Tightening torque	
Door hinge to door	20 Nm (15 ft-lb)

Door check, replacing

WARNING!

E46 cars are fitted with side-impact

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airbags in the front doors and as an option on 4-door models. When servicing doors on cars with front side-impact airbags, always disconnect the negative (-) battery terminal. See ⇒ 721 Airbag System (SRS) for cautions and procedures relating to the airbag system.

- Close door window completely.

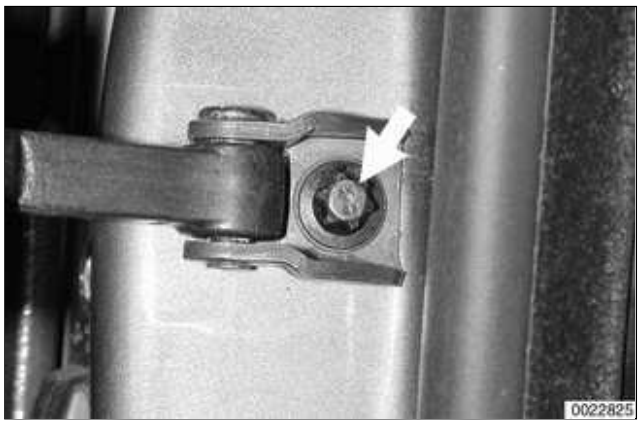
- Disconnect negative (-) battery cable.

CAUTION!

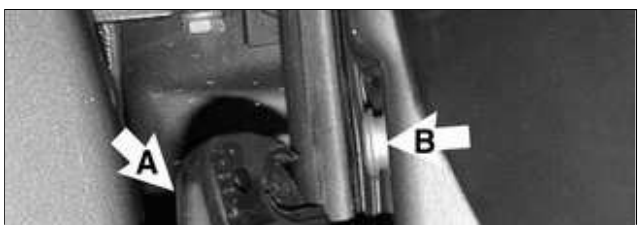
Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

- Remove interior door panel as described later.

- Where applicable, remove side-impact airbag from door. See ⇒ 721 Airbag System (SRS) Remove door vapor barrier.



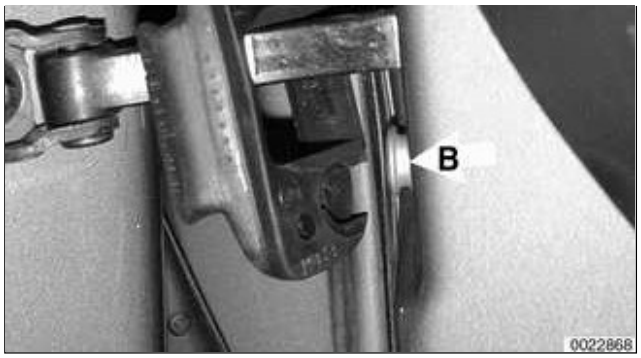
➢ Remove door check mounting bolt (**arrow**).



➢ Remove rubber cover (**A**) and bolts (**B**) from door check lockplate on door.

- Remove door check from inside door.

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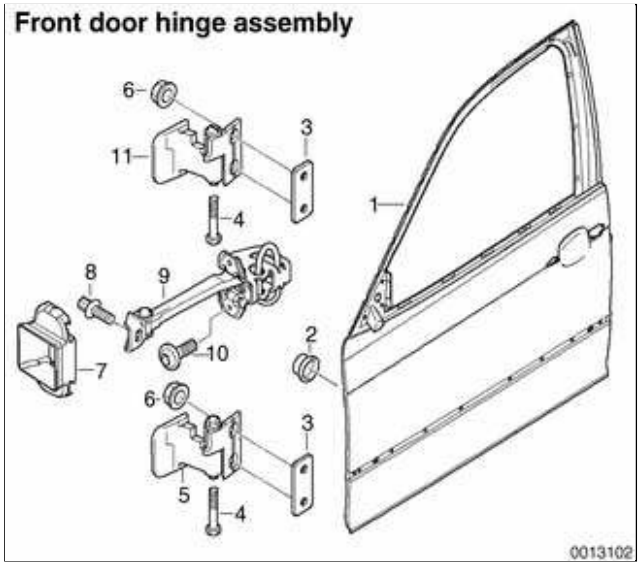
- Installation is reverse of removal.

- Lubricate door check before installing.

- Use new mounting bolts when reinstalling the side-impact airbag to the door (where applicable).

Tightening torque	
Door check to door	24 Nm (16 ft-lb)

Door hinge adjustment



If the installed door is uneven or out of parallel, shims can be used to correct its position. The shims are placed behind the hinge plate and are available in two different thicknesses (0.5 mm and 1.0 mm).

1 - Door

2 - Protective cap

3 - Spacer plate

4 - Hex bolt

5 - Lower door hinge

6 - Hex nut with plate

7 - Door check gasket

8 - Torx bolt with washer

9 - Door check

10 - Torx bolt

11 - Upper door hinge

Front and rear doors are similar.

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Tightening torques	
Door hinge to door	20 Nm (15 ft-lb)

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Door Panels

WARNING!

E46 cars are fitted with side-impact airbags in the front doors and as an option on 4-door models. When servicing doors on cars with front side-impact airbags, always disconnect the negative (-) battery terminal. See ⇒ 721 Airbag System (SRS) for cautions and procedures relating to the airbag system.

Door trim panel, removing and installing

- Disconnect negative (-) battery cable.

CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.



- Gently pry off door panel trim strip.

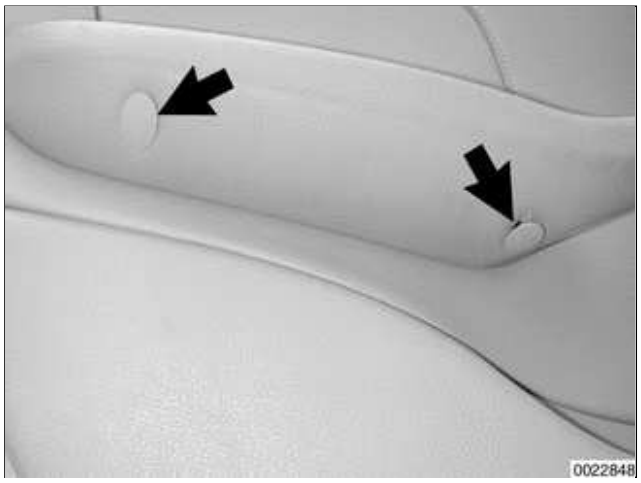


- Carefully pry out mirror adjustment switch and disconnect harness connector from switch.

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- For rear trim panel: Pry out window switch at top of armrest.



- Pry off concealing plugs (**arrows**) from under armrest.



- Remove door panel retaining screws (**arrows**).



- Unclip door panel from door perimeter using a trim panel tool. Pull panel retaining clips off one at a time.

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- Pry off inside door release Bowden cable at end of clip (**arrow**).



- Pull off panel: Detach cable from interior door release lever.

  - Disconnect radio speaker harness connector.

  - Installation is reverse of removal, noting the following:

    - Replace any damaged plastic parts or clips.

    - Renew vapor barrier if it is damaged.

    - Use new mounting bolts when reinstalling side-impact airbag to door.

    - When installing door panel, align metal retainers on window sill with openings on top of door panel.

    - Check door-lock mechanism and window for ease of movement.

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Rear side trim panel, removing and installing (Coupe model)

- Remove rear seat cushion. Remove rear backrest side section. See ⇒ 520 Seats.



Using a trim tool, gently pry up door threshold trim. Starting at A-pillar, press radius of trim downwards while sliding trim forward off trim clips. Remove clips from body using pliers. Save for installation.

- Remove trim plugs on armrest. Remove panel mounting screws.
- Gently pry off panel using trim tool.
- Disconnect electrical harness connectors as necessary. Remove side panel by lifting up and toward interior.
- Installation is reverse of removal. Replace any damaged plastic parts or clips.

Rear side trim panels, removing and installing (Convertible model)

- Remove rear seat cushion. Remove rear backrest side section. See ⇒ 520 Seats.
- Lower side windows; open convertible roof.
- Remove side panel insert:

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- Remove trim plugs on side panel armrest.
- Remove insert panel retaining screws.
- Gently pry side panel insert from upper and lower side panels.
- Disconnect electrical harness connectors as necessary.

- Remove upper side trim panel:

- Remove trim retaining rivet from upper corner at door. Pull trim cap upwards from weather-stripping.
- Unhook spring from linkage at convertible top.
- Remove retaining screws from lower edge of upper panel.
- Gently pull weather-stripping from rear edge of upper panel as necessary.
- Pry up on upper panel and remove.

- Remove lower side trim panel:

- Gently pry lower side trim panel from body.
- Make sure to feed lower front corner of side trim panel out from door threshold trim.

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- Installation is reverse of removal. Make sure to replace any broken trim clips.

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General

This repair group covers trunk lid and tailgate removal and installation. Also included here are replacement procedures for the gas-charged support struts that hold the trunk lid or tailgate in the open position.

Note:

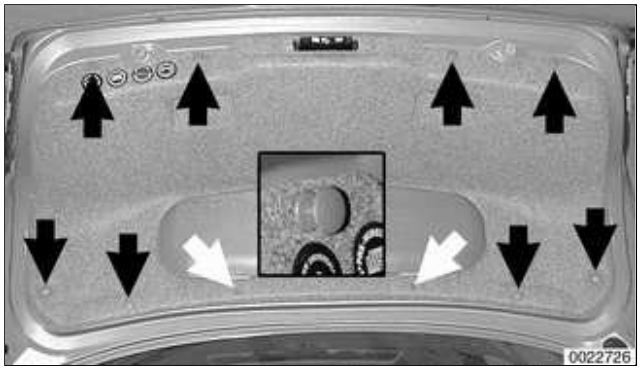
The body is painted at the factory after assembly. Realignment of body panels may expose unpainted metal. Paint all exposed metal once the work is complete.

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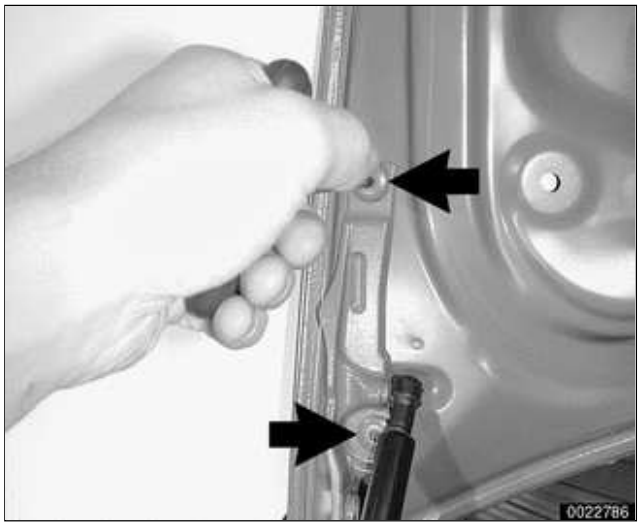
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Trunk Lid

Trunk lid, removing and installing



- Raise trunk lid.
  - Open tool kit and remove screws attaching tool kit to trunk lid (**white arrows**).
  - Unclip retaining strap at trunk lid and remove tool kit.
  - Remove insulating liner expansion rivets (**black arrows**), by prying upper portion out (**inset**).
  - Remove trunk liner.
  - Disconnect electrical harness connectors from components and remove wiring harness from trunk lid.



- While supporting trunk lid, loosen top hinge screws (**arrows**) and remove lower screws from left and right sides.

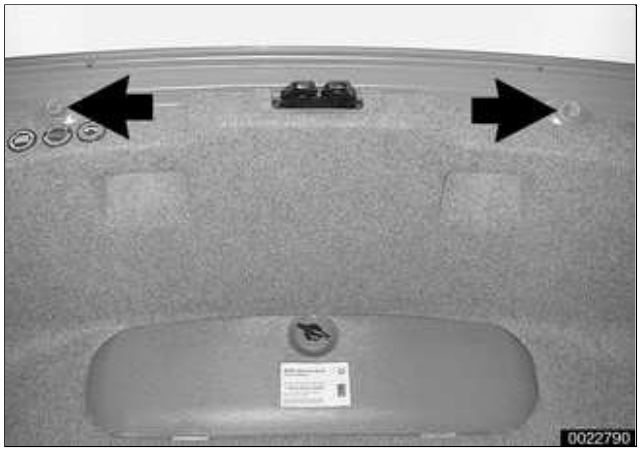
Note:

Before loosening hinge bolts, mark hinge and hinge bolt locations for reinstallation.

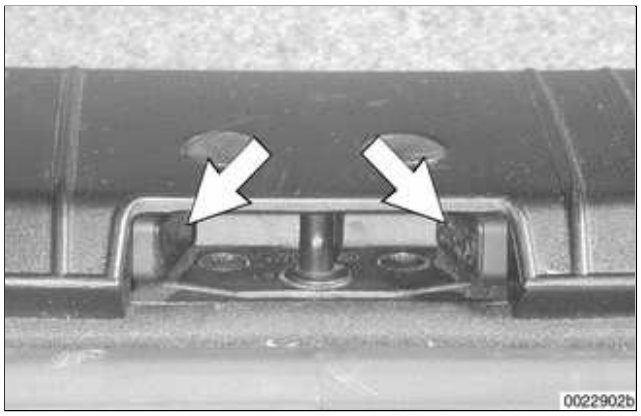
  - Installation is reverse of removal. If necessary, align trunk lid to body as described next.

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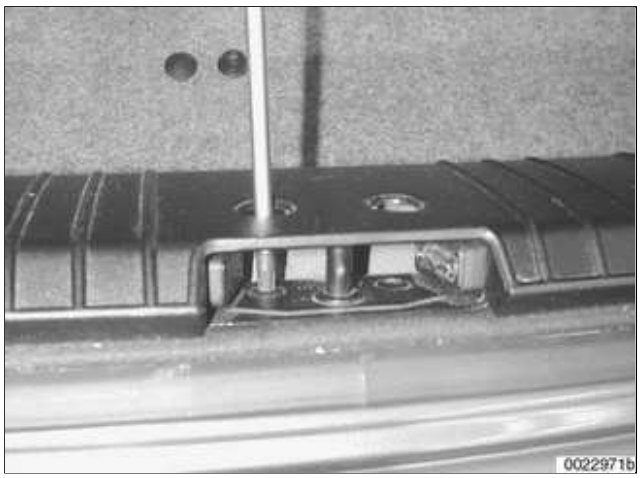
Trunk lid, aligning



- Raise trunk lid. Working at lower corners of trunk lid, unscrew out rubber buffers (**arrows**) on left and right sides.



- Inspect pads (**arrows**) on each side of latch assembly for damage or wear and replace if necessary.



- Remove protective caps at trunk lower trim panel and loosen screws of trunk lock until it can be moved.



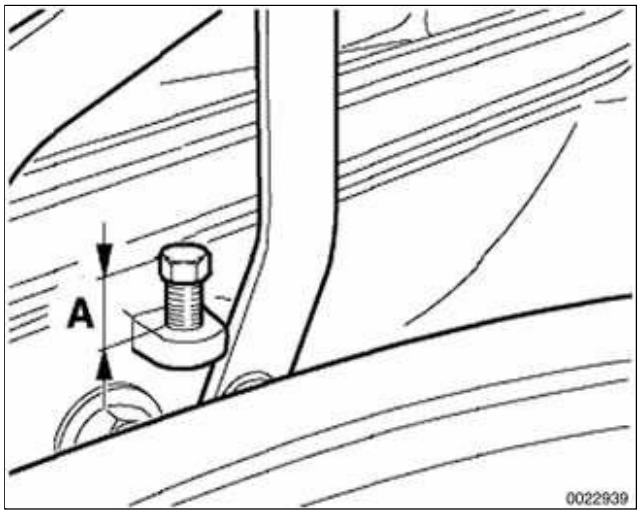
- Check stop screw at trunk lid hinge:
  - If stop screw has a round plastic head, cut or grind off bolt head. If head is removed, replace round headed stop screw with flat head

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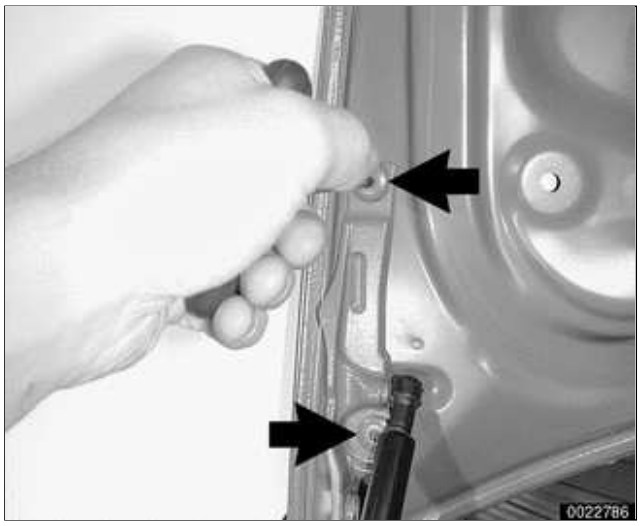


screw and protective cap.

- If stop screw has removable protective cap (**arrow**) remove protective cap from stop screw.



- Adjust stop screw so that head is set to (**A**) 10 mm (0.40 in.) above bore height.



- To adjust trunk lid gap at rear fender:

  - Loosen bolts retaining trunk hinge to trunk lid (**arrows**) until trunk lid is just able to move.

  - If range of adjustment is insufficient, loosen lower bolts on trunk hinge

  - Once trunk lid gap is within specification, tighten trunk hinge to lid bolts.

Trunk lid gap specification	
Trunk lid gap at rear fender	4.25 ± 0.75 mm (0.17 ± 0.03 in.)

CAUTION!

Before closing truck lid, be sure that trunk lid and body are not damaged.

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To adjust trunk lid at lock:

- Remove protective caps from trim panel and loosen screws retaining latch assembly until it can just be moved.
- Inspect pads (**arrows**) on each side of latch assembly for damage or wear and replace if necessary.
- Insert key in trunk lock, and hold key in unlock position to prevent lock from closing. Close trunk lid to center latch assembly.
- Open trunk lid and tighten screws retaining latch. Replace protective caps on trim panel.
- Check adjustment of trunk lid and lock, repeat adjustment process if necessary.

- Screw in trunk lid detent buffers until left and right sides of lid rest on buffers with trunk lid closed.

CAUTION!

Top surface of trunk lid must not protrude above top lip of fenders or height adjustment can be distorted.

- Gently twist detent buffer ejector clockwise with screwdriver to unlock buffer and release ejector.

- To adjust stop screw at trunk lid hinge:

- Working at trunk lid hinge, set stop screw to a height of 10 mm (0.40 in.). Place a strip of paper on

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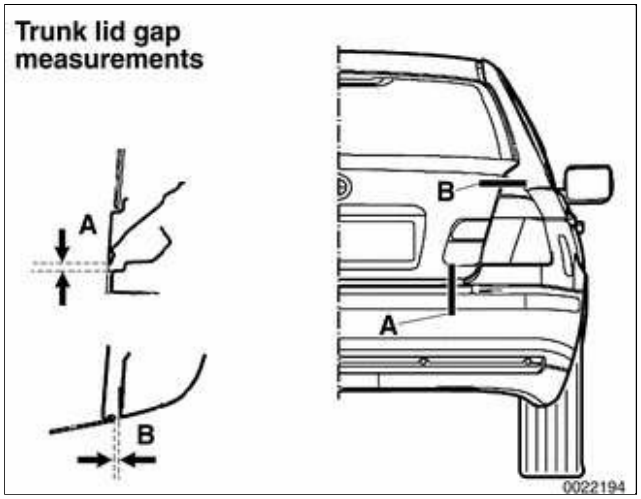
top of stop screw, and gently close trunk lid.

- Adjust height of stop screw until paper strip can be removed with slight resistance. Once stop screw height has been adjusted, lower adjusted height of stop screw 2.5 mm (0.1 in.) to accommodate for stop screw protective cap.

- Fit protective cap on stop screw. Check that trunk lid is in correct position, adjust if necessary.

CAUTION!

Excessive force should not be needed to close trunk lid.



➢ Set gap measurements as listed below.

Trunk position gap adjustment	
Trunk lid / trunk panel (**A**)	5 ± 1.5 mm (0.2 ± 0.06 in.)
Trunk lid / rear fender (**B**)	4.25 ± 0.75 mm (0.17 ± 0.03 in.)

Trunk lid support strut, removing and installing

WARNING!

Make sure to support trunk lid before removing strut.



➢ Open trunk lid and support in open position. Remove spring clips (**arrows**) from support strut ends.

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- Remove strut from trunk lid.
- Installation is reverse of removal. Replace retaining clips damaged during removal.

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Tailgate (Sport wagon models)

Tailgate, removing and installing

- Raise complete tailgate. Remove interior trim and disconnect wiring harnesses.
- Disconnect left and right support struts as detailed below.
- While supporting tailgate, remove hinge bolts for tailgate on left and right sides.

CAUTION!

The tailgate is very heavy. Use assistance to properly support both sides prior to removal of the hinge bolts.

- Installation is the reverse of removal. Follow alignment procedures as shown below.

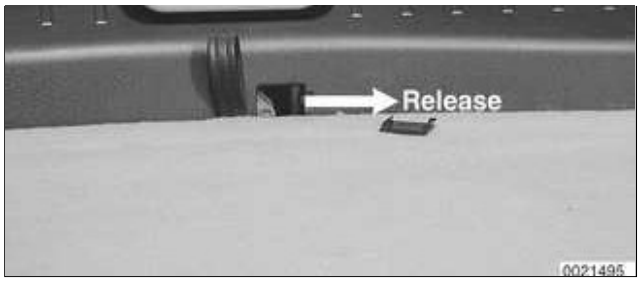
Tightening torques	
Tailgate to tailgate hinge (M8)	20 Nm (15 ft-lb)

Tailgate, emergency release



The tailgate of the E46 Sport Wagon has no key cylinder. An emergency release mechanism is incorporated into the tailgate latch. This allows mechanical opening of the latch in

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case of an electrical failure. The release is located in the rear cargo area, along the lower edge of the rear apron behind a small access cover.

- Working inside car, at base of tailgate:

♦ Remove release cover.

♦ Push lever toward driver's side (**arrow**).

Tailgate support strut, removing and installing



➢ Open tailgate fully. Support tailgate and remove retaining clips (**arrow**) on upper end of pressurized lifting struts.

CAUTION!

The tailgate is very heavy, and will close without both pressurized lifting struts installed. Properly support tailgate prior to removal of the lifting struts.

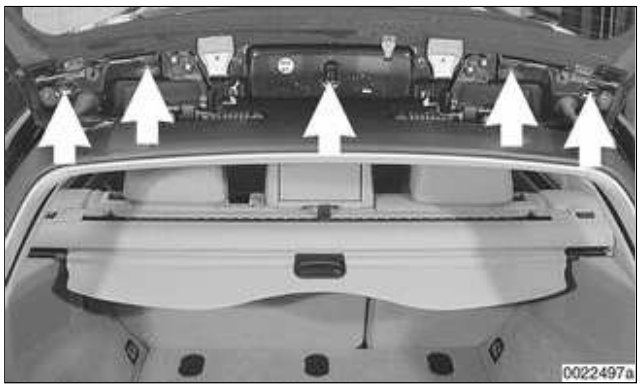
- Pull struts off tailgate.

- Remove spring retainer from lower end of support strut and remove strut.

- Installation is reverse of removal. Replace retaining clips if damaged during removal.

Rear spoiler, removing and installing

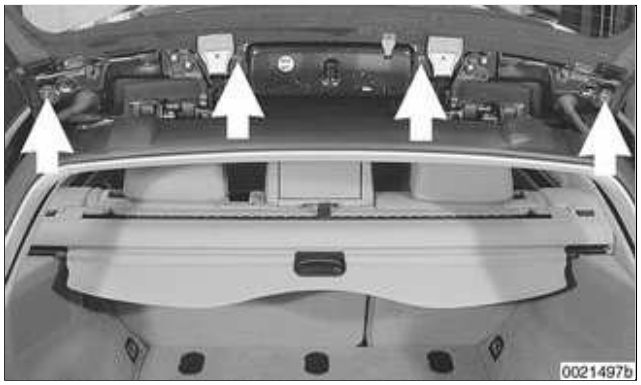
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- Raise rear window. Remove inner trim from glass panel by releasing clips on trim from retainers (**arrows**). For clarity, trim is removed in photo.

Note:

Use two plastic prying wedge tools to release each pin retaining trim.



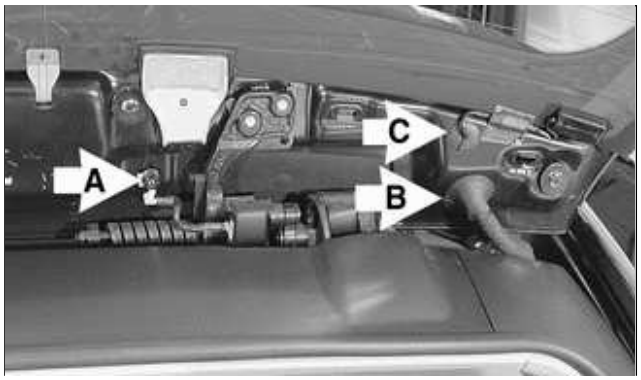
- Release spoiler mounting bolts (**arrows**). Disconnect wiring to brake light and AM radio antenna and release washer hose. Remove spoiler. (Window shown in place).

  - Installation is the reverse of removal. Replace any waterproofing sheeting disturbed during removal. Adjust spoiler as shown later in this section.

Rear window, removing and installing

- Remove rear spoiler as detailed above.

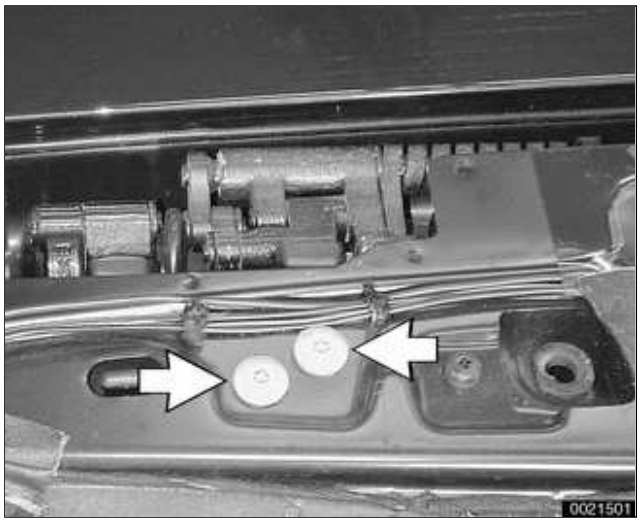
- Working at top outside of window, remove waterproofing sheeting over antenna amplifier and disconnect wiring connections. Release tape retaining wiring harnesses.



- Release grounds (**A**) and rubber grommets (**B**, **C**) at both hinges.

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- Support window in open position. Working at top of tailgate, loosen screws (**arrows**) on each window hinge. Note positions of any spacers for reinstallation.

CAUTION!

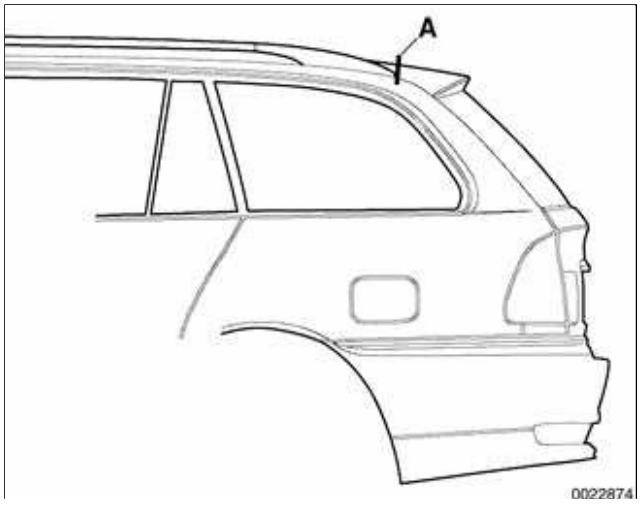
Rear window is heavy. Use a second person to support window prior to releasing from hinges.

- Remove screws and lift off window, taking care to release wiring to rear defroster/antenna.

- Installation is the reverse of removal. Replace waterproofing sheeting where disturbed. Align window as described below.

Tightening torques	
Hatchback window to hinge (M8)	16 Nm (12 ft-lb)

Alignment of spoiler, rear window and tailgate



- Alignment procedures involve adjusting tailgate, window, and spoiler to have equal space between left and right sides and to be flush with body. Measurement locations and specific dimensions are shown.

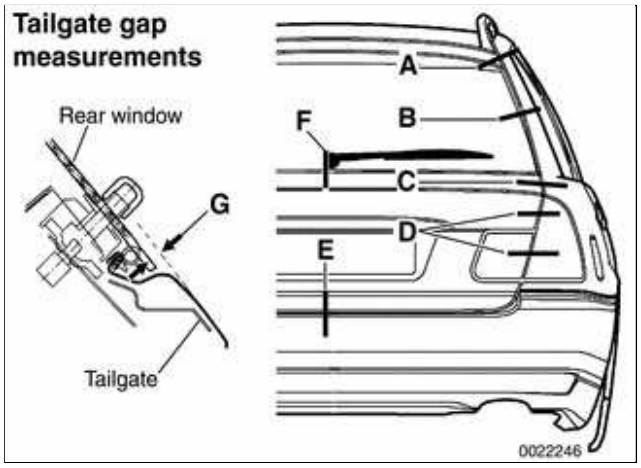
- If alignment has been disturbed during repair adjust fit of tailgate to body. Then adjust fit of rear window to hatch.

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- Clearance of the rear window is adjusted by adding or removing shims between hinge bracket and rear window (maximum of three shims).

- Adjust spoiler gap to body last. Height of spoiler is set by alignment of the rear hatch. Gap of spoiler to body is set by adjusting spoiler attachment bolts.

Seam clearance specification	
Rear spoiler to roof (A)	4.25 - 5 mm (0.167 - 0.197 in.)
Max. deviation from parallel	0.5 mm (0.019 in.)

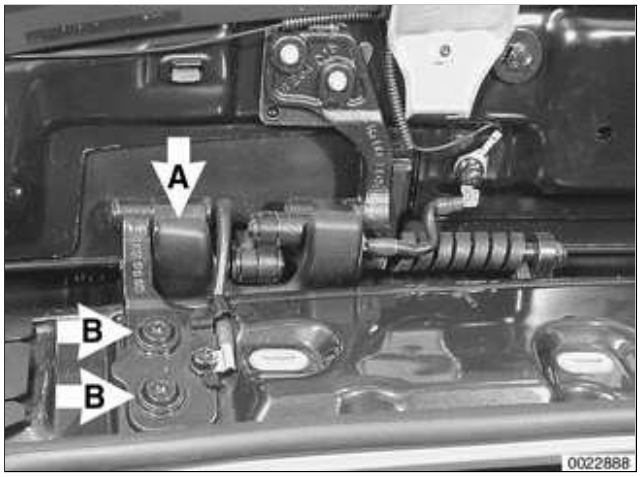


Lateral and vertical alignment is adjusted using hinge bolts for window and tailgate. Fine adjustment of the tailgate to the body is made using rubber stop buffers and latch assembly.

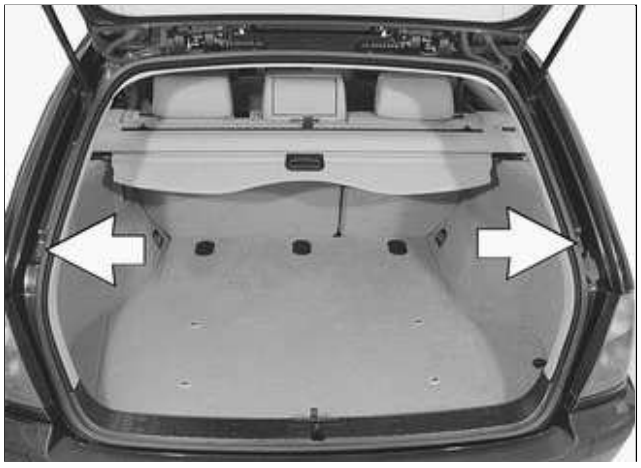
Tailgate and rear window position gap adjustment	
Rear spoiler / side panel (**A**)	3.75 ± 1.3 mm (0.15 ± 0.05 in.)
Rear window / side panel (**B**)	3.5 ± 1.4 mm (0.14 ± 0.06 in.)
Tailgate / side panel (**C**)	3.6 ± 0.75 mm (0.14 ± 0.03 in.)
Tailgate / side panel (height) (**D**)	flush to 2 mm (0.08 in.) lower
Tailgate light / corner light (**D**)	4.25 ± 0.75 mm (0.17 ± 0.03 in.)
Tailgate / rear bumper (**E**)	5 ± 1 mm (0.2 ± 0.04 in.)

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Tailgate and rear window position gap adjustment	
Rear window / tailgate (**F**)	4 ± 1 mm (0.16 ± 0.04 in.)
Rear window / tailgate (**G**)	5.4 ± 1 mm (0.21 ± 0.04 in.)



- To adjust fit of tailgate to body:
  - Close tailgate and open rear window.
  - Tailgate hinge bolts (**A**, behind trim) should be centered both vertically and horizontally within their adjustment range. When centered, tighten bolts.
  - Loosen screws (**B**) on left and right to adjust horizontal location (gap on left and right). When gap is correct, tighten screws.
  - To prevent damage or poor operation adjustments must be made to the rear window f the vertical adjustment of the tailgate is changed.
  - Window hinge must be parallel to the tailgate hinge.

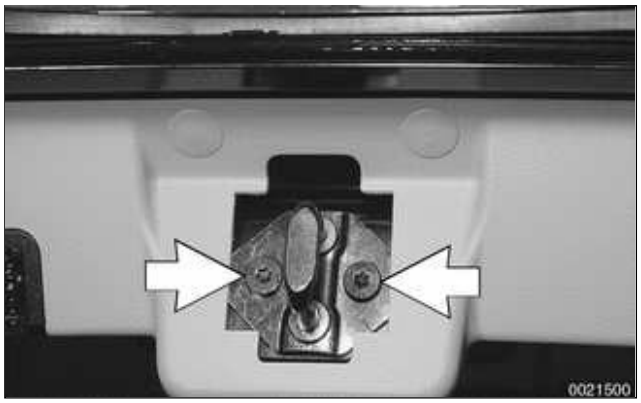


- Stop buffers (**arrows**) are adjustable and set height between tailgate and body at sides.
  - To adjust buffers, remove inner trim panel and loosen lock nut.
  - Initially adjust buffers to just contact tailgate when closed, then tighten buffers one turn. Tighten lock nut.

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Tightening torques	
Lock nut for stop buffer (M8)	15 Nm (11 ft-lb)



- Loosen screws (**arrows**) and reposition rear latch to further adjust gap between tailgate and body at sides, and to assure smooth operation.

  - To adjust striker position:

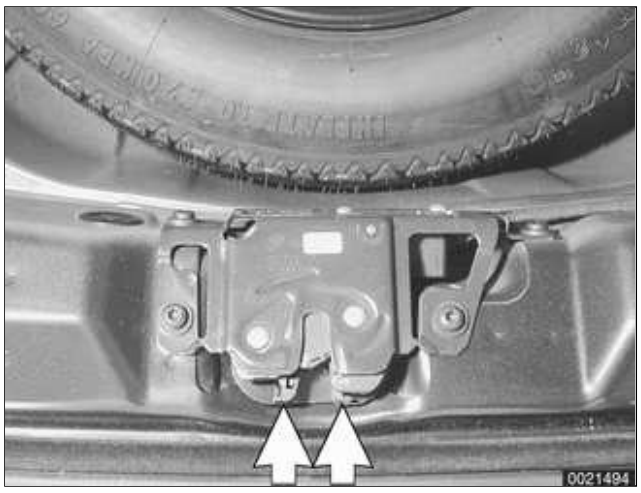
    - Close tailgate slowly, allowing striker to center itself on lock.

    - Striker must not touch lock housing.

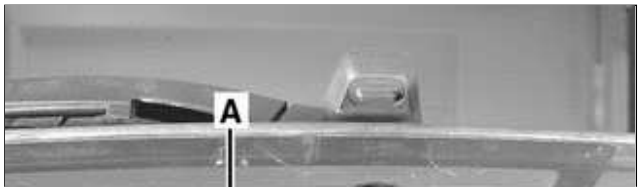
    - Tighten striker mounting bolts, then check tailgate to body gaps as shown below.

Note:

Do not lubricate lock or lock striker with grease.

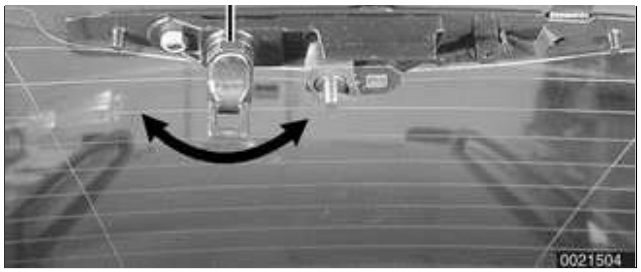


- Inspect plastic guides (**arrows**) on lock assembly for damage or wear, and replace if necessary. Trim panel is removed for clarity.

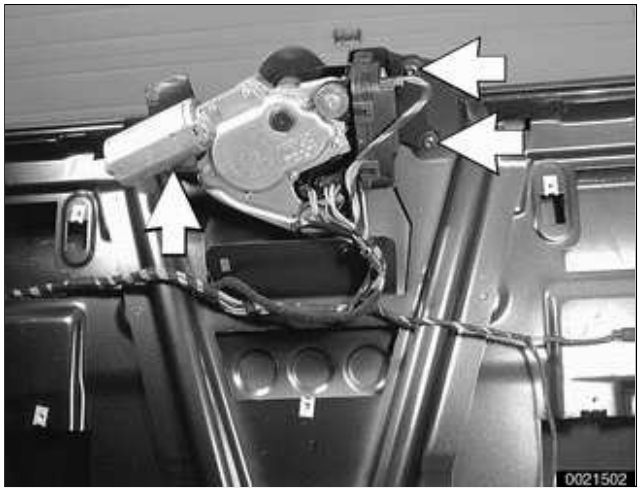


- The rear window lock striker height is adjusted by loosening lock nut **A**, then turning striker in or out.

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- Retighten lock nut when window latch operates smoothly.



- To adjust rear window lock position, initially loosen lock mounting bolts (**arrows**).
  - Close window slowly, allowing lock to center itself on striker.
  - Tighten mounting bolts, then check rear window to body gaps as shown above.

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510-1

General

This repair group includes repair information for the outside rear view mirror, front and rear bumpers, and the easily removable exterior trim parts.

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Outside Rear View Mirrors

Many of the mirror components are separately available from an authorized BMW dealer, including the glass and outside plastic housing.

Outside mirror glass, replacing

CAUTION!

Mirror should be at or above room temperature before removal. Otherwise, small plastic parts or glass may break.

- Insert thin pry tool (wooden or tape-wrapped screwdriver) between bottom mirror edge and mirror housing and carefully pry out mirror glass from housing.



Prying mirror glass out of mirror housing. Note screwdriver shaft wrapped with tape.

- Heated mirror: remove heating element harness connectors from back of mirror glass.

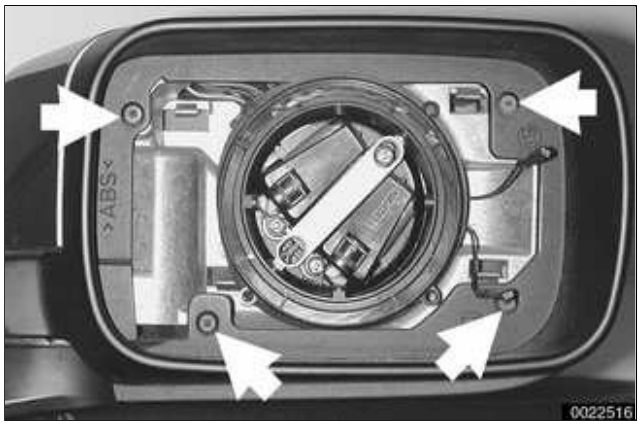
- Install new glass into position by pressing firmly until it snaps into place.

Outside mirror housing, removing and installing

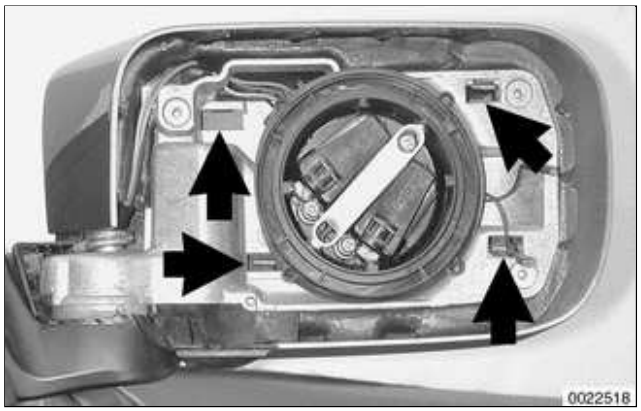
- Remove mirror glass as described

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above.



- Remove housing retaining screws (**arrows**) and lift off rear housing.



- Tilt mirror housing forward and compress plastic retainers (**arrows**) and lift off front housing.

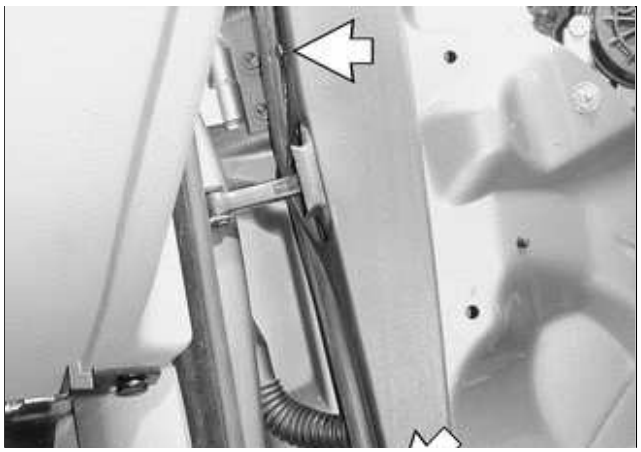
Note:

The front mirror housing is retained by either three or four clips, depending on model.

- Installation is reverse of removal. Check mirror function before installing covering parts.

Outside mirror, removing and installing

- Remove front door panel trim. See ⇒ 411 Doors.



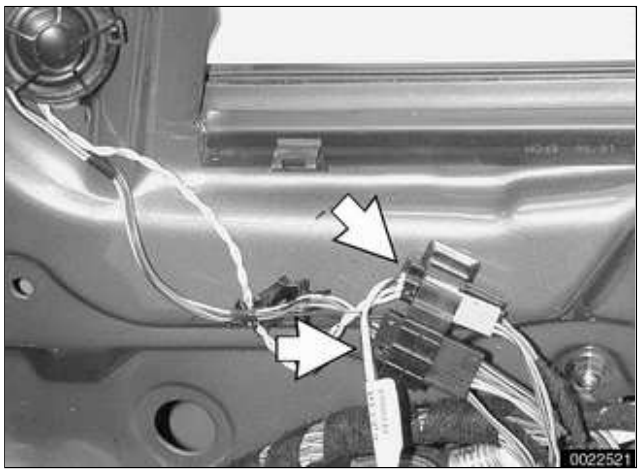
- Working at door hinge, remove door inner trim panel retaining pins (**arrows**).

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- Gently pry off door inner trim panel from retaining clips (**arrows**).



- Disconnect electrical harness connectors for window anti-trapping protection and speaker (**arrows**), if equipped.



- Remove inner door panel trim. On sedan models, trim strip extends around window to door latch area.



- Support mirror and speaker (if equipped) and remove mounting bolts (**arrows**). Lift speaker and mirror off door and feed out cable.

  - Installation is reverse of removal.

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Check mirror function before installing covering parts.

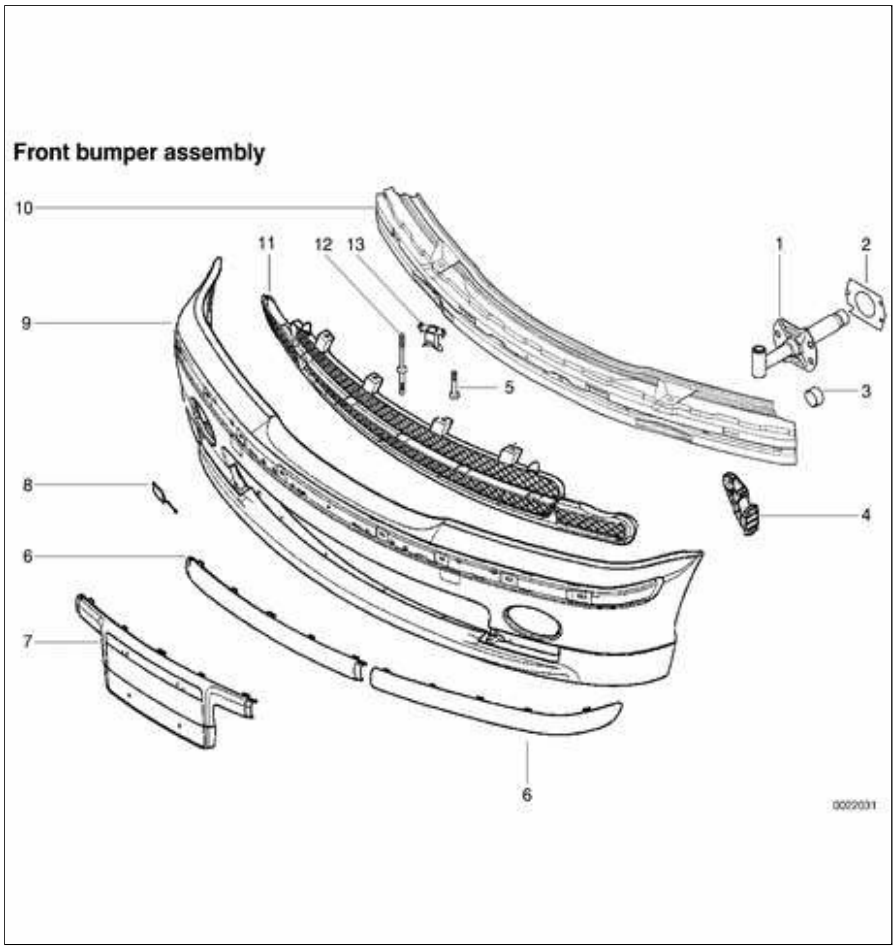
Tightening torque	
Outside mirror to door (M6)	6 Nm (4.5 ft-lb)

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510-3

Bumpers



Front bumper assembly

1 - **Impact absorber**

2 - **Spacer**

3 - **Cap**

4 - **Support bracket**

5 - **Bumper bracket bolt**

♦ tighten to 41 Nm (30 ft-lb)

6 - **Protective rubber strip**

7 - **License plate bracket**

8 - **Tow eye cover**

9 - **Bumper cover**

10 - **Carrier bumper**

11 - **Grill**

12 - **ASA bolt**

♦ tighten to 41 Nm (30 ft-lb)

13 - **Mounting sleeve**

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Front bumper, removing and installing

- Raise and properly support vehicle.

WARNING!

Make sure that the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.

- Working underneath car, remove screws from left and right side corner trim, then remove trim.



➢ Remove bumper cover retaining screws (**arrows**).



➢ Remove screws (**arrows**) retaining bumper bar to impact absorbers on left and right sides.

- Slide bumper assembly out a few inches and disconnect the following connections, if applicable:

♦ Electrical harness connectors at fog light assemblies.

♦ Electrical harness connector at signal horn.

♦ Electrical harness connectors at

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outside temperature sensor at rear of left side of bumper and temperature switch at rear of right side of bumper.

- Slide bumper straight off side brackets.

- Installation is reverse of removal, noting the following:

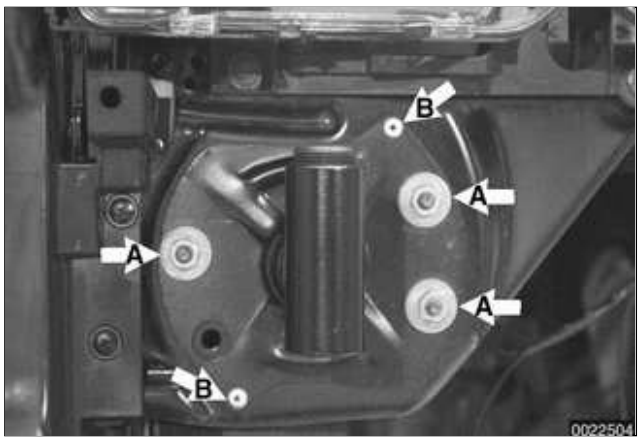
♦ Slide side brackets on bumper and body carefully together.

♦ Make sure gap between body and bumper is set to specifications, adjust height as necessary. See ⇒ Bumper height, adjusting.

Tightening torque	
Bumper to impact absorber (M10)	41 Nm (30 ft-lb)

Front bumper impact absorber, replacing

The bumper mounting bracket and impact absorber mounting hardware are accessible with the front bumper removed, as described above.

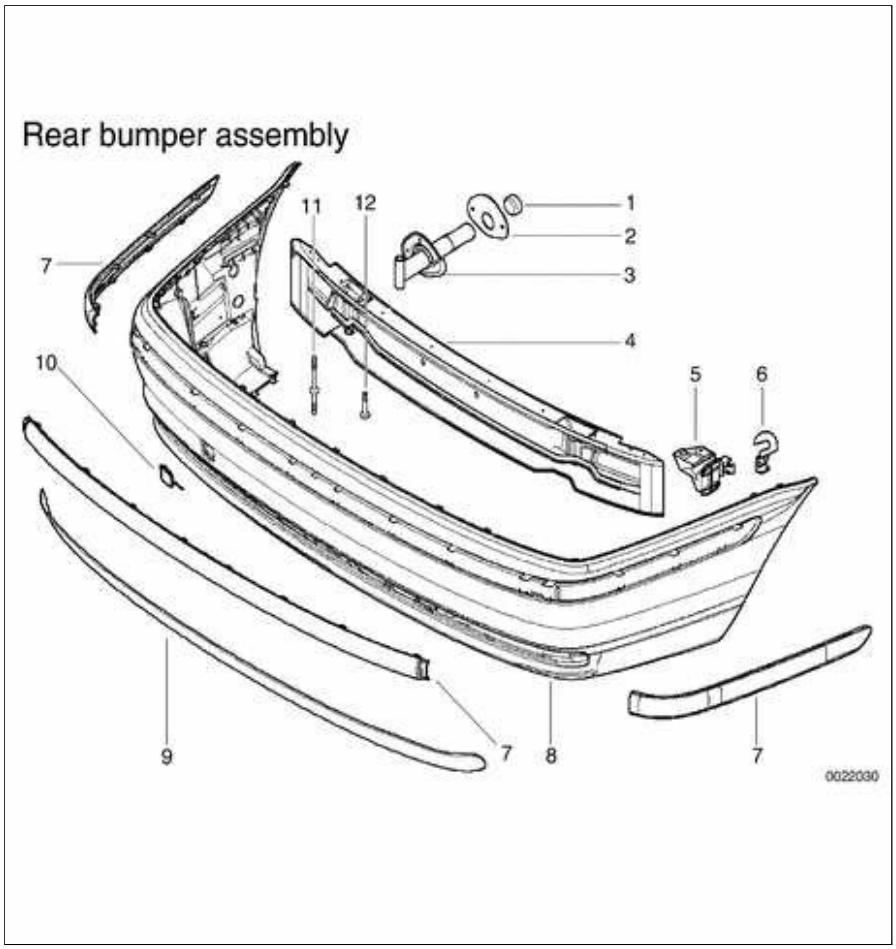


➢ Front bumper impact absorber mounting nuts (**A**) and drill out pop rivets (**B**).

Note:

Install the bumper bracket bolt with thread locking compound such as Loctite®270 or equivalent.

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Rear bumper assembly

1 - **Cap**

2 - **Casket**

3 - **Impact absorber**

4 - **Carrier bumper**

5 - **Support bracket**

6 - **Bracket**

7 - **Protective rubber strip**

8 - **Bumper cover**

9 - **Lower part cover**

10 - **Tow eye cover**

11 - **ASA bolt**

- tighten to 41 Nm (30 ft-lb)

12 - **Bumper bracket bolt**

- tighten to 41 Nm (30 ft-lb)

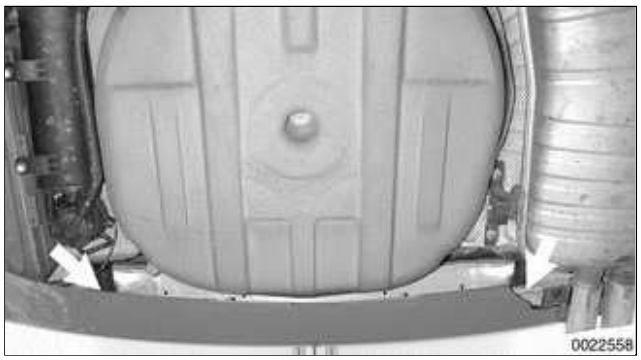
Rear bumper, removing and installing

- Raise and properly support vehicle.

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WARNING!

Make sure that the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.



- Remove bumper support bolts using special BMW tool 00 2 150.



- Remove nut from bumper cover retaining bracket at rear of left and right rear wheel wells.
  - Remove expansion pin from lower rear wheel well. Remove wheel well liner from left and right sides.



- Release bumper bar retaining bolt (**arrow**) from impact absorber using BMW special tool 00 2 150, or similar Torx head socket.

CAUTION!

Protect possible contact areas to prevent damage or scratches to vehicle bumper and paint.

  - Installation is reverse of removal.

Note:

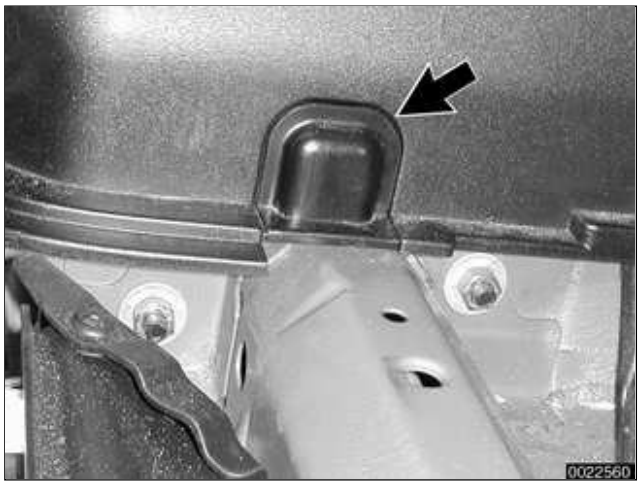
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Install the bumper bracket bolt with thread locking compound such as Loctite®270 or equivalent.

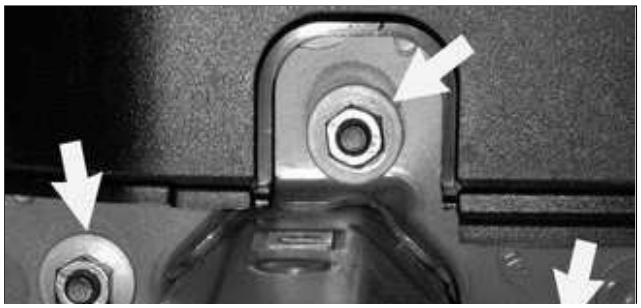
Tightening torque	
Bumper bracket to impact absorber (M10 bolt)	41 Nm (30 ft-lb)

Rear bumper impact absorber, replacing

- Remove bumper as described above.
- Remove luggage compartment floor covering.
- Remove battery and battery tray on right side and trunk trim panel on left side.



➢ Remove trim caps (**arrow**) at rear of frame rails.



➢ Release nuts on inside on vehicle trunk and remove absorber.

- Installation is reverse of removal. Replace body seal and protective cap if necessary. Make sure to check bumper height. See ⇒

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Bumper height, adjusting.

Tightening torques	
Bumper bracket to impact absorber (M10 bolt)	41 Nm (30 ft-lb)
Impact absorber to chassis (M8 nut)	22 Nm (16 ft-lb)

Bumper height, adjusting

The adjustment procedure applies to either front or rear bumpers. A 14 mm allen socket is needed to make adjustments.

- Raise and properly support vehicle.

WARNING!

Make sure that the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.

- Front bumper:

♦ Remove bumper as described earlier.

♦ Remove bumper bracket bolt.

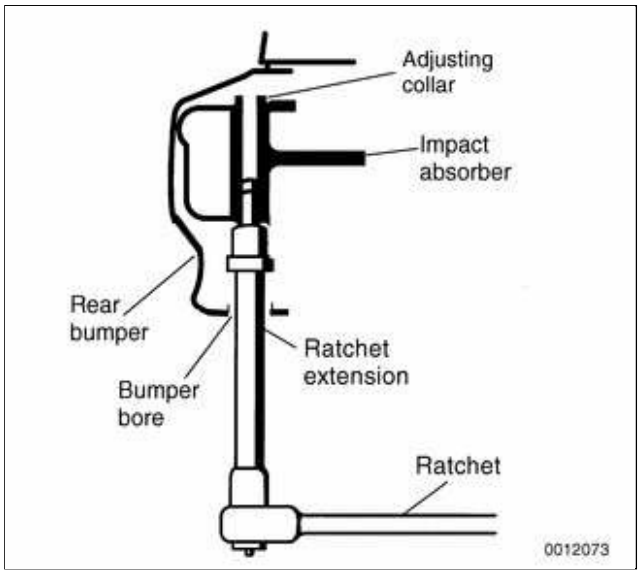
- Rear bumper:

♦ Remove lower bumper panel as described in ⇒ Rear bumper, removing and installing.

♦ Remove bumper bracket mounting

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bolt at impact absorber.



- Using a 12-inch extension and a 14 mm Allen socket, turn adjusting collar clockwise or counterclockwise as needed to change height of adjusting collar.

- Reinstall mounting bolts and check bumper height. Refit front bumper.

Tightening torques	
Front bumper to bumper bracket (M8 nut)	22 Nm (16 ft-lb)
Front bumper bracket to impact absorber (M10 bolt)	55 Nm (41 ft-lb)
Rear bumper bracket to impact absorber (M10 bolt)	42 Nm (31 ft-lb)

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Exterior Trim

Exterior trim is retained to the body by plastic clips and fasteners that may be damaged during removal. Be sure to have necessary fasteners on hand when reinstalling exterior trim pieces.

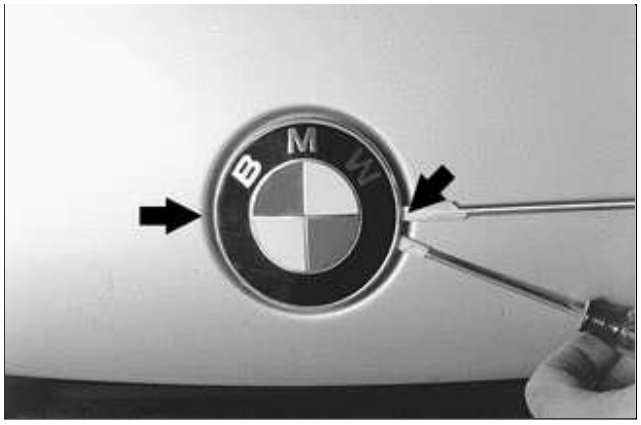
BMW emblem, removing and installing

The procedure given below applies to both front and rear emblems.

- Wrap end of a screwdriver with tape.

CAUTION!

Protect hood paint by covering area around emblem with tape.



➢ Carefully pry out emblem. Pry up emblem carefully on either side (**arrows**). Note tape on screwdriver tips.

- Installation is reverse of removal.

♦ Replace plastic inserts in body if damaged.

♦ If emblem fits loosely, use a small amount of body molding tape or adhesive on rear of emblem before installing.

Body side molding, replacing

To remove body side moldings, carefully pry moldings straight off.

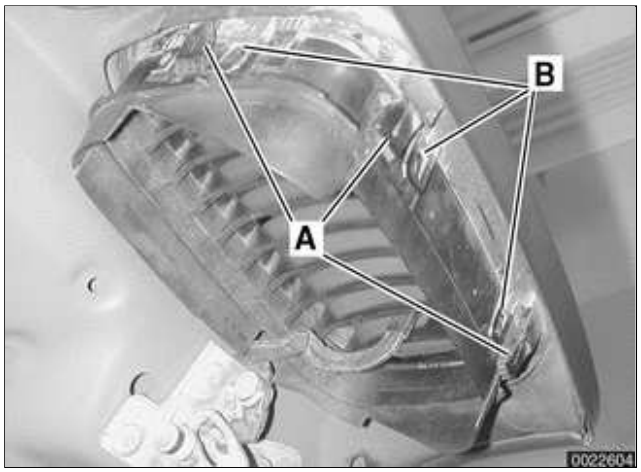
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- Installation is reverse of removal. Replace any clips or clip covering boots damaged during removal.

Radiator grill, removing and installing

- Open hood.



- Gently pry out tab on left or right side of grill trim ring (**A**), as well as tabs on bottom.

- Feed grill out through opening. Be careful of hood lever on driver's side grill.

- Once grill is removed, pry remaining tabs (**B**) to separate inner grill from chrome trim ring.

- Before installation, assemble chrome trim ring and grill insert securely. Replace components if tabs or catches are broken or missing.



- To install align grill and trim ring in appropriate location in hood. Press on trim ring until grill snaps into place.

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Headlight housing trim panel, removing and installing

- Open hood.

- Remove spray nozzle of vehicles equipped with headlight cleaning systems. See ⇒ 611 Wipers and Washers.



➢ Unclip inner tab at radiator support.

- Press pane downward, out of retaining brackets. Feed out retaining hook at fender.

- Installation is reverse of removal.

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512-1

General

This repair group covers door glass, window regulator and power window motor repair information.

CAUTION!

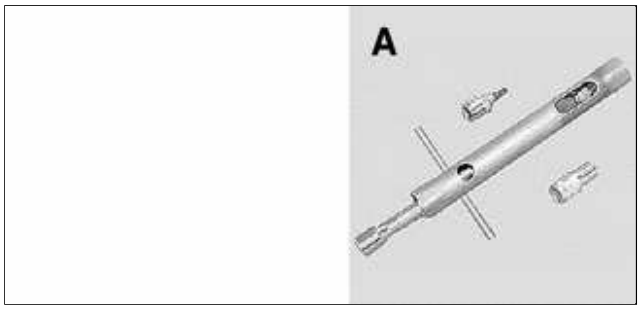
All E46 models are equipped with side-impact airbags in the front doors. Some models are also equipped with airbags in the rear doors. Be sure to read the airbag warnings and cautions in ⇒ 721 Airbag System (SRS).

Electric window switch replacement is covered in ⇒ 612 Switches.

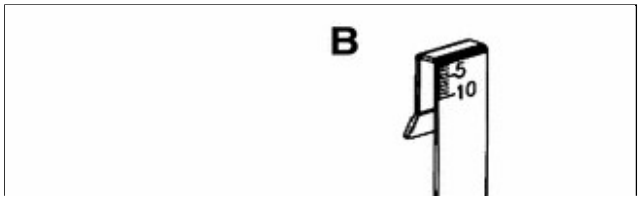
The windshield, rear window, fixed rear door glass, and cargo compartment glass (Sport Wagon only) are bonded using special adhesives and tools. It is recommended that bonded glass replacement be done by an authorized BMW service facility or an automotive glass installer.

Special tools

Some window repair operations require the use of special tools.

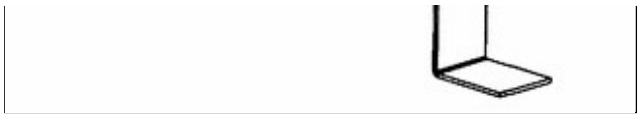


- 2-door window adjustment tool BMW 41 6 120



- Window height gauge BMW 51 3 080

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Power windows

Power window features in E46 models include:

- Control of the front and rear door window motors is carried out directly by the General Module (GM V).
- One-touch operation in both directions on all four windows, where applicable.
- Cable type window regulator used for all door windows.
- Anti-trap protection is provided by the pressure sensitive finger guard.
- The window switch is pulled up to raise the window and pushed down to lower.
- 4-door models: Each rear door has a single window switch located in the door handle trim.
- The rear window switches can be deactivated by pressing the child lock-out switch in the center console.
- Convenience closing/opening of the windows from the driver's lock cylinder or convenience opening only from the FZV remote key. FZV operation can be owner

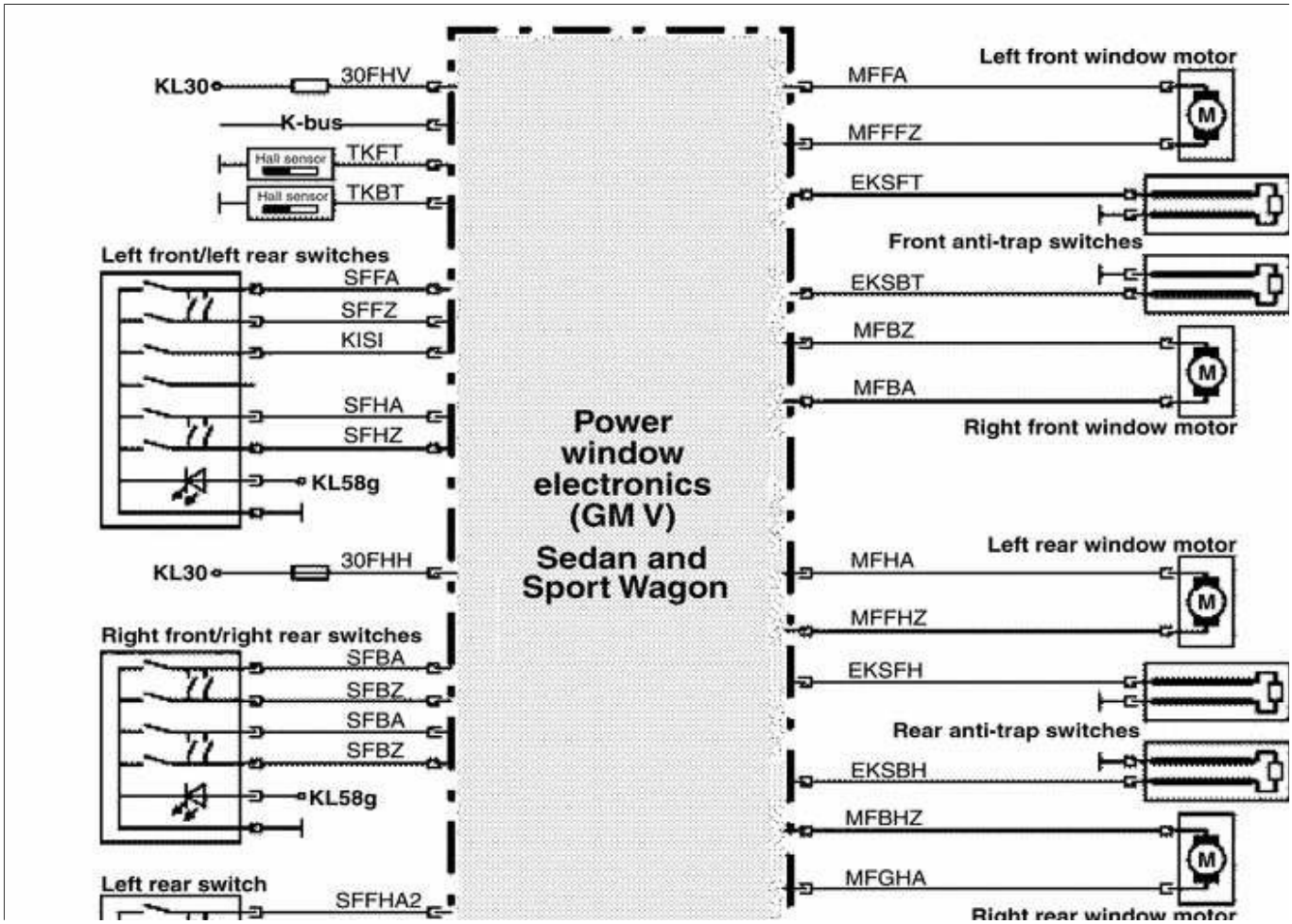
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customized with the Car Memory function. See ⇒ 515 Central Locking and Anti-theft.

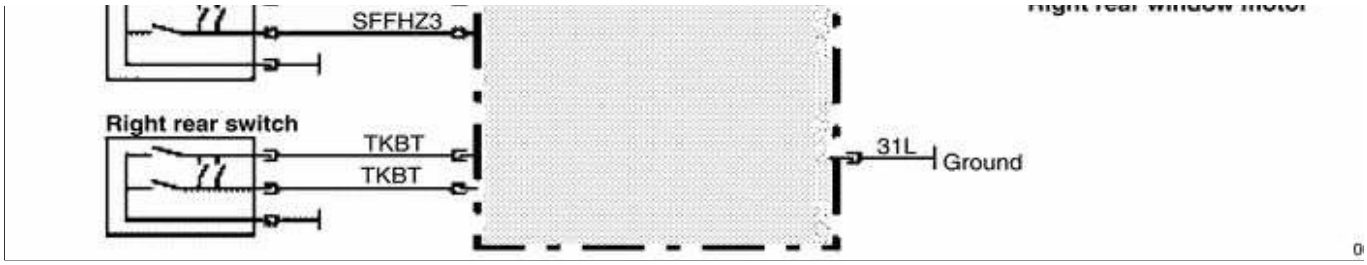
- After the ignition is switched off, electric windows can be operated until a door is opened or until 16 minutes has elapsed.

- The GM V bases window motor end position on current draw (load). There is a maximum window motor run time of 8 seconds. The motor is then switched off even if the end position load sensor fails.

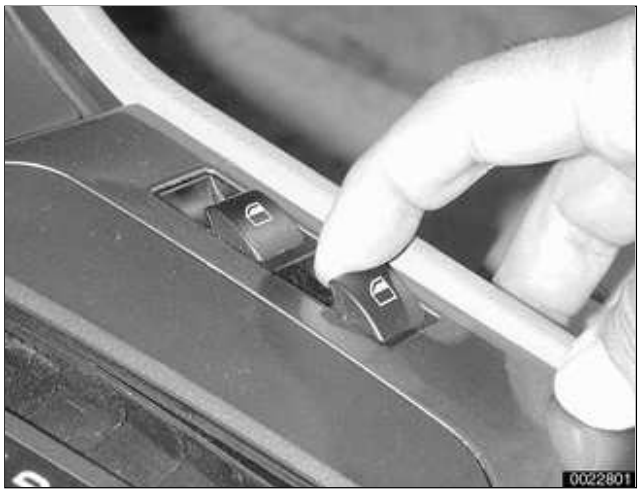
Power window electronics (GM V) Sedan and Sport Wagon



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Window switches



The push-pull type window switch provides the GM V with a coded ground signal. Holding a switch at the first detent provides a single ground signal on one wire requesting the GM V to open the window. When released, the ground signal is removed and the window motor stops.

Momentarily pushing the switch to the second detent and releasing provides an additional ground signal on the second wire requesting "one touch mode". The GM V lowers the window automatically until it reaches the end position.

The switch functions in the same manner for window closing but the ground signal sequence is reversed.

Note:

- *In Coupe models, the rear windows switches are used for operating the rear swing-out vent windows.*
- *Electric window switch replacement is covered in ⇒ 612 Switches.*

Rear window child lockout switch

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In 4-door models, the rear window child lockout switch (**arrow**) is incorporated in the driver's window switch block to the left of the shifter. When activated, it provides a constant ground signal to the GM V, preventing the windows from being operated from the rear door switches.

The lockout switch ground signal is overridden by the GM V if a passive safety system (MRS) crash signal is received.

Note:

In Convertible models the four-window control switch is in the position occupied by the rear window lockout switch in 4-door models.

Power window motors

The window motors are mounted on cable regulators. The window motor control circuit consists of two wires for operating the motor in both directions.

The motors are activated by relays in the GM V. The relays provide either power or ground depending on the direction of window travel. The GM V controls the polarity based on a request to run the window from a window switch or a convenience opening/closing signal.

Convenience opening/closing

The GM V provides the convenience open/close feature, providing control of the power windows (and sunroof) from outside the vehicle with the key in the driver's door lock. The FZV (remote key) provides the same function for window opening only.

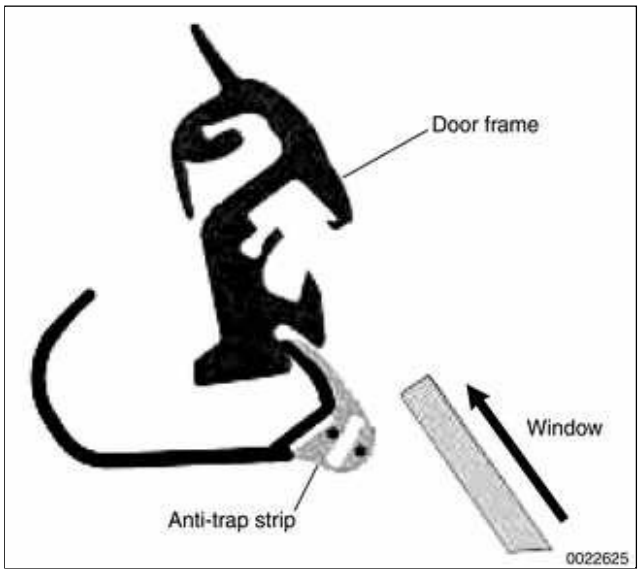
Anti-trap protection is active during convenience closing from the driver's

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door lock.

If the GM receives a request to operate convenience closing or opening for more than 110 seconds, the function is deactivated and a fault code is stored.

Window anti-trap protection



In 4-door models, a rubber pressure guard located at the top edge of each door frame consists of two contact strips that close when subjected to pressure. When the contact strip closes (for example, a hand is trapped between the top of the window and the door frame), an anti-trap signal is sent to the GM V. The window immediately (within 10 milliseconds) reverses direction. This feature does not require initialization.

The E46 pressure sensor finger guard has a resistance of 3 K Ω and it is monitored for open circuit. When pressed, the monitored resistance changes to < 1KΩ. If anti-trap protection becomes faulty the one touch window closing will not function.

Window anti-trap protection is only active in the one touch and convenience close modes of operation. If the window switch is pulled and held, anti-trap protection will not function.

Window motor limit stop function

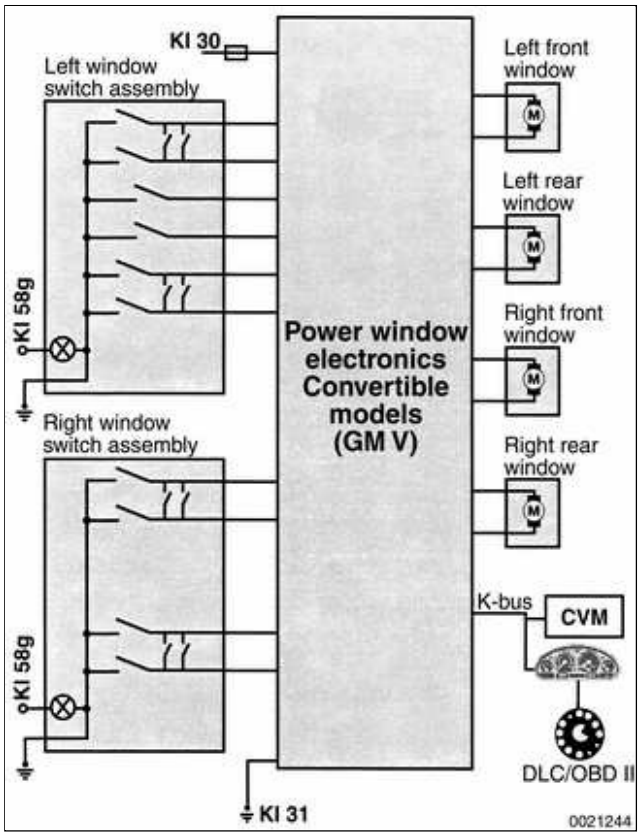
If repeated window activation (up/down cycles) exceeds one minute, the GM V deactivates the internal relays and disregards any further up/down requests. The GM V provides motor activation after a short duration but not for the full one minute monitoring cycle.

The GM V monitors the number of times

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a window motor is activated. It counts each cycle and stores the number in memory. After the stop function limit is reached and the window motor is deactivated, the GM V slowly reverses the stored count of activation until the stored number equals 0, thus allowing the window motor to cool down.

Convertible windows



A central power window switch is located in the Convertible console between the left side window switches. This switch allows all four windows to be opened with one-touch operation and closed if the switch is held.

The Convertible is not supplied with window anti-trap protection. Therefore only the driver's window allows one touch closing.

When the convertible top is opened, the power windows are lowered for approx. 1.5 seconds to ensure clearance for the top. Once the top is stored in the storage compartment, the windows will close again if the top switch is held in the open position.

WARNING!

- ***Always wear hand and eye protection when working with broken glass.***
- ***If a window is broken, all of the glass bits should be vacuumed out of the door cavity. Use a blunt screwdriver to clean out any remaining glass pieces from the window guide rails.***
- ***When servicing the door windows, the harness connector***

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to the window regulator should always be disconnected to prevent pinching fingers in the moving window mechanism.

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Window Service, 4-door Models

Sedan and Sport Wagon doors are similar. Use the following procedures for window service on these models.

WARNING!

- ***E46 cars are fitted with side-impact airbags in the front doors. Some are equipped with airbags in the rear doors as well. When servicing the door windows on cars with side-impact airbags, always disconnect the negative (-) battery cable. See ⇒ 721 Airbag System (SRS) for cautions and procedures relating to the airbag system.***

- ***Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.***

Window anti-trap strip, testing

- To test function of anti-trap strip on any window:

- With key ON and window down, pull up window switch to second detent, thus activating one-touch close operation.

- Insert wooden block or other soft object between glass and upper door frame.

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- Window should contact block, then immediately reverse direction and lower by approx. 25 mm (1 in.).

Note:

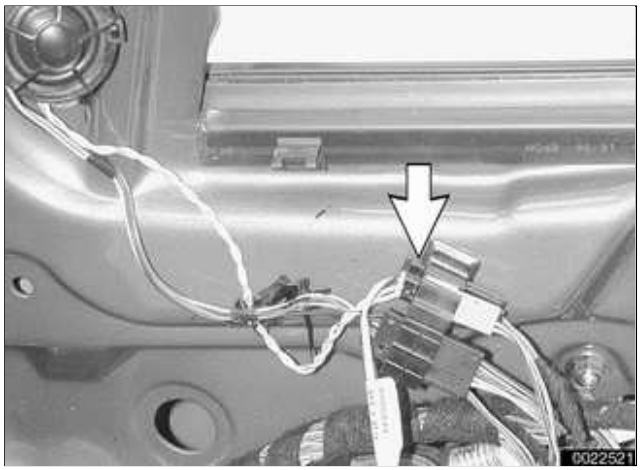
Anti-trap strip is integrated into the molding strip of the door window frame.

Front window anti-trap strip, removing

- Remove front door panel and vapor barrier as described in ⇒ 411 Doors.



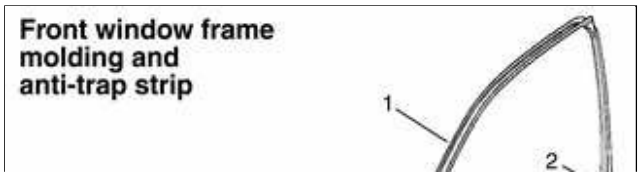
➢ Detach window frame molding strip and peel toward inside of vehicle.



➢ Separate anti-trap electrical harness connector (**arrow**) at top front of door.

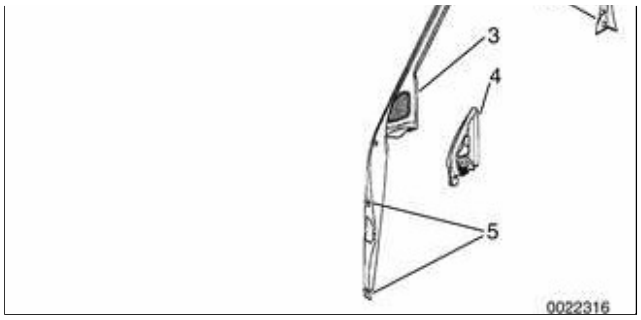
Note:

Wire colors for anti-trap strip are black-white.



➢ If replacing molding with new one, transfer mounting clips and foam insulation as necessary.

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1 - Window frame molding

2 - Clip

3 - Door corner speaker cover

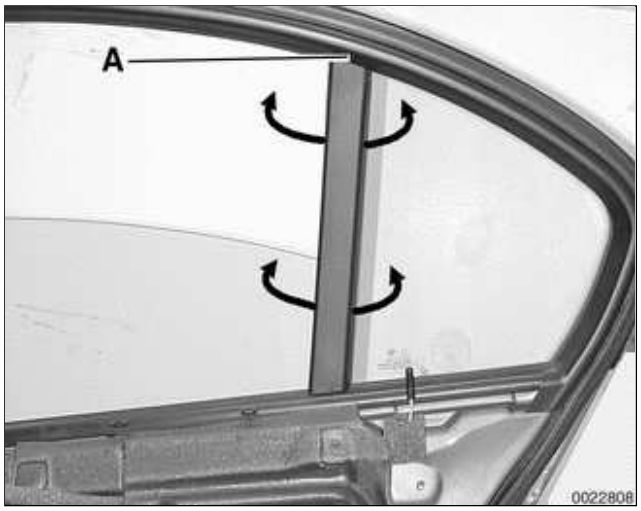
4 - Foam insulation

5 - Mounting clip

- After installation, recheck anti-trap protection.

Rear window anti-trap strip, removing

- Remove rear door panel and vapor barrier as described in ⇒ 411 Doors.



Detach window frame molding strip, peeling it off fixed window partition (**arrows**). Do not tear strip in area **A**.

- Detach electrical harness connector at top front of door, just below window.

Note:

Wire colors for anti-trap strip are black-white.

- After installation, recheck anti-trap protection.

Front door window, adjusting (4-door models)

Whenever the front window or window regulator is removed, window adjustment should be checked. The glass should contact the top of the window squarely and should seat

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against the window seal uniformly.

Note:

If the window does not contact the window seal uniformly, wind noise or water infiltration may result.

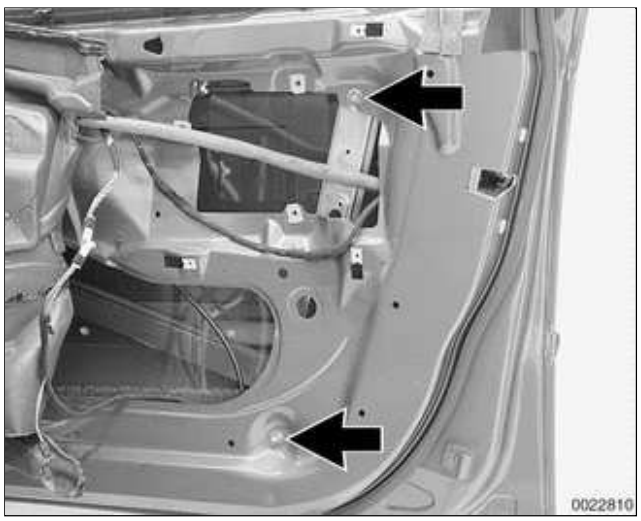
- Remove front door panel as described in ⇒ 411 Doors.

- Disconnect negative (-) cable from battery. Then remove airbag unit and vapor barrier from door. See ⇒ 721 Airbag System (SRS).

WARNING!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

- Partially detach rear of vapor barrier/sound insulation from door and fold forward. Hold in place using adhesive tape.



Loosen window guide rail mounting nuts (**arrows**), but do not remove.

- Reconnect battery. Open window fully.

- Tighten guide rail nuts.

Tightening torque	
Window regulator guide rail to door	9 Nm (80 in-lb)

Front door window, removing and installing (4-door models)

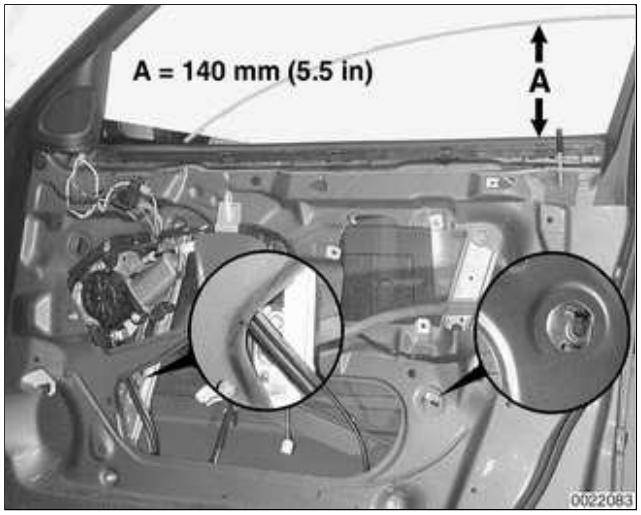
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- Remove front door panel as described in ⇒ 411 Doors.

- Disconnect negative (-) cable from battery. Then remove airbag unit and vapor barrier from door. See ⇒ 721 Airbag System (SRS).

WARNING!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.



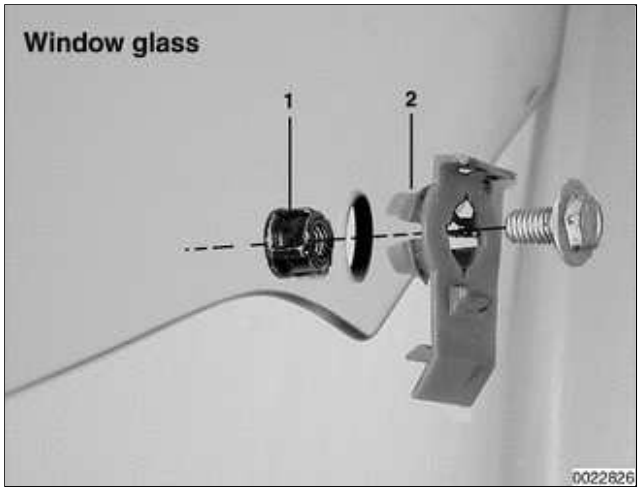
➢ Detach window from window regulator rails:

- Reattach battery. Move window to approx. 140 mm (5.5 in.) from bottom.

- Remove window retaining screws (**insets**) at window regulator rails.

WARNING!

Once the window is positioned correctly, disconnect harness connector from power window motor to prevent accidental operation of the window.



➢ Detach plastic window retainers from glass:

- Push expander nut (**1**) out of plastic retainer.

- Squeeze retainer tabs (**2**) and remove from glass.

Note:

BMW recommends replacing the plastic

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window retainers every time the glass is removed from the door.



- Turn window glass carefully inside door cavity and lift out of door.

- Installation is reverse of removal.

- Replace plastic window retainers once glass is inside door.

- Use new mounting bolts when reinstalling side-impact airbag to door.

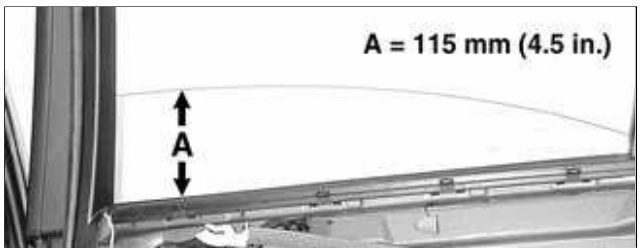
- Adjust window as described earlier.

Tightening torque	
Side-impact airbag to door	8.5 Nm (75 in-lb)
Window to regulator guide	8 Nm (71 in-lb)

Rear door window, removing and installing (4-door models)

- Remove rear door panel and vapor barrier. See ⇒ 411 Doors.

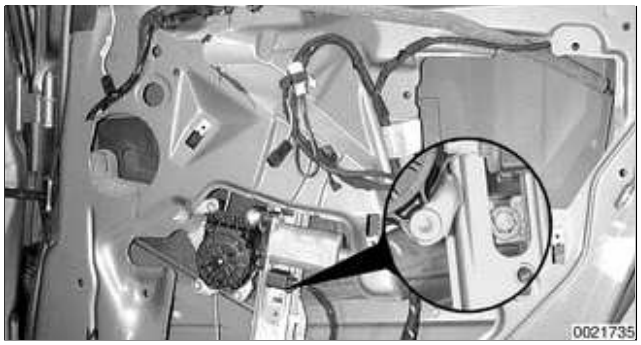
- In model with rear side impact airbag: Disconnect negative (-) cable from battery. Then remove airbag unit from door. See ⇒ 721 Airbag System (SRS).



- Detach window from window regulator rail:

- If applicable, reattach battery. Move window to approx. 115 mm

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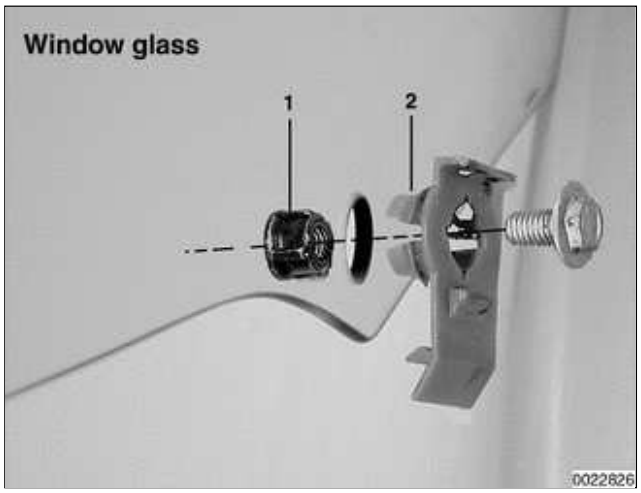


(4.5 in.) from bottom.

- Remove window retaining screw (**inset**) at window regulator rail.

WARNING!

Once the window is positioned correctly, disconnect harness connector from power window motor to prevent accidental operation of the window.



Detach plastic window retainer from glass:

- Push expander nut (**1**) out of plastic retainer.
- Squeeze retainer tabs (**2**) and remove from glass.

Note:

BMW recommends replacing the plastic window retainer every time the glass is removed from the door.

- Pull window glass straight up to lift out of door.
- Installation is reverse of removal.
- Replace plastic window retainer once glass is inside door.
- If applicable, use new mounting bolts when reinstalling side-impact airbag to door.
- Rear window does not need adjustment.

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Tightening torque	
Side-impact airbag to door	8.5 Nm (75 in-lb)
Window to regulator guide	8 Nm (71 in-lb)

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Window Service, 2-door Models

2-door models are equipped with the "close with door shut" feature. In this mode, the window glass moves down slightly when the door latch is activated, then jams up tightly against the weather-strip when the door is fully closed.

WARNING!

- ***E46 cars are fitted with side-impact airbags in the front doors. When servicing the door windows on cars with side-impact airbags, always disconnect the negative (-) battery cable. See ⇒ 721 Airbag System (SRS) for cautions and procedures relating to the airbag system.***

- ***Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.***

Front door window, adjusting (2-door models)

The "close with door shut" feature of 2-door cars with frameless windows makes window adjustment critical.

CAUTION!

There is risk of window glass breakage if correct adjustment procedures are not used. If in doubt, this procedure should be left to a trained BMW technician.

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The following adjustments can be made to the window:

- Longitudinal adjustment
- Pretension (or window rake)
- Parallelism (or window tilt)
- Vertical adjustment (or retraction depth)
- Glass protrusion (when open)
- Distance between side window and door window

Emergency operation

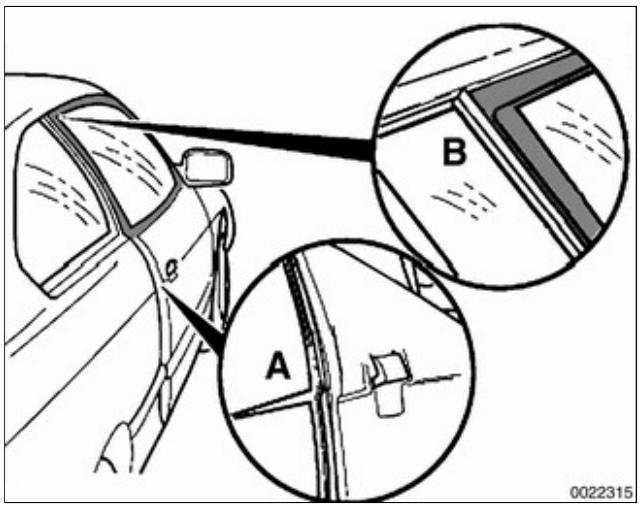
Adjusting the "close with door shut" feature insures low wind noise and water leakage past windows. With the door closed, the window must jam a predetermined amount up into the seal. When the door is opened, the window must lower immediately to clear the seal.



With door open, close window.

- To simulate closed door, use screwdriver or finger to push door lock rotary latch in direction of arrow.
- Window must rise to its full closed position.

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- Close door as far as possible without forcing.
  - Coupe models: Top edge of glass must rest on door seal (**A**).
  - Convertible models: Gap between door and B-pillar (**B**) must be 25 mm (1 in.).

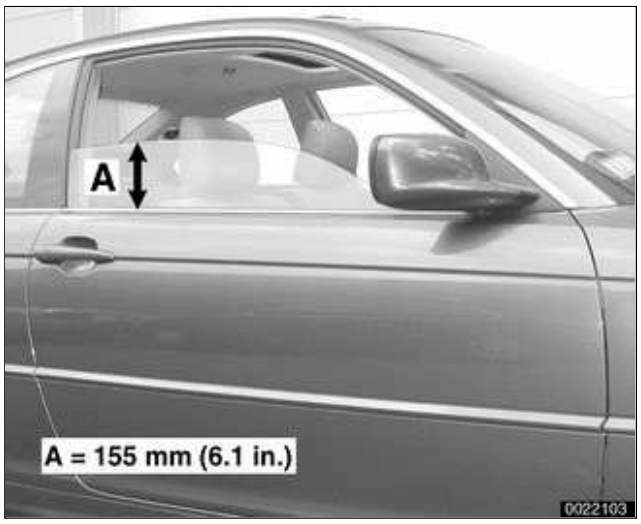
Note:

Window must seal with water drain at mirror triangle in A-pillar.

- Use door handle to open rotary latch:
  - Window should lower a small amount.
- Close door:
  - Window should raise a small amount.
- Reopen door:
  - Window should lower a small amount and clear rubber seal.
- If window gets stuck in rubber seal:
  - Lower glass.
  - Adjust retraction depth as described later.

Longitudinal adjustment

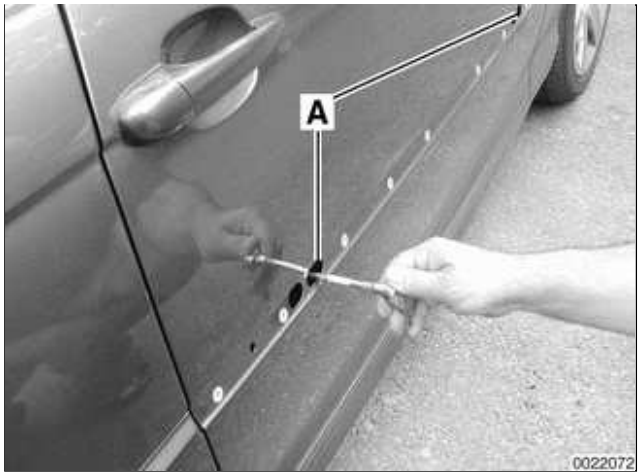
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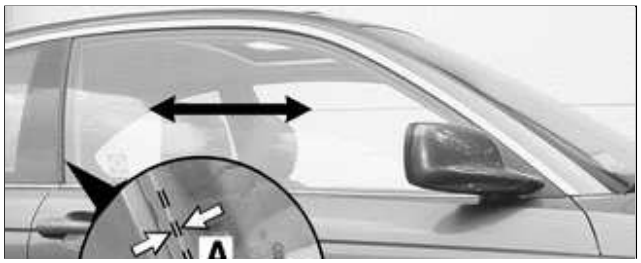
- Position window approx. 155 mm (6.1 in.) above dead bottom.



- Working carefully with a plastic prying tool, detach outside trim strip from door.



- Reach through door bores (**A**) using Torx driver E7 on extension with ratchet wrench (BMW special tool 41 6 120 or equivalent). Loosen but do not remove longitudinal adjustment screws.



- Raise glass to top. Move glass fore or aft to attain correct adjustment.
  - Coupe models: When fully closed, rear edge of window must protrude by distance **A** from edge

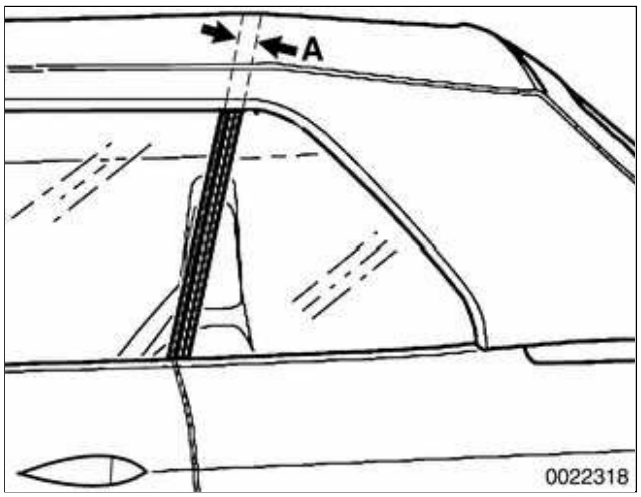
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of window outer sealing lip.

- If necessary, replace side window trim.

Window longitudinal adjustment	
Dimension **A**	1 - 2 mm (0.04 - 0.08 in.)
Door window rear edge to side window seal (Coupe)	6 ± 0.75 mm (0.24 ± 0.03 in.)



Convertible models: When all the way up, measure door window gap to side window trim.

- Gap **A** is measured from edge of door window to rear of side window seal.

Window longitudinal adjustment	
Door window rear edge to side window seal (Convertible)	25 mm (1 in.)

- Tighten longitudinal adjustment screws.

Tightening torque	
Window to guide	8 Nm (71 in-lb)

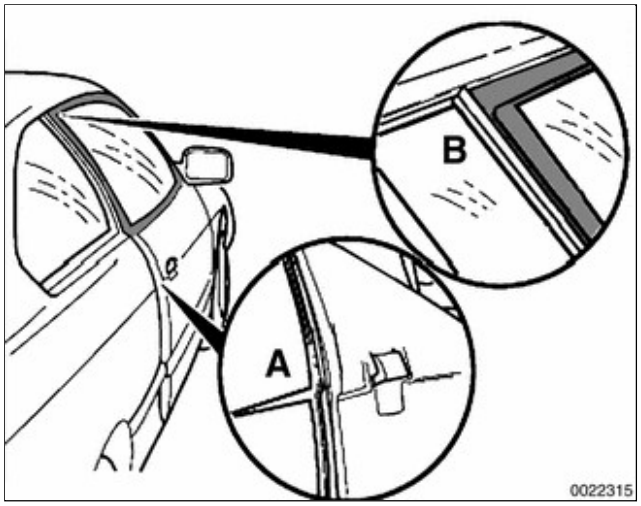
Pretension

Note:

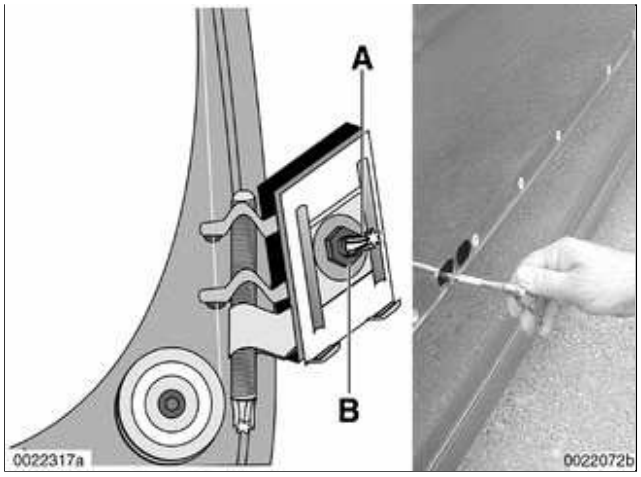
Window pretension can also be thought of as the inward rake of the window.

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- Remove outer door trim strip as described earlier.



- Latch door to first catch of door lock (**A**). Check that top of window rests on rubber door seal (**B**).



- Reach through rear bore in door with BMW special tool 41 6 120 or equivalent ratchet wrench.
  - Loosen window adjustment Torx screw (**A**) 180° counterclockwise.
  - Turn slider adjustment nut (**B**) until it is hard to move.
  - Continue loosening window adjustment Torx screw and tightening slider adjustment nut (see previous step) until correct window rake is reached.
  - Tighten window adjustment screw.

Tightening torque	
Window to guide	8 Nm (71 in-lb)

Vertical adjustments

Note:

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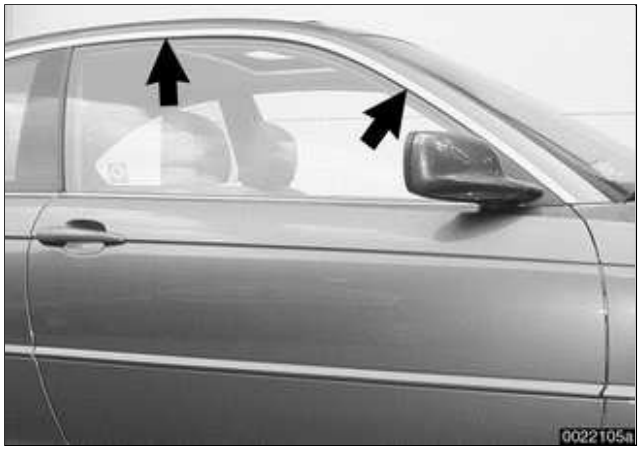
Adjusting the depth that the window retracts into the door seal insures that wind noise and water leakage past window is kept to a minimum.



- Parallelism. Top edge of door window must be parallel to contour of water drain in roof.

Note:

Window parallelism is also referred to as window tilt.



- Retraction depth. With door closed, raise window to top.
  - Use BMW special tool 51 3 080 or equivalent device to measure depth of window in rubber seal.

Window retraction	
At A-pillar or roof line (**arrows**)	3 - 4 mm (0.12 - 0.16 in.)

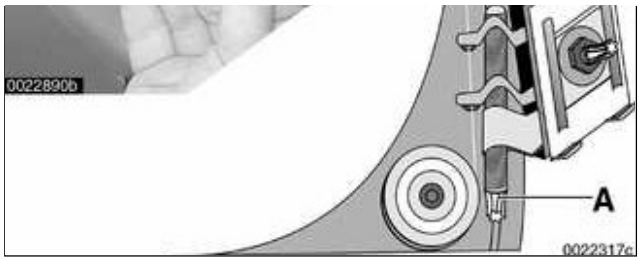
- Window protrusion. When all the way down, measure door window glass protrusion above top edge of door.

Window protrusion	
Door window above top of door	max. 2 mm (0.08 in.)



- To adjust:
  - Lower door glass.

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- Pry out rubber plugs at base of door.
- Starting at rear of door, reach through bore in door to turn Torx screw (**A**).

Note:

Torx screw size is T20.

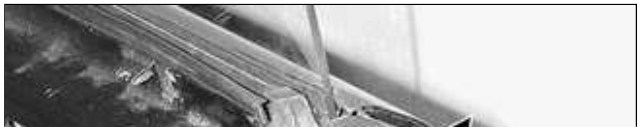
- Repeat at front bore.
- Raise window and check for parallelism and correct depth of retraction.
- Repeat as necessary.
- Reinsert rubber plugs.

Front door window, removing and installing (2-door models)

- Remove interior door panel. See ⇒ 411 Doors.
- Disconnect negative (-) cable from battery. Then remove airbag unit and vapor barrier from door. See ⇒ 721 Airbag System (SRS).

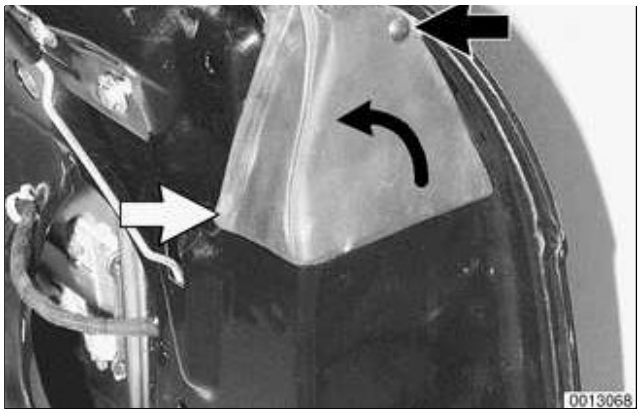
WARNING!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

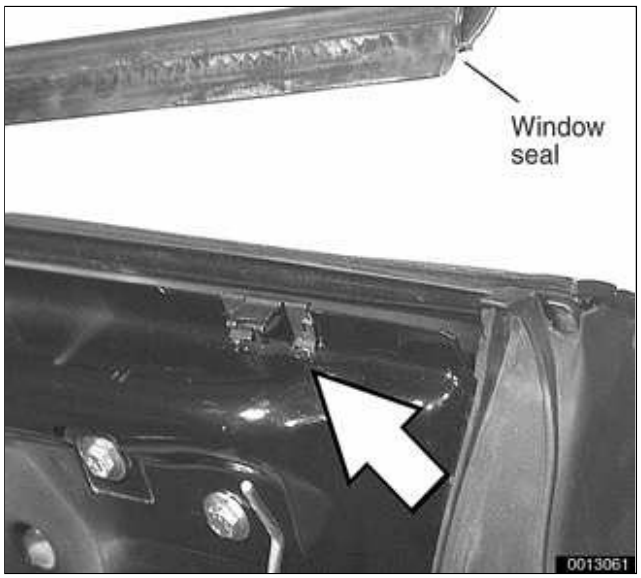


- Detach door corner rubber seal mounting clips (**arrows**). Remove seal by pulling up in direction of **curved**

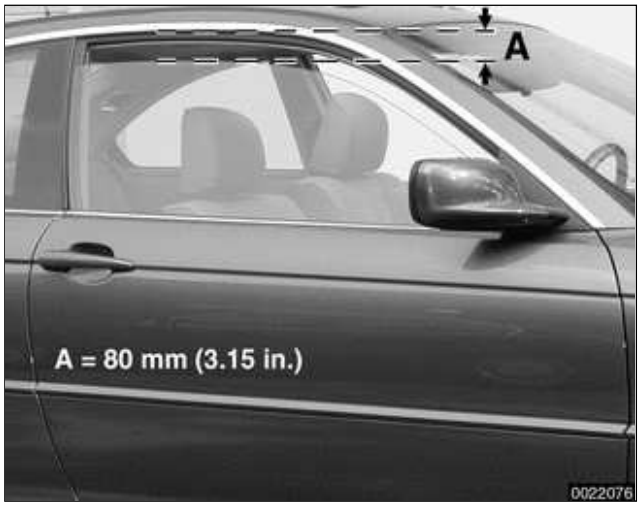
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arrow.



- Lift off window inner lip seal.
  - If necessary, replace any defective retaining clip (**arrow**).



- Position door window approximately 80 mm (3.15 in.) below roofline. If necessary, temporarily reconnect battery cable.

WARNING!

Once the window is lowered, disconnect harness connector from power window motor to prevent accidental operation of the window.

- Remove window mounting screws from window regulator rails.

Note:

- *Window mounting screws have left-hand thread.*

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- *Window rear mounting hardware will stay with glass.*

- Tilt rear edge of window glass up and out of door.

- If glass is being replaced, transfer window rear mounting hardware (mounting shim, threaded sleeve and clamping retainer) from lower rear corner of glass to new window.

- Installation is reverse of removal.

- Install window rear mounting screw with adjusting sleeve through guide rail and threaded sleeve in glass.

Note:

Window mounting screws have left-hand thread.

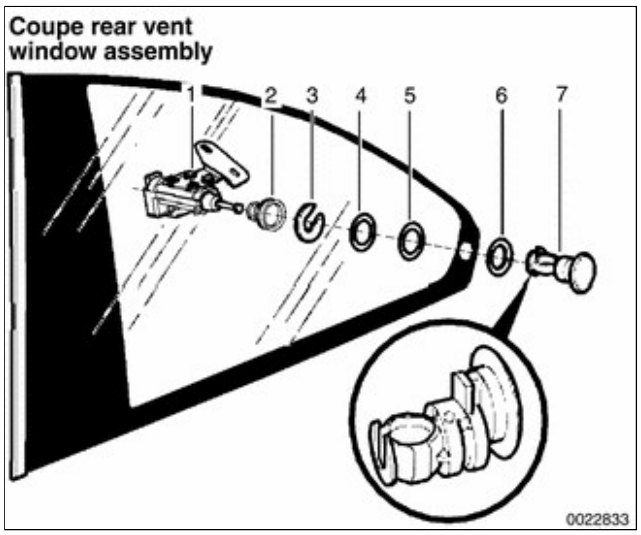
- Use new mounting bolts when reinstalling side-impact airbag to door.

- Adjust window as described earlier.

Tightening torque	
Side-impact airbag to door	8.5 Nm (75 in-lb)
Window to guide	8 Nm (71 in-lb)

Rear vent window or vent latch, (Coupe models)

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Refer to accompanying illustration when removing Coupe rear vent window or vent latch mechanism.

1 - Vent window drive

2 - Inner cap

3 - Retainer

4 - Washer

5 - Washer

6 - Shim

7 - Glass support

- When installing, make sure U-shaped opening in glass support points to rear of car.
- To access rear vent hinges, remove B pillar (door pillar) trim.
- When reinstalling make sure window seals completely. Note gap clearances below.

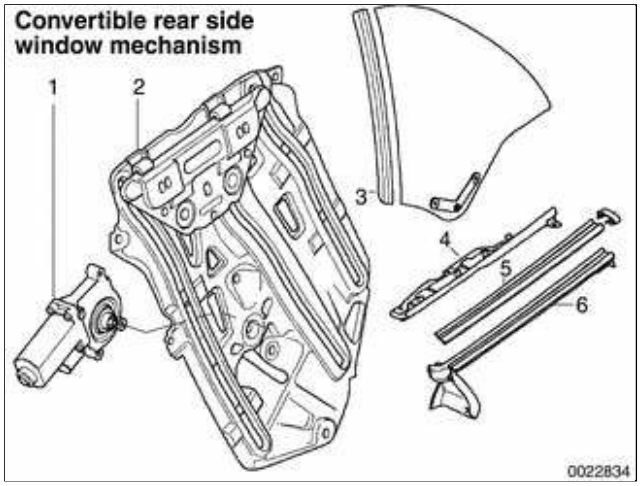
Vent window clearances	
Front trim strip to rear edge of front window	up to 6 mm (0.24 in.)
Rear of window to water drain	up to 1.8 mm (0.07 in.)
Top of window to water drain	1 mm (0.04 in.)

Tightening torques	
Vent window to body (M6 nut)	6.2 Nm (55 in-lb)

Rear side window (Convertible

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models)



Refer to accompanying illustration when removing Convertible rear window or window motor.

1 - Window motor

2 - Window regulator assembly

3 - Window glass

4 - Insert

5 - Inner seal

6 - Outer seal

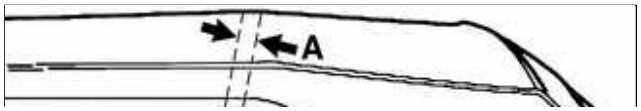
CAUTION!

Convertible rear window removal, installation and adjustment is complex. If the final adjustment is incorrect glass breakage may result. This job is best left to be done by a trained technician at a qualified BMW repair facility.

Rear side window, adjusting (Convertible models)

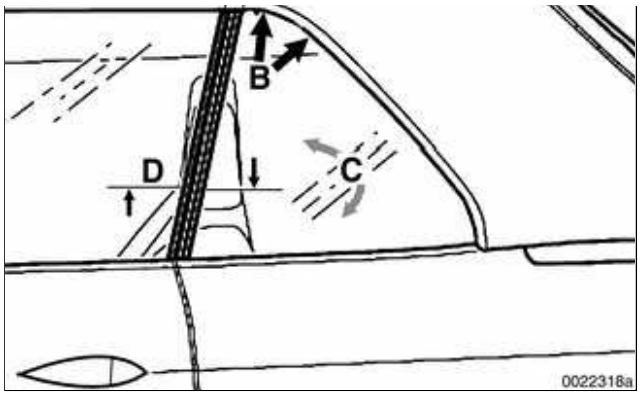
The Convertible rear side window shares a version of "close with door shut" feature of the front window: It retracts slightly when the top is raised or lowered, then rises to seal against the folding top once the top is locked in place.

The procedure for setting Convertible rear side window adjustment, while similar in principle to front window adjustment, also depends on correct adjustment of the folding top and of the front window glass.



Refer to the accompanying illustration when adjusting Convertible side

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window.

- Distance to front door window (longitudinal adjustment) (**A**) must be set by loosening Torx bolt through bore in outer shell of car, after removing exterior side trim strip.
- To set retraction depth (submersion) into top rubber seal (**B**), rear interior side trim panel must be removed to access adjustment screws.
- To set window centering (**C**), rear interior side trim panel must be removed to access adjustment screws.
- To set side window depth in relation to door window (**D**), rear interior side trim panel must be removed to access adjustment screws.

Convertible rear side window adjustments	
A	23 - 25 mm (0.9 - 1.0 in.)
B	Window must run into convertible top seal when top is closed. With top open, glass must rest firmly against window seal.
C	With convertible top open, window must be centered in channel
D	up to 1 mm (0.04 in.) toward inside of car

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512-4

Window Regulator Service

WARNING!

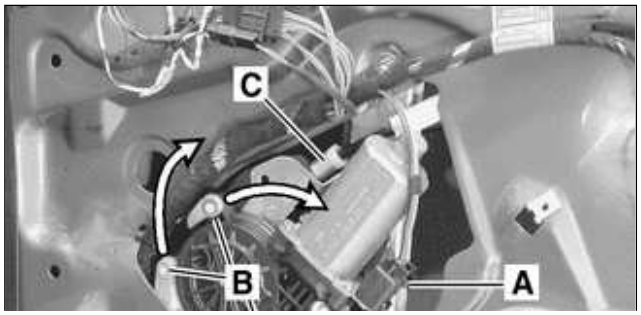
- ***E46 cars are fitted with side-impact airbags in the front doors. Some are equipped with airbags in the rear doors as well. When servicing the door windows on cars with side-impact airbags, always disconnect the negative (-) battery cable. See ⇒ 721 Airbag System (SRS) for cautions and procedures relating to the airbag system.***

- ***Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.***

Window regulator motor

Note:

Because window operation is electronically controlled, a window motor does not have mechanical end positions. For this reason it can be removed and installed with the window in any position and does not need reinitialization.



To remove motor:

- Remove inner door panel and vapor barrier
- Detach window motor electrical

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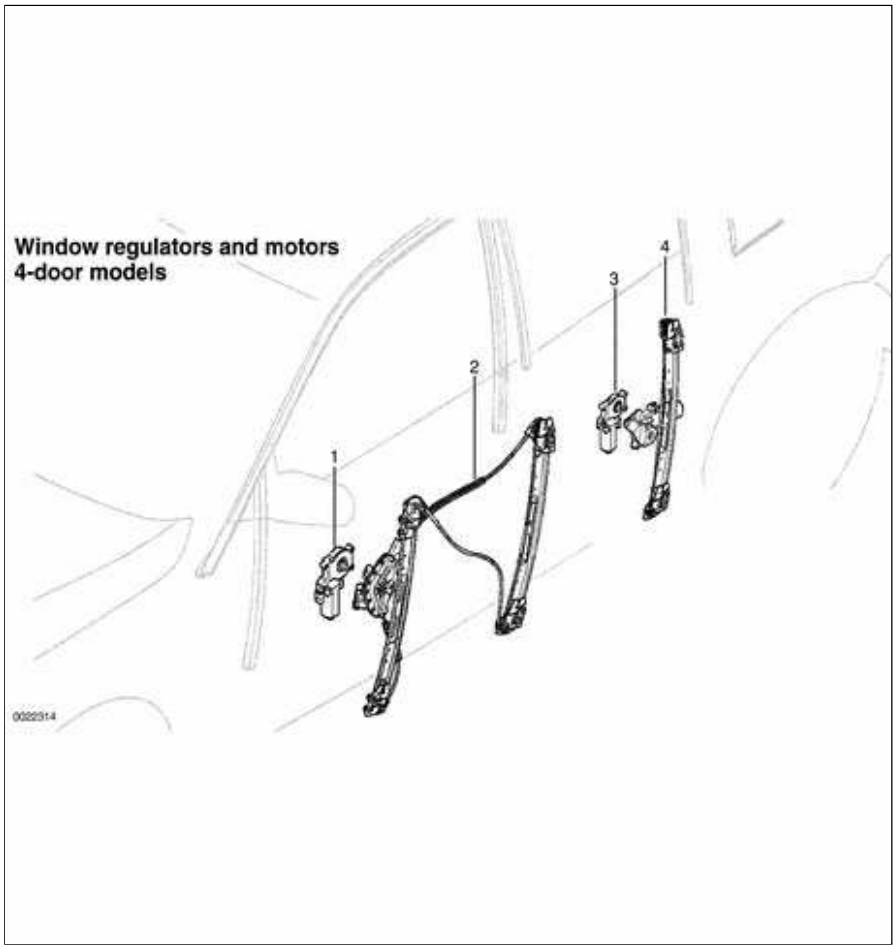


harness connector (**A**).

- Remove motor mounting bolts (**B**).
- Twist motor slightly (**arrows**) to clear window regulator mounting tabs.

- When reinstalling:

- Make sure window has not travelled fully downward.
- Manipulate spring-loaded window control cable (**C**) to engage motor teeth to regulator gears.



Window regulators and motors 4–door models, assembly

1 - Front window motor

2 - Front window regulator

3 - Rear window motor

4 - Rear window regulator

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Window regulator and motor, removing and installing (4-door models)

Sedan and Sport Wagon doors are similar. There are two window rails in each front window regulator, only one in the rear. Otherwise the front and rear regulators are similar.

Note:

BMW recommends removing the window regulator and motor as one unit, then separating the two on the bench.

- Remove door panel as described in ⇒ 411 Doors.

- Disconnect battery negative cable and remove side impact air bag, if applicable. See ⇒ 721 Airbag System (SRS).

WARNING!

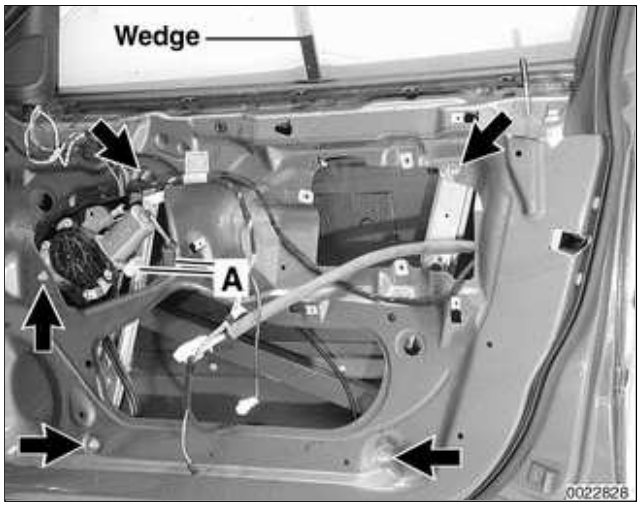
- ***E46 cars are fitted with side-impact airbags in the front doors. Some are equipped with airbags in the rear doors as well. When servicing the door windows on cars with side-impact airbags, always disconnect the negative (-) battery cable. See ⇒ 721 Airbag System (SRS) for cautions and procedures relating to the airbag system.***

- ***Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.***

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- Remove vapor barrier.

- Detach window from window regulator as described earlier. Do not remove window from door. Push window up and use wedge to hold in position.



➢ Detach window regulator from door:

- ♦ Disconnect electrical harness connector (**A**) to power window motor.

- ♦ Remove regulator mounting nuts (**arrows**).

- Remove window regulator through opening in bottom of door, checking for any wiring harnesses that might become snagged during removal.

- Installation is reverse of removal.

- ♦ Be sure to route wiring harnesses to keep them away from moving window mechanism. Use new wire ties as necessary.

- ♦ Adjust front window as described earlier.

Tightening torques	
Window motor to regulator	5 Nm (4 ft-lb)
Window regulator to door	9 Nm (7 ft-lb)
Window to guide	8 Nm (71 in-lb)

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Door window regulator and motor, removing and installing, (2-door models)

- Remove door panel as described in ⇒ 411 Doors.

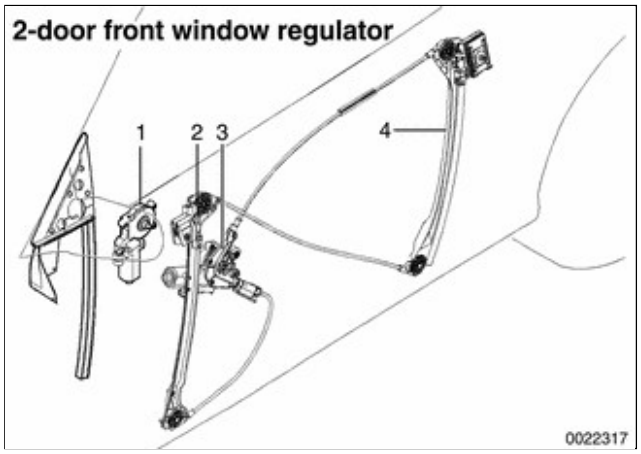
- Disconnect negative (-) cable from battery. Then remove airbag unit and vapor barrier from door. See ⇒ 721 Airbag System (SRS).

- Remove door glass as described earlier.

- Lower window regulator completely.

WARNING!

Once the window regulator is positioned correctly, disconnect harness connector from power window motor to prevent accidental operation of the mechanism.



➢ Detach window regulator from door:

1 - Window motor

2 - Front window rail

3 - Window regulator mechanism

4 - Rear window rail

♦ Disconnect electrical harness connector to power window motor.

♦ Remove regulator mounting nuts.

- Remove window regulator through opening in bottom of door, checking for any wiring harnesses that might become snagged during regulator

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removal.

- Installation is reverse of removal, noting the following:

- Inspect rubber insulators. Replace if brittle.
- After inserting window regulator into door cavity, install and tighten down mounting nuts on rear window rail.
- Install front window rail mounting nuts but do not tighten.
- Install glass. See ⇒ Front door window, removing and installing (2-door models)
- Tighten upper nut of front rail.
- Lower window glass fully.
- Tighten front rail lower nuts.
- Adjust window. See ⇒ Front door window, adjusting (2-door models).

Tightening torques	
Window motor to regulator	5 Nm (4 ft-lb)
Window regulator to door	9 Nm (7 ft-lb)
Window to guide	8 Nm (71 in-lb)

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513-1

General

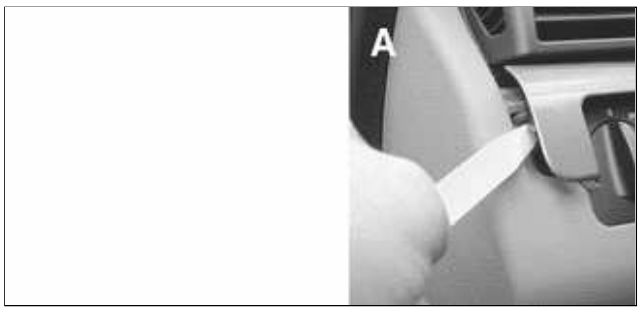
This repair group covers interior trim removal and installation procedures.

Refer to the following repair groups for additional information:

- ⇒ 250 Gearshift Linkage
- ⇒ 411 Doors (interior door panels)
- ⇒ 612 Switches
- ⇒ 620 Instruments
- ⇒ 640 Heating and Air Conditioning (IHKA control panel)
- ⇒ 650 Radio
- ⇒ 721 Airbag System (SRS)

Special tools

Use plastic prying tools or wrap the screwdriver tip with tape to avoid marring interior trim.



Plastic prying tool BMW 00 9 321

Interior trim repairs

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Interior trim and finish panels are clipped or screwed into place. Many of the trim retaining clips are designed to be used only once. When removing trim that is held in place with clips, it is a good idea to have spares on hand before beginning the job.

Note:

The BMW E46 is equipped with SRS airbags mounted in the steering wheel, the dashboard on the passenger side, the front doors, the A-pillars, and as an option in rear doors on four door models. See warnings and cautions on below and in ⇒ 721 Airbag System (SRS).

WARNING!

- ***Special precautions must be observed when servicing the BMW Supplemental Restraint System (SRS). Serious injury may result if system service is attempted by persons unfamiliar with the BMW SRS and its approved service procedures. BMW specifies that all inspection and service should be performed by an authorized BMW dealer.***

- ***Before performing any work involving airbags, disconnect the negative (-) battery cable. See ⇒ 721 Airbag System (SRS).***

- ***Airbags contain a back-up power supply within the SRS control module. A 5 second discharge period should be allowed after the battery cable has been disconnected.***

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CAUTION!

- ***When working on electrical switches or lights, always disconnect the negative (-) cable from the battery and insulate the cable end to prevent accidental reconnection.***

- ***Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.***

- ***To prevent marring the trim when working on interior components, work with plastic prying tools or wrap the tips of screwdrivers and pliers with tape before prying out switches or electrical accessories.***

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Center Console

The console between the two front seats starts behind the shifter housing. It houses the parking brake handle, optional telephone and oddments storage tray. The rear portion of the console houses the ashtray and covers the emergency brake cable ends.

The optional front seat armrest is part of this console.

Center console, removing and installing



- Press rolling cover of rear ashtray down. Depress cover fully to pop ashtray out of console. Remove ashtray.

  - Remove retaining screws and bracket.

  - Remove ashtray cover and housing. Disconnect electrical harness connector for ashtray courtesy light.

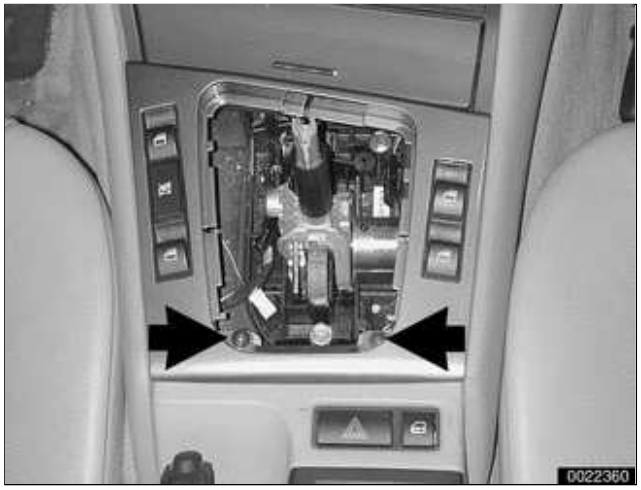
  - Remove screws at base of ashtray compartment in console.



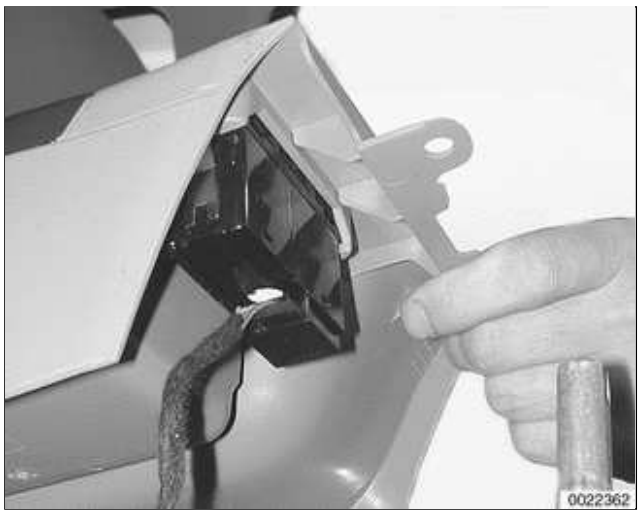
- Unclip trim boot for parking brake lever and pull boot and handle forward off brake lever.

  - Gently pry up boot or trim at transmission selector. On automatic transmission vehicles, unplug connector for gear indicator light.

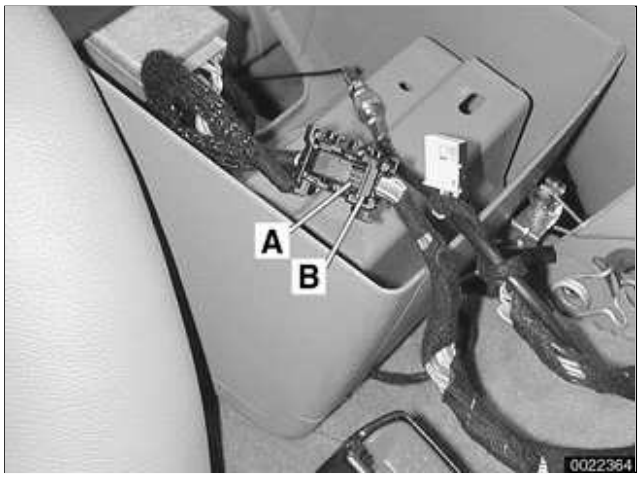
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- Remove trim panel retaining screws (**arrows**) under transmission selector boot/trim.



- Slide center console back and lift up. Disconnect electrical harness connector from hazard light and central locking switch.



- If applicable disconnect wiring for factory installed cellular telephone. To release phone connector, press catch (**A**) and slide lock (**B**) forward. Disconnect antenna connection.

  - On vehicles with center armrest: Tilt armrest upright. Lift parking brake lever upwards. Feed center console panel out over armrest and brake lever.

  - Installation is reverse of removal. Make sure to securely fasten all electrical harness connectors during reassembly.

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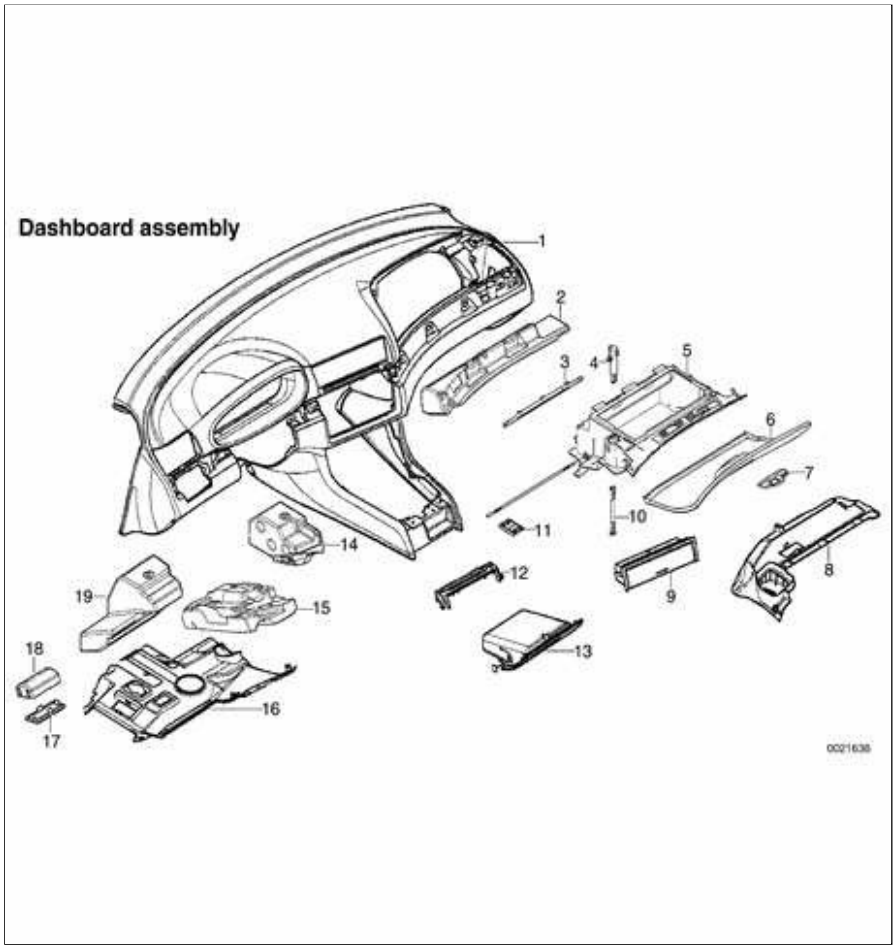
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513-3

Dashboard

The E46 dashboard assembly includes the instrument cluster, passenger side airbag, glove compartment, fuse and relay panel, radio, IHKA control panel or on-board monitor (if equipped with GPS), front ashtray, shifter assembly, and window control switches.

Dashboard removal is a complex operation. Read the procedures through before starting work.



Dashboard assembly

1 - **Dashboard**

2 - **Passenger knee protector**

3 - **Reinforcement**

4 - **Damper piston**

5 - **Glove compartment**

6 - **Glove compartment door**

7 - **Latch**

8 - **Right top footwell trim panel**

9 - **Storage compartment**

10 - **Glove compartment door strap**

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11 - Glove compartment hinge

12 - Steering column cover

13 - Left glove compartment (optional)

14 - Center knee protector

15 - Steering column knee protector

16 - Left footwell (pedal cluster) trim panel

17 - Footwell light cover

18 - Footwell light socket

19 - Left knee protector

Glove compartment and right footwell trim panel, removing and installing

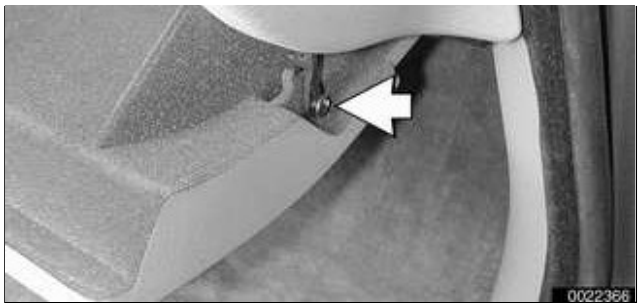
- Open glove compartment door.
- Snap out glove compartment light fixture and detach electrical harness connector.



To detach glove compartment:

- Pull out retaining pin (**arrow**) for

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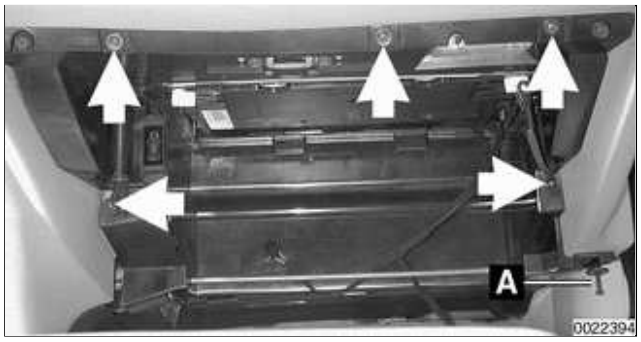


right side strap.

- Pull out pin from bottom of left side dampening rod.



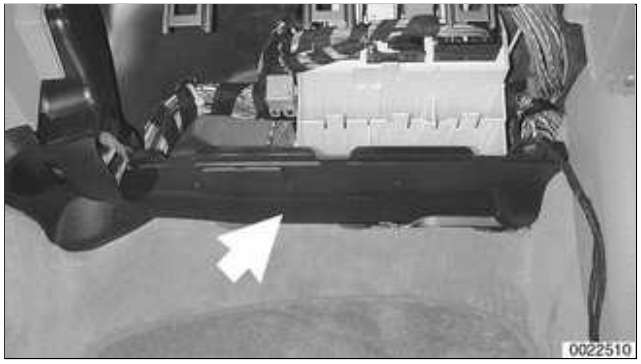
- Remove glove compartment hinge mounting bracket screws (**arrows**). Lift glove compartment over mounting rod to remove.



- Remove glove compartment housing:
  - Remove insert mounting screws (**arrows**).
  - If necessary, release mounting pin (**A**) at right side of housing.
  - Pull glove compartment housing down.

Note:

Detach glove compartment electrical harness from guides while removing housing.



- Remove right footwell trim panel (**arrow**) by pulling backward to detach from mounting points.

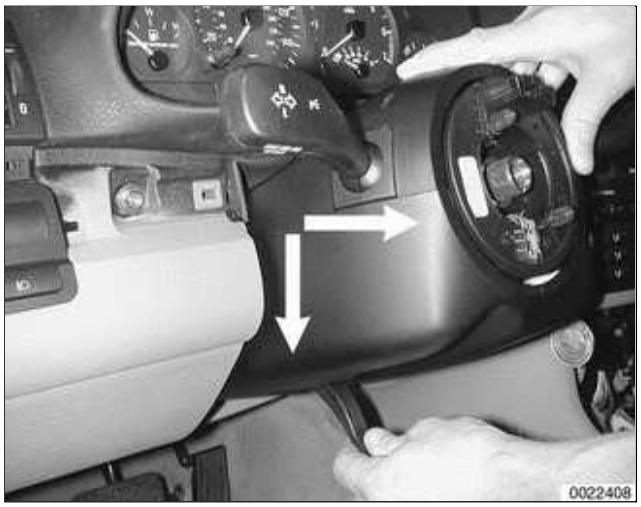
Note:

Detach electrical harness connector(s) from panel while removing.

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Steering column trim, removing and installing

- Remove steering wheel as described earlier.

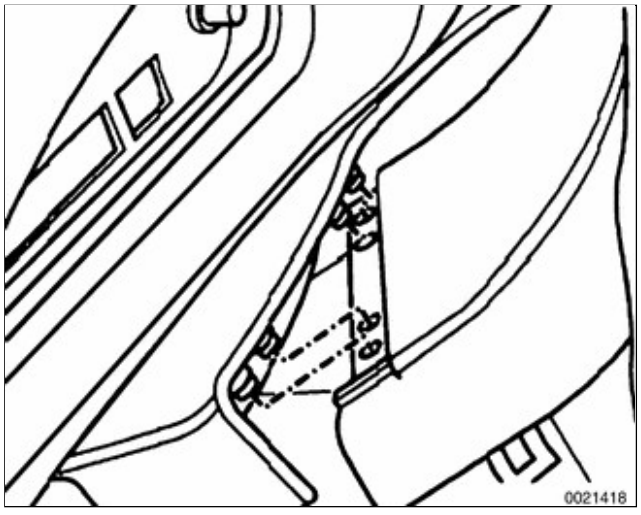


- Fully lower and extend (**arrows**) adjustable steering column.

- Remove retaining screw from top of steering column upper trim cover.



- Push in sides of upper trim cover (**arrow**) to release from lower trim. Pull back and up on upper trim.



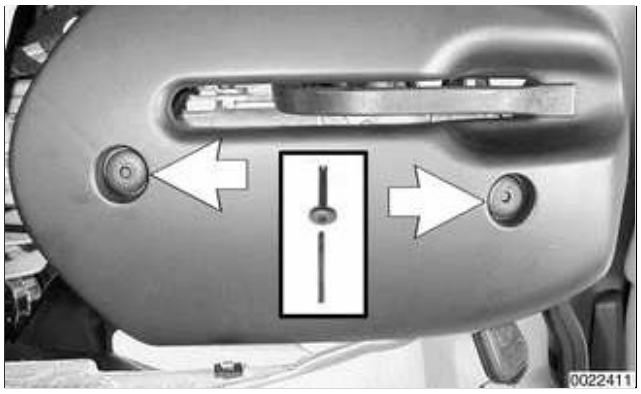
- Pry gently to detach flexible cover from upper trim. Lift off trim.

- Remove left footwell (pedal cluster) trim panel. See ⇒ Steering column trim, removing and installing.



- To remove steering column lower trim, drive pins into expansion rivets (**arrows**)

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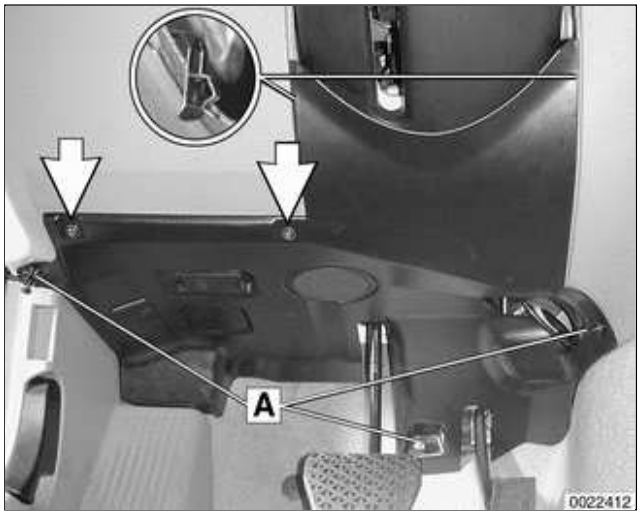


to release. Pull down on trim.

- Installation is reverse of removal. Replace any broken or missing fasteners.

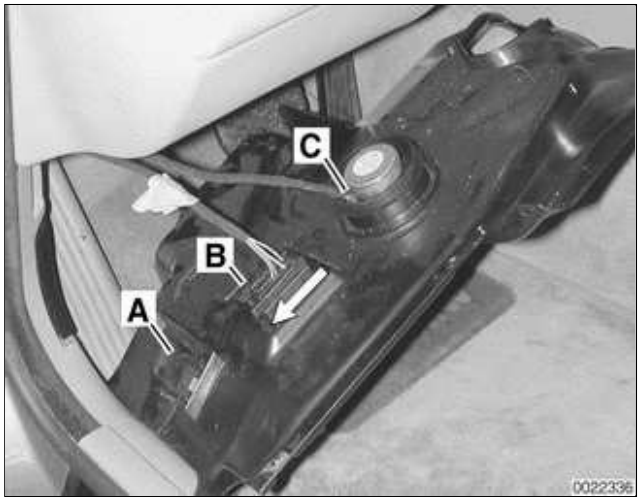
Left footwell (pedal cluster) trim panel, removing and installing

- Move steering column to maximum extended position.



➢ Working at trim panel, remove screws (**arrows**) and expansion rivets (**A**).

- Clips (**inset**) must be rotated 90° to remove.
- If equipped detach electrical harness connectors from footwell light and warning chime.
- Release OBD II socket from panel and pull out.



➢ Disconnect electrical harness connectors at left footwell trim panel and remove panel:

- Unplug connector at footwell interior light (**A**), if equipped.
- Slide lock at OBD II connector (**B**) in direction of **arrow**.
- Unplug connector at chime (**C**).

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Dashboard/shifter console assembly, removing and installing

- Disconnect negative (-) cable from battery and cover terminal with insulating material.

CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.



- Using a plastic trim tool pry gently to remove left, center and right dashboard trim.

CAUTION!

To avoid marring interior trim, work with a plastic prying tool.

Note:

- *Left side shown. Center and right trim are similar.*
- *To remove center trim, right trim must be removed first.*

- Remove steering wheel. See ⇒ 320 Steering and Wheel Alignment.

- Remove left footwell trim panel as described earlier.

- Remove upper and lower steering column trim. Detach steering column stalk switch electrical connectors and remove stalk switch. See ⇒ 612 Switches.

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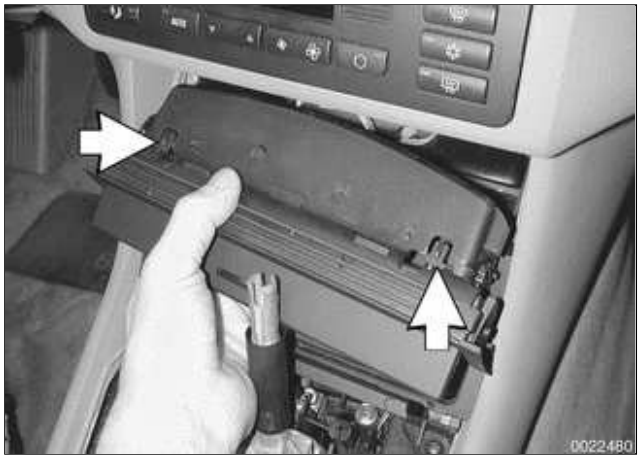


- Remove shifter knob by pulling straight up.

Note:

Apply approx. 90 lb. of force to pull off knob from shift rod.

- Lift up and remove shifter bezel by prying gently.
- Unclip bottom of shifter boot from center console trim by pushing forward. Pull boot up around shifter.
- Remove center console as described earlier.
- Lift off switch carrier and detach electrical harness connectors to window switches.
- Remove glove compartment as described earlier.



- To remove storage compartment below IHKA control panel:
  - Open compartment door.
  - Push upward on tabs (**arrows**), then pull out.



- Remove A-pillar (windshield pillar) trim on left and right sides by prying out finishing strip.

CAUTION!

The Head Protection Airbag is behind the A-pillar. Do not use sharp

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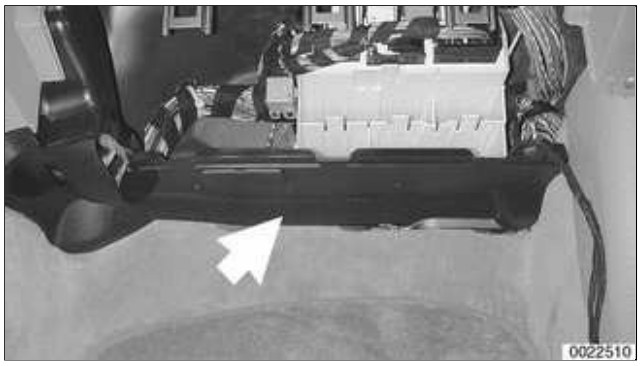
instruments to remove trim or finisher strip

- Remove screws beneath finishing strip.



➢ Carefully pull away A-pillar trim.

- Remove headlight switch. See ⇒ 612 Switches.
- Remove instrument cluster. See ⇒ 620 Instruments.
- Remove IHKA control panel and module. See ⇒ 640 Heating and Air Conditioning.
- If applicable: Reach through IHKA control panel opening and disconnect solar sensor harness connector.
- Remove radio. See ⇒ 650 Radio.
- Remove front passenger airbag. See ⇒ 721 Airbag System (SRS).
- Remove glove compartment as described earlier.



➢ Remove right footwell trim panel (**arrow**) by pulling backward to detach from mounting points.

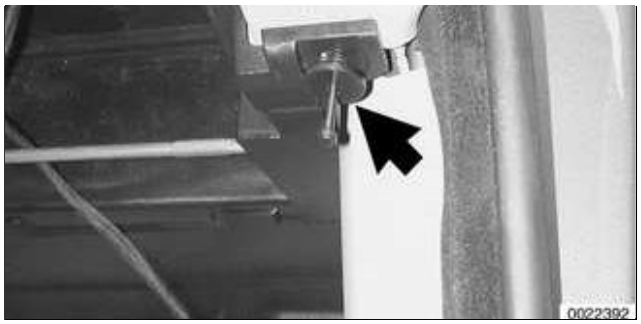
Note:

Detach electrical harness connector(s) from panel while removing.



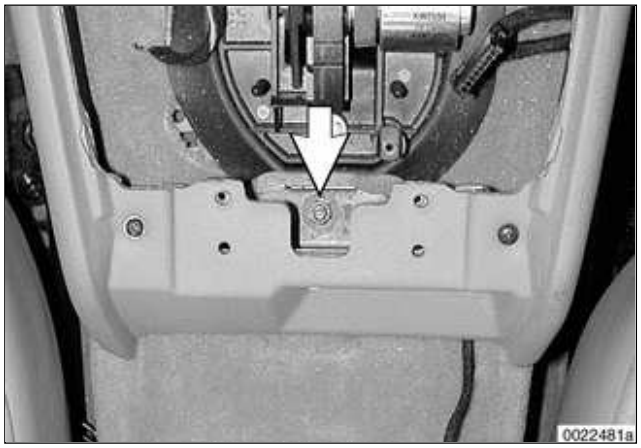
➢ Remove dashboard mounting screw or expansion rivet (**arrow**) in lower right

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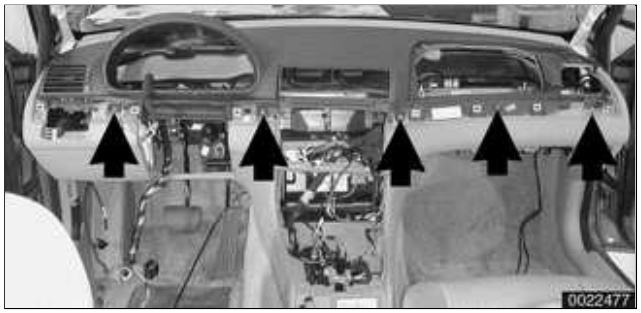


dashboard.

- Similarly, remove left side dashboard mounting screw or expansion rivet.



➢ Remove dashboard mounting nut (**arrow**) at shifter console.



➢ Remove mounting nuts and screw (**arrows**) at dashboard face.

- To remove dashboard:

♦ Pull up parking brake fully.

♦ Push seats fully back.

♦ Lift instrument panel off carefully, making sure all harness connectors and wiring are disconnected.

♦ Remove through passenger door.

- When installing, fit dashboard guide pin into locator slot at base of windshield in center.

- Install center console with dashboard mounting nuts loose. Align and center parts before

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tightening fasteners.

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General

This section covers repair information for door, trunk and cargo compartment locks and central locking. Also covered are Electronic Immobilization System (EWS) and anti-theft alarm (DWA).

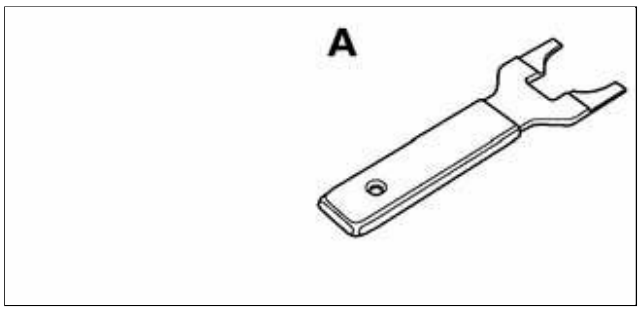
Keep in mind that E46 cars are equipped with sophisticated and self-diagnostic electrical systems. When experiencing malfunctions relating to central locking or anti-theft systems, it is recommended that the system be diagnosed using the BMW service tester DIS or MoDiC or equivalent. An advanced diagnostic scan tool can usually pinpoint electrical faults quickly and safely. Consult an authorized BMW dealer.

Note:

Additional general electrical information can be found in ⇒ 610 Electrical Component Locations and Electrical Wiring Diagrams.

Special tools

A few special tools may be necessary for repairs in this section.



- Ring antenna removal tool BMW 61 3 300



- Front door lock adjustment tool 4 mm Allen wrench

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Central Locking

Note:

There is a door lock key cylinder on the driver's door only

Central locking in E46 vehicles controls the door locks, trunk or cargo compartment lock and fuel filler flap lock. The Central Body Electronics (ZKE V) control module, known as the General Module (GM V), controls central locking.

The door lock actuators are sealed, self contained units with no replaceable parts. The actuators use Hall effect sensors in place of pin contacts and microswitches to provide door OPEN/CLOSED status signal. Each door lock-button only affects the actuator it controls. There is no effect on the central lock control of other doors.

The automatic locking feature can activates the door lock actuators when a road speed signal of 2.5 MPH is detected via the K-Bus. The factory default coding for this feature is OFF, but can be coded ON for individual users with the Key Memory function. See ⇒ Car Memory/Key Memory later in this section.

The driver's door lock location is the only point outside of the vehicle where the key can mechanically control all of the central locking system functions. The outside locks (driver's door and trunk) incorporate an overrunning lock cylinder that breaks away and freewheels if an attempt is made to destroy either with a screwdriver or dent puller.

The rear doors are equipped with the child lock-out lever preventing the door

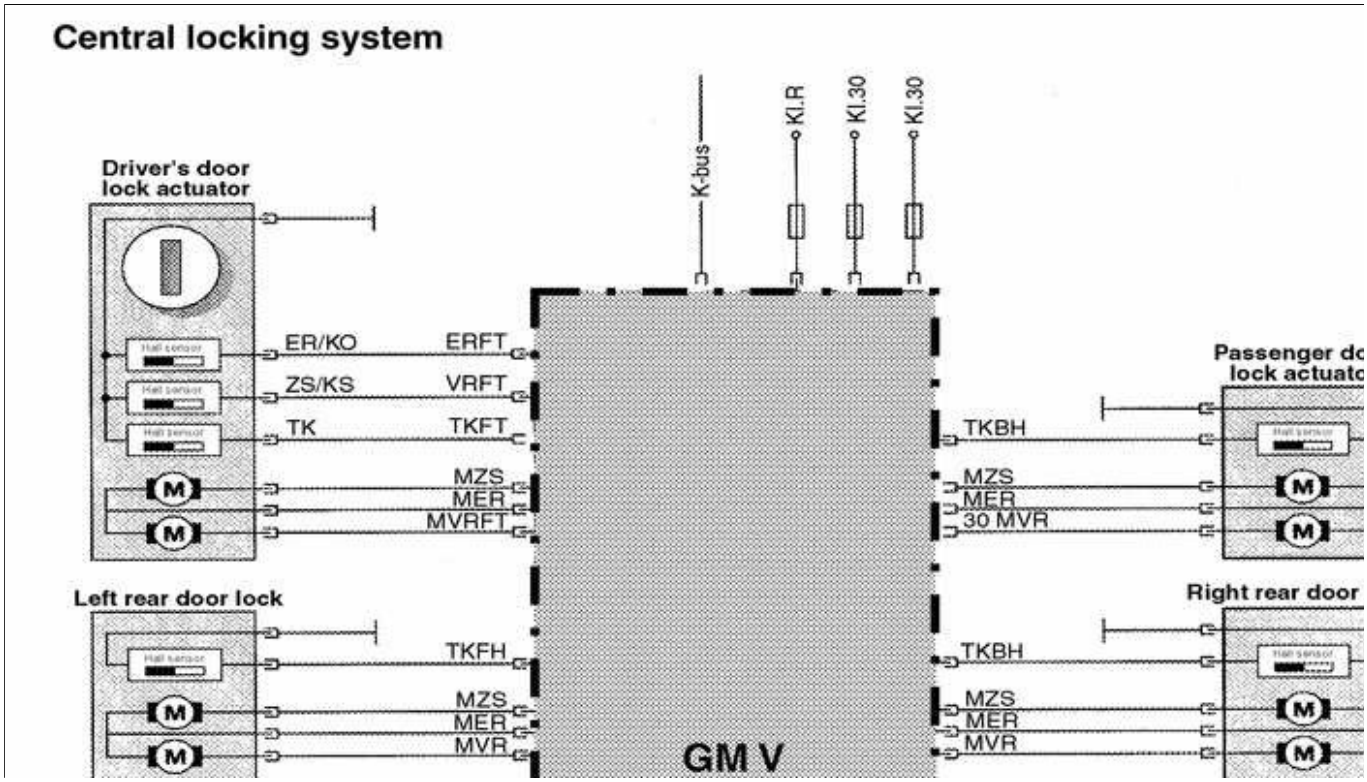
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from being opened from the inside regardless of lock-button position.

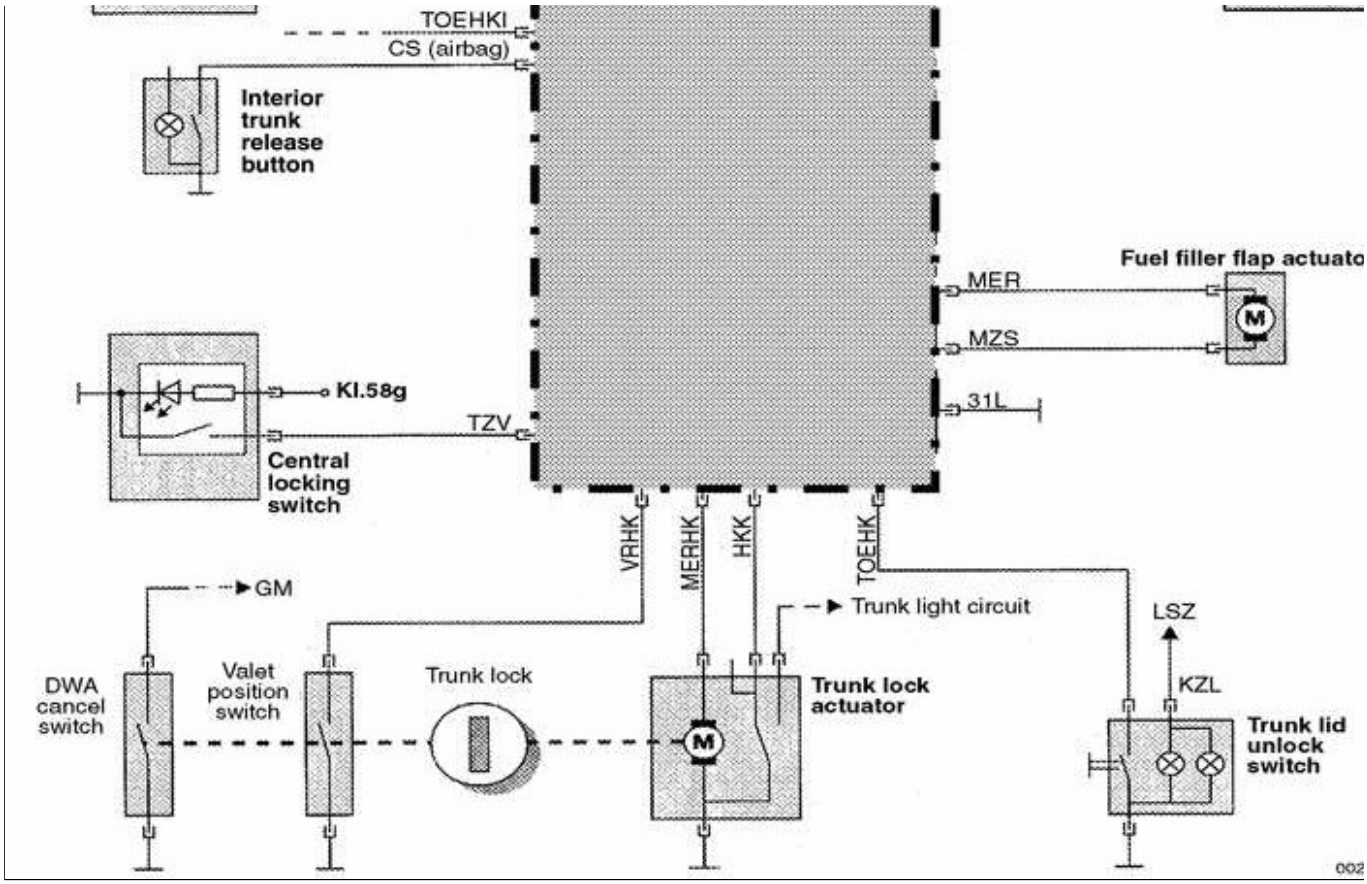
The General Module (GM V) and Electronic Immobilization (EWS 3.3) interface via the K-bus to monitor double lock status and to initiate double lock override. This feature allows the doors to be opened from the inside if a key accepted by EWS is switched on in the ignition when the doors are double locked.

Continuous locking/unlocking will initiate a timed arrest of the locking system. The GM V counts each time the locks are actuated. After approximately 12 cycles, the timed arrest is active. The timed arrest is deactivated one actuator cycle for every 8 seconds until the counter is reset to 0. The timed arrest is overridden if a crash signal is received from the multiple restraint system (MRS).

Central locking system



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Central locking switch



The central locking switch is housed in a combined housing with the hazard flasher switch. The central switch locks all vehicle locks except for the fuel filler flap.

The switch provides a momentary ground input signal to the GM V. This input single locks each door and the trunk. The fuel filler flap remains unlocked for refueling purposes. If a door is manually unlocked and opened while centrally locked, the remaining doors stay locked. The opened door can be re-locked when closed by manually locking or pushing the central switch twice. This allows the locks of the remaining doors to be resynchronized.

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Single lock and double lock function

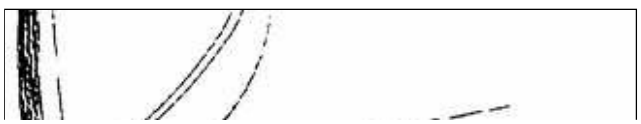
Each door lock actuator incorporates two motors:

Single lock motor controls the mechanical lock mechanism when the central lock switch is pressed to single lock the vehicle. The lock mechanism is fully locked at this point but can still be opened from the interior by pulling the appropriate interior door handle twice or by pressing the central lock switch again. When single lock function is activated, the fuel filler flap actuator is not locked.

Double lock motor, also known as central arrest, is activated only when the vehicle is locked from the outside at the driver's door lock with a key or when the General Module (GM V) receives a lock request from the remote entry (FZV) system. In this case the double lock motor is activated simultaneously with the single lock motor. The function of the double lock motor is to mechanically offset an internal rod in the lock actuator, disabling it from unlocking the vehicle from the interior. This prevents the doors from being unlocked by any means except from an unlock request at the driver's door or via the FZV remote key.

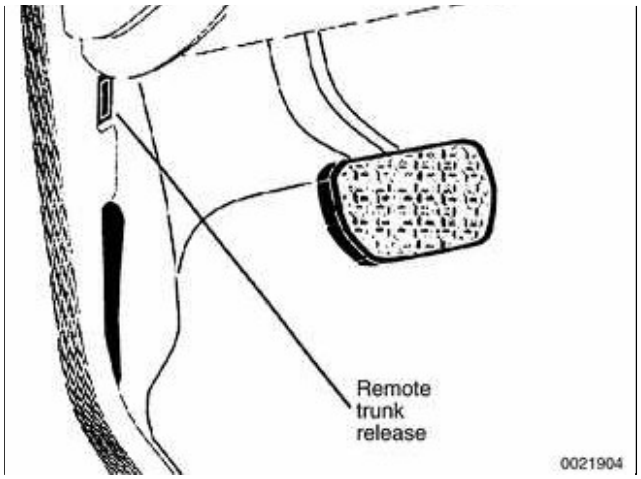
Trunk lock

The trunk lock can be operated with the key but does not lock or unlock the entire vehicle. When unlocked, the trunk can be opened by pressing the trunk release switch pad located above the license plate or from the remote trunk button in the left kick panel.



The trunk can also be opened from inside the vehicle by pressing the remote trunk lid release button in driver's

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footwell area. The button provides the GM V with a ground signal when pressed.

The vehicle must be unlocked or single locked from the central lock switch for the remote unlock to work. The remote trunk release is locked out when the trunk is locked in the valet setting or when the GM V detects a vehicle speed over 4 mph via the K-bus.

Pressing the trunk release button on an FZV key also opens the trunk.

The trunk lid position (open/closed) and trunk lock key positions are input signals to the General Module (GM V). The trunk lid OPEN/CLOSED signals come from the trunk lid switch contact located in the trunk lock motor. When closed, the trunk contact provides a ground signal to the GM V signifying a CLOSED trunk. This contact also serves as the trunk light switch when the trunk is OPEN.

The actuator motor only operates in one direction to release the latch mechanism. The latch mechanism can also be manually unlocked with the key.

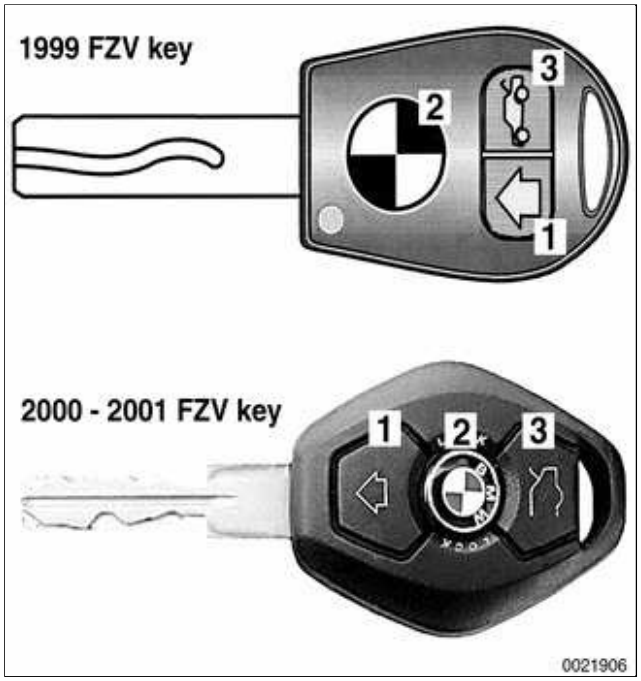
Located on the trunk lock are two additional microswitches for key position status signalling to the GM V.

- Valet position switch: With the key lock in the valet position, this switch provides a ground signal to the GM V. The GM V locks out the interior trunk release button preventing the trunk from being opened.

- DWA cancel switch: When the trunk is opened with the key, this switch provides a ground signal to the GM preventing the DWA alarm system from activating, if armed.

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Remote entry (FZV)



The E46 remote (keyless) entry system (usually called FZV) uses a tiny radio transmitter in the vehicle key to lock and unlock the doors and the trunk by remote control.

1	Press once: ♦ unlock driver's door ♦ DWA disarmed ♦ interior lights on Press twice: ♦ total unlocking Hold ♦ convenience opening
2	Press once: ♦ lock ♦ DWA armed ♦ interior lights ON when vehicle is locked Press twice within 10 seconds ♦ deactivate interior and tilt monitoring
3	Press momentarily ♦ trunk lid opens Press and hold:

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	♦ panic mode (alarm if equipped)

There are a number of other features incorporated in FZV:

- Locking/unlocking of fuel filler lid
- Selective unlocking of driver's door (as with key in lock)
- Arming/disarming of DWA alarm system (if equipped)
- Remote unlocking of the trunk only
- Comfort opening of windows, sunroof, and convertible top.
- Interior lighting activation (search mode)
- Panic mode alarm activation (if equipped)
- Automatic correction for up to 1000 erroneous activation signals.
- Low transmitter battery fault code storage in the GM V
- 3 volt lithium battery (commercially available CR 2016) used as power supply for key transmitters
- An EEPROM to stores key data. Data is no longer lost when key battery is replaced; reinitialization is not required.

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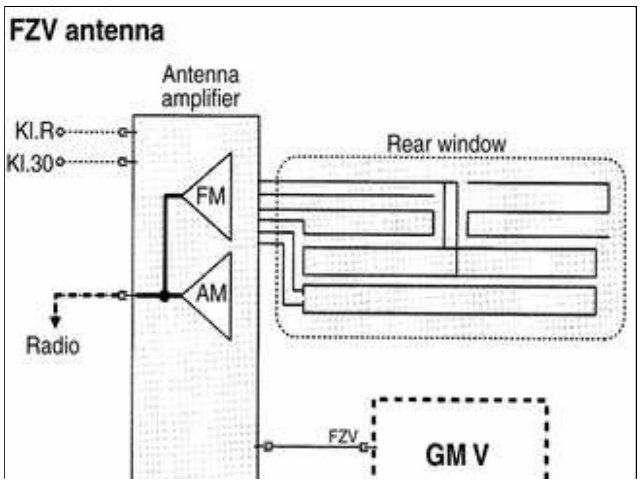
- Key incorporates an LED that signals operator of signal transmitting, key initialization status and key self-test indication

- Keys delivered with four different colored labels. This is helpful to differentiate FZV keys during initialization, preventing possibility of misassigning key ID which would change coded Key Memory functions.

Note:

- *A single unlock request from the driver's door with the FZV key unlocks the driver's door only. A second unlock request unlocks the remaining doors and trunk. This feature can be modified for individual users with the Key Memory capabilities to activate all lock actuators simultaneously. Car Memory/Key Memory is covered later in this section.*

- *Starting with 2000 models, the battery in the FZV ignition key is recharged while the key is in the ignition switch. Therefore there is no need to replace the key battery.*



The remote key receiver is part of the antenna amplifier and is installed in the left "C" pillar. The receiver produces a digital signal based on the transmitter command and sends it to the GM V for processing. The GM V then carries out all remote lock system, window/sunroof convenience closing features and DWA arming/disarming functions. The frequency of the FZV key radio signal to the antenna amplifier is 315 MHz. The system is also used to convey the key identification number being used to

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lock/unlock the vehicle. This is a requirement of the Key Memory feature, covered below.

Car Memory/Key Memory

A number of features and functions can be customized to the driver(s) preference. The identity of the vehicle user is provided by a signal from the keyless entry system (FZV).

Car Memory and Key Memory are actually two separate functions, although they are marketed as a combined feature.

Car Memory

The owner is provided with a list of systems that can be customized. Prior to vehicle delivery, the BMW scan tool DIS or MoDiC is used to code the driver preferences into the appropriate control modules. Thereafter these choices cannot be changed without recoding with a BMW scan tool.

The functions that can be set using Car Memory include:

- Alarm system (DWA) features such as arming/disarming with keyless entry (FZV), activation of tilt sensor or interior sensor
- Interior light activation when central locking is used
- Convenience opening of windows/sunroof
- Interior and external lighting preferences

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- Heating/A/C preferences (IHKA)
- Seat and mirror preferences (triggered by Key Memory)
- Instrument cluster display units (for example: km vs. miles)

Key Memory

Whenever one of the FZV keys is used to lock or unlock the car, the user is identified by the GM V. A maximum of four keys can be programmed with the Key Memory feature. The use of the personalized key then triggers Car Memory functions such as heating/A/C (IHKA) settings or memory seat position adjustment.

Most programming of Key Memory requires the use of BMW scan tools DIS or MoDiC. However, features such as IHKA blower speed and temperature store automatically without the use of scan tools.

Available Key Memory functions vary based on vehicle equipment. The functions that can be set include:

- Automatic locking after start off
- Selective locking
- Heating/A/C blower speed, heated or cooled air distribution, automatic blower setting.

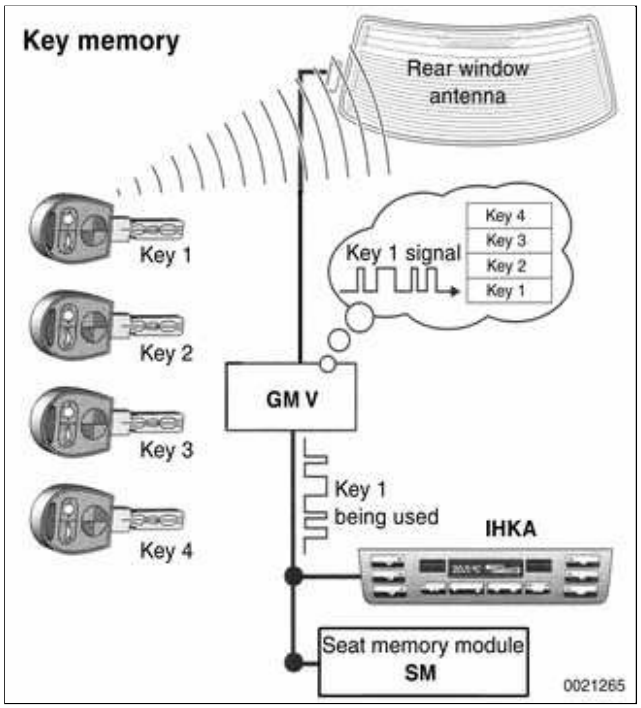
Note:

Key Memory is only activated when using keyless entry. If the driver's door is unlocked manually, no electronic input is

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received at the GM V. Therefore Car Memory/Key Memory features will not be activated.

Remote key initialization



Initialization of FZV keys is required to establish lock/unlock signal synchronization with the GM V. The initialization procedure provides the GM V with a key identification number and a "rolling code" for each key. If initialization is not performed, the GM V will not respond to the key signals.

Up to 4 remote keys can be initialized. They must be initialized at the same time. Key initialization is only possible with the vehicle unlocked.

- Close all doors and have all keys available.
- Using key number 1, turn the ignition switch to KL R (accessory position), then switch off within 5 seconds and remove the first key.
- Within 30 seconds of turning the ignition switch to OFF Press and hold button #2
- While holding button #2, press and release ("tap") button #1 three times within 10 seconds.
- Release both buttons.

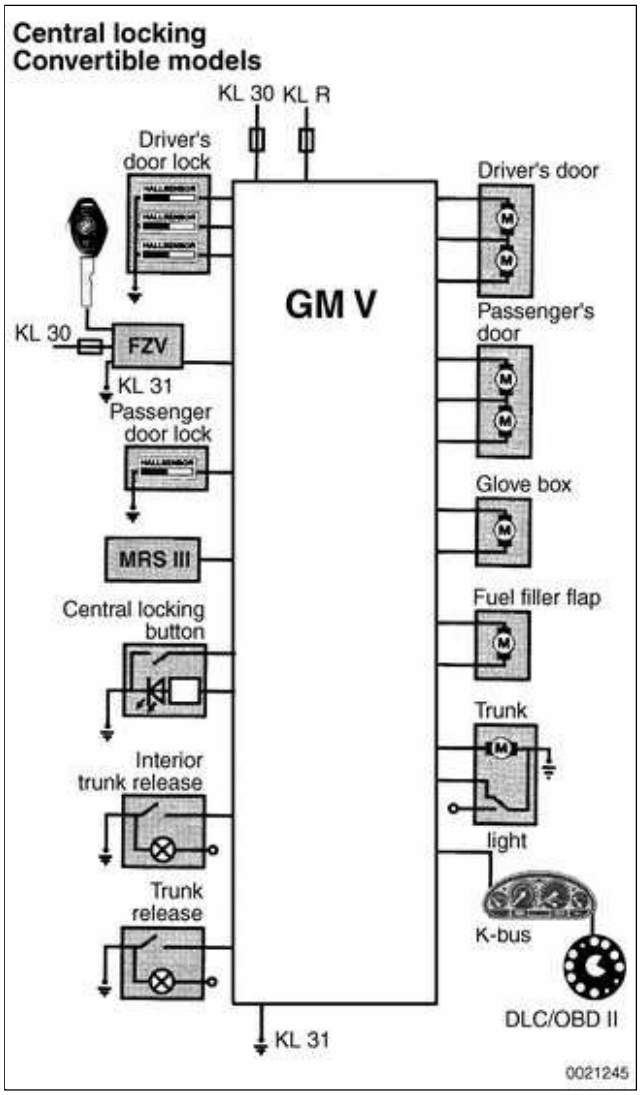
Note:

The Key Memory function of the GM responds to the key identification number of each key. If the keys are not initialized in the same order prior to initialization,

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the key memory functions activated by the keys will not be assigned correctly. Always initialize the keys in the same order.

Convertible central locking



In Convertible models, the glove compartment lock is integrated into central locking functions. An additional lock actuator is positioned above the glove compartment lock, locking it whenever central locking is activated.

A microswitch on the glove compartment lock cylinder signals the GM V to lock the trunk electrically. This is the equivalent of valet key position. The trunk can only be opened with either the remote (FZV) key or the wallet key.

Also, the trunk is locked whenever the top storage compartment is unlocked while the top is raised or lowered. The top storage cover motor Hall sensor signals the GM V whenever the cover is unlocked.

The Convertible Top Module (CVM II) receives a signal from the GM V over the K-bus to lock out convertible top operation whenever the trunk is OPEN.

The FZV antenna for the Convertible is incorporated into the rear view mirror.

Tailgate and rear window locking

The Sport Wagon tailgate can be opened from:

- Remote key (FZV)

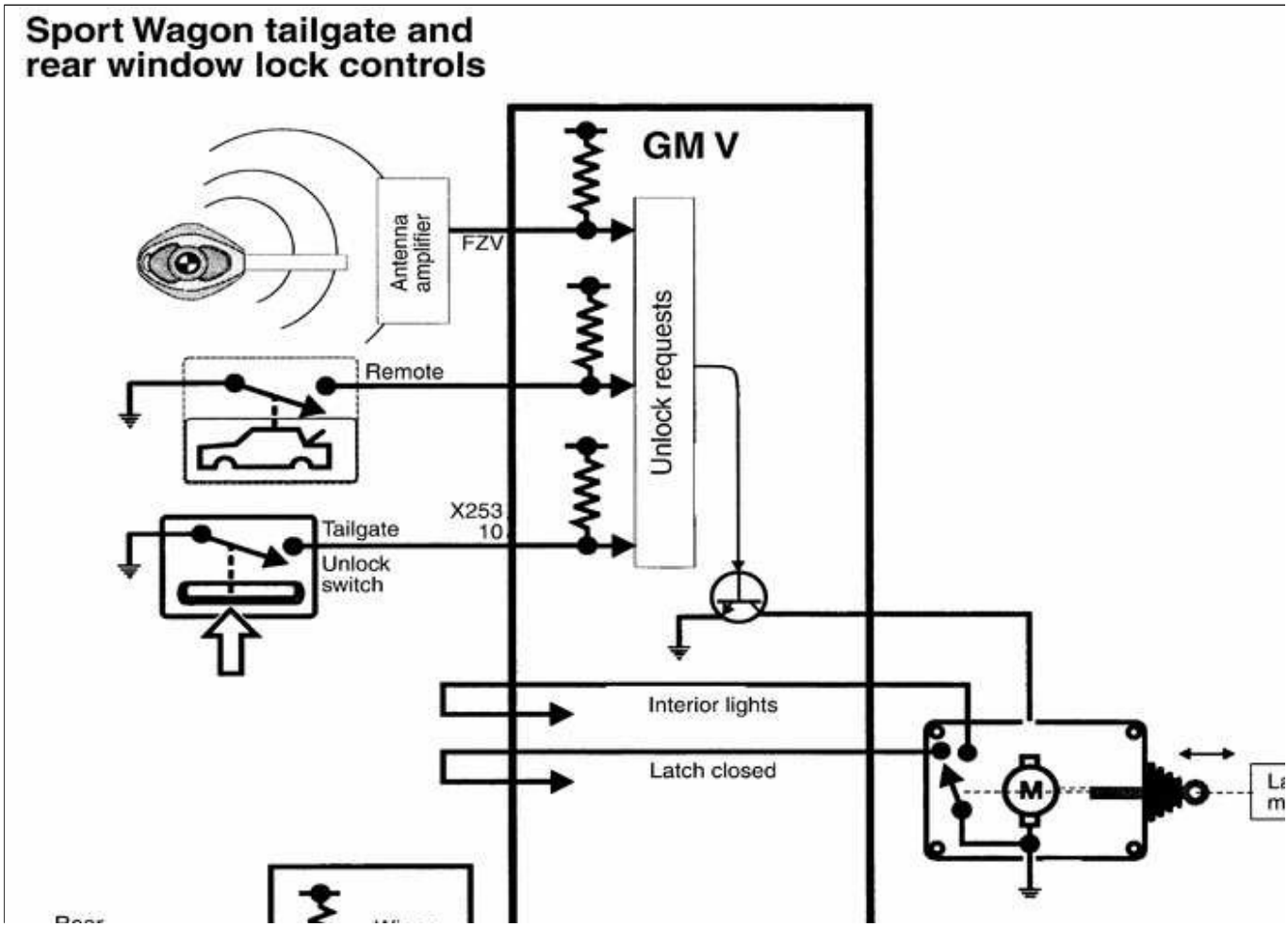
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- Interior tailgate release button at driver's kickpanel
- Unlock microswitch above rear license plate

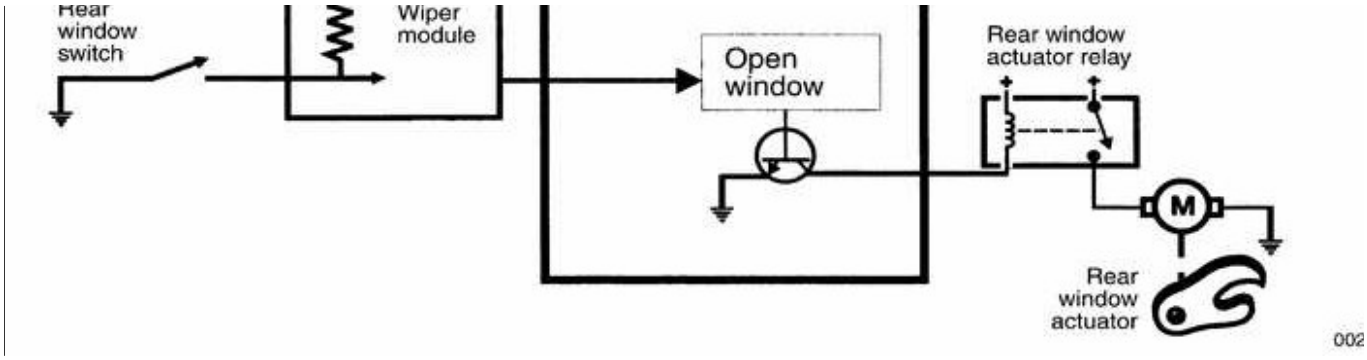
Any of these input requests to the GM V activate the tailgate latch motor. The GM V will also switch on the interior lights with a tailgate unlock request.

The rear window is opened with the release switch on the rear wiper arm cover. Pressing the switch signals the GM V to activate the rear window release relay.

Sport Wagon tailgate and rear window lock controls



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Door Handles and Locks

Any time a door lock is removed and reinstalled, be sure to check and reset:

- Unlocking of rotary latch
- Outside door handle overtravel

These adjustments and measurements must be made by closing the door lock rotary latch with a screwdriver, then attempting to open it with the outside door handle. Both adjustment procedures are described below, under ⇒ Rotary latch adjustments.

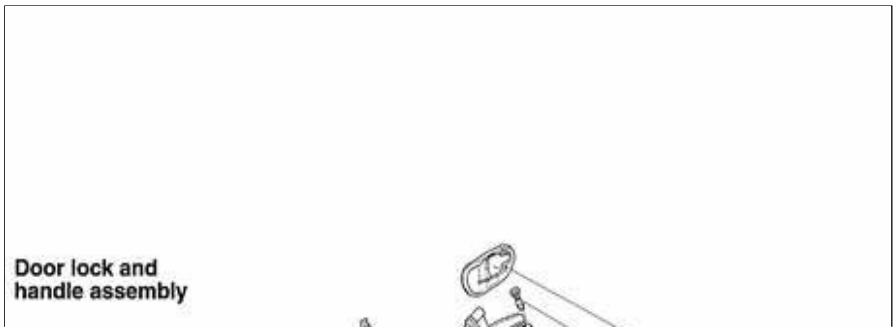
CAUTION!

Do not close the door before resetting rotary latch adjustment. The door may lock and be unopenable from outside.

Rotary latch adjustments

CAUTION!

Carry out rotary latch checks and adjustments with the door open. If the door is closed with the incorrect latch setting, it may not be possible to open the door without destroying the inner door panel.

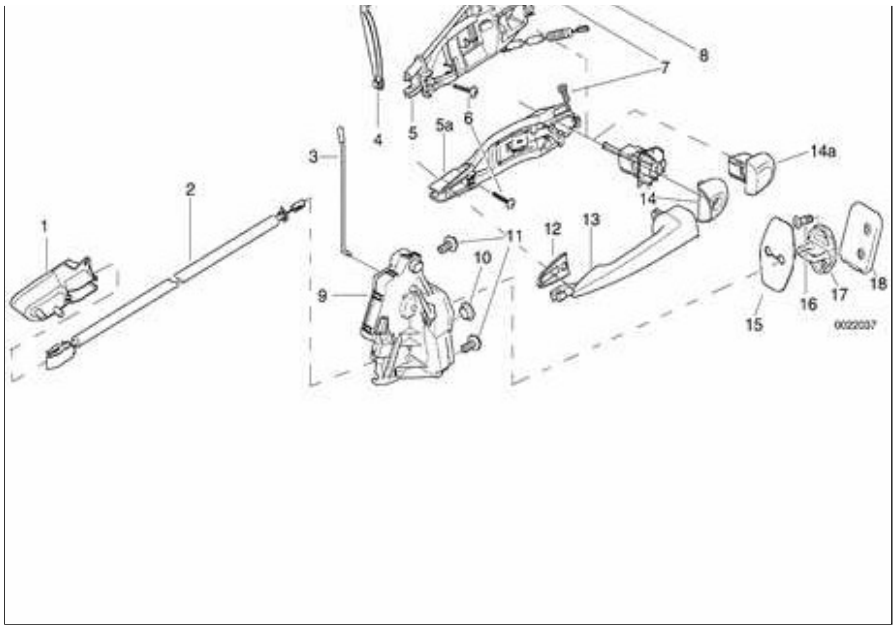


Door lock and handle assembly

1 - Inside door lock release

2 - Inside door

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release Bowden cable

3 - Lock button and rod

4 - 9/2000 and later models: Bowden cable bracket

5 - 9/2000 and later models: Door handle inner mechanism

5a - Models to 9/2000: Door handle inner mechanism

6 - Inner handle mounting bolt

7 - Key cylinder mounting bolt (Torx)

8 - Gasket

9 - Door lock with rotary latch

10 - Plug

11 - Bolt M6 (always replace)

- ♦ tighten to 9 Nm (80 in-lb)

12 - Gasket

13 - Outer door handle

14 - Driver's door: Door lock

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cylinder and cover

14a - **Rear or right door: Outer handle rear anchor**

15 - **Door striker cover**

16 - **Torx bolt M8**

- tighten to 24 Nm (18 ft-lb)

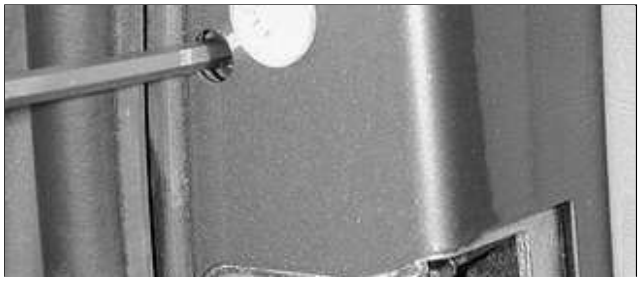
17 - **Door lock striker**

18 - **Lock plate**

Rotary latch unlocking, resetting

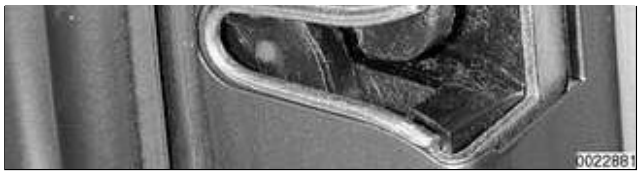


- With door open, close rotary latch.
  - Lock car with key or lock button.
  - Unlock car.
  - Open rotary latch using outside handle.
  - If latch unlocks, adjustment is correct.



- If latch fails to unlock:
  - Remove latch adjuster access hole cover.
  - Use 4 mm Allen wrench to loosen

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adjustment screw, then retighten.

- Carry out check again.

Note:

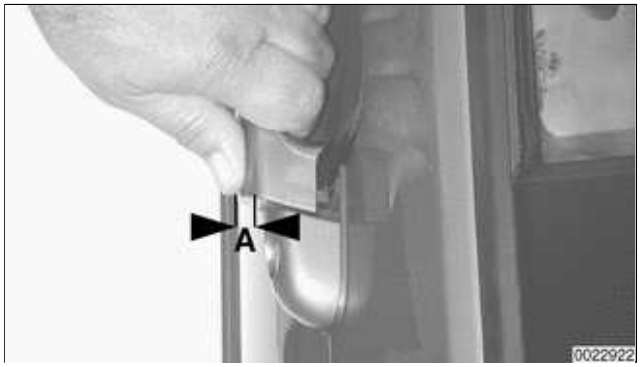
The right side latch adjusting screw is threaded left-handed.

Tightening torque	
Door lock adjustment screw	3 + 2 Nm (27 + 18 in-lb)

Outside handle overtravel, resetting

- With door open, close rotary latch with a screwdriver.

- Open rotary latch with outside door handle.



➢ Measure additional distance (**A**) handle can travel once rotary latch releases.

- If measurement **A** is obtained, rotary latch adjustment is correct.

- If measurement **A** is not obtained, readjust rotary latch through access hole, as described above, and check handle overtravel again.

- If measurement **A** is still not obtained, replace door lock.

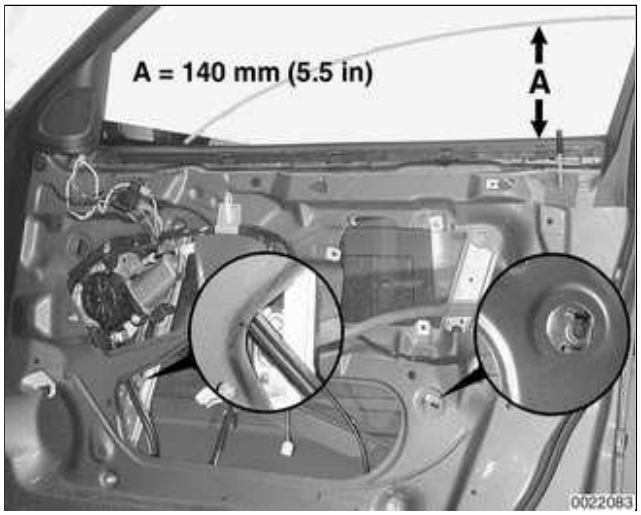
Outside door handle overtravel	
Measurement **A**	min. 2 mm (0.08 in.)

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Door lock, removing and installing

The front and rear door locks for all E46 models are similar. Early production cars, up to 9/2000, use a lock actuator with an external lever which couples with the outside door handle mechanism. Cars produced from 9/2000 use a Bowden cable to attach the outside door handle to the lock release mechanism.

- Remove front door tim panel, air bag, and vapor barrier as described in ⇒ 411 Doors and ⇒ 721 Airbag System (SRS).



➢ Detach window from window regulator rails:

- Reattach battery. Move window to approx. 140 mm (5.5 in.) from bottom.

- Remove window retaining screws (**insets**) at window regulator rails.

WARNING!

Once the window is positioned correctly, disconnect harness connector from power window motor to prevent accidental operation of the window.

Note:

Be prepared to retrieve the captured nut corresponding to the retaining screw on the back side of the window rail. It may fall to the bottom of the door.

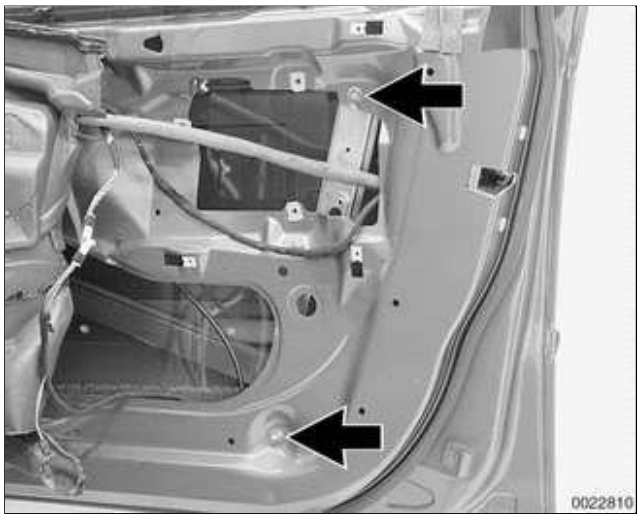
- Be sure to separate plastic lug at base of window from rail.

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- Raise window to top.

CAUTION!

Guide the window up manually in order to avoid binding.



- Remove window regulator rear rail:

  - Remove top and bottom rail mounting fasteners (**arrows**).

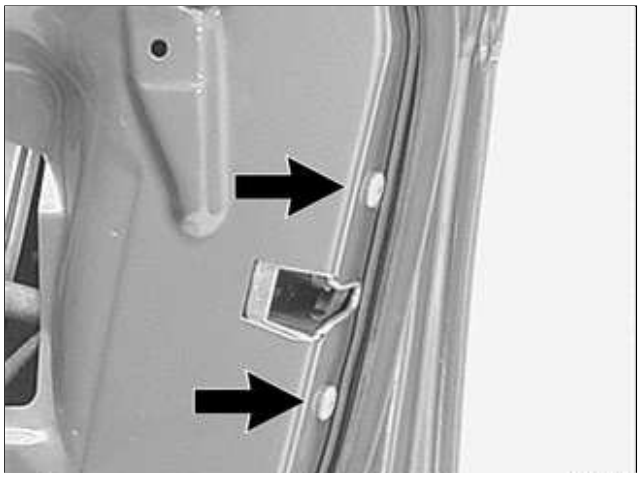
  - Slide rail down, allowing it to hang to the side out of the way.

WARNING!

E46 cars are fitted with side-impact airbags in the front doors. When servicing the door locks on cars with front side-impact airbags, always disconnect the negative (-) battery terminal. See ⇒ 721 Airbag System (SRS) for cautions and procedures relating to the airbag system.

  - Driver's door: Remove door lock cylinder as described later.

  - Models produced from 9/2000: Carefully pry outside door handle Bowden cable off lock assembly.



- Remove lock mounting bolts (**arrows**) from rear edge of door. Support lock to prevent it from falling into bottom of door.

  - Disconnect harness connector from lock assembly.

  - Remove lock assembly, complete with lock-button linkage.

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- Installation is reverse of removal, noting the following:

- Insert lock button up through inner door plate, taking care to avoid bending linkage.

- On models produced to 9/2000: Tilt lock assembly outward while lifting it into position inside the door. This is done to make sure lock lever is inserted between outside door handle pawl and outer door skin.

- Use new door lock mounting bolts.

- Use new self-locking mounting bolts when reinstalling side-impact airbag to door (where applicable).

- Secure wire harnesses with wire ties, as applicable.

- Be sure to check unlocking of rotary latch and outside door handle overtravel as described above under ⇒ Rotary latch adjustments.

- Check function of window mechanism before reinstalling vapor barrier and inner door panel.

Tightening torques	
Airbag to door (replace screws)	8.5 Nm (75 in-lb)
Door lock to door M6 bolt (always replace)	9 Nm (80 in-lb)
Window guide to door	9 Nm (80 in-lb)

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Tightening torques	
Window to guide	8 Nm (71 in-lb)

Driver's door lock cylinder, removing and installing

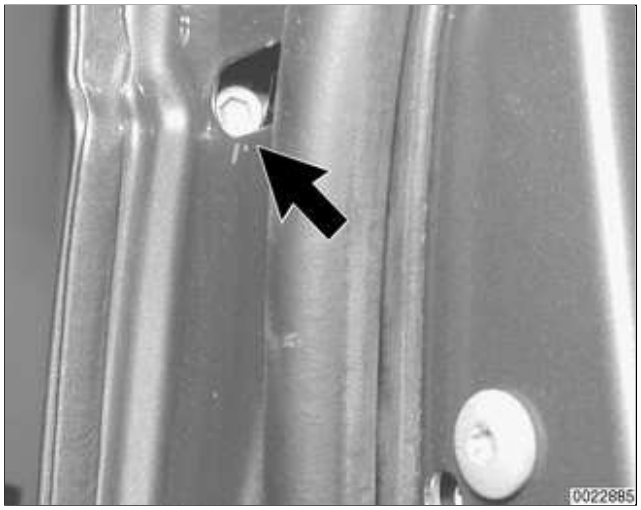
Only the driver's door is equipped with a lock cylinder. The procedure for removing the door handle rear anchor on the other three doors is similar to that for removing the driver's door lock cylinder.



- Open door and remove plastic plug (Sedan or Sport Wagon shown in illustration) or rubber covering (Coupe or Convertible) at lock cylinder mounting bolt access hole in upper rear door edge.

Note:

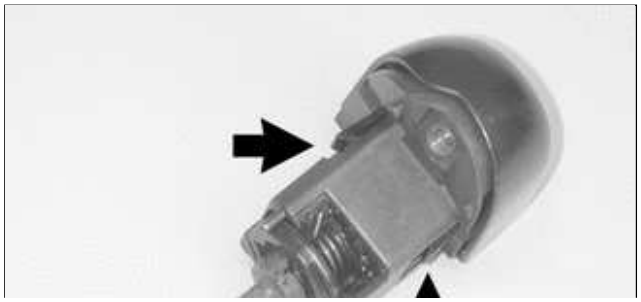
On Sedan or Sport Wagon: Remove inner plug by prying with screwdriver, then peel off outer (oval) plastic trim.



- Remove lock cylinder mounting screw (**arrow**).
  - Pull out lock cylinder.

Note:

Use key in cylinder to help pull cylinder out.



- Use a small screw driver to pry cylinder cover locking tabs (**arrows**). Slide cover off cylinder gently to avoid breaking tabs.
  - Installation is reverse of removal.

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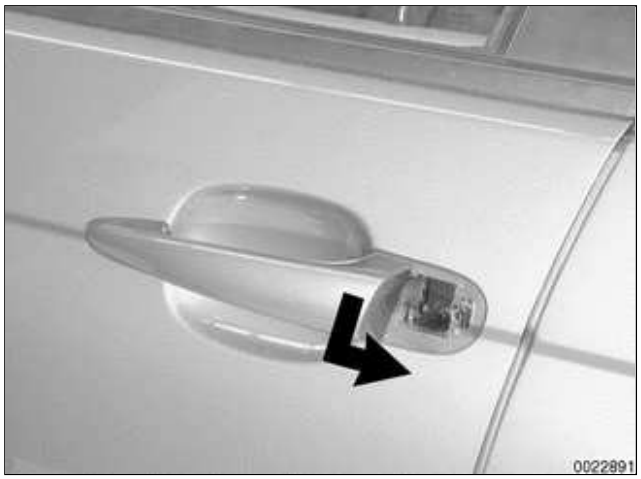


- On Sedan or Sport Wagon: Replace cylinder mounting bolt access hole trim cover if necessary.

Door handle, removing and installing (to production date 9/2000)

- On driver's door: Remove door lock cylinder as described earlier.

- Other doors: Remove door handle rear anchor. Procedure is similar to removing driver's door lock cylinder described earlier.



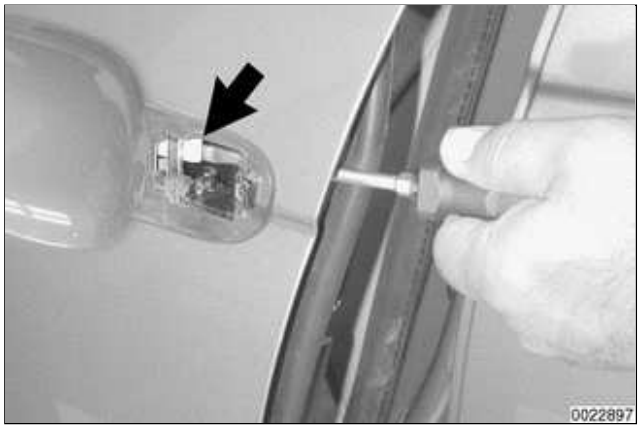
- Pull handle out as far as it will go, then backward approx. 2 mm (0.08 in.).

- Push handle in slightly (approx. 4 mm/0.16 in.).

- Remove door handle from door by angling out of door cavity.

Note:

Make sure the lock release pawl at the rear of the handle and the mounting guide at the front of the handle are intact.



- Before reinstalling, insert screwdriver through access hole in edge of door to push lock release lever (**arrow**) outward.

- Insert outside handle and snap forward until a click is heard.

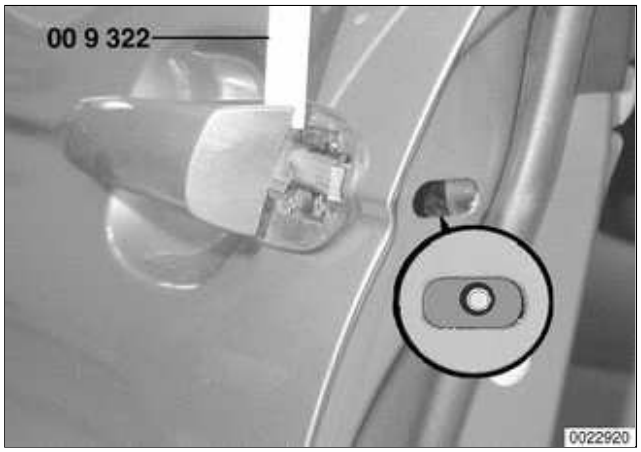
- Be sure to check unlocking of rotary latch and outside door handle overtravel as described above under ⇒ Rotary latch adjustments.

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Door handle, removing and installing (from production date 9/2000)

- On driver's door: Remove door lock cylinder as described earlier.

- On other doors: Remove door handle rear anchor. Procedure is similar to removing driver's door lock cylinder described earlier.



➢ Pull outside door handle out and wedge BMW special tool 00 9 322 under handle.

- Working in lock cylinder mounting bolt access hole, tighten down screw (counterclockwise direction). Lock is now in "installation position". Remove special tool 00 9 322.

Tightening torque	
Outside handle to lock (left-hand thread)	2.0 ± 0.4 Nm (18 ± 3.5 lb-in)

- Pull outside door handle outward and unhook from front guide.

Note:

Make sure the lock release bore at the rear of the handle and the mounting guide at the front of the handle are intact.

- Before reinstalling handle, make sure lock mechanism is in "installation position" as described earlier:

♦ Distance between inner door handle lever and outer door skin must not

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exceed measurement **A**.

- If measurement exceeds specification, pull lever outward with fingers until measurement is correct.

Installation distance: inner door handle lever to door	
Measurement **A**	less than 8 mm (0.32 in.)

- Insert handle and snap into place.

Note:

Take care that the door handle base gasket is not deformed when the handle is installed.

- Be sure to check unlocking of rotary latch and outside door handle overtravel as described above under ⇒ Rotary latch adjustments.

Door handle inner mechanism, removing and installing (to production date 9/2000)

- Remove door lock and outside door handle as described earlier.

- Remove front door tim panel, air bag, and vapor barrier as described in ⇒ 411 Doors and ⇒ 721 Airbag System (SRS).

- Remove outside handle base seals.



Loosen inner handle mounting bolt (**arrow**).

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- Working inside door opening, slide inner handle toward front and remove.

- Installation is reverse of removal.

Note:

Inspect mounting bolt and replace if necessary.

Door handle inner mechanism, removing and installing (from production date 9/2000)

- Remove outside door handle as described earlier.

- Remove outside handle base seals.

- Remove front door tim panel, air bag, and vapor barrier as described in ⇒ 411 Doors and ⇒ 721 Airbag System (SRS).

- Lever out Bowden cable from door handle with screwdriver.

- On Sedan or Sport Wagon: Slide Bowden cable out of guide.

Note:

Foam insulation on bowden cable must be placed in original position during reinstallation.

- On Coupe or Convertible: Remove inner door guide (plastic) to gain access to Bowden cable.

Note:

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Take care to not damage inner door guide during removal and installation.

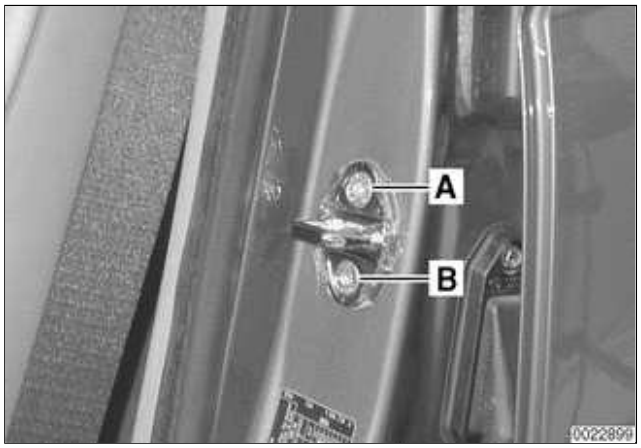
- Loosen handle mounting bolt.
- Working inside door opening, slide inner handle toward front and remove.
- Installation is reverse of removal.

Note:

- *Inspect handle mounting bolt and replace if necessary.*
- *Bowden cable end must be correctly fitted in lock actuator.*

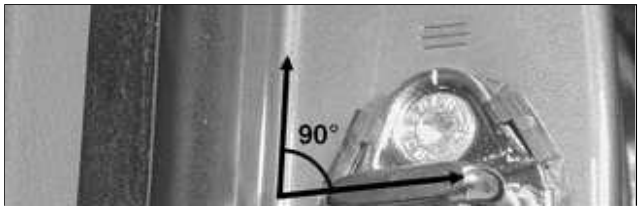
Door striker, replacing

- Remove striker plastic cover.



➢ Remove striker top mounting bolt (**A**).

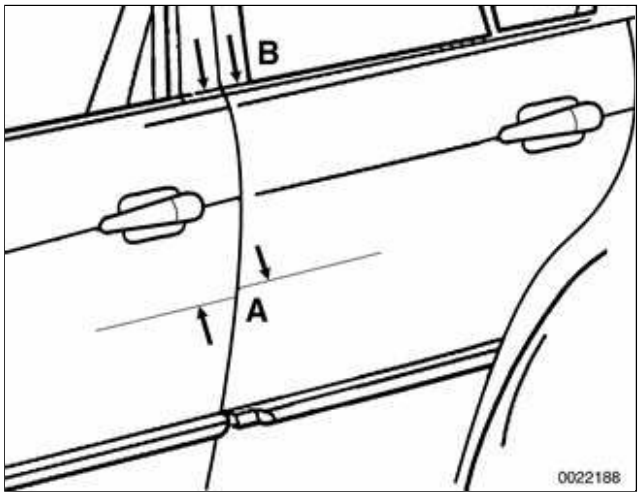
- Screw M8 stud into top bolt hole to keep striker backing plate from falling down into B-pillar cavity.
- Remove lower bolt (**B**).
- Remove and reinstall striker and gasket while holding on to stud. Install striker mounting bolts finger-tight.



➢ Position striker bar approx. 90° to inside edge of door frame. Leave striker mounting bolts finger-tight.

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➢ Set position of striker:

- When closed, rear edge of front door must be even with front edge of rear door (Sedan or Sport Wagon) or with rear quarter panel (Coupe or Convertible). Maximum deviation allowed measured at **A**.
- When closed, shoulder of front door must be flush to shoulder of rear door (Sedan or Sport Wagon) or with top of rear quarter panel (Coupe or Convertible). No deviation is allowed at measurement **B**.
- When door is closed, striker must not contact lock housing.
- With door closed, there must be no in/out movement of door.

- Torque striker bolts. Recheck door alignment. Reinstall plastic cover.

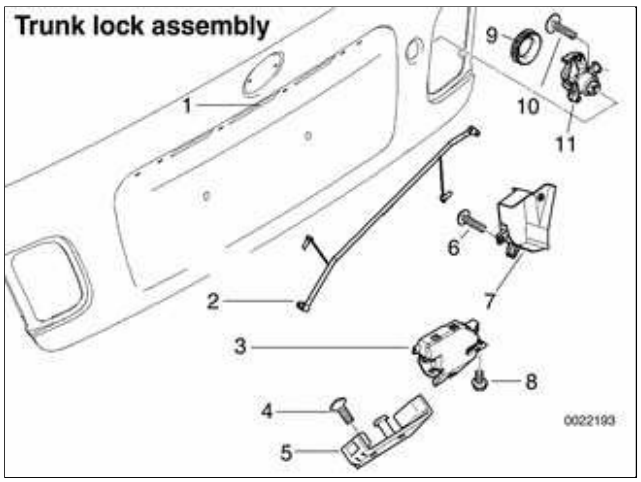
Door striker position	
Deviation from parallelism of closed door (**A**)	max. 1 mm (0.04 in.)
Deviation from flush at door shoulder (**B**)	0

Tightening torque	
Striker plate to	24 Nm (18 ft-lb)

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Tightening torque	
body pillar	

Trunk locking mechanism



Trunk lock assembly

1 - Trunk release microswitch

2 - Connecting rod

3 - Lock with microswitch

4 - Torx screw M6

5 - Striker plate

6 - Trim screw

7 - Lock cover

8 - Torx bolt M6

9 - Lock cylinder gasket

10 - Self-threading screw

11 - Lock cylinder

The trunk can be unlocked by using:

- Central locking button
- Left door key
- FZV remote entry system
- Trunk lock cylinder in the trunk lid right side taillight assembly
- Trunk release in the driver's footwell, if equipped
- Microswitch in the center of the

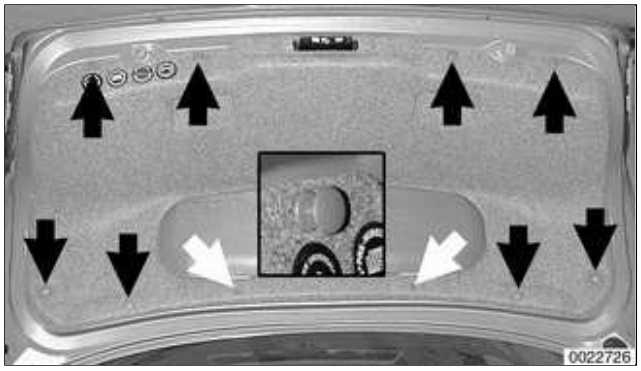
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license plate light strip

The trunk lock cylinder does not actuate central locking control.

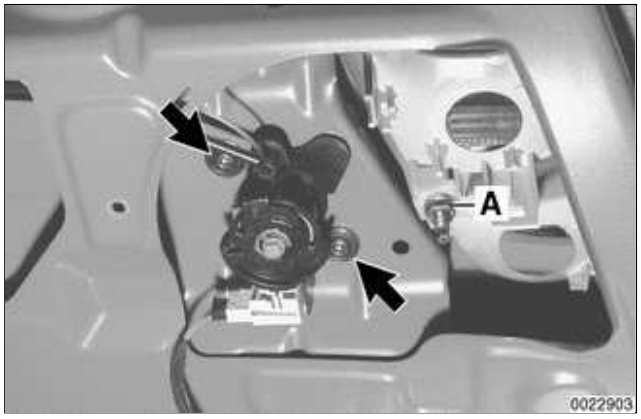
- To remove the trunk lock microswitch:

- Remove licence plate light strip.
- Separate electrical harness connector from strip.
- Separate microswitch from strip.



➢ To access trunk lock cylinder or lock:

- Raise trunk lid.
- Open tool kit and remove screws attaching tool kit to trunk lid (**white arrows**). Unclip retaining strap at trunk lid and remove tool kit.
- Remove insulating liner expansion rivets (**black arrows**). and remove trunk liner. Expansion rivets are released by pry upper portion out (**inset**).
- Lift off trim panel.



➢ To remove trunk lock cylinder:

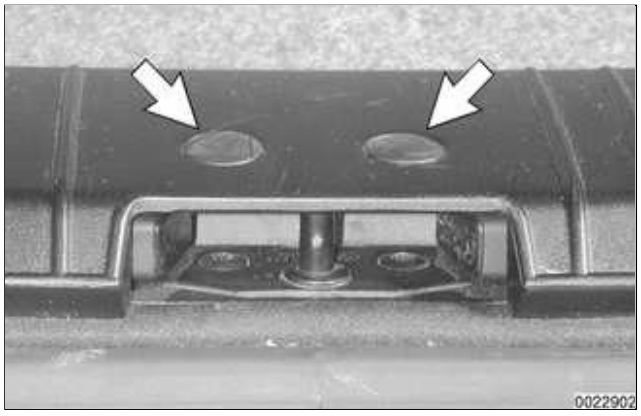
- Remove right taillight socket from trunk lid. See ⇒ 630 Lights.
- Remove right tail lens mounting nut (**A**) and detach tail lens from trunk lid.

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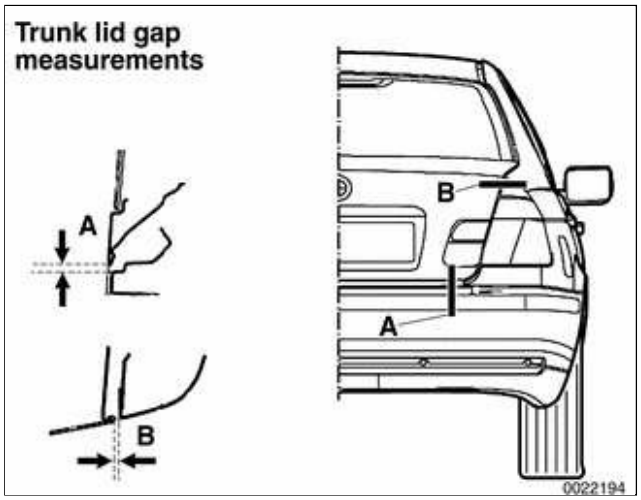
- Remove lock cylinder cover mounting screws (**arrows**). Slide cover to right to remove.

Note:

- *On Convertible models: Remove third brake light to access trunk lock mechanism.*
- *Use new self-tapping screws to reinstall trunk lock cylinder.*



- Pry out rear trunk edge trim caps (**arrows**) to access mounting screws to remove trunk lock striker.



- When reinstalling, or to adjust trunk lid alignment, adjust position of trunk lock striker with mounting bolts finger tight.
  - Set gap measurements as listed below.
  - Check trunk lid lock operation with lid open.
  - Also see ⇒ 412 Trunk Lid, Tailgate.

Trunk position gap adjustment	
Trunk lid / trunk panel (**A**)	5 ± 1.5 mm (0.2 ± 0.06 in.)
Trunk lid / rear fender (**B**)	4.25 ± 0.75 mm (0.17 ± 0.03 in.)

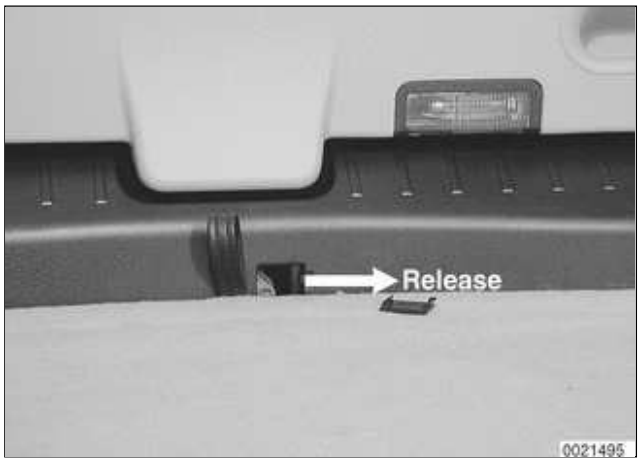
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Note:

Do not lubricate lock or lock striker with grease.

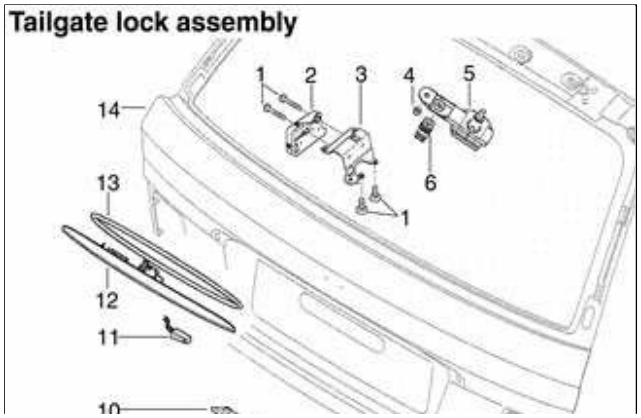
Tailgate lock, emergency release

The Sport Wagon tailgate can be unlocked using the central locking switch, the left door key or the FZV remote entry system. The tailgate can be opened by pushing the tailgate release button in the left front kickpanel or by pressing the microswitch in the center of the license plate light strip. There is no key lock cylinder in the tailgate.



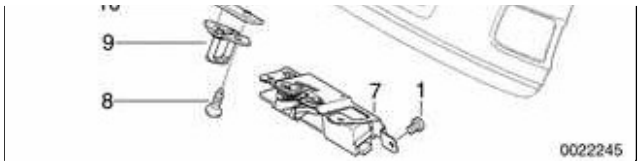
- In case of electrical failure, there is an emergency tailgate lock release. The release is located in the rear cargo area, along the lower edge of the rear apron behind a small access cover. Remove access cover and push release in direction of arrow to open tailgate.

Tailgate and rear window locking mechanism



- Tailgate lock assembly
  - 1 - Torx bolt M6
  - 2 - Rear window lock
  - 3 - Rear window lock cover
  - 4 - Nut M6
  - 5 - Rear window striker mounting bracket and wiper pivot

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6 - Rear window lock striker

7 - Tailgate lock

8 - Torx bolt M8

9 - Tailgate lock striker

10 - Lock plate

11 - Tailgate release microswitch

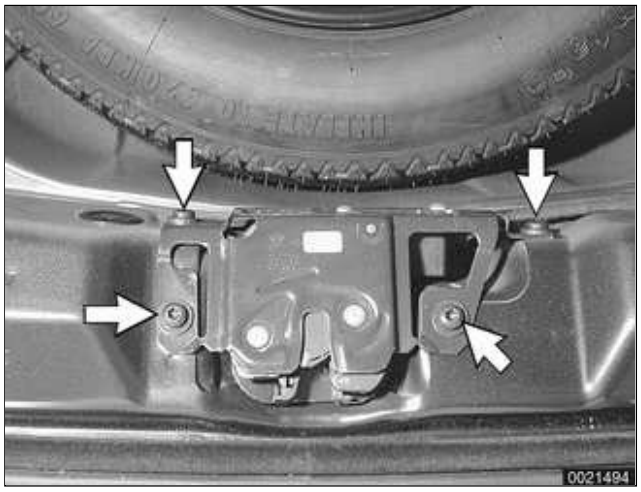
12 - Tailgate grip

13 - Tailgate grip gasket

14 - Tailgate

To remove tailgate lock microswitch:

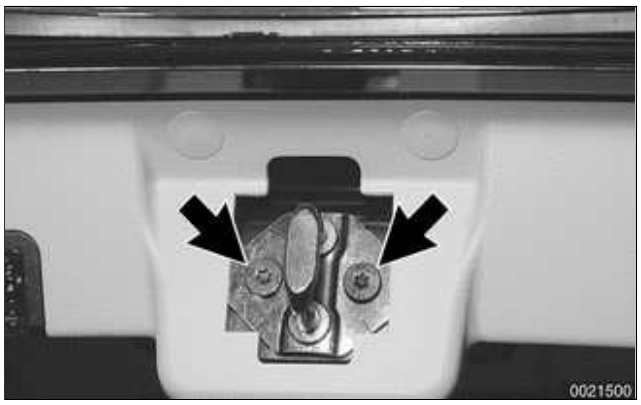
- Remove license plate light strip.
- Separate electrical harness connector from strip.
- Separate microswitch from strip.



To remove tailgate lock:

- Open tailgate and remove tailgate rear panel trim.
- Mark position of lock on rear panel.
- Remove lock mounting bolts (**arrows**).
- Detach lock mechanism electrical harness contractor.
- Electric lock actuator and emergency release lever can now be separated from tailgate lock mechanism.

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To remove tailgate lock striker:

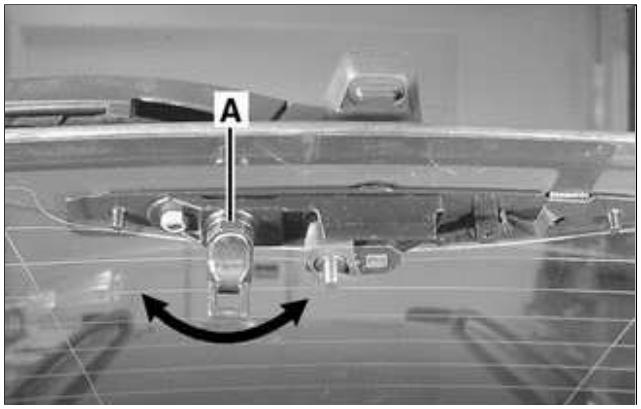
- Open tailgate and pry out lock striker trim from bottom of tailgate.
- Remove one striker mounting screw (**arrows**).
- Thread in M8 stud to keep striker lock plate from falling inside door.
- Remove second screw and striker.
- Reinstall striker bolts finger tight. Adjust striker position before tightening bolts.

- To adjust striker position:

- Close tailgate slowly, allowing striker to center itself on lock.
- Striker must not touch lock housing.
- Tighten striker mounting bolts, then check tailgate to body gaps as shown below.

Note:

Do not lubricate lock or lock striker with grease.

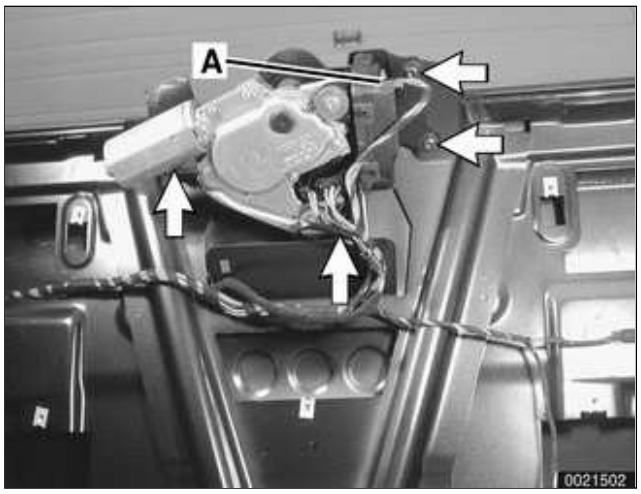


To remove rear window lock striker:

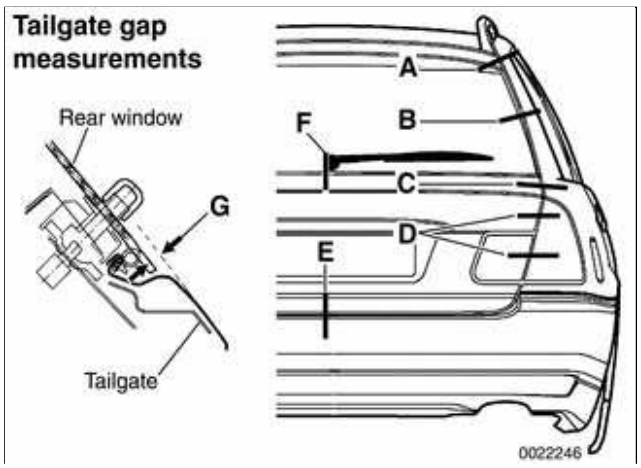
- Adjust striker height by loosening lock nut **A**, then turning striker in or out.
- Retighten lock nut.

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- To remove rear window lock:
  - Open tailgate. Remove tailgate trim panel.
  - Detach window lock electrical harness connector (**A**).
  - Remove lock mounting screws (**arrows**).
  - Slide lock out from under rear window wiper motor.
  - Reinstall lock mounting bolts finger tight. Adjust lock position before tightening bolts.
  - To adjust lock position:
  - Close window slowly, allowing lock to center itself on striker.
  - Tighten striker mounting bolts, then check rear window to body gaps as shown below.
  - Tighten lock mounting bolts.



- When reinstalling, or to adjust tailgate or rear window alignment, adjust position of tailgate striker or window lock with mounting bolts finger tight.
  - Set gap measurements as listed below.
  - Also see ⇒ 412 Trunk Lid, Tailgate.

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Tailgate and rear window position gap adjustment	
Rear spoiler / side panel (**A**)	3.75 ± 1.3 mm (0.15 ± 0.05 in.)
Rear window / side panel (**B**)	3.5 ± 1.4 mm (0.14 ± 0.06 in.)
Tailgate / side panel (**C**)	3.6 mm ± 0.75 mm (0.14 ± 0.03 in.)
Tailgate / side panel (height)	flush to 2 mm (0.08 in.) lower
Tailgate light / corner light (**D**)	4.25 ± 0.75 mm (0.17 ± 0.03 in.)
Tailgate / rear bumper (**E**)	5 ± 1 mm (0.2 ± 0.04 in.)
Rear window / tailgate (**F**)	4 ± 1 mm (0.16 ± 0.04 in.)
Rear window / tailgate (**G**)	5.4 ± 1 mm (0.21 ± 0.04 in.)

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Electronic Immobilization (EWS)

E46 cars are equipped with a passive theft-prevention system. The Electronic Immobilization System (EWS 3.3) makes it impossible to start the engine using any means other than the special keys furnished with the vehicle.

Note:

- *EWS is sometimes also referred to as Driveaway Protection.*
- *If a vehicle key is lost or stolen, the electronic authorization for that key can be cancelled using the BMW scan and diagnostic tools DIS or MoDiC.*
- *Force applied to a key can damage the electronic circuitry. A damaged key will not start the engine.*

In the EWS system, the ignition key is embedded with a computer chip and permanently coded. The key communicates with the vehicle using a transponder in the key and a ring antenna surrounding the steering lock cylinder.

A primary code is programmed into the key and into the vehicle itself. A secondary code is changed every time the vehicle is started. If the key code and EWS control module code do not match, the engine management control module and the starter are disabled. EWS ignition keys cannot be duplicated.

The system is designed to have up to

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ten keys. Only an authorized BMW dealer can provide replacement keys.

Note:

- *It is possible to damage the electronic circuitry in the key, rendering it unusable. In that case, a new key should be purchased and initialized by an authorized BMW dealer.*

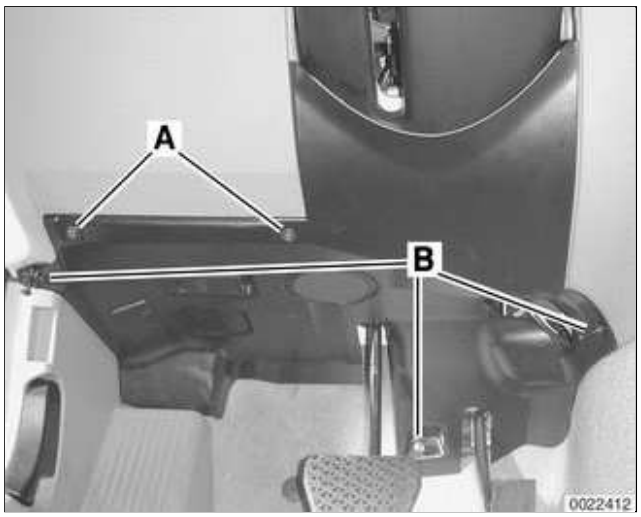
- *Starting with 2000 models, the battery in the FZV ignition key is recharged while the key is in the ignition switch. Therefore there is no need to replace the key battery.*

EWS control module, replacing

- Disconnect negative (-) cable from battery.

CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

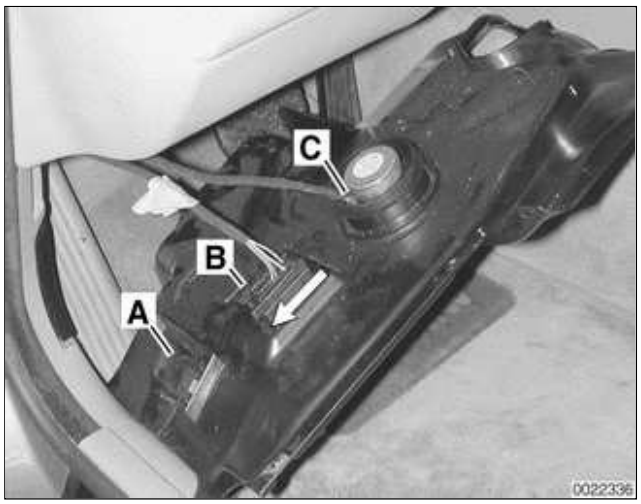


Lower left footwell (pedal cluster) trim panel.

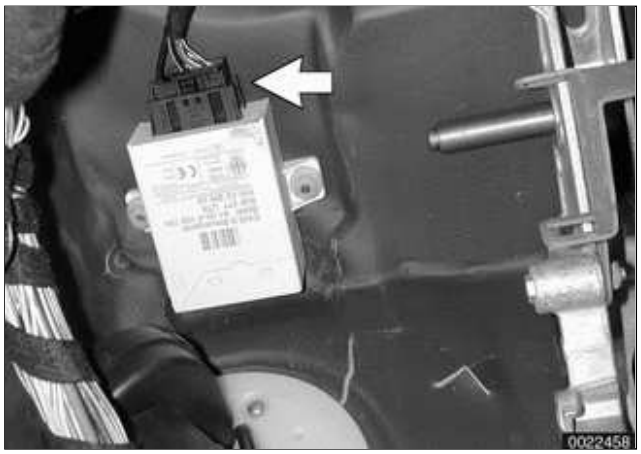
- Remove screws (**A**).

- Remove fasteners (**B**).

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- Disconnect electrical harness connectors at left footwell trim panel and remove panel:
  - Unplug connector at footwell interior light (**A**), if equipped.
  - Slide lock at OBD II connector (**B**) in direction of **arrow**.
  - Unplug connector at speaker if equipped (**C**).



- Remove EWS control module harness connector (**arrow**).
  - Remove module mounting screws. Remove module.

Note:

The EWS module should be identified with EWS markings.

- Installation is reverse of removal.

Ring antenna

To remove the ring antenna using BMW special tool 61 3 300, it is necessary to remove the upper and lower steering column trim. Alternatively, remove the ignition switch key cylinder.



- With ignition key in "ON" position (60° from "LOCKED"), insert a thin piece of stiff wire into opening (**arrow**) in lock cylinder and pull lock cylinder out.
  - Detach ring antenna harness connector.

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- Gently work ring antenna off key cylinder.

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Anti-Theft Alarm (DWA)

The DWA anti-theft system is a dealer installed accessory option. All E46 vehicles are factory prepared to provide the DWA function. This means that the vehicle is prewired and the General Module (GM V) is preprogrammed for the system. However, once the DWA system components are installed the GM V must be coded, using the DIS or MoDiC, to recognize the installed components and carry out DWA functions.

The GM V utilizes existing components and/or circuits as part of the DWA system:

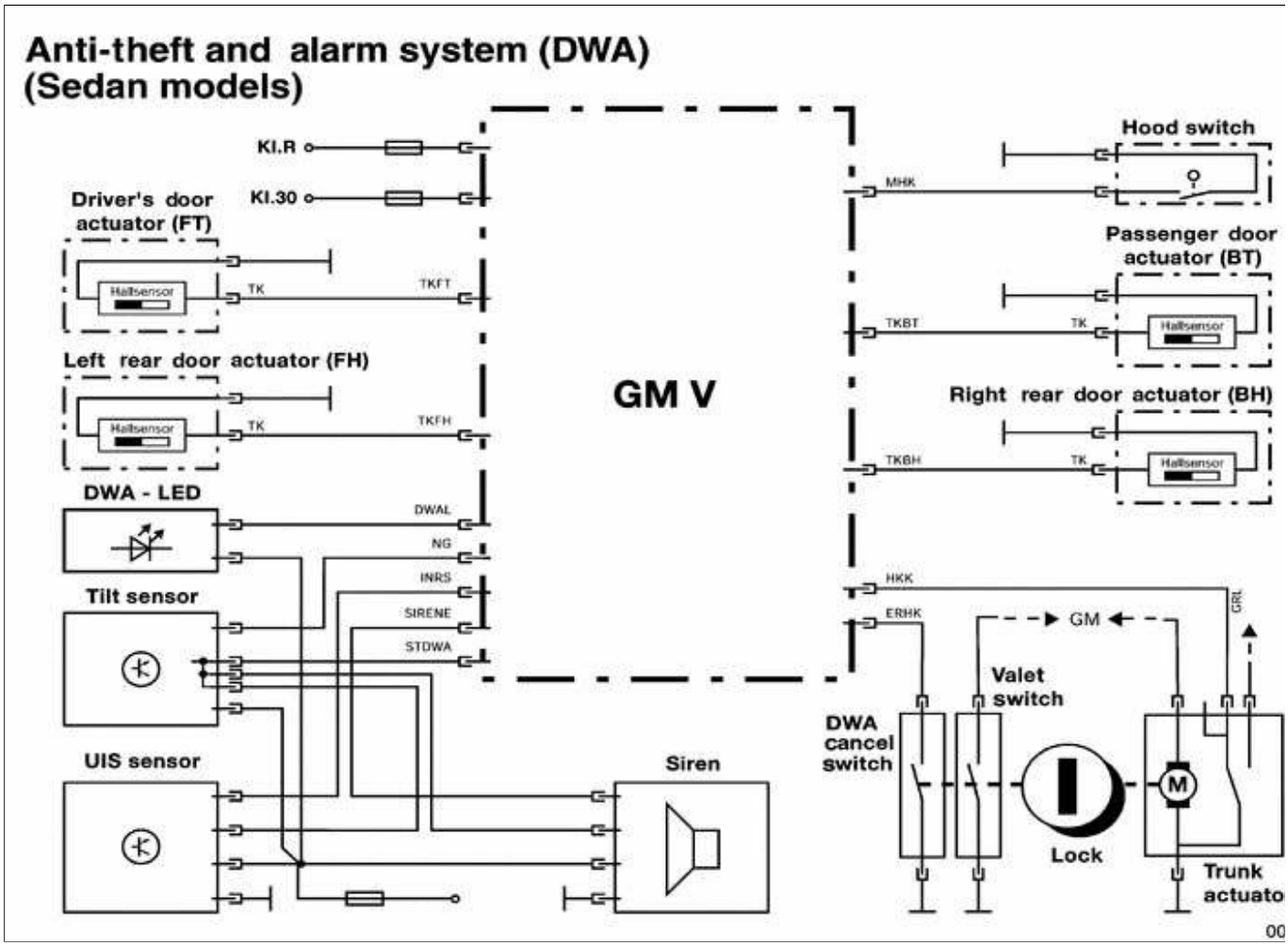
- Door lock hall effect sensor contacts
- Trunk lid switch contact
- Trunk lock key position switch
- Hood switch
- DWA status (LED)

The DWA accessory kit includes the following:

- Tilt sensor in right trunk area
- UIS (interior monitoring sensor) in center of headliner
- Siren in cowl area next to IHKA housing

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Anti-theft and alarm system (DWA) (Sedan models)



DWA alarm arming/disarming

The DWA alarm is armed every time the vehicle is locked from the outside with the door lock cylinder or FZV key.

The LED in the rear view mirror flashes as an acknowledgment, along with flashing exterior lights and a momentary chirp from the siren.

The GM V monitors all required input signals for CLOSED status (door closed, trunk closed, etc.) The inputs must be in CLOSED status for a minimum of 3 seconds for the GM V to include them as

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an activation component. If after 3 seconds any input signal not in CLOSED status is excluded (this is acknowledged by the DWA LED) preventing false alarm activation.

If the DWA is armed a second time within 10 seconds, the tilt sensor and interior protection sensor are also excluded as alarm activation components. This function is useful for preventing false alarm activation if the vehicle is transported on a train or flat bed truck.

While armed the trunk can be opened without the alarm being triggered as follows:

- If opened with the trunk remote button via the FZV, the GM V prevents the alarm from activating. (This feature is customizable under the Car Memory function.)

- If opened with the key at the trunk lock cylinder, the trunk key position switch signals the GM V and in the same manner prevents the alarm from activating.

- In either case, when the trunk is returned to the CLOSED position, it will no longer activate the alarm.

Alarm operation

When the alarm is triggered, the siren will sound for 30 seconds. At the same time the headlight low beams and hazard lights will flash for 5 minutes. The GM V signals the Light Center Switch (LSZ) via the K-bus to flash the lights. Following an alarm trigger, the system will reset and trigger again if further tampering is done to the vehicle.

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Door contacts

The door lock Hall effect sensors provide status of door OPEN/CLOSED:

- When the door latch is CLOSED, current flow through the sensor is <5 mA.
- When the door is OPEN, current flow through the sensor is >12 mA.

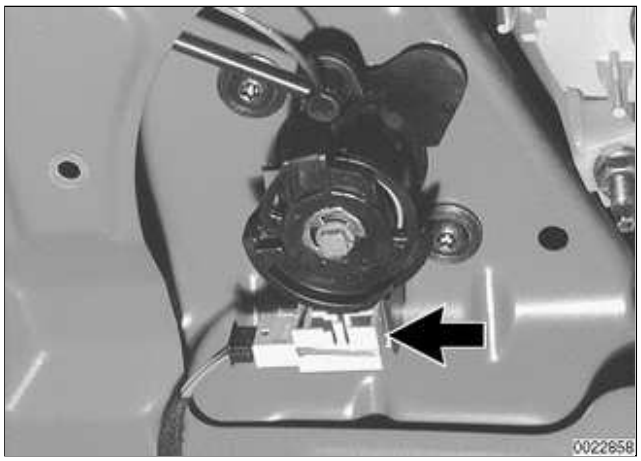
With the DWA armed, the GM V will activate the siren if it receives a door OPEN signal.

Trunk lid switch contact

The trunk switch contact is located in the trunk lock assembly. When closed, the trunk contact provides a ground signal to the GM V signifying a CLOSED trunk.

With the DWA armed, the GM V will activate the siren if it receives a trunk OPEN signal.

Trunk lock key position switches



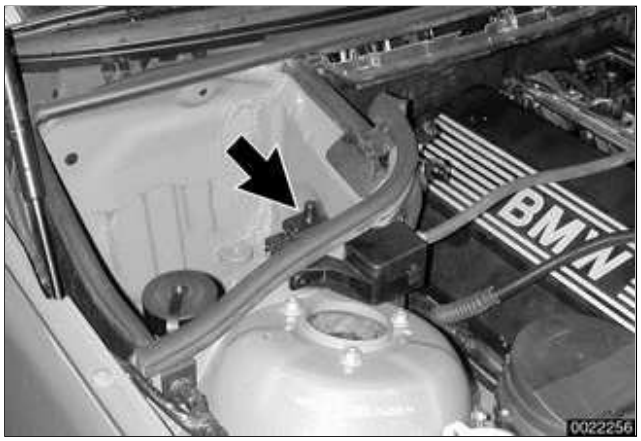
There are two switches mounted in one block (**arrow**) on the trunk lock cylinder:

- Valet position switch. With the key lock in the valet position, this switch provides a ground signal to the GM V. The GM V locks out the interior trunk release button preventing the trunk from being opened.
- DWA deactivation switch. When the trunk is opened mechanically with

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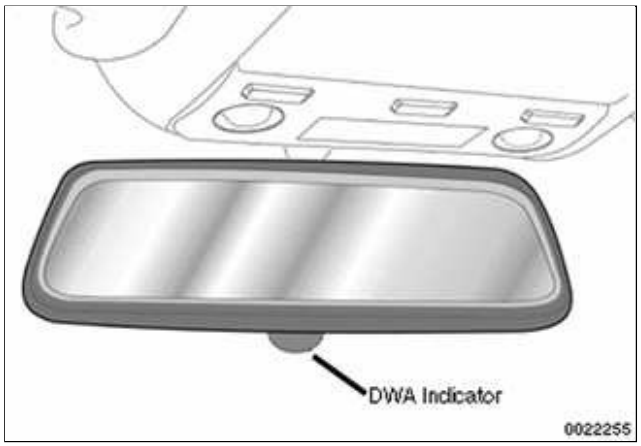
the key, this switch provides a ground signal to the GM V preventing the DWA from activating if armed.

Hood contact switch



- Located on the right side engine compartment, the hood contact switch (**arrow**) provides a ground signal to the GM V signifying an open hood. The plunger of this switch can be pulled up past a detent causing the switch contact to open. This feature can be used to simulate a CLOSED hood with the hood open when diagnosing the DWA system.

DWA LED



- The DWA indicator is located in the rear view mirror. All E46 vehicles are equipped with the LED. It is not part of the retailer installed accessory DWA system.

The LED is provided with constant battery voltage (KL 30). The GM V provides a switched ground signal providing the various blinking signals used to convey DWA status to the vehicle operator. DWA LED status is summarized in ⇒ Table a.

Table a. DWA LED status

DWA status	DWA LED condition
Disarmed	OFF
Armed	Continual slow flash

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Table a. DWA LED status	
DWA status	**DWA LED condition**
Armed with one or more monitored inputs not in CLOSED position (trunk not closed, etc.)	Rapid flash for 10 seconds, then continual slow flash
Alarm activated	Rapid flash for 5 minutes, then continual slow flash
Rearmed in less than 10 seconds	ON for 1 second
Disarmed after activated alarm	Rapid flash for 10 seconds, then OFF

Tilt sensor

Located in the right trunk area above the battery, the solid state tilt sensor monitors the vehicle parked angle when DWA is armed. The sensor requires three signal wires to perform its function:

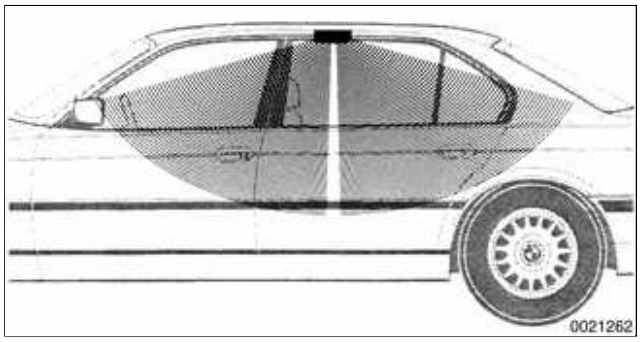
- KL 30. Constant battery voltage
- STDWA signal. Switched ground input signal provided by the GM V indicating DWA armed/disarmed status. The tilt sensor is used as a splice location for the STDWA signal to the siren and interior protection sensor.
- NG signal. Switched ground output signal provided to the GM V. This signal is used for two purposes: a. As a momentary acknowledgment that the tilt sensor received STDWA

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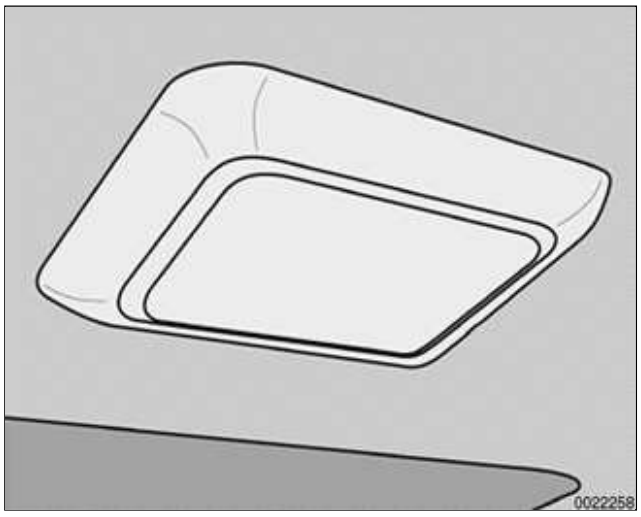
and is currently monitoring the vehicle angle. b. If the tilt sensor detects a change in the vehicle angle when DWA is armed, the NG signal is switched to inform the GM V to activate the siren.

When the tilt sensor receives the STDWA signal from the GM V, the angle of the vehicle is memorized and monitored by the solid state electronics. Once armed, if the angle changes, the tilt sensor provides a switched ground signal to the GM V to activate DWA.

Interior protection (UIS)



- The combined ultrasonic transmitter and receiver in UIS monitors the vehicle interior for motion.



- The UIS is mounted in the center of the headliner panel even with the door (B) pillar. Due to the design of the vehicles interior, the sensor is unidirectional and must be installed in the proper direction to ensure proper operation of the system (trim cover ensures directional installation).

Every time the DWA system is armed (STDWA signal), the sensor adapts to whatever objects are stationary in the interior. The sensor emits ultrasonic waves in a programmed timed cycle. It receives echoes of the emitted signals. The UIS amplifies the received sound wave signals and compares them with the transmitted waves. The UIS also checks the incoming echoes for background hiss (wind noise through a

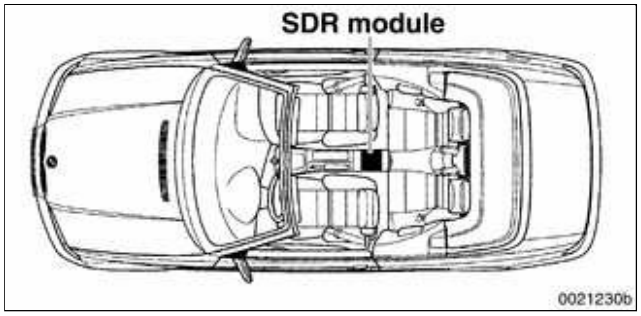
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partially open window) and adapts for this.

If the echoes are consistently similar, no movement is detected. If the echoes are altered or inconsistent, the UIS changes to a constant cycle and the echo is compared again. If the inconsistency is still present the UIS sends the activate siren signal (INRS) to the GM V.

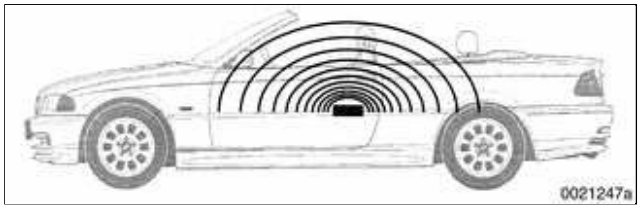
As with the tilt sensor, the UIS is also switched OFF when the vehicle is locked two times within ten seconds. This allows the sensor to be switched OFF for transportation purposes.

Convertible interior protection (SDR)



- In Convertible models, the interior motion detector for the alarm system is a short distance radar (SDR) detector located on the center tunnel, under the center console next to the parking brake handle. The central position allows the most effective monitoring of the vehicle interior.

The SDR detector consists of two printed circuit boards, one being the transmitter/receiver and the other the processing electronics. The module housing is highly conductive material for high frequency transmission.



- The SDR sensor transmits an electromagnetic field in a hemispherical pattern within the vehicle interior. The monitoring radius is preset in the module. The receiving antenna monitors reflected signals from the interior. The module evaluates these signals as a base line for vehicle security. Any objects that come into this monitoring radius will be detected and evaluated by the SDR module.

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The module operates in pulse mode. The radar unit transmits a signal, then pauses for the reflected signals to be received by the module.

The detection range of the radar is adjusted by rapid switching when the system is armed. This allows the sensor to adjust its range to either the windshield with the top lowered or to the soft top when it is raised.

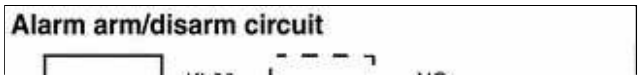
The module will signal the GM V to trigger the alarm if a new object is detected within its sensing hemisphere. However, false alarms may be triggered by objects falling into the interior when the system is armed with the top lowered. Also, large metal objects, such as the seat backrests, will shield the microwave pulse and create a sensor "shadow" effect in the interior.

As with the tilt sensor and the UIS, the SDR sensor can be switched OFF by activating the central locking system twice within 10 seconds.

Alarm siren

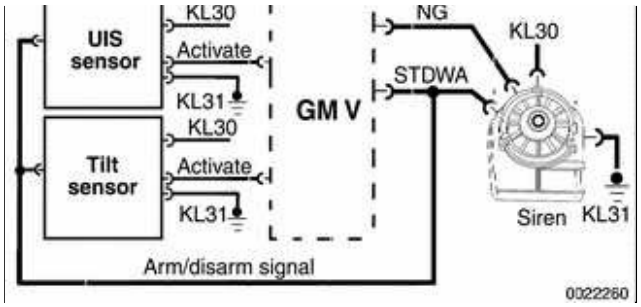
The DWA siren is installed in the right rear engine compartment. This location provides a secure position with loud acoustic output.

The siren contains electronic circuitry for producing the warning tone when the alarm is triggered. The siren also contains a rechargeable battery that is used to power the siren when the alarm is triggered. The rechargeable battery will allow the siren to sound if it or the vehicle battery is disconnected. The siren battery is recharged from the vehicle battery when DWA is not in the armed state.



The siren has four wires connecting it to

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the alarm system:

- KL 30 (power)
- KL 31 (ground)
- STDWA signal (arm/disarm signal from GM V)
- NG signal (activate siren output signal to the GM V)

The arm/disarm output signal from the GM V (STDWA) is provided to the tilt sensor, UIS sensor and the siren simultaneously. The arm/disarm signal is a switched ground that signals the components of DWA armed/disarmed status.

The activate the siren, the NG signal is high whether DWA is armed or disarmed. If a monitored input activates the alarm, the high signal to the siren is switched to a 50% duty cycle at the GM V. The control circuitry in the siren activates the siren. If the DWA is armed and the battery is disconnected, the siren circuitry recognizes the normally high NG signal as suddenly going low. In this case the siren is also activated.

Panic mode operation

When the trunk button on an FZV key is pressed and held, the GM V activates the siren for the panic mode. The panic mode is functional with either an armed or disarmed DWA system.

Emergency disarming

Emergency disarming occurs automatically if a key is used to turn the ignition switch ON and EWS accepts it.

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The EWS signals the GM V to unlock the doors and to deactivate the DWA.

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General

This repair group covers removal and installation of the front and rear seats.

Seat design and upholstery



- The front seats installed in E46 cars come in either manual or powered versions. They offer firm support and comfort. Their internal construction is engineered to work together with the vehicle suspension to absorb vibration. The internal ventilation system of the seats adds to the built-in comfort of these seats.

  Convertible front seats are unique to those models in that they incorporate the seat belts. This is called the Seat Integrated Seatbelt (SGS) system.

  Vinyl is the most common upholstery, and leather is an available option. The leather appears not only on the seats but on the door panels and other areas as well.

  Front seatback nets are standard.

Seat adjustments



- Regardless of level of trim, E46 seats offer the following minimum adjustments, with manual (**photo**) or power controls (**below**):

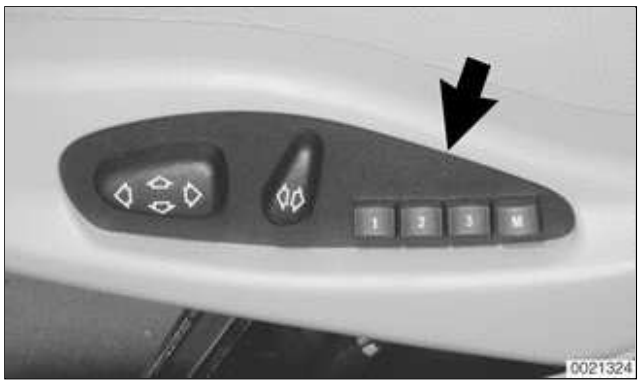
  - Fore-aft position
  - Backrest angle

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- Cushion height
- Head restraints.

Seat memory system



In cars with seat memory, the driver's front seat incorporates two control modules: One in the seat adjusting switch (**arrow**) and the second under the seat cushion. The two modules process the following:

- Seat adjustments
- Comfort entry aid switch (2-door models)
- Seat backrest lock microswitch (2-door models)
- Seat belt fastened
- K-bus communication with the General Module (GM V) and instrument cluster

The driver seat module stores three seat positions for recall. The information is stored in non-volatile memory, preventing loss of memory in case of electrical power failure or battery disconnection.

The seat adjusting switch block in the driver's seat communicates with the seat cushion control module over dedicated lines. The output stages for seat motor movement are in the seat cushion control module. Seat positions are recognized through the use of Hall sensors in the motors. All components

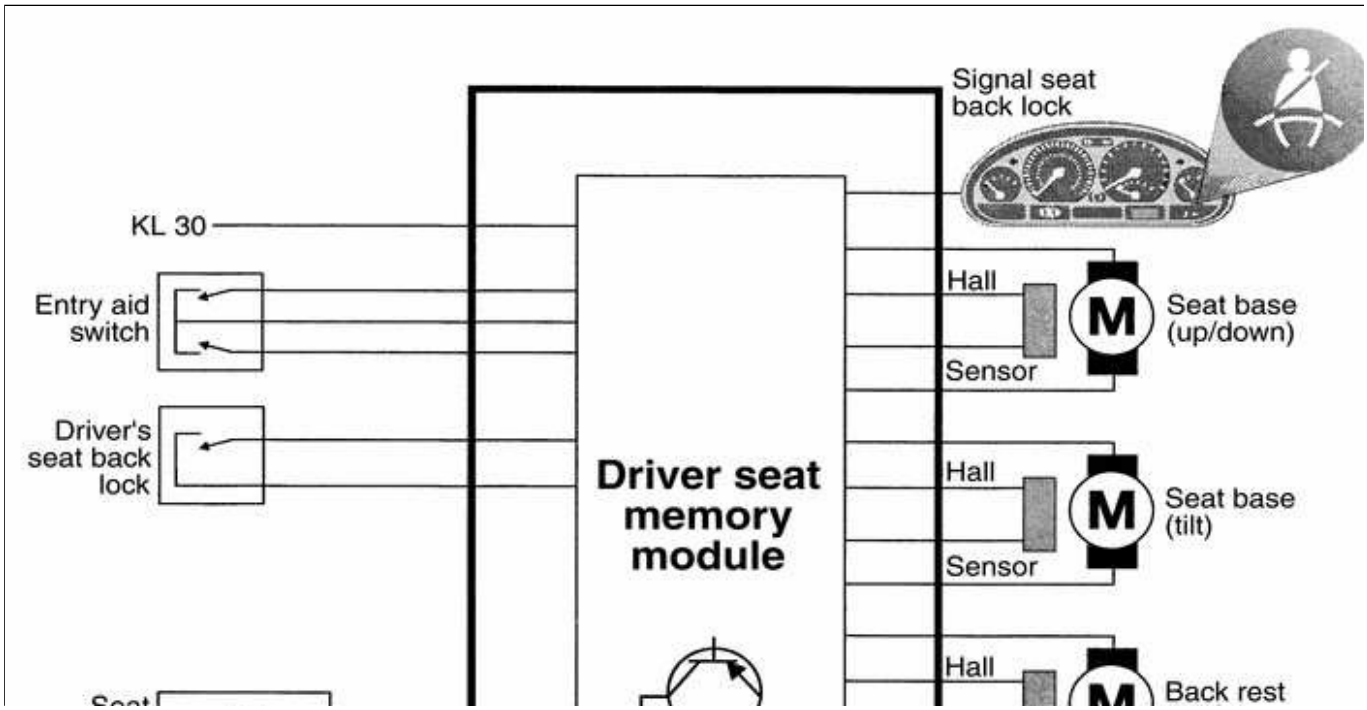
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of the seat memory system are monitored for faults. Access the fault codes using BMW scan tool DIS or MoDiC.

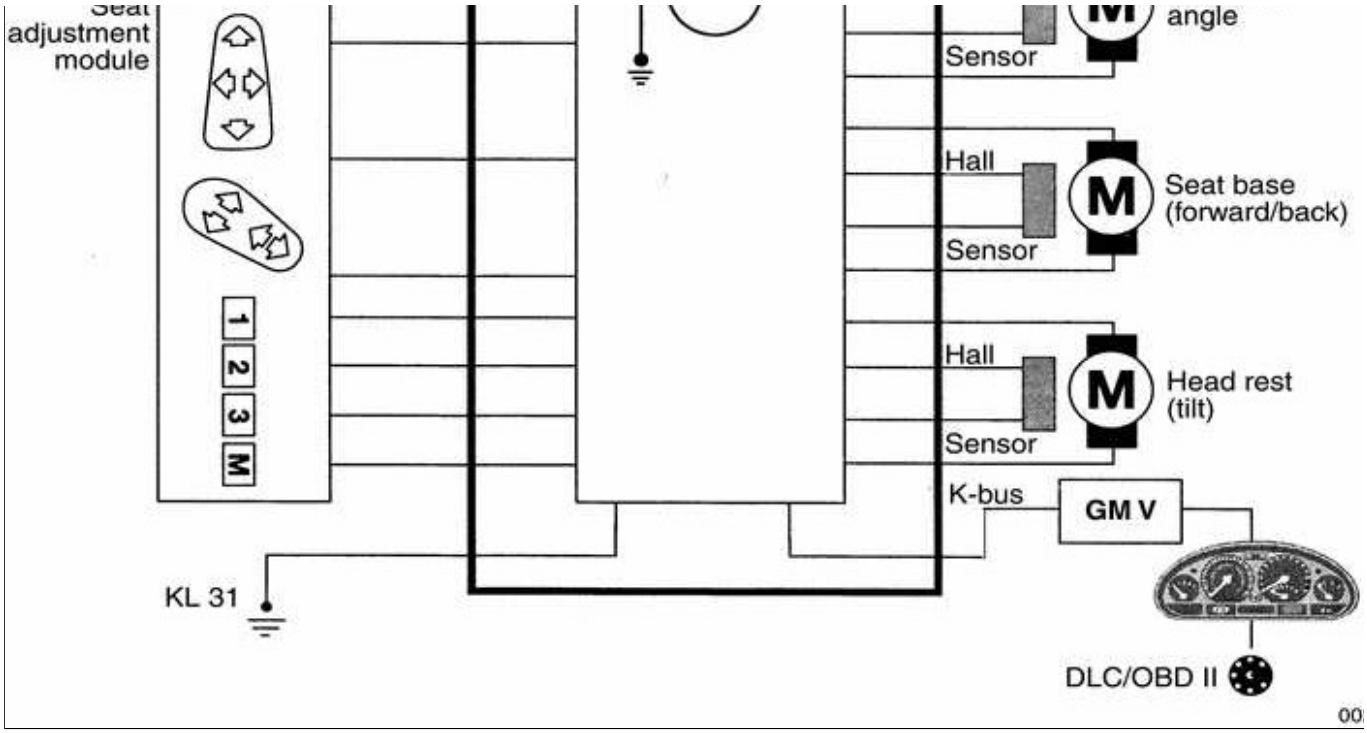
In Coupe and Convertible models, the easy entry feature facilitates access to the rear seats. When a front backrest is folded over, the entire seat moves forward 90 mm (3.54 in.) to facilitate rear entry. In models with seat memory, the seat control module memorizes the position of the seat and headrest when the entry aid feature is activated. The seat will return to its previous set position when the entry aid button is pressed rearward or the seat backrest is locked.

The passenger's seat on four door models uses a simplified control system within the switch block and does not include a memory module. No on board diagnostics are incorporated into the passenger seat on these models.

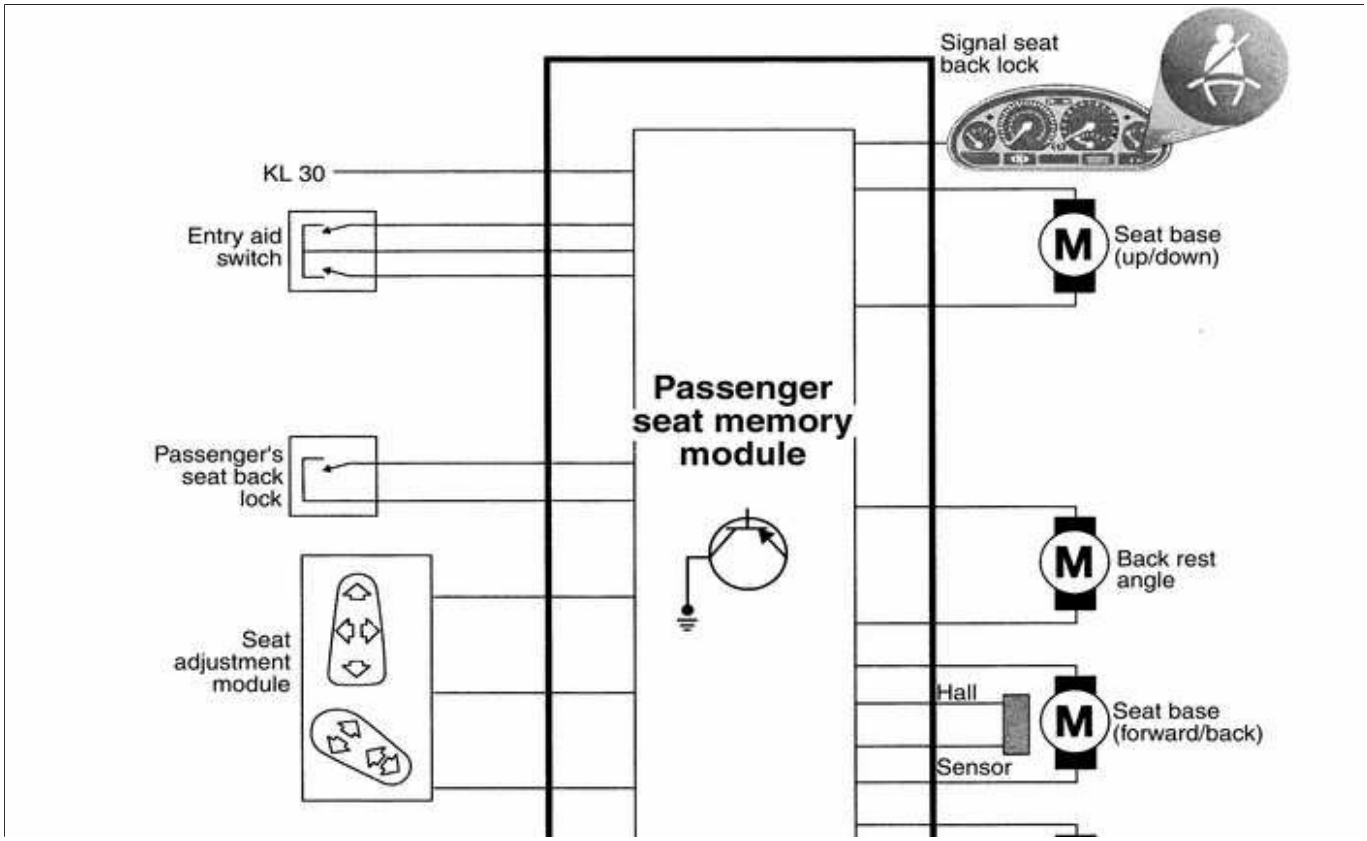
Driver seat memory module



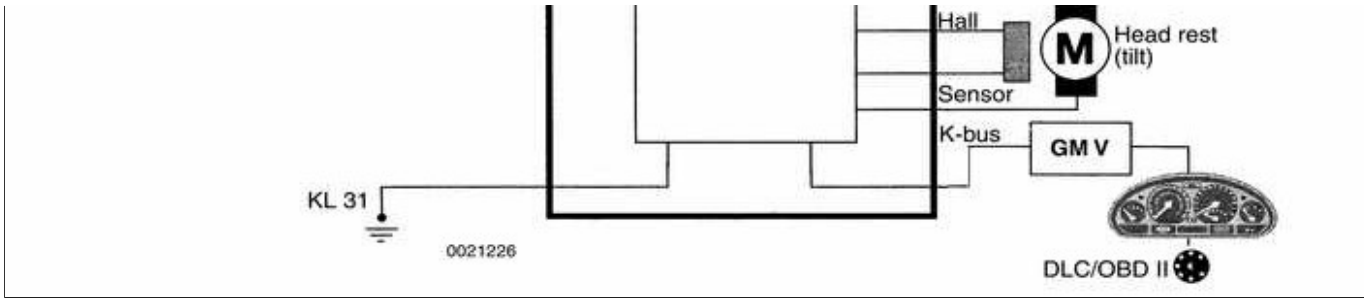
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Passenger seat memory module



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Rear seat configuration



Split rear folding seats are optional in the Sedan and standard in the Sport Wagon and Coupe. They are split 1/3 right to 2/3 left with a folding center armrest in the left portion. The armrest, when folded down, is equipped with a storage compartment and cupholders.

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Front Seats

Seat removal and installation is similar for all versions. Seat disassembly differs in detail among the many models of seats.

Seat repair and component replacement is possible once the seat has been removed from the vehicle.

Front seat, removing and installing

WARNING!

- ***The front seats are equipped with pyrotechnic seat belt tensioners. These tensioners are powerful devices and should be handled with extreme care. Incorrect handling can trigger off the tensioner and cause injury.***

- ***BMW recommends that all repair or replacement work on pyrotechnic devices must be carried out by a qualified BMW technician.***

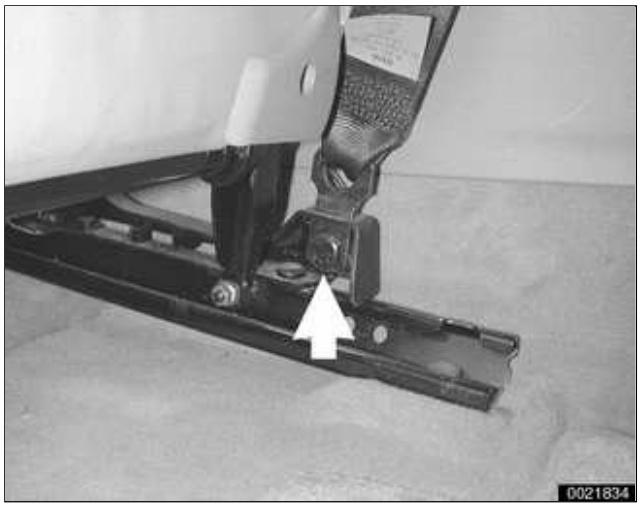
- ***Be sure to disconnect the battery and wait 5 seconds before attempting to work on pyrotechnic devices.***

- ***Pyrotechnic devices cannot be repaired. Always replace them.***

- ***Never treat pyrotechnic components with cleaning agents or grease.***

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- ***Do not expose pyrotechnic components to temperatures above 75°C (167°F).***
- ***Pyrotechnic components can only be tested electrically when installed, using BMW service tester DIS, MoDiC or equivalent scan tool.***
- ***Do not fire a pyrotechnic gas generator prior to disposal. It must be fired by a special disposal company or shipped back to BMW in the packaging of the new components.***
- ***During body straightening and welding with an electric arc welder, always disconnect the battery and the connection to the pyrotechnic gas generators.***



- 4-door models: raise seat and move to its forward position. Working at base of seat near doors, remove seat belt mounting bolt (**arrow**).
  - Remove headrests (not convertible).



- Remove two mounting bolts (**arrows**) at rear of seat rails.
  - Move seat to its rear most position, keeping it raised.

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- Remove plastic caps over front seat mounting nuts, then remove mounting nuts (**arrows**).

  - Disconnect negative (-) cable from battery.

CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.



- Tilt seat back to access electrical harness connectors. Slide lock to release and disconnect. Cut or untwist wire ties as necessary.

  - Remove seat from car. The headrests may be removed to provide additional clearance.

Note:

Use a blanket to protect door sill from scuffing by seat rail during seat removal.

  - Installation is reverse of removal. Use wire ties or equivalent means to keep seat harness wiring from fraying.

Tightening torque	
Front seat to floor	45 Nm (33 ft-lb)
Seat belt end to seat	48 Nm (35 ft-lb)

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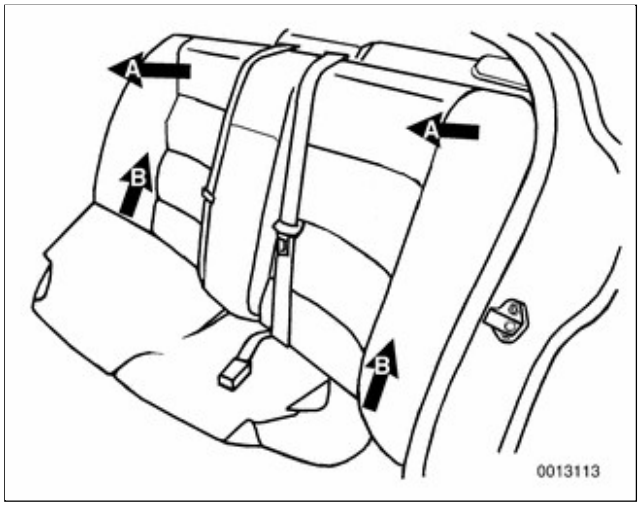
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Rear Seats

Rear seat cushion and backrest, removing and installing (fixed seat back models)

- Pull front of rear seat cushion up to release clips. While holding front of cushion up, pull cushion forward to remove.



➢ Remove rear seat backrest:

- Pull top outer corners of backrest forward (**A**) to detach from top retainers.
- Pull entire backrest up (**B**) to detach from bottom hooks.
- Slide backrest to side to clear seat belts.

Note:

If the car is equipped with heated rear seats, detach electrical harness connector(s) as you remove the seat components.

- When reinstalling, be sure to pull seat belts and buckles up through appropriate slots in seat cushion.

Rear seat cushion and backrest, removing and installing (fold-down seat back models)

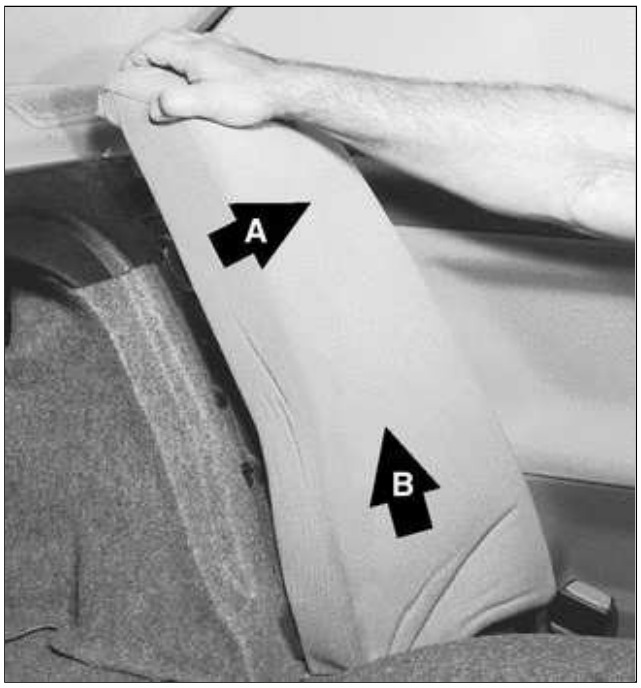
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- Pull front of rear seat cushion up and out of clips. While holding front of cushion up, pull cushion forward to remove.

- Tilt backrests forward.

Note:

Remove rear headrests, if equipped, by pulling straight up.



- Remove backrest side section by pulling out (**A**) and up (**B**).

- Working between two sections of backrest, remove backrest center mount screws.

- Remove outer backrest mounting screws.

- Raise backrests in middle slightly and separate left and right backrest guide. Lift backrest(s) out through back door(s).

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General

This repair group covers the slide-tilt sunroof assembly.

Component locations, initialization, sunroof panel replacement, and sunroof height adjustment are covered. Replacement of the cable assembly or frame require that the headliner be removed. Removal and repair of the sunroof assembly and other components inside the roof cavity is beyond the scope of this manual.

Sunroof electronic controls, initializing

Initialize the sunroof in the following situations:

- Malfunctions such as lack of one-touch function, lack of comfort opening/closing or lack of safety (anti-trapping) features
- If sunroof motor has been removed and reinstalled
- If power supply to the sunroof has been interrupted
- If repairs have been performed on the slide/tilt mechanism

Normalization

During normalization the mechanical end positions of the sunroof are detected and stored by the General Module (GM V).

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- Press and hold sunroof switch in "lift" direction.
  - After reaching end position, keep switch pressed for approximately 20 seconds longer.
  - The sunroof motor will briefly jerk upwards, signalling normalization is complete.

Characteristic curve

The characteristic resistance curve of the E46 sunroof is learned using coding software. This resets the safety (anti-trapping) feature. See your BMW dealer service department.

Sunroof panel, emergency closing



- Remove access panel from below sunroof motor by gently prying at the rearmost edge with a plastic tool.



- Disconnect the electrical connections and lay switch panel aside.

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- Insert hex key into drive in sunroof motor, and turn hex key to manually close sunroof.

Note:

The hex key for manually (emergency) closing the sunroof can be found in the tool kit located in the trunk lid (sedan, coupe and convertible) or under the cargo area floor panel (Sport Wagon).

Sunroof panel, adjusting

Note:

Be sure to check drains in front corners of sunroof carrier if water is entering car through headliner.

The sunroof is controlled by a set of cables that move the sunroof panel along guide rails when the motor is operated. The sunroof can be adjusted without removing it from the car.

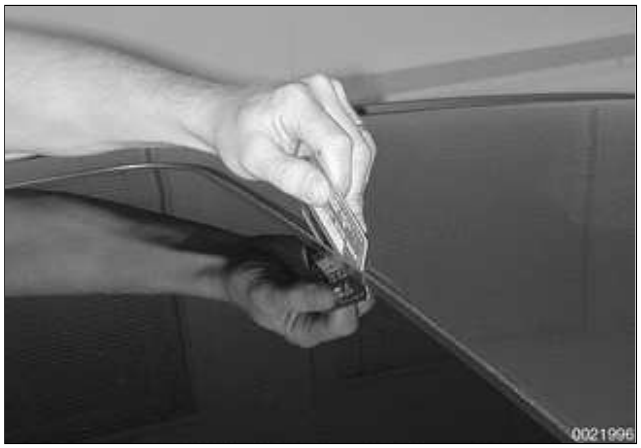
The sunroof panel should be adjusted under the following circumstances:

- Sunroof misaligned with roof
- Sunroof does not close squarely
- Wind noise at high speeds (sunroof closed)

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- Sunroof has been removed

Whenever the top of the closed sunroof becomes misaligned with the roof of the car, if it does not close squarely, if there are wind noises at speed, if there are water leaks, or if the sunroof has been removed.



- Correct sunroof alignment:

  - Sunroof must be fully closed.

  - Gap must be even all around edge of sunroof.

Note:

Use a credit card to measure the gap. The card should insert through the gap with equal resistance all around the perimeter.

  - Front of sunroof must be flush to 1 mm (0.04 in.) below surface of roof.

  - Rear of sunroof must be flush to 1 mm (0.04) above surface of roof.

  - To adjust sunroof height, shut sunroof fully.



- Slide sunroof liner back into roof cavity until approx. 90 mm (3.5 in.) is exposed.

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The sunroof panel is retained by three Torx screws (**arrows**) on each side. To adjust sunroof height:

- Loosen Torx screws until sunroof can just be moved.
- Push sunroof panel forward.
- Push sunroof panel up or down until correct height is achieved.
- Tighten screws. Recheck height.
- Check sunroof function.nothing

Sunroof height adjustment specifications	
Rear	flush/1 mm higher than roof top
Front	flush/1 mm lower than roof top

Tightening torque	
Sunroof panel to roof (Torx)	4.5 Nm (40 in-lb)

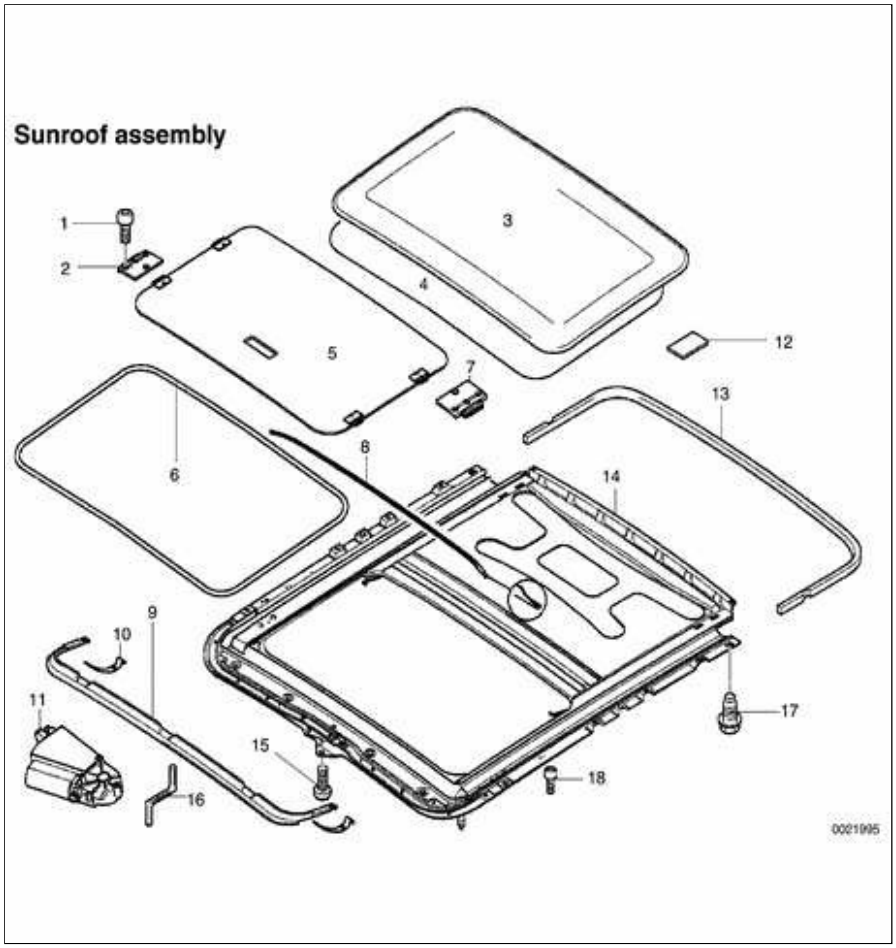
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Sunroof Components

Sunroof assembly removal and installation involves headliner removal, and is not covered in this manual. After sunroof repairs be sure to follow initialization and adjustment procedures given earlier.



Sunroof assembly

1 - **Torx bolt M5**

2 - **Slider**

3 - **Glass sunroof panel**

4 - **Sunroof panel gasket**

5 - **Velour ceiling panel**

6 - **Synthetic strip**

7 - **Slider**

8 - **Gasket**

9 - **Wind deflector**

10 - **Deflector spring**

11 - **Sunroof motor**

12 - **Felt**

13 - **Frame gasket**

14 - **Sunroof frame**

15 - **Torx bolt M5**

♦ tighten to 3.5 Nm

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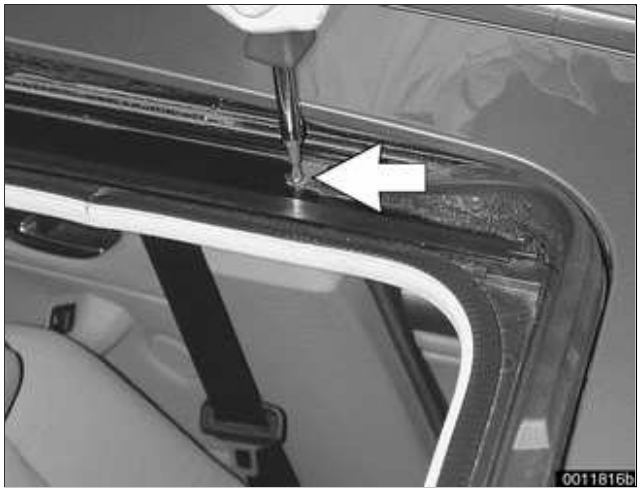
(31 in-lb)

16 - **Emergency operation crank handle**

17 - **Hex bolt with washer**

18 - **Torx bolt M4**

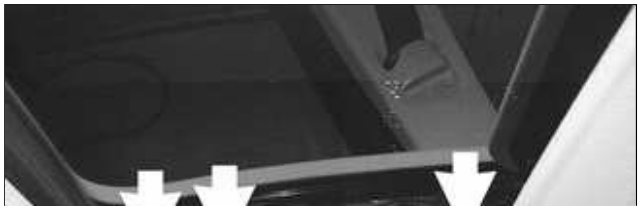
Sunroof panel, removing and installing



- To remove sunroof panel, open sunroof and remove wind blocker by removing Torx screw (**arrow**) on each side.



- Close sunroof and slide sunroof liner back into roof cavity until approximately 90 mm (3.5 in.) is exposed.



- Remove three Torx screws (**arrows**) on each side, and lift panel out.

  - Installation is reverse of removal.

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Adjust sunroof height and gap as described earlier.

Tightening torque	
Wind blocker to roof (Torx)	1 Nm (9 in-lb)
Sunroof panel to roof (Torx)	4.5 Nm (40 in-lb)

Sunroof panel gasket, replacing

- Remove sunroof panel as shown above.

♦ Pull old seal from panel.

♦ Coat new seal and channel in sunroof panel with soapy water.

♦ Starting at back center of panel, install new seal, taking care to not pull seal too tightly around four corners of panel.

- Installation is reverse of removal. Adjust sunroof height and gap as shown earlier in this repair group.

Tightening torque	
Wind blocker to roof (Torx)	1 Nm (9 in-lb)
Sunroof panel to roof (Torx)	4.5 Nm (40 in-lb)

Sunroof motor, replacing



Remove access panel from below sunroof motor by gently prying at the

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rearmost edge with a plastic tool.



- Remove sunroof motor mounting screws (**arrows**).

- Installation is the reverse of removal. Perform intitialization procedure as described earlier.

Tightening torque	
Sunroof motor to sunroof carrier	2.8 Nm (25 in-lb)

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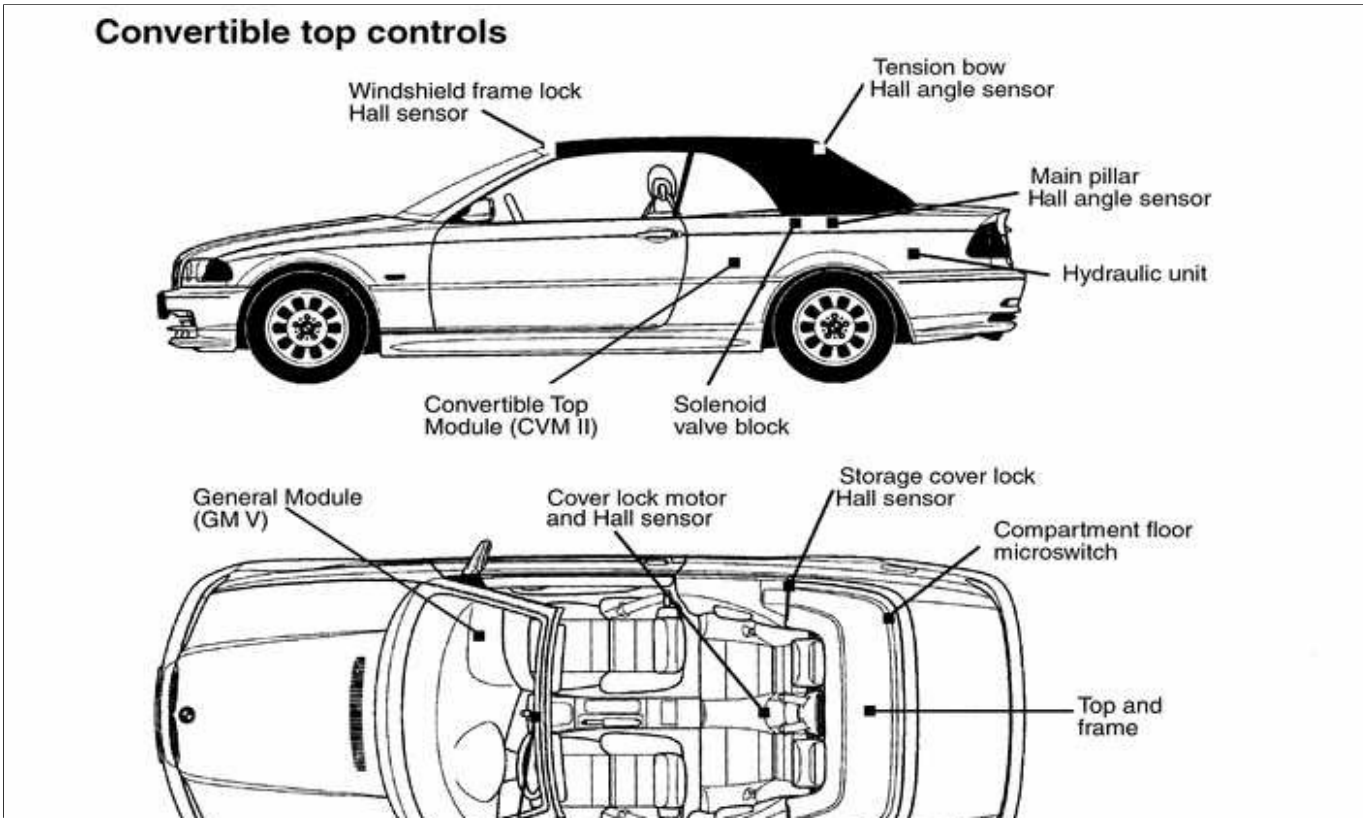
General

This repair group covers the automatic electro-hydraulic convertible top. Information on the Rollover Protection System is also included here.

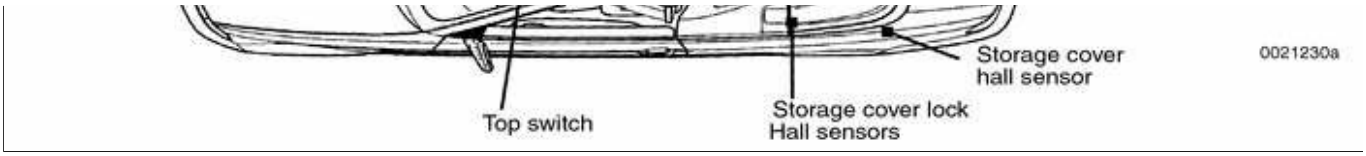
Note:

- *The convertible top control module (CVM II) is located behind the left rear side trim panel. For the location of other convertible top electric components see ⇒ 610 Electrical Component Locations.*
- *The glass rear window in the Convertible is not replaceable separately.*

Convertible top controls



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Convertible battery

BMW has designed a special battery tray for the Convertible which serves to dampen Convertible body flexing and vibration.

CAUTION!

The E46 Convertible requires a special battery which is designed for constant vibration. A battery not designed for this will fail much earlier.

Convertible top operation

The automatic E46 Convertible top system completely opens and closes the top using hydraulic cylinders and electric motors.

The convertible top system features:

- Convertible Top Module (CVM II) with fault memory storage.
- Electro-hydraulic operation
- Convenience opening using FZV (remote) key or door lock cylinder
- Convenience closing using door lock cylinder
- Glass rear window

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- Top monitoring during operation using Hall sensors and angle Hall sensors

Emergency operation

- Manually unlock top storage cover:

- Remove center arm rest.

- Lift seat upholstery below ski bag.

- Press button on motor assembly to release motor from gear linkage.

- Use hand crank (stored on assembly cover) to turn linkage assembly through access hole in motor assembly cover.

- Unlock top cover and open.

- Switch off ignition. Hydraulic pressure will be released in steps after approximately 10 seconds until all pressure is drained from cylinders.

- Manually raise or lower top. Use handcrank to lock or unlock top at windshield top frame.

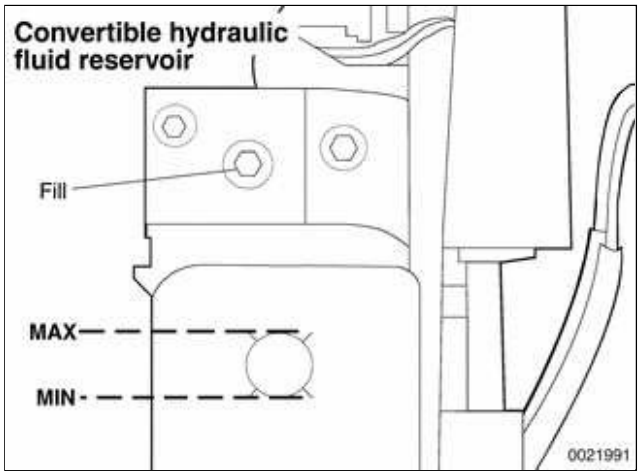
Hydraulic fluid level, checking or filling

Note:

Make sure top is lowered into storage compartment and storage cover is closed.

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- Working in trunk, remove trunk trim liner and soundproofing. If necessary, partially remove hydraulic unit to gain view of fill plug and fluid reference mark (circle). DO NOT detach hydraulic lines.



To check:

- Level must be between **MAX** and **MIN** marks.
- Reference mark is circle in translucent reservoir.

- To fill:

- Detach hydraulic unit and pull out without disconnecting fluid lines.
- Lay unit on its side and fill through fill plug.
- Turn unit upright and recheck level.
- Install new fill plug seal.

- To drain:

- Detach hydraulic unit and pull out without disconnecting fluid lines.
- Lay unit on its side and allow to drain through fill plug.
- Turn unit upright and recheck level.
- Install new fill plug seal.

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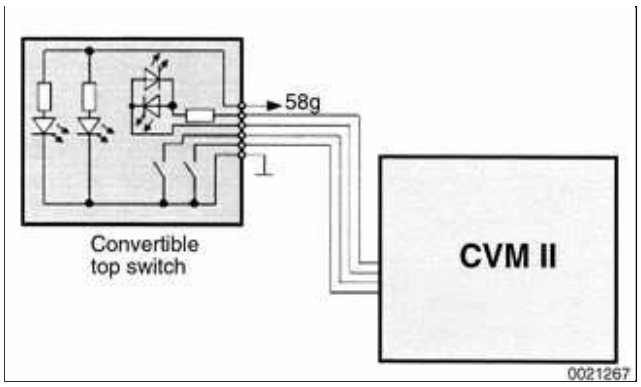
Convertible top fluid	
Hydraulic fluid	Aral Vitamol

Tightening torques	
Filler plug to hydraulic unit	10 + 1 Nm (89 + 9 in-lb)
Hydraulic unit to body	10 Nm (89 in-lb)

Note:

The convertible top hydraulic fluid is supplied in the spare parts kit. To restock fluid, check with an authorized BMW dealer parts department.

Convertible top switch



The convertible top switch assembly is in the center console below the IHKA control panel. Two push buttons, one for each direction of travel, provide ground input signals to the Convertible Top Module (CVM II).

Two LEDs are positioned in the center of the switch assembly. The top LED will flash whenever the top is being operated and not locked to the windshield or stored completely in the storage compartment. The lower LED will illuminate if the top switch is pushed (open top signal) and the storage compartment floor is in the folded up position. See ⇒ Top storage compartment floor later in this group.

The top ceases moving once the switch is released. The hydraulics hold the top in position and remain under pressure for approximately 20 minutes if the ignition key is left in the ON position.

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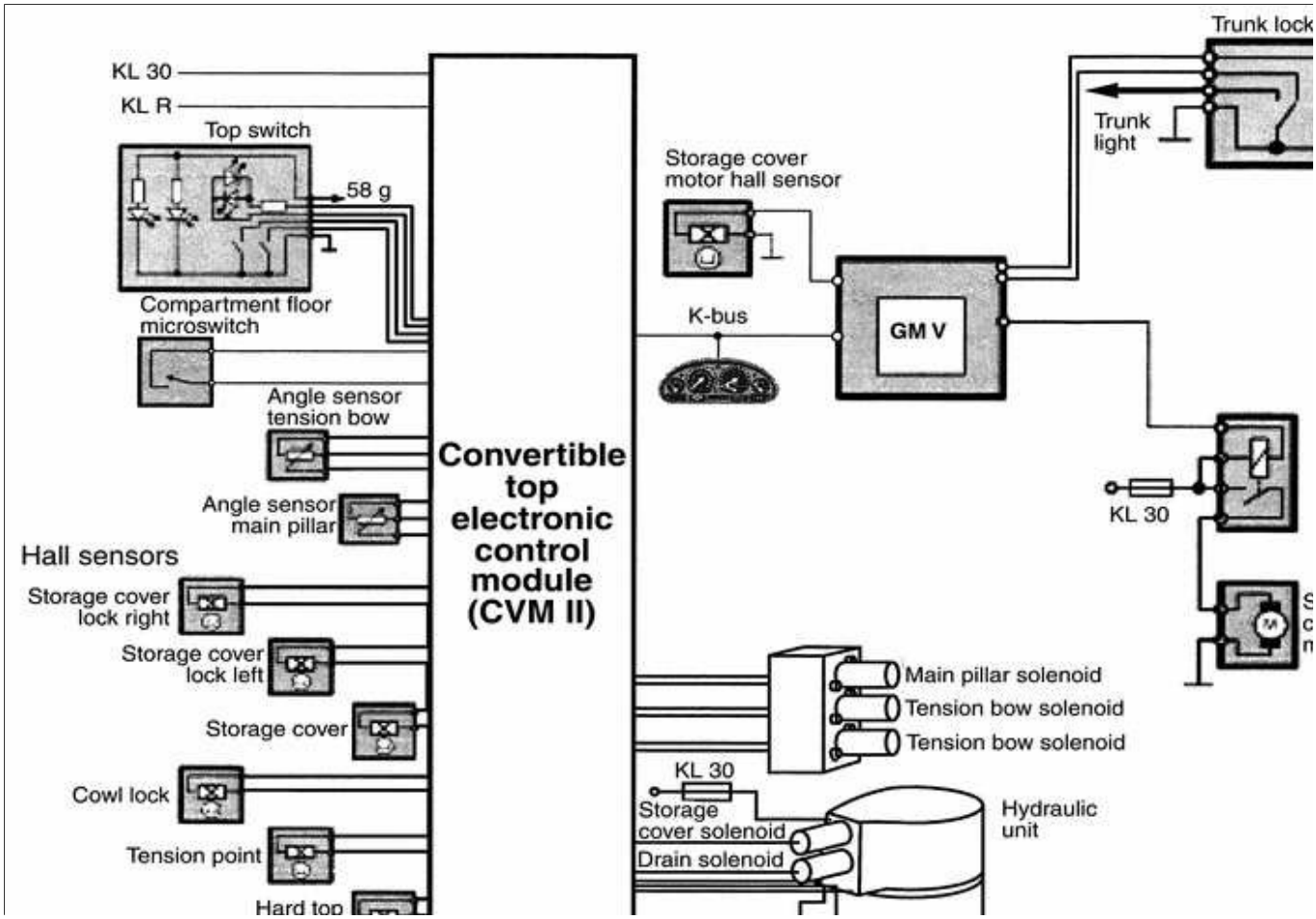
Convertible Top Module (CVM II)

The CVM II is installed in the left rear of the car behind the side trim (next to the seat). It contains the processing, controlling and monitoring electronics for top operation.

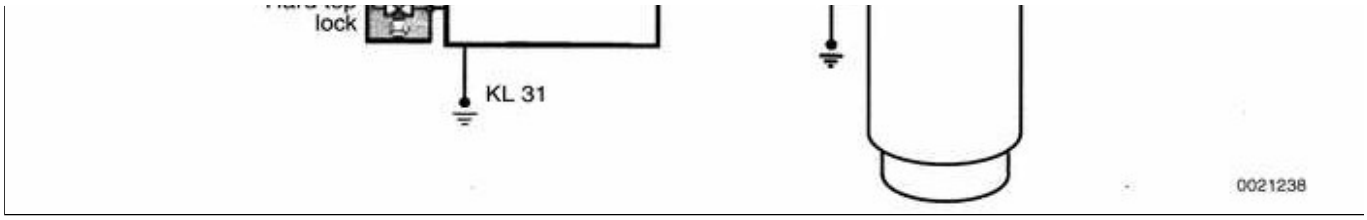
The CVM II communicates with the General Module (GM V) over the K-bus for operation of top storage cover and windows.

The CVM II is fully self-diagnostic and is capable of storing monitored faults. Fault code access and diagnosis is carried out over the K-bus with BMW diagnostic scan tools DIS or MoDiC.

Convertible top electronic control module (CVM II)



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Fault memory storage

Convertible Top Module (CVM II) fault memory is stored in NVRAM. Up to 16 fault codes can be stored in order of occurrence. A distinction is made between permanent and sporadic faults.

If a fault occurs during raising or lowering the top, all top movement will cease and a fault code will be stored in memory. Then the emergency closing procedure must be followed.

Depending on the location and type of the fault, it may be possible to raise or lower the top fully by pressing the switch in the opposite direction.

If the top switch is held on more than 20 seconds after the top is completely raised or lowered, a fault code will be set. CVM II assumes a fault to ground in the switch or electrical harness. The ignition switch must then be cycled OFF - ON to clear the fault before the top will function again. The fault will remain in memory until cleared with a scan tool (DIS, MoDiC or equivalent).

All sequenced movements of the convertible top have time-out limits preset in CVM II. If a time-out occurs before the end position is reached, movement will be switched off to prevent damage to any of the top components.

Note:

The temperature sensor in the convertible top system signals CVM II to

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cease operation if the hydraulic fluid temperature exceeds 95°C (203°F). However, any functions that have been started will be completed before the system is switched off. If the temperature exceeds 105°C (221°F) the system is immediately switched off. Close the top using the emergency closing procedure. Automatic operation can be resumed when the fluid temperature drops below 95°C.

Comfort operation

Comfort closing of the top is possible by using the key in the driver door lock cylinder. Holding the key in the locking position the will raise the top and close the windows.

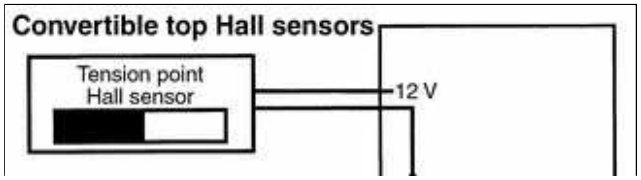
Comfort opening is possible from either the driver door or remotely using the FZV key.

Windshield frame lock

The windshield frame lock assembly consists of the top lock motor positioned in the center of the top frame and two lock drive mechanisms positions on either side of the top frame.

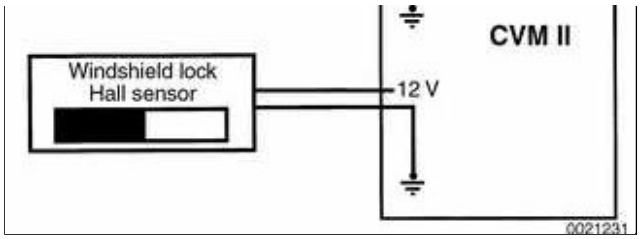
The lock motor and drive mechanism unlock the top from the windshield and raise the front of the top past the tension point. Flexible drive shafts are used to activate the lock assemblies and drive the tension link rods.

Convertible top sensor operation

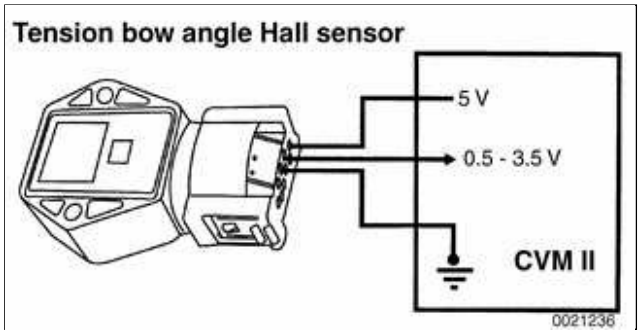


Three Hall sensors detect the position of the top frame are located on the left lock drive assembly. All three sensors receive power and ground from CVM II.

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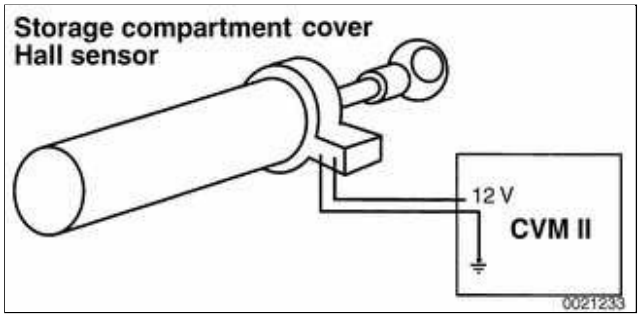
Windshield lock sensor provides low signal when top frame is unlocked from windshield. LED in convertible top switch will flash.



Tension point position sensor provides high signal when top frame is raised past tension point. The angle sensor provides a linear voltage signal input to CVM II (approx. 0.5 - 3.5 volts) as tension bow moves from a vertical to a horizontal position.

Main pillar Hall angle sensor is similar in function and output to tension point position sensor. It is mounted on left side top linkage by left main pillar hydraulic cylinder. The CVM uses input signal from main pillar angle sensor for top frame positioning.

Top storage compartment cover



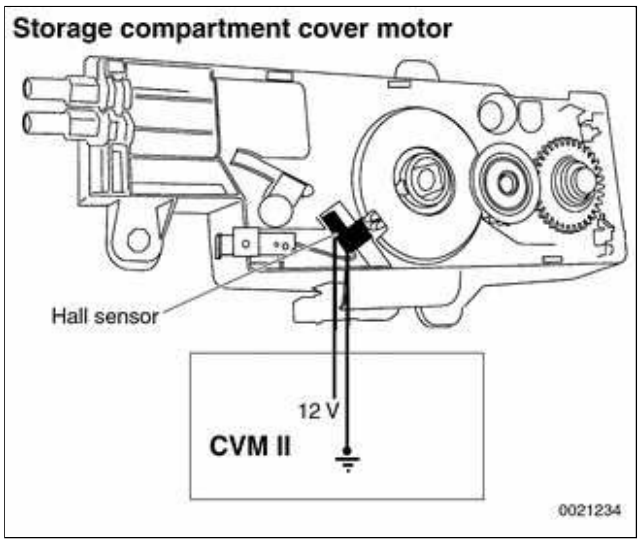
Top storage compartment cover position is detected and signalled to CVM II by a Hall sensor on left side storage cover hydraulic cylinder in trunk. The sensor provides a high signal when storage cover is fully open.

The CVM II uses this input as a switching signal:

- For activating tension bow solenoid during top lowering
- For activating main pillar solenoid during top raising.

Top storage compartment cover lock motor

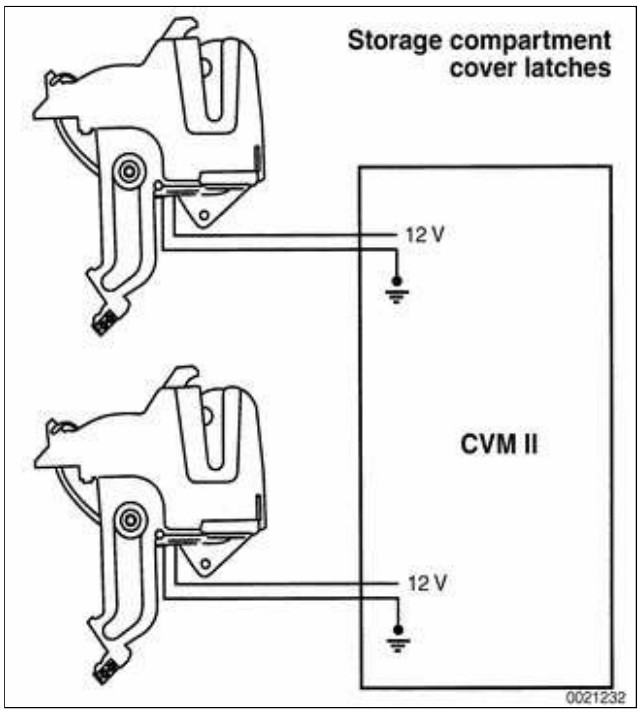
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- The convertible top storage compartment cover lock motor is on driveshaft tunnel under rear seat. It consists of a motor with Hall sensor, gear assembly and two bowden cables connected to cover locks on two sides of cover. The Hall sensor detects locked/unlocked position of cover.

  During convertible top operation (raising or lowering) CVM II signals General Module (GM V) over K-bus to unlock storage compartment. The lock motor runs 180° to unlock cover latches. The motor always turns in same direction to lock or unlock.

  Once motor has turned 180°, the Hall sensor will signal GM V to switch off motor. At the same time, GM V will signal CVM II to continue top operation.



- There are two storage compartment cover lock Hall sensors, one mounted on each storage cover latch. The switches receive power and ground from CVM II. Each switch input provides a high signal when cover is unlocked and raised far enough by cover hydraulic cylinders to clear latches.

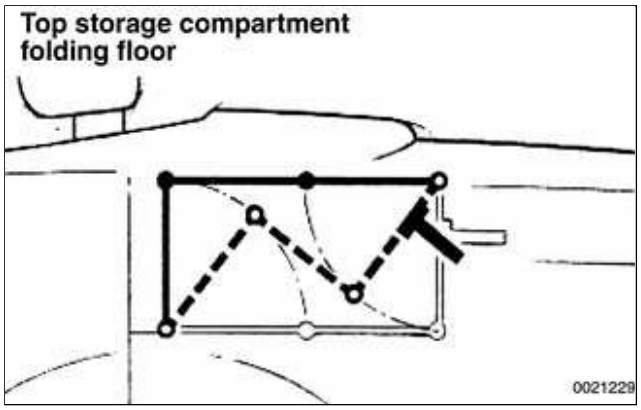
  When cover is completely lowered by hydraulic cylinders, the Hall sensors send a signal to CVM II which signals GM V to relock storage cover.

Top storage compartment floor

The trunk of the E46 Convertible offers the variable convertible top storage compartment floor. This feature allows the luggage storage area to be enlarged by approximately 40 liters (1.5 cu. ft.)

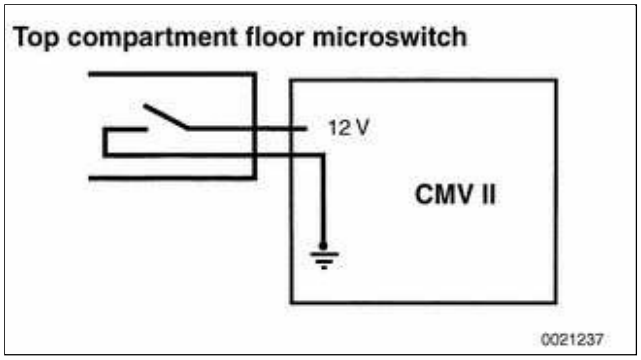
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when soft top is raised or removed for hard top installation.



- The plastic variable compartment floor is hinged at four point so that it can articulate and be rotated up into top storage space.

  A lever on right side of variable floor actuates and locks floor into position.



- A dampening piston on right side maintains position of variable floor. The lower dampening piston hinge switches a microswitch on right side of variable floor when floor is in folded (raised) position. This signal to CVM II locks out operation of top.

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541-2

Convertible Top Components

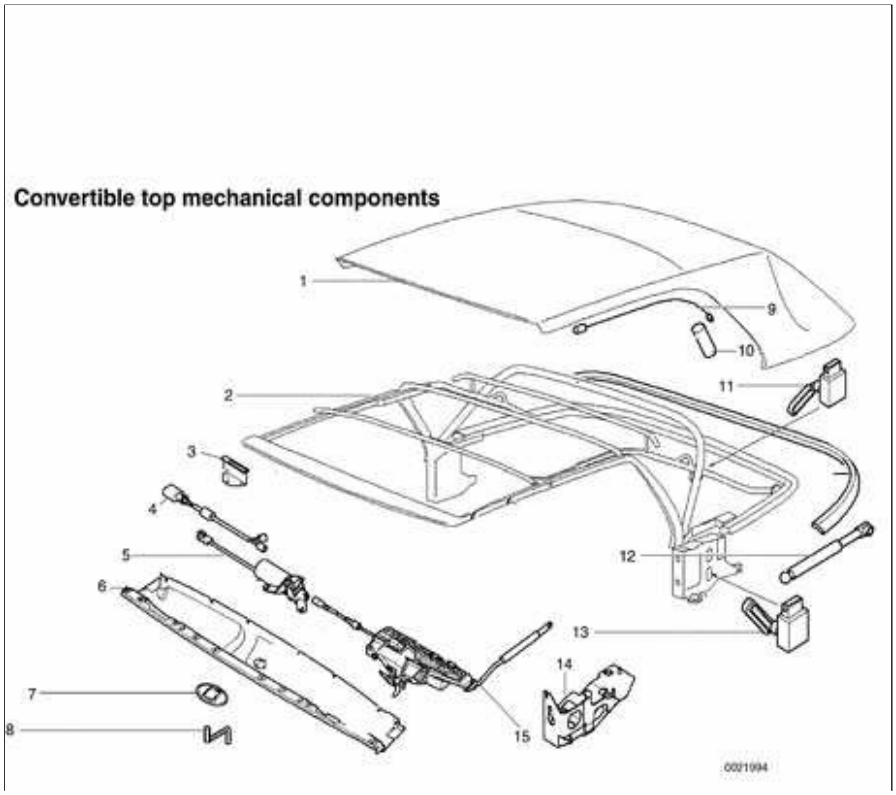
Mechanical top components

The metal folding frame of the top is bolted to the sides of the car behind the door pillars (B-pillars).

The three layer soft top consists of:

- Fabric outer layer
- Middle fleece liner
- Inner liner

Refer to the accompanying illustration for mechanical component locations.



Convertible top mechanical components

1 - Folding top

2 - Folding top frame

3 - Base plate

4 - Windshield frame lock microswitch

5 - Windshield frame lock drive motor

6 - Windshield

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frame cover

7 - Emergency mechanism cover

8 - Emergency operation crank

9 - Tension rope Insulation

10 - Tension bow

11 - Hall sensor

12 - Gas pressurized spring

13 - Main pillar Hall sensor

14 - Console

15 - Windshield latch (left side)

Hydraulic system repairs

CAUTION!

- ***When working on hydraulic system, system must be at zero pressure.***
- ***Disconnect supply and return lines a with convertible top stowed and in untensioned state.***
- ***Once hydraulic system has been opened, a function test must be carried out after work has been completed.***

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- ***Once hydraulic lines have been disconnected from hydraulic components, top must not be moved. Fluid will leak from separated coupling.***

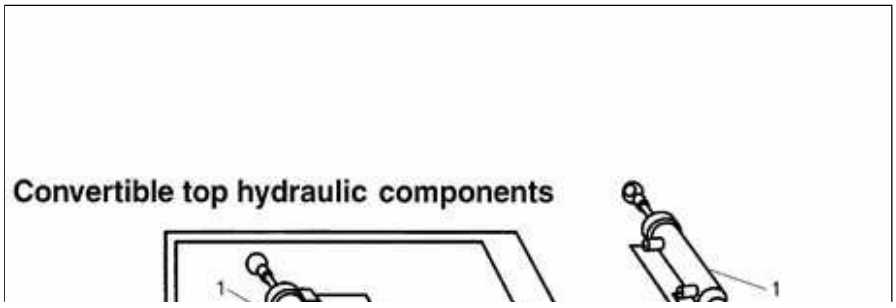
- ***Avoid scratching hydraulic piston rods. Even paint mist and welding spots are harmful.***

- ***When working around hydraulic cylinders, cover with a protective cloth.***

Working in the trunk at the convertible top hydraulic unit, disconnect the supply and return lines and connect them to each other (short circuit). The system is thus closed and the couplings are protected against damage. The hydraulic system cannot build up high pressure and convertible top can be moved manually.

Hydraulic system compontents and electronics are shown in the accompanying illustrations.

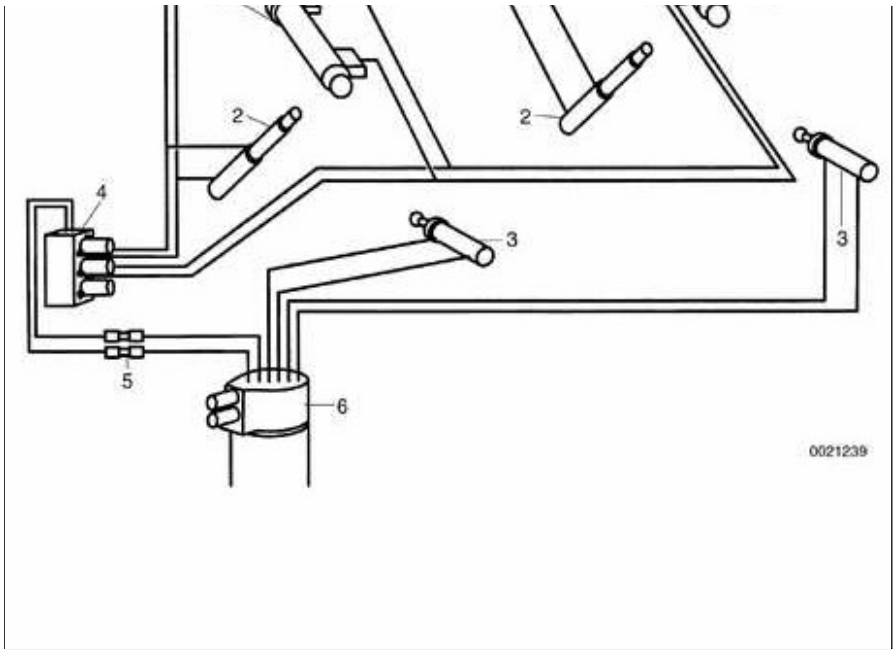
Terms and definitions used in diagnosing and repairing the convertible top hydraulic system are listed in ⇒ Table a. Definition of hydraulic system terms. Basic repair procedures for hydraulic system repair are listed in ⇒ Table b. Convertible top hydraulic system repair procedures.



Convertible top hydraulic components

1 - Tension bow (rear of top) hydraulic

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cylinders:

- Operate on top frame linkage to raise and lower bow
- Located on two sides of tension bow, at sides of rear window
- Angle Hall sensor on left tension bow linkage detects bow position
- Hydraulic lines for right tension bow cylinder routed under top fabric along tension bow

2 - **Main pillar hydraulic cylinders:**

- Actuate soft top frame
- Located on two sides of top frame linkage
- Angle hall sensor detects position of main top linkage
- Hydraulic lines for right main pillar cylinder routed under top fabric along tension bow

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3 - **Top storage compartment cover hydraulic cylinders:**

- Open and close storage compartment cover
- Located in trunk
- Left cylinder equipped with Hall sensor to detect fully opened position of cover

4 - **Solenoid valve block on left side of top frame:**

- Solenoid V1 controls operation of main pillar hydraulic cylinder
- Solenoid V2 controls tension bow cylinders for raising top
- Solenoid V3 controls tension bow cylinders for lowering top

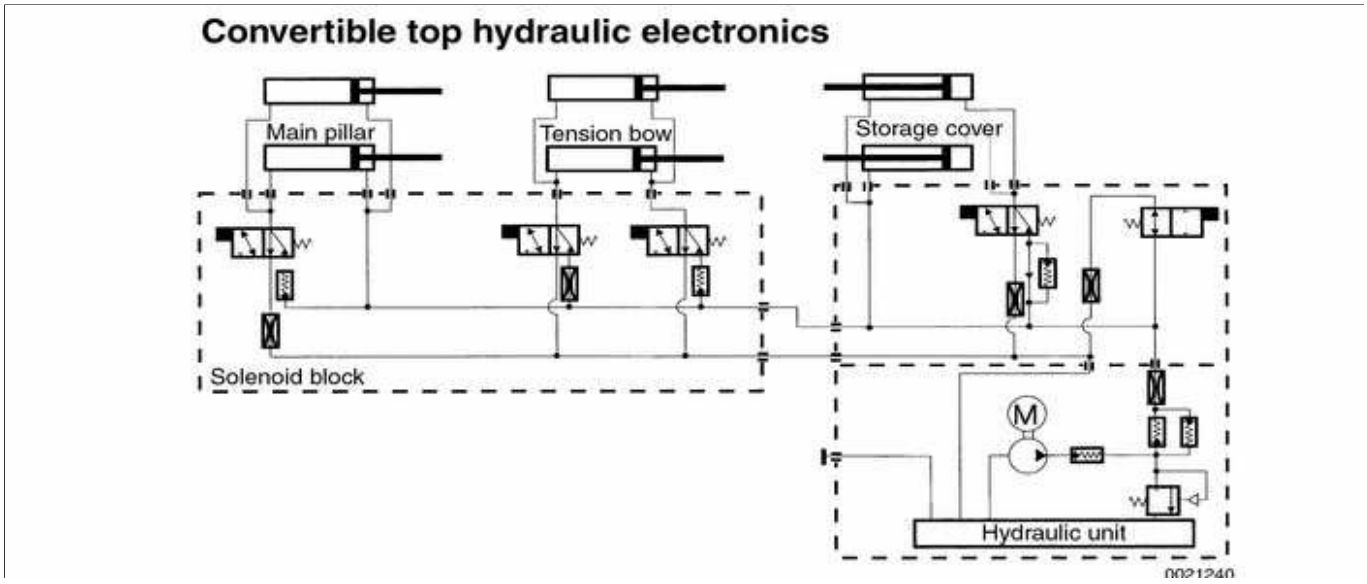
5 - **Quick disconnect in trunk**

6 - **Hydraulic pump unit:**

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- In left side of trunk behind trim
- Mounted on rubber bushings and covered by sound insulation
- Unit consists of: Hydraulic motor and pump, Storage cover solenoid valve, Drain solenoid valve, Hydraulic fluid reservoir, Hydraulic fluid temperature sensor
- Operates at pressures of up to 200 bar (2900 lb/in^2).

Convertible top hydraulic electronics



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Table a. Definition of hydraulic system terms

Term	Action	Notes
Hydraulic system at zero pressure	Turn ignition to 0 position. Wait 15 seconds.	Hydraulic system has no or very low pressure.
Untensioned state		
Mechanical (emergency) actuation	Open or close top by hand.	See ⇒ Emergency operation
Closed system	All hydraulic lines connected.	Even short-circuiting of lines is possible.
Function test	Open and close top several times (min. 3 times). Check hydraulic unit fluid level and top up if necessary.	Refer to Operating Instructions.
Short circuit	Unfasten quick release coupling. Connect supply and return lines to each other.	Hydraulic system cannot build up pressure. Convertible top can be moved.

Table b. Convertible top hydraulic system repair procedures

Operation	Procedures
Mechanical (manual) operation of top	♦ Ignition must be turned off ♦ Hydraulic lines must be disconnected. (Reconnect when finished) ♦ After repeated actuation, system fluid is pumped into supply tank of hydraulic unit. If hydraulic components are replaced, there will be too much fluid in system.
Fluid level check	♦ Stow convertible top and close storage compartment

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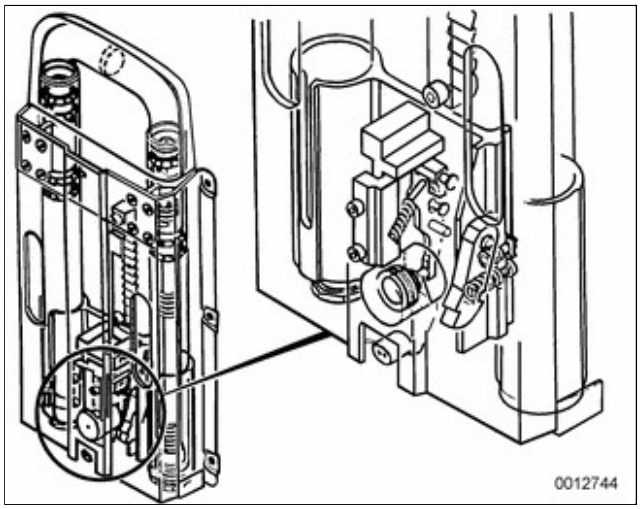
Operation	Procedures
	lid.
Fluid topping up or draining	♦ Follow directions in ⇒ Hydraulic fluid level, checking or filling, earlier in this group.

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Rollover Protection System



Two spring-loaded rollbar cassettes are mounted behind the rear seat. The cassettes are bolted into the reinforced carrier behind the seat backs. When retracted they are covered by the rear headrest which incorporates a flap at the back, that will open when the rollbars deploy.

A rollover sensor, mounted in the rear behind the left rear seat back on the rollbar cassette, contains the electronics for rollover detection and deployment final stage for triggering the rollover bar solenoids. Two capacitors are installed for rollbar deployment in case of a power failure during a crash.

The rollover sensor performs a self-check every time the ignition is switched on. The sensor is connected to the diagnostic link (DLC) for troubleshooting purposes.

If faults are detected, the warning lamp in the instrument cluster will light up. In case of a crash, the system will attempt to trigger the rollover cassettes to deploy even if a fault code is stored in fault memory.

Note:

Diagnosis of convertible top and Rollover Protection System are beyond scope of this book. Your authorized BMW dealer has proper diagnostic equipment and tools to carry out these tasks.

After deployment, the detent pawl in a rollover protection cassette can be retracted by pulling the reset lever

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forward so that rollbar can be pushed down and locked into the solenoids.

WARNING!

Ensure that area above and adjacent to rollover bars remains clear and unobstructed at all times.

CAUTION!

- ***It is not possible to close convertible top with rollover bars extended.***

- ***If a hardtop is mounted, be sure to install the protective rollover bar covers provided with hardtop to prevent damaging rear window in case of deployment.***

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General

A brief description of the principal parts of the electrical system is presented here. Also covered here are basic electrical system troubleshooting tips.

See also ⇒ 121 Battery, Alternator, Starter.

Electrical test equipment

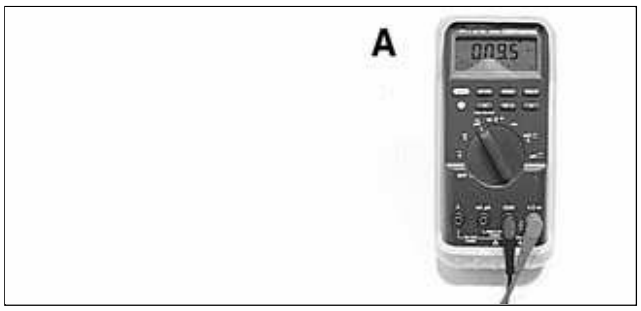
Many electrical tests described in this manual call for measuring voltage, current, or resistance using a digital multimeter. Digital meters are preferred for precise measurements and for electronics work because they are generally more accurate than analog meters. An analog meter (swing-needle) may draw enough current to damage sensitive electronic components.

An LED test light is a safe, inexpensive tool that can be used to perform many simple electrical tests that would otherwise require a digital multimeter. The LED indicates when voltage is present between any two test-points in a circuit.

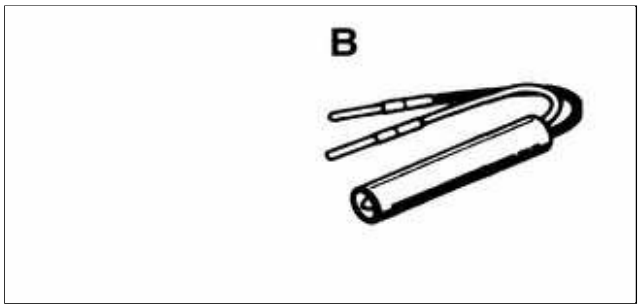
The integrated safety, comfort, security and handling systems on E46 cars are designed with self-diagnostic capabilities. The quickest way to diagnose many problems is to start out with a scan tool read out of Diagnostic Trouble Codes (DTCs). See ⇒ OBD On Board Diagnostics at rear of manual.

Special Tools

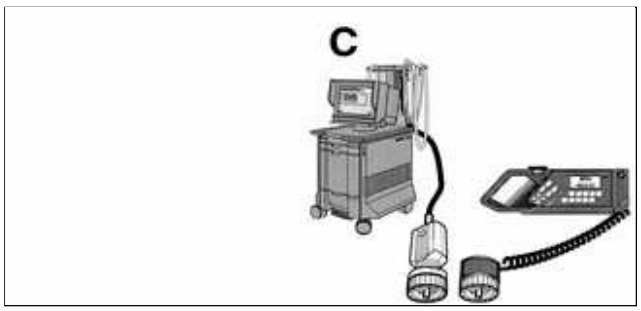
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- Automotive digital multimeter Fluke 87



- LED tester with thin spade probes Baum 1115 (Source: Baum Tools Unlimited)



- Scan tools BMW DIS/MoDiC



- Aftermarket scan tool Baum CS2000 (Source: Baum Tools Unlimited)

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E46 Electrical System

E46 cars are electrically complex. Many vehicle systems and subsystems are interconnected or integrated. In addition, the requirements of second generation On-Board Diagnostics (OBD II) are such that there are now many more circuits and wires in the vehicle than ever before. The components must exchange large volumes of data with one another in order to perform their various functions.

The use of dedicated data lines for each link in the system has reached the limits of its capabilities. On the one hand, wiring harnesses now must be so complex that they become unmanageable. In addition, the finite number of pins on conventional connectors becomes a limiting factor in electronic control module development.

The solution has been found in the use of specialized, vehicle compatible serial bus systems. The E46 bus system is summarized in ⇒ Table a.

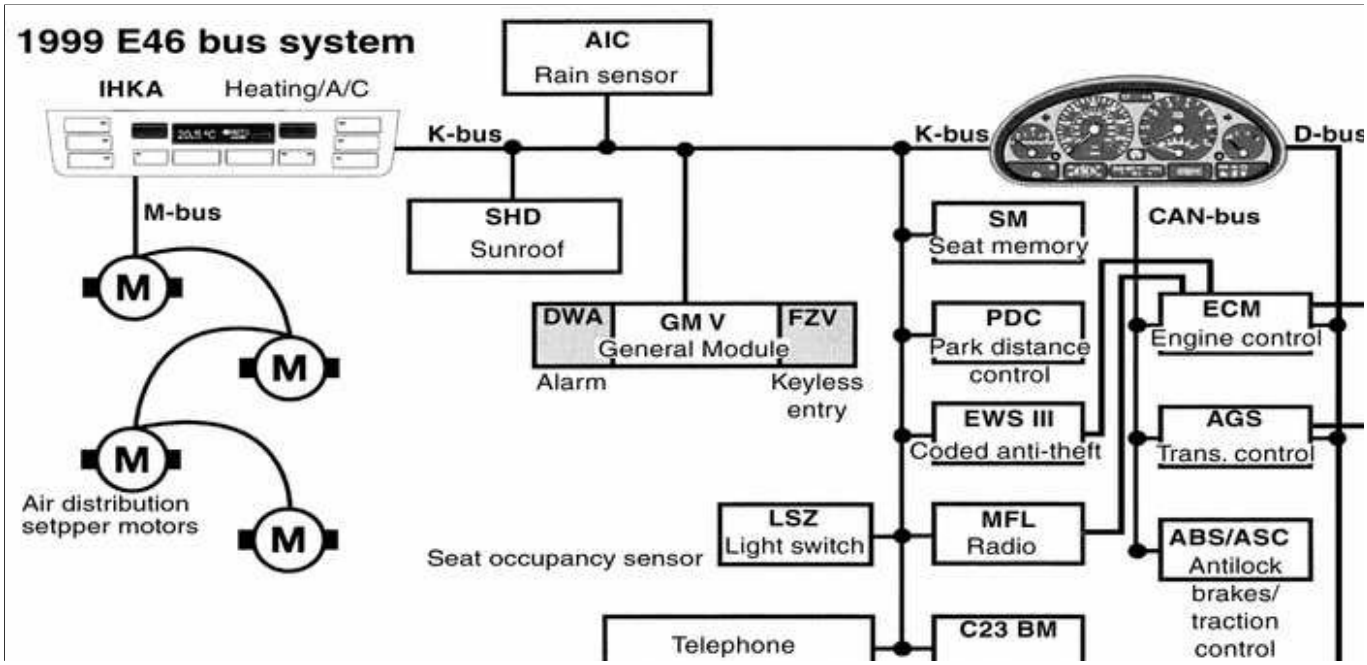
Table a. E46 busses

Bus	Circuits covered
K-bus	Driver information systems (instrument cluster, Check Control, on-board computer) Central Body Electronics (ZKE V) General Module (GM V) Seat memory (SM) Sunroof (SHD) Rain sensor (AIC) Telephone and sound system Headlight module (LSZ)

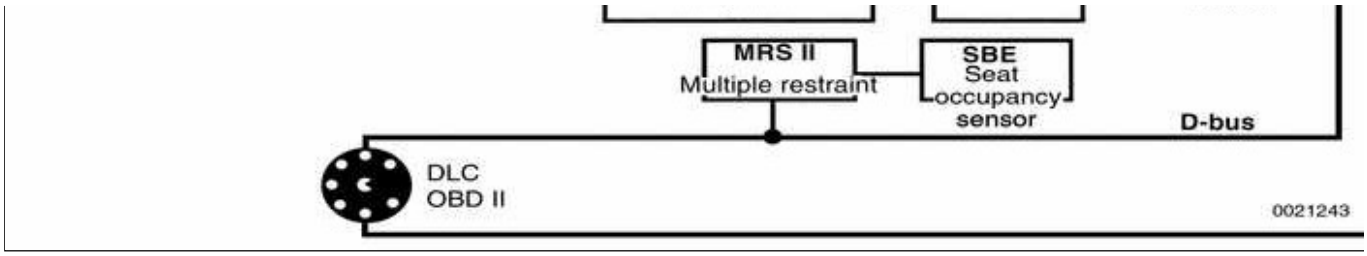
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Table a. E46 busses	
Bus	**Circuits covered**
	Coded anti-theft (EWS III) and anti-theft (DWA) Remote entry (FZV) Park distance control (PDC)
M-bus	Heating and air conditioning (IHKA) components
CAN-bus	Engine management system (DME) Transmission control (AGS) Antilock brakes (ABS) Traction control (ASC) Dynamic stability control (DSC)
D-bus	Data link connector (DLC) OBD II connector Multiple restraint system (MRS II)

1999 E46 bus system, diagram



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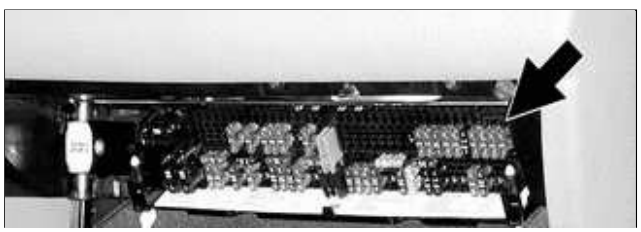
Voltage and polarity

The vehicle electrical system is a 12-volt direct current (DC) negative-ground system. A voltage regulator controls system voltage at approximately 12-volts. All circuits are grounded by direct or indirect connection to the negative (-) terminal of the battery. A number of ground connections throughout the car connect the wiring harness to chassis ground. These circuits are completed by the battery cable or ground strap between the body and the battery negative (-) terminal.

Wiring, fuses and relays

Electrical components connect using one of the following:

- Heavy cables with lug-type connectors (battery and starter)
- Electrical harnesses with keyed, push-on connectors that lock into place
- Busses with modular connectors



With the exception of the starter and the charging system, most electrical power is routed from the ignition switch or the battery through the main relay panel in back of the glove compartment or the

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main fuse box (**arrow**) above the glove compartment. Fuses are color coded to indicate current capacities.

The relays and control modules are mounted in various places throughout the vehicle. See ⇒ 610 Electrical Component Locations.

Central Body Electronics (ZKE V)

E46 vehicles are equipped with an integrated complex of electronic modules connected mostly via K-bus. This system, called ZKE V, is primarily controlled by the General Module (GM V).

These functions are controlled directly by the GM V:

- Windshield wiper/washer system, with optional Rain Sensor Interface. See ⇒ 611 Wipers and Washers.
- Central locking, power trunk release, keyless entry (FZV). See ⇒ 515 Central Locking and Anti-theft.
- Power window control. See ⇒ 512 Door Windows.
- Car Memory/Key Memory. See ⇒ 515 Central Locking and Anti-theft.
- Interior lighting. See ⇒ 612 Switches.
- Alarm system (DWA). See ⇒ 515 Central Locking and Anti-theft.
- Electronic consumer sleep mode, described later in this section

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Other functions are not directly controlled by the GM V but interconnected:

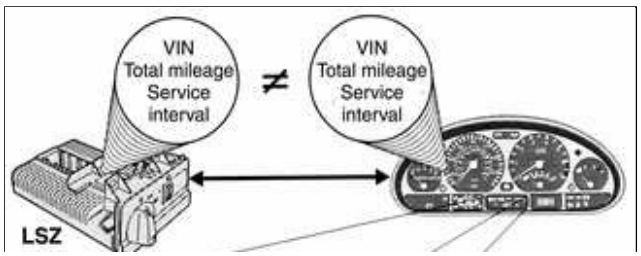
- Rain sensor (AIC). See ⇒ 611 Wipers and Washers.
- Sunroof operation (SHD). See ⇒ 540 Sunroof.
- Seat memory (SM) and electrical operation. See ⇒ 520 Seats.
- Outside rear-view mirror control and heating. See ⇒ 510 Exterior Trim, Bumpers.
- Windshield washer jet heating. See ⇒ 611 Wipers and Washers.

Redundant data storage

The following vehicle information is stored redundantly in the instrument cluster and the light switch module:

- Vehicle identification number (VIN)
- Total mileage
- Service interval data

This redundancy means that the instrument cluster or light module may be replaced without loss of stored data.



The data between the two units is compared each time the ignition is switched on (KL 15 on). If the data does not match the tamper warning dot (**arrow**) in the mileage display will be illuminated. Under certain circumstances

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a fault code (DTC) will be set.

Resetting and resynchronizing of codes and data requires the use of BMW scan tools DIS or MoDiC.

Car Memory/Key Memory

A number of features and functions can be customized to the driver(s) preference. The identity of the vehicle user is provided by a signal from the keyless entry system (FZV).

Car Memory and Key Memory are actually two separate functions, although they are marketed as a combined feature. See ⇒ 515 Central Locking and Anti-theft for further details.

Electrical consumer sleep mode

Central body electronics (ZKE V) is designed to bring the vehicle electrical consumers into "sleep mode" after 16 minutes of inactivity.

In order to test sleep mode:

- Switch ignition off.
- Close all doors, trunk and hood.
- Lock vehicle using central locking.
- Wait 16 minutes.

If one of a number of inputs into the General Module (GM V) is activated before the vehicle is in sleep mode, the 16 minute cycle starts again. Once the vehicle is in sleep mode, the GM V will "wake up" if it receives a change of signal from one of the following sensors:

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- K-bus
- Door jamb sensors
- Trunk lid lock cylinder microswitch
- Interior trunk lid release push-button microswitch
- Central locking button
- Engine hood latch microswitch
- Trunk key position switch
- Interior light switch
- Internal motion sensor
- Tilt sensor
- Driver's door lock sensors

Note:

If an interior light is accidentally left on, the GM V will override the signal from it after 16 minutes and implement sleep mode.

Electrical system safety precautions

Please read the warnings and cautions in this section before doing any work on your electrical system.

WARNING!

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- ***An airbag unit houses an explosive powerful charge. Making repairs without the proper knowledge and special test equipment may cause serious personal injury. See ⇒ 721 Airbag System (SRS).***

- ***The ignition system of the car operates at lethal voltages. People with pacemakers or weak hearts should not expose themselves to the ignition system electric currents. Extra caution must be taken when working on the ignition system or when servicing the engine while it is running or the key is on. See ⇒ 120 Ignition System for additional ignition system warnings and cautions.***

- ***Keep hands, clothing and other objects clear of the electric radiator cooling fan when working on a warm engine. The fan may start at any time, even when the ignition is switched off.***

CAUTION!

- ***Always turn off the engine and disconnect the negative (-) cable from the battery before removing any electrical components. Disconnecting the battery may erase fault code(s) stored in control module memory. Check for fault codes using special BMW diagnostic equipment.***

- ***Prior to disconnecting the battery, read the battery disconnection cautions given at***

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the front of this manual on page viii.

- ***Connect and disconnect ignition system wires, multiple connectors and ignition test equipment leads only while the ignition is off.***
- ***Do not disconnect the battery with the engine running.***
- ***Do not quick-charge the battery (for boost starting) for longer than one minute, and do not exceed 16.5 volts at the battery with the boosting cables attached. Wait at least one minute before boosting the battery a second time.***
- ***Do not use an analog meter. Use only a digital multimeter.***
- ***Many of the solid-state modules are static sensitive. Static discharge will permanently damage them. Always handle the modules using proper static prevention equipment and techniques.***
- ***To avoid damaging harness connectors or relay panel sockets, use jumper wires with flat-blade connectors that are the same size as the connector or relay terminals.***
- ***Always switch a digital multimeter to the appropriate function and range before making test connections.***

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- ***Do not try to start the engine of a car which has been heated above 176F/80C, (for example, in a paint drying booth). Allow it to cool to normal temperature.***
- ***Disconnect the battery before doing any electric welding on the car.***
- ***Do not wash the engine while it is running, or anytime the ignition is switched on.***
- ***Choose test equipment carefully. Use a digital multimeter with at least 10 megaohm input impedance, or an LED test light. An analog meter (swing-needle) or a test light with a normal incandescent bulb may draw enough current to damage sensitive electronic components.***
- ***An ohmmeter must not be used to measure resistance on solid state components such as control units or time delay relays.***
- ***Always disconnect the battery before making resistance (ohm) measurements on the circuit.***

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Wiring Diagrams

The wiring diagrams shown in Electrical Wiring Diagrams have been specially designed to enable quick and efficient diagnosis and troubleshooting of electrical malfunctions.

Wiring codes and abbreviations

A lot of information is included in each wiring diagram if you know how to read them. Wire colors in the diagrams are abbreviated. Combined color codes indicate a multi-colored wire. For example the code BLU/RED indicates a blue wire with a red stripe.

Many electrical components, connectors, fuses, and ground locations are identified using a unique number. Each of these numbers corresponds to a particular part in the circuit commonly found in Electrical Wiring Diagrams.

Note:

Sometimes the color of an installed wire may be different than the one on the wiring diagram. Don't be concerned. Just be sure to confirm that the wire connects to the proper terminals.

Table b. Wire color codes

German code	English code	Color
SW	BLK	Black
BL	BLU	Blue
BR	BRN	Brown
GN	GRN	Green

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Table b. Wire color codes		
German code	**English code**	**Color**
GR	GRY	Grey
	ORG	Orange
RT	RED	Red
VI	VIO	Violet
WS	WHT	White
GE	YEL	Yellow

Most terminals are identified by numbers on components and harness connectors. Terminal numbers for major electrical connections are shown in the diagrams. Though many terminal numbers appear only once, several other numbers appear in numerous places throughout the electrical system and identify certain types of circuits. Some common circuit numbers are listed below in ⇒ Table c.

Table c. Terminal and circuit numbers	
Number	**Circuit description**
1	Low voltage switched terminal of coil
4	High voltage center terminal of coil
+X	Originates at ignition switch. Supplies power when the ignition switch is in the PARK, RUN, or START position
15	Originates at ignition switch. Supplies power when ignition switch is in RUN or START position

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Table c. Terminal and circuit numbers	
Number	**Circuit description**
30	Battery positive (+) voltage. Supplies power whenever battery is connected. (Not dependent on ignition switch position, unfused)
31	Ground, battery negative (-) terminal
50	Supplies power from battery to starter solenoid when ignition switch is in START position only
+54	Originates at ignition switch. Supplies power when ignition switch is in the RUN position only
85	Ground side (-) of relay coil
86	Power-in side (+) of relay coil
87	Relay actuated contact
D	Alternator warning light and field energizing circuit

Additional abbreviations shown in the wiring diagrams are given below.

Table d. Common E46 abbreviation

Abbreviation	Component or system	Abbreviation	Component or system
ABS	antilock brakes	KL 50	ignition switch start position
A/C	air conditioning	LDP	fuel tank leak diagnosis pump (DME MS 42.0)

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Abbreviation	Component or system	Abbreviation	Component or system
ADB, ADB-X	automatic differential lock	LEV	low emission vehicle
AGS	adaptive transmission control	LSZ	light switch module
AIC	rain sensor	MAF	mass air flow sensor
ASC	traction control	MBC	maximum braking control
AUC	automatic air recirculation	MFL	multifunction steering wheel
BST	Battery safety terminal	MRS	multiple restraint system
CAN	Controller Area Network (BUS)	NLEV	national low emission vehicle program
CBC	cornering brake control	NTC	negative temperature coefficient resistor
DBC	dynamic brake control	OBC	on board computer
DK	throttle valve	OBD II	second generation on-board diagnostics
DLC	diagnostic link connector	ORVR	on-board refueling vapor recovery
DME	digital motor electronics	PDC	park distance control (optional)
DMTL	diagnosis module-tank leakage (DME MS 43.0)	PWG	pedal position sensor
DSC III	dynamic stability control	RAM	random access memory
DTC	diagnostic trouble code	RDC	tire pressure control (optional)
DWA	anti-theft alarm system	RPS	rollover protection system
E-box	electronics box under engine hood	RXD	receive data line
ECM	engine control module	SBE	front passenger seat sensor
EGS	electronic transmission control	SGS	seat integrated belt system
EPROM	erasable/programmable read-only memory	SHD	sunroof module
EWS	electronic immobilizer	SII	service interval indicator
FZV	keyless entry	SM	seat memory module

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Abbreviation	Component or system	Abbreviation	Component or system
GM	general module (see ZKE)	SRS	supplemental restraint system-airbag
HPS	head protection system	TCM	transmission control module
IHKA	automatic heating and air conditioning system	TDC	top dead center
IHKR	manual heating and air conditioning system	TLEV	transitional low emissions vehicle
ITS	head protection system	TXD	transmit data line
KL 15	battery positive, ignition switch on "run"	UIS	ultrasonic interior protection
KL 30	battery positive "hot" all the time	ULEV	ultra low emissions vehicle
KL 31	battery/chassis ground	ZKE	central body electronics

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Electrical Troubleshooting

Four things are required for current to flow in any electrical circuit: a voltage source, wires or connections to transport the voltage, a load or device that uses the electricity, and a connection to ground.

Most problems can be found using a digital multimeter (volt/ohm/amp meter) to check the following:

- Voltage supply
- Breaks in the wiring (infinite resistance/no continuity)
- A path to ground that completes the circuit.

Electric current is logical in its flow, always moving from the voltage source toward ground. Electrical faults can usually be located through a process of elimination. When troubleshooting a complex circuit, separate the circuit into smaller parts. General tests outlined below may be helpful in finding electrical problems. The information is most helpful when used with wiring diagrams.

Be sure to analyze the problem. Use wiring diagrams to determine the most likely cause. Get an understanding of how the circuit works by following the circuit from ground back to the power source.

When making test connections at connectors and components, use care to avoid spreading or damaging the connectors or terminals. Some tests may require jumper wires to bypass

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components or connections in the wiring harness. When connecting jumper wires, use blade connectors at the wire ends that match the size of the terminal being tested. The small internal contacts are easily spread apart, and this can cause intermittent or faulty connections that can lead to more problems.

Voltage and voltage drops

Wires, connectors, and switches that carry current are designed with very low resistance so that current flows with a minimum loss of voltage. A voltage drop is caused by higher than normal resistance in a circuit. This additional resistance actually decreases or stops the flow of current. A voltage drop can be noticed by problems ranging from dim headlights to sluggish wipers. Some common sources of voltage drops are corroded or dirty switches, dirty or corroded connections or contacts, and loose or corroded ground wires and ground connections.

A voltage drop test is a good test to make if current is flowing through the circuit, but the circuit is not operating correctly. A voltage drop test will help to pinpoint a corroded ground strap or a faulty switch. Normally, there should be less than 1 volt drop across most wires or closed switches. A voltage drop across a connector or short cable should not exceed 0.5 volts.

Note:

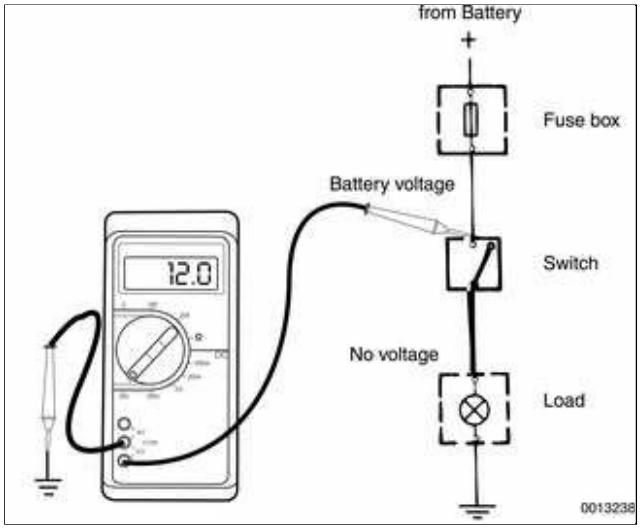
- *A voltage drop test is generally more accurate than a simple resistance check because the resistances involved are often too small to measure with most ohmmeters. For example, a*

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resistance as small as 0.02 ohms would results in a 3 volt drop in a typical 150 amp starter circuit. (150 amps x 0.02 ohms =3 volts).

- *Keep in mind that voltage with the key on and voltage with the engine running are not the same. With the ignition on and the engine off (battery voltage), voltage should be approximately 12.6 volts. With the engine running (charging voltage), voltage should be approximately 14.0 volts. Measure voltage at the battery with the ignition on and then with the engine running to get exact measurements.*

Voltage, measuring



- Connect digital multimeter negative lead to a reliable ground point on car.

Note:

The negative (-) battery terminal is always a good ground point.

- Connect digital multimeter positive lead to point in circuit you wish to measure.

- If a reading is obtained, current is flowing through circuit.

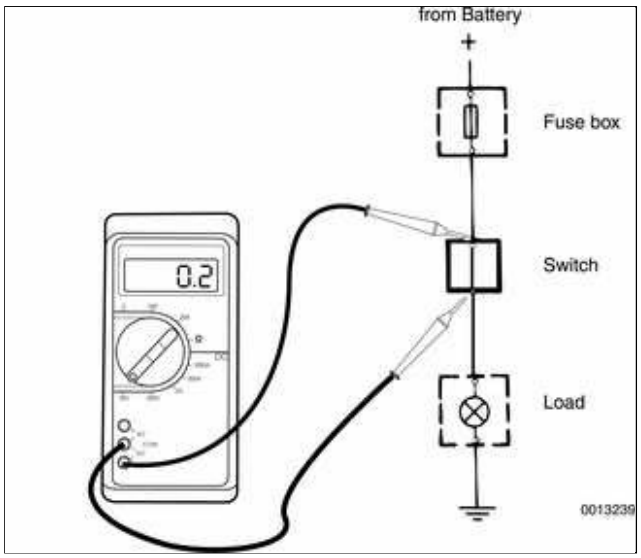
Note:

The voltage reading should not deviate more than 1 volt from voltage at the battery. If voltage drop is more than this, check for a corroded connector or loose ground wire.

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Voltage drop, testing

Voltage drop can only be checked when there is a load on the circuit, such as when operating the starter motor or turning on the headlights. A digital multimeter should be used to ensure accurate readings.



- Connect digital multimeter positive lead to positive (+) battery terminal or a positive power supply close to battery source.

  - Connect digital multimeter negative lead to other end of cable or switch being tested.

  - With power on and circuit working, meter shows voltage drop (difference between two points). This value should not exceed 1 volt.

Note:

The maximum voltage drop in an automotive circuit, as recommended by the Society of Automotive Engineers (SAE), is as follows: 0 volts for small wire connections; 0.1 Volts for high current connections; 0.2 volts for high current cables; and 0.3 volts for switch or solenoid contacts. On longer wires or cables, the drop may be slightly higher. In any case, a voltage drop of more than 1.0 volt usually indicates a problem.

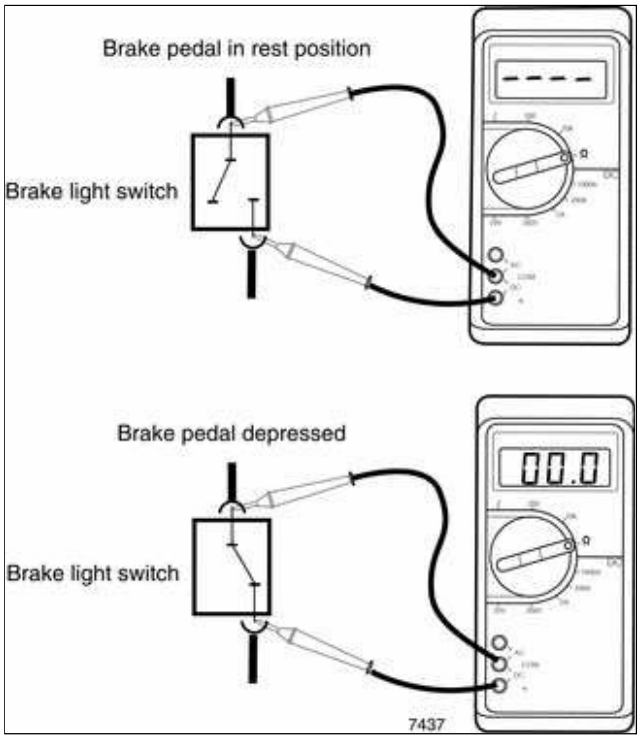
Continuity, checking

Continuity tests can be used to check a circuit or switch. Because most automotive circuits are designed to have little or no resistance, a circuit or part of a circuit can be easily checked

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for faults using an ohmmeter. An open circuit or a circuit with high resistance will not allow current to flow. A circuit with little or no resistance allows current to flow easily.

When checking continuity, the ignition should be off. On circuits that are powered at all times, the battery should be disconnected. Using the appropriate wiring diagram, a circuit can be easily tested for faulty connections, wires, switches, relays and engine sensors by checking for continuity.



For example, to test brake light switch for continuity:

- With brake pedal in rest position (switch open) there is no continuity (infinite Ω).
- With pedal depressed (switch closed) there is continuity (0Ω).

Short circuits

Short circuits are exactly what the name implies. The circuit takes a shorter path than it was designed to take. The most common short that causes problems is a short to ground where the insulation on a positive (+) wire wears away and the metal wire is exposed. When the wire rubs against a metal part of the car or other ground source, the circuit is shorted to ground. If the exposed wire is live (positive

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battery voltage), a fuse will blow and the circuit may possibly be damaged.

Shorts to ground can be located with a digital multimeter. Short circuits are often difficult to locate and may vary in nature. Short circuits can be found using a logical approach based on current path.

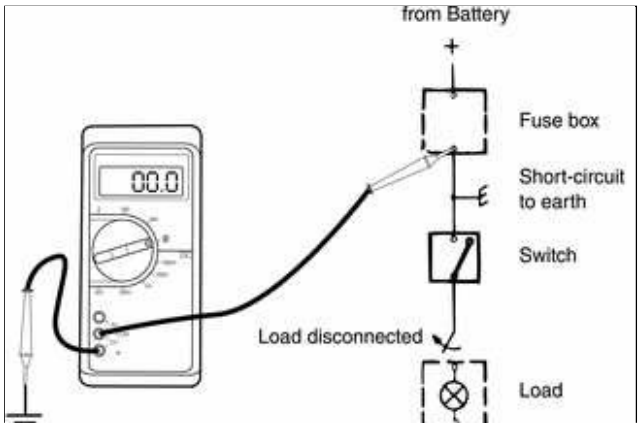
CAUTION!

- ***On circuits protected with high rating fuses (25 amp and greater), wires or circuit components may be damaged before the fuse blows. Always check for damage before replacing fuses of this rating.***

- ***When replacing blown fuses, use only fuses having the correct rating. Always confirm the correct fuse rating printed on the fuse/relay panel cover.***

Short circuit, testing with ohmmeter

- Remove blown fuse from circuit and disconnect cables from battery. Disconnect harness connector from circuit load or consumer.



- Using an ohmmeter, connect one test lead to load side of fuse terminal (terminal leading to circuit) and the other test lead to ground.

- If there is continuity to ground, there is a short to ground.

- If there is no continuity, work from wire harness nearest to fuse/relay

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panel and move or wiggle wires while observing meter. Continue to move down harness until meter displays a reading. This is the location of short to ground.

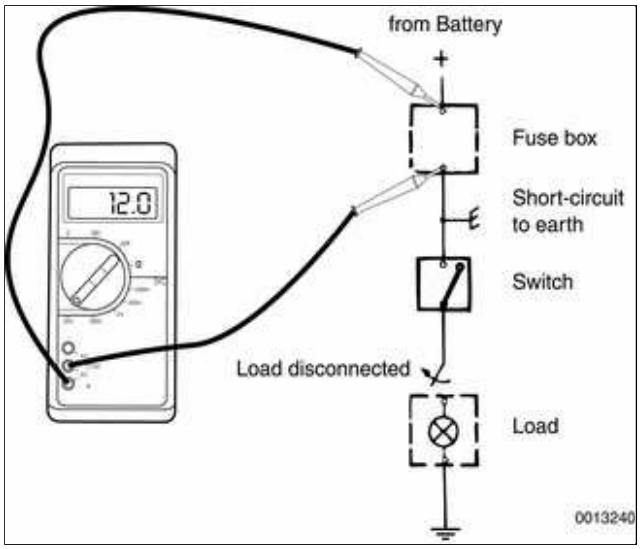
- Visually inspect wire harness at this point for any faults. If no faults are visible, carefully slice open harness cover or wire insulation for further inspection. Repair any faults found.

Short circuit, testing with voltmeter

- Remove blown fuse from circuit. Disconnect harness connector from circuit load or consumer.

Note:

Most fuses power more than one consumer. Be sure all consumers are disconnected when checking for a short circuit.



- Using a digital multimeter, connect test leads across fuse terminals. Make sure power is present in circuit. If necessary turn key on.

- If voltage is present at voltmeter, there is a short to ground.

- If voltage is not present, work from wire harness nearest to fuse/relay panel and move or wiggle wires while observing meter. Continue to move down harness until meter displays a reading. This is the location of short to ground.

- Visually inspect wire harness at

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this point for any faults. If no faults are visible, carefully slice open harness cover or wire insulation for further inspection. Repair any faults found.

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General

This repair group covers fuse, relay and control module location information. Ground points and other component locations are also covered, primarily via photos or illustrations.

For additional E46 electrical system information, see:

- ⇒ 600 Electrical System–General.
- Electrical Wiring Diagrams

Fuses, relays and control modules

The complex nature of E46 electrical systems requires a very large number of fuses and electrical components. Locating this array of equipment is always an important first step in any kind of electrical diagnosis.

Investigating and correcting ground problems often clears mysterious and difficult to trace electrical problem. This repair group covers the major ground locations on the vehicle.

Keep in mind that electrical equipment and accessories installed vary depending on model and model year. Always confirm that the proper electrical component has been identified by using the electrical wiring diagrams at the back of this manual.

Electrical system safety precautions

Please read the following warnings and

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cautions before doing any work on your electrical system.

WARNING!

The battery safety terminal, pyrotechnic seat belt tensioners, and airbags utilize explosive devices and must be handled with extreme care. Refer to the warnings and cautions in ⇒ 121 Battery, Alternator, Starter; ⇒ 720 Seat Belts; and ⇒ 721 Airbag System (SRS).

CAUTION!

- ***Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.***
- ***Relay and fuse positions are subject to change and may vary from car to car. If questions arise, an authorized BMW dealer is the best source for the most accurate and up-to-date information.***
- ***A good way to verify a relay position is to compare the wiring colors at the relay socket to the colors indicated on the wiring diagrams located at the rear of this manual.***
- ***Always switch the ignition off and remove the negative (-) battery cable before removing any electrical components. Connect and disconnect ignition system wires, multiple connectors, and ignition test equipment leads only while the ignition is switched off.***

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- ***Only use a digital multimeter for electrical tests.***

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Fuse Positions

There are three locations for fuses in E46 cars:

- Main harness fuse in trunk
- Fuse panel above glove compartment
- E-box in engine compartment left side

Note:

- *In BMW repair information, fuses are numbered F1 through F108. There are two fuses with the same designation: F5 in the main fuse panel is rated 5A and protects the horn circuit. F5 in the E-box fuse carrier is rated 30A and protects the unloader relay circuit in 1999 - 2000 models, and fuel injector relay in 2001 models.*
- *In a few cases, a fuse may have two different amperage ratings depending on equipment in the vehicle. In such cases the second rating is put in parenthesis in the fuse rating tables.*

Main harness fuse



Fig. 1 Main harness fuse in trunk:

- Working ahead of battery in trunk, remove trim liner clips.

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- Peel back liner to access F108 (200 amp) fuse (**arrow**) in main power distribution circuit.

Electronics box (E-box) fuse carrier

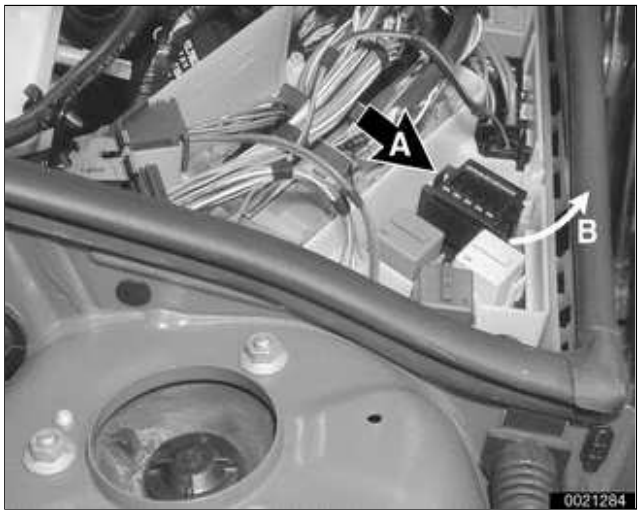
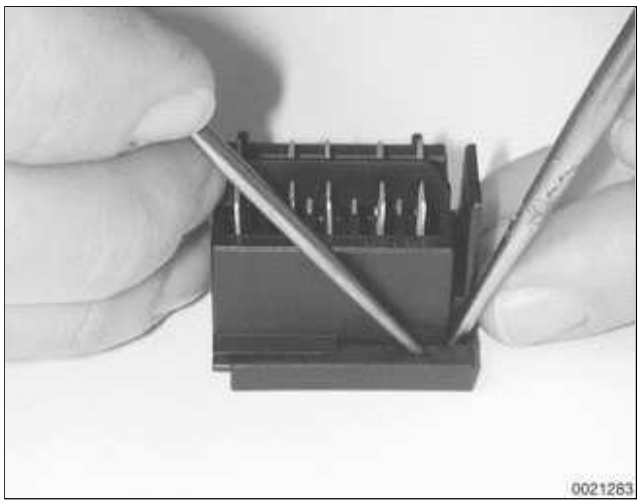


Fig. 2 Engine electronics fuse pack in E-box:

- Working in left rear of engine compartment, remove E-box plastic cover.
- Push on hold-down lock clip (**A**) to release fuse pack carrier.
- Pull up on fuse pack lock clip (**B**) to release fuse pack.



To remove an individual defective fuse inside fuse pack carrier, slide cover off by prying gently while you use pin tool to squeeze lock tabs. nothing

CAUTION!

Once cover is off, fuses can fall out easily. Be sure to keep them in order while replacing defective fuse.

Table a. E-box fuse pack

Fuse	Rating	Protected circuits
1	30A	Not used (1999 - 2000 models) DME main relay (2001 models) Ignition coils

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Table a. E-box fuse pack		
Fuse	**Rating**	**Protected circuits**
		(2001 models)
2	30A	DME control module (ECM) Evaporative emissions valve Fuel injectors Idle speed control valve Resonance valve, intake manifold Secondary air injection pump Suction jet pump valve, LDP system Vanos solenoids
3	20A	A/C compressor clutch relay Camshaft position sensors Crankshaft position sensor DME main relay Fuel pump relay Leakage diagnosis pump (fuel tank) Mass air flow sensor Secondary air injection pump relay Thermostat
4	30A	Changeover valve, running losses (3/2 valve) Oxygen sensors
5	30A	Fuel injector relay (2001 models) Unloader relay to ignition coils (1999 - 2000 models)

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Main fuse panel

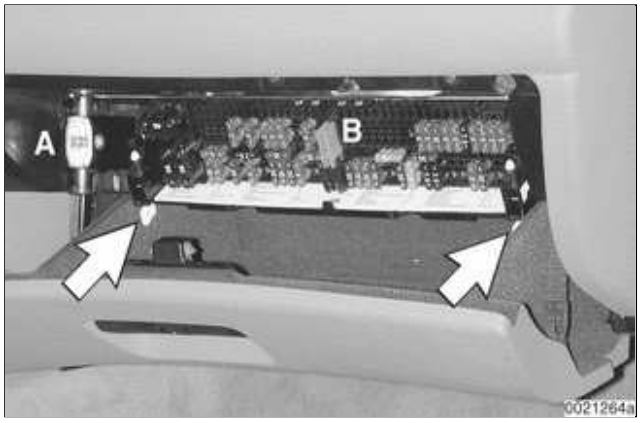


Fig. 3 Fuse panel above glove compartment:

- Open glove compartment door.
- Working inside compartment, twist each plastic lock tab (**arrows**) at top of compartment 90°.
- Pull down on fuse panel to swing it down.

Note:

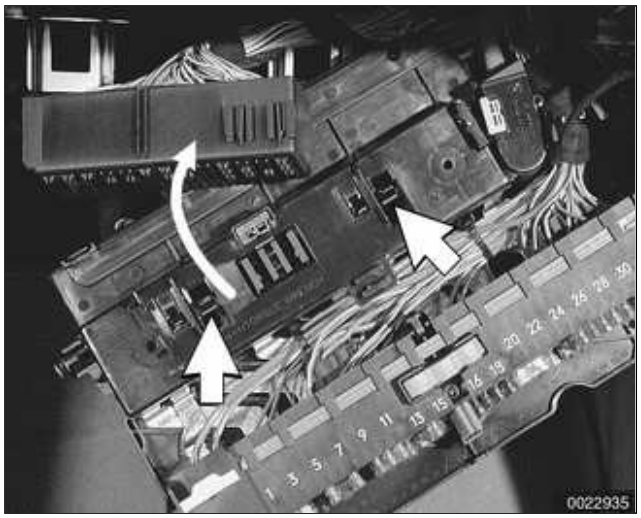
- *When the fuse box is up in locked position, the plastic tabs should point toward each other. When unlocked, they point to the back of the car.*
- *A small built in flashlight (**A**) is in the glove compartment next to the fuse box.*
- *A red plastic fuse puller (**B**) is in the center of the fuse box.*
- *The sheet of paper with the fuse assignments, below the fuses, can be slid out for reference.*
- *Vertical fuses are active. Horizontal fuses are spares.*

Fuse locations in the main panel are detailed in ⇒ Table c. 1999 fuse positions and ⇒ Table d. 2000-2001 fuse positions.

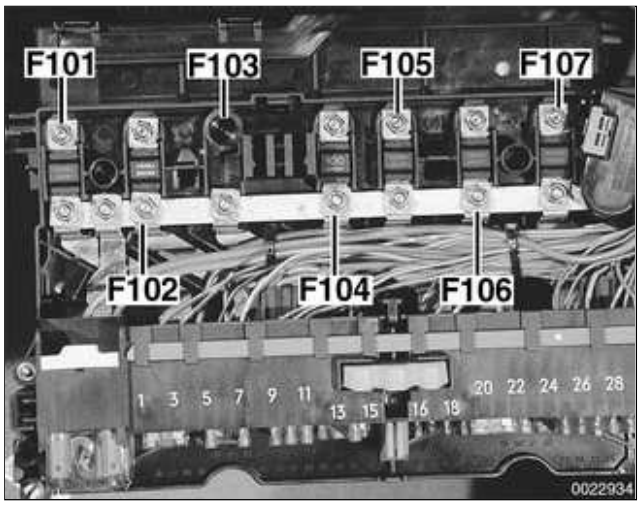
Additional high amperage fuses are

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found on top of the glove compartment fuse panel beneath an access panel.



- Lower glove compartment fuse panel fully.
  - Slide harness connector block off top of panel (**curved arrow**).
  - Detach access panel by squeezing retaining clips (**arrows**).



- Fig. 4 High amperage fuses above main fuse panel:
  - Fuses F101 through F107 are mounted in this location.

Table b. High amperage fuse positions

Fuse	Rating	Protected circuits
101	50A	Engine cooling fan (1999 - 2000 models)
102	80A	B+ terminal DME mail relay Engine control module Fuse 5 E-box fuse pack Transmission control module (TCM)
103	80A	not used
104	100A	Preheater relay
105	50A	Ignition switch DLC

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Table b. High amperage fuse positions		
Fuse	**Rating**	**Protected circuits**
106	50A	Light switching center control module
107	50A	Light switching center control module Trailer module
108	200A	Main harness fuse (in trunk, see ⇒ Fig. 1)

E46 main fuse panel



Table c. 1999 fuse positions

Fuse	Rating	Protected circuit
1	not used	
2		
3		
4		
5	5A	Horn (see also fuse 55)
6	5A	Make-up mirror light

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Fuse	Rating	Protected circuit
7	5A	Navigation (see also fuse 41) On-board monitor (see also fuse 41) Radio (see also fuse 41) Telephone (see also fuse 39)
8	not used	
9	5A	Brake light Light module (see also fuse 32) On-board computer Speed control
10	5A	Instrument cluster (see also fuses 34, 43)
11	5A	Airbag Side-impact airbag
12	7.5A	Roller sun blind
13	not used	
14	5A	Electronic immobilizer (EWS) (see also fuse 67) Starter interlock
15	5A	Rain sensor
16	not used	
17		
18		
19		
20		
21		
22		
23		
24	5A	Electrochromic rear view mirror (see also fuse 67) Parking distance control
25	5A	Heated outside mirror, passenger Heated spray nozzles
26	5A	Garage door opener Overheat JP
27	10A	Back-up lights

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Fuse	Rating	Protected circuit
28	5A	Heater-A/C (see also fuses 62, 63) Heater-A/C blower (see also fuse 37)
29	5A	Engine control (see also fuse 30)
30	7.5A	Engine control (see also fuse 29) OBD II system
31	5A	Outside mirror Tire pressure control (see also fuse 69)
32	5A	Light module (see also fuse 9)
33	5A	ABS/ASC (see also fuses 53, 56) ABS/DSC (see also fuses 40, 53, 56, 61)
34	5A	Instrument cluster (see also fuses 10, 43)
35	not used	
36	50A	Secondary air pump
37	50A	Heater-A/C blower (see also fuse 28)
38	10A (15A)	Front fog lights
39	5A	Telephone (see also fuse 7)
40	5A	ABS/DSC (see also fuses 33, 53, 56, 61) Shift gate illumination
41	30A	Navigation (see also fuse 7) On-board monitor (see also fuse 7) Radio (see also fuse 7)
42	not used	
43	5A	Clock Instrument cluster (see also fuses 10, 34) OBD II system
44	20A	Trailer module
45	not used	
46	30A	Sunroof
47	15A (20A)	Cigarette lighter / power outlet
48	30A	Window, front (see also fuse 49)
49	5A	Anti-theft (see also fuse 67) Central locking system (see also fuse 60) Interior light (see also fuse 52)

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Fuse	Rating	Protected circuit
		Power window, front (see also fuse 48) Windshield washer system (see also fuses 52, 59)
50	25A	Seat heating
51	30A	Headlight cleaning system
52	30A	Central locking system, trunk Glove box light Interior light (see also fuse 49) Passenger compartment/trunk lighting Windshield washer system (see also fuses 49, 59)
53	30A	ABS/ASC (see also fuses 33, 56) ABS/DSC (see also fuses 33, 40, 56, 61)
54	15A	Fuel pump
55	15A	Horn (see also fuse 5)
56	30A	ABS/ASC (see also fuses 33, 53) ABS/DSC (see also fuses 33, 40, 53, 61)
57	5A	Outside mirror
58	not used	
59	30A	Windshield washer system (see also fuses 49, 52)
60	25A	Central locking (see also fuse 49)
61	30A	ABS/DSC (see also fuses 33, 40, 53, 56)
62	7.5A	A/C (see also fuses 28, 63)
63	7.5A	A/C (see also fuses 28, 62)
64	20A	Auxiliary heater (diesel)
65	30A	Driver seat adjustment
66	not used	
67	5A	Anti-theft (see also fuse 49) Electrochromic rear view mirror (see also fuse 24) Electronic immobilizer (EWS) (see also fuse 14)
68	30A	Heated rear window
69	5A	Tire pressure control (see also fuse 31)

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Fuse	Rating	Protected circuit
70	30A	Passenger seat adjustment
71	30A (10A Coupe)	Hinged window (Coupe) Window, rear

Table d. 2000-2001 fuse positions

Fuse	Rating	Protected circuit
1	not used	
2		
3		
4		
5	5A	Horn (see also fuse 55)
6	5A	Make-up mirror light Power top (Convertible, see also fuses 12, 35, 42, 46)
7	5A	Heated rear window (Convertible, see also fuse 68) Navigation system (see also fuse 41) On-board monitor (see also fuse 41) Radio (see also fuse 41) Telephone (see also fuse 39)
8	5A	Sequential transmission (M3, see also fuse 22)
9	5A	Brake light Light module (see also fuse 32) On-board computer Speed control
10	5A	Instrument cluster (see also fuses 34, 43)
11	5A	Airbag Side-impact airbag
12	7.5A	ABS/ASC (see also fuses 33, 42, 53, 56) ABS/DSC (see also fuses 33, 40, 42, 53, 56, 61) ABS/DSC all-wheel drive (see also fuses 33, 35, 40, 42, 53) Manual top (Convertible, see also fuses 42, 46) Power top (Convertible, see also fuses 6, 35, 42,

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Fuse	Rating	Protected circuit
		46) Seat heating (see also fuse 42) Roller sun blind (see also fuse 42) Tire pressure control (see also fuses 31, 42, 69)
13	7.5A	Roll-over protection system (Convertible)
14	5A	Electronic immobilizer (EWS) (see also fuse 67) Starter interlock
15	5A	Rain sensor Rear wiper (Sport Wagon, see also fuse 45)
16	not used	
17		
18		
19		
20		
21		
22	5A	Engine control (M3, see also fuses 29, 30) Sequential transmission (M3, see also fuse 22)
23	5A	Heater (see also fuses 28, 62)
24	5A	Electrochromic rear view mirror (see also fuse 67) Park distance control
25	5A	Heated outside mirror, passenger Heated spray nozzles
26	5A	Cigarette lighter (Australia, see also fuse 47) Garage door opener
27	10A	Engine control (see also fuses 29, 30) Back-up light
28	5A	Air conditioner (see also fuses 62, 63) Blower (see also fuse 50) Heater (see also fuses 23, 62)
29	5A	Engine control (see also fuses 27, 30) Engine control (M3, see also fuses 22, 30)
30	7.5A	Engine control (see also fuses 27, 29) Engine control (M3, see also fuses 22, 29) OBD II system (see also fuse 43)

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Fuse	Rating	Protected circuit
31	5A	Outside mirror (see also fuse 57) Tire pressure control (see also fuses 12, 42, 69)
32	5A	Light module (see also fuse 9)
33	5A	ABS/ASC (see also fuses 12, 42, 53, 56) ABS/DSC (see also fuses 12, 40, 42, 53, 56, 61) ABS/DSC all-wheel drive (see also fuses 12, 35, 40, 42, 53)
34	5A	Instrument cluster (see also fuses 10, 43)
35	50A	Power top (Convertible, see also fuses 6, 12, 42, 46) ABS/DSC all-wheel drive (see also fuses 12, 33, 40, 42, 53)
36	50A	Secondary air pump
37	50A	Engine cooling fan
38	10A (15A)	Front foglights
39	5A	Telephone (see also fuse 7)
40	5A	ABS/DSC (see also fuses 12, 33, 42, 53, 56, 61) ABS/DSC all-wheel drive (see also fuses 12, 33, 35, 42, 53) Shift gate illumination
41	30A	Navigation system (see also fuse 7) On-board monitor (see also fuse 7) Radio (see also fuse 7)
42	30A	ABS/ASC (see also fuses 12, 33, 53, 56) ABS/DSC (see also fuses 12, 33, 40, 53, 56, 61) ABS/DSC all-wheel drive (see also fuses 12, 33, 35, 40, 53) Manual top (Convertible, see also fuses 12, 46) Power top (Convertible, see also fuses 6, 12, 35, 46) Seat heating (see also fuse 12) Roller sun blind (see also fuse 12) Tire pressure control (see also fuses 12, 31, 69)
43	5A	Instrument cluster (see also fuses 10, 34) OBD II system (see also fuse 30)
44	20A	Trailer module
45	20A	Rear wiper (Sport Wagon, see also fuse 15)

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Fuse	Rating	Protected circuit
46	30A (20A convertible)	Power top (Convertible, see also fuses 6, 12, 35, 42) Manual top (Convertible, see also fuses 12, 42) Sunroof
47	15A (20A)	Cigarette lighter / power outlet (Australia, see also fuse 26)
48	30A	Power window, front (see also fuse 49)
49	5A	Anti-theft (see also fuse 67) Central locking system (see also fuses 52, 60, Sport Wagon, see fuse 58) Interior light (see also fuse 52) Windshield washer system (see also fuses 52, 59) Window, front (see also fuse 48)
50	40A	Heater-A/C blower (see also fuse 28)
51	30A	Headlight washer system
52	30A	Central locking system (see also fuses 49, 60, Sport Wagon see fuse 58) Glove compartment light Hand lamp Interior lights (see also fuse 49) Passenger compartment/trunk lighting Windshield washer system (see also fuses 49, 59)
53	30A	ABS/ASC (see also fuses 12, 33, 42, 56) ABS/DSC (see also fuses 12, 33, 40, 42, 56, 61) ABS/DSC all-wheel drive (see also fuses 12, 33, 35, 40, 42)
54	15A	Fuel pump
55	15A	Horn (see also fuse 5)
56	30A	ABS/ASC (see also fuses 12, 33, 42, 53) ABS/DSC (see also fuses 12, 33, 40, 42, 53, 61)
57	5A	Outside mirror (see also fuse 31)
58	7.5	Central locking (Sport Wagon, see also fuses 49, 52, 60)
59	30A	Windshield washer system (see also fuses 49, 52)

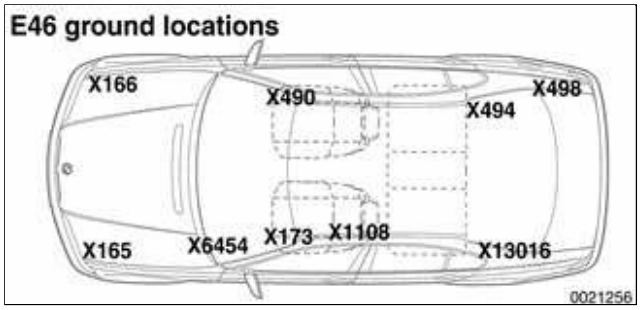
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Fuse	Rating	Protected circuit
60	25A	Central locking (see also fuses 49, 52, Sport Wagon, see fuse 58)
61	30A	ABS/DSC (see also fuses 12, 33, 40, 42, 53, 56, 61)
62	7.5A	Heater-A/C (see also fuses 28, 63) Heater (see also fuses 23, 28)
63	7.5A	Heater-A/C (see also fuses 28, 62)
64	not used	
65	30A	Driver seat adjustment
66	not used	
67	5A	Anti-theft (DWA) (see also fuse 49) Electrochromic rear view mirror (see also fuse 24) Electronic immobilizer (EWS) (see also fuse 14)
68	30A	Heated rear window (Convertible, see also fuse 7)
69	5A	Tire pressure control (see also fuses 12, 31, 42)
70	30A	Passenger seat adjustment
71	30A (10A Coupe)	Hinged window (Coupe) Window, rear

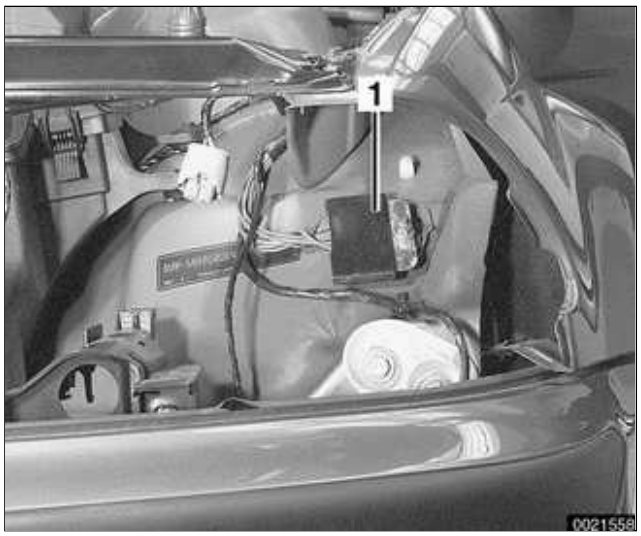
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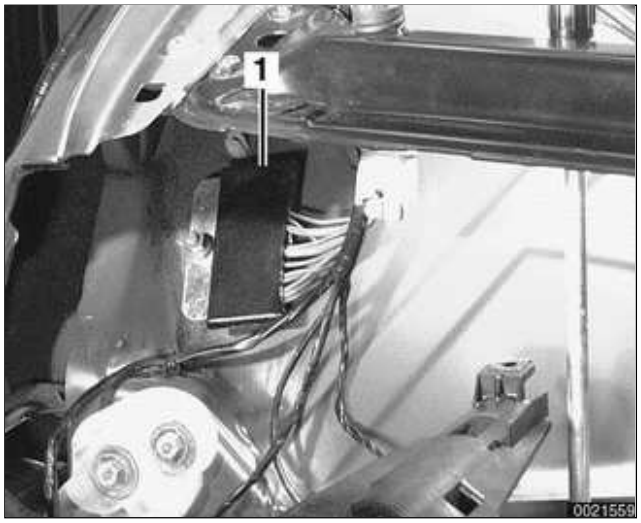
Ground Locations



- Grounds are widely distributed throughout the vehicle body. Several are found under the interior carpets. Lugs and connectors attached to ground are susceptible to damage and corrosion. Clean or renew them as necessary.



- Fig. 5 Left front engine compartment, behind left headlight
  1 - Ground X165



- Fig. 6 Right front engine compartment, behind right headlight
  1 - Ground X166



- Fig. 7 On bulkhead behind E-box
  1 - Ground X6454

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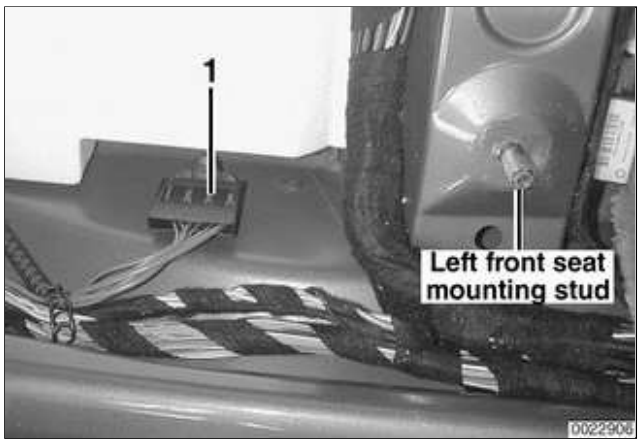


Fig. 8 Under left front carpet on door sill

1 - Ground connector X173

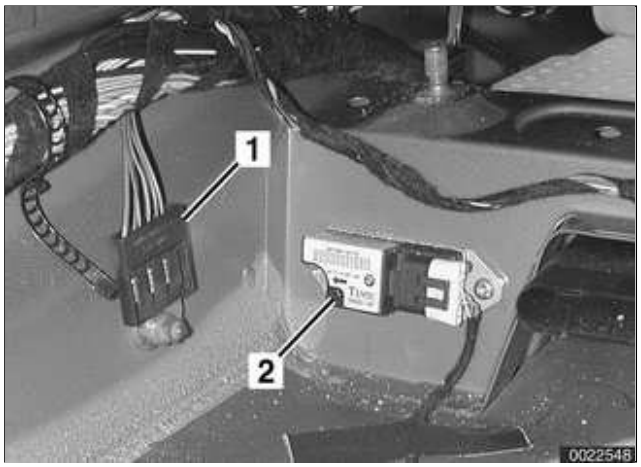


Fig. 9 On door sill, under driver seat carpet

1 - Ground connector X1108

2 - Side impact airbag crash sensor

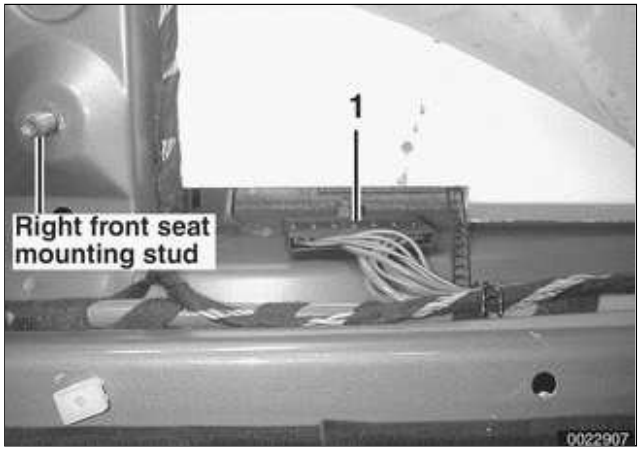


Fig. 10 Under right front carpet on door sill

1 - Ground connector X490



Fig. 11 Behind right rear seat backrest

1 - Ground X494

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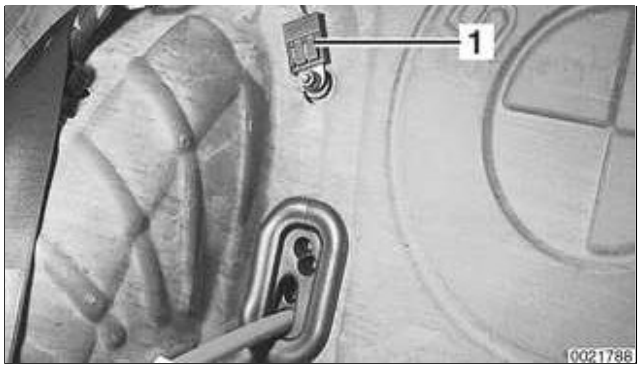




Fig. 12 Right side trunk, behind trim

1 - Ground X498

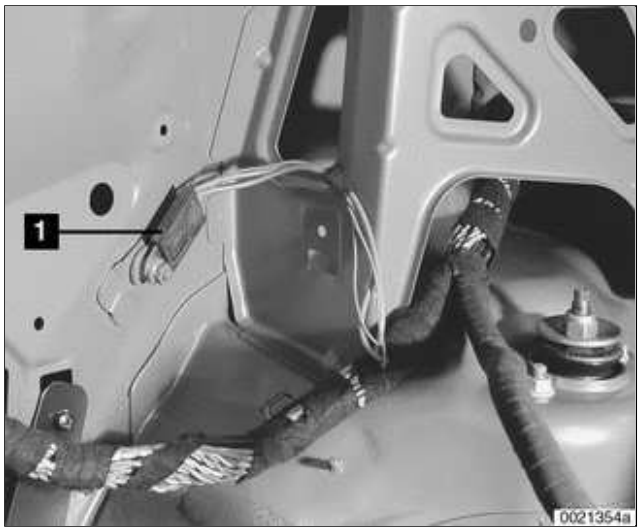


Fig. 13 Left side trunk, behind trim

1 - Ground X13016

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610-4

Component Locations

On the following pages are photos and illustrations showing the location of major electrical components in E46 vehicles.

Note:

- *Every component is not installed in every car.*
- *Due to changes in production, component locations may vary from what is illustrated. Consult your BMW dealer for the latest information.*
- *The automatic transmission range switch is also sometimes referred to as the gear-position switch.*
- *The EWS 3.3 system is also known as the driveaway protection system or the electronic immobilization system.*
- *All-Season Traction (AST) is a marketing term that refers to ABS/ASC.*

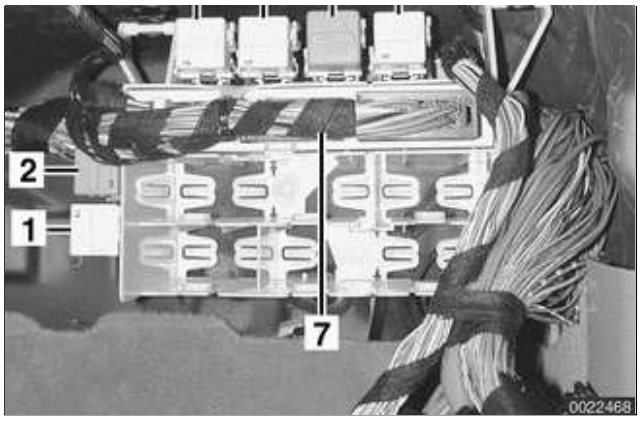
Main relay panel

- To access main relay panel, located under right side of dashboard, remove glove compartment as described in ⇒ 513 Interior Trim.



Fig. 14 Behind glove compartment (no headlight cleaning system)

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1 - A/C relay

2 - Secondary air pump relay

3 - Fuel pump relay

4 - A/C relay

5 - Foglight relay

6 - Horn relay

7 - General module (GM V)

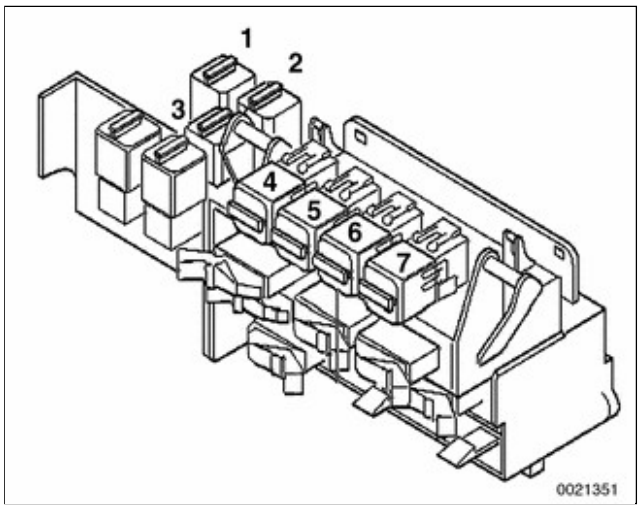


Fig. 15 Behind glove compartment (with headlight cleaning system)

1 - Headlight cleaning relay

2 - Secondary air pump relay

3 - A/C relay

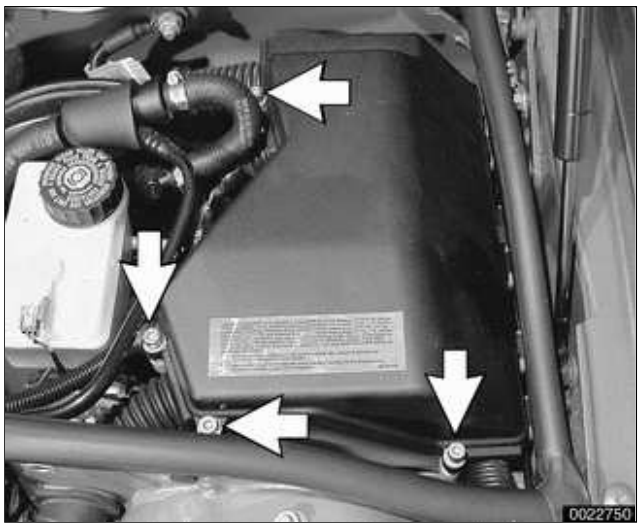
4 - Fuel pump relay

5 - A/C relay

6 - Foglight relay

7 - Horn relay

Electronics box (E-box)



To access E-box components:

- Working in left rear of engine compartment, remove M6 Allen head bolts (**arrows**).
- Lift off E-box cover.

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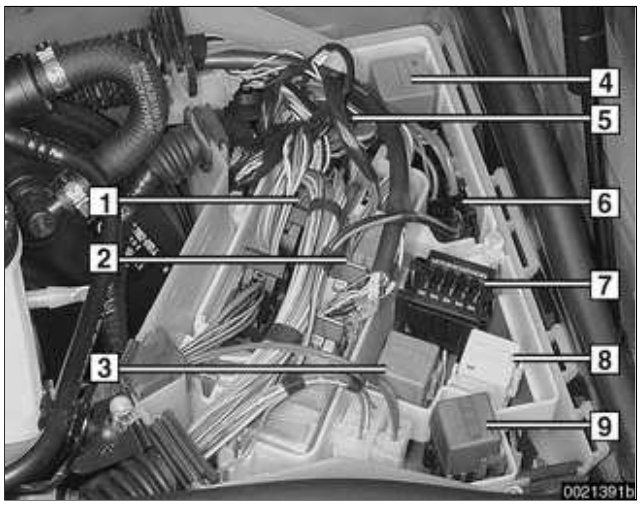


Fig. 16 E-box

1 - Engine control module (ECM)

2 - Automatic transmission control module (TCM)

3 - DME main relay

4 - Windshield washer double relay

5 - E-box temperature sensor

6 - B+ connector

7 - Engine electronics fuse pack

8 - 1999 - 2000 models: Unloader relay 2001 models: fuel injector relay

9 - Back-up light relay (automatic transmission only)

Component location table

⇒ Table e. E46 component locations is a cross-referenced listing of electrical components in E46 vehicles. Where available, photos of components in this repair group are referred to in the fourth column.

Note:

- *Every attempt has been made in this repair manual to standardize component names. Nevertheless, in some cases, the same component may appear with different names.*

- *No E46 vehicle is equipped with all components illustrated. Where necessary, year and model applications are given in the component location table and the illustrations.*

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Table e. E46 component locations

Component	Year, model	Location	Refer to
12 volt auxiliary power socket		see Power socket, 12-volt	
3/2-way valve	1999 - 2000	Under car ahead of fuel filter, under protective cover	
A/C blower final stage (resistor pack)	1999 - 2001	Right side of IHKA housing below glove compartment	⇒ Fig. 40
A/C blower relay	1999 - 2001	Main relay panel behind glove compartment	⇒ Fig. 14, ⇒ Fig. 15
A/C blower	1999 - 2001	Behind engine compartment rear bulkhead	
A/C compressor	1999 - 2001	Right front lower engine compartment	
A/C compressor clutch relay	1999 - 2001	Main relay panel behind glove compartment	⇒ Fig. 14, ⇒ Fig. 15
A/C control module	1999 - 2001	Center of dashboard	
A/C evaporator temperature sensor	1999 - 2001	Left side of IHKA housing below instrument cluster	⇒ Fig. 39
A/C pressure sensor	1999 - 2001	Behind right headlight on top of receiver/drier	⇒ Fig. 32
ABS wheel speed sensor connector, front (right/left)	1999 -2001	In wheel housing (right/left)	⇒ Fig. 62
ABS wheel speed sensor connector, rear (right/left)	1999 - 2001	Ahead of rear wheel housing (right/left)	
ABS wheel speed sensor, front (right/left)	1999 - 2001	In front wheel bearing housing(right/left)	⇒ Fig. 60
ABS wheel speed sensor, rear (right/left)	1999 - 2001	In rear wheel bearing housing (right/left)	⇒ Fig. 61
ABS/ASC control module/hydraulic unit	1999	Left rear engine compartment, below brake master cylinder	

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Component	Year, model	Location	Refer to
ABS/ASC/DSC warning lights	1999 - 2001	In instrument cluster	
ABS/DSC charge pressure sensor	1999 - 200 rear wheel drive with DSC	Base of master cylinder, left side	⇒ Fig. 18
ABS/DSC charge pressure sensor	2001 rear wheel drive	In ABS/DSC hydraulic unit, right rear engine compartment	
ABS/DSC control module/hydraulic unit	1999 - 2000; 2001 all wheel drive	Right rear of engine compartment	⇒ Fig. 19
ABS/DSC control module/hydraulic unit	2001 rear wheel drive	Left rear of engine compartment	
ABS/DSC lateral acceleration sensor	1999 - 2001 rear wheel drive	Behind driver kickpanel	
ABS/DSC lateral acceleration sensor	200 all wheel drive	Combined with rotational rate (yaw) sensor under driver side carpet	
ABS/DSC precharge pump	1999 - 2001	Left rear engine compartment, below brake master cylinder	⇒ Fig. 18
ABS/DSC rotational rate (yaw) sensor	1999 - 2001	Under driver side carpet	
ABS/DSC steering angle sensor	1999 -2001	Base of upper steering column	⇒ Fig. 35
ABS/DSC switch		see ASC/DSC switch	
Accelerator pedal sensor (PWG)	1999 - 2000	At throttle housing	
Accelerator pedal sensor (PWG)	2001	Above accelerator pedal	
AGS (adaptive transmission control)		see Automatic transmission control module	
Air distribution motors	1999 - 2001	In IHKA housing under dashboard (see ⇒ 640 Heating and Air Conditioning)	
Air flow sensor		see Mass air flow sensor	
Air quality sensor (AUC) (for automatic	2000 - 2001	Right side of radiator	⇒ Fig. 17, ⇒ Fig. 29

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Component	Year, model	Location	Refer to
recirculation system)			
Airbag connector, passenger side	1999 - 2001	Right side dashboard support	⇒ Fig. 41
Airbag connector, steering wheel	1999 - 2001	Under steering wheel airbag	⇒ Fig. 34
Airbag control module (MRS module)	1999 - 2001	Under parking brake lever console, under carpet	⇒ Fig. 9
Airbag crash sensor, side-impact airbag (left/right)	1999 - 2001	Front seat crossmember under carpet (left/right)	
Airbag warning light	1999 - 2001	In instrument cluster	
Airbag, driver side	1999 - 2001	Steering wheel center pad	
Airbag, head protection (HPS), electrical connector (left/right)	1999 - 2001	At bottom of windshield pillar (A pillar) behind dashboard (left/right)	⇒ Fig. 42
Airbag, passenger side	1999 - 2001	Right side dashboard	⇒ Fig. 41
Airbag, side-impact (left/right front/rear)	1999 - 2001	Inside door (left/right, front/rear)	
Alarm control module (DWA)	1999 - 2001	Above main fuse box behind glove box	
Alarm indicator LED (DWA)	1999 - 2001	Attached to rear view mirror	
Alarm siren (DWA)	1999 - 2001	Right side rear of engine compartment near wipers	
Alarm siren battery (DWA)	1999 - 2001	Inside alarm siren	
All season traction (AST)		see ABS/ASC entries	
Alternator (generator)	1999 -2001	Left front of cylinder block	
Amplifier, radio	1999 - 2001	Left side trunk or cargo compartment behind trim panel	⇒ Fig. 54, ⇒ Fig. 57

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Component	Year, model	Location	Refer to
Antenna amplifier, diversity	Convertible	On convertible top storage cover	
Antenna amplifier, diversity	Sport Wagon	Behind left side cargo area storage cover	⇒ Fig. 57
Antenna amplifier, main	Convertible	Below mast antenna in trunk	
Antenna amplifier, main	Sedan, Coupe	Behind left rear roof pillar (C-pillar) trim panel	⇒ Fig. 44
Antenna amplifier, main	Sport Wagon	Below rear spoiler	
Antenna diversity switching module	Convertible	Below mast antenna in trunk	
Antenna, AM	Sport Wagon	In rear spoiler	
Antenna, diversity	Convertible	In convertible top storage cover	
Antenna, diversity	Sport Wagon	Left rear side window	
Antenna, FZV (keyless entry)	Convertible	Interior rear view mirror	
Antenna, FZV (keyless entry)	Sedan, Coupe	Rear window, lower antenna grid	
Antenna, FZV (keyless entry)	Sport Wagon	Center rear window, combined with FM2 antenna	
Antenna, main	Convertible	Mast on left rear fender	
Antenna, main (FM1 and FM2)	Sport Wagon	Rear window center and right	
Antenna, telephone	Convertible	Wound around mast antenna	
Antenna, telephone	Coupe, Sedan, Sport Wagon	In roof above rear window	
Anti-slip (traction)		see ABS/ASC entries	
Anti-slip (traction) control switch		see ASC/DSC switch	
Anti-theft		see Alarm entries	
ASC		see ABS/ASC entries	
ASC+T		see ABS/ASC entries	

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Component	Year, model	Location	Refer to
ASC/DSC switch	1999 - 2001	Bottom of center console, left of shifter	
AST		see ABS/ASC entries	
Automatic climate control (IHKA)		see A/C entries	
Automatic transmission control module (TCM)	1999 - 2001	Left rear engine compartment in E-box	⇒ Fig. 16
Automatic transmission range switch (gear position/neutral safety switch)	GM trans.	Left side of transmission, inside transmission case	
Automatic transmission range switch (gear position/neutral safety switch)	ZF trans.	Left side of transmission	⇒ Fig. 64
Automatic transmission range switch harness connector	ZF trans.	Left side of transmission	⇒ Fig. 64
B+ jumper connector	1999 - 2001	Next to right front strut tower, right rear engine compartment	⇒ Fig. 17, ⇒ Fig. 19
B+ supply, E-box		Left side of E-box	⇒ Fig. 16
Back-up light switch (automatic transmission)		see Automatic transmission range switch	
Back-up light switch (manual transmission)	1999 - 2000	Top left side of transmission housing	
Back-up light relay (automatic transmission)	1999 - 2001	Left rear engine compartment, in E-box	⇒ Fig. 16
Battery	1999 - 2001	Right side trunk or cargo compartment, under tray	
Battery safety terminal (BST)	1999 - 2001	On positive battery terminal	

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Component	Year, model	Location	Refer to
Blower		see A/C blower	
Body electronics control module		see General module (GM V)	
Brake fluid level sensor	1999 - 2001	Top of brake fluid reservoir, left rear engine compartment	⇒ Fig. 17, ⇒ Fig. 18
Brake fluid pressure sensor		see ABS/DSC charge pressure sensor	
Brake light switch	1999 -2001	At pedal cluster	⇒ Fig. 37
Brake pad sensor, left front	1999 - 2001	Left front brake pad	
Brake pad sensor, right rear	1999 - 2001	Right rear brake pad	
Brake pad wear sensor connector, left front	1999 - 2001	In left front wheel housing	⇒ Fig. 62
Brake pad wear sensor connector, right rear	1999 - 2001	Ahead of right rear wheel housing	
Camshaft actuator (VANOS)		see VANOS	
Camshaft position sensor, exhaust	1999 - 2001	Right front of cylinder head	⇒ Fig. 29
Camshaft position sensor, intake	1999 - 2001	Left front of cylinder head	⇒ Fig. 28
Carbon canister valve	1999 - 2000	Right side of spare tire well under floor pan	
CD changer	1999 - 2001	Left side of trunk	
Center brake light	Sedan, Coupe	Rear of headliner	
Central locking switch		see Hazard warning/central locking switch	
Changeover valve, intake manifold		see Resonance valve, intake manifold	
Changeover valve, running losses		see 3/2-way valve	

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Component	Year, model	Location	Refer to
Charge pressure sensor		see ABS/DSC charge pressure sensor	
Child protection window control		see Window lock-out switch, rear	
Chime module, park distance control (PDC)	1999 - 2001	In left footwell top trim	
Clock	1999 - 2001	In on-board computer display of instrument cluster	
Clutch pedal position switch	1999 - 2001	On pedal cluster	
Combination (stalk) switch		see Turn-signal/headlight dimmer switch (stalk switch) see also Wiper/washer switch (stalk switch)	
Convertible top control module (CVM II)	Convertible	Left rear quarter panel behind trim panel	⇒ Fig. 66
Convertible top hydraulic motor	Convertible	In left side of trunk behind trim cover	⇒ Fig. 66
Convertible top main pillar Hall sensor	Convertible	Behind rear seat in C pillar position	⇒ Fig. 66
Convertible top solenoid valves	Convertible	Left and right rear main pillar, behind quarter panel windows	⇒ Fig. 66
Convertible top storage compartment floor microswitch	Convertible	Right side storage compartment hinge in trunk	⇒ Fig. 66
Convertible top storage cover Hall sensor	Convertible	Left rear of convertible top cover	⇒ Fig. 66
Convertible top storage cover lock Hall sensor	Convertible	Center of cover, between rear seat backrests	⇒ Fig. 66
Convertible top storage cover lock motor Hall sensor	Convertible	Center of cover, between rear seat backrests	⇒ Fig. 66
Convertible top storage cover motor	Convertible	Center of cover, between rear seat backrests	⇒ Fig. 66

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Component	Year, model	Location	Refer to
Convertible top switch	Convertible	Bottom of center console, ahead of shifter	⇒ Fig. 66
Convertible top tension bow Hall sensor	Convertible	Top rear of convertible top	⇒ Fig. 66
Convertible top visor latch Hall sensor	Convertible	Top of windshield	⇒ Fig. 66
Coolant level sensor	1999 - 2001	At bottom of coolant expansion tank	
Coolant temperature sensor, radiator outlet	1999 - 2001	In lower radiator hose, right front of engine	⇒ Fig. 31
Coolant temperature sensor		see Engine coolant temperature (ECT) sensor	
Coolant thermostat	1999 - 2001	Front of cylinder head	
Cooling fan		see Engine cooling fan entries	
Crankshaft position sensor	1999 - 2001	Left rear of engine block, under starter motor	⇒ Fig. 22
Cruise control cut-off switch	1999 -2001	At pedal cluster	⇒ Fig. 37
Cruise controls (steering wheel)	1999 - 2001	Steering wheel right side keypad	
Data link connector (20-pin DLC)	1999 - 2000	Right rear engine compartment (see also OBD II connector)	⇒ Fig. 17
Diagnosis module tank leakage (DMTL)	2001	see Fuel tank leakage diagnosis pump (LDP or DMTL)	
Digital motor electronics control module		see Engine control module (ECM)	
Directional switch (stalk switch)		see Turn signal/headlight dimmer switch (stalk switch)	
DLC		see Data link connector see also OBD II connector	
DME control module		see Engine control module (ECM)	
DME main relay	1999 - 2001	Left rear engine compartment in E-box	⇒ Fig. 16

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Component	Year, model	Location	Refer to
DMTL	2001	see Fuel tank leakage diagnosis pump (LDP or DMTL)	
Door lock	1999 - 2001	In door	
Door lock Hall sensor	1999 - 2001	In door lock mechanism	
Door lock microswitch	1999 - 2001	In door lock mechanism	
Drive-away protection		see EWS	
DSC		see ABS/DSC entries	
DSC switch		see ASC/DSC switch	
DWA		see Alarm entries	
Dynamic stability control		see ABS/DSC entries	
E-box	1999 - 2001	Left rear engine compartment, under plastic cover	⇒ Fig. 16
E-box cooling fan	1999 - 2001	Bottom rear of E-box	
E-box temperature sensor	1999 - 2001	Rear of E-box	⇒ Fig. 16
ECT sensor		see Engine coolant temperature (ECT) sensor	
Electric coolant thermostat		see Coolant thermostat	
Electronic immobilizer		see EWS entries	
Electronics box		see E-box entries	
Engine compartment light switch		see Engine hood contact switch	
Engine control module (ECM)	1999 - 2001	Left rear engine compartment in E-box	⇒ Fig. 16
Engine coolant temperature (ECT) sensor	1999 - 2001	Under rear of intake manifold at rear of cylinder block	⇒ Fig. 21
Engine cooling fan (electric)	1999 - 2001	Models with automatic transmission: In front of radiator	⇒ Fig. 17

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Component	Year, model	Location	Refer to
		Models with standard transmission: In back of radiator	
Engine cooling fan final stage (resistor)	1999 - 2001	In engine cooling fan housing	
Engine electronics fuse pack		see Fuses, engine electronics	
Engine hood contact switch	1999 - 2001	Right rear engine compartment	⇒ Fig. 19
Evaporative control valve	1999 - 2001	Left front of engine mounted on intake manifold	
Evaporator temperature sensor		see A/C evaporator temperature sensor	
EWS control module	1999 - 2001	On passenger compartment bulkhead, above pedal cluster	⇒ Fig. 38
EWS ring antenna	1999 - 2001	Around ignition switch	⇒ Fig. 36
EWS transmitter module	1999 - 2001	In ignition key	
Exhaust camshaft position sensor	1999 - 2001	Right front of engine, top	⇒ Fig. 29
Exhaust camshaft VANOS solenoid	1999 - 2001	Right front of engine, top	⇒ Fig. 29
Fog light relay	1999 - 2001	Main relay panel behind glove compartment	⇒ Fig. 14, ⇒ Fig. 15
Footwell light, left	1999 - 2001	In left footwell top trim (pedal cluster trim)	
Footwell light, right	1999 - 2001	In right footwell top trim	
Fresh air distribution motor		see Air distribution motors	
Fuel filler door lock motor	1999 - 2001	In right side of trunk or cargo compartment, behind trim	
Fuel injector relay	2001	Left rear engine compartment in E-box	⇒ Fig. 16
Fuel injectors electrical harness	1999 - 2001	Top of engine, under plastic cover	

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Component	Year, model	Location	Refer to
Fuel level sensor, left	1999 - 2001	Top of fuel tank, under left rear seat cushion	⇒ Fig. 52
Fuel level sensor, right	1999 - 2001	Top of fuel tank, under right rear seat cushion, combined with fuel pump	⇒ Fig. 52
Fuel pump	1999 - 2001	Top of fuel tank, under right rear seat cushion, combined with right fuel level sensor	⇒ Fig. 52
Fuel pump relay	1999 - 2001	Main relay panel behind glove compartment	⇒ Fig. 14, ⇒ Fig. 15
Fuel tank leakage diagnosis pump (LDP or DMTL)	1999 - 2001	Under right rear of vehicle, right side of trunk, under protective cover	⇒ Fig. 65
Fuel tank vent valve		see Evaporative control valve	
Fuse for main harness F108 (200 amp)	1999 - 2001	Right wheel housing in trunk	⇒ Fig. 1
Fuse panel, main	1999 - 2001	Above glove compartment	⇒ Fig. 14, ⇒ Fig. 15
Fuses, additional high amperage	1999 - 2001	Above main fuse panel	⇒ Fig. 4
Fuses, engine electronics	1999 - 2001	Left rear engine compartment in E-box	⇒ Fig. 2
FZV antenna		see Antenna, FZV (keyless entry)	
Gas generator, airbag		see Airbag entries	
Gear position indicator light	1999 - 2001	Under shifter bezel	⇒ Fig. 47
Gear position/neutral safety switch		see Automatic transmission range switch	
General module (GM V)	1999 - 2001	Main relay panel behind glove compartment	⇒ Fig. 14
Generator		see Alternator (generator)	
Glove compartment lock motor		Above glove compartment lock	
GM V		see General module (GM V)	

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Component	Year, model	Location	Refer to
GPS receiver module	1999 - 2001	In trunk, mounted behind left rear well	
Ground jumper connection	1999 - 2001	Right rear engine compartment	⇒ Fig. 19
Grounds:			
X1108	1999 - 2001	Under driver seat carpet on door sill	⇒ Fig. 9
X13016	1999 - 2001	Left side trunk	⇒ Fig. 13, ⇒ Fig. 54
X165	1999 - 2001	Left front, engine compartment	⇒ Fig. 5
X166	1999 - 2001	Right front, engine compartment	⇒ Fig. 6
X173	1999 - 2001	Under left front carpet on door sill	⇒ Fig. 8
X217	1999 - 2001	Under right side dashboard	
X218	1999 - 2001	Under right side tunnel carpet	
X490	1999 - 2001	Under right front seat carpet on door sill	⇒ Fig. 10
X494	1999 - 2001	Behind rear seat backrest	⇒ Fig. 11
X498	1999 - 2001	Right side trunk	⇒ Fig. 12, ⇒ Fig. 53
X6454	1999 - 2001	On bulkhead, left rear engine compartment	⇒ Fig. 7
Hazard warning/central locking switch	1999 - 2001	On center console, behind shifter	
Head protection airbag (HPS)		see Airbag listings	
Headlight dimmer relay	1999 - 2001	In light control center (LSZ)	
Headlight flasher		see Turn-signal/headlight dimmer switch (stalk switch)	
Headlight vertical aim actuator (left/right) (models with xenon headlights)	1999 - 2001	In headlight assembly (left/right)	

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Component	Year, model	Location	Refer to
Headlight vertical aim load sensor, front	1999 - 2001	Front subframe, right side	⇒ Fig. 59
Headlight vertical aim load sensor, rear	1999 - 2001	Rear subframe, right side	
Headlight washer pump	1999 - 2001	Front of washer tank, right front engine compartment	
Heater blower		see A/C blower entries	
Heater core temperature sensor	1999 - 2001	Behind center console below radio	⇒ Fig. 45
Heater recirculation distribution motor		see Air distribution motors	
Heater regulator air distribution motor		see Air distribution motors	
Heater valve assembly	1999 - 2001	Mounted on inner side of left strut tower	⇒ Fig. 27
Heating-A/C		see A/C entries	
High beam switch		see Turn signal/headlight dimmer switch (stalk switch)	
Hood switch		see Engine hood security switch	
Horn button	1999 - 2001	On steering wheel pad	
Horn relay	1999 - 2001	Main relay panel behind glove compartment	⇒ Fig. 14, ⇒ Fig. 15
Horn (left/right)	1999 - 2001	Next to front bumper impact absorber (left/right)	
Hot-film mass air flow sensor		see Mass air flow sensor	
Idle speed control valve	1999 - 2001	Under intake manifold	⇒ Fig. 23
Ignition coils	1999 - 2001	Top of cylinder head, under plastic cover	⇒ Fig. 25
Ignition relay		see Unloader relay	
Ignition switch	1999 - 2001	Right side steering column	
IHKA		see A/C entries	

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Component	Year, model	Location	Refer to
Individual control intake system valve		see Resonance valve, intake manifold	
Inflator assembly, airbag		see Airbag entries	
Instrument cluster control unit	1999 - 2001	In instrument cluster	
Intake air temperature (IAT) sensor	1999 - 2001	Center top of engine, between intake manifold and cylinder head	⇒ Fig. 25
Intake manifold resonance valve		see Resonance valve, intake manifold	
Interior protection control module (SDR)	Convertible	On center tunnel below console	
Interior protection control module (UIS)	Sedan, Coupe, Sport Wagon	In headliner	
Interior temperature intake fan	1999 - 2001	In A/C control module in center console	
Keyless entry antenna		see Antenna, FZV (keyless entry)	
Kickdown switch, automatic transmission		see Accelerator pedal sensor (PWG)	
Knock sensors	1999 - 2001	Under intake manifold	⇒ Fig. 24
Lateral acceleration sensor		see ABS/DSC lateral acceleration sensor entries	
LDP		see Fuel tank leakage diagnosis pump (LDP or DMTL)	
Leakage diagnosis pump (LDP)		see Fuel tank leakage diagnosis pump (LDP or DMTL)	
Light control module	1999 -2001	In light switch center (LSZ)	
Light switch assembly	1999 - 2001	In light switch center (LSZ)	
Light switch center (LSZ)	1999 - 2001	In dashboard, left of steering wheel	
Load-reduction relay		see Unloader relay	

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Component	Year, model	Location	Refer to
Lumbar support air compressor	1999 - 2001	Under each seat equipped with support system	
Lumbar support control switch	1999 - 2001	Below seat base trim	
Lumbar support switch	1999 - 2001	Four-way toggle switch at base of seat, near seat control switches	
Main fuse panel		see Fuse panel, main	
Main relay panel		see Relay panel, main	
Main harness fuse		see Fuse for main harness F108 (200 amp)	
Mass air flow sensor	1999 - 2001	Left side engine compartment	⇒ Fig. 17
Mixing actuators		see Air distribution motors	
MRS module		see Airbag control module	
Multi-function clock	1999 - 2001	In dash cluster below speedometer and tachometer	
Multiple restraint system (MRS) module		see Airbag control module	
Navigation computer	1999 - 2001	Left side of trunk	
Neutral safety switch		see Automatic transmission range switch	
OBD II connector (16-pin DLC)	1999 - 2001	In left footwell top trim, under left side of instrument cluster (see also Data link connector)	
Oil pressure switch	1999 - 2001	Left front of engine at oil filter housing	⇒ Fig. 26
Oil temperature sensor	1999 - 2001	Left front of engine at oil filter housing	⇒ Fig. 26
On-board computer	1999 - 2001	In instrument cluster	
On-board monitor	1999 - 2001	In center of dashboard	
Outside air temperature sensor	1999 - 2001	Under left side of front bumper	
Outside mirror control switch	1999 - 2001	On left front door arm rest	

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Component	Year, model	Location	Refer to
Oxygen sensor connector, post-catalyst	1999 - 2001	Top of engine, between intake manifold and cylinder head cover	⇒ Fig. 25
Oxygen sensor connector, precatalyst	1999 - 2001	Top of engine, between exhaust manifold and cylinder head cover	⇒ Fig. 25
Oxygen sensor, post-catalyst	1999 - 2001	Bottom of exhaust manifold (access from below)	⇒ Fig. 58
Oxygen sensor, precatalyst	1999 - 2001	Top of exhaust manifold	⇒ Fig. 25
Park angle/tilt sensor	1999 - 2001	In right side trunk behind trim	
Park distance control (PDC) module	1999 -2001	In right side trunk above battery	
Park distance control sensors	1999 - 2001	Rear bumper trim strip	⇒ Fig. 67
Park distance control warning speaker	1999 - 2001	Right rear speaker, rear parcel shelf	
Parking brake warning switch	1999 -2001	Under center console, rear of parking brake handle	⇒ Fig. 49
Pedal position sensor		see Accelerator pedal sensor (PWG)	
Pinch protection, window		see Window anti-trap strip	
Power socket, 12-volt	Sport Wagon	Cargo compartment behind left rear seat	⇒ Fig. 57
Power window motors		see Window motors	
Power window switches		see Window switches	
Pressure sensitive finger guard		see Window anti-trap strip	
Radiator fan		see Engine cooling fan (electric)	
Radio antenna		see Antenna entries	
Radio controls (steering wheel)	1999 - 2001	On steering wheel left keypad	

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Component	Year, model	Location	Refer to
Radio speaker: front tweeter (left/right)	1999 - 2001	Front door window frame (left/right)	⇒ Fig. 33
Radio/cassette/CD player	1999 - 2001	Center of dashboard	
Rain sensor	1999 - 2001	Top center of interior windshield surface, directly ahead of rear view mirror	
Rain sensor control module (AIC)	1999 - 2001	Attached to rain sensor at top of windshield	
Rear power window lock-out switch		see Window lock-out switch, rear	
Rear window defogger relay	Convertible	Right rear quarter panel behind trim panel	
Rear window defogger relay	Sedan, Coupe	Right trunk wall, behind trim liner	⇒ Fig. 53
Rear window defogger relay	Sport Wagon	Right rear cargo area behind trim panel	
Rear window washer pump	Sport Wagon	Behind panel in right rear cargo area	⇒ Fig. 56
Relay panel, main	1999 - 2001	Behind glove compartment	
Resonance valve, intake manifold	1999 - 2001	Left of intake manifold	⇒ Fig. 17
Reversing light switch		see Back-up light entries	
Ride level sensor		see Headlight vertical aim sensor entries	
Ring antenna (EWS)		see EWS ring antenna	
Rollover cassette	Convertible	Rear seat headrest	
Rollover sensor	Convertible	Rear seat headrest	
Rotational rate (yaw) sensor		see ABS/DSC rotational rate (yaw) sensor	
Seat backrest motor	1999 -2001	Bottom of seat backrest	⇒ Fig. 51
Seat control switch module	1999 - 2001	At base of seat, on side of seat cushion	⇒ Fig. 50

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Component	Year, model	Location	Refer to
Seat cushion tilt motor	1999 - 2001	Bottom of seat cushion	⇒ Fig. 50
Seat forward-back motor	1999 -2001	Bottom of seat cushion	⇒ Fig. 50
Seat headrest motor	1999 - 2001	Top of front seat backrest	⇒ Fig. 51
Seat heater	1999 - 2001	In front seat cushion and backrest	
Seat heater switch	1999 - 2001	Center console, below IHKA control panel	
Seat heater temperature sensor	1999 - 2001	Front of front seat cushion	
Seat height motor	1999 - 2001	Back of seat cushion	⇒ Fig. 50
Seat load sensor	2000 - 2001	Under passenger seat cushion	
Seat memory module (SM)	1999 - 2001	Front of seat cushion	⇒ Fig. 50
Seat belt lock Hall sensor	1999 - 2001	In seat belt lock	
Seat belt tensioner, pyrotechnic (left/right)	1999 - 2001	Base of seat belt lock (left/right)	
Secondary air injection pump	1999 - 2001	Right side engine compartment, above exhaust manifold	⇒ Fig. 17, ⇒ Fig. 30
Secondary air injection pump relay	1999 - 2001	Main relay panel behind glove compartment	⇒ Fig. 14, ⇒ Fig. 15
Secondary air injection pump valve	1999 - 2001	Left front of engine	⇒ Fig. 30
Shift interlock cable	1999 - 2001	Under shifter bezel	⇒ Fig. 46
Shiftlock solenoid	1999 - 2001	Under shifter bezel	
Side-impact airbag		see Airbag entries	
Slip control		see ABS/ASC or ABS/DSC entries	
Socket, 12 volt		see Power socket, 12-volt	
Solar sensor	2000 - 2001	Right defroster outlet at base of windshield	
Sound system amplifier		see Amplifier, radio	

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Component	Year, model	Location	Refer to
Speed sensor		see ABS wheel speed sensor entries	
Spiral spring		see Volute spring	
Starter	1999 - 2001	Left rear of engine, under intake manifold	
Starter immobilization switch (manual transmission)		On clutch pedal	
Starter terminals 30, 50	1999 - 2001	Left rear of engine, under intake manifold	⇒ Fig. 22
Steering angle sensor		see ABS/DSC steering angle sensor	
Stepper motors		see Air distribution motors	
Steptronic switch	2000 - 2001	Under shifter bezel	
Stop light switch		see Brake light switch	
Sunroof motor	1999 - 2001	In headliner	⇒ Fig. 43
Sunroof/sunshade switch	1999 - 2001	In center console ahead of shifter	
Supplemental restraint system (SRS)		see Airbag entries	
Tailgate lock (central locking)	Sport Wagon	In tailgate lock	
Tailgate emergency release actuator	Sport Wagon	Rear deck sill, under trim panel, integrated with lock mechanism	
Tailgate unlock switch, exterior	Sport Wagon	Above license plate	
Tailgate unlock switch, interior	Sport Wagon	Left kick panel	
Telephone connector	1999 - 2001	Under center console	⇒ Fig. 48
Telephone antenna		see Antenna entries	
Telephone controls (steering wheel)	1999 - 2001	Steering wheel left keypad	
Telephone speaker	1999 - 2001	In left footwell top trim	

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Component	Year, model	Location	Refer to
Telephone transceiver	Sedan, Coupe	In trunk below parcel shelf	
Thermostat, characteristic map cooling		see Coolant thermostat	
Throttle housing (MDK/EDK)	1999 - 2001	Under intake manifold	⇒ Fig. 23
Throttle position sensor		see Accelerator pedal sensor (PWG)	
Tilt sensor		see Park angle/tilt sensor	
Tire pressure control system (RDC) control unit	1999 - 2001	Behind glove compartment	
Toroidal coil		see EWS ring antenna	
Traction control		see ABS/ASC or ABS/DSC entries	
Trailer module	1999 - 2001	Right side trunk	
Transmission control module		see Automatic transmission module	
Transmission range switch		see Automatic transmission range switch	
Transverse acceleration sensor		see ABS/DSC lateral acceleration sensor entries	
Trunk lid microswitch	Sedan, Coupe, Convertible	In trunk lid lock	
Trunk light switch	Sedan, Coupe, Convertible	In trunk lid lock	
Trunk lock (central locking)	Sedan, Coupe, Convertible	In trunk lid lock	
Turn-signal/headlight dimmer switch (stalk switch)	1999 - 2001	Left side of steering column	
Ultrasonic sensor (motion detector) (UIS)	Coupe, Sedan, Sport Wagon	In headliner	
Unloader relay	1999 - 2001	Left rear engine compartment in E-box,	⇒ Fig. 16

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Component	Year, model	Location	Refer to
Valet position switch	1999 - 2001	On trunk lock cylinder	
VANOS solenoid, exhaust side	1999 - 2001	Right front of cylinder head	⇒ Fig. 29
VANOS solenoid, intake side	1999 - 2001	Left front of cylinder head	⇒ Fig. 17
Variable camshaft control		see VANOS	
Volute spring	1999 - 2001	In center of steering wheel under driver airbag	
Washer fluid level sensor	1999 - 2001	Bottom of windshield washer tank	
Wheel speed sensor		see ABS wheel speed sensor entries	
Window anti-trap strip	Sedan, Sport Wagon	Top of window frame in door	
Window lock-out switch, rear	Sedan, Sport Wagon	Left side shifter bezel	
Window motors	1999 - 2001	Inside doors	
Window switches	1999 - 2001	On shifter bezel	
Windshield washer nozzle heaters	1999 - 2001	In nozzles at rear of engine hood	
Windshield washer pump	1999 - 2001	At rear of washer tank, right front engine compartment	
Windshield washer relay	1999 - 2001	Left rear engine compartment in E-box	⇒ Fig. 16
Wiper motor	1999 - 2001	Rear of engine compartment, behind bulkhead	⇒ Fig. 20
Wiper/washer switch (stalk)	1999 - 2001	Right side steering column	
Yaw sensor		see ABS/DSC rotational rate (yaw) sensor	
ZKE V control module		see General Module (GM V)	

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Engine compartment electrical components



Fig. 17 Engine compartment (1999 323i)

1 - Data link connector (DLC) (1999 - mid-2000 models)

2 - Hood contact switch

3 - B+ jumper connector

4 - DSC control module/hydraulic unit

5 - Secondary air pump

6 - Interior microfilter housing

7 - Resonance valve, intake manifold (changeover valve)

8 - Mass air flow sensor

9 - Brake fluid level sensor

10 - Ground lug X6454

11 - Electronics box (E-box)

12 - Air quality sensor (AUC) (for automatic recirculation control)

13 - Intake camshaft VANOS solenoid

14 - Engine cooling fan (electric)

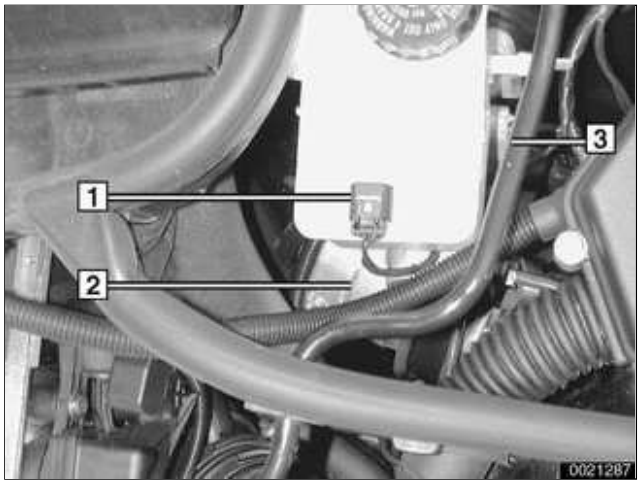


Fig. 18 Left rear corner of engine compartment (near E-box)

1 - Brake fluid level sensor

2 - DSC precharge pump (Teves DSC MK 20/60)

3 - Brake fluid pressure sensor

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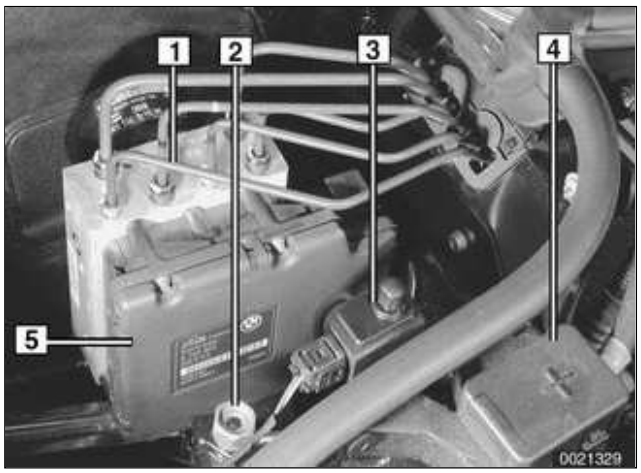


Fig. 19 Right rear corner of engine compartment (Teves DSC MK 20/60)

1 - DSC hydraulic unit

2 - Ground jumper connection

3 - Hood contact switch

4 - B+ jumper connection

5 - DSC control module

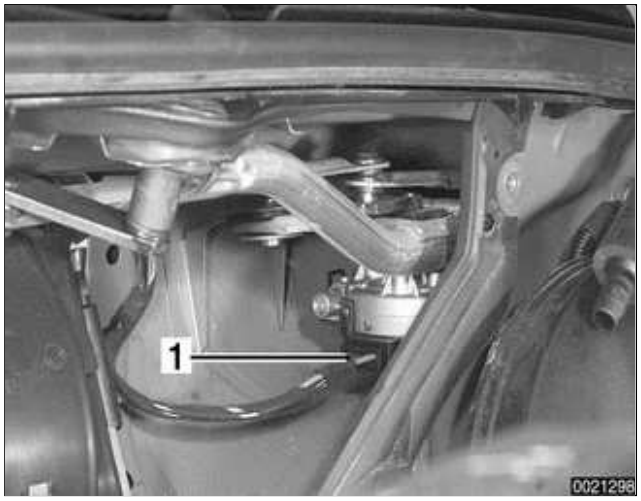


Fig. 20 Rear of engine compartment, behind bulkhead

1 - Wiper assembly electrical harness connector

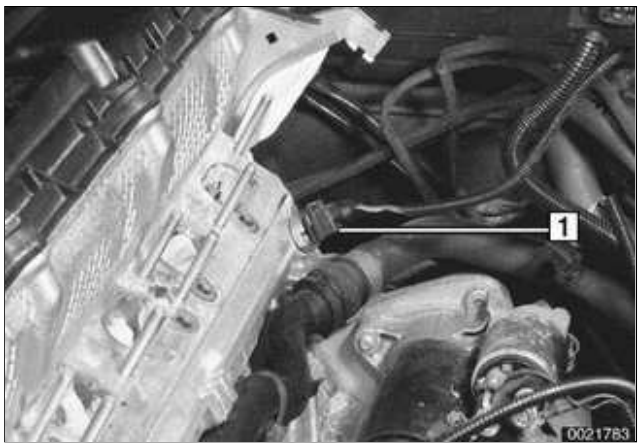


Fig. 21 Under rear of intake manifold

1 - Engine coolant temperature (ECT) sensor

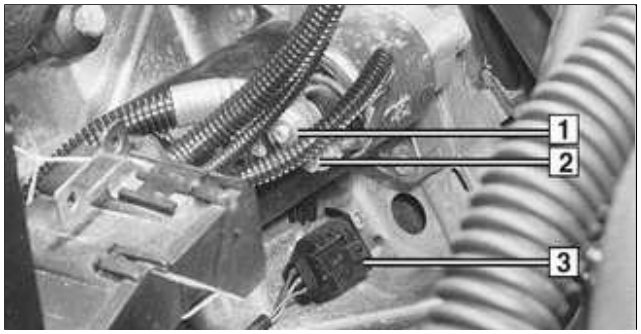


Fig. 22 Left rear of engine block, under intake manifold

1 - Starter motor terminal 50

2 - Starter motor terminal 30

3 - Crankshaft position sensor

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4 - Bore hole for crankshaft locking tool

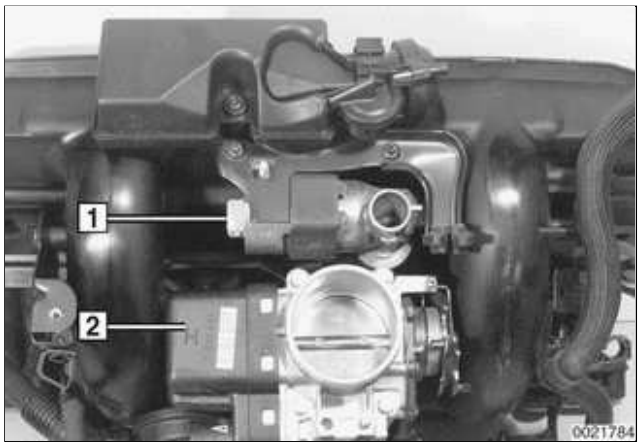


Fig. 23 Under intake manifold

1 - Idle speed control valve

2 - Throttle housing (MDK/EDK)

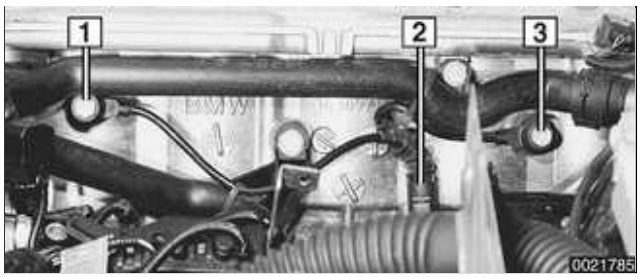


Fig. 24 Under intake manifold, at cylinder head

1 - Knock sensor cylinder 1 - 3

2 - Knock sensor harness connector

3 - Knock sensor cylinder 4 - 6

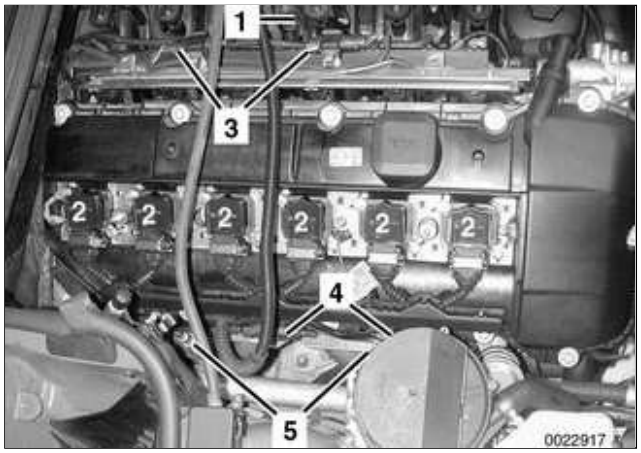


Fig. 25 Center top of engine, under covers

1 - Intake air temperature (IAT) sensor

2 - Ignition coils

3 - Post-catalyst oxygen sensor connectors

4 - Precatalyst oxygen sensor connectors

5 - Precatalyst oxygen sensors

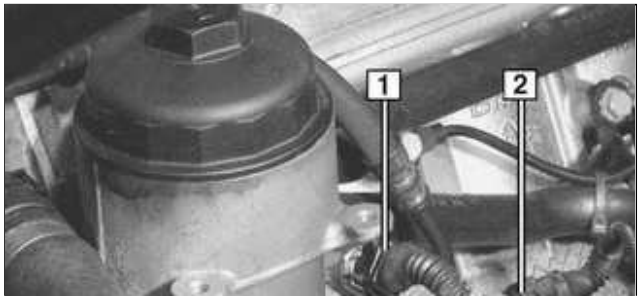


Fig. 26 Left front of engine, at oil filter housing

1 - Oil/coolant temperature sensor

2 - Oil pressure switch

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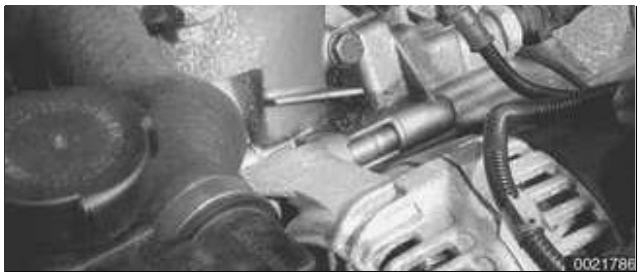




Fig. 27 Left side of engine compartment

1 - Heater control valve

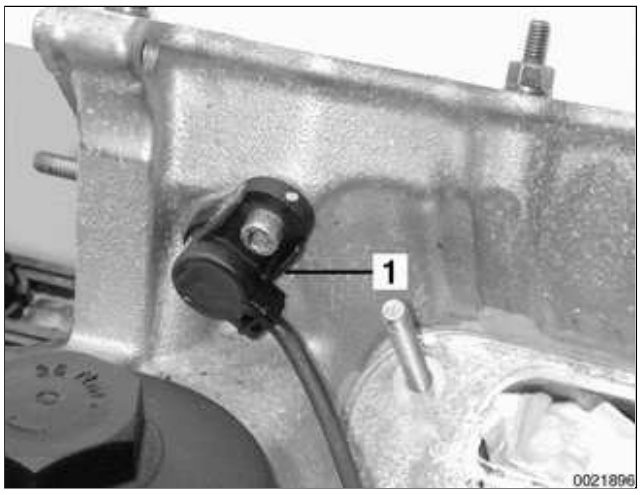


Fig. 28 Cylinder head, left front

1 - Intake camshaft position sensor

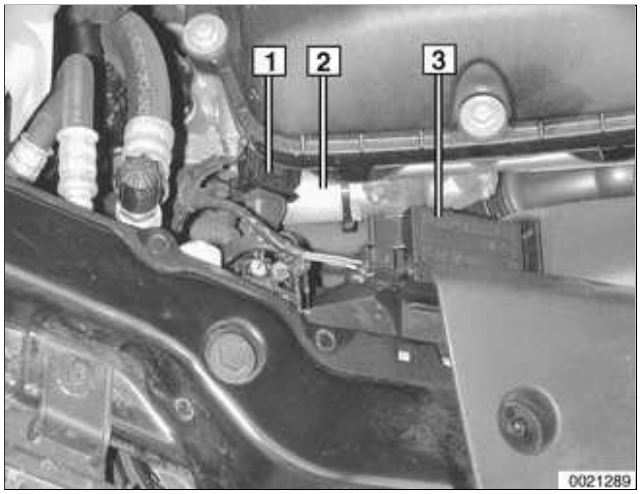


Fig. 29 Right front of engine, top

1 - Exhaust camshaft position sensor

2 - Exhaust camshaft VANOS solenoid

3 - Air quality sensor (AUC) (for automatic recirculation control)

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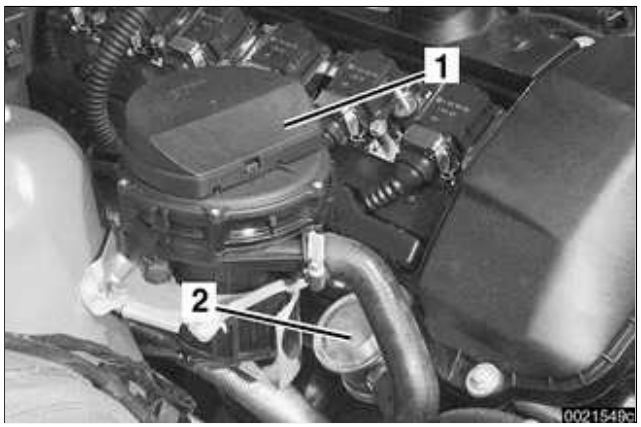


Fig. 30 Right front of engine

1 - Secondary air injection pump

2 - Secondary air injection pump valve

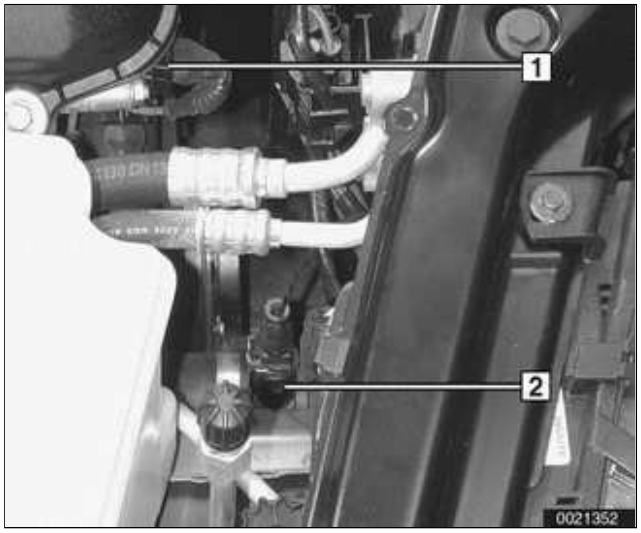


Fig. 31 Right front of engine, low

1 - Exhaust camshaft position sensor

2 - Coolant outlet temperature sensor

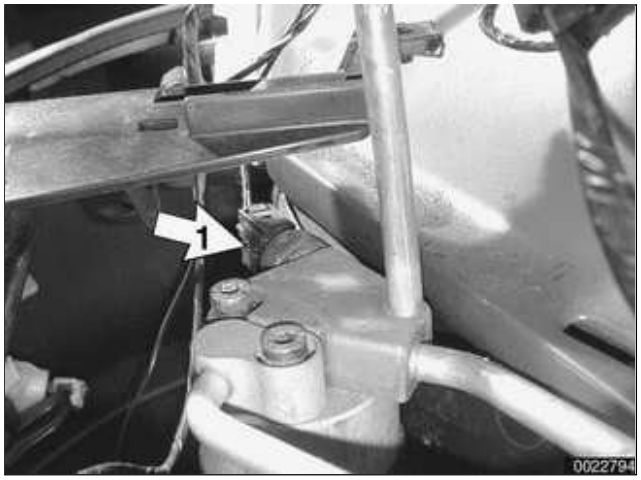


Fig. 32 Top of A/C receiver/drier, right front engine compartment

1 - A/C pressure sensor

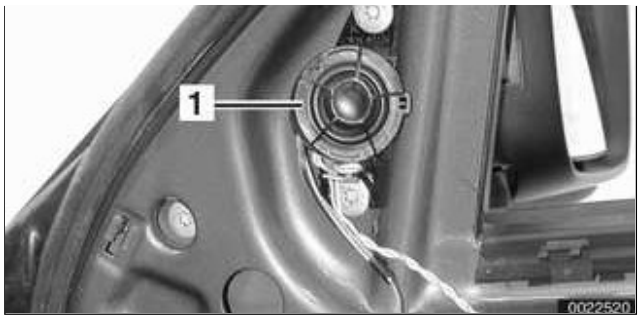
Car interior electrical components



Fig. 33 Front door window frame

1 - Door mounted tweeter

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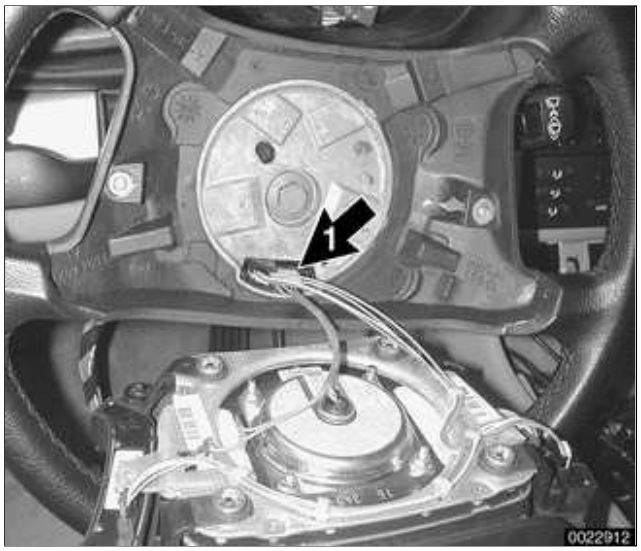


Fig. 34 Underneath horn pad at steering wheel

1 - Airbag connector

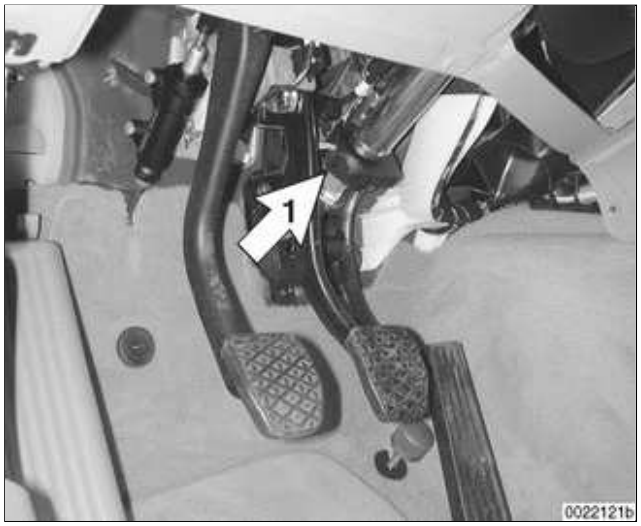


Fig. 35 Left side of steering column, below dashboard

1 - Steering angle sensor

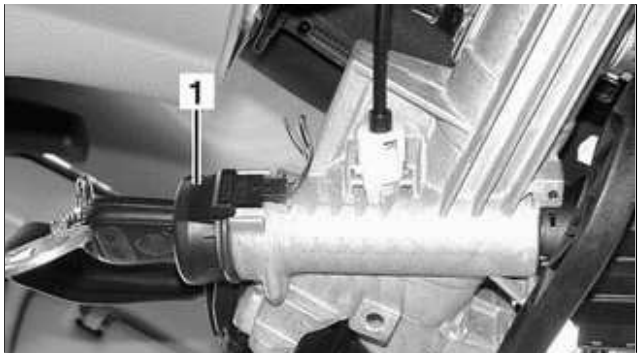


Fig. 36 At ignition switch

1 - EWS (electronic immobilizer) ring antenna

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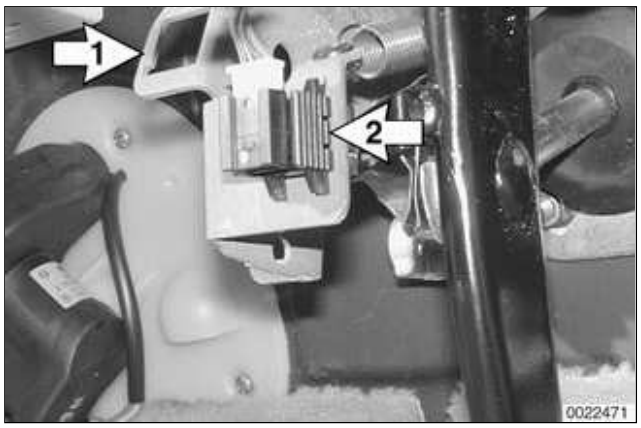


Fig. 37 At pedal cluster

1 - Cruise control cut-off switch (if equipped)

2 - Brake light switch

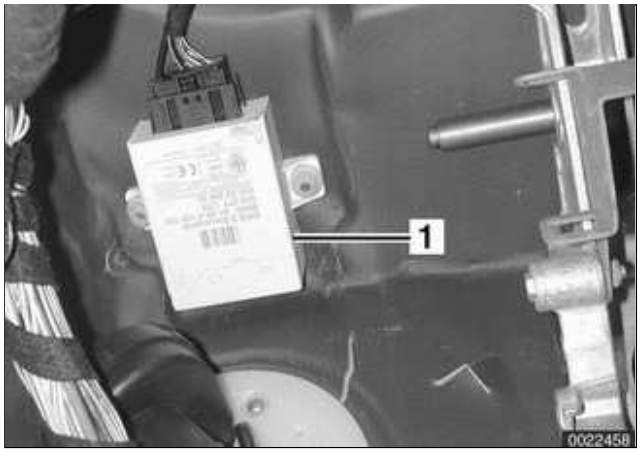


Fig. 38 Above pedal cluster

1 - EWS control module

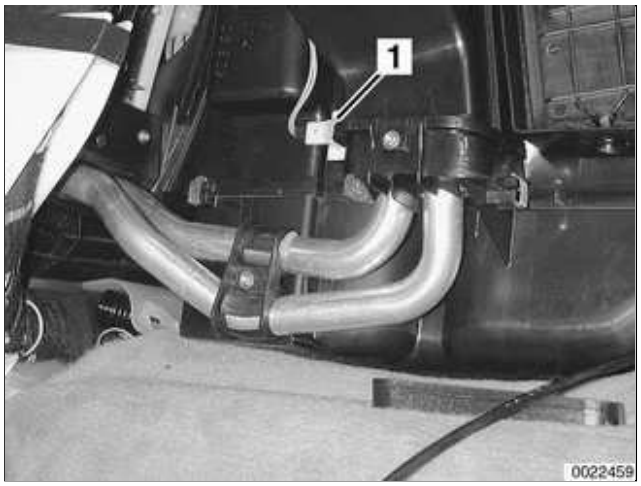


Fig. 39 Left side IHKA housing, below instrument cluster

1 - A/C evaporator temperature sensor



Fig. 40 Right side IHKA housing, below glove compartment

1 - Blower motor resistor pack

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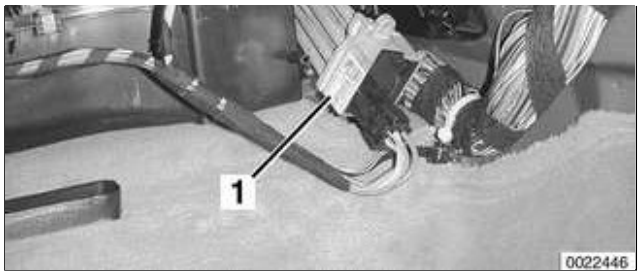




Fig. 41 Right side dashboard

1 - Passenger airbag

2 - Passenger airbag connector

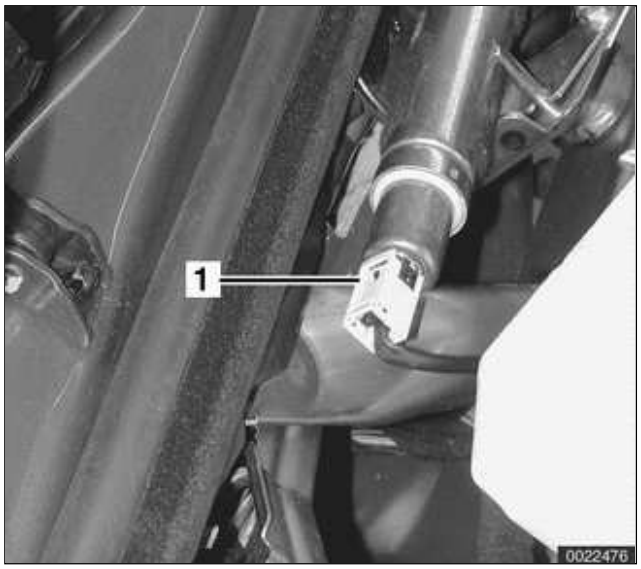


Fig. 42 In windshield pillar (A-pillar)

1 - Head protection airbag (HPS) electrical connector



Fig. 43 In headliner

1 - Sunroof motor

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Fig. 44 In left rear roof pillar (C pillar)

1 - Antenna amplifier



Fig. 45 Behind center console utility bin

1 - Heater core temperature sensor



Fig. 46 Under shifter bezel

1 - Shiftlock solenoid



Fig. 47 At shifter bezel

1 - Gear position indicator light

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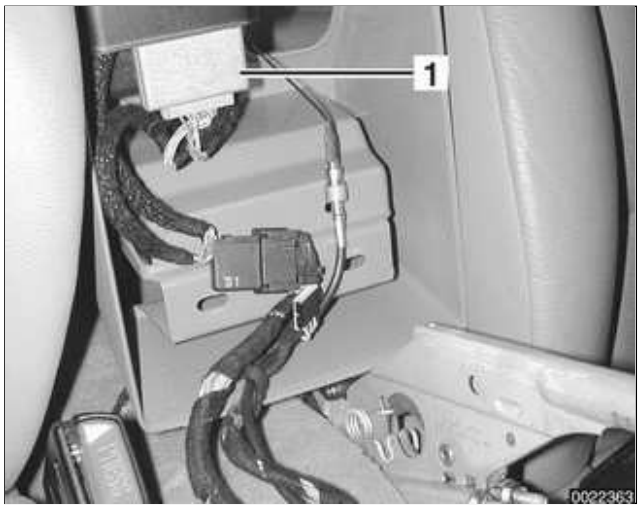


Fig. 48 Under center console

1 - Telephone connector



Fig. 49 Under center console, rear of parking brake handle

1 - Parking brake warning switch



Fig. 50 Driver seat (Convertible seat front view)

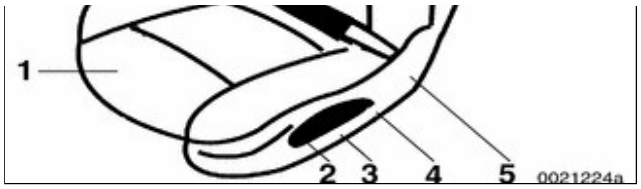
1 - Seat memory module

2 - Seat control switch module

3 - Seat tilt motor

4 - Seat forward-back motor

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5 - Seat height motor

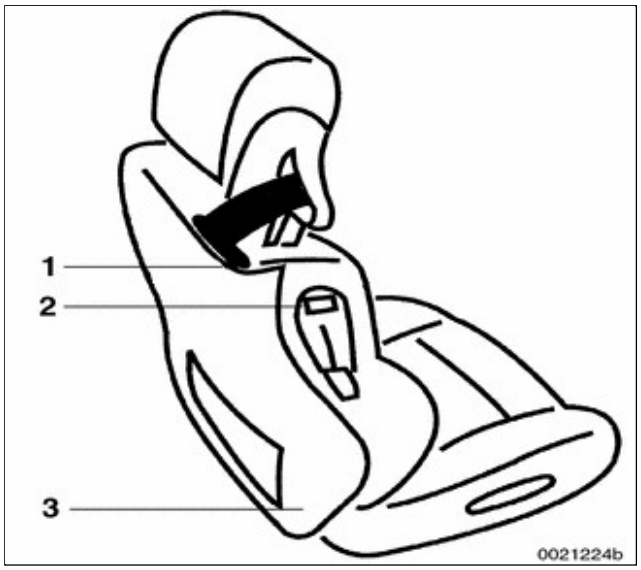


Fig. 51 Passenger seat (Convertible seat rear view)

1 - Headrest motor

2 - Comfort entry switch

3 - Backrest motor



Fig. 52 Below rear seat cushion, under access covers (top of fuel tank)

1 - Right side: Electric fuel pump and fuel level sender connector

2 - Left side: Fuel level sender connector

Electrical components in luggage/cargo compartment

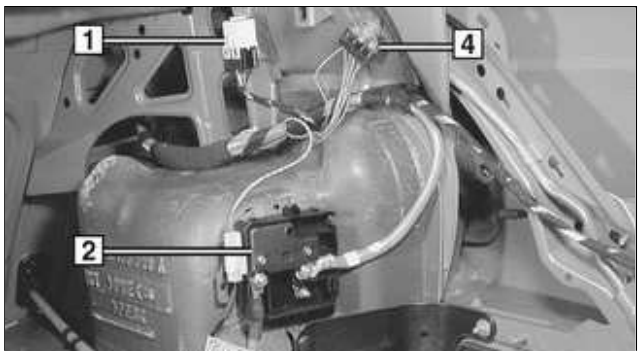


Fig. 53 Right side trunk

1 - Rear window defogger relay

2 - F108 (200 amp fuse) in main harness

3 - Battery safety terminal (BST) (explosive charge)

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4 - Ground X498

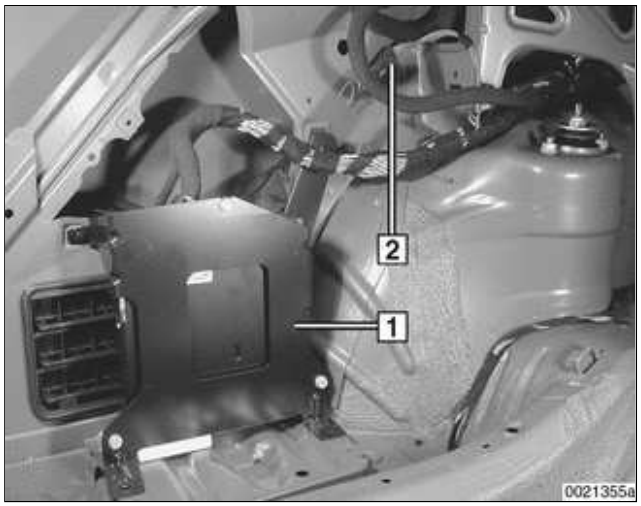


Fig. 54 Left side trunk

1 - Sound system amplifier

2 - Ground X13016

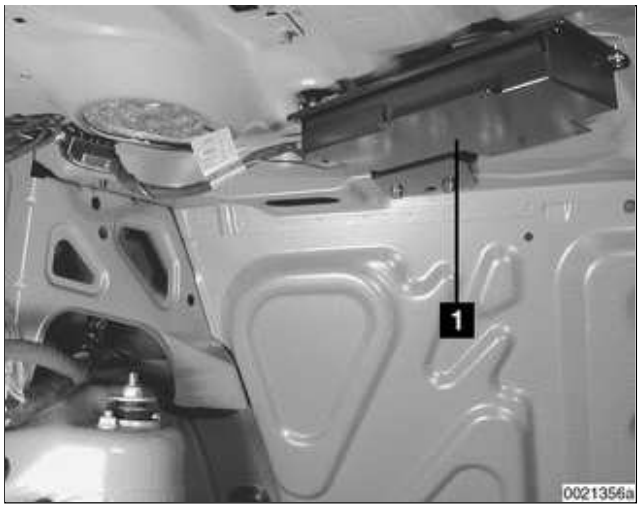


Fig. 55 Trunk, below parcel shelf

1 - Telephone transceiver



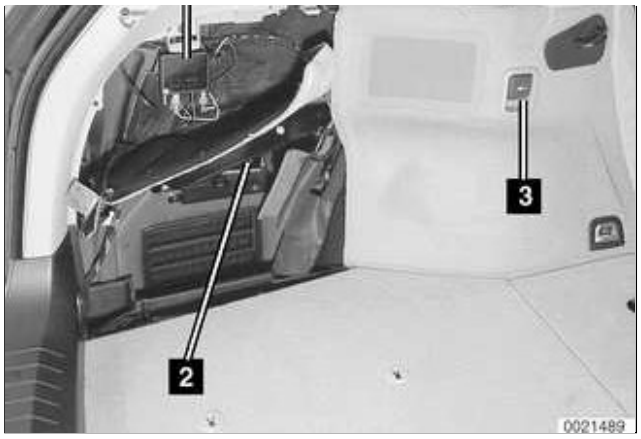
Fig. 56 Right cargo area, behind trim panel (Sport Wagon)

1 - Rear window washer pump



Fig. 57 Left cargo area (Sport Wagon)

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1 - Antenna diversity amplifier

2 - Sound system components

3 - Power socket, 12 volt

Electrical components underneath car

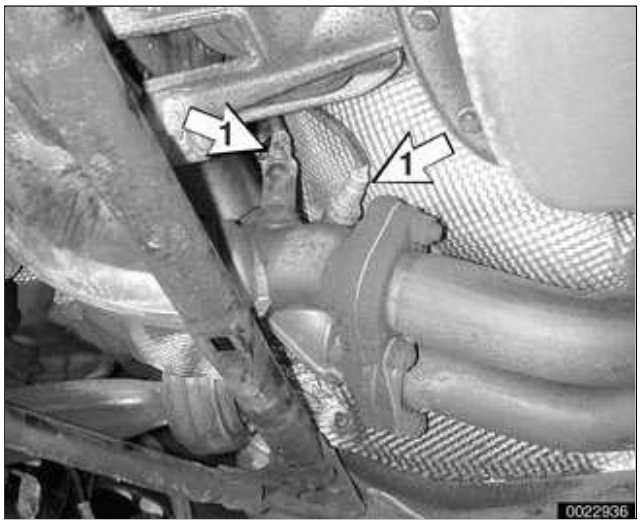


Fig. 58 Underneath right side of engine, at lower end of front exhaust pipes

1 - Post-catalyst oxygen sensors

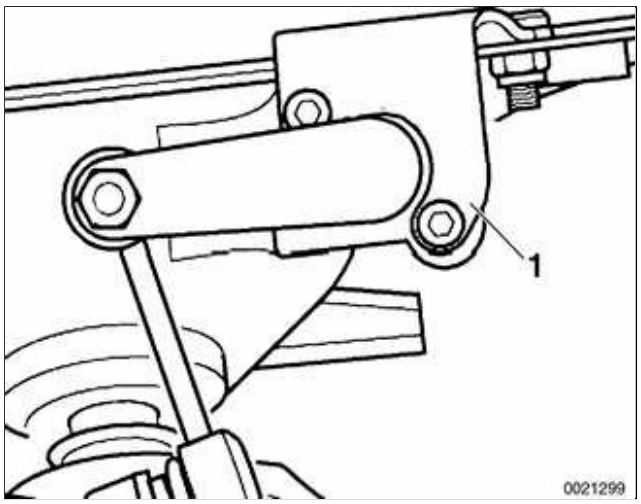


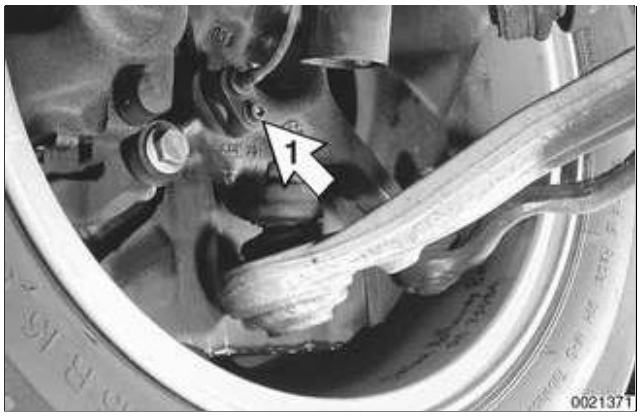
Fig. 59 At front subframe, right side

1 - Front ride level sensor



Fig. 60 Right front steering arm (rear wheel drive model shown)

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1 - ABS wheel speed sensor, front

Note:

Left front wheel speed sensor is similar.

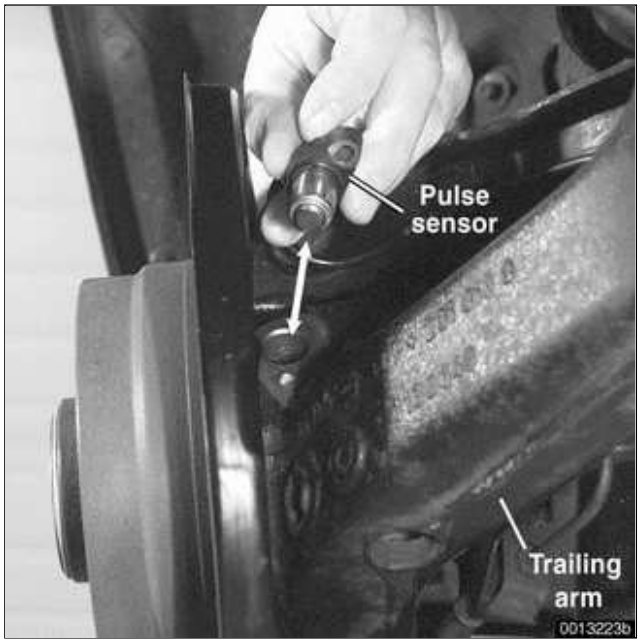


Fig. 61 Right rear wheel bearing housing (1999 rear wheel drive model shown)

ABS wheel speed sensor, rear

Note:

Left rear wheel speed sensor is similar.

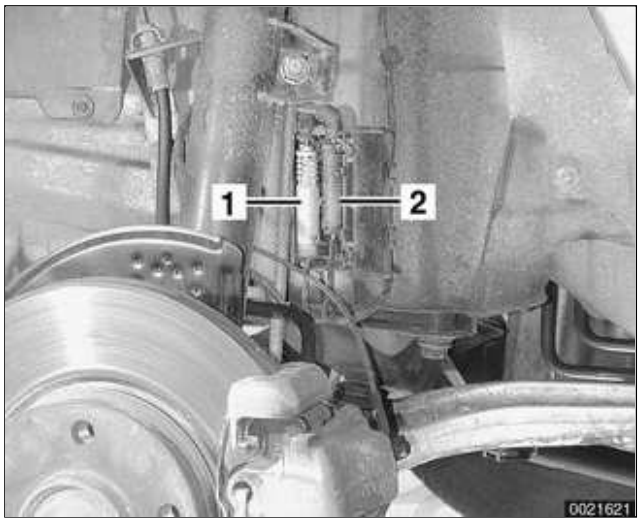


Fig. 62 In left front wheel housing

1 - ABS wheel speed sensor connector (2-pin grey)

2 - Brake pad wear sensor connector (2-pin black)

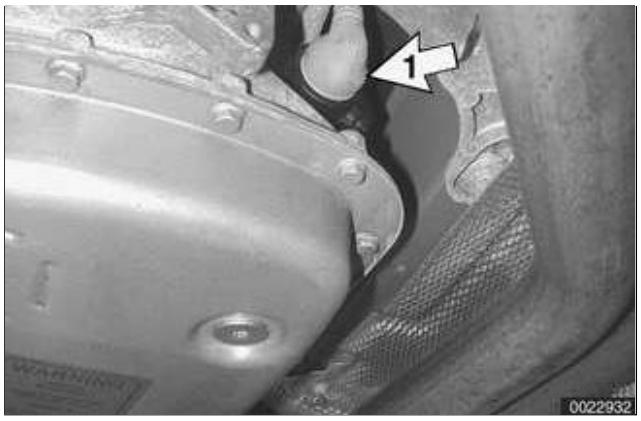
Note:

- *Right rear wheel speed sensor connector is similar.*
- *The right front and left rear brake pads lack the wear sensor.*



Fig. 63 Rear of automatic transmission (GM)

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1 - Transmission control (AGS) connector

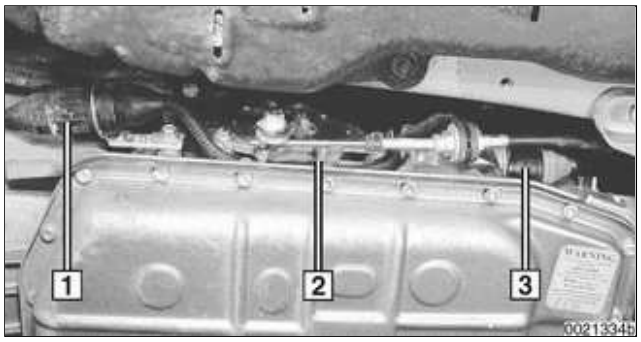


Fig. 64 Left side of automatic transmission (ZF)

1 - Transmission range switch/back-up light switch harness connector

2 - Transmission range switch/back-up light switch

3 - Transmission control (AGS) harness connector

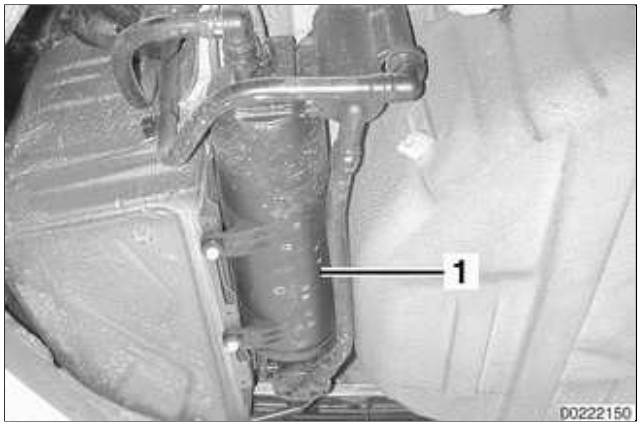


Fig. 65 Underneath trunk

1 - LDP/DMTL fuel tank diagnosis pump

Convertible top electrical components

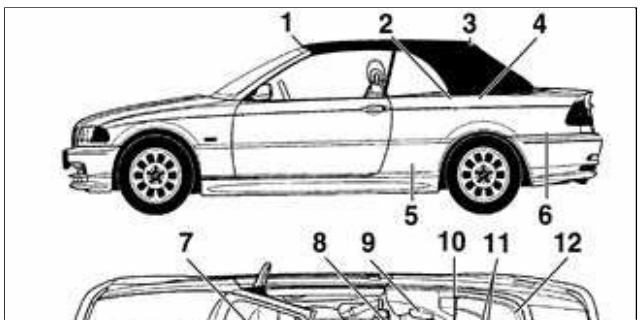


Fig. 66 Convertible

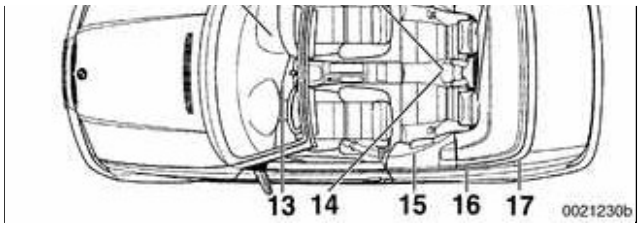
1 - Visor latch hall sensors

2 - Solenoid valves

3 - Tension bow hall sensor

4 - Main pillar hall sensor

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5 - Convertible top module (CVM II)

6 - Hydraulic motor

7 - General module (GM V)

8 - Top storage cover lock motor

9 - Rear window defogger relays

10 - Storage cover lock hall sensor

11 - Roll-over cassettes and sensors

12 - Storage compartment floor microswitch

13 - Convertible top switch

14 - Cover lock motor hall sensor

15 - Convertible top module (CVM II)

16 - Storage cover and hard top lock hall sensor

17 - Storage cover hall sensor

Exterior electrical components

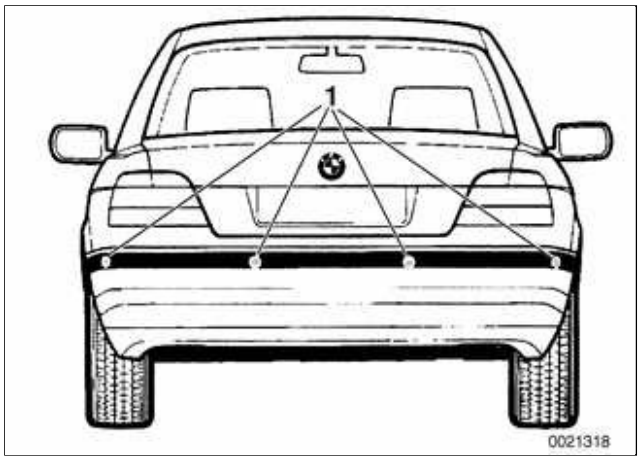


Fig. 67 Rear bumper

1 - Park distance control (PDC) ultrasonic sensors

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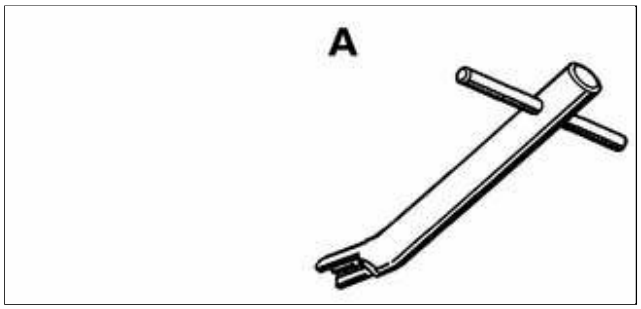
General

This repair group covers repair information for windshield, headlight (optional) and rear window (Sport Wagon) wiper and washer systems.

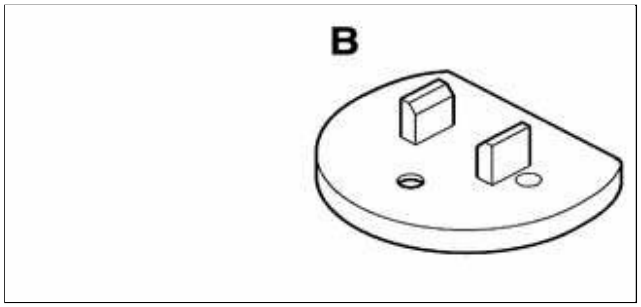
Replacement of the wiper/washer stalk switch assembly is covered in ⇒ 612 Switches. Electrical wiring diagrams and relays for the wiper/washer system are covered in Electrical Wiring Diagrams.

Special tools

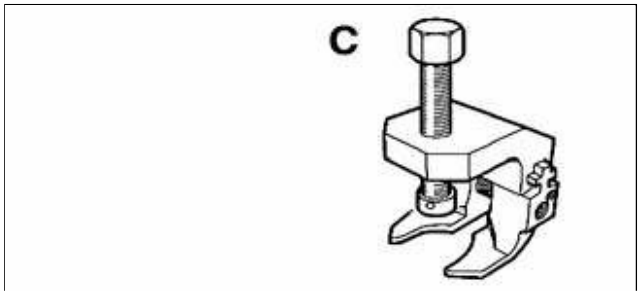
Although most wiper system repairs can be carried out with normal shop tools, a few special tools may be necessary as well.



- Headlight washer nozzle aligning tool BMW 00 9 100



- Rear wiper drive aligning tool BMW 61 1 330



- Wiper arm removal tool BMW 61 6 060

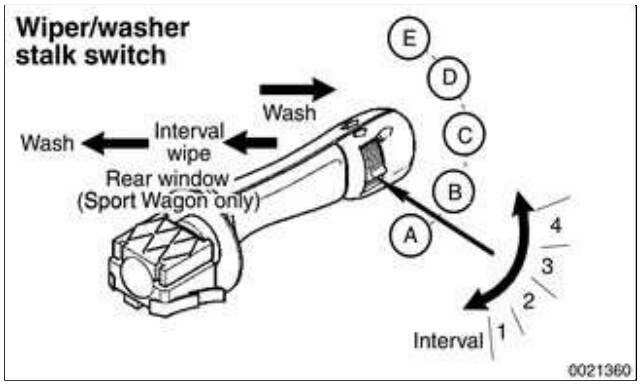
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Wiper and washer system

The wiper and washer functions in E46 vehicles are controlled by the ZKE V general module (GM V). Driver input to the system is via the multi-function stalk switch to the right of the steering column.

Operational faults in the wiper/washer system will set Diagnostic Trouble Codes (DTCs) which can be accessed through BMW scan tools DIS or MoDiC.

The components of the wiper/washer system are described below. Some functions or components are optional, as indicated.



- Wiper/washer stalk switch. The system has four wiper settings for the windshield at the steering column stalk switch.

The settings are:

- **A**: Single wipe (hold stalk switch down)
- **B**: Off
- **C**: Interval (thumb wheel on stalk switch)
- **D**: Slow (automatically switches to interval when car is stopped.)
- **E**: Fast (automatically switches to slow speed when car is stopped.)

In "interval" setting, wiping intervals are dependent on road speed. See ⇒ Table a. Wiper interval (seconds).

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The windshield washer system is activated by pulling the stalk switch toward the driver.

In Sport Wagon models with rear wiper/washer, pushing the stalk switch one detent away from the driver activates the interval rear wiper. Pushing the stalk further forward activates the rear window washer.

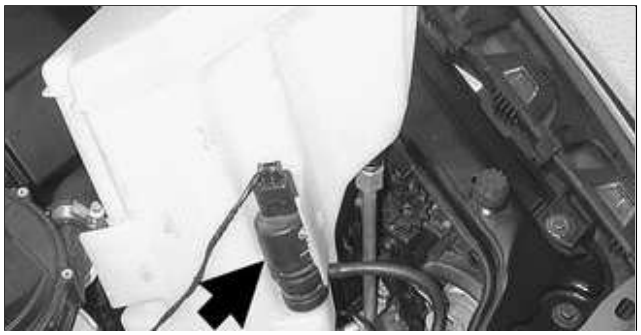


- Windshield wiper double relay is in E-box, left rear of engine compartment (**arrow**) under plastic cover.

Rain sensor (optional). The infrared rain sensor and module switch on the windshield wipers automatically when water drops are detected on the windshield. The rain sensor system is described more fully below.



- **Windshield/headlight washer fluid tank** is in right front of engine compartment.



- **Windshield washer pump** is in rear portion of front washer tank (**arrow**).

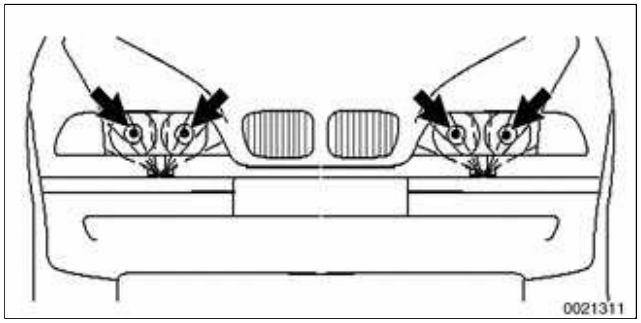
Headlight washer pump (optional) is in front portion of front washer tank.

Windshield washer nozzle jets are located on the engine hood. With the ignition ON, the washer jets are

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automatically heated. The nozzle heaters, being of the positive temperature coefficient (PTC) design, increase resistance as they heat up and automatically cut back on current consumption.



- **Headlight washer system** (optional). Headlight washer nozzles are on top of the front bumper. The headlight washer pump uses fluid from the front washer tank. If headlights are on, they will be cleaned every fifth time the windshield washers are activated.

Rear window wiper assembly (Sport Wagon) is mounted to the tailgate and linked to the rear wiper shaft via a mechanical coupling.



- **Rear washer fluid tank and pump** (Sport Wagon) is mounted in the right cargo compartment behind trim panel. Fill reservoir through cap in right side rear deck pillar.

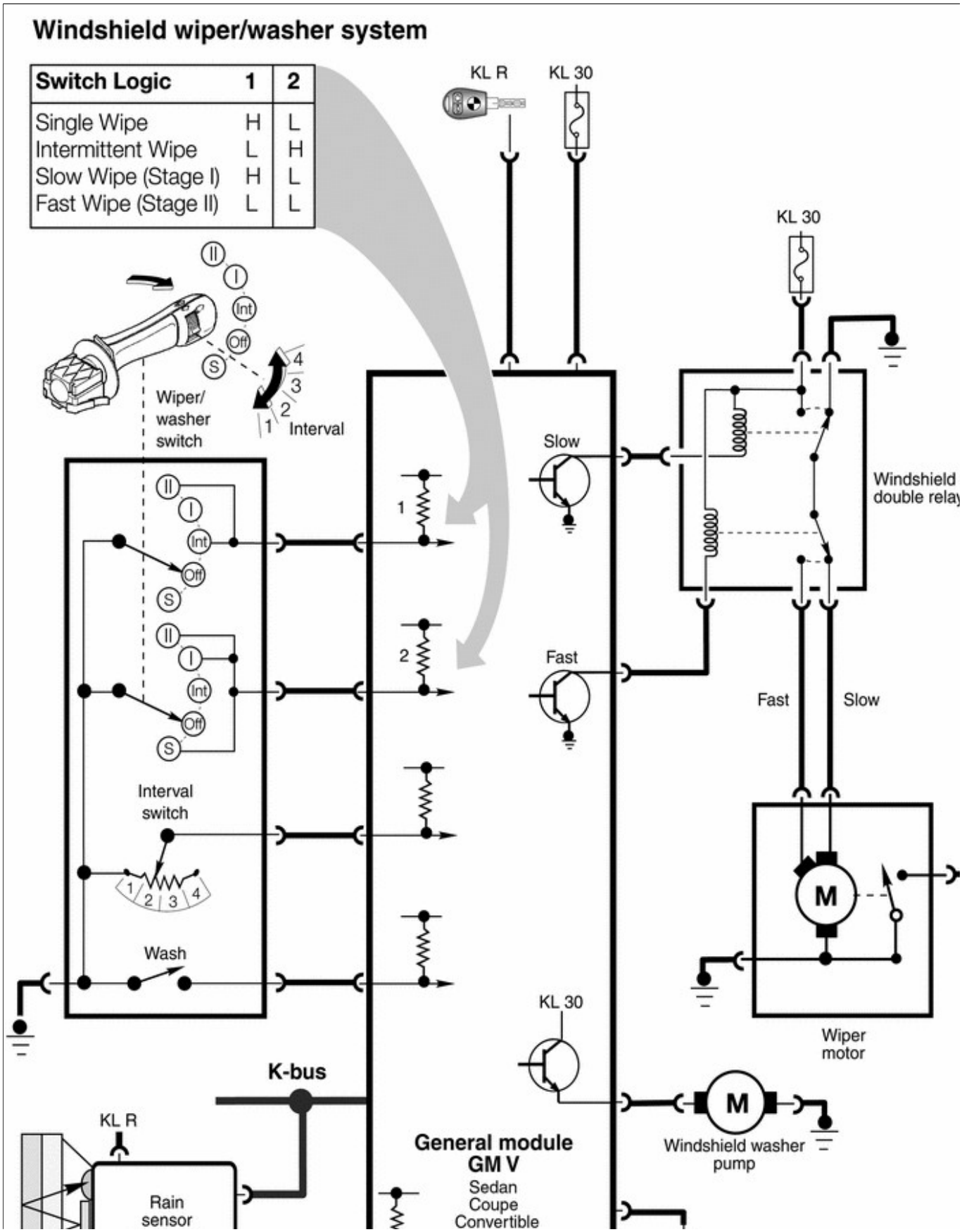
The rear window wiper/washer system is described more fully below.

Table a. Wiper interval (seconds)

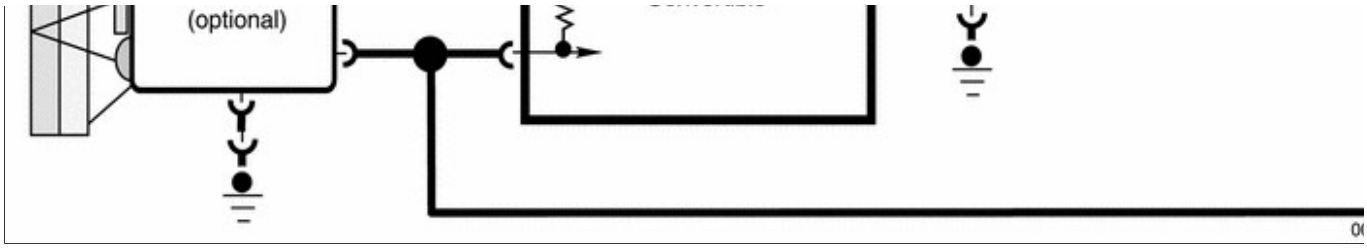
Thumb wheel position	Vehicle speed (mph)					
	<4	5 - 22	23 - 45	46 - 60	61 - 87	>87
1	26	19	17	15	15	13
2	17	12	11	10	9	7
3	10	6	6	5	4	3
4	5	3	3	2	2	2

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Windshield wiper/washer system

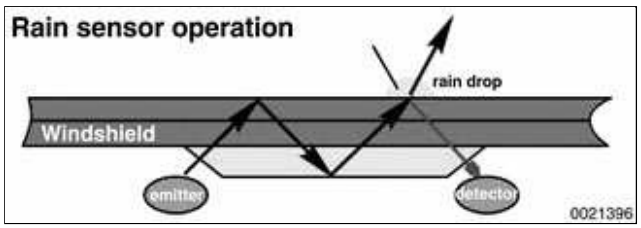


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Rain sensor system (optional)

The optional rain sensor system uses an infrared sensor, located at the top of the windshield in front of the rear view mirror, to detect the presence of water drops (or dirt) on the windshield. The signal from the sensor is communicated to the GM V, which activates the interval wipe cycle if the wiper stalk switch knurled knob (interval control) is in one of the four interval settings.



The rain sensor functions by aiming a beam of infrared light through the windshield at a set angle. The beam is reflected back and forth within the windshield until it is detected by the detector component of the rain sensor. Rain drops (or other impurities) on the outside of the windshield cause some of the infrared to be dissipated outside the windshield. As a result the detector "sees" less infrared intensity. This is interpreted as a need for the wiper to be turned on.

System components:

- An optical prism body attached to the top of the windshield
- Infrared emitter and detector diodes
- Optics heater (to prevent condensation from forming on diodes and prism)

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- Control module (connected to GM V via K-bus)

The rain sensor is on-line as soon as it receives KL R (ignition on) operating power.

- When the windshield wiper stalk switch is placed in the intermittent position, the GM V signals the rain sensor control module via the K-bus of the request for intermittent wiping and the position of the knurled wheel (sensitivity).

- As an acknowledgment, the rain sensor sends a command via the K-bus to activate the wiper motor.

- If more than 12 seconds pass before the GM V receives the acknowledgment, it concludes the rain sensor has a defect and operates the intermittent wipe function as a system not equipped with a rain sensor. The wiper intermittent cycling is based solely on the knurled wheel setting.

The rain sensor continuously monitors the windshield for rain accumulation and signals the GM V to activate the wipers based on the knurled wheel position and how fast rain accumulates on the windshield.

The knurled wheel position signal (1 - 4) via the K-bus informs the rain sensor of the selected level of sensitivity:

- Position 1 (least sensitive) delays the wiper activation signal.

- Position 4 (most sensitive) sends the wiper activation signal to the

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GM V sooner.

Depending on the intensity of the rain the wipers can be operated continuously as if set in the normal wiper stalk switch position regardless of the knurled wheel setting. For this reason, the vehicle speed signal on the K-bus is not utilized on rain sensor equipped wiper systems.

If the ignition switch is turned off with the wiper switch in the intermittent position, the rain sensor will only become active after the ignition is switched back on and one of the following occurs:

- The stalk switch is moved from the intermittent position and then back.
- The knurled wheel setting is adjusted.
- The wash function is activated.

The reasoning behind this switching strategy is to have the driver make a conscious decision to activate the system.

The rain sensor control module adapts to the optics system environment as follows:

- Windshield aging: As the vehicle ages, windshield pitting in the rain sensor monitoring area may cause a loss of light in the optics system. The control module adapts for loss of light based on the intensity of the detected infrared light with a cleared windshield. Therefore, rain sensor function is not adversely affected due to windshield aging.
- Dirty windows: The rain sensor adaptation reacts less sensitively to

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a dirty windshield (dirt, road salt, wax residue) after a completed wipe cycle. A dirty windshield has a film on it that diminishes the ability of infrared to refract into water droplets that are present. This causes a delay in the rain sensor detection capabilities which lengthens the time intervals on an intermittent wipe.

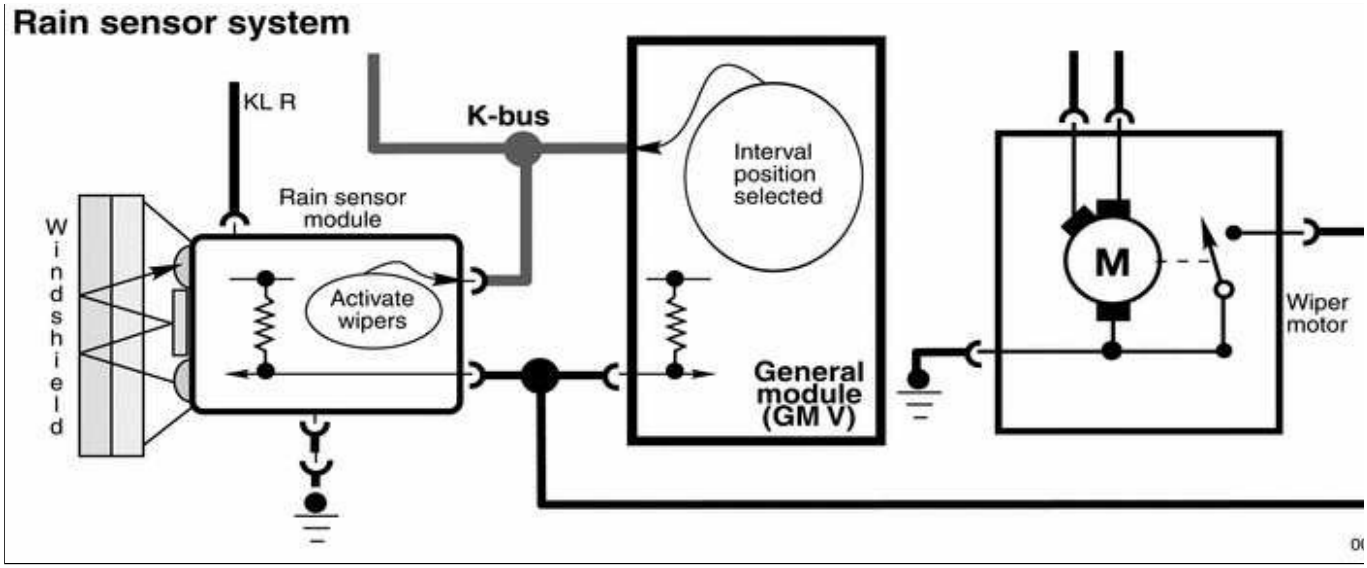
CAUTION!

On rain sensor equipped models, make sure the wiper blades are in perfect condition. Only use window cleaner to clean the windshield.

Note:

A dirty windshield can cause the rain sensor control module to set a fault due to approaching limits of its adaptation abilities.

Rain sensor system



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Rear window wiper/washer system (Sport Wagon)

The rear wiper motor assembly in Sport Wagon models is mounted in the tailgate through a sound-insulating rubber bushing.

The rear wiper/washer is controlled by the wiper/washer steering column stalk switch via the ZKE V system. The functions of the system are:

- Normal interval wipe
- Programmed interval wipe
- Continuous wipe
- Washing

Normal operation is a timed interval of approx. 7 seconds. This is triggered by pressing the stalk switch forward to the first detent. Full sweep and park position of the wiper arm are recognized by two hall sensors on the motor assembly. If the wiper is switched OFF, the wiper arm will return to the park position.

Programmed interval wipe:

- Quickly switch rear wiper ON and OFF.
- Wait the needed interval time.
- Switch rear wiper ON again.

The OFF time will be the programmed interval, up to approx. 30 seconds.

Continuous wiping is activated any time the rear wiper is on and the transmission

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is in reverse. The signal is provided by the back-up light switch via the LSZ (light control module).

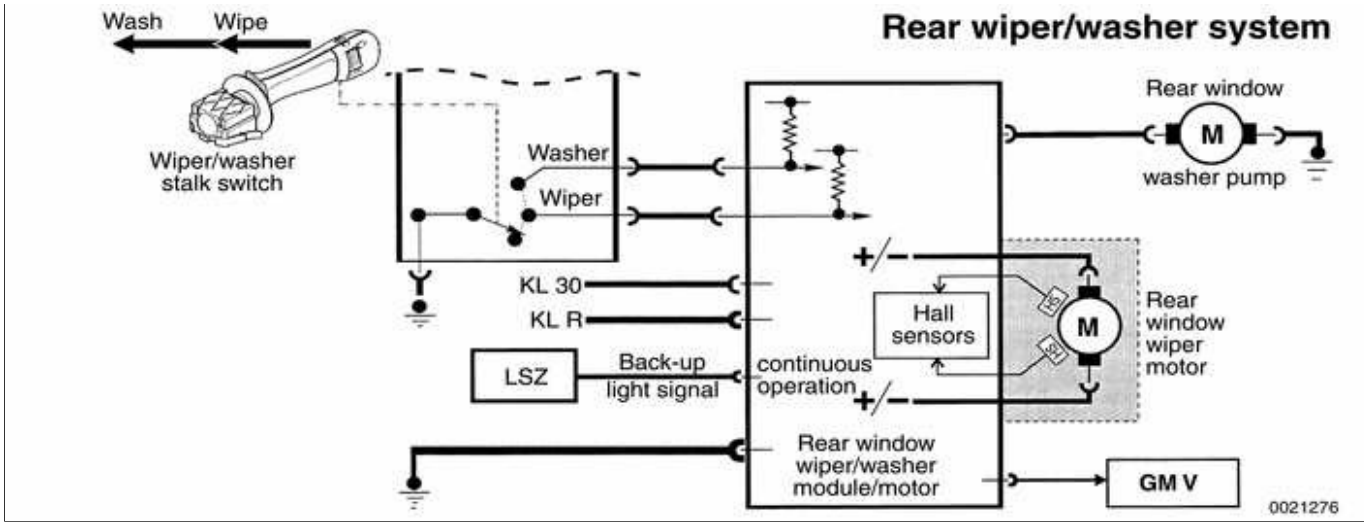
Rear window washing is activated when the stalk switch is pushed forward past the first detent:

- Wash cycle 1. Washer pump ON for 1.5 seconds. Wiper ON 1 second later.
- Wash cycle 2. Washer pump ON for 0.5 second after 0.8 second delay. Wiper continues.
- Wash cycle 3. Washer pump ON for 0.5 second after 0.8 second delay. Wiper ON for two wipe-dry cycles.

Note:

After washing, the rear wiper will remain in interval (normal) wiping mode until switched OFF.

Rear wiper/washer system



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Wiper Blades

Wiper blade cleaning problems

Common cleaning problems with the wipers include streaking or sheeting, water drops after wiping, and blade chatter.

CAUTION!

Never turn on the wiper blades while the hood is open. Damage to the wiper system and hood may occur. To ensure safety during wiper system repair procedures, remove the windshield wiper fuse. See ⇒ 610 Electrical Component Locations.

Streaking is usually caused when wiper blades are coated with road film or car wash wax. Clean the blades using soapy water. If cleaning does not cure the problem, the blades should be replaced. BMW recommends replacing the wiper blades twice a year, before and after the cold season.

Water drops that remain behind after wiping are usually caused by oil, road film, or diesel exhaust residue on the glass. Use an alcohol or ammonia solution or a non-abrasive cleaner (such as Bon-Ami®) to clean the windshield.

Chatter may be caused by dirty or worn blades, or by wiper arms that are out of alignment. Clean the blades and windshield as described above. Adjust the wiper arm so that there is even pressure along the blade, and so that the blade at rest is perpendicular to the windshield. If problems persist, the blades and wiper arms should be replaced.

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Note:

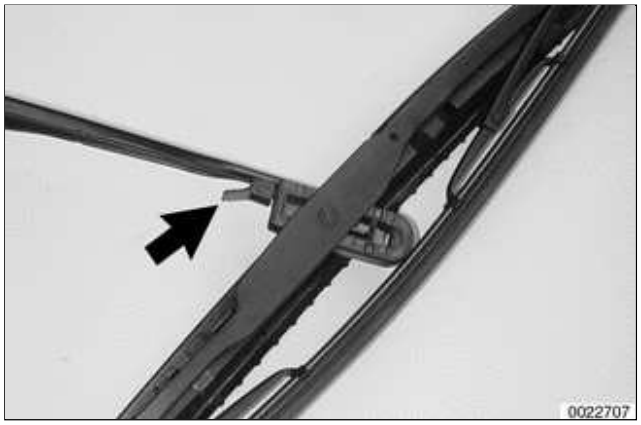
BMW has available a special tool/gauge (BMW special tool 00 9 210) to align the angle of the wiper arm to the windshield glass.

The wiper blades can be renewed in one of two ways:

- Complete blade replacement
- Rubber insert replacement

Insert replacement is the most economical method, although over time the wiper blade itself will become worn. One rule of thumb would be to replace just the inserts every second time.

Wiper blades, replacing



To replace wiper blades:

- Pivot wiper arm off windshield.
- Position wiper blade approximately perpendicular to wiper arm.
- Remove wiper blade from wiper arm by depressing retaining tab (**arrow**) and sliding blade out of arm.
- Installation is reverse of removal. Install wiper blade to wiper arm until retaining tab can be heard to click into position.

Note:

Some wiper blade versions may have two retaining tabs.

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Wiper blade inserts, replacing

To replace wiper inserts:

- Remove wiper blade as described earlier.
- Unhook wiper blade insert from wiper arm guide. If necessary, guide slightly using needle nose pliers.
- Pull old insert from wiper arm guides, noting installation position.
- Remove metal support strips from old insert and install into slots in new insert, noting installation direction of cutouts in support strips.
- Slide new insert through wiper blade guides. Lock insert in place at end guides.

Note:

The notched cutouts in the retaining strips should engage the molded notches in the inserts.

Wiper arms, removing and installing

Note:

- *Wiper arm removal and installation on the Sport Wagon rear window is similar to the operation on the front wiper arms.*

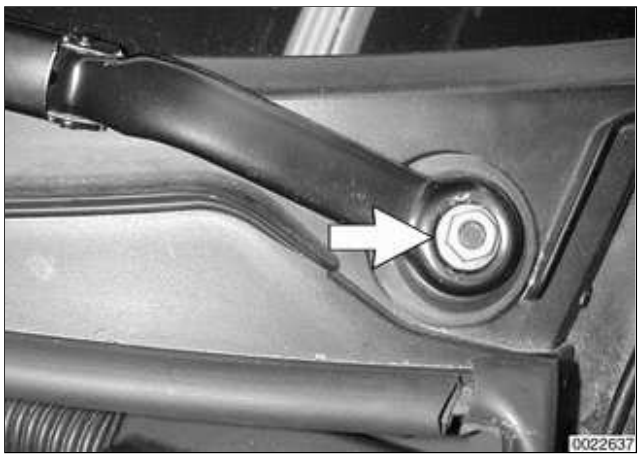
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- *It may be necessary to raise the engine hood to the service position to access the front wiper arm fasteners. See ⇒ 410 Fenders, Engine Hood.*

CAUTION!

- ***Make sure wipers are parked (stalk switch in OFF position) and the ignition is also OFF.***
- ***Use fender cover to protect windshield.***

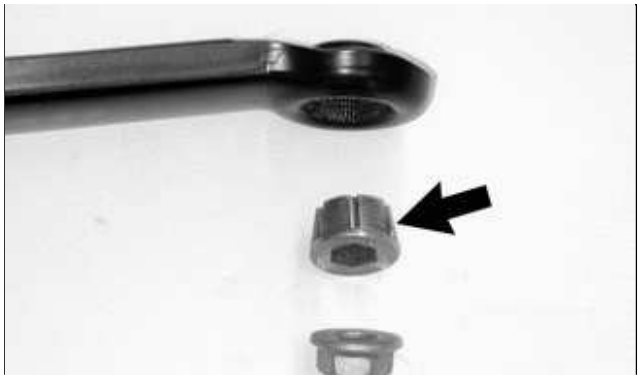
- With engine hood in closed position, remove both wiper blades.
- Open hood. Gently pry off caps covering wiper arm retaining nuts.



➢ Remove each wiper arm retaining nut (**arrow**). Detach arm from shaft.

Note:

Use BMW special tool 61 6 060 or equivalent puller to remove arm.



➢ If wiper arm sleeve (**arrow**) at shaft is loose, it must be replaced.

- Install arms and thread nuts on loosely. Torque nuts after installing wiper blades.

Tightening torque

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Tightening torque	
Front wiper arm to wiper shaft	30 Nm (22 ft-lb)
Rear wiper arm to wiper shaft	9.5 Nm (7 ft-lb)

- Check to make sure blades are positioned correctly Front wiper arms should be installed with tips to the right (passenger) side of the vehicle. Measure distance of wiper arms from lower portion of window gasket with wiper blades installed before tightening to correct torque.

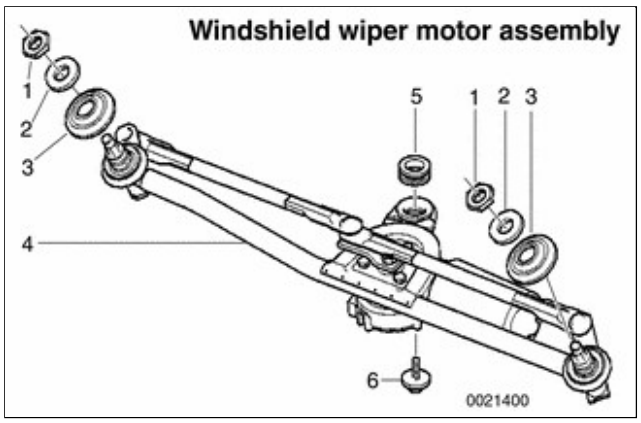
Wiper blade park position	
Front wiper blade tip distance from windshield gasket	
Right blade	24 mm (1 in.)
Left blade	44 mm (1.7 in.)
Rear wiper blade tip distance from rear window gasket	12 mm (1/2 in.)

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Wiper Assemblies

Windshield wiper assembly, removing and installing



The windshield wiper assembly (linkage and motor) is removed as a single unit. Once the assembly is removed, the wiper motor and other linkage parts can be repaired or replaced.

1 - Wiper assembly mounting nut -tighten to 10 Nm (88 in-lb)

2 - Washer

3 - Damping ring

4 - Motor and rod assembly

5 - Rubber damper

6 - Center mounting bolt -tighten to 10 Nm (88 in-lb)

Note:

- *BMW does not provide the windshield wiper motor as a separate component.*

- *It may be necessary to raise the hood to the service position to access the wiper arm fasteners. See ⇒ 410 Fenders, Engine Hood.*

CAUTION!

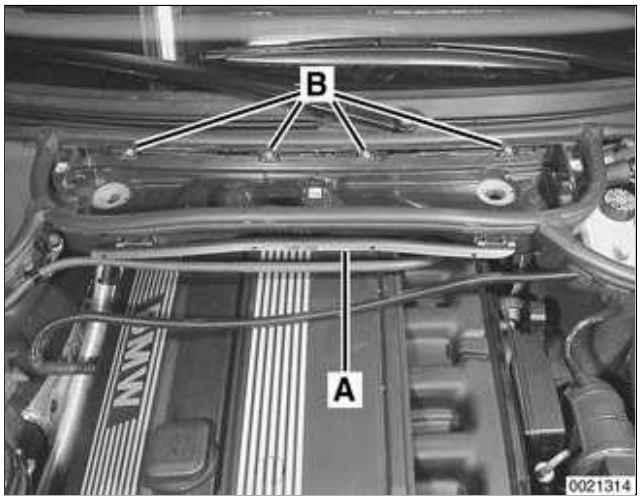
- ***Make sure wipers are parked (stalk switch in OFF position) and the ignition is also OFF.***

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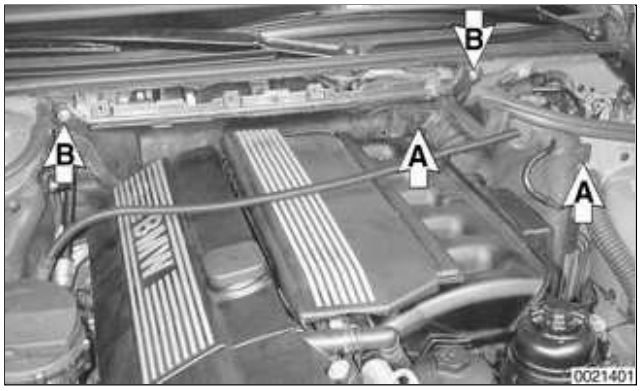
- ***Use fender cover to protect windshield.***

- ***To avoid damaging the wiper arms and pivots, do not manually slide or force the wiper arms across the windshield.***

- Remove wiper arms as described earlier.



- Remove housing for microfilter for interior ventilation.
  - Remove upper cover and microfilter.
  - Open wiring harness loom (**A**) and remove wires.
  - Unfasten screws (**B**) and remove lower microfilter housing.



- Remove heater bulkhead cover.
  - Remove engine compartment side trim panel. Turn locking knobs (**A**) and slide trim panel from mounting lip.
  - Remove heater bulkhead cover mounting screws (**B**) and lift cover up and out from firewall.



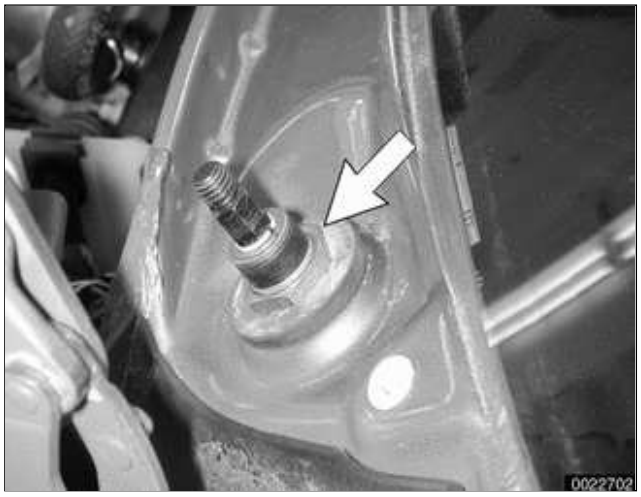
- Detach wiper assembly inside cowl:
  - Remove assembly center mounting bolt (**A**).
  - Disconnect electrical harness connector (**B**).

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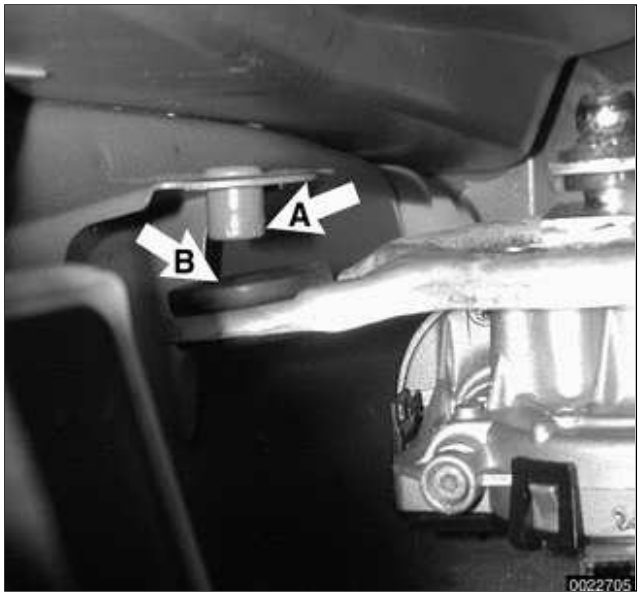
- Remove right side wiper rod (**arrow**) from transmission arm.
  - Release retaining clips and remove windshield base trim tray.



- Remove large nuts (**arrow**) at base of wiper arm shafts in cowl panel. Remove assembly.

Note:

Cover inside edges of cowl panel sheet metal with thick tape to prevent damage during wiper assembly removal.



- Installation is reverse of removal, noting the following:
  - Fit center mounting rubber damper over pin (**A**) into wiper motor mounting arm (**B**).
  - Install all fasteners finger-tight first.
  - Once installed, wiper motor should first be run to parked position and switched off.

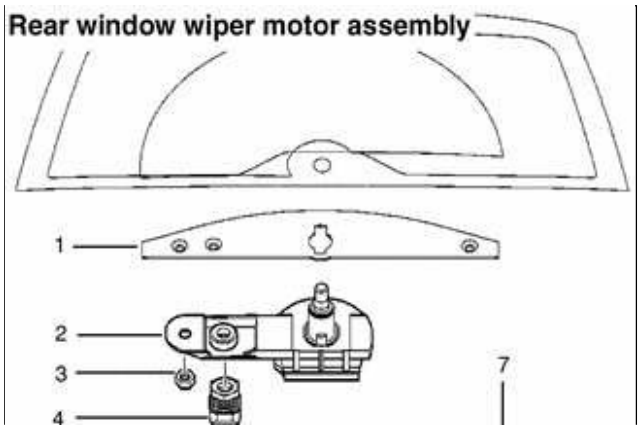
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- Next, install wiper arms but not blades.
- Close hood and fit wiper blades.
- Recheck wiper blade position as described earlier under ⇒ Wiper arms, removing and installing.
- Check all electrical harness fittings and sealing grommets for correct reinstallation. Replace any wire ties cut off during removal.

Tightening torques	
Center wiper assembly mount to cowl	10 Nm (88 in-lb)
Wiper arm to wiper shaft	30 Nm (22 ft-lb)
Wiper shaft nut at cowl	10 Nm (88 in-lb)

Rear window wiper motor, removing and installing (Sport Wagon)

- Remove rear deck interior trim panel.



Detach electrical harness connector(s) and remove screws mounting motor assembly to rear deck lid. Remove motor assembly.

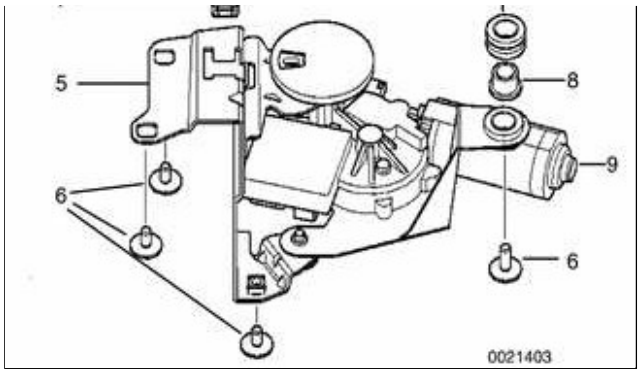
1 - Plastic trim

2 - Rear wiper pivot assembly

3 - Nut M6 -tighten to 9.5 Nm (7 ft-lb)

4 - Mechanical coupling

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5 - Wiper motor assembly

6 - Torx bolt M6 -tighten to 9.5 Nm (7 ft-lb)

7 - Damper ring

8 - Mounting sleeve

9 - Rear wiper motor assembly

- To install:

- Remove rear window lock assembly from rear deck.
- Install wiper motor assembly and thread mounting bolts finger tight.
- Place BMW special tool 61 1 330 on rear window wiper drive and close rear window.
- With rear wiper vertical, allow rear wiper shaft mechanical coupling to snap into special tool bore.
- Tighten down wiper motor assembly.
- Remove special tool.
- Remainder of assembly is reverse of removal.

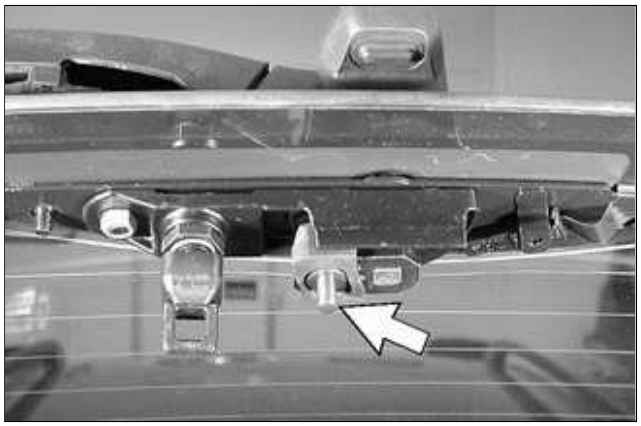
Tightening torque	
Wiper motor to rear deck (Torx)	9.5 Nm (7 ft-lb)

Rear window wiper shaft, removing and installing (Sport

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Wagon)

- Remove rear wiper arm.
- Lift rear window and remove wiper shaft housing plastic trim covers.
- Remove housing mounting nuts. Remove housing.
- Slacken rear window lift nut.



- Remove wiper shaft assembly mounting nut (**arrow**). Pull shaft and bearing out of housing.
- Installation is reverse of removal. Adjust wiper arm position as described earlier.

Tightening torques	
Rear window button to rear window	9.5 Nm (7 ft-lb)
Wiper arm to wiper shaft	9.5 Nm (7 ft-lb)
Wiper shaft housing to rear window	9.5 Nm (7 ft-lb)

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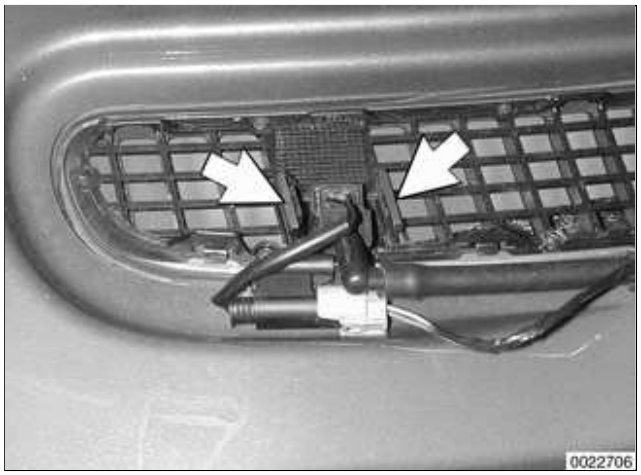
Washer Systems

The windshield washer system includes the heated spray nozzles in the engine hood, the washer fluid pump, and the washer fluid reservoir in the front passenger side of the engine compartment.

The headlight washer system (optional) consists of the front washer fluid tank (shared with the windshield washer system), a separate washer pump and spray nozzles in the front bumper.

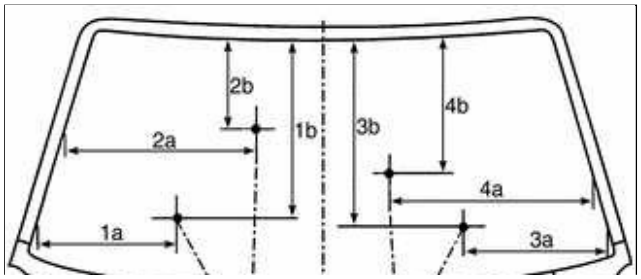
The rear window washer system (Sport Wagon only) consists of a washer tank and pump in the right side cargo compartment behind a trim panel and a spray nozzle at the top of the rear window frame.

Windshield spray nozzle, removing and installing



- Working under open engine hood, gently squeeze retaining clips (**arrows**) on nozzle sides to free nozzle from plastic intake grille.

  - Carefully disconnect hose from nozzle. Disconnect harness connector for nozzle heater.

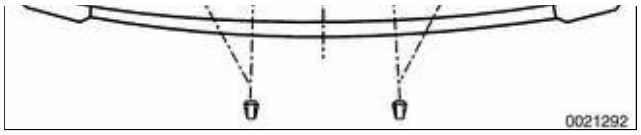


- Installation is reverse of removal:

  - Check and adjust nozzles before driving. Use diagram.

1a - 265 mm (10.4 in)

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1b - 445 mm (17.5 in.)

2a - 400 mm (15.7 in.)

2b - 270 mm (10.6 in.)

3a - 260 mm (10.2 in.)

3b - 550 mm (21.7 in.)

4a - 500 mm (19.6 in.)

4b - 350 mm (13.8 in.)

Note:

The windshield spray nozzles can be aimed by using a sewing needle or a similar diameter stiff piece of wire.

Headlight washer spray nozzle, removing and installing

Note:

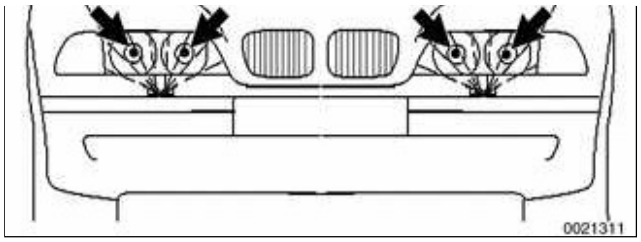
Headlight nozzles are marked L or R on the underside. Do not mix them up.

- Prior to removal, cover spray nozzle with shop rag. Wash water drains out.
- Gently pry out spray nozzle and pull out to stop. Tug on nozzle to detach from washer fluid duct.
- Transfer trim to new nozzle before installing.
- Snap new nozzle on fluid duct by pushing into opening. Check to make sure nozzle is fully snapped into place.



Using BMW special tool 00 9 100 or equivalent, adjust headlight washers

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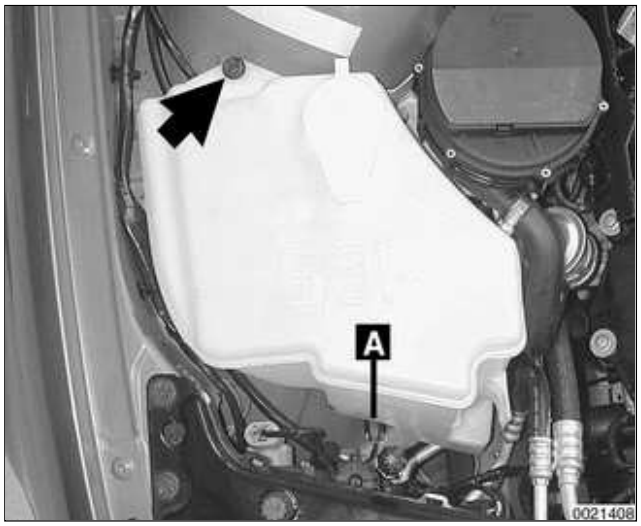
so that spray jets strike approximately in center of each beam (**arrows**).

Note:

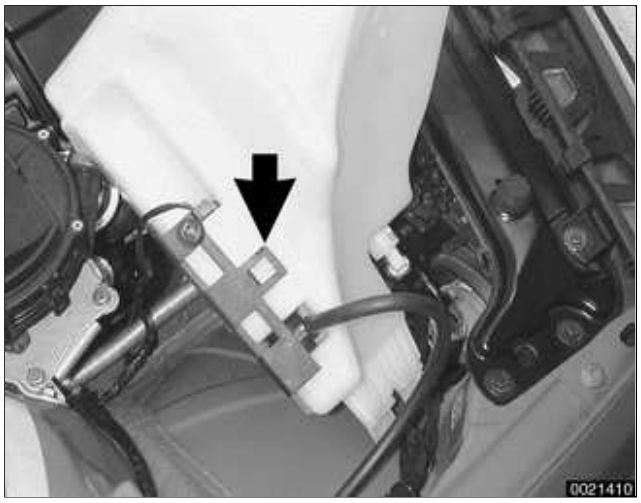
To turn on headlight washer jets, turn on ignition, lights and windshield washer system. To repeat spray procedure, turn off ignition, then back on again. Otherwise the headlight washers are disabled for 3 minutes.

Front washer fluid reservoir and washer fluid pumps, replacing

- Open hood and siphon washer fluid from reservoir.



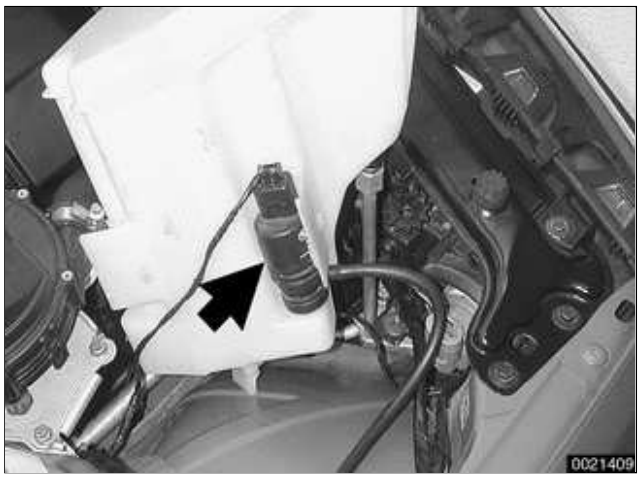
➢ Detach washer fluid level sensor harness connector (**A**) in front bottom of fluid reservoir. Remove reservoir retaining screw (**arrow**).



➢ Lift reservoir. Pry gently at retaining clip (**arrow**) on heat shield to disengage from reservoir.

- Cut off wire tie to release washer pump harness from heat shield. Lay heat shield aside.

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To remove windshield washer pump (**arrow**) and headlight washer pump if equipped:

- Disconnect electrical connection at pump.
- Twist pump clockwise.
- Pull pump out of reservoir.

- Installation is reverse of removal, noting the following:

- Twist washer fluid level sensor clockwise to remove from base of reservoir.
- Transfer reservoir cover and strainer to new container.
- Coat fluid pump sealing ring with anti-friction agent.
- On installation check that fluid hoses are not kinked.
- Make sure reservoir heat shield is correctly engaged. Replace wire tie.
- Refill reservoir.

Front washer fluid level sensor, replacing



Remove front washer fluid reservoir:

- Twist washer fluid level sensor

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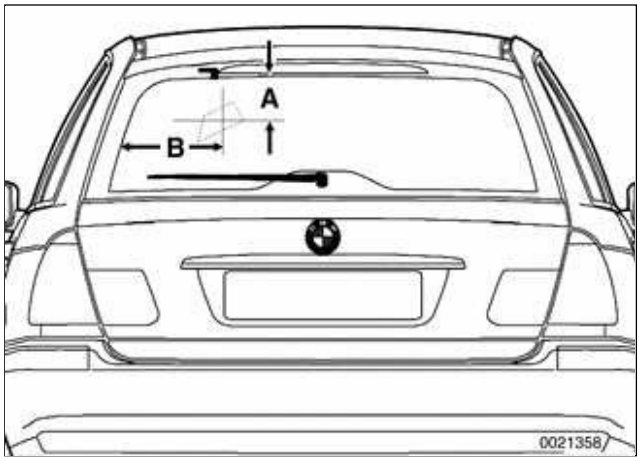
(**arrow**) clockwise to remove from base of reservoir.

- Installation is reverse of removal.

Rear window spray nozzle, removing and installing (Sport Wagon)

- Use plastic prying tool to lever nozzle out of rubber strip at top of rear window.

- Push new nozzle into rubber strip.



Adjust nozzle spray pattern using alignment specifications.

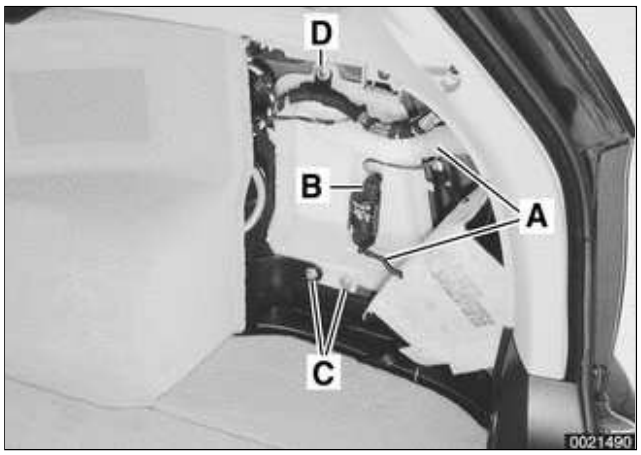
Rear window spray nozzle alignment specifications	
A	100 mm (3.9 in.)
B	320 mm (12.6 in.)

Rear window washer fluid reservoir, replacing (Sport Wagon)

- Working in right rear cargo area, remove side trim panel, then remove sound insulation.

- Siphon out washer fluid reservoir.

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➢ To remove tank:

- Detach filling and pressure hoses (**A**).
- Remove washer pump electrical harness connector (**B**).
- Loosen mounting nuts at bottom of tank (**C**) slightly.
- Remove top mounting nut (**D**) and remove reservoir.

- To remove fluid pump:

- Detach electrical harness connector (**B**).
- Pry pump gently outward and up to remove from tank.

- When installing:

- Coat pump sealing ring with anti-friction agent.
- Make sure hoses are not kinked.
- Refill reservoir.

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612-1

General

This section covers replacement of electrical switches at the steering wheel, steering column, dashboard, pedal cluster, center console and other locations.

See also the following sections:

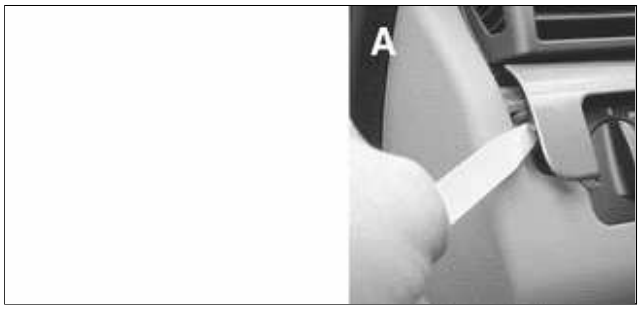
- ⇒ 119 Lubrication System for information on testing the oil pressure switch
- ⇒ 250 Gearshift Linkage for information about the gearshift lever
- ⇒ 515 Central Locking and Anti-theft for information about the electronic immobilization system (EWS 3.3)
- ⇒ 520 Seats for information about power seat controls
- ⇒ 540 Sunroof
- ⇒ 541 Convertible Top
- ⇒ 610 Electrical Component Locations
- ⇒ 630 Lights
- Electrical Wiring Diagrams.

Special tools

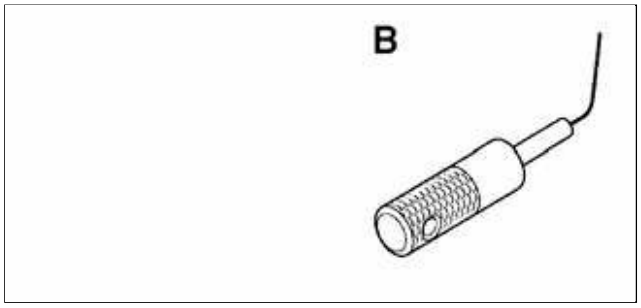
A few special tools are necessary for

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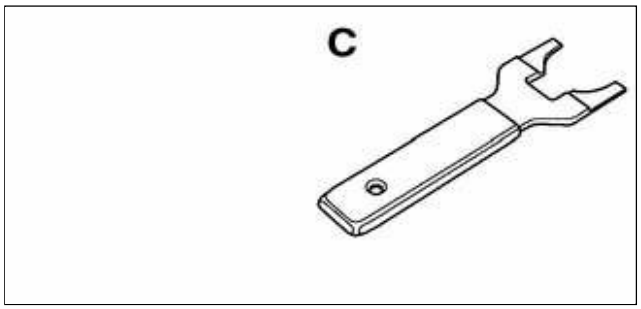
the repairs detailed in this section.



- Plastic prying tool BMW 00 9 321



- Ignition cylinder removal tool BMW 32 3 110



- Ring antenna removal tool BMW 61 3 300

CAUTION!

- ***When working on electrical switches or lights, always disconnect the negative (-) cable from the battery and insulate the cable end to prevent accidental reconnection.***
- ***Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.***
- ***To prevent marring the trim when working on interior components, work with plastic prying tools or wrap the tips of screwdrivers and pliers with tape before prying out switches or electrical accessories.***

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612-2

Steering Wheel Switches

E46 vehicles are equipped with either the multi-function (MFL) steering wheel or the sports steering wheel. Incorporated into each steering wheel are an SRS airbag, horn contacts, selected cellular phone and radio controls and cruise control buttons.

To replace the steering wheel switches, remove the airbag first. See ⇒ 721 Airbag System (SRS).

WARNING!

Improper handling of the airbag could cause serious injury. Store the airbag with the horn pad facing up. If stored facing down, accidental deployment could propel it violently into the air, causing injury.

CAUTION!

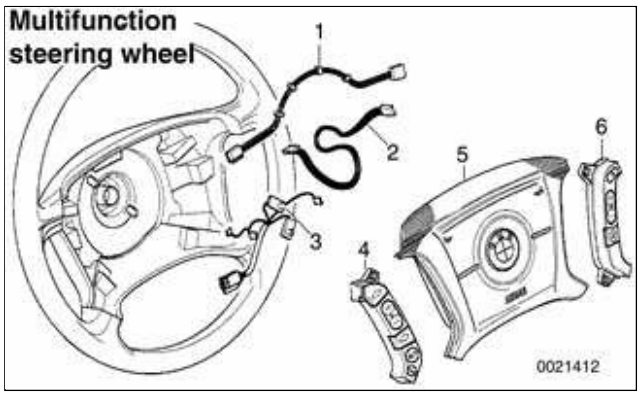
Special test equipment is required to retrieve SRS fault codes, diagnose system faults, and reset/turn off the SRS indicator light. The SRS indicator light will remain on until any problem has been corrected and the fault memory has been cleared.

Multi-function (MFL) steering wheel switches, accessing



- Remove airbag.

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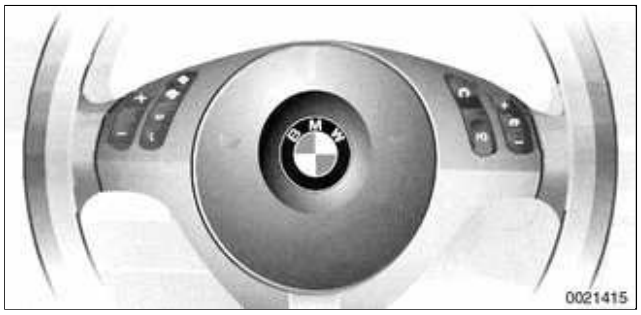


- Detach electrical harness connectors
  - 1 - Cruise control/radio/telephone electrical harness
  - 2 - Horn button electrical harness
  - 3 - Airbag electrical harness
  - 4 - Radio/telephone control switch set
  - 5 - Airbag
  - 6 - Cruise control switch set
- Remove small screws on back side of airbag pad to release left or right switch set.

Note:

BMW does not provide the horn contact switch as a separate part.

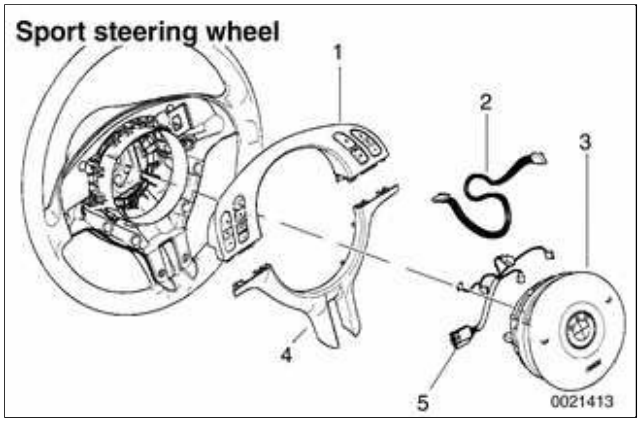
Sport steering wheel switches, accessing



- Remove airbag.

Note:

There is a special procedure for detaching the airbag from the sport steering wheel. See ⇒ 721 Airbag System (SRS).



- Remove screws mounting switch carrier to steering wheel.
  - 1 - Switch carrier
  - 2 - Steering wheel switch set electrical harness
  - 3 - Airbag
  - 4 - Lower cover

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5 - Horn button and airbag electrical harness

- Pull switch carrier and trim down to detach from steering wheel. Remove electrical harness connector.

- Separate bottom trim piece from switch carrier.

Note:

BMW does not provide the horn contact switch as a separate part.

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612-3

Steering Column Switches

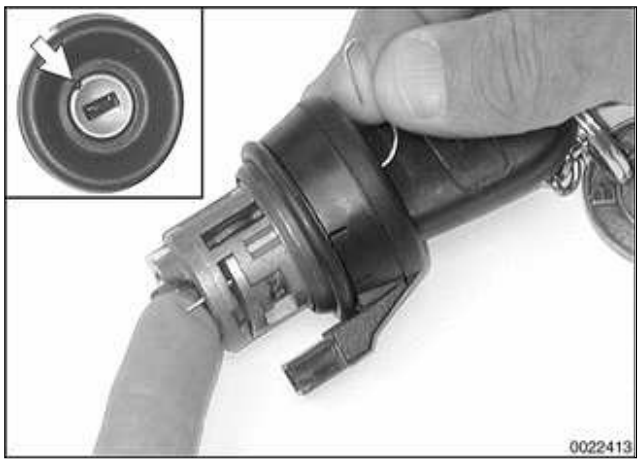
To remove any of the steering column switches, it is necessary to first remove the upper and lower column trim pieces. See ⇒ 513 Interior Trim.

CAUTION!

To prevent marring interior trim, work with plastic prying tools or wrap the tips of screwdrivers and pliers with tape before prying out switches or electrical accessories.

Ignition lock cylinder, removing and installing

To remove the EWS ring antenna prior to removing ignition lock cylinder, it is necessary to remove the upper and lower steering column trim. Use BMW special tool 61 3 300 to force off the ring antenna. Alternatively, remove the ignition switch key cylinder first.



With ignition key in ON position (60° from LOCKED):

- Insert a thin piece of stiff wire into opening (**arrow**) in lock cylinder and pull lock cylinder out.
- Detach ring antenna harness connector.
- Gently work ring antenna off key cylinder.
- Reinstallation is reverse of removal.

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Steering column stalk switch assembly, removing and installing

To replace either the directional/headlight dimmer stalk switch or the wiper/washer stalk switch, you must first remove the entire stalk switch assembly from the steering column.

CAUTION!

To prevent marring interior trim, work with plastic prying tools or wrap the tips of screwdrivers and pliers with tape before prying out switches or electrical accessories.

- Disconnect negative (-) cable from battery and cover terminal with insulating material.

CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

- Remove airbag unit from steering wheel. See ⇒ 721 Airbag System (SRS). Store airbag unit in a safe place with pad facing up.

WARNING!

Any work involving the SRS system should only be performed by an authorized BMW dealer. Making repairs without the proper knowledge and special test equipment may cause serious personal injury. See ⇒ 721 Airbag System (SRS)

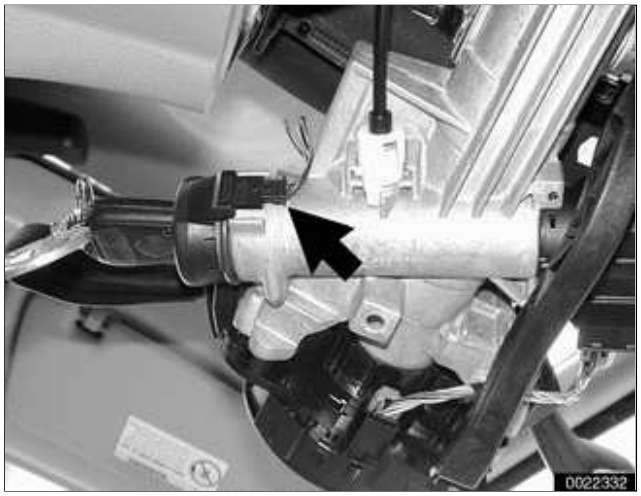
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- With front wheels pointed straight ahead, remove steering wheel. See ⇒ 320 Steering and Wheel Alignment.

Note:

To help with reassembly, mark steering wheel and spindle shaft before disassembly.

- Remove steering column trim. See ⇒ 513 Interior Trim.



➢ Detach EWS ring antenna electrical harness connector (**arrow**).



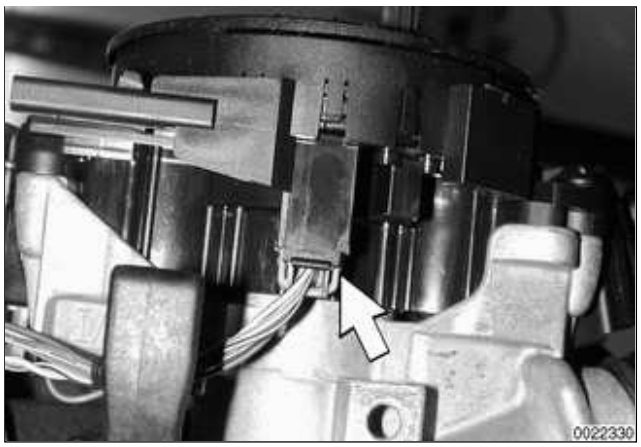
➢ Detach wiper/washer switch electrical harness connector (**arrow**).



➢ Detach turn signal/headlight dimmer switch electrical harness connector (**arrow**).

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- Detach airbag electrical harness connector (**arrow**).



- Remove stalk switch housing retaining screws (**arrows**). Slide switch housing off steering column.

- Installation is reverse of removal, noting the following:

- Place turn signal indicator in center position before installing.

- Ensure that self cancelling cams on turn signal switch are not damaged during installation.

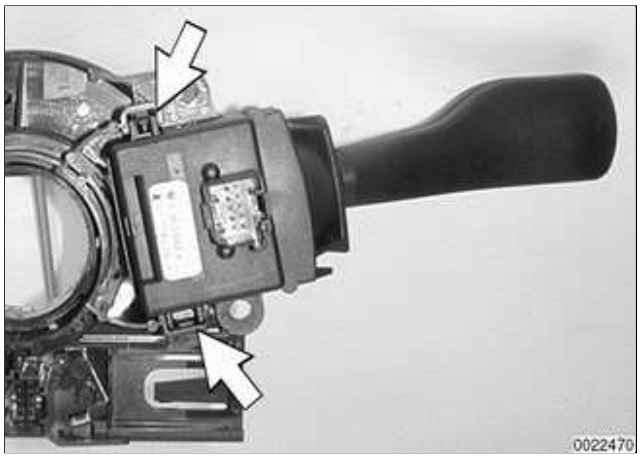
Tightening torque	
Steering wheel to steering column spindle shaft	63 Nm (46 ft-lb)

Turn signal/headlight dimmer switch/ wiper switch removing and installing

- After removing steering column stalk switch assembly, as

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described above, turn switch assembly face-down on work bench.



- Squeeze locking tabs (**arrows**) on sides of switch and slide switch out of assembly holder.

  - Push in new switch until it positively snaps into switch housing.

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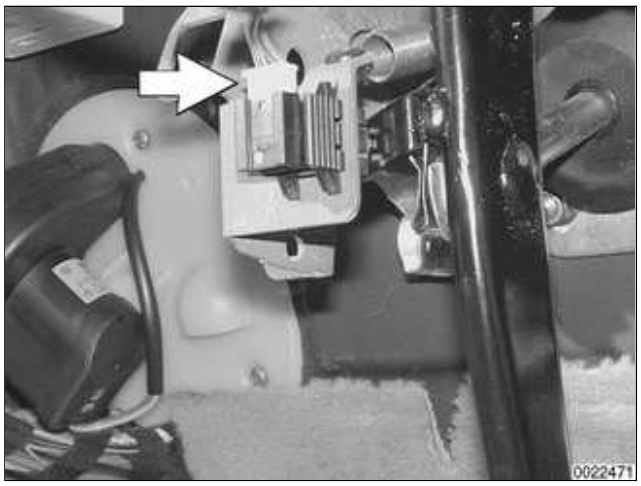
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612-4

Pedal Cluster Switches

To access either the brake pedal or the clutch pedal switch, remove the left footwell trim (above pedals). See ⇒ 513 Interior Trim.

Brake light switch, replacing



Working at pedal cluster:

- Detach electrical harness connector (**arrow**) from brake light switch.
- Slide switch out of holder (toward rear of car).

Note:

The brake light switch is held in place via a serrated mounting. Remove switch mounting from pedal cluster bracket.

- Push brake pedal down, install new switch, then allow brake pedal to spring back slowly, automatically adjusting switch position.

Cruise control clutch switch, replacing

- Working at pedal cluster:
- Push clutch pedal to floor and lock in position using a pedal stop.
- Detach electrical harness

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connector from switch.

- Squeeze together retaining clips at front of switch. Slide switch out of holder (toward rear of car).

- Install new switch, then allow clutch pedal to spring back slowly, automatically adjusting switch position.

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Other Interior Switches

Many of the remaining electrical switches are housed at the bottom center of the dashboard, or in the center console.

The ASC or DCS switch is ahead of the shifter console at the bottom of the center dashboard. When equipped, seat heater switches are in the same location.

The right front and right rear window switches are ganged into one unit on the right side of the shifter. The left front and left rear window switches are ganged with the child safety rear window lockout switch (sedan and Sport Wagon models) on the left side of the shifter.

The central locking switch and hazard warning switch are ganged into one unit behind the shifter mechanism.

Replacement of the above switches is covered below, noting when each switch is accessible.

The left and right electric outside rear view mirrors are controlled by one switch on the driver door armrest.

Lower dashboard/console switches, replacing

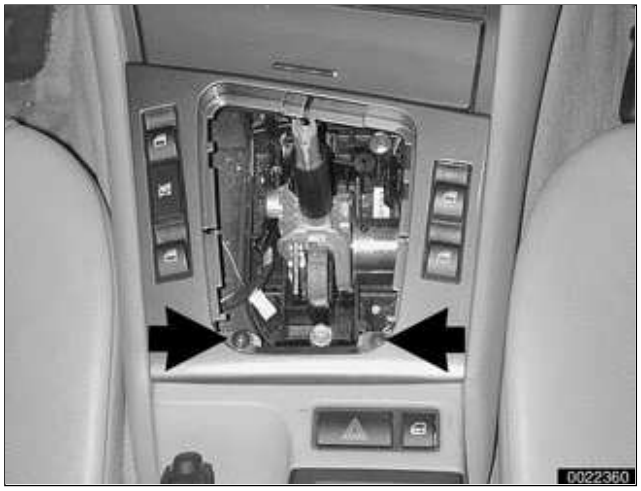
- Remove shift knob by pulling knob straight off the gearshift lever.

Note:

Removal of the shift knob will require about 90 lbs. of force. Do not twist knob or locating key can be damaged.

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- Pry up on rear of shift boot/bezel to unclip, then remove boot from front retainers.



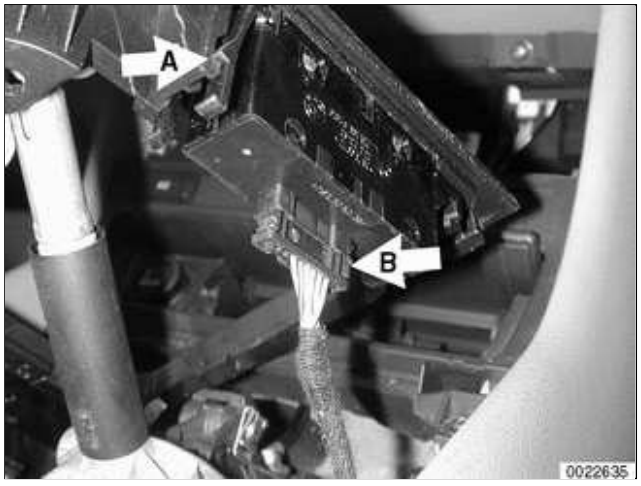
➢ Remove retaining screws (**arrows**) under transmission selector boot/trim.

Power window switches, replacing

- To remove left or right ganged window switches:

♦ Shifter bezel: Lift up by prying gently.

♦ Shifter boot: Unclip bottom of boot from center console trim by pushing forward. Pull boot up around shifter, but do not remove.



➢ Unclip switch retainer (**A**) and pull out switches from under console trim.

♦ Detach electrical harness connector (**B**) from switches.

- Installation is reverse of removal.

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ASC/DSC/seat heater switches, replacing

Either the ASC or DSC switch is located in the storage compartment/ash tray housing. Seat heater switches are also located here, if equipped.

This procedure can be skipped in order to access center console switches.



- Remove storage compartment below IHKA control panel:
  - Open compartment door.
  - Push upward in center of compartment, then pull out.
  - Remove retaining screws from storage compartment/ash tray housing.
  - Slide housing out and disconnect electrical harness connectors. Remove housing from lower dashboard
  - With housing removed slide switches out of housing by gently pushing from behind.
  - Installation is reverse of removal.

Central locking/hazard warning switches, replacing



- Working at rear of center console, press rolling cover of rear ashtray down. Depress cover fully to pop ashtray out of console. Remove

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ashtray.

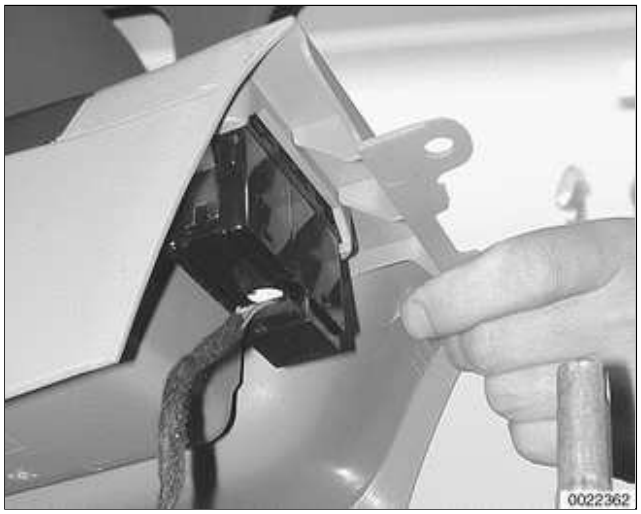
- Remove retaining screws and storage tray housing. Disconnect electrical harness connector for storage tray courtesy light.

- Remove screws at base of storage tray compartment in console.



- Unclip trim boot for parking brake lever and pull boot and handle forward off brake lever.

- Slide center console back from dash and lift up.



- Disconnect electrical harness protector from hazard light/central locking switch.

- To remove switch from console, depress retaining tabs on each side of switch and push switch out through surface of console trim.

- Installation is reverse of removal.

Outside mirror switch, replacing



- Carefully pry outside mirror switch from door arm rest.

- Disconnect harness connector

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from switch.

- Installation is reverse of removal.

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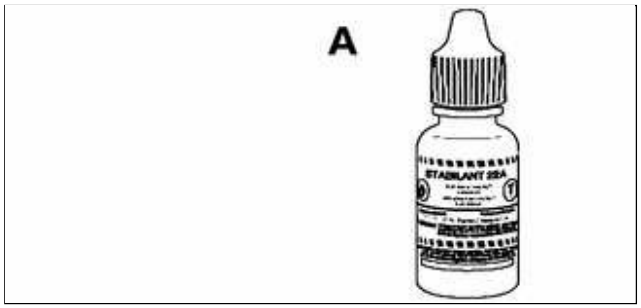
620-1

General

This repair group covers removal and installation of the instrument cluster. Instrument cluster self-test procedures are also included.

Special tools

Individual instrument cluster components are not available. Since instrument clusters are only available as complete units, BMW recommends no special tools.



- Würth Stabilant® 22A Electrical contact enhancer

Experience has found that the use of an electrical contact enhancer will help prevent oxidation and intermittent circuit malfunctions at electrical harness connectors.

CAUTION!

When servicing the instrument cluster, always disconnect the negative (-) cable from the battery and insulate the cable end to prevent accidental reconnection.

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620-2

Instrument Cluster

The dashboard mounted instrument cluster is the control and information center of the E46 cars. It is connected to most of the systems and sensors in the car through the use of "bus" networks:

- K-bus connects to Central Body Electronics (ZKE V) functions, heating/A/C (IHKA), rain sensor system, exterior and interior lights, Multiple Restraint System (MRS III), and Driveway Protection (EWS III).
- CAN-bus connects to engine management (DME), transmission control (AGS) and traction/stability control (ASC/DSC).
- D-bus connects to 20-pin Diagnostic Link Connector (DLC) and/or 16-pin OBD II diagnostic connector.

The instrument cluster stores and communicates Diagnostic Trouble Codes (DTCs) via the D-bus diagnostic link.

If the vehicle is equipped with On-Board Computer, pushing the button at the end of the directional stalk switch brings up on the cluster information of interest to the driver:

- Time
- Outside temperature
- Average fuel consumption

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- Cruising range
- Average vehicle speed

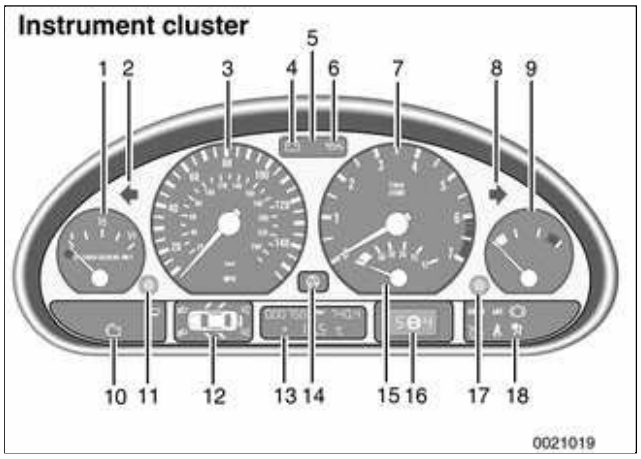
These functions are more fully explained in the Owner's Manual.

The cluster also stores important vehicle memory functions such as total mileage and service interval data. Instrument cluster replacement must be followed by special procedures, using BMW scan tools DIS or MoDiC or equivalent, to synchronize vehicle memory and mileage with the new cluster unit.

Note:

Specific vehicle information is stored redundantly in the instrument cluster and the light control module. This information includes: Vehicle identification number (VIN), Total vehicle mileage, and Service interval data.

Instrument cluster layout



The instrument cluster uses stepper motor driven analog gauges for display of engine and road speed, engine temperature, fuel level and economy.

1 - Fuel Gauge

2 - Left directional

3 - Tachometer

4 - Alternator warning light

5 - High beam warning

6 - Oil warning light

7 - Speedometer

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8 - Right directional

9 - Temperature gauge

10 - Warning lights (Check Engine, etc.)

11 - Left reset button (odometer/service interval)

12 - Check Control LCD

13 - Odometer/On-Board Computer LCD

14 - ASC/DSC warning light

15 - Fuel economy gauge

16 - Transmission range/ program LCD (includes transmission fault indicator)

17 - Right reset button (clock)

18 - Warning lights (brakes, etc.)

In addition, three LCD blocks display:

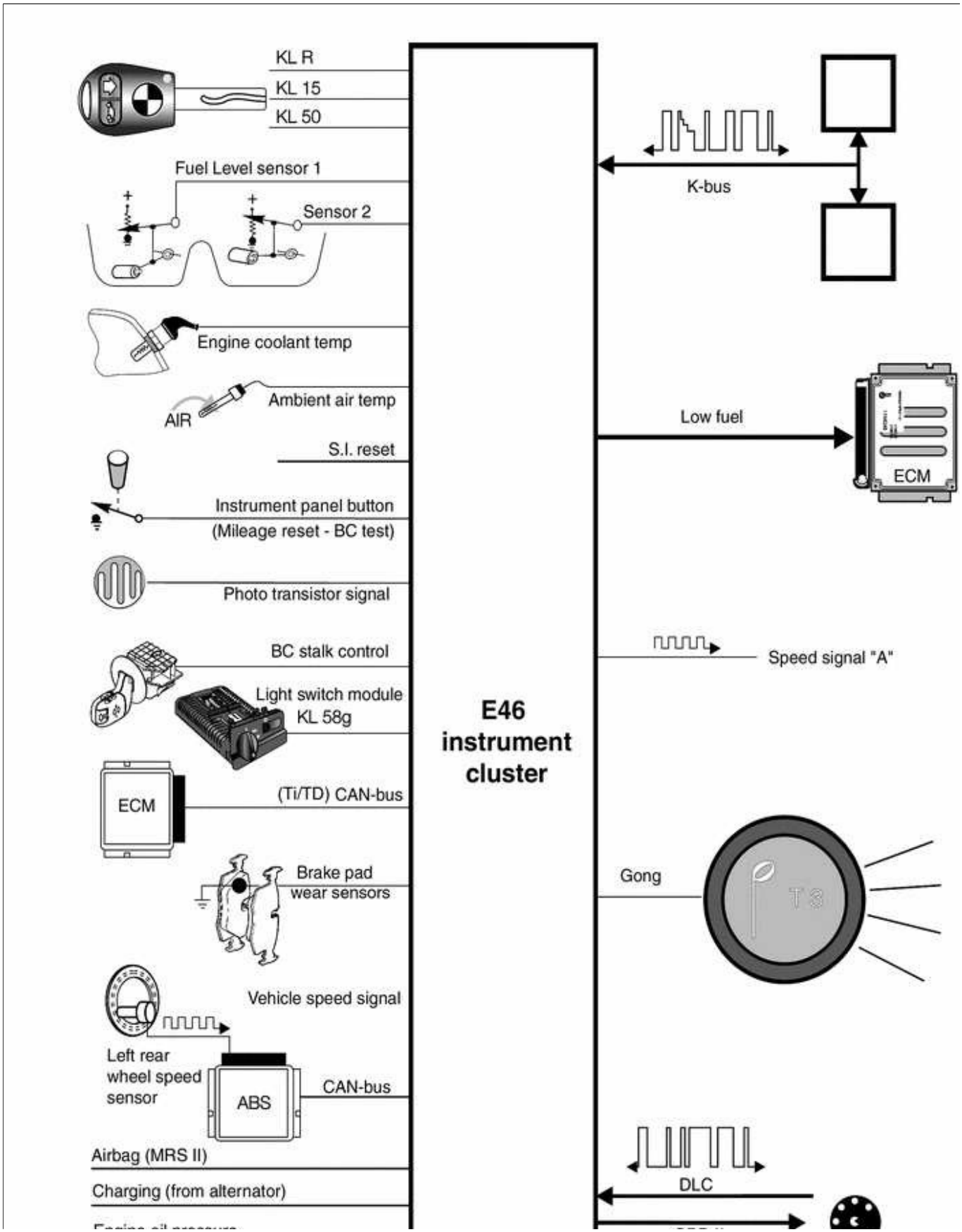
- Check Control pictographs
- Service interval and mileage (On-Board Computer)
- Automatic transmission range/program and failure display

Warning indicators and lamps are arranged to the right and left of the LCD blocks. The ASC/DSC light, charge indicator, high beam and oil pressure lamps are located between the speedometer and tachometer.

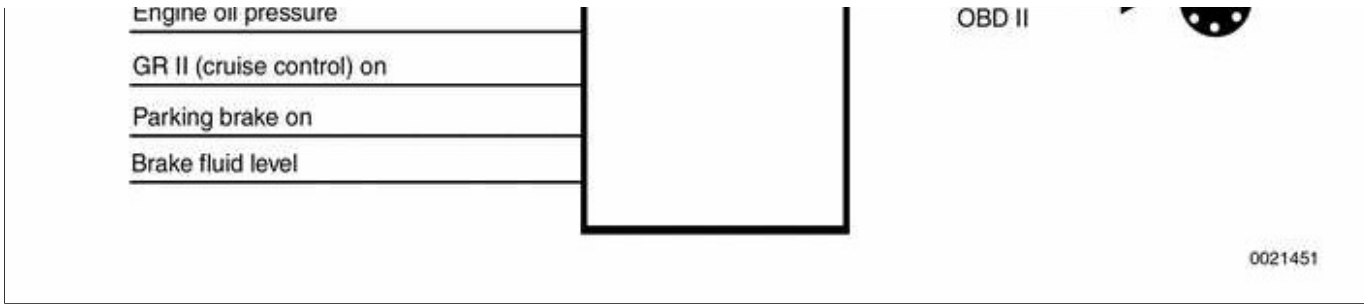
The instrument cluster is a sealed unit and contains no serviceable components.

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E46 instrument cluster



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Instrument cluster, self-testing



In addition to the storing diagnostic trouble codes (DTCs) and communicating through the diagnostic link, the instrument cluster is programmed with a series of test menus that can be accessed to check various functions and values. The odometer/On-Board Computer LCD block is used to display the test menus and results. There are a total of 21 test menus.

⇒ Table a. Instrument cluster test functions lists instrument cluster test menus and submenus.

To scroll through numbered test menus:

- Make sure ignition switch is OFF.
- Press and hold left cluster button.
- Turn ignition switch to "radio". Test 1 main menu will be displayed.
- Do nothing and display will automatically scroll through Test 1 submenus.
- Tap or press instrument cluster left button. This signals cluster to

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display submenus or continue on to next main test menu.

Note:

- *Tests 1 and 2 are always unlocked.*
- *Tests 3 - 21 are only accessible after unlocking the test function.*
- *Test 19 is the unlock function for accessing the displays.*
- *If adjustment is necessary, enter into Test 20 using the cluster button. The correction factor number is changed by using the sub-menus for the 1s, 10s and 100s of the factor number. The digits will automatically scroll through 0 - 9 within each group (1s, 10s, 100s).*

Table a. Instrument cluster test functions

Menu	Submenu	Sample output	Meaning
Test 1: Vehicle specific data (see Note below)	1.0	12345	Vehicle identification number (VIN)
	1.1	4812	Body number
	6_1.2	834762	Part number of cluster
	1.3	010203	Coding/diagnosis/bus index
	1.4	3499	Manufacturing date (calendar week/year)
	1.5	04_600	Hardware/software version of cluster (hardware = 04, software = 6.00)
	3_1.6	415_06	Injection status, number of cylinders, engine factor
	1.7		

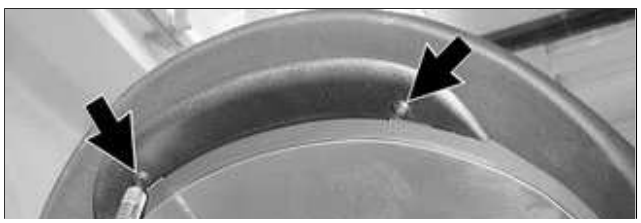
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Menu	Submenu	Sample output	Meaning
Test 2: Cluster system test - activates gauge drivers, indicators and LEDs to confirm function (see Note)			
Test 3: SI data	3.0	1500	Liters
	3.1	0	Periodic inspection days (not applicable for US)
Test 4: Fuel consumption data (current)	4.0	0267	26.7 liters/1000km
	4.1	0073	7.3 liters/hour
Test 5: Fuel consumed/distance traveled	5.0	0195	9.5 liters/100 km
	5.1	226	Distance left to go (226 km)
Test 6: Fuel level sensor input in liters	6.0	237415	Fuel level averaged ♦ Left side fuel sensor input = 23.7 liters ♦ Right side fuel sensor input = 41.5 liters
	6.1	0652	Total tank level averaged = 65.2 liters
	1_6.2	0667	Indicated value and tank phase ♦ 1 = Both sensors OK ♦ 2 = One sensor faulty ♦ 3 = Implausible input
Test 7: Temperature and speed	7.0	032	Coolant temperature input = 32°C
	7.1	245	Outside temperature input = 24.5°C
	7.2	5283	Engine speed = 5,283 RPM
	7.3	058	Vehicle speed = 58 km/h
Test 8: Input values in HEX code	8.0 - 8.3	XXX	HEX code, instrument cluster inputs

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Menu	Submenu	Sample output	Meaning
Test 9: Battery voltage	9.0	125	12.5 volts
Test 10: Country coding	10.0	02	US (= 02)
Test 11: Cluster code	11.0	000003	Cluster code
Test 12: Not used			
Test 13: Gong test	13.0	"Gong"	Activate gong by pressing button (gong response is delayed).
Test 14 Fault memory (not for diagnosis)			
Tests 15 - 18: Not used			
Test 19: Lock/unlock (see Note)		L-ON	Display changes from L-ON to L-OFF every second. To unlock test functions, press cluster button immediately when it changes to L-OFF. Tests are automatically locked when exiting test functions.
	19.0	L-OFF	
Test 20: Average fuel consumption correction factor (see Note)	20.0	XXX9	Press button when correct 1s position is attained.
	20.1	XX5X	Press button when correct 10s position is attained.
	20.2	12XX	Press button when correct 100s position is attained.
Test 21: Software reset	21.0	reset	Reset software

Instrument cluster, removing and installing



- Remove instrument cluster retaining screws (**arrows**).

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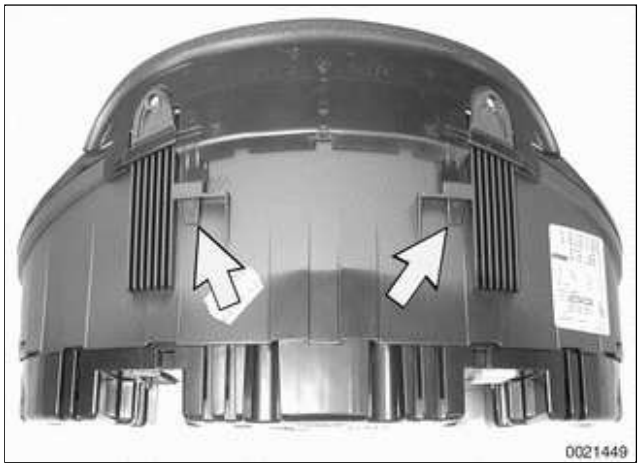




- Place a towel over steering column. Carefully tilt top of cluster out of dash panel. Unlock and disconnect harness connectors (**arrow**s) from back of cluster.

Note:

Steering wheel does not need to be removed to remove instrument cluster.



- If it is necessary to replace cluster, detach trim by unlocking plastic clips (**arrows**) and pushing through slots.

- Installation is reverse of removal, noting the following:

- Instrument cluster harness connector locking levers must be in up position before installing connector.

- Recode new or replacement cluster using BMW scan tools DISplus, MoDiC or equivalent.

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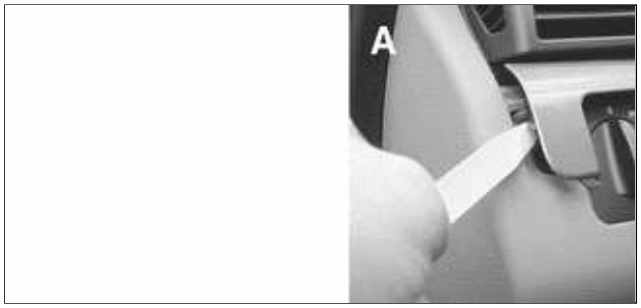
630-1

General

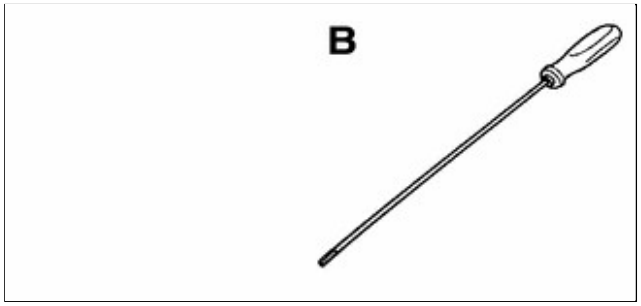
This repair group covers interior and exterior lighting, including repairs to the light switch assembly.

Special tools

Some special tools may be necessary to install or adjust lights and light fixtures.



- Plastic trim prying tool BMW 00 9 321



- Foglight/headlight adjusting tool 4 mm/6 mm Allen

Bulb applications

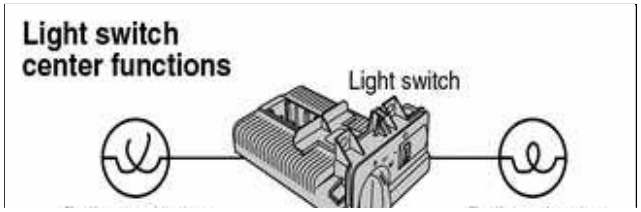
For convenience, the bulb applications for E46 cars are listed in ⇒ Table a.

Table a. E46 bulb applications	
Location	**Type & rating**
Headlights	
High beam	H7 12V 55W
Low beam (Halogen)	H7 12 V 55 W

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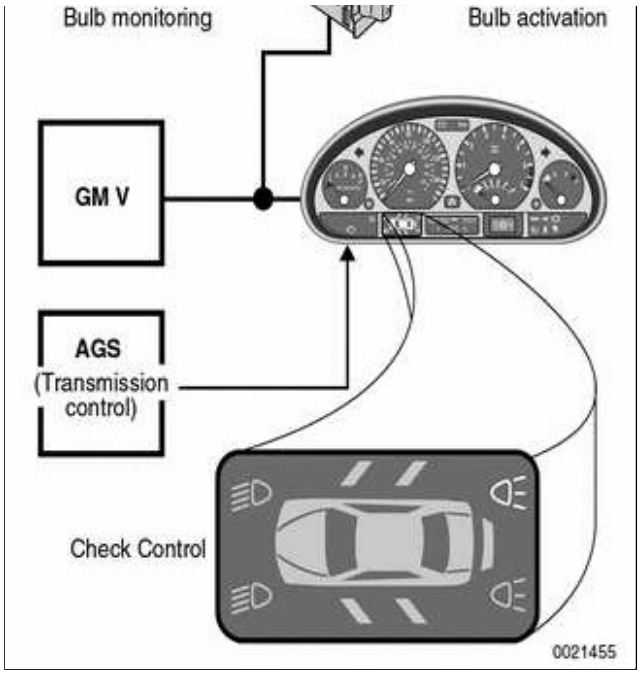
Table a. E46 bulb applications	
Location	**Type & rating**
Low bean (Xenon)	D2-S
Foglights	
Front	HB4
Rear (Euro only)	12V 21W
Turn signal and taillight	
Back-up	12V 21W
Brake	12V 21W
Brake/taillight	12V 21/4W
Licence plate	12V 5W
Side turn signal	W5W
Third brake light	LED
Turn signal (front or rear)	12V 21W
Interior lights	
Footwell	Softlite 5W
Glove compartment	Softlite 5 W
Passenger compartment, front or rear	Softlite 5W
Reading, front or rear	6W
Trunk or tailgate	Softlite 10W
Visor vanity	Softlite 10W

Light switch center (LSZ)



The light switch center (LSZ), mounted in the left side of the dashboard, consists of the following components:

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- Headlight/taillight/running light control switch
- Foglight switch
- Instrument dimmer control
- Light control module

In addition to normal light control, the LSZ provides the following functions:

- Hot and cold monitoring of the exterior bulbs
- Emergency lighting function
- Short circuit protection
- Redundant storage of mileage and service interval data
- Automatic headlight adjustment (LWR) programmed control (if equipped)

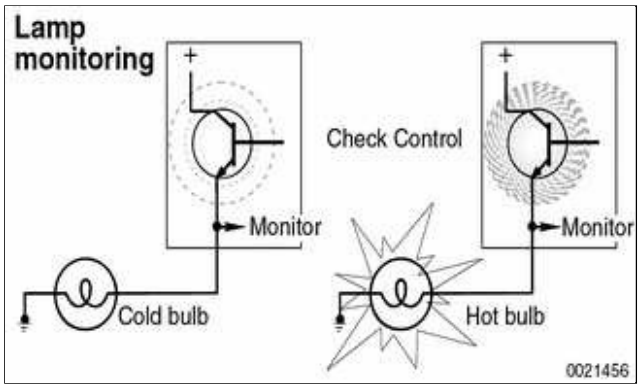
Bulb monitoring

The light control module monitors the following bulbs in both hot and cold states:

- High/low beams
- Brake lights
- Turn signal lights
- Taillights

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- Parking lights
- Side marker lights
- License plate lights

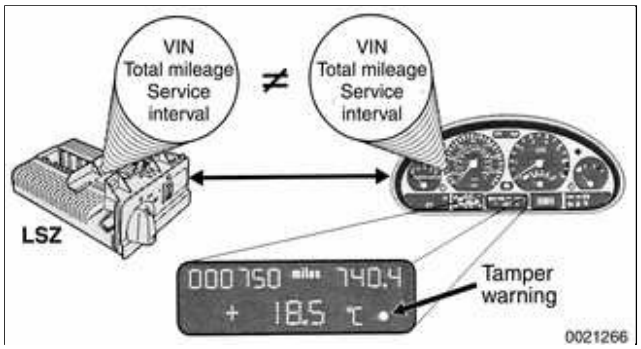


Hot and cold monitoring of light bulbs allows the LSZ to detect defective bulbs. Hot monitoring checks the continuity of circuits while the lights are switched on. Cold monitoring consists of a brief pulse of current which is too short for the lights to illuminate.t If the module detects a defective bulb, a signal is sent to the instrument cluster and Check Control is illuminated with the appropriate warning.

Home lighting

This convenience feature provides lighting for the driver and passengers to leave the vehicle and enter their house. The feature is switched on by activating the headlight flasher switch after the lights and ignition are switched OFF. The feature is switched off after the coded time delay or by switching the ignition ON.

Redundant data storage



The light control module serves as the redundant storage module in parallel with the instrument cluster. This includes all data used for vehicle identification, encoded on the assembly line. In addition the total mileage and service interval data are also stored in the light control module. If either the instrument cluster or light control module has to be replaced, the data is taken from the remaining

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module and transferred to the replacement unit.

Emergency (fail safe) lighting

The light control module provides emergency lighting in the event of an electronic module failure. Back up hardware allows the following lighting circuits to function:

- Low beam headlights
- Taillights
- Brake lights

The headlights and taillights come on as soon as the ignition is switched ON. The brake light operates when the brake pedal is pressed.

WARNING!

When working on electrical systems, remove the fuse protecting the circuit under repair. See ⇒ 610 Electrical Component Locations.

CAUTION!

- ***The headlight and foglight assemblies use halogen bulbs. To ensure the longevity of halogen bulbs, the bulb glass should not be handled. Dirt and skin oils may cause a bulb to fail prematurely. If necessary wipe bulb using a clean cloth dampened with rubbing alcohol.***
- ***Use only original equipment replacement bulbs. Non-original equipment bulbs may cause false failure readings on the***

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Check Control display.

- ***To avoid marring car paint or trim, work with plastic prying tools or wrap the tips of tools with tape.***

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Light Switch

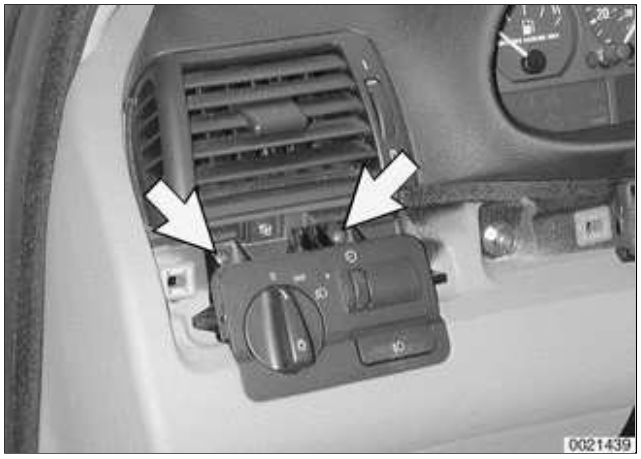
Light switch assembly, removing and installing



- Pry gently at left dashboard trim to remove.

CAUTION!

To avoid marring interior trim, work with a plastic prying tool.



- Remove light switch mounting screws (**arrows**).
  - Lift switch slightly and withdraw from dashboard.

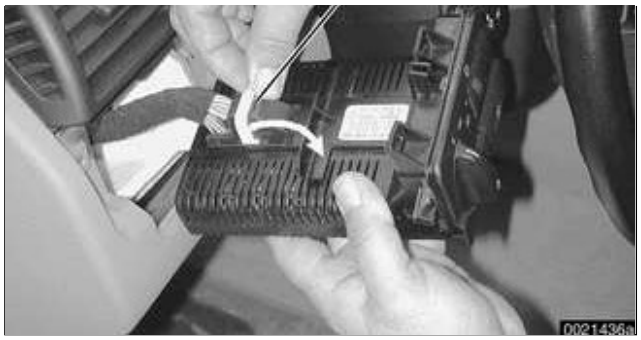
Note:

- *If the vehicle is equipped with a left side glove compartment, remove the compartment for improved access to the back of the headlight switch and its electrical harness.*
- *Remove the left side footwell trim (above the pedals) for better access to the headlight switch electrical harness. See ⇒ 513 Interior Trim.*



- To release harness connector latch:

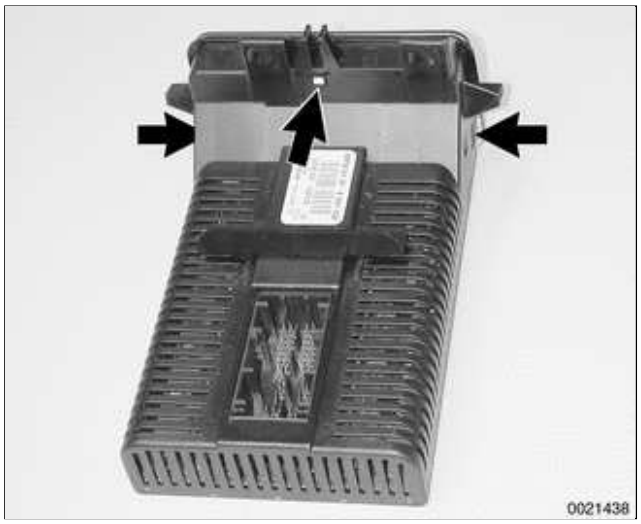
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- Swing latch backward (**arrow**).
- Pull electrical harness connector off switch assembly.
- Installation is reverse of removal.

Light control module, separating

- Remove light switch assembly as described earlier.



- Press in on tabs (**arrows**) in light switch assembly to separate light switch from light control module.



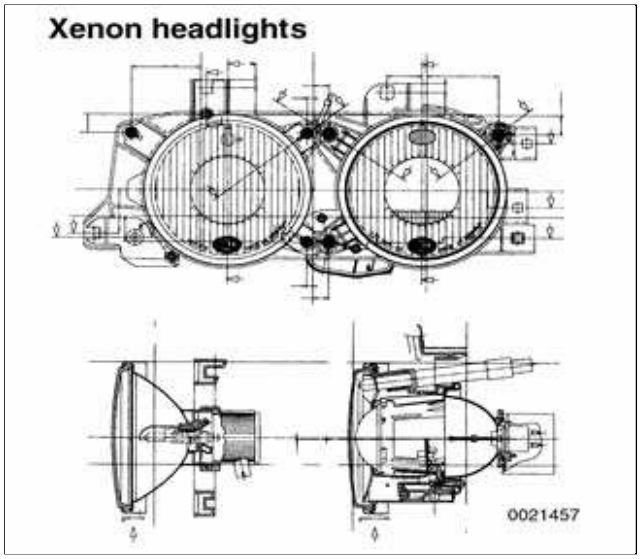
- Gently wiggle harness connector to remove from switch.

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Headlights

E46 cars are equipped with Halogen headlights as standard equipment. Halogen bulb replacement is performed from the back (engine) side of the headlight assembly. The front face of each headlight assembly is a removable plastic cover.



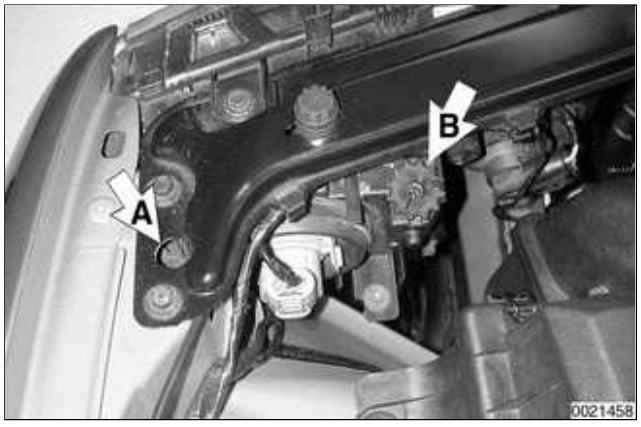
- Optional Xenon low-beam headlights illuminate the road ahead and to the sides in greater detail than conventional headlights. Sometimes referred to as High Intensity Discharge (HID) lights, Xenon lights use less energy and last longer than other headlight bulbs.

Cars equipped with Xenon headlights also feature automatic headlight adjustment control (LWR) for varying passenger and cargo loads.

Components of the headlight system can be purchased from BMW. Use illustrations on the following pages to identify components.

Headlight aim, adjusting

Adjust headlight aim with correct tire pressures, fuel tank full, and weight of one person (approx. 75 Kg/200 lb) in driver seat.



- Use 6 mm Allen wrench, phillips head screwdriver, or hand to adjust headlight by turning adjusting knobs.

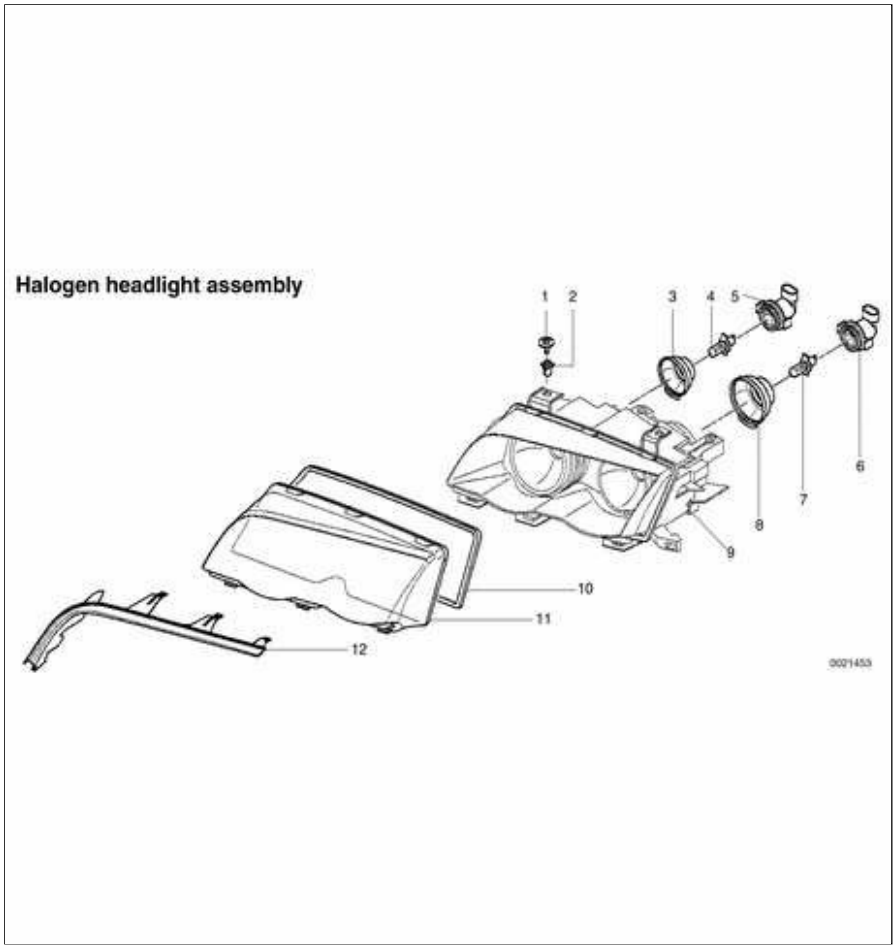
  - **A** is primarily for lateral adjustment.

  - **B** is primarily for vertical adjustment.

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Note:

When adjusting headlights with automatic adjuster system (LWR), wait at least 30 seconds for the LWR to cycle and adjust to its calculated position.



Halogen headlight assembly

1 - Mounting screw

2 - Expanding nut

3 - High beam cover

4 - High beam bulb

5 - High beam bulb socket

6 - Low beam bulb socket

7 - Low beam bulb

8 - Low beam cover

9 - Headlight housing

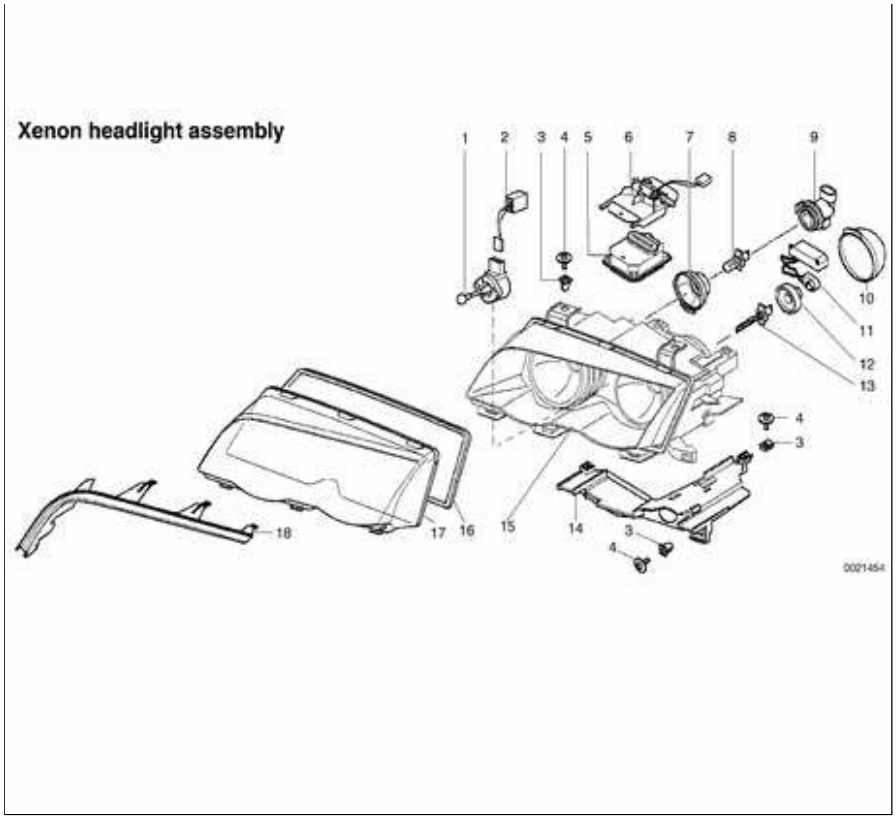
10 - Sealing gasket

11 - Cover

12 - Cover lock strip

Xenon headlight asembly

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1 - Automatic headlight adjustment (LWR) stepper motor

2 - Electrical harness connector

3 - Expanding nut

4 - Mounting screw

5 - Xenon bulb control module

6 - Control module bracket

7 - High beam cover

8 - High beam bulb

9 - High beam bulb socket

10 - Low beam cover

11 - Xenon bulb ignition element

12 - Supporting ring

13 - Xenon low beam bulb

14 - Headlight assembly carrier plate

15 - Headlight housing

16 - Sealing gasket

17 - Cover

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18 - Cover lock strip

Headlight bulb (Halogen), replacing



- Working in back of headlight assembly:
  - Rotate headlight bulb retaining ring (**arrows**) counterclockwise.
  - Pull bulb socket and bulb out of headlight assembly.
  - Disconnect harness connector from socket.
  - Gently wiggle bulb and pull straight out of socket.
  - Replace bulb by pushing firmly into socket. Headlight bulb applications are listed below.
  - Installation is reverse of removal.

Note:

To remove left side high beam bulb, remove air filter housing cover. See ⇒ 020 Maintenance.

CAUTION!

Do not touch halogen bulbs with your bare hands. If necessary wipe bulb using a clean cloth dampened with rubbing alcohol.

Headlight bulb (Xenon),

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replacing

- Working in back of headlight assembly:

- Remove low beam (Xenon) cover.
- Twist Xenon ignition element counterclockwise and remove.
- Rotate headlight bulb retaining ring counterclockwise. Pull bulb out of headlight assembly.
- Installation is reverse of removal. Headlight bulb applications are listed below.

CAUTION!

Do not touch bulbs with your bare hands. If necessary wipe bulb using a clean cloth dampened with rubbing alcohol.

Headlight bulb application	
Low beam (Halogen)	H7 12V 55W
Low bean (Xenon)	D2-S
High beam	H7 12V 55W

Headlight assembly, removing and installing

CAUTION!

Following headlight assembly work, headlight beam aim must be adjusted using special equipment.

- Disconnect harness connectors

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from headlight assembly.

- If necessary, remove headlight washer spray nozzles. See ⇒ 611 Wipers and Washers.

- Remove front turn signal assembly as described later in this repair group.



➢ Use plastic prying tool to detach and remove trim piece below headlight assembly.



➢ Remove headlight mounting screws (**arrows**). Lift headlight assembly forward and out of car.



➢ During reassembly:

- Install top mounting screws hand tight.

- Pull headlight assembly toward front of car.

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- Close engine hood and check to make sure that gap between hood and headlight assembly (**A**) is correct. See specification below.
- Open hood and tighten down mounting screws.
- Remainder of assembly is reverse of removal.

Headlight to hood gap	
Dimension **A**	5.0 ± 1.0 mm (0.2 0.± 04 in.)

- Adjust headlight aim as described earlier.

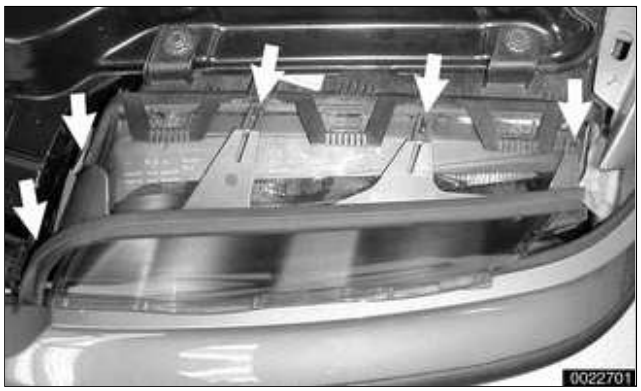
Headlight lens, removing and installing

- If necessary, remove headlight washer spray nozzles. See ⇒ 611 Wipers and Washers.
- Remove front turn signal assembly as described later in this repair group.

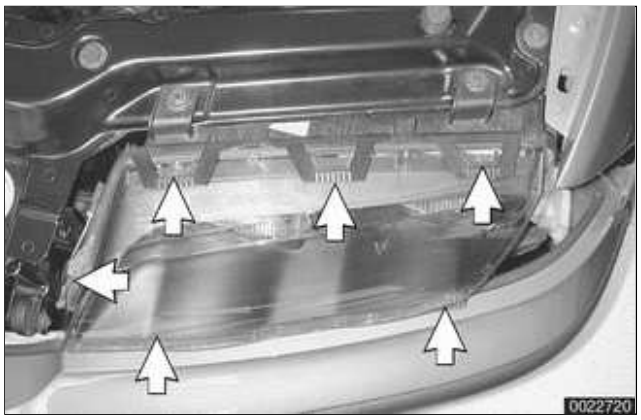


➢ Use plastic prying tool to detach and remove trim piece below headlight assembly.

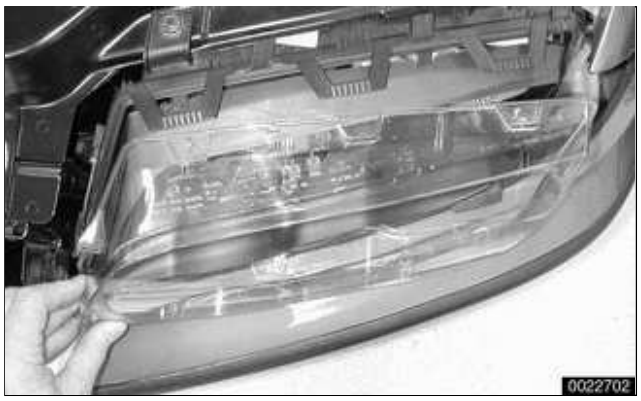
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- Unclip sealing gasket (**arrows**) and remove.



- Release clips (**arrows**) retaining front lens.



- Pull lens forward to remove.

  - Installation is reverse of removal. Replace gasket between lens and body of light if necessary.

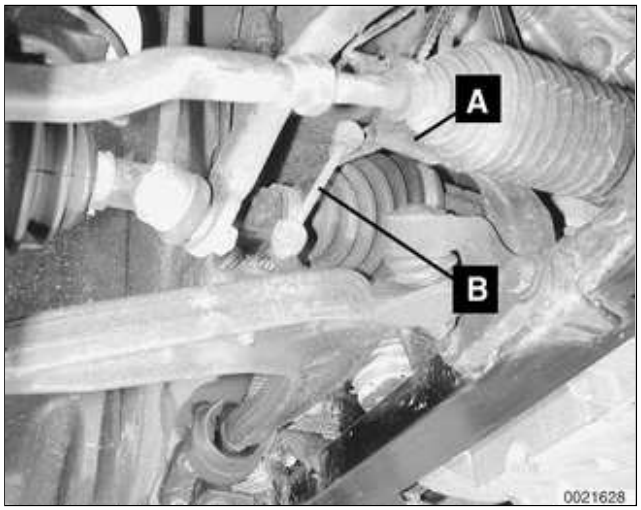
Automatic headlight adjustment (LWR)

Vehicles equipped with the optional Xenon low-beam headlight bulbs also feature automatic headlight adjustment (LWR). This system automatically adjusts the vertical positioning of the headlights to maintain optimum headlight beam angle for maximum driving visibility and to prevent undue glare for oncoming motorists. The system compensates for vehicle load

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angle changes.

LWR monitors vehicle load via two hall effect sensors mounted to the front and rear suspension members. When an adjustment to the angle of the headlight beams is necessary, LWR simultaneously activates two stepper motors (one in each headlight assembly). The stepper motors drive a threaded rod that moves the lower edge of the headlight carrier plates. The pivoting movement adjusts the vertical position of the headlight beams.

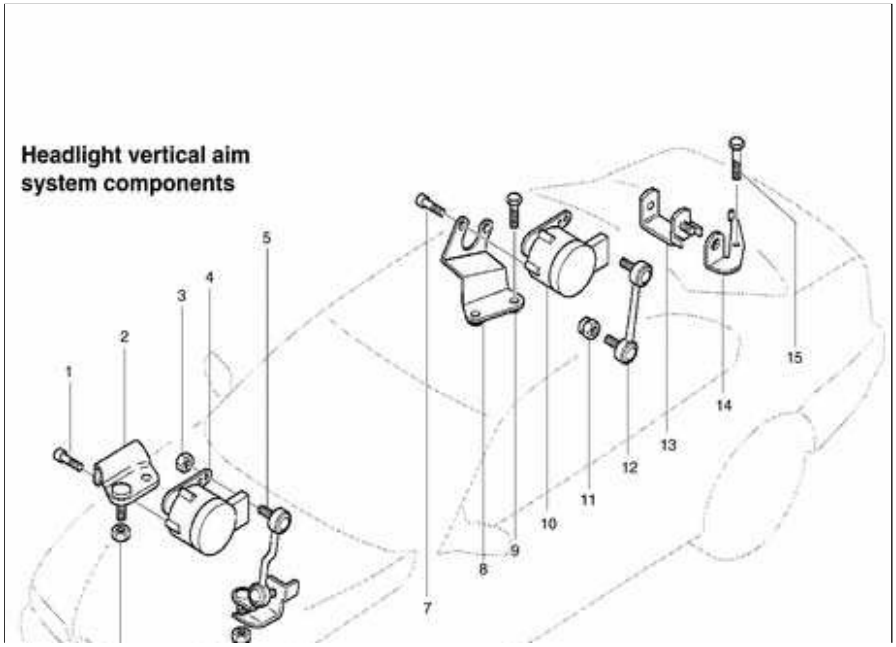


- At each axle of the vehicle, the LWR sensor (**A**) is mounted to a fixed point on the suspension subframe. A lever (**B**) is connected to the moving suspension member. The sensor output voltage changes as the suspension moves up and down.

All LWR diagnosis is accessed through the light control module.

Note:

LWR is not available with standard halogen headlights.



Headlight vertical aim system components

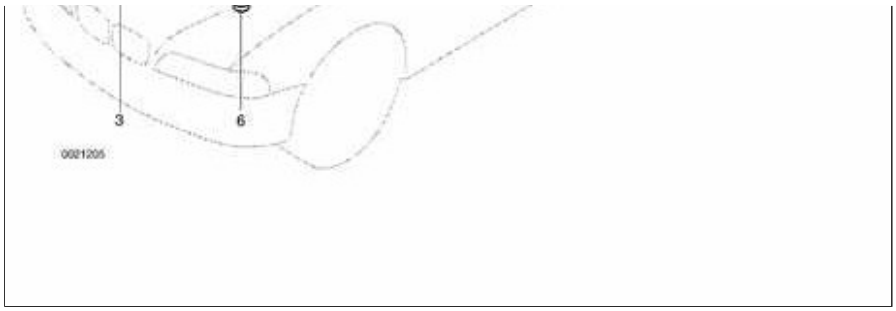
1 - Bolt M5

2 - Right front ride height sensor mounting bracket

3 - Self-locking nut M6

4 - Front ride height sensor

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5 - Front ride height sensor link

6 - Self-locking nut M8

7 - Bolt M5

8 - Right rear ride height sensor mounting bracket

9 - Bolt M6

10 - Rear ride height sensor

11 - Self-locking nut M6

12 - Rear ride height sensor link

13 - Extension

14 - Bracket

15 - Bolt M6

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Front Foglights

Foglight aim, adjusting



- Sedan or Sport Wagon: Use 4 mm Allen wrench to turn plastic adjuster (**arrow**) on outer edge of foglight.



- Coupe or Convertible: Use adjuster (**arrow**) on inside upper edge of foglight.



- 2001 models:
  - Using plastic pry tool, pry off foglight cover at slot (**arrow**).
  - Adjust using 6 mm Allen on outside upper corner of foglight.

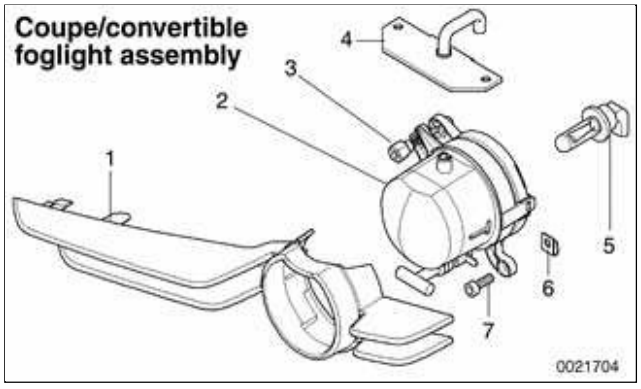
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Foglight assembly, removing and installing



- **Sedan or Sport Wagon**:
  - Use plastic prying tool to lever out foglight assembly.
  - Detach electrical harness connector.
  - **Coupe or Convertible**:
  - Gently remove lower bumper trim.
  - Working at foglight, detach grille and loosen mounting screws.
  - Remove foglight assembly with grille attached.
  - Detach electrical harness connector.



- Unclip grille from foglight.

1 - Grille

2 - Foglight

3 - Adjuster

4 - Support with grommet

5 - Foglight bulb

6 - Body nut

7 - Self-tapping screw

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- Installation is reverse of removal, noting the following:

- Sedan/Sport Wagon: Foglight must be snapped firmly into bumper retainers.

- Coupe/Convertible: Keep ventilation grommets unkinked and firmly seated.

- Adjust foglight aim as described earlier.

Foglight bulb, replacing

- Remove foglight assembly as described earlier.

- Twist and remove bulb from rear of foglight assembly.

CAUTION!

Do not touch halogen bulbs with your bare hands. If necessary wipe bulb using a clean cloth dampened with rubbing alcohol.

- Installation is reverse of removal. Check electrical connector for corrosion. Spray with contact cleaner, if necessary.

Foglight application	
Front foglight bulb	HB4

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Turn Signals, Taillights

Front turn signal assembly, removing and installing

The procedure below also includes turn signal bulb replacement.



- With engine hood open, use a screwdriver to press turn signal assembly retaining clip down to disengage from retaining tab on headlight assembly frame.



- Screwdriver must reach into fender hole a minimum of 3 in. to reach the retaining tab.

  - Push turn signal forward. Light slides straight out.

  - Detach electrical harness connector.

  - Twist and remove bulb from rear of turn signal assembly.

CAUTION!

Do not touch bulb with your bare hands. If necessary wipe bulb using a clean cloth dampened with rubbing alcohol.

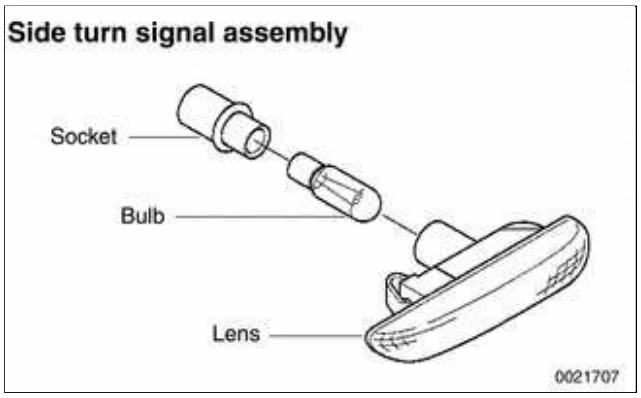
Note:

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Before reinstalling, make sure rubber seal on wrap-around trim (underneath headlights) is firmly glued to trim. Reglue if necessary.

Front turn signal	
Turn signal bulb	12V 21W

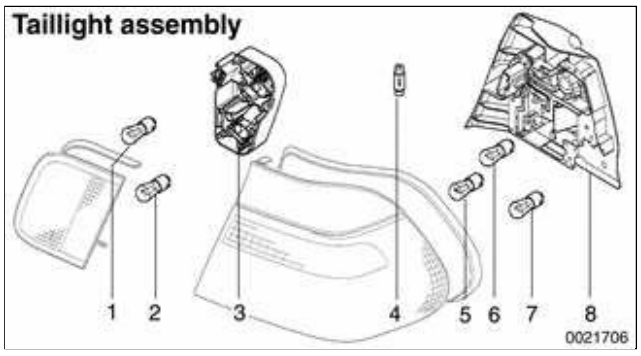
Side turn signal assembly



The yellow marker lights on the sides of the front fenders are turn signals. Use plastic prying tool to gently lever assembly out of fender.

Side turn signal	
Side light bulb	12V 5W

Taillight assembly, removing and installing



Taillight assembly

1 - Backup light bulb 12V 21W

2 - Rear foglight bulb (Euro only) 12V 21W

3 - Trunk lid/tailgate bulb carrier

4 - Trunk light bulb 12V 10W

5 - Taillight/brake light bulb 12V 21/4W

6 - Turn signal bulb 12V 21W

7 - Brake light bulb 12V 21W

8 - Corner bulb carrier

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In E46 cars, taillight functions are split. The corner bulb carrier on each side contains:

- Taillight bulb
- Turn signal bulb
- Brake light bulb
- Trunk light bulb

The bulb carrier on each side of the trunk or tailgate contains:

- Back-up light
- Rear foglight (European models only)

- To access taillight bulbs carriers, open trunk lid or tailgate.



To access corner bulbs:

- Sport Wagon: Remove cargo area side trim. See ⇒ 513 Interior Trim.
- Unlatch bulb carrier retainer (**arrow**), then pull carrier off taillight assembly.

- Detach electrical harness connector.

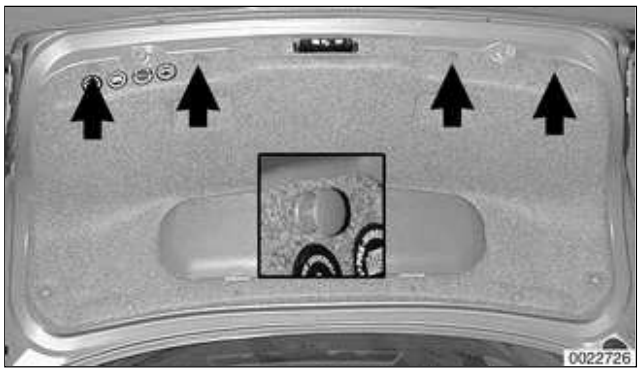
- Replace bulbs as necessary.

CAUTION!

Do not touch bulb with your bare hands. If necessary wipe bulb using

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a clean cloth dampened with rubbing alcohol.



- To access trunk lid taillight bulbs: Partially remove trunk lid trim panel by removing plastic expansion rivets (**arrows**). Expansion rivets are released by prying upper portion out (**inset**), then pulling off trunk lid.

  - To access tailgate taillight bulbs: Remove tailgate inside trim panel. See ⇒ 412 Trunk Lid, Tailgate.



- Unlatch bulb carrier retainer (**arrow**), then pull carrier off.

  - Detach electrical harness connector.

  - Replace bulb(s) as necessary.

CAUTION!

Do not touch bulb with your bare hands. If necessary wipe bulb using a clean cloth dampened with rubbing alcohol.

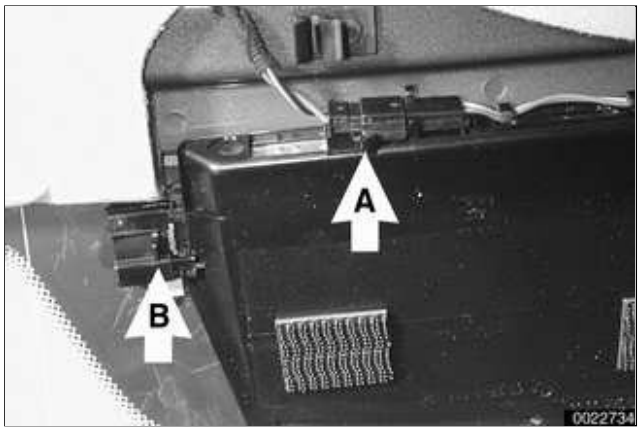
  - Installation of either bulb carrier is reverse of removal.

Taillight applications	
Backup light bulb	12V 21W
Brake light bulb	12V 21W
Brake light/taillight bulb	12V 21/4W
Rear foglight (European only)	12V 21W
Turn signal bulb	12 V 21W

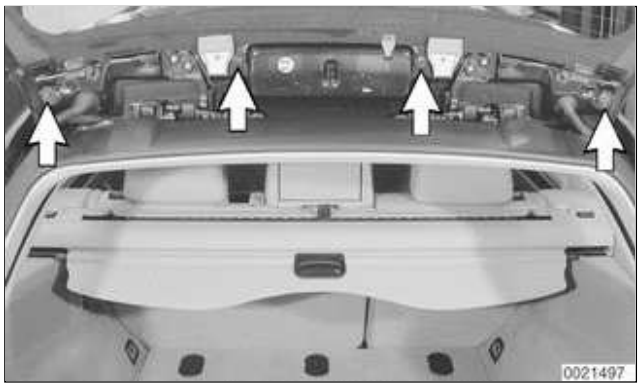
Center brake light

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The center brake light in all models is an LED unit. There are no replaceable bulbs.



- **Sedan or Coupe**: Working from rear seat in passenger compartment, gently pull off trim cover over third brake light (at top of rear glass).
  - Detach electrical harness connector (**A**).
  - Remove retaining clips (**B**) on either side and remove assembly.
  - **Convertible**: Remove inner trunk lid trim adjacent to license plate light assembly.
  - Detach electrical harness connector
  - Push center brake light out.



- **Sport Wagon**: Open rear window.
  - Carefully detach rear window hinge cover.
  - Remove rear spoiler mounting bolts (**arrows**).
  - Detach electrical harness connector and rear washer hose from spoiler.
  - Remove mounting screws and remove third brake light assembly from spoiler.
  - When installing, be sure electrical harness and rear window washer

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hose are not damaged or kinked.

Note:

Replace sealing plastic and grommets as necessary during reassembly.

Tlghtening torque	
Rear spoiler to rear glass	6 Nm (4 ft-lb)

License plate light, removing and installing



- Using a flat tipped screw driver, pry gently on right side of license plate light assembly (**arrow**). Lift off lens.

CAUTION!

To avoid marring trim, wrap the screwdriver tip with tape.

- Remove bulb.

Note:

Inspect bulb contact springs for damage and corrosion. Replace socket assembly if necessary.

License plate light application	
License plate bulb	12V 5W

- Installation is reverse of removal.

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Interior Lights

The ZKE V general module (GM V) controls the interior lighting automatically using input from several monitors. The lighting can also be manually controlled.

Each door lock actuator contains a hall effect sensor for the purpose of monitoring door open/closed status. The hall effect sensor is located directly behind the rotary latch plate encased in the lock actuator. The sensor is activated by the rotary latch plate position.

- Door closed: Rotary latch plate in latched position. Current flow through hall sensor <5 mA.

- Door open: Rotary latch plate in open position. Current flow through hall sensor >12 mA.

A change in current flow informs the GM V when a door is opened or closed.

The overhead front seat interior/map light unit contains a single main interior light. The light is controlled by the GM V automatically or by momentarily pressing the interior light switch located on the light assembly. The switch provides a momentary ground signal that the GM V recognizes as a request to either turn the light on (if off) or turn the light off (if on).

If the switch is held for more than 3 seconds, the GM V interprets the continuous ground signal as a request to turn the interior light circuit off (workshop mode). Workshop mode is stored in memory: Even if the GM V is removed from the power supply and reconnected, the lights do not come

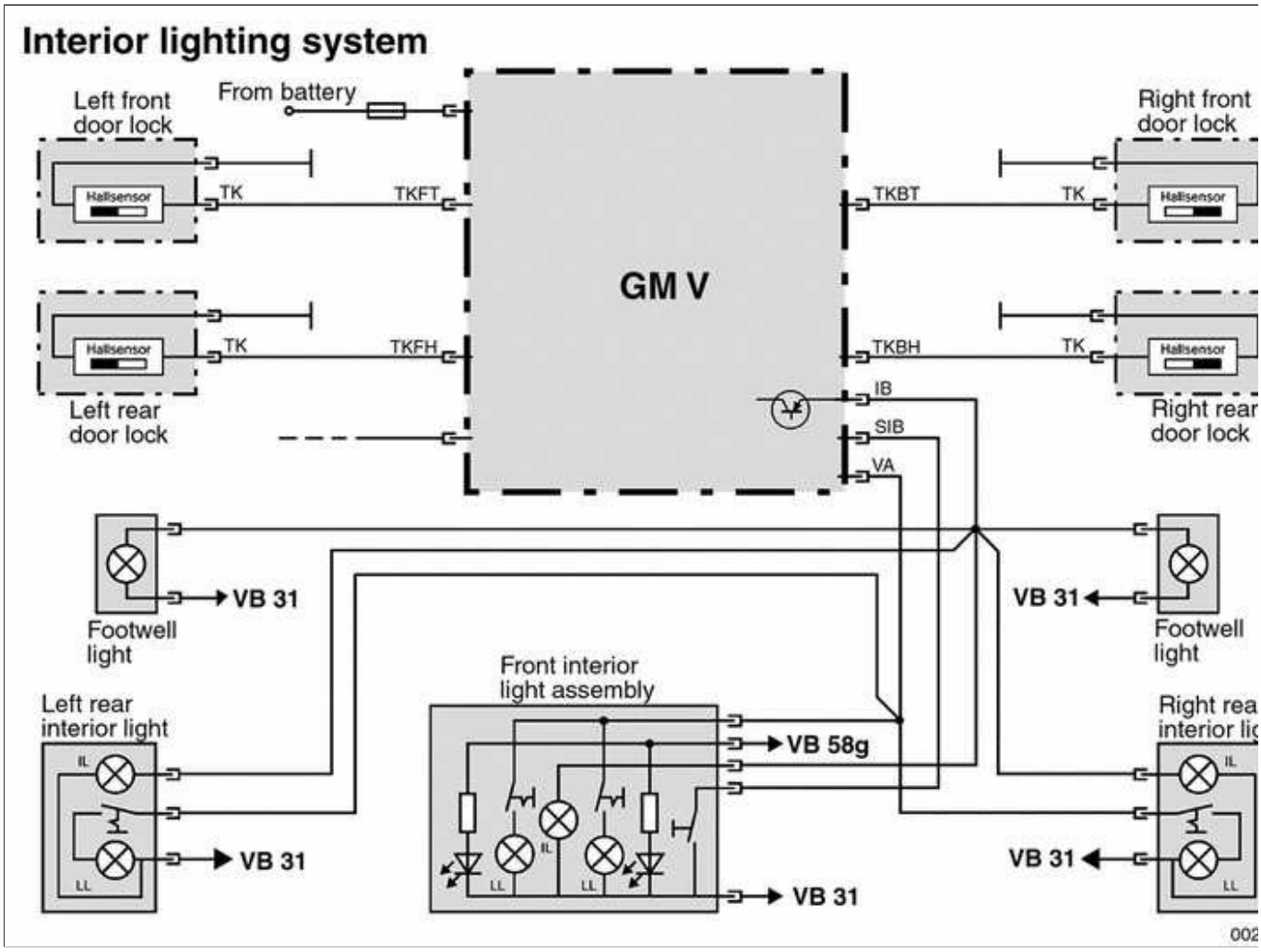
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back on unless the switch is pressed again.

There are two reading/map lights located in the front interior light assembly. Each is mechanically controlled by depressing the corresponding switch. The power supply for the map lights is supplied by the GM V.

There is a courtesy light in each front footwell. These lights are only operated when the GM V provides power to the interior lighting circuit.

Interior lighting system



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Interior light automatic controls

The GM V provides 12 volts to the interior lighting circuit when the status of one of the following input signals changes:

- Door contact hall sensor active (door open)
- "Unlock" request received from driver door key lock hall sensor (ignition switch OFF)
- "Unlock" request from FZV keyless entry system received via K bus (ignition switch OFF)
- Vehicle exterior lights on for minimum of 2 minutes when ignition switch is OFF
- Active crash signal from MRS II control module
- Lock button of FZV key pressed with vehicle already locked (interior search function)
- Immediately after ignition switch is turned to "radio" position with driver door closed.
- When vehicle is locked (single or double) with door contacts closed.
- When vehicle door contacts are closed. Lights remain on for 20 seconds, then go to soft off.
- After interior search function is

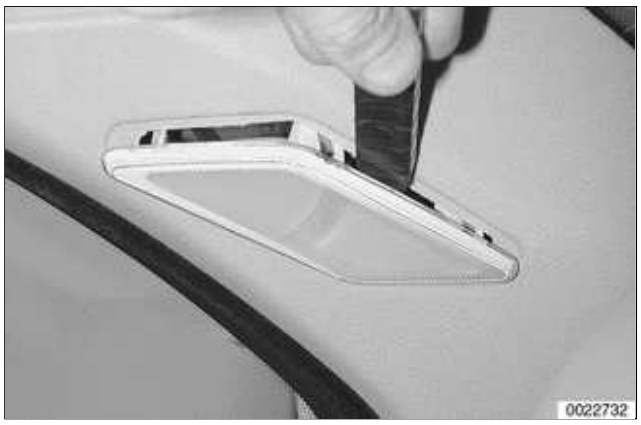
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activated, lights automatically turn off (soft off) after 8 seconds.

- After 16 minutes with door contact active (open door) and key off, lights are switched off (consumer cutoff function).

The component activation function of DIS also has the ability to switch the lights.

Interior light, footwell light, or cargo compartment light (Sport Wagon), replacing bulb



➢ Pry interior light fixture gently to remove.

- Detach electrical harness connector.

- Remove bulb and replace.

CAUTION!

When replacing bulbs, do not touch glass of bulb with fingers. Only touch bulb with clean cloth or bulb packaging.

- Installation is reverse of removal. Bulb types and specifications for various interior lamps are listed below.

Interior light applications	
Footwell light bulb	Softlite 5W
Glove compartment light bulb	Softlite 5W
Passenger compartment bulb,	Softlite 5W

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Interior light applications	
front or rear	
Reading bulb, front or rear	6W
Tailgate courtesy light bulb	Softlite 10W
Visor vanity light bulb	Softlite 10W

Trunk light bulb, replacing

The trunk lights are integrated with the taillight assembly.



Pry trunk light cover (**arrow**) gently to remove from taillight corner bulb carrier.

- Remove bulb and replace.
- Installation is reverse of removal.

Trunk light application	
Trunk light bulb	Softlite 10W

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General

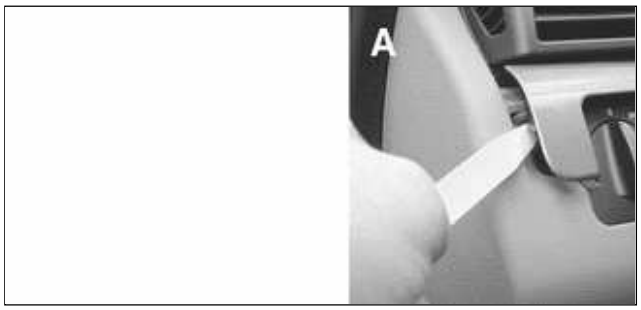
The repair information given under this heading applies to the heating and air conditioning system. Many of the procedures require that the A/C refrigerant charge be evacuated. See ⇒ A/C system warnings and cautions later in this repair group.

For information on the engine cooling system, see ⇒ 170 Radiator and Cooling System.

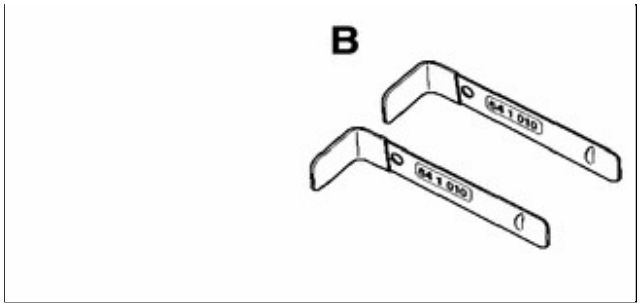
Special tools

Some special tools are necessary for heating and A/C repair procedures.

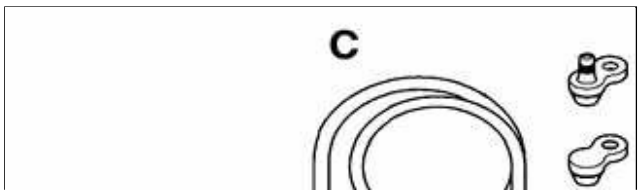
A variety of A/C system evacuation and recharge equipment is available. Follow the equipment manufacturer's recommendations and instructions.



- Plastic tool for prying off interior trim BMW 00 9 321



- IHKA control panel removal tools BMW 64 1 010

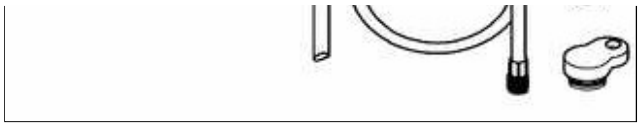


- A/C line plug kit BMW 64 5 100

Note:

A/C system recharging procedures are

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beyond the scope of this manual.

Integrated heating and cooling system (IHKA)

The E46 integrated automatic climate control system (IHKA) offers powerful cooling and heating, effective ventilation, and smooth operation in A/C mode.

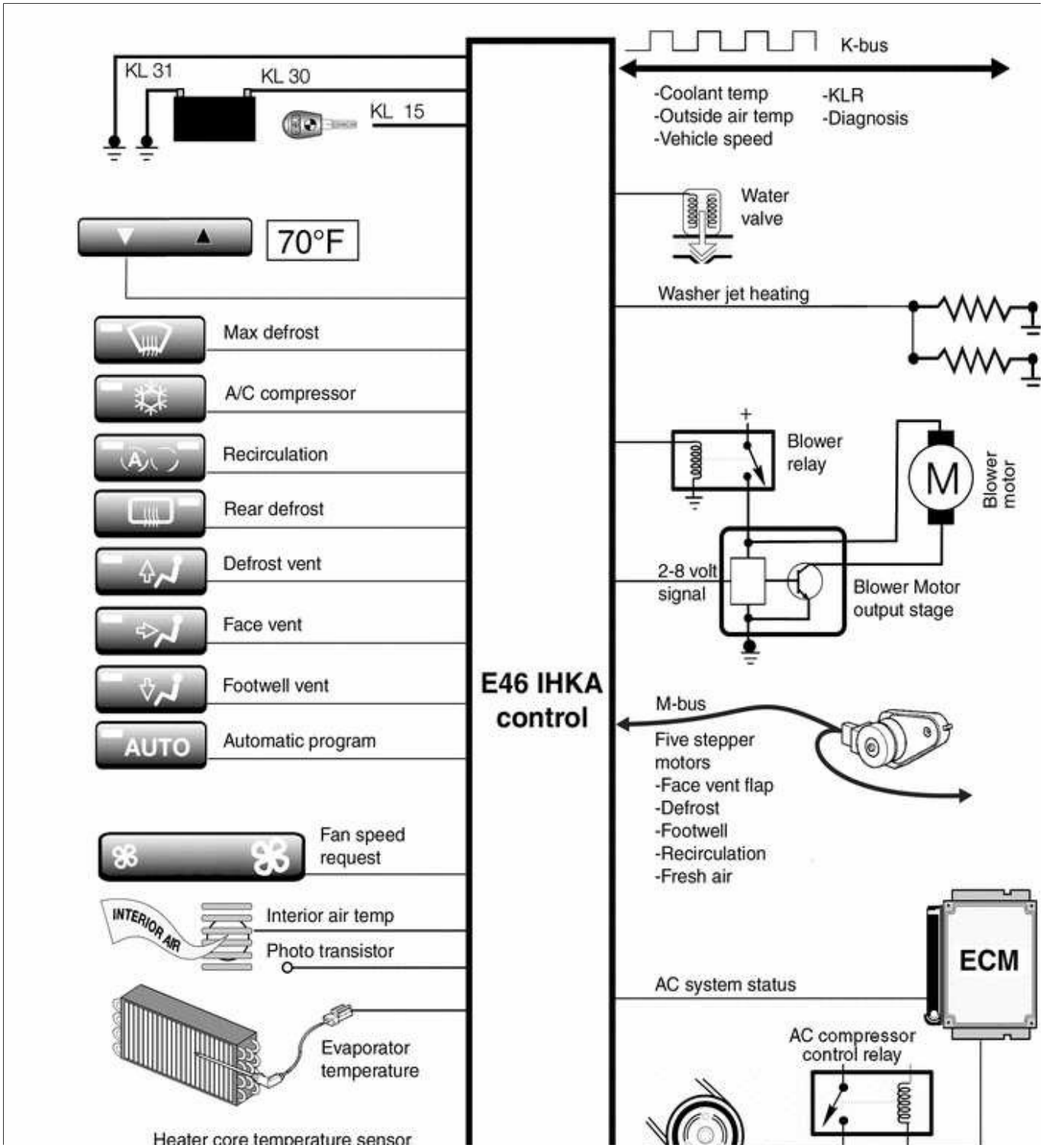
The E46 IHKA design includes the following:

- Use of R134a refrigerant only
- Single heater core for temperature regulation
- Maximum heating and cooling for defroster functions
- Rear window defogger operation integrated into the heating/cooling system
- Blower controlled through a final stage variable resistor
- Road speed dependent air distribution and fresh air volume
- Self-calibrating air distribution stepper motors controlled via M-bus
- Fresh air microfilter system
- Electronically regulated A/C compressor

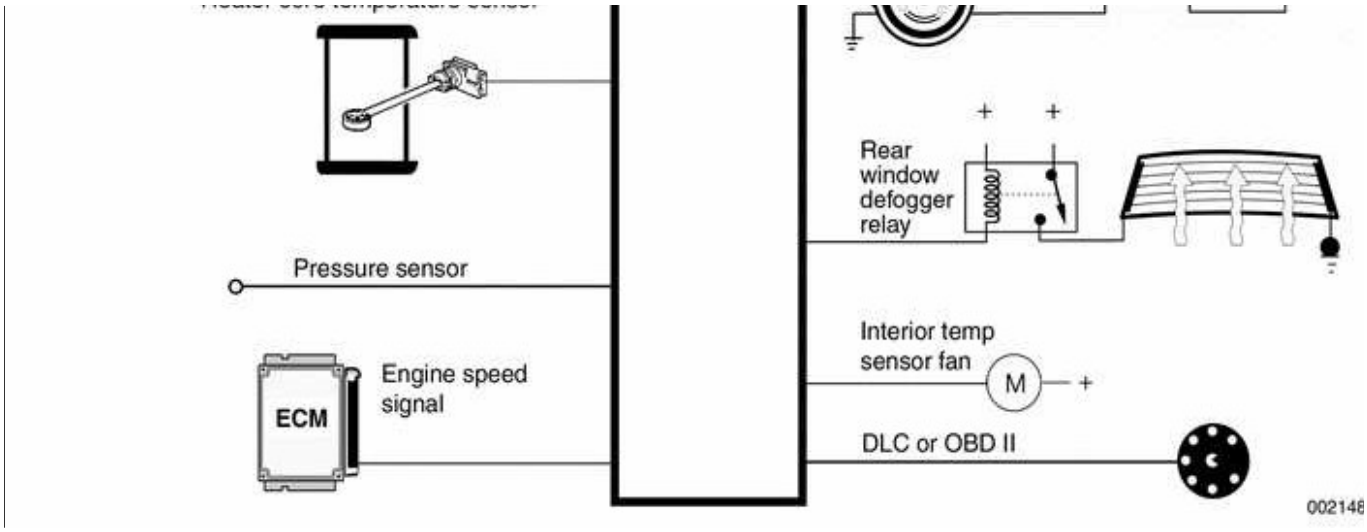
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- Heater control personalization via Car Memory/Key Memory

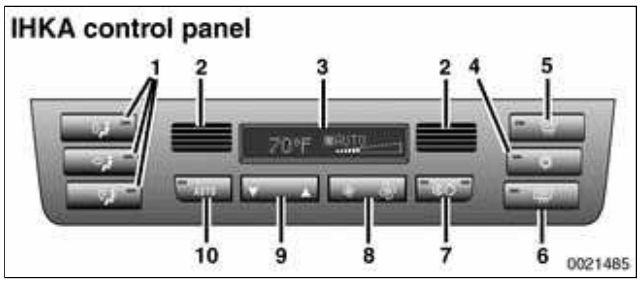
E46 IHKA control



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Control panel and module



Heating and air conditioning functions are programmed via the center console mounted control panel. The control panel has large, easy to use soft-touch controls, an LED display and a single temperature setting.

1 - Manual air distribution control buttons

2 - Interior temperature sensor intake/outlet

3 - LCD matrix

4 - A/C control (“snowflake”)

5 - Windshield defrost control

6 - Rear window defogger control

7 - Recirculation control

8 - Blower control

9 - Temperature control

10 - Automatic air distribution

The IHKA control module, integral with

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the front panel, includes an EEPROM chip for storage of Diagnostic Trouble Codes (DTCs). Inputs to the module include:

- Heater core temperature sensor
- A/C evaporator temperature sensor
- Other programmed functions from Car Memory (such as rear window defrost timing).

The module can go into "sleep mode" to reduce power consumption when the ignition is switched OFF but still retain control panel settings and DTC information. If the control module is replaced it must be recoded using BMW scan tools DIS or MoDiC.

Heat regulation



The E46 uses a single water valve and heater core to provide passenger compartment heat. The water valve is electrically pulsed to control the flow of coolant through the heater core.

Temperature regulation is based on the following inputs:

- Temperature control switch setting
- Interior temperature sensor signal
- Ambient temperature signal
- Heater core temperature sensor signal
- Evaporator temperature signal

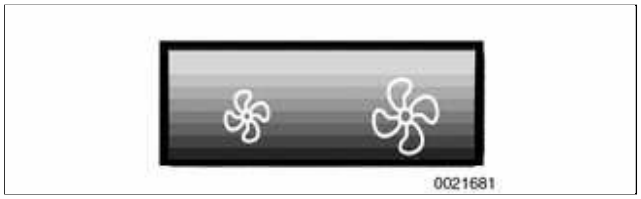
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- Solar sensor input (if applicable)

A rocker switch is used to select the desired cabin temperature, shown in the display matrix of the control panel. The range for temperature display is from 15° to 32°C (60° to 90°F).

A "service station" feature is integrated into the E46 IHKA. This prevents the heater core from being flooded with hot coolant when refueling the vehicle.

Blower control



The blower rocker switch on the IHKA control panel is the master switch for the entire system. Rocking the switch to select slower and slower fan speeds eventually results in the following:

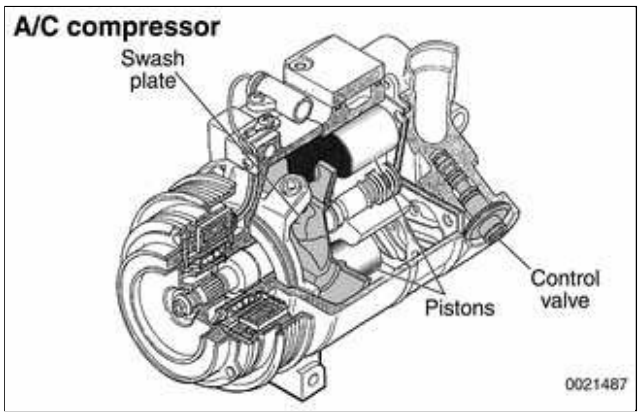
- Blower motor turns off.
- All air distribution valves are closed.
- LED and LCD displays are switched off.
- Rear window defroster is switched off.
- A/C compressor is switched off.

Even in the lowest setting, the interior temperature sensor blower continues to operate and the IHKA control panel continues to signal the heater water valve for heat.

Regulated A/C compressor

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The operation of the A/C compressor is modulated, eliminating noticeable on/off cycling. In order to reduce fuel consumption and improve vehicle performance, the system default is with the compressor OFF.



The A/C system uses a variable displacement compressor. The swash plate of the compressor is hinged so that is can vary piston travel based on output requirements of the system.

A/C compressor function is controlled by the Engine Control Module (ECM) based on inputs from the IHKA control panel. Pressing the "snowflake" button is a request for A/C activation. As long as the evaporator temperature is above 2°C (36°F), the IHKA signals the ECM to activate the compressor.

The IHKA control module sends the following signals to the ECM over the K-bus and CAN-bus via the instrument cluster:

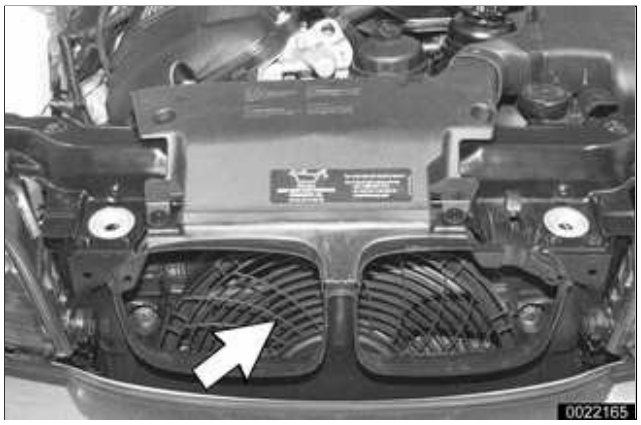
- Request for A/C activation
- Load torque for switching the compressor
- Requested cooling fan speed

The IHKA determines the load torque for compressor activation and required engine cooling fan speed from the pressure sensor mounted on the receiver/dryer. The pressure sensor provides a linear voltage input signal (0 - 5 volts) to the IHKA control module. The module processes this signal and determines the load torque of the system (0 to 30 Nm with a variable displacement compressor). The higher the pressure in the system, the higher the voltage input signal to the IHKA module. The output

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signal to the ECM enables the ECM to modify the idle speed, timing and fuel injection amount based on the load that is imposed when the compressor is activated.

Regulated engine cooling fan operation

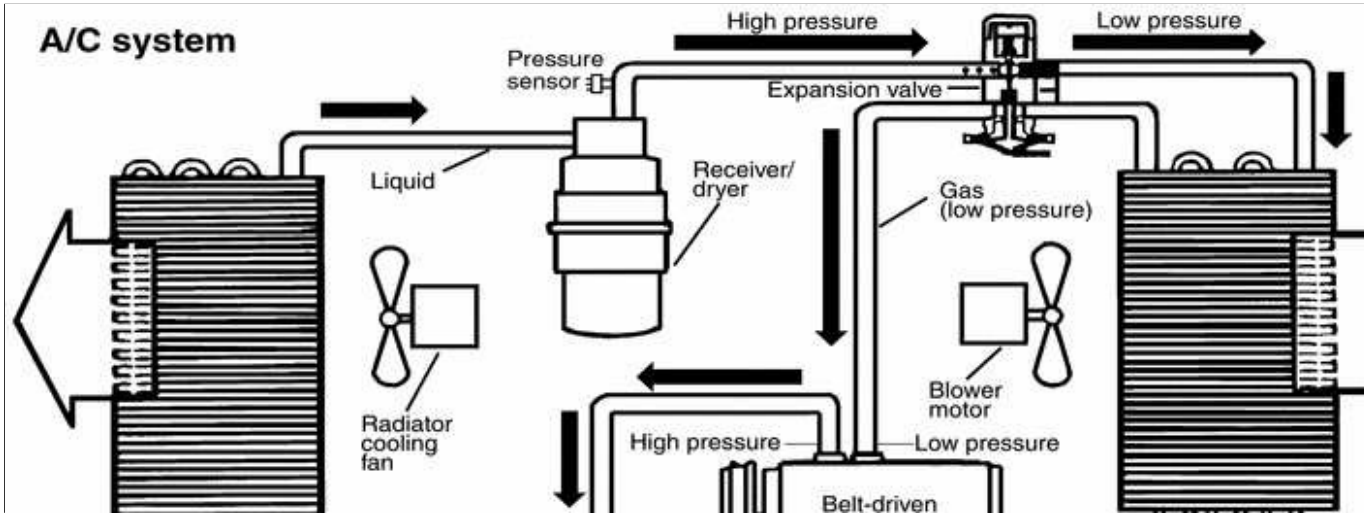


- The engine cooling fan (**arrow**) operates at variable speeds (15 stages) based on cooling system load. The ECM activates the fan through a pulse modulated final stage control. See ⇒ 170 Radiator and Cooling System for further details.

Note:

- *Automatic transmission models: The engine cooling fan is located in front of the radiator. A belt-driven fan and fan clutch assembly is installed at the rear of the radiator.*
- *Standard transmission models: The electric engine cooling fan is installed at the rear of the radiator.*

A/C system



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Maximum defrosting



- Pressing the defrost button turns on maximum defrost functions:
  - Fresh air distribution valves are opened.
  - Recirculation valves are closed.
  - Windshield defrost vents are opened.
  - All other air distribution vents are closed.
  - Blower runs at maximum speed.
  - Rear window defroster is switched on.

Note:

When windshield defrosting is turned on, the A/C compressor does not run automatically, although it can be turned on manually.

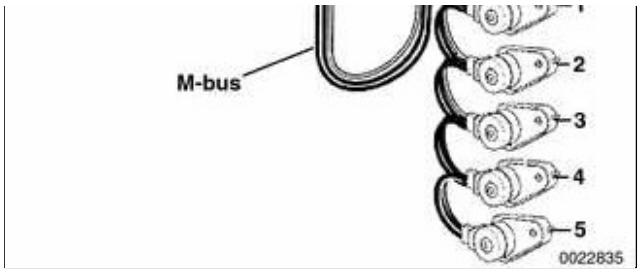
Air distribution control via M-bus



- Five stepper motors control fresh, heated and air conditioned air distribution.

1 - Face vent

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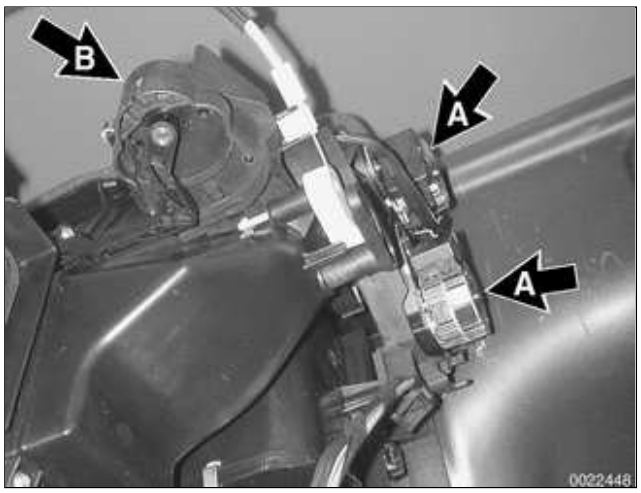


2 - Defrost

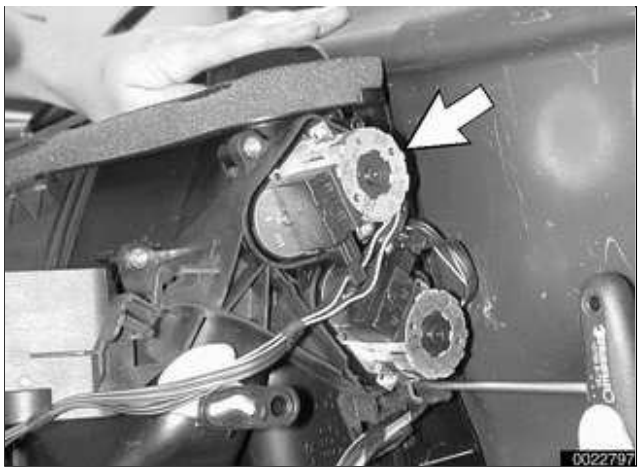
3 - Footwell

4 - Recirculation

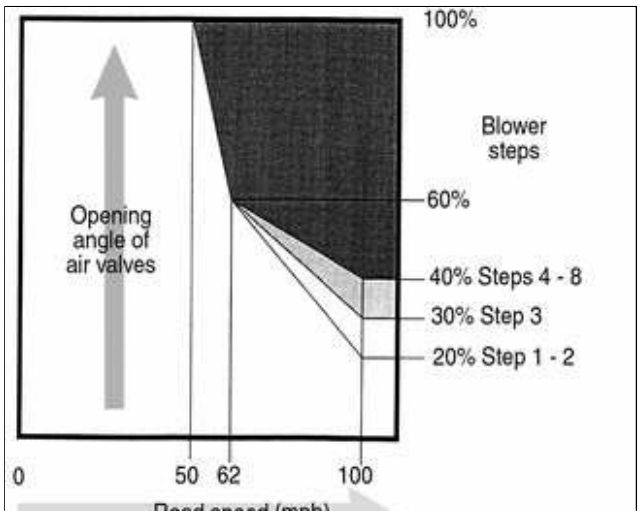
5 - Fresh air



- Two different types of air distribution motors are used in the system. Fast acting motors (**A**) are used for the fresh air/recirculation flaps. (Right side shown.)
  - Slower acting motors (**B**) are used for the other operations.



- The center dashboard air outlet distribution motor (**arrow**) allows ventilation air temperature to be controlled by the driver or passenger.



- When fresh air is selected, the fresh air inlet distribution flaps are positioned according to road speed and blower motor speed. The motors close the air inlet flaps incrementally according to road speed but the motion is dampened to avoid closing and opening continually due to slight speed changes.

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IHKA personalization

Car Memory/Key Memory allows various functions and features of IHKA control to be tailored to the driver's wishes. The functions of IHKA that can be programmed by the driver include:

- Automatic activation of recirculation when the vehicle is started
- Blower speed adjustment (8-speed blower)
- Automatic opening of ventilation flaps with warm coolant
- Automatic closing of footwell flaps with A/C activation
- Automatic closing of defroster flaps with A/C activation
- Adjustments to set temperature
- Automatic activation of compressor control when the ignition is switched on
- Auto program for blower control when the ignition is switched on

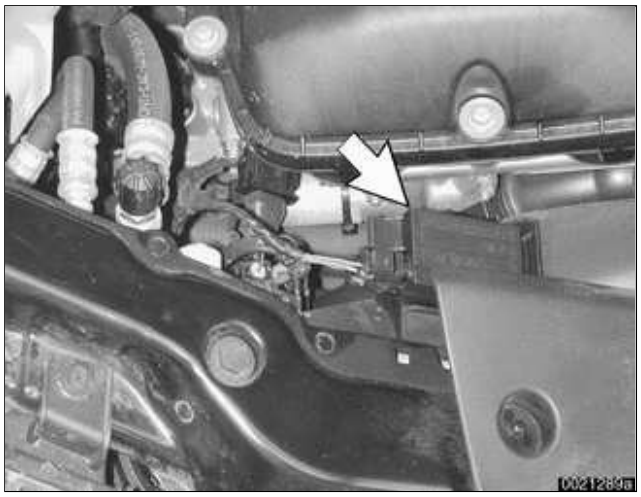
These features are programmed using the coding/programming function of the DIS/MoDiC.

Note:

See ⇒ 515 Central Locking and Anti-theft for an explanation of Car Memory/Key Memory.

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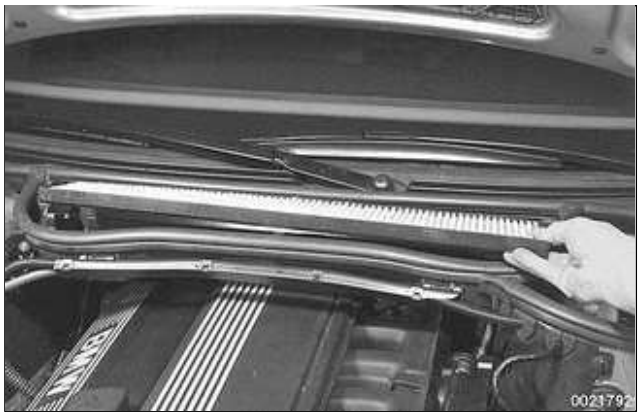
Automatic air recirculation



- As of model year 2000, automatic recirculation control is available. This system uses an air quality sensor (AUC) (**arrow**), located at the top right corner of the radiator, to detect high levels of air pollution and automatically switch the IHKA to recirculation of interior air. The recirculation button on the IHKA control panel can be toggled to allow automatic, manual or no recirculation.

  Once recirculation is turned on, it runs until it is turned off using the button. Once the ignition is turned off, the recirculation setting is saved for 15 minutes, after which the IHKA system reverts to fresh air mode. This feature can be over-ridden using the Car Memory feature, so that recirculating interior air is automatically selected on engine start-up.

Fresh air micro filter system



- A fresh air micro filter system is used in all E46 models. The filter is housed below the fresh air inlet at the rear of the engine compartment. The filter can be serviced by releasing three-quick release screws and removing a plastic cover.

Service

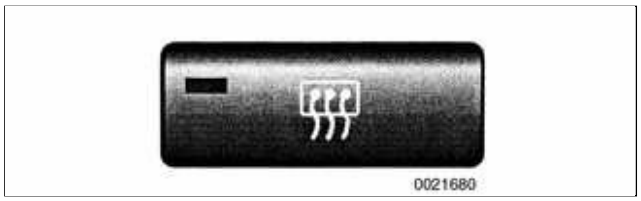
The heating system is part of the engine cooling system and is sealed. The only required service is periodic coolant flushing. See ⇒ 170 Radiator and

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Cooling System.

Servicing the A/C system requires the use of specialized equipment. Follow the equipment manufacturer's instructions.

Rear window defogger



- The electric rear window defogger switch is integrated in the IHKA control panel. Pressing the rear window defogger button activates the rear window heating element for about 17 minutes, although this can be changed through Car Memory settings. Pressing the button again activates a cycle of 40 seconds on/80 seconds off for 5 minutes.

The defogger element in the rear glass is integrated with the radio antenna.



- The rear window defogger relay (**arrow**) is located in the right side of the luggage or cargo (Sport Wagon) compartment behind the trim.

Convertible heated rear window

In the E46 Convertible, both the soft top and the hard top are equipped with rear window defogger. Power is supplied by two relays located on the right side rear quarter panel behind the interior trim cover.

Rear defogger operation is controlled by the IHKA control module.

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On hard top:

- Rear relay is energized.
- Power to hard top window is supplied through connector strip on hard top lock.

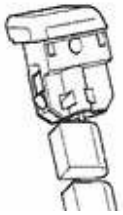
On convertible top:

- Rear relay is energized. It powers front relay.
- If convertible top control module (CVM) signals that convertible top is locked to windshield frame, front relay powers rear window heater grid.
- If convertible top is lowered, a signal from CVM to front relay prevents heated top operation.
- Front relay also signals sound system to switch stereo sound ON when top is up, stereo sound OFF when top is down.

Solar sensor

The purpose of the solar sensor is to detect and relay information about the amount and intensity of solar heating to the IHKA control module. The settings of the climate control system are changed to compensate for this additional influence.

Solar sensor



The solar sensor consists of a photoresistor installed in the right defroster outlet and a short harness.

The solar sensor receives power (5 volts) and ground from the IHKA control

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module. The module then calculates voltage drop across the photoresistor and determines the degree of solar heating based on the change in voltage. Voltage drop across the photoresistor increases as solar radiation increases. The IHKA control module processes the photoresistor input every 10 seconds and also checks it for plausibility based on mapped values. Values outside the limit indicate a malfunction and the solar sensor signal is ignored by the module.

The IHKA module regulates interior climate settings using the following:

- Blower. The blower activation curve is changed.
- Ventilation. The opening angles of air distribution flaps are changed.

Troubleshooting of the solar sensor is carried out through the IHKA diagnostic program incorporated in DIS or MoDiC. The IHKA control module may set codes indicating a short or an open circuit.

To access the solar sensor, remove the trim in front of the main dashboard panel, ahead of the dashboard vents.

Troubleshooting

Trouble with the heating and A/C system can be broken down into one or more of the following categories.

Mechanical problems

- Control head malfunction
- Blower motor malfunction

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- Noisy or seized compressor
- Noisy compressor clutch
- Malfunctioning belt

Diagnosis of noisy engine compartment components is covered in ⇒ 100 Engine–General. A/C belt replacement is covered in ⇒ 020 Maintenance.

Cooling system problems

- Coolant problems
- Cooling fan problems

Cooling system pressure testing and other diagnosis is covered in ⇒ 170 Radiator and Cooling System.

Refrigerant leak

Use diagnostic equipment to pinpoint refrigerant leaks. Replace leaky components or seals.

Note:

Diagnosis of A/C system components is beyond the scope of this manual. Follow the equipment manufacturer's instructions.

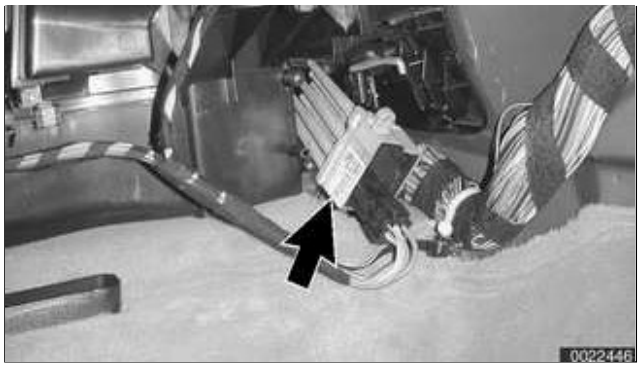
Odors

Mlldew in the IHKA housing and in the evaporator fins can cause strong odors.



Working under right side of dash, remove blower fan resistor pack (**arrow**) as described later in this repair group.

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- Poke a spray wand through IHKA housing opening and spray commercially available cleaning agent on evaporator. Move wand back and forth to cover evaporator fins with liquid.

- Allow 5 minutes for liquid to drip through evaporator drain.

- Start car and run heater and A/C at maximum power for 5 minutes to dry out evaporator.

Functional problems

IHKA self diagnostics monitors the inputs and outputs of the system. If a fault is detected, a Diagnostic Trouble Code (DTC) is initially entered in RAM and then in the EEPROM when the ignition is switched off. A maximum of six DTCs can be stored in the EEPROM when the ignition is switched off. The E46 IHKA module is connected to the Diagnostic Link Connector (DLC) via the K-bus/instrument cluster. Use DIS, MoDiC or other suitable scan tool to access DTCs.

When troubleshooting problems with the E46 IHKA, it is important to note that because the Car Memory/Key Memory feature can change the functionality of the system, a review of memory settings should be performed prior to condemning a component as faulty.

Substitute value operation

If an input potentiometer, sensor or circuit fails or the signal from it is not plausible, the control module ignores the faulty signal and substitutes a

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programmed substitute value. See ⇒ Table a.

Table a. Substitute programmed values for IHKA component inputs		
Input	**Working range**	**Substitute value**
Heat exchanger sensor	5° to 124°C (41° to 255°F)	55°C (131°F)
Evaporator sensor	-10° to 30°C (14° to 86°F)	0°C (32°F)
Interior temperature sensor	10° to 40°C (50° to 104°F)	20°C (68°F)
Exterior temperature	K-bus	0°C (32°F)
Coolant temperature	K -bus	100°C (212°F)
Specified temperature	16° to 32°C (61° to 90°F)	22°C (72°F)

Note:

The substitute value for the evaporator temperature sensor is below the A/C compressor cycling temperature (2°C/34°F). If the evaporator temperature sensor signal is not plausible, the substitute value will switch the A/C OFF.

⇒ Table b lists resistance values and fault limits for IHKA temperature sensors.

Table b. Temperature sensor resistance values at 25°C (77°F)		
Sensor	**Resistance**	**Fault limit**
Heater core	9 kΩ ± 2%	Temp >

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Table b. Temperature sensor resistance values at 25°C (77°F)		
Sensor	**Resistance**	**Fault limit**
		125°C (257°F)
Evaporator	9 kΩ ± 2%	Temp > 120°C (248°F)
Interior	10 kΩ ± 2%	Temp ≤ -46°C (-51°F)

⇒ Table c lists A/C evaporator temperature-dependent resistance values.

Table c. A/C evaporator temperature sensor resistance values	
Temperature °C/°F	**Resistance range kΩ**
-5/23	11.7 - 11.9
0/32	8.8 - 9.2
5/41	6.8 - 7.2
10/50	5.3 - 5.6
15/59	4.2 - 4.5
20/68	3.3 - 3.6
25/77	2.6 - 2.9
30/86	2.1 - 2.3
35/95	1.7 - 1.9

⇒ Table d lists A/C expansion valve pressure values.

Table d. Expansion valve pressure values

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Table d. Expansion valve pressure values	
Inlet pressure	14 bar (203 psi)
Outlet pressure	1.8 bar (26 psi)
Leak test with detector pressure	1 - 2 bar (14.5 - 29 psi)

A/C system warnings and cautions

WARNING!

- ***Always wear hand and eye protection (gloves and goggles) when working around the A/C system. If refrigerant does come in contact with your skin or eyes: do not rub skin or eyes; immediately flush skin or eyes with cool water for 15 minutes; rush to a doctor or hospital; do not attempt to treat yourself.***
- ***Work in a well ventilated area. Switch on exhaust/ventilation systems when working on the refrigerant system.***
- ***Do not expose any component of the A/C system to high temperatures (above 80C/176F) or open flames. Excessive heat causes a pressure increase which could burst the system.***
- ***Keep refrigerant away from open flames. Poisonous gas is produced if it burns. Do not smoke near refrigerant gases for the same reason.***

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- ***The A/C system is filled with refrigerant gas which is under pressure. Pressurized refrigerant in the presence of oxygen may form a combustible mixture. Never introduce compressed air into any refrigerant container (full or empty).***

- ***Electric welding near refrigerant hoses causes R-134a to decompose. Discharge system before welding.***

CAUTION!

- ***As of January 1, 1992, any person who services a motor vehicle air conditioner must, by law, be properly trained and certified, and use approved refrigerant recycling equipment. Technicians must complete an EPA-approved recycling course to be certified.***

- ***It is recommended that all A/C service be left to an authorized BMW dealer or other qualified A/C service facility.***

- ***State and local governments may have additional requirements regarding air conditioning servicing. Always comply with state and local laws.***

- ***Do not top off a partially charged refrigerant system. Discharge system, evacuate and then recharge system.***

- ***Do not use R-12 refrigerant, refrigerant oils or system***

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components in R-134a system. Component damage and system contamination results.

- ***The mixture of refrigerant oil (PAG oil) and refrigerant R-134a attacks some metals and alloys (for example, copper) and breaks down certain hose materials. Use only hoses and lines that are identified with a green mark (stripe) or the lettering "R-134a".***

- ***Immediately plug open connections on A/C components and lines to prevent dirt and moisture contamination.***

- ***Do not steam clean A/C condensers or evaporators. Use only cold water or compressed air.***

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Vents and Ducts

The IHKA air distribution system includes 5 air distribution motors (stepper motors), right and left footwell ducts, dashboard mounted defroster vents, and three sets of face level vents.

Removal of at least one of the stepper motors (right footwell vent) involves removal of the passenger side airbag in the dashboard.

WARNING!

Airbags are inflated by an explosive device. Handled improperly or without adequate safeguards, the system can be very dangerous. Special precautions must be observed prior to any work at or near the airbags. See ⇒ 721 Airbag System (SRS).

CAUTION!

When working on interior trim removal, work with plastic prying tools or wrap the tips of screwdrivers and pliers with tape.

Air distribution motors

The five air distribution motors are installed under the dashboard. They are made accessible by removing either the glove compartment and right footwell trim panel or the left footwell (pedal cluster) trim panel as described below.



Each motor can be removed after its electrical wiring harness connector has been removed.

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- Squeeze plastic clip (**arrow**) to release motor.
- Tilt motor out of housing.

- During installation, be sure to align air distribution flap and motor drive (**A**).

Right side air distribution motors, accessing

Four of the air distribution motors are under the right side of the dashboard:

- Right side fresh air/recirculation
- Defroster
- Ventilation flaps
- Right footwell vent

- Remove glove compartment and right footwell trim panel for access. See ⇒ 513 Interior Trim.

CAUTION!

Disassemble interior trim carefully to avoid damage.

- Disconnect negative (-) battery cable in trunk.

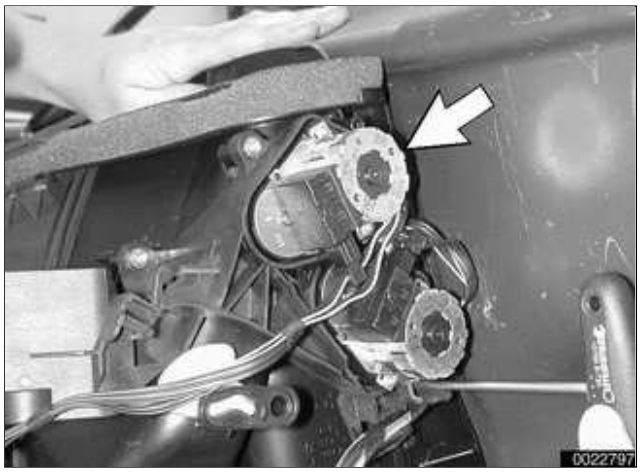
CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

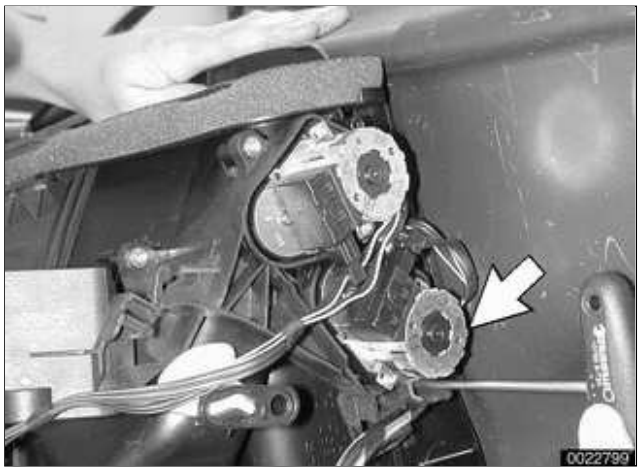
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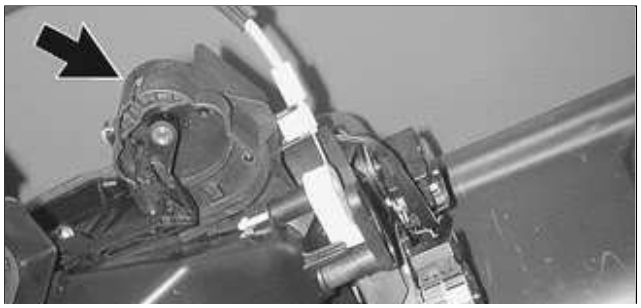
- Right side fresh air/recirculation motor (**arrow**):
  - For access, remove right footwell duct as described below.
  - Unhook linkage, then remove motor.



- Defroster air distribution motor (**arrow**)



- Ventilation distribution motor (**arrow**)
  - For access, remove defroster air distribution motor.



- Right footwell vent air distribution motor (**arrow**):
  - For access, remove passenger side airbag as described in ⇒ 721 Airbag System (SRS).

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- Unhook linkage, then remove motor.

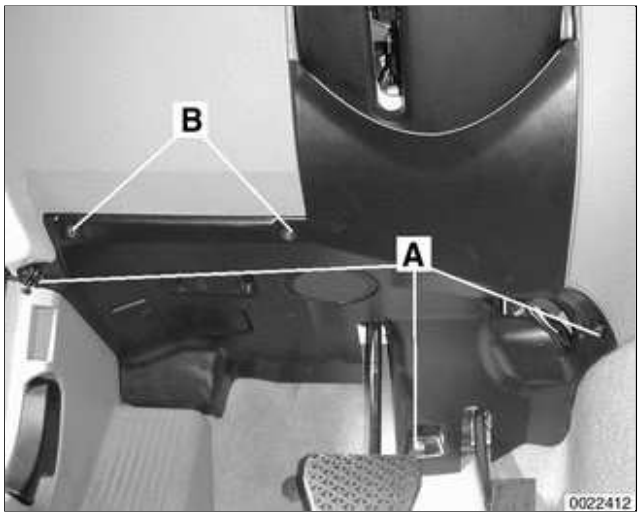
Left side air distribution motor, accessing

The fresh air distribution motor is under the left side of the dashboard. Remove the left footwell (pedal cluster) trim panel for access.

CAUTION!

Disassemble interior trim carefully to avoid damage.

- Move steering column to maximum extended position.

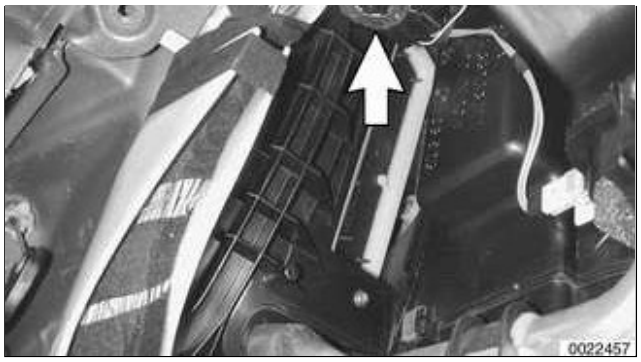


- Working at trim panel, remove fasteners.
  - Note locking clips (**A**) which must be rotated 90° to remove.
  - Remove mounting screws (**B**).
  - Unhook retaining clip from steering column lower trim.
  - Detach electrical harness connectors from footwell light and speaker (if equipped).
  - Release OBD II socket from panel and pull out.



- Reach up above accelerator pedal to gain access to fresh air distribution motor (**arrow**).

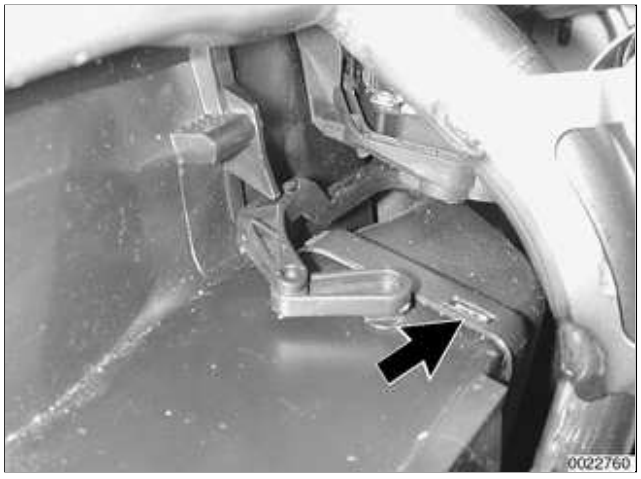
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Right footwell duct, removing and installing

- Remove glove compartment as described in ⇒ 513 Interior Trim.

- Remove IHKA control panel or GPS On-Board Monitor, as applicable (described below).



➢ Reach through control panel opening to detach air duct locking clip (**arrow**) from heater/evaporator housing.

- Separate bottom of air duct from rear compartment duct.

- Pull forward and down to remove.

- Installation is reverse of removal.

Dashboard vent, removing and installing

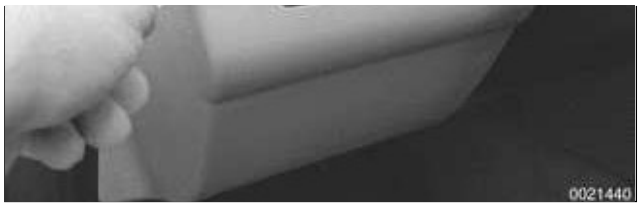


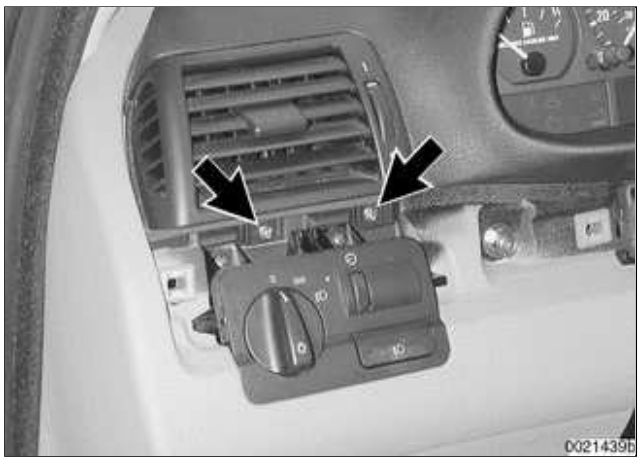
➢ Pry gently at dashboard trim to remove.

CAUTION!

To avoid marring interior trim, work with a plastic prying tool.

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- Remove air vent mounting screws (**arrows**).
  - Lift vent slightly and withdraw from dashboard.
  - Installation is reverse of removal.

Note:

- *Removal of right or center dashboard vent is similar.*
- *To fully remove the center dashboard vent, use pliers to detach control cable housing and remove from control lever.*
- *Remove trim on right side prior to removing center trim.*

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640-3

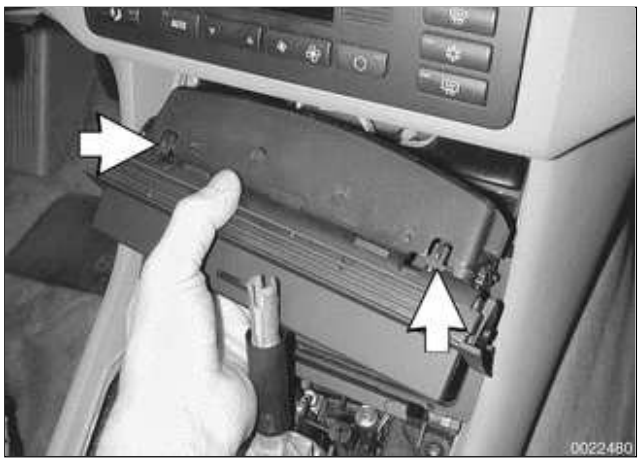
Heating and A/C Controls

The IHKA control module is integrated with the control panel in the center console below the radio. There is a built-in interior temperature sensor and fan.

Models with GPS navigation are equipped with a center console-mounted On-Board Monitor. This combines sound system control functions, GPS monitoring and heating/A/C control functions.

IHKA control panel, removing

If BMW special tools 64 1 010 are available, slide them between IHKA control panel front bezel and dashboard, then pull panel out. Otherwise, use the following procedure.



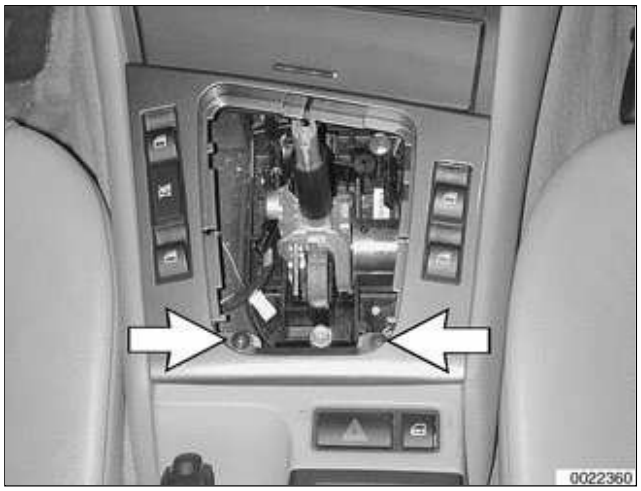
➢ Remove utility compartment below IHKA control panel:

- Open compartment door.
- Push upward in center of compartment to release locking tabs (**arrows**).
- Pull out compartment.

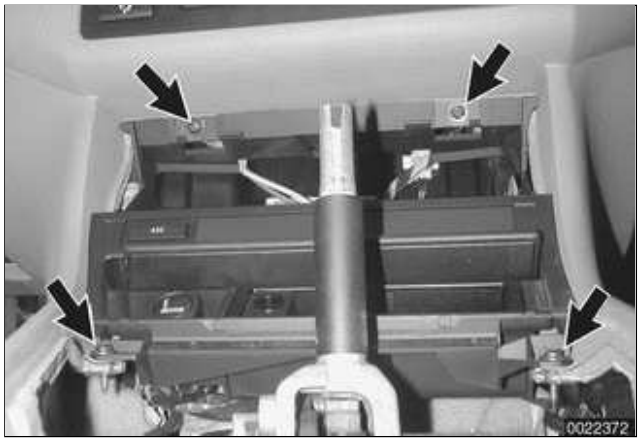
- Shifter bezel: Lift up by prying gently.
- Shifter boot: Unclip bottom of boot from shifter trim (window switch carrier) by pushing forward. Pull boot up around shifter, but do not

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remove.



- Remove screws (**arrows**) at rear of shifter trim (window switch carrier). Lift trim at back to unhook from front.



- Remove screws (**arrows**) at front and rear of ashtray carrier. Lift up ashtray carrier.

  - Reach up through opening and push IHKA control module and panel out.

  - Detach electrical harness connectors.

  - Disassemble panel from module using an anti-static mat as a working surface.

CAUTION!

Do not touch circuit boards with bare fingers.

  - Installation is reverse of removal.

On-Board Monitor, removing

  - Remove dashboard center vent as described earlier.

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- Pull off menu button on face of monitor. Reach through apertures with screwdriver to twist catches. This releases monitor from console.

- Pull out monitor and detach electrical harness connectors in back.

Heater core temperature sensor, removing and installing

- Remove IHKA control panel or On-Board Monitor as described earlier.

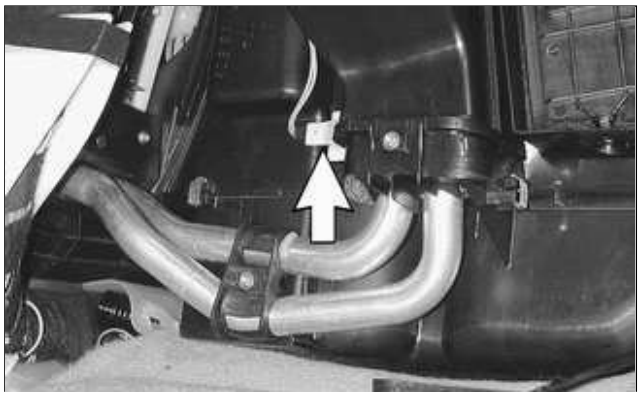


➢ Reach through dashboard opening and detach heater core temperature sensor electrical harness connector (**arrow**).

- Pull sensor out of IHKA housing.

- Installation is reverse of removal.

Evaporator temperature sensor



➢ To gain access to evaporator temperature sensor (**arrow**):

- Remove left footwell trim panel (above pedals). See ⇒ 513 Interior Trim.

- Sensor is installed in left side of IHKA housing above coolant

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pipes.

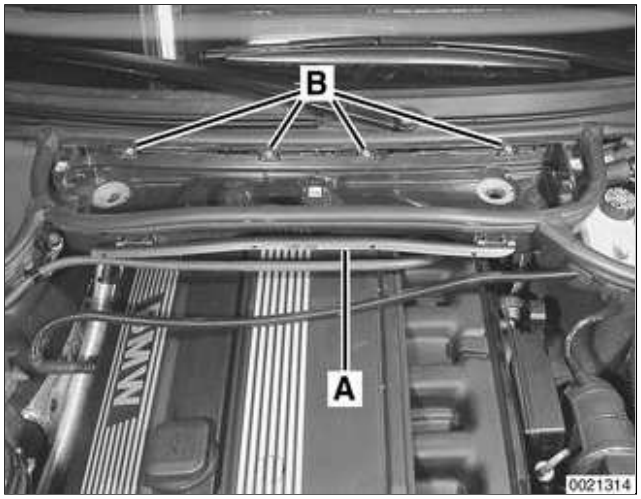
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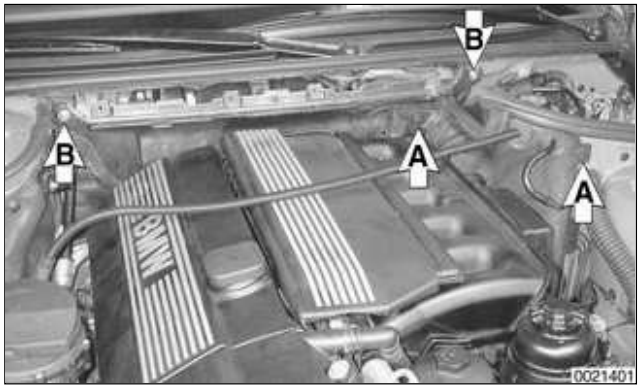
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Blower Components

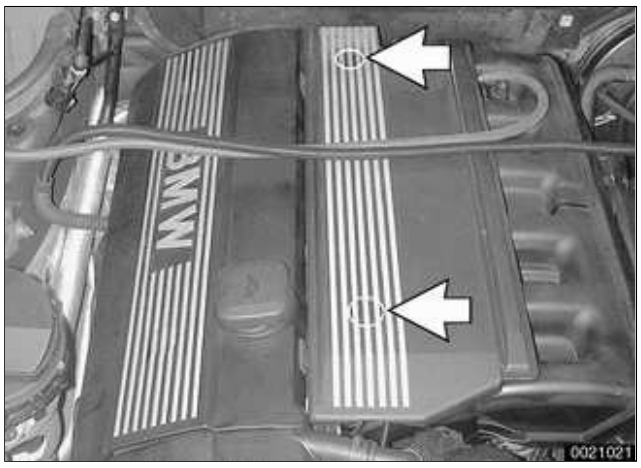
Blower motor, removing and installing



- Remove housing for interior ventilation microfilter.
  - Remove upper cover and microfilter.
  - Open wiring harness loom (**A**) and remove wires.
  - Unfasten screws (**B**) and remove lower housing.

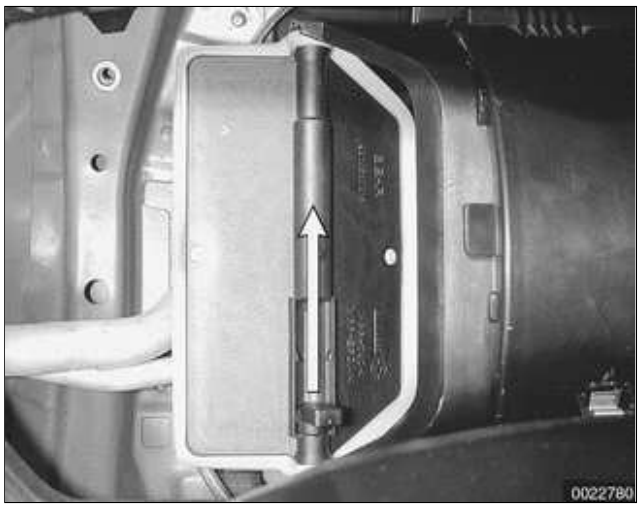


- Remove heater bulkhead cover:
  - Remove engine compartment side trim panel. Turn locking clips (**A**) and slide trim panel up.
  - Remove heater bulkhead cover mounting screws (**B**) and lift cover off bulkhead.

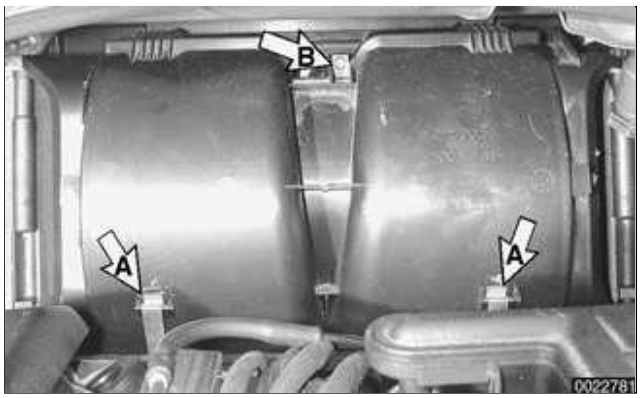


- Remove intake manifold cover:
  - Remove plastic trim covers (**arrows**).
  - Remove cover hold down bolts and lift off cover.

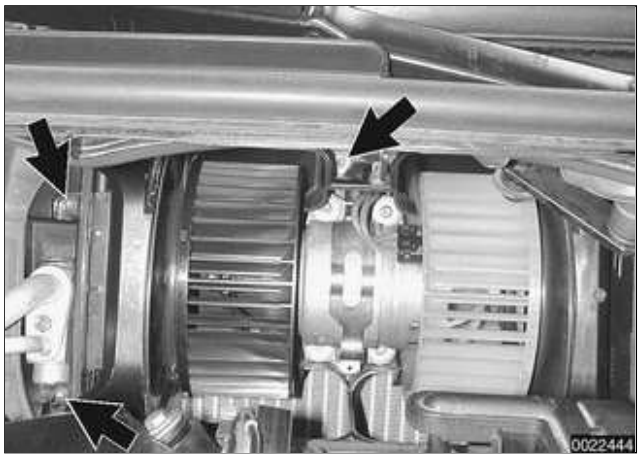
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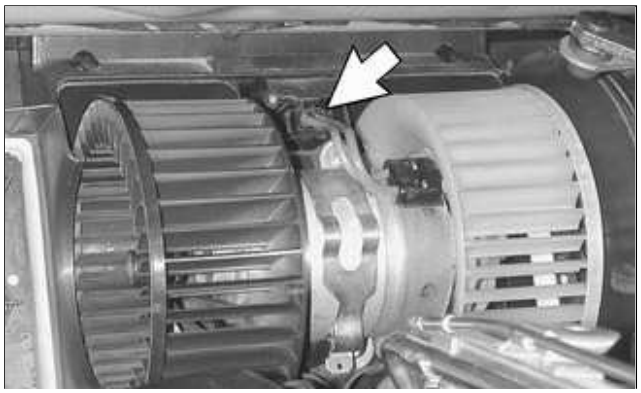
- Working inside right side of cowl, pull up on lever (**arrow**) and detach right air intake flap from blower housing.



- Pry off blower cover retaining clips (**A**). Remove screw (**B**) and lift off outer blower housing cover.

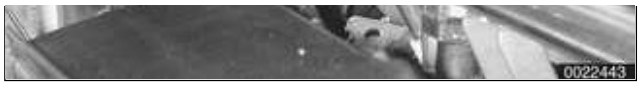


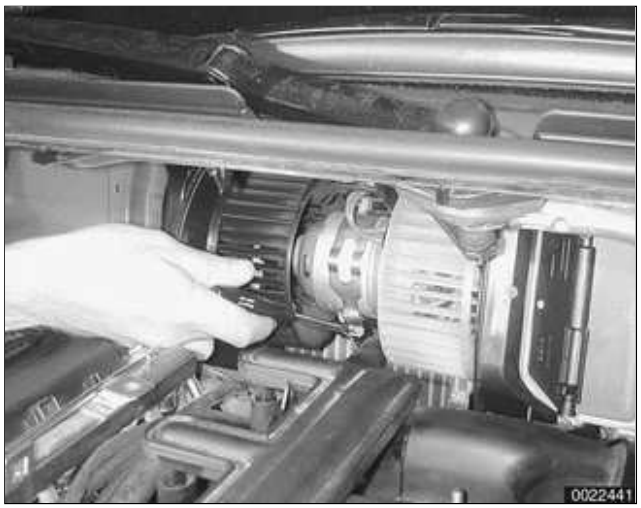
- Remove blower cover retaining screws (**arrows**). Lift off cover.



- Detach electrical harness connector (**arrow**).

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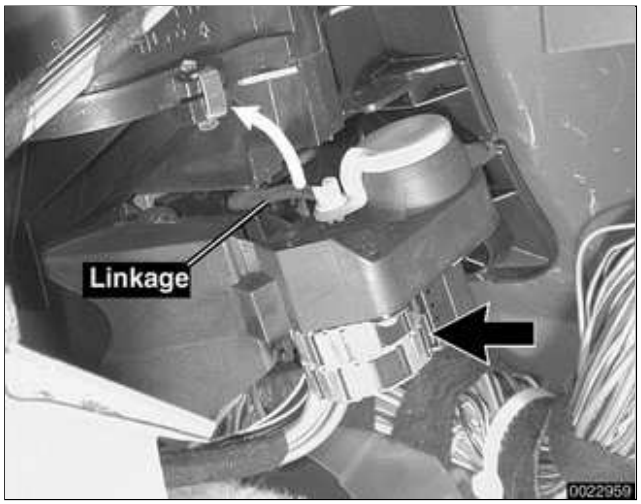
- Pry off blower motor retaining strap.
  - Pull blower motor forward to remove.
  - Installation is reverse of removal:
    - Align slot in blower motor with mounting tab in blower motor housing.

Blower motor resistor pack, replacing

Note:

The blower motor resistor pack is also referred to as the final stage unit.

- Remove right footwell air duct as described earlier.

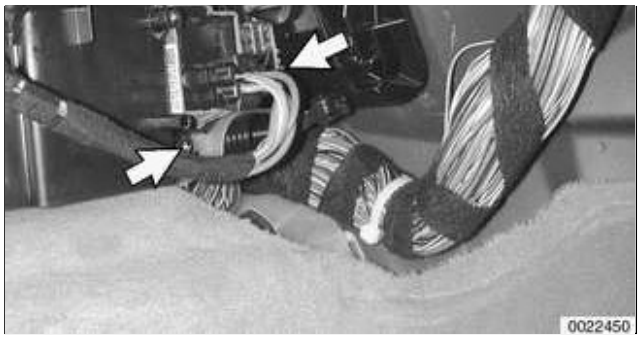


- Working under right side of dashboard at side of IHKA housing, unhook linkage, then remove air distribution motor (**arrow**).



- To remove blower resistor pack from IHKA housing:
  - Remove mounting screws

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(**arrows**).

- Detach electrical harness connector.
- Press retaining clip away from switch to release switch.

- Installation is reverse of removal.

- Make sure electrical harness is routed as before.
- Align guides and clips correctly.

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Heater Components

The heater valve is located in the left side of the engine compartment, attached to the left strut tower. The solenoid operated valve controls coolant flow through the heater core.

The IHKA housing, located underneath the center of the dashboard, houses the heater core, the A/C evaporator, the heating and A/C blower and associated sensors and air distribution motors.

CAUTION!

Removal of either the heater core or the IHKA housing involves dashboard removal. Before starting work, disconnect the battery negative (-) cable in the trunk. Be sure to read the battery disconnection cautions on page viii and the airbag warnings in ⇒ 721 Airbag System (SRS).

Heater valve, replacing

- Drain engine coolant. See ⇒ 170 Radiator and Cooling System.

WARNING!

Allow the cooling system to cool before opening or draining the cooling system.



- Disconnect hoses (**A**) and electrical harness connector (**B**) at heater valve on left inner fender.

- Carefully pull heater valve out of rubber mounting and pull up and out of engine compartment.

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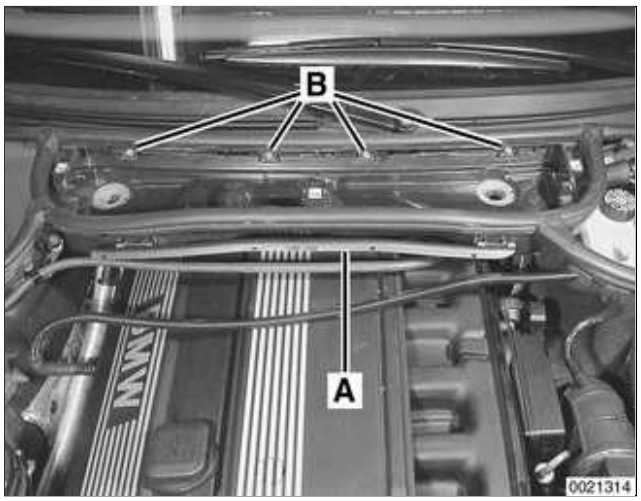
- Installation is reverse of removal.

♦ Inspect hoses and rubber mounts. Replace as necessary.

♦ Use new hose clamps.

Tightening torque	
Coolant hose clamp 32 - 48 mm (2 1/4 - 4 in.)	2.5 Nm (22 in-lb)

Heater core, replacing



➢ Remove housing for interior ventilation microfilter.

♦ Remove upper cover and microfilter.

♦ Open wiring harness loom (**A**) and remove wires.

♦ Unfasten screws (**B**) and remove lower housing.

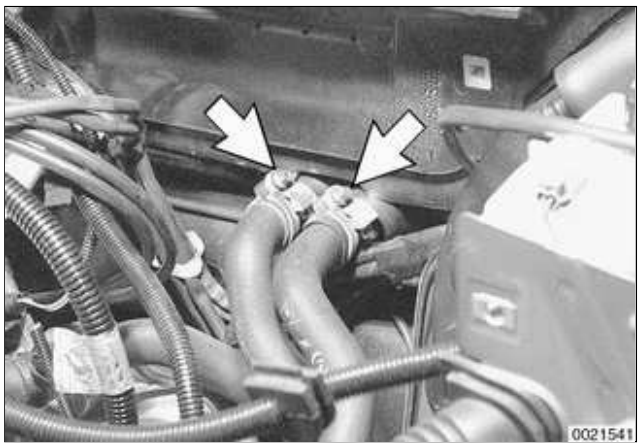
- Remove center console and dashboard. See ⇒ 513 Interior Trim.

- Drain engine coolant. See ⇒ 170 Radiator and Cooling System.

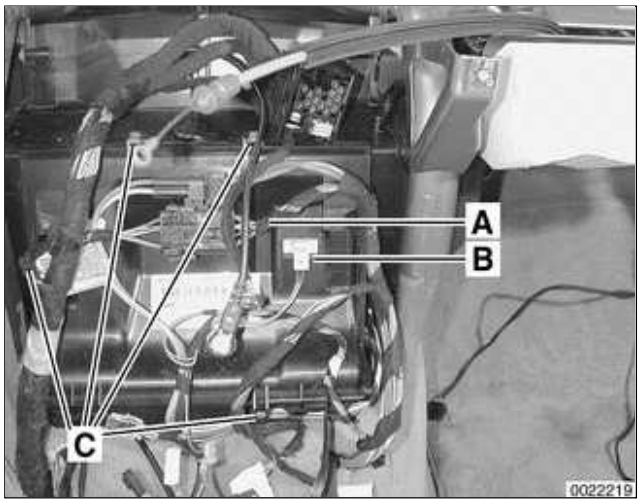
WARNING!

Allow the cooling system to cool before opening or draining the cooling system.

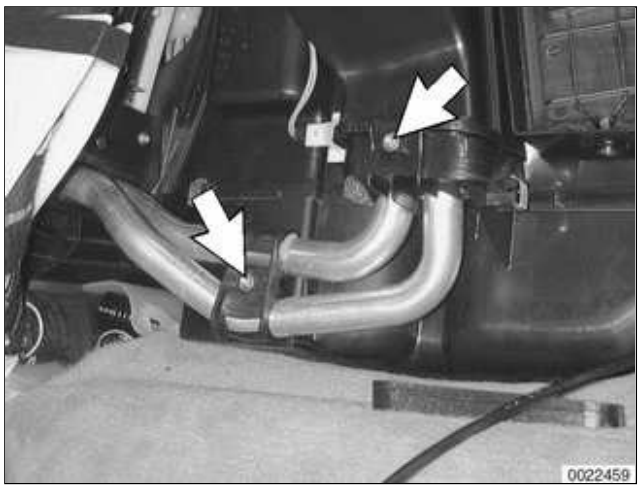
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- Working at rear engine compartment bulkhead, loosen hose clamps (**arrows**) and detach heater hoses.
  - Blow out excess coolant from heater core using compressed air at coolant lines.
  - Release right air duct from IHKA housing.



- Working inside passenger compartment at IHKA housing:
  - Detach wiring harness (**A**) from housing.
  - Remove heater core temperature sensor (**B**) by pulling straight out.
  - Remove retaining clips (**C**) from housing cover.
  - Lift off front of cover, then unhook tabs from housing at rear.



- Remove coolant pipe retaining clamps mounting screws (**arrows**).



- To remove heater core from IHKA housing:
  - Remove coolant pipe retainers

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(**arrows**) to detach pipes.

- Tilt heater core to remove from housing.

- Installation is reverse of removal.

- Fit lugs in back of housing cover in heater housing slots.

- Use new sealing O-rings and coat with anti-seize agent.

- Fill and bleed cooling system. See ⇒ 170 Radiator and Cooling System.

CAUTION!

Replace coolant flange O-rings and tighten fasteners to specified torques.

Tightening torque	
Coolant hose clamp 32 - 48 mm (2 1/4- 4 in.)	2.5 Nm (22 in-lb)

IHKA housing, removing and installing

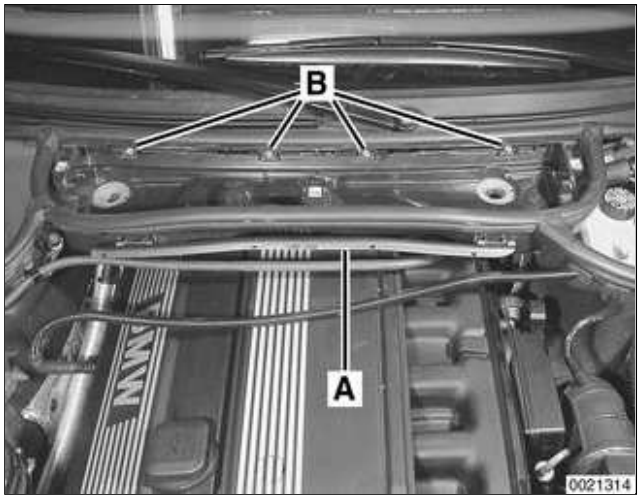
CAUTION!

- ***Removing the IHKA housing requires evacuating the A/C system. DO NOT attempt this procedure without proper tools and training.***

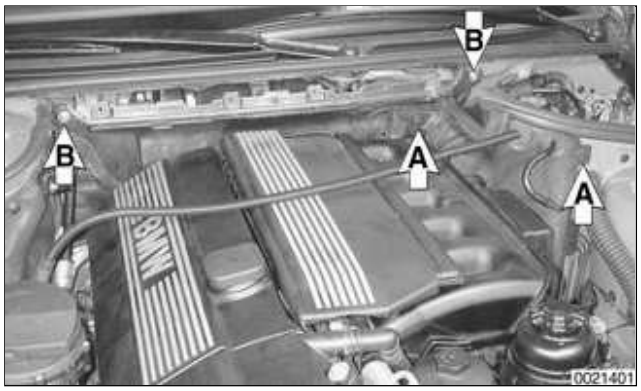
- ***Any person who services a***

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motor vehicle air conditioner must, by law, be properly trained and certified, and use approved refrigerant recycling equipment. Technicians must complete an EPA-approved recycling course to be certified



- Remove housing for interior ventilation microfilter.
  - Remove upper cover and microfilter.
  - Open wiring harness loom (**A**) and remove wires.
  - Unfasten screws (**B**) and remove lower housing.

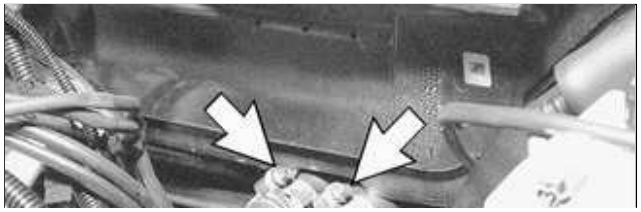


- Remove heater bulkhead cover:
  - Remove engine compartment side trim panel. Turn locking clips (**A**) and slide trim panel up.
  - Remove heater bulkhead cover mounting screws (**B**) and lift cover off bulkhead.

- Drain engine coolant. See ⇒ 170 Radiator and Cooling System.

WARNING!

Allow the cooling system to cool before opening or draining the cooling system.

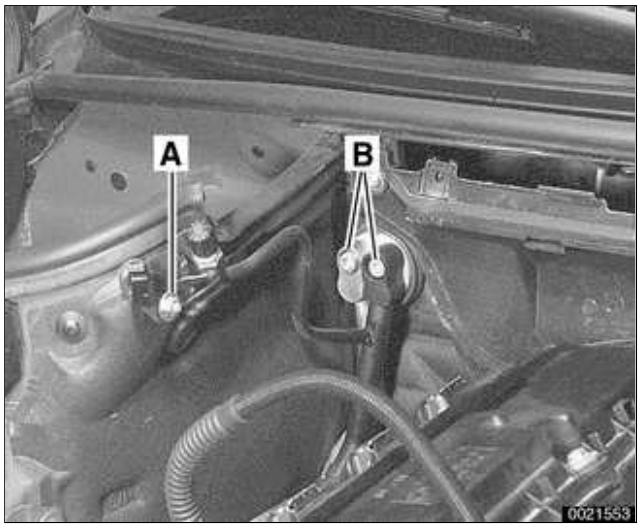


- Working at rear engine compartment bulkhead, loosen hose clamps (**arrows**) and detach heater hoses.

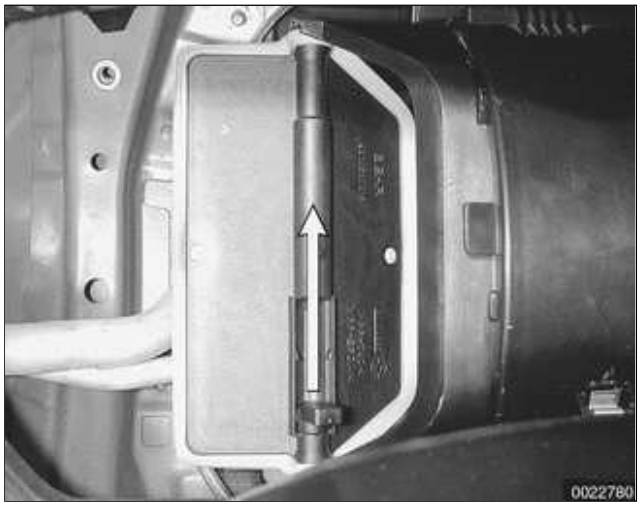
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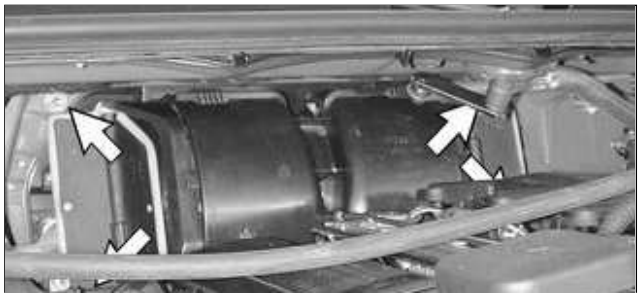
- Blow out excess coolant from heater core using compressed air at coolant lines.
- Following manufacturer's instructions, connect approved refrigerant recovery/recycling /recharging unit to A/C system and discharge system.



- Working in right rear of engine compartment, detach A/C lines:
  - Remove A/C recharging port bracket mounting nut (**A**).
  - Remove allen bolts (**B**) at bulkhead.
  - Using BMW special tool 64 5 102 or equivalent, detach and plug A/C lines.



- Working inside right side of cowl, pull up on lever (**arrow**) and detach right air intake flap from blower housing.
  - Working in right front of IHKA housing, detach double pipe (A/C line) from expansion valve.
  - Lay double pipe aside.
  - Plug up open A/C ports.



- Remove IHKA housing mounting nuts (**arrows**) at bulkhead.
  - Remove center console and dashboard. See ⇒ 513 Interior Trim.

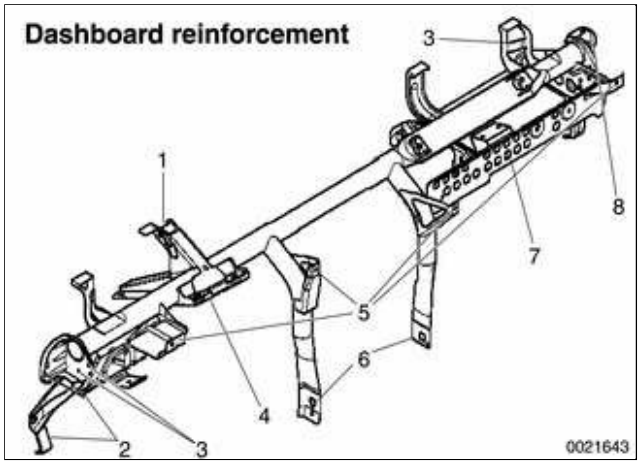
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- Working inside passenger compartment below steering column, drill out steering column shear bolt. See ⇒ 320 Steering and Wheel Alignment.

- Remove steering column mounting bolts.

- Lower column.



Under dash attachments

1 - Bulkhead

2 - Left A-pillar

3 - Head protection airbag

4 - Steering column

5 - Dashboard mounts

6 - Center tunnel

7 - Relay panel

8 - Right A-pillar

Remove dashboard reinforcement fasteners:

- Detach bulkhead brace (**1**).

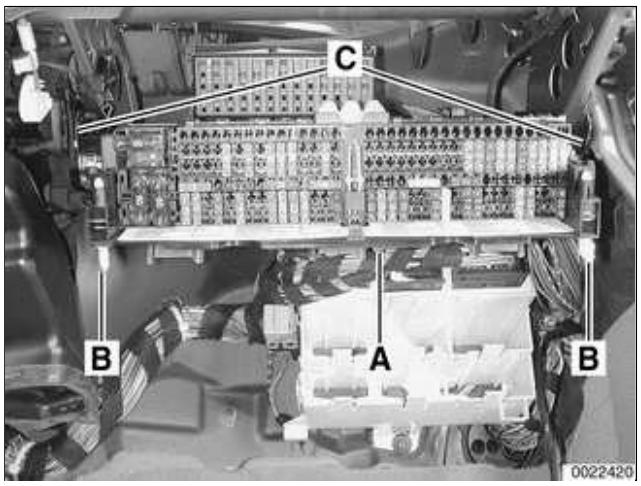
- Detach left and right A-pillar braces (**2** and **8**).

- Detach head protection airbag (**3**).

- Remove center tunnel mounting bolts (**6**).

- Detach heater housing electrical harness connectors.

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- Working at right side of dash:
  - Cut wire tie (**A**) at dashboard reinforcement support for relay panel.
  - Turn fuse panel lock tabs (**B**) 90° and swing fuse panel down.
  - Detach fuse panel pivots (**C**) from dashboard reinforcement.
  - Lift off dashboard reinforcement, making sure all electrical harnesses and hoses are free.
  - Remove IHKA housing, making sure all electrical harnesses and hoses are free.
  - Installation is reverse of removal. Note the following:
    - Make sure A/C condensate drain is routed correctly.
    - Replace wire ties, sealing O-rings and hose clamps.
    - Use new shear bolt at steering column mounting. Tighten bolt until head shears off.
    - Evacuate and recharge A/C system using specialized equipment.
    - Fill and bleed cooling system. See ⇒ 170 Radiator and Cooling System.

CAUTION!

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Replace heater and A/C flange O-rings and tighten fasteners to specified torques.

Tightening torques	
Coolant hose clamp 32 - 48 mm (2 1/4 - 4 in.)	2.5 Nm (22 in-lb)
Steering column to dashboard reinforcement	22 Nm (16 ft-lb)

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640-6

Air Conditioning Components

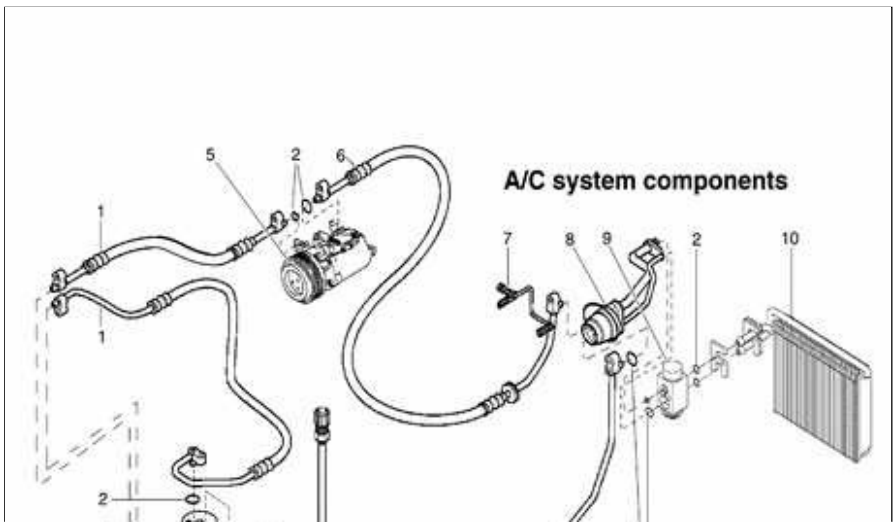
This section covers removal and installation of air conditioning refrigerant components. A/C testing and diagnosis, refrigerant discharge, evacuation and recharge are not covered here.

The A/C condenser, compressor, receiver dryer, pressure sensor, refrigerant lines and expansion valve are either installed in the engine compartment or accessible from the engine compartment.

The A/C evaporator is located in the IHKA housing. Removal of the IHKA housing involves dashboard removal. Before starting work, disconnect the battery negative (-) cable in the trunk. Be sure to read the battery disconnection cautions on page viii and the airbag warnings in ⇒ 721 Airbag System (SRS).

Note:

The air conditioning system is filled with R-134a refrigerant.



A/C system components

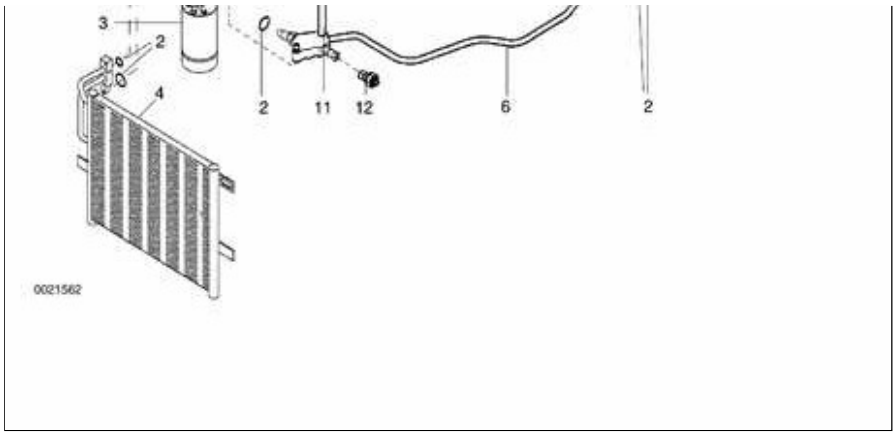
1 - **High pressure line**

2 - **Sealing O-ring (always replace)**

3 - **Receiver-dryer**

4 - **Condenser**

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5 - **Compressor**

6 - **Low pressure line**

7 - **Access port**

8 - **Double pipe**

9 - **Expansion valve**

10 - **Evaporator**

11 - **Access port**

12 - **Pressure sensor**

A/C compressor, replacing

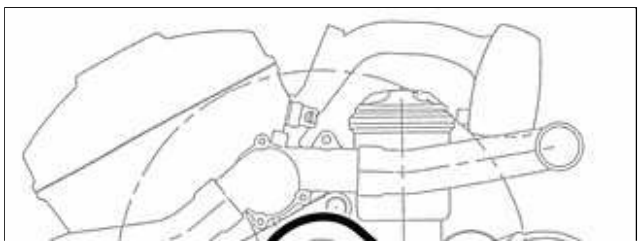
- Following manufacturer's instructions, connect an approved refrigerant recovery/recycling /recharging unit to A/C system and discharge system.

WARNING!

Do not discharge/charge the A/C system without proper equipment and training. Damage to the vehicle and personal injury may result.

- Remove splash shield from under engine.

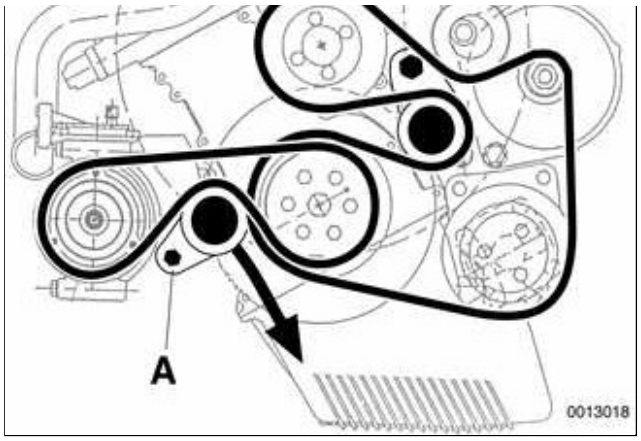
- Mark A/C drive belt with direction of rotation.



➢ Release tension on A/C belt:

♦ Use long-handled wrench to turn tensioner pulley release lug (**A**) clockwise (against spring tension).

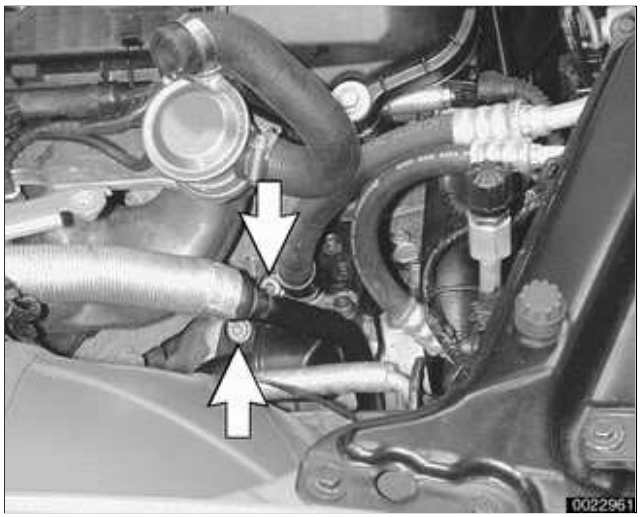
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- Remove drive belt.

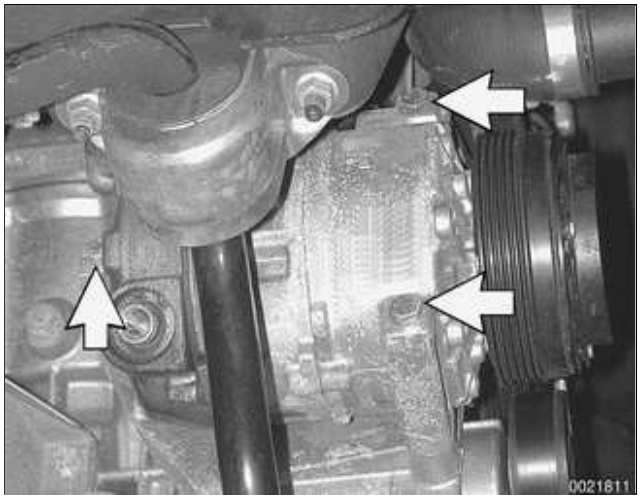
- Detach and set aside front washer fluid reservoir. See ⇒ 611 Wipers and Washers.

- Disconnect electrical harness connector from compressor.



- Remove A/C pressure hose and suction hose flange bolts (**arrows**) from compressor. Plug hoses immediately.

  - All-wheel-drive model: Unbolt and lower front stabilizer bar. See ⇒ 310 Front Suspension.



- Support compressor while removing compressor mounting bolts (**arrows**). Remove compressor.

  - Installation is reverse of removal.

CAUTION!

- ***Always replace O-rings when reconnecting refrigerant lines.***

- ***When installing a new compressor always replace receiver/drier unit.***

Tightening torque	
A/C line to A/C compressor	20 Nm (15 ft-lb)

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- Recharge system following equipment manufacturer's instructions. See ⇒ Table e for A/C system fluid specifications.

Table e. A/C system fluid specifications	
Fluid	**Quantity**
R-134a refrigerant	740 ± 25 g (2 lb ± 1 oz.)
Refrigerant oil	PAG oil

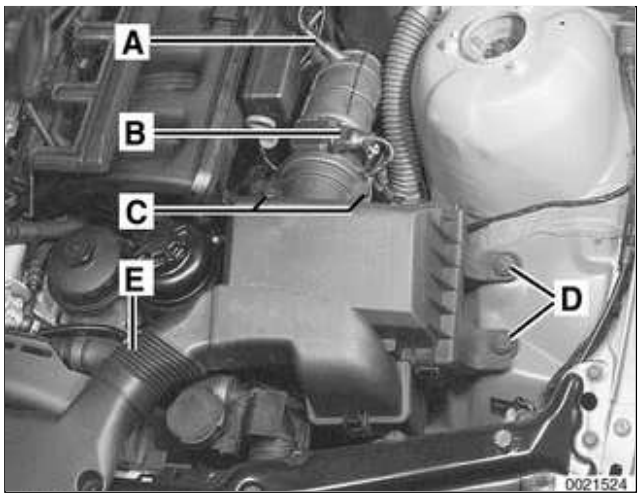
A/C condenser, replacing

The A/C condenser is located in front of the radiator.

- Following manufacturer's instructions, connect an approved refrigerant recovery/recycling /recharging unit to A/C system and discharge system.

WARNING!

Do not discharge/charge the A/C system without proper equipment and training. Damage to the vehicle and personal injury may result.



Remove complete air filter housing:

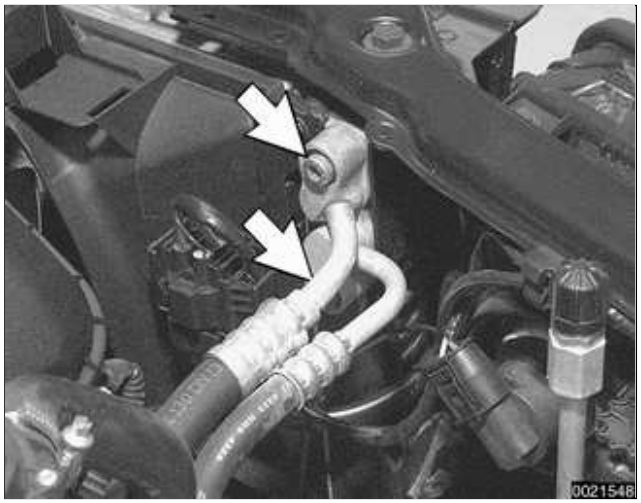
- Detach vacuum line at intake boot (**A**).
- Disconnect electrical harness connector on mass air flow sensor (**B**).
- Release mass air flow sensor clips (**C**).

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- Remove filter housing mounting screws (**D**).

- Detach air duct connections (**E**) and lift complete air filter housing out of engine compartment, pulling it forward away from mass air flow sensor.

- Remove intake hood, cooling fan and shroud, and radiator, as described in ⇒ 170 Radiator and Cooling System.



➢ Detach A/C lines from upper right corner of condenser. Plug lines immediately.

- Remove fastener (expansion rivet) from top left corner of condenser.

- Remove Torx screw from top right corner of condenser, just below refrigerant line flange.

- Lift up condenser to disengage from plastic bracket and remove from above.

- Installation is reverse of removal.

CAUTION!

- ***Always replace O-rings when reconnecting refrigerant lines.***

- ***When installing a new condenser always replace receiver/drier unit.***

- Recharge system following equipment manufacturer's instructions.

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A/C system fluid specifications	
Fluid	**Quantity**
R-134a refrigerant	740 ± 25 g (2 lb ± 1 oz.)
Refrigerant oil	PAG oil

A/C receiver/drier, replacing

The receiver/drier is mounted in the front right corner of the engine compartment behind and below the headlight assembly.

- Following manufacturer's instructions, connect an approved refrigerant recovery/recycling /recharging unit to A/C system and discharge system.

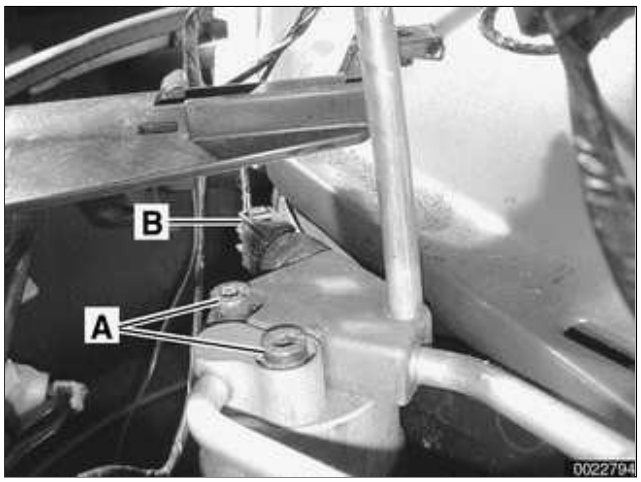
CAUTION!

The receiver/drier must be replaced when

- ***There is dirt in the A/C system***
- ***The compressor has seized or has been replaced for any reason***
- ***The condenser or evaporator are replaced for any reason***
- ***The A/C system is leaking and there is no more refrigerant***
- ***The A/C system was open for 24 hours or more.***

- Remove right headlight assembly. See ⇒ 630 Lights.

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- Remove refrigerant pressure line mounting bolts (**A**) from receiver/drier.
  - ♦ Plug lines immediately.
  - ♦ Disconnect high pressure switch harness connector (**B**).
  - - Working beneath right front of car, remove splash shield retaining screws. Remove splash shield.
  - - Loosen receiver/drier mounting strap bolts and slide receiver/dryer down and out.
  - - Installation is reverse of removal.

CAUTION!

Always replace O-rings when reconnecting refrigerant lines.

- Recharge system following equipment manufacturer's instructions.

A/C system fluid specifications	
Fluid	**Quantity**
R-134a refrigerant	740 ± 25 g (2 lb ± 1 oz.)
Refrigerant oil	PAG oil

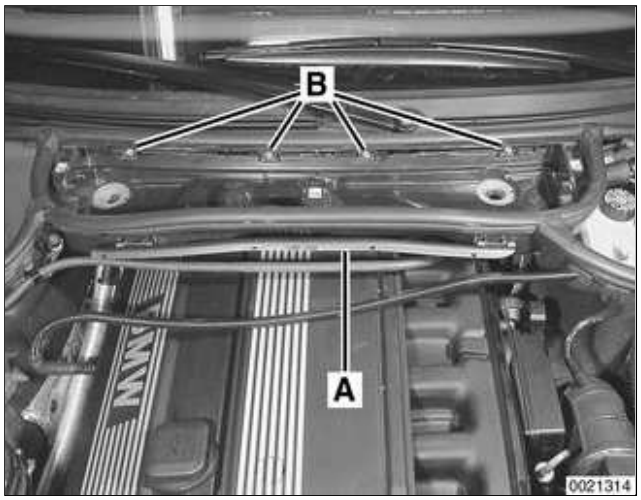
A/C expansion valve, removing and installing

- Following manufacturer's instructions, connect an approved refrigerant recovery/recycling /recharging unit to A/C system and discharge system.

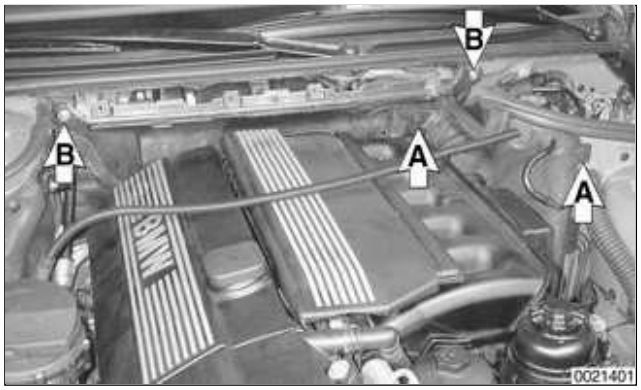
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WARNING!

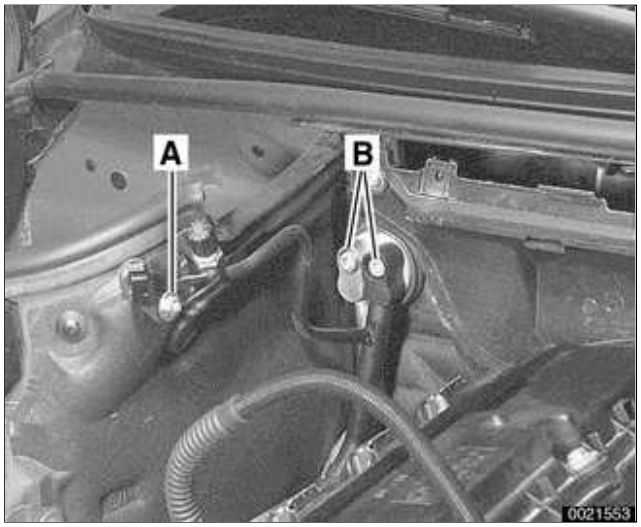
Do not discharge/charge the A/C system without proper equipment and training. Damage to the vehicle and personal injury may result.



- Remove housing for interior ventilation microfilter.
  - Remove upper cover and microfilter.
  - Open wiring harness loom (**A**) and remove wires.
  - Unfasten screws (**B**) and remove lower housing.

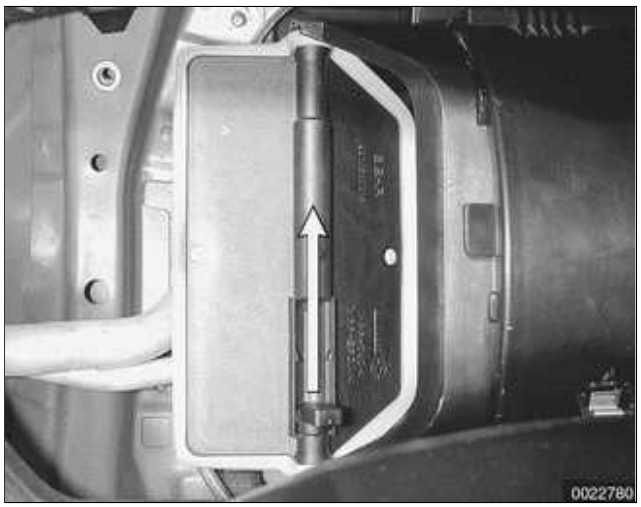


- To remove heater bulkhead cover:
  - Remove engine compartment side trim panel. Turn locking clips (**A**) and slide trim panel up.
  - Remove heater bulkhead cover mounting screws (**B**) and lift cover off bulkhead.



- Working in right rear of engine compartment, detach A/C lines:
  - Remove A/C recharging port bracket mounting nut (**A**).
  - Remove allen bolts (**B**) at bulkhead. Release and plug open A/C lines.

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- Working inside right side of cowl, pull up on lever (**arrow**) and detach right air intake flap from blower housing.
  - Working in right front of IHKA housing, detach double pipe (A/C line) from expansion valve.
  - ♦ Lay double pipe aside.
  - ♦ Plug up open A/C ports.
  - Remove expansion valve mounting bolts and remove valve.
  - Installation is reverse of removal.

CAUTION!

Always replace O-rings when reconnecting refrigerant lines.

- Recharge system following equipment manufacturer's instructions.

A/C system fluid specifications	
Fluid	**Quantity**
R-134a refrigerant	740 ± 25 g (2 lb ± 1 oz.)
Refrigerant oil	PAG oil

A/C evaporator, removing and installing

- Following manufacturer's instructions, connect an approved refrigerant recovery/recycling /recharging unit to A/C system and discharge system.

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- Drain engine coolant. See ⇒ 170 Radiator and Cooling System.

- Remove complete IHKA housing as described earlier.

- Remove heater core as described earlier.

- Working on left side of IHKA housing:

♦ Detach evaporator temperature sensor electrical harness connector and pull out sensor.

♦ Detach wiring harness from housing.

♦ Detach linkage from fresh air distribution motor.

- Working on right side of IHKA housing:

♦ Unclip and remove fresh air/recirculation motor.

♦ Remove evaporator cover mounting screw and remove cover.

- Detach and remove microswitch at side of IHKA housing.

- Working in front of IHKA housing:

♦ Remove blower housing mounting screws. Lift out blower housing.

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- Remove double coolant pipe.

- Pry off evaporator housing retaining clips and remove cover. Pull evaporator and expansion valve out of bottom of housing.

- If installing new evaporator, switch over expansion valve. Use new sealing O-rings.

CAUTION!

Do not bend cooling fins on evaporator. If necessary, straighten with fin comb.

- Installation is reverse of removal.

- Make sure electrical harnesses are routed as before.

- Align guides and clips correctly.

- Recharge system following equipment manufacturer's instructions.

A/C system fluid specifications	
Fluid	**Quantity**
R-134a refrigerant	740 ± 25 g (2 lb ± 1 oz.)
Refrigerant oil	PAG oil

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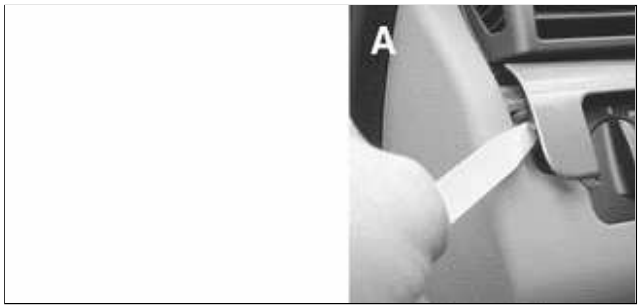
650-1

General

This section covers the BMW factory-installed sound system, including radio, amplifier and speaker removal. Radio antenna information is also included.

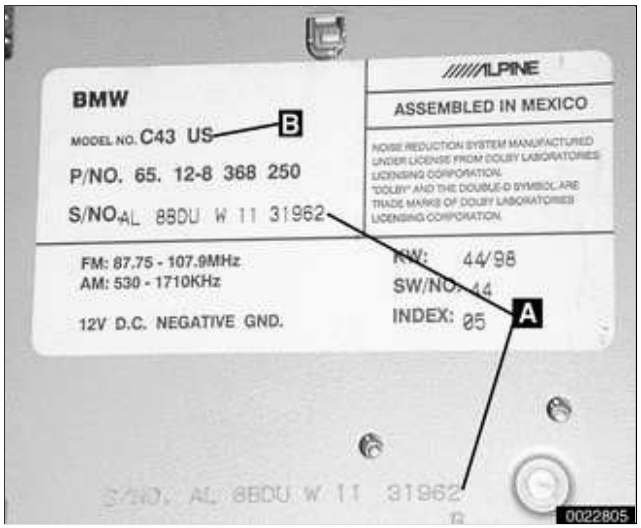
Special tools

Use BMW special tool 00 9 321 or equivalent plastic prying tool to pry out plastic interior parts without damage or marring.



- Plastic prying tool BMW 00 9 321

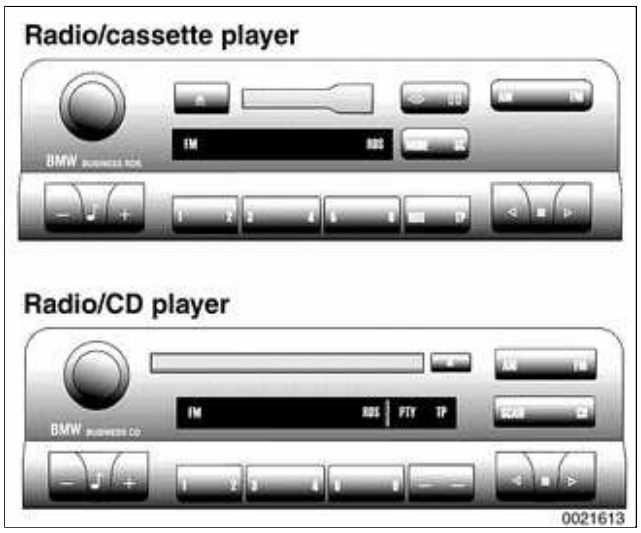
General



- A tag on the bottom of the radio contains the serial number (**A**) and model number (**B**).

Sound system

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The standard E46 radio features a cassette player. The optional radio has a single in-dash CD player. Both radios are prewired for the optional CD changer that mounts in the trunk. Another option, the On-Board Monitor, integrates GPS navigation with radio and IHKA controls. Basic radio controls are also incorporated in the steering wheel.

Sound system components are interconnected via K-bus. Theft proofing of the radio by code is no longer required as the radio will not function without the K-bus connection and a valid signal from the instrument cluster.

Other features of the sound system include:

- Autostoring of stations
- Speed dependent volume
- Telephone muting

Diversity antenna, described later in this group, is optional on some models and standard on the Convertible and Sport Wagon.

RDS

Radio Data System (RDS) is a transmit and receive system operated in the FM band. It is a data service offered by radio stations in which the information is transmitted inaudibly with the audio programs. The name of the station is displayed in the radio when the RDS system is active. Program identification, program service name and RDS quality are also displayed.

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Troubleshooting

Although electronic radio and sound system troubleshooting is beyond the scope of this manual, there are number of self-tests that are possible with the standard BMW radio installed in E46 cars.

Radio test functions are activated by pressing the M button within 8 seconds of switching the radio on. Hold it pressed in for 8 seconds to start the tests.

The test functions include:

- Radio serial number
- Software version display
- Speed dependent volume control adjustment
- Station signal strength, including FM frequency set, signal strength and quality of signal received
- AM frequency set and signal strength

The test also checks antenna functions:

- Antenna signal strength (F number) indicates the quality of the signal received by the antenna. The scale ranges from 0 to 15, with the optimum value being 15. If the value falls below 10, radio stations can not be listened to in stereo.

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650-2

Radio and Audio Accessories

Radio, removing and installing

CAUTION!

- ***Before beginning work on the radio or sound system, verify that the radio is an original equipment BMW radio and that the wiring harness has not been modified.***

- ***Servicing of aftermarket sound equipment should be referred to an authorized agent of the equipment's manufacturer.***

Note:

On-Board Monitor removal is covered in ⇒ 640 Heating and Air Conditioning.

- Prying gently, remove right dashboard trim, then center dashboard trim.

CAUTION!

To avoid marring interior trim, work with a plastic prying tool.



Remove radio mounting screws (**arrows**).

- Pull radio out of instrument panel opening. Detach electrical harness connector and antenna lead.

- Installation is reverse of removal.

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Amplifier

In all models the sound system amplifier is installed behind the trim on the left side of the car.

- Sedan or Coupe: To access amplifier, carefully remove trunk trim clips on left side and peel back trim.



- Sport Wagon: Remove left cargo compartment trim cover. Sound system amplifier (**arrow**) is behind sound insulation.

- Convertible:

  - Disconnect battery negative terminal.
  - Remove lower section of rear seat left side trim.
  - If necessary, remove convertible top module. See ⇒ 541 Convertible Top.
  - Amplifier is attached to side wall.

CD changer

The optional CD changer is located in the left side of the trunk behind the trim panel. An access door allows loading of up to 6 CDs.

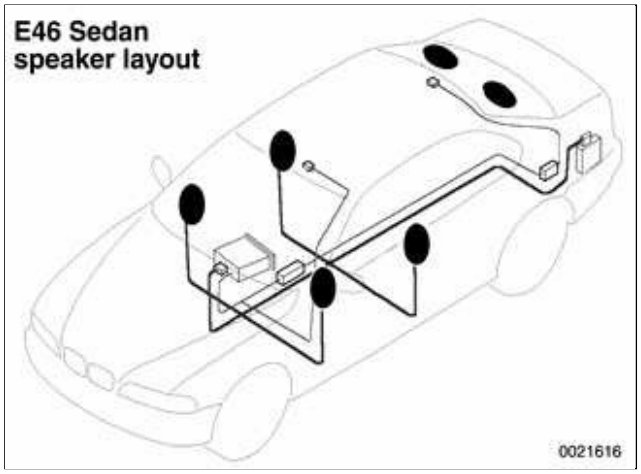
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650-3

Speakers

Each model in the E46 model line-up features a slightly different speaker setup. Speaker and other component locations also vary depending on the type of sound system installed. Some of the common speaker installations are covered in this section.



- Sedan and Sport Wagon: The standard installation is six speakers, one in each door and two in the rear. The rear speakers in the Sedan are in the parcel shelf. The rear speakers in the Sport Wagon are mounted on the left and right wheel housings behind trim covers.

Coupe: A tweeter and a mid-range speaker are installed in one housing unit in each front door panel. Another speaker pair is in the left and right rear side trim panels.

Convertible: The standard speaker set-up consists of four speakers mounted in the rear side trim panels, two on each side. One speaker on each side is a 130 mm wide band and the other is a tweeter.

The Harman/Kardon system incorporates an additional subwoofer installed in the trunk. The amplification for this subwoofer comes from the main sound system amplifier.

In the Convertible, the subwoofer is installed in the ski bag cover. It is hinged so that it can be swung aside when the ski bag is used. A magnet on the subwoofer cover holds it inplace against the rear bulkhead while the ski bag is used. The subwoofer functions in either position.

Also in the Convertible, the sound system receives a signal from the rear

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window defroster relay when the top is lowered. This switches off the stereophonic function.

Door mounted speaker, removing

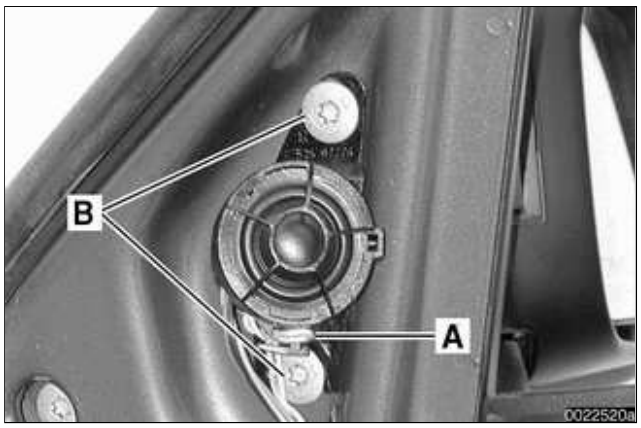
WARNING!

All E46 cars are equipped with front door airbags. Rear door airbags are optional. Before performing any work involving airbags, disconnect the negative (-) battery cable. See ⇒ 721 Airbag System (SRS).

CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

- Remove interior door panel as described in ⇒ 411 Doors.



➢ Detach electrical harness connector (**A**) and remove speaker mounting screws (**B**).

- Remove speaker.

Rear side panel speaker, removing

- Disconnect battery negative terminal.

CAUTION!

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Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

- Remove lower section of rear seat side trim.

- If necessary, remove convertible top module. See ⇒ 541 Convertible Top (left side only).

- Speaker is attached to side wall.

Rear speaker, removing and installing



- Working at rear parcel shelf, pry speaker cover by inner edge and remove.

CAUTION!

To avoid marring interior trim, work with a plastic prying tool.

- Remove mounting screws, lift up speaker and detach electrical harness connector.

- When reinstalling, make sure speaker and harness are seated as before.

Subwoofer, removing

- Coupe:

- Working in trunk under parcel shelf, remove subwoofer mounting

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screws.

- Unhook and pull subwoofer down. Remove electrical harness connector.

- Convertible:

- Working in trunk, unhook and swing out subwoofer.

- Squeeze plastic harness cover and remove.

- Detach electrical harness connector.

- Using plastic pry tool, gently pry subwoofer at bottom left and pull out.

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650-4

Antenna

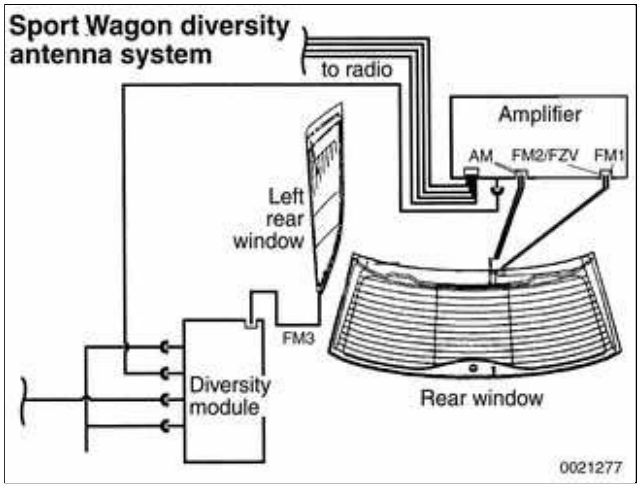
Antenna and diversity

The antenna used for the radio, telephone and FZV remote entry system is integrated with the rear window defogger in the Sedan and Coupe models.

Convertible and Sport Wagon models feature a diversity antenna system to provide the strongest possible radio station signal to the sound system.

In this system there are two (or more) antennas. Both the main and the auxiliary antenna(s) receive radio signals and both signals are amplified in separate amplifiers. The signals are then transmitted to the diversity switching module, which locks onto the strongest signal and sends it to the radio receiver.

Sport Wagon antenna system

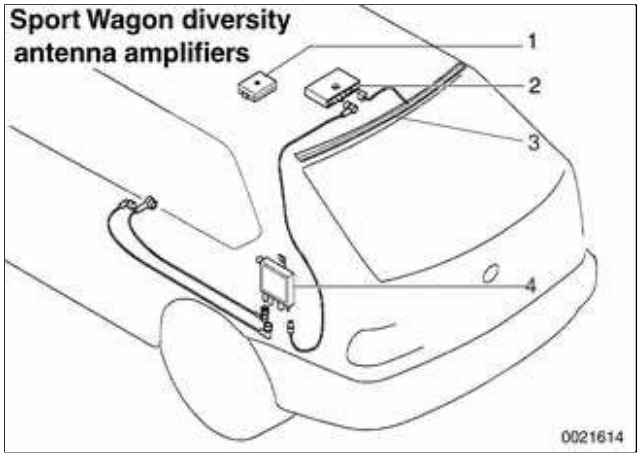


The diversity antenna system on the E46 Sport Wagon consists of the following;

- FM1 antenna in rear window (right half)
- FM2 antenna in rear window (center)
- FM3 antenna in left rear side window
- AM antenna in rear spoiler

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- FZV (keyless entry) antenna combined with FM2 antenna



The FM1/FM2 antenna amplifier is located beneath the rear spoiler. The signal from this amplifier is transmitted to the diversity module in the cargo compartment behind the left trim panel.

1 - Suppression filter

2 - Antenna amplifier

3 - AM antenna

4 - Diversity module

The FM3 antenna has a separate amplifier integrated into the diversity module. The module will select the clearest signal from the three antennas and transmit that to the sound system.

The AM antenna is glued to the bottom of the rear spoiler.

Convertible antenna system

The diversity antenna system on the E46 Convertible consists of the following:

- Main antenna mast on left rear fender
- Auxiliary antenna in convertible top storage cover
- Main antenna amplifier, mounted directly below the antenna mast
- Auxiliary antenna amplifier, mounted on convertible top storage cover and powered through antenna lead

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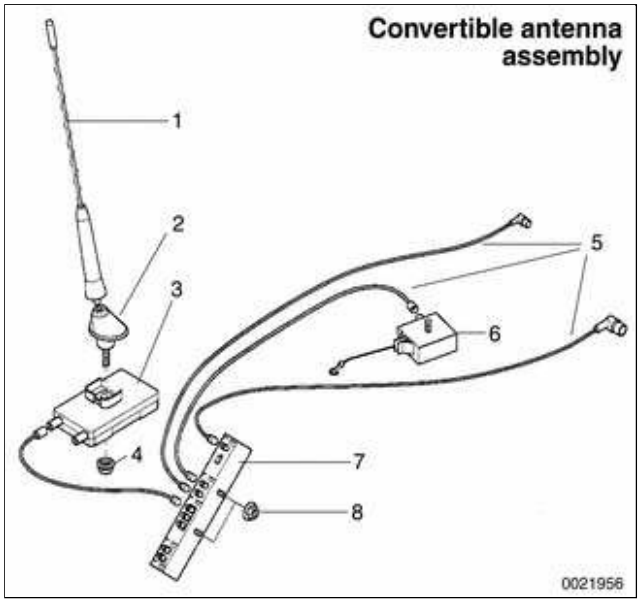
- Diversity switching module, mounted below antenna mast in trunk

More information on the rear window defogger/antenna system is in ⇒ 640 Heating and Air Conditioning.

Note:

The telephone antenna is wound around the main antenna mast.

Antenna, removing (Convertible models)



- Unscrew and remove antenna mast.

1 - Antenna mast

2 - Antenna head

3 - Antenna base

4 - Nut (M5)

5 - Antenna cable

6 - Antenna FM amplifier

7 - Antenna diversity amplifier

8 - Nut (M6)

- Detach and remove wheel housing trim liner in left side of trunk.

- Through elongated hole of antenna retaining bracket, unscrew M5 nut.

- This releases antenna head from base.

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- Place antenna base down on bracket.
- Remove antenna head from above fender.

- To remove base, slide toward rear of car, then detach cable connections.

- When installing, make sure the offset of antenna head points toward back of car.

Antenna amplifier, accessing

- Convertible main antenna amplifier:

- Detach and remove wheel housing trim liner in left side of trunk.
- Antenna amplifier is mounted below antenna bracket.

- Convertible auxiliary antenna amplifier:

- Open convertible top compartment lid.
- Auxiliary amplifier is attached to left rear corner of lid.



Sedan or Coupe antenna amplifier:

- Remove left roof pillar (C-pillar) trim panel as described in ⇒ 513 Interior Trim to access amplifier.

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- Sedan or Coupe antenna suppressor:

♦ Remove right roof pillar (C-pillar) trim panel to access suppressor.



➢ Sport Wagon FM3 antenna/diversity module:

♦ Remove left cargo compartment trim cover to gain access to module (**arrow**).

- Sport Wagon FM1/FM2 antenna amplifier:

♦ Remove rear spoiler. See ⇒ 412 Trunk Lid, Tailgate.

♦ Amplifier is in center of rear window beneath spoiler.

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720-1

General

This section covers repairs to the seat belts.

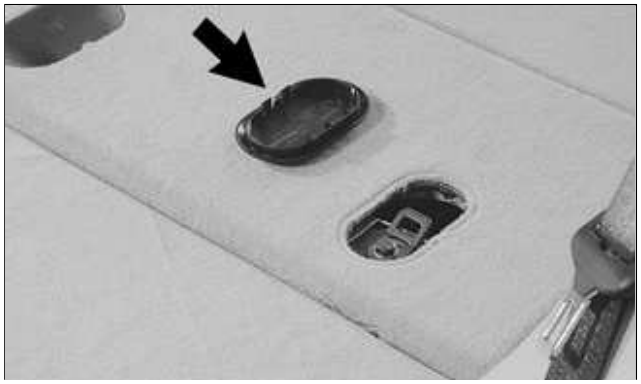
Multiple Restraint System (MRS II) electronics integrate seat belt operations and airbag deployment. Airbag repair information is covered in ⇒ 721 Airbag System (SRS).

All E46 models are equipped with 3-point shoulder belts at four seating positions.

- Sport Wagon models are equipped with an additional 3-point shoulder belt in the center of the rear seat.
- Sedan and Coupe models are equipped with a lap belt in the center rear seat position.
- Convertible models are equipped with seat-integrated seat belt system (SGS) in the front seats.

Child safety anchors

Sport Wagon models are equipped with three child safety harness anchors behind the rear seat in the cargo compartment floor.



- Remove plastic cover (**arrow**) to access safety anchor eye.

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Troubleshooting

The seat belt reel should lock when driving quickly through curves, during severe braking or in case of a collision. The automatic reel does not require any servicing and should never be opened.

In case of an accident, follow the seat belt troubleshooting procedures presented in ⇒ Table a. Troubleshooting the automatic seat belt system.

Note:

The rear bench seat belt strap may not retract fully due to increased friction between strap and seat cover. A small remaining loop in belt strap when fully retracted is acceptable.

WARNING!

- ***For maximum protection from injury, seat belts should be replaced as a set (including all hardware), if they are subject to occupant loading in a collision.***
- ***Seat belts should not be modified or repaired. The seat belt mounting points should not be changed or modified.***
- ***Do not bleach or dye seat belt webbing. Webbing that is severely faded or re-dyed will not meet the strength requirements of a collision and must be replaced. Clean belts***

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with a luke-warm soap solution only.

- ***Seat belts should be periodically inspected for webbing defects such as cuts or pulled threads.***

- ***Immediately after replacing a damaged or worn seat belt, destroy the old belt to prevent it from being used again.***

Table a. Troubleshooting the automatic seat belt system

Problem	Probable cause	Repairs
Damage to seat belt:	Accident in which bumper impact absorbers were permanently deformed	Replace complete automatic seat belt. Also check and replace, if necessary: ♦ Seat belt mounting on car body ♦ Seat belt mounting on seat runner
Belt creased, unraveled, pinched, cut or melted	Seat belts aged or worn	Replace complete automatic seat belt.
Belt buckle or belt lock plastic casing worn, damaged or missing		
Seat belt buckle is not ejected with spring pressure when red button on seat belt lock is pressed	Seat belt lock mechanism worn or damaged	Replace seat belt lock.
Seat belt automatic reel does not lock when pulled out suddenly.	Automatic reel defective	Replace reel assembly.
Seat belt automatic reel jams when pulled out.	Automatic reel loose	Tighten reel mounting bolt.
	Return spring broken inside reel	Replace reel assembly.

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Problem	Probable cause	Repairs
Seat belt does not retract automatically. (See note.)	Automatic reel loose	Tighten reel mounting bolt.
	Return spring broken inside reel	Replace reel assembly.
Automatic belt squeaks when belt fastened or unfastened.	Excessive friction in belt guides	Replace reel assembly.
	Automatic reel loose	Tighten reel mounting bolt.
	Return spring broken inside reel	Replace reel assembly.
Seat belt pyrotechnic tensioner triggered	Accident triggered pyrotechnic deployment	Replace complete automatic seat belt. Also check retaining bracket of belt tensioner for twist.
Convertible models only:		
Front seat back requires excessive force to lock or unlock	Accident damage to seat via seat belt	Replace front seat.
Seat back lock warning lamp on when seat back is locked; or warning lamp lights up when seat back is shaken	Seat back lock microswitch defective	Replace microswitch
	Microswitch electrical harness connectors loose or defective	Repair electrical leads.
	Seat back lock is damaged	If fault persists, replace front seat.
Contact surface of inertia reel warped	Accident damage	Replace front seat.
Seat back warped or deformed	Accident damage	
Head restraint carrier not parallel	Accident damage	
Seat movement sticky or sluggish at some point in its range; unusual noises	Accident damage (side)	
Front seat shows evidence of contact with body structural part (e.g., door)	Accident damage (side)	
Front seat shows evidence of contact with external objects	Accident damage (rollover)	

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Front Seat Belt Assembly

Front seat belt tensioner, removing and installing

The front seat belt locks are equipped with pyrotechnic (explosive charge) automatic tensioners. These tensioners are designed to automatically retract and tension the seat belt by 55 mm (approximately 2 inches) in the event of an accident.

WARNING!

- ***Pyrotechnic seat belt tensioners are powerful devices and should be handled with extreme care. Incorrect handling can trigger the tensioner and cause injury.***
- ***BMW recommends that all repair or replacement work on pyrotechnic devices must be carried out by a qualified BMW technician.***
- ***Be sure to disconnect the battery and wait 5 seconds before attempting to work on pyrotechnic devices.***
- ***Pyrotechnic devices cannot be repaired. Always replace them.***
- ***Never treat pyrotechnic components with cleaning agents or grease.***

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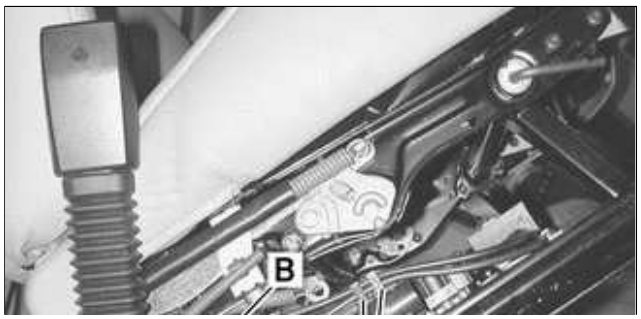
- ***Do not expose pyrotechnic components to temperatures above 75°C (167°F).***
- ***Pyrotechnic components can only be tested electrically when installed, using BMW service tester DIS, MoDiC or equivalent scan tool.***
- ***Do not fire a pyrotechnic gas generator prior to disposal. It must be fired by a special disposal company or shipped back to BMW in the packaging of the new components.***
- ***During body straightening and welding with an electric arc welder, always disconnect the battery and the connection to the pyrotechnic gas generators.***

- Detach battery negative (-) cable in luggage compartment.

CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

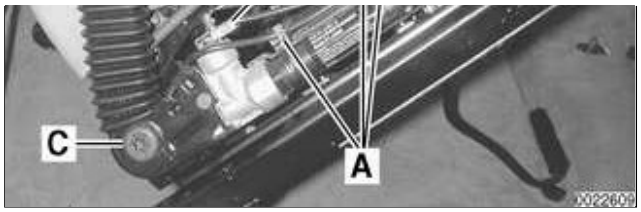
- Remove front seat as described in ⇒ 520 Seats.



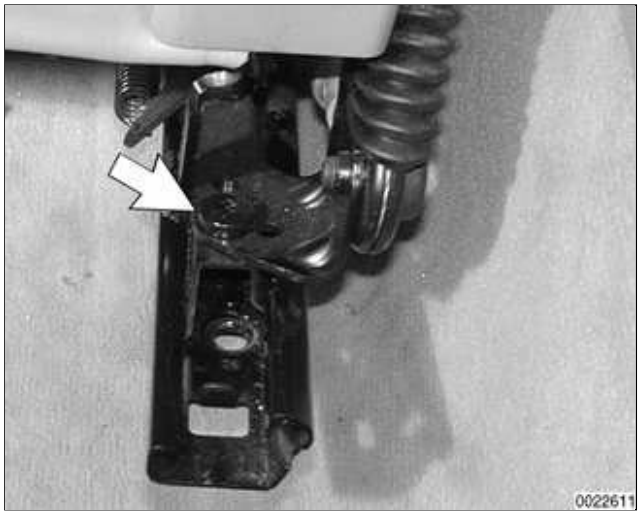
Remove pyrotechnic belt tensioner:

- Detach tensioner harness connector from seat rail by cutting wire tie (**A**).

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- Detach harness connection (**B**).
- Remove tensioner mounting bolt (**C**).



➢ Check tensioner mounting bracket (**arrow**) for damage or bending. Replace if necessary.

CAUTION!

A bent tensioner mounting bracket may make it impossible to adjust seat height.



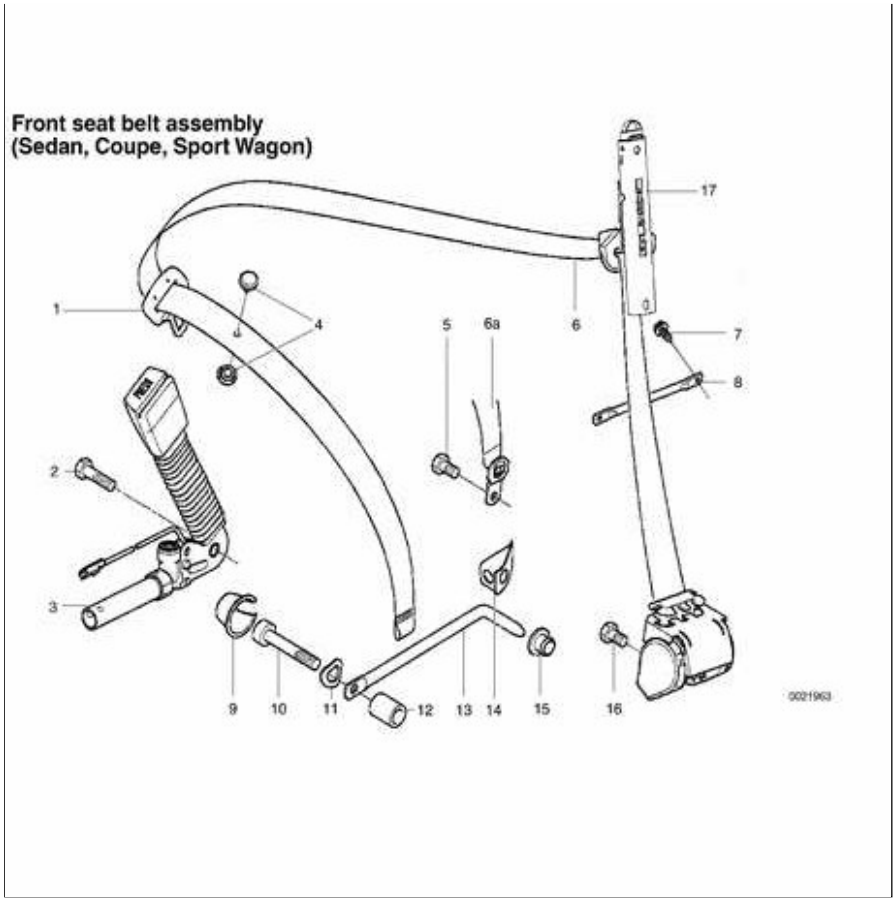
➢ When reinstalling:

- Replace wire ties to relieve tension on the pyrotechnic belt tensioner harness connector.
- Make sure tensioner harness connector mounting bracket (**arrow**) is installed correctly.

Tightening torques	
Front seat to floor (M10 fastener)	45 Nm (33 ft-lb)
Seat belt to seat	48 Nm (35 ft-lb)
Tensioner mounting bracket to seat rail	24 Nm (18 ft-lb)
Tensioner to mounting bracket	48 Nm (35 ft-lb)

Front seat belt

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assembly (Sedan, Coupe, Sport Wagon)

1 - Seat belt buckle

2 - Tensioner mounting bolt

- tighten to 48 Nm (35 ft-lb)

3 - Seat belt lock with pyrotechnic tensioner

4 - Seat belt stop button

5 - Seat belt anchor bolt

- tighten to 48 Nm (35 ft-lb)

6 - Seat belt reel assembly

6a - Seat belt anchor end (Sedan/Sport Wagon models)

7 - Bolt M8

8 - B-pillar cross-brace

9 - Plastic cap

10 - Bolt M10

- tighten to 31 Nm (23 ft-lb)

11 - Spring washer

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12 - **Spacer**

13 - **Seat belt anchor bar (Coupe only)**

14 - **Cap**

15 - **Grommet**

16 - **Seat belt reel mounting bolt M10**

- tighten to 31 Nm (23 ft-lb)

17 - **Seat belt height adjuster**

Front seat belt reel, removing and installing (Sedan, Coupe or Sport Wagon models)

- Detach battery negative (-) cable in luggage compartment.

CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

- Remove front seat as described in ⇒ 520 Seats.

- Coupe models: Working just inside door sill.

- Pry off plastic protective cap over end of seat belt anchor bar.

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- Remove anchor bar bolt and slip off end of seat belt from bar.

Note:

Replace anchor bar if it is bent.



➢ Prying gently upward, remove plastic door sill protector strip.



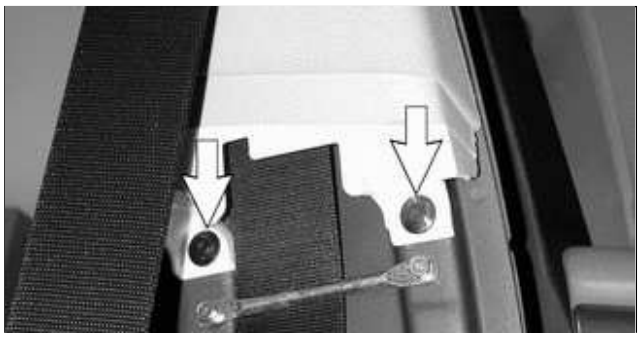
➢ Sedan or Sport Wagon models: Remove lower B-pillar (door pillar) plastic trim.

- Pry gently along bottom of trim to disengage clips from pillar.
- Slide trim down and out.

- Coupe models: Remove rear side panel as described in ⇒ 411 Doors.

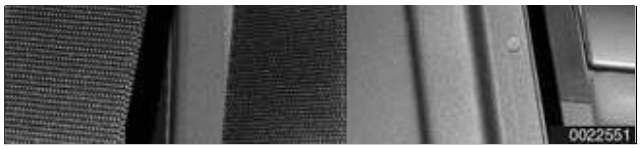
Note:

Partially peel rubber door seal(s) away from B-pillar.



➢ Remove upper B-pillar (door pillar) plastic trim expansion rivets (**arrows**).

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➢ Pull B-pillar upper trim down to remove.



➢ Remove automatic reel from B-pillar:

- ♦ Remove upper seat belt anchor bolt (**A**).
- ♦ Remove cross-brace mounting bolts (**B**).
- ♦ Remove sound insulation at base of B-pillar. Then remove automatic seat belt reel mounting bolt (**C**).
- ♦ Lift out reel.
- \- If it is necessary to remove sliding seat belt height adjuster, unscrew mounting bolts from B-pillar.
- \- Installation is reverse of removal.
- ♦ Install automatic reel housing to

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B-pillar by sliding tab into locating slot.

Tightening torques	
Front seat to floor (M10 fastener)	45 Nm (33 ft-lb)
Seat belt anchor bar to door sill	31 Nm (23 ft-lb)
Seat belt to seat	48 Nm (35 ft-lb)
Seat belt to B-pillar sliding anchor	31 Nm (23 ft-lb)
Seat belt reel to B-pillar bottom	31 Nm (23 ft-lb)
Sliding seat height adjuster to B-pillar	24 Nm (18 ft-lb)

Seat-integrated seat belt system (SGS) (Convertible models)



The front seats of E46 Convertible models are designed with integrated seat belts. In this way, the forces acting on a front seat occupant during a collision are channeled to the reinforced floor.

All belt fastening points move with the seat as it is adjusted. This ensures the best possible body strapping regardless of seat position or occupant size. With the shorter free belt length, the occupant is held more reliably with vehicle deceleration.

The fixed anchor point and the seat belt lock/tensioner are mounted on the seat frame. The upper seat belt guide is attached to the headrest. In this way the belt is optimally positioned regardless of headrest position.

The inertia reel is attached to the inside of the seat backrest. The mechanism is

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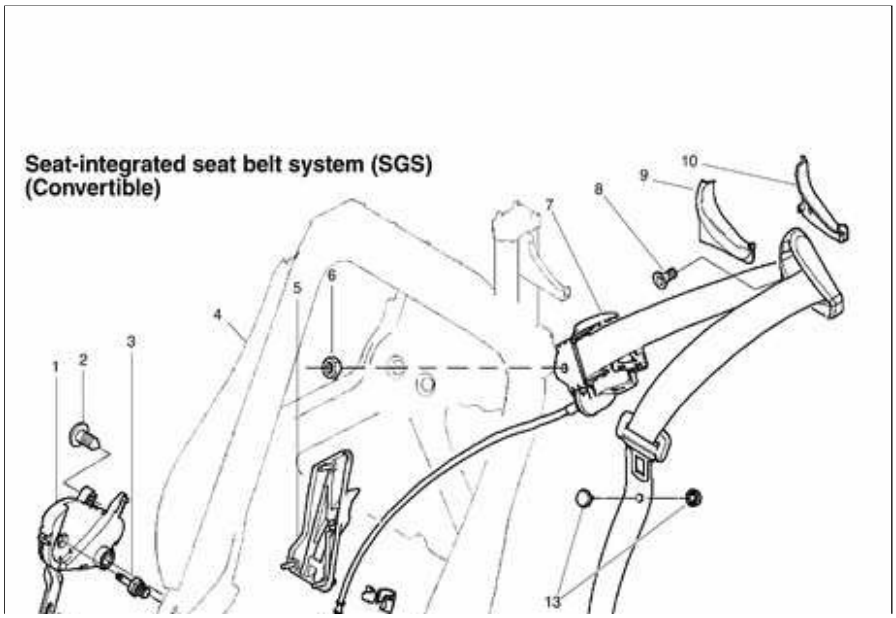
connected to the backrest hinge through a lever and a cable drive (coupler mechanism). As the angle of the backrest is adjusted, the cable drive will change the angle of the inertia lock. In this way the reel is in the proper position for locking at any seat back angle.

The seat belt lock and tensioner on the SGS system is a pyrotechnic device similar to that on other E46 models. When working on SGS belts, be sure to read the warnings and cautions in the procedure for front seat belt tensioner removal and installation, earlier in this group.

Note:

- *SGS seat belt removal can only be carried out with the seat out of the car. See ⇒ 520 Seats.*

- *Once the seat has been removed, the seat backrest must be partially disassembled. The accompanying illustration provides information on SGS component locations and fastener torques.*



Seat-integrated seat belt system (SGS) (Convertible)

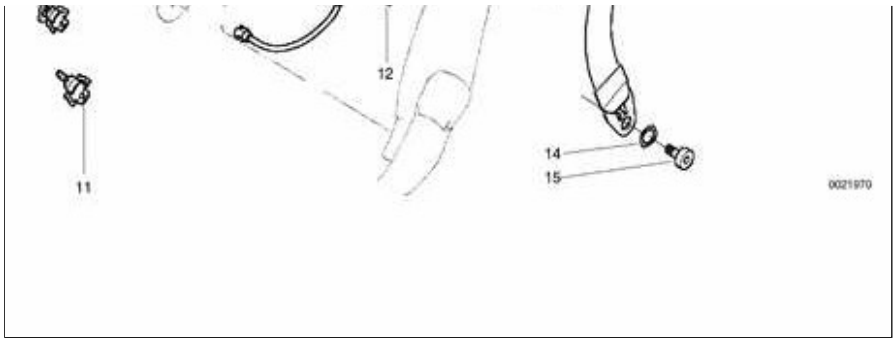
1 - Coupler mechanism

2 - Self-tapping screw M4.2

- tighten to 2.5 Nm (22 in-lb)

3 - Threaded pin

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4 - **Front seat backrest**

5 - **Support**

6 - **SGS belt reel mounting nut M10**

- tighten to 39 Nm (29 ft-lb)

7 - **SGS inertia reel assembly**

8 - **Torx bolt M6**

- tighten to 4.5 Nm (40 in-lb)

9 - **Seat belt guide cover, front**

10 - **Seat belt guide cover, rear**

11 - **Connector**

12 - **Clip**

13 - **Seat belt button**

14 - **Bushing**

15 - **Bolt M10 (self-locking, always replace)**

- tighten to 45 Nm (33 ft-lb)

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720-3

Rear Seat Belt Assembly

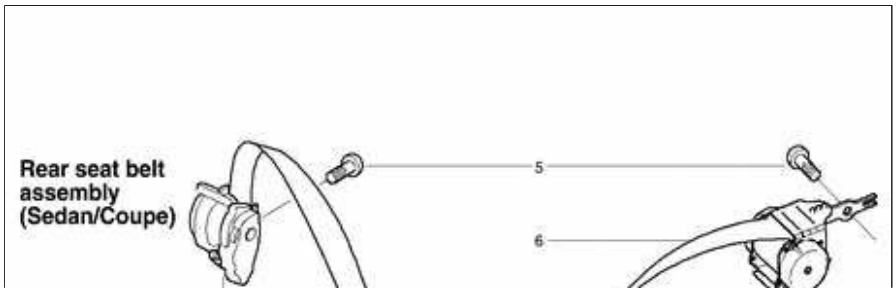
Rear seat belts (Sedan or Coupe models)

- Remove rear parcel shelf to access shoulder belt assembly mounting bolts.
- Remove rear seat cushion to access rear seat belt lock mounting bolts. See ⇒ 520 Seats.
- The accompanying illustration provides information on rear seat belt component locations and fastener torques.
- When installing seat belt lock straps:

♦ Install right lock strap (which is shorter) underneath middle lock strap.

♦ Install left lock strap underneath middle lap belt strap.

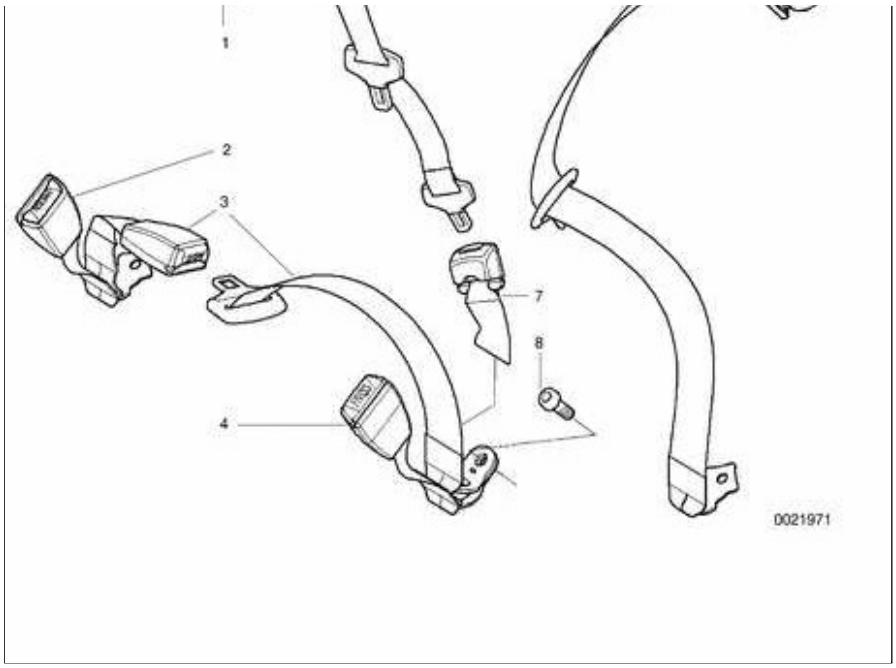
♦ Metal strap ends must rest against stop on floor underneath seat.



Rear seat belt assembly (Sedan/Coupe)

1 - Center shoulder belt reel assembly (if

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equipped)

2 - **Right shoulder belt lock**

3 - **Lap-belt assembly**

4 - **Left shoulder belt lock**

5 - **Bolt M10**

- tighten to 31 Nm (23 ft-lb)

6 - **Left shoulder belt reel assembly**

7 - **Center shoulder belt lock (if equipped)**

8 - **Bolt M12**

- tighten to 31 Nm (23 ft-lb)

Rear seat belts (Sport Wagon models)

- Center shoulder belt:

- Remove shoulder belt guide trim at top of seat backrest. Feed belt out through slot in trim.

- Working in cargo compartment, partially remove backrest cover to access shoulder belt reel.

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- Remove shoulder belt reel mounting bolt inside backrest.

Note:

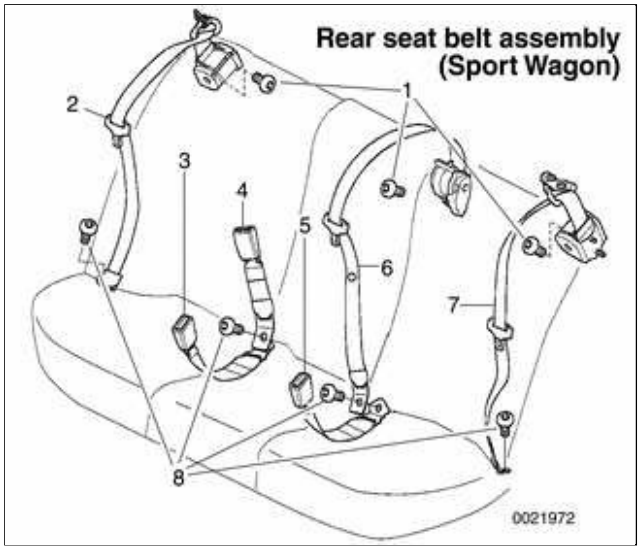
Remove bowden cable from backrest brackets and unhook from backrest release latch. Center seat belt reel can be then be removed.

- Outboard shoulder belt:

- Remove roof-pillar (C-pillar) trim.

- Remove center shoulder belt.

- Lift up rear seat cushion(s) to access rear seat belt lock mounting bolt(s).



The accompanying illustration provides information on rear seat belt component locations and fastener torques.

1 - Bolt M10 -tighten to 31 Nm (23 ft-lb)

2 - Right shoulder belt reel assembly.

3 - Center belt lock

4 - Right belt lock

5 - Left belt lock

6 - Center shoulder belt reel assembly

7 - Left shoulder belt reel assembly

8 - Bolt M12 -tighten to 31 Nm (23 ft-lb)

- When installing seat belt lock straps:

- Install right belt lock strap (which is shorter) underneath center belt lock

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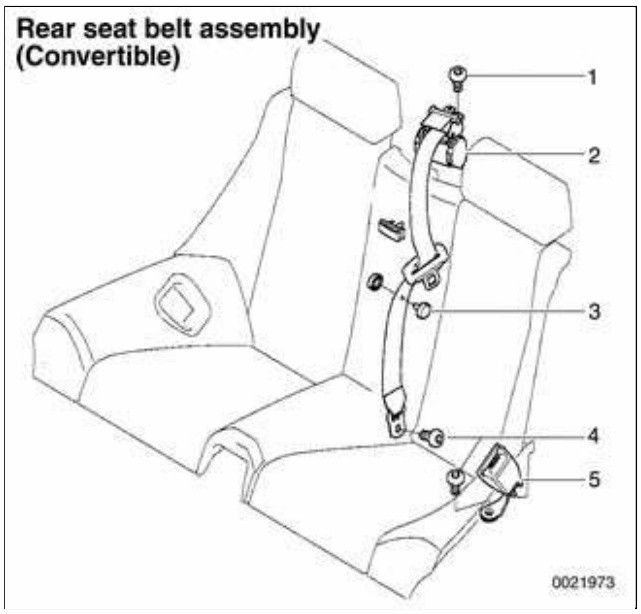
strap.

- Install left belt lock strap underneath center lap belt strap.
- Metal strap ends must rest against stop on floor underneath seat.

Rear seat belts (Convertible models)

- Access shoulder belt or seat belt lock mounting bolts:
- Remove center armrest.
- Push shoulder belts toward sides and feed out of top guides.
- Lift seat cushion up and forward to remove.
- Remove lower backrest securing screws located below backrest. Lift backrest straight up and unhook from tabs in back.
- Remove rear head restraints by pulling straight up.
- Remove cover of rollover protection bars for right and left side.
- Open convertible top compartment cover.
- Shoulder belt reels are bolted to convertible top storage compartment.

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The accompanying illustration provides information on rear seat belt component locations and fastener torques.

1 - Bolt M10 -tighten to 31 Nm (23 ft-lb)

2 - Left shoulder belt reel assembly.

3 - Seat belt stop button

4 - Left belt lock

5 - Bolt M12 -tighten to 31 Nm (23 ft-lb)

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721-1

General

This repair group covers airbag components. Airbag system repair and fault diagnosis is not covered here. Diagnostics, component testing, and airbag system repair should be carried out by trained BMW service technicians.

Note:

- *Airbags are also known as the Supplemental Restraint System (SRS). In the E46 cars the occupant safety system is called the Multiple Restraint System (MRS).*

- *Special test equipment is required to retrieve airbag fault codes, diagnose system faults, and reset/turn off the airbag indicator light. The indicator light will remain on until any problem has been corrected and the fault memory has been cleared.*

Individual airbag system components can only be tested electronically when installed in the car. BMW service testers DIS or MoDiC or equivalent must be used for diagnostic work.

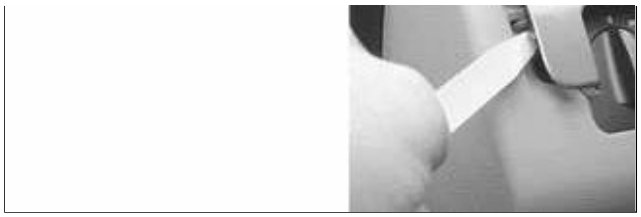
Special tools

Most airbag system repairs can be performed with normal shop tools. Use BMW special tool 00 9 321 or equivalent plastic prying tool to pry out plastic interior parts without damage or marring.



A Plastic prying tool BMW 00 9 321

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Airbag system

The E46 airbag system consists of the following:

- Driver airbag in the center of the steering wheel hub
- Passenger airbag in the right side of the dashboard
- Front side-impact airbags, one in each front door
- Head Protection System (HPS) airbags, one in each front roof pillar (A-pillar)

As an option, some cars may be equipped with:

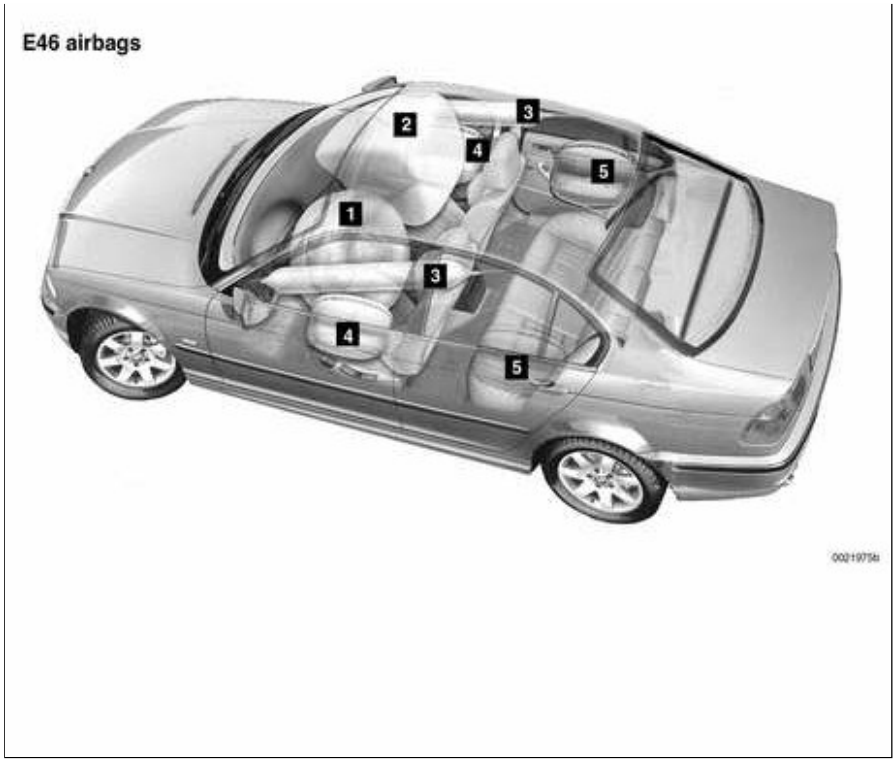
- Rear side-impact airbags, one in each rear door (4-door Sedan or Sport Wagon).

The airbags and seat belts are integrated into the Multiple Restraint System (MRS). The MRS control module is located on the center tunnel, underneath the rug below the parking brake handle.

E46 Airbags

1 - Driver air bag

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2 - **Passenger airbag**

3 - **Head Protection System (HPS) airbag**

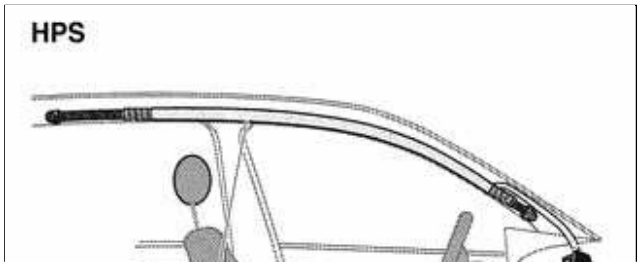
4 - **Front door side-impact airbag**

5 - **Rear door side-impact airbag (optional)**

2-stage airbag

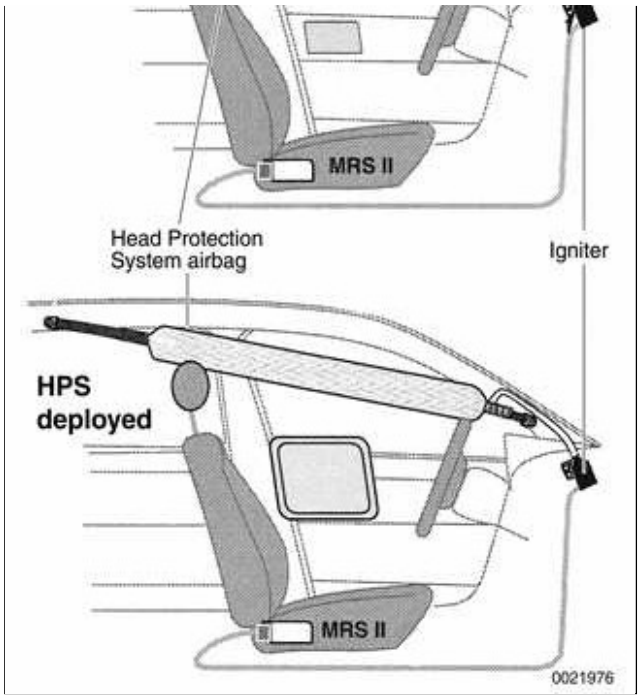
Beginning in the 2000 model year (9/1999 production) the front airbags were changed to a 2-stage style airbag. This ensures that the force of airbag inflation is not greater than necessary to provide protection. The airbags are designed to provide "soft" deployment if the acceleration sensor detects a low-speed impact, with a "hard" deployment only in higher speed impacts.

Head protection airbags (HPS)



This protective system covers a large area between the front roof pillar (A-pillar) and the rear section of the roof. A hollow flexible tube about 5 feet long and 1.5 inches in diameter is anchored inside the A-pillar and front roof rail and concealed by interior trim.

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Upon severe side impact, a gas generator unit fills the Head Protection System (HPS) tube with inert gas. The expanding tube pops out of the trim to form a straight tube 5.1 inches in diameter and stretched in a straight line from the lower windshield pillar to above the rear door. The inflated tube is located to prevent the front occupant's head from contacting the A-pillar, the B-pillar, or side window. The tube's sloping position allows protection for both short and tall people. The inflated tube is stiff enough to retain much of its effectiveness even if the window is broken. The HPS tube remains inflated for approximately 7 to 8 seconds to extend protection time in case the vehicle encounters additional side impacts during the crash.

Rear side-impact airbags

Similar to the standard-equipment front side-impact airbags, the rear airbags are built into the doors of sedan models. These were offered as a special order option on certain models only. They can be deactivated to protect infants or small children riding in the rear seat. Activation and deactivation can be performed by using either DIS or MoDiC BMW scan tools.

MRS deployment logic

Main sensing and triggering functions for the front-impact airbags and seat belt tensioners are combined into a single MRS control module located above the center tunnel, under the rug, beneath the parking brake handle.

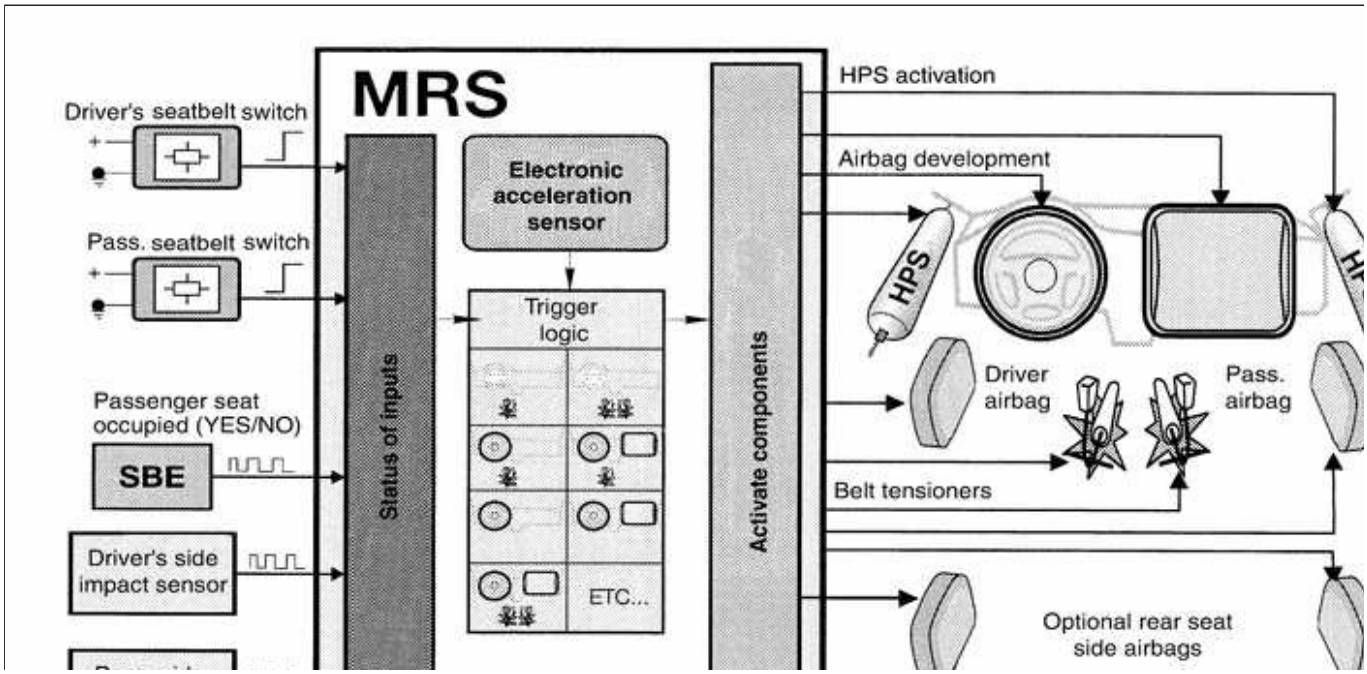
Side-impact and head protection airbags are controlled by separate sensors, one for each side of the vehicle.

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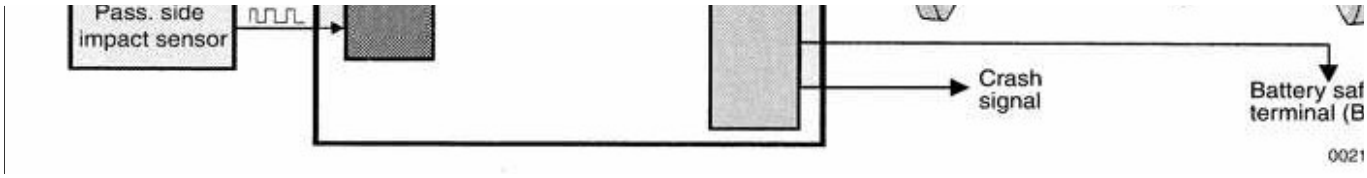
MRS deployment logic provides two thresholds for the activation of the safety system, depending upon the severity of impact and whether or not occupants have fastened their seat belts:

- Belts fastened, low impact speed: Lower deployment threshold. Only seat belt pyrotechnic tensioners are deployed.
- Belts fastened, high impact speed: Higher deployment threshold. Tensioners and front-impact airbags are deployed.
- Belts not fastened, low or high impact speed: Airbags are deployed.
- Passenger seat not occupied: Neither belt tensioner nor airbag is deployed on that side.

MRS



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Airbag indicator light

The MRS control module detects and stores system status.

The airbag indicator light in the instrument cluster displays the status of the airbag system when the ignition key is in "accessory" or ON positions.

- System normal: Indicator light comes on briefly, then goes out.
- System malfunction: Indicator light fails to come on.
- System malfunction: Indicator light comes on briefly, goes out and lights up again.

The airbag indicator light also comes on if the seat belt pyrotechnic tensioners have been triggered.

Warnings

When servicing airbag equipped cars, the following precautions must be observed to prevent personal injury.

WARNING!

- ***If the airbag indicator light is on, there is a risk that the airbags will not be triggered in case of an accident. Be sure to have the system inspected and repaired***

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immediately.

- ***Airbag(s) are inflated by an explosive device. Handled improperly or without adequate safeguards, the system can be very dangerous. Special precautions must be observed prior to any work at or near the airbags.***

- ***The airbag is a vehicle safety system. Serious injury may result if system service is attempted by persons unfamiliar with the BMW MRS II and its approved service procedures. BMW advises that all inspection and service be performed by an authorized BMW dealer.***

- ***Always disconnect the battery and cover the negative (-) battery terminal with an insulator before starting diagnostic, troubleshooting or service work not associated with the airbags, and before doing any welding on the car.***

- ***After disconnecting the battery, wait 5 seconds before beginning work on airbag components.***

- ***If an airbag has been activated due to an accident, BMW specifies that airbag components be replaced. For more information on post-collision airbag service, see an authorized BMW dealer.***

- ***Do not fire an airbag unit prior to disposal. It must be fired by a***

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special disposal company or shipped back to BMW in the packaging of the new components.

- ***When removing a fired airbag unit, avoid contact with the skin; wear gloves. In case of skin contact, wash with water.***
- ***Do not allow airbag system components to come in contact with cleaning solutions or grease. Never subject airbag components to temperatures above 167F (75C). When reconnecting the battery, no person should be inside the vehicle.***
- ***Always place an airbag unit that has been removed from its packaging with the padded side facing upward. Do not leave an airbag unit unattended.***
- ***If the airbag unit or airbag control module has been dropped from a height of meter (1 ft.) or more, the airbag unit should not be installed.***

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Airbag Electronics

Airbag harnesses and connectors

If airbag connection harnesses show visible signs of wear or damage, they must be replaced or repaired.

- To repair airbag harness:

- Disconnect negative (-) cable from battery and cover negative terminal with insulating material.
- Disconnect harness connector at airbag module or on intermediate plug.
- Cut through one cable, then the other, and repair.

CAUTION!

- ***Do not under any circumstances cut through both wires of an airbag harness at the same time.***
- ***Perform only one repair on an airbag harness wire. If more than one spot is damaged, replace the entire section of harness.***

MRS control module, replacing

- Disconnect negative (-) cable from battery and cover negative terminal with insulating material.

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CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

- Remove center utility tray between front seats. See ⇒ 513 Interior Trim.



➢ Cut open carpet on top of center tunnel to access MRS II module.

- Remove module mounting nuts and lift up control module. Detach electrical harness connector.

- Installation is reverse of removal.

♦ Be sure that MRS module ground cable is attached to the module mounting stud.

Side-impact crash sensor, removing and installing

- Make sure ignition key is OFF.

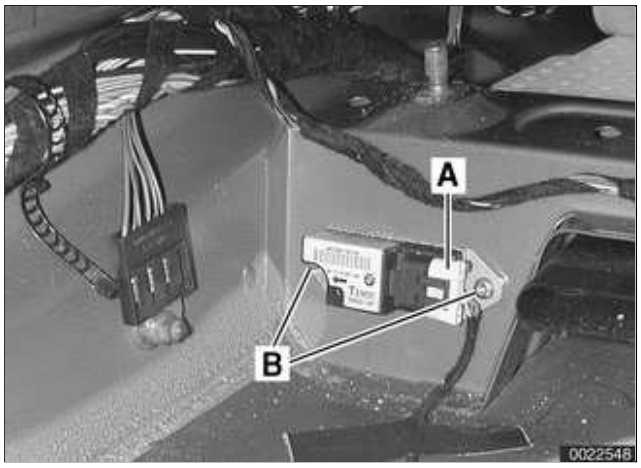
- Remove front seat. See ⇒ 520 Seats.



➢ Remove plastic door sill trim by lifting to release clips at one end, then sliding off. Fold up carpet towards rear seat floor. If necessary, remove floor level heater duct.

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- Remove electrical harness connector from crash sensor (**A**). Remove sensor retaining screws (**B**) and remove sensor. Note direction of sensor arrow before removing.

- Installation is reverse of removal.

Note:

Arrow on sensor must point to door sill.

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Airbags

Driver airbag, removing and installing

- Disconnect negative (-) cable from battery and cover negative terminal with insulating material.

WARNING!

After disconnecting the battery, wait 5 seconds before beginning work on airbag components.

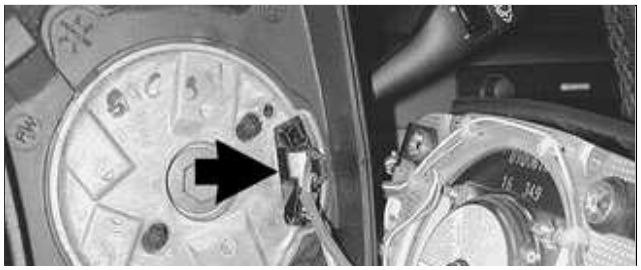
CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.



➢ Multifunction (MFL) steering wheel:

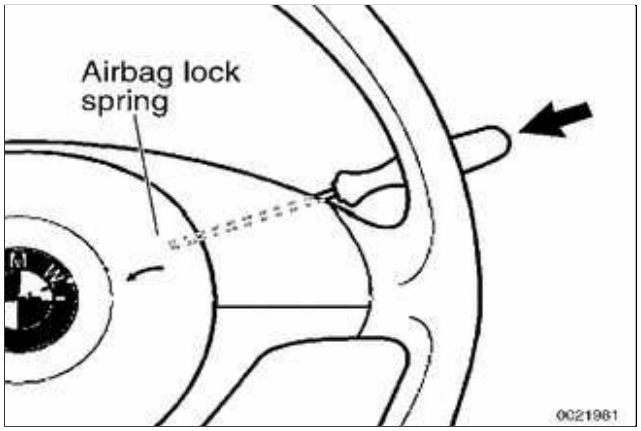
- Working behind steering wheel, completely loosen Torx screws (T30) while holding airbag in place.
- Support airbag unit to prevent it from falling out.



➢ Carefully lift airbag unit off steering wheel and disconnect harness connector (**arrow**) from rear of airbag unit.

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- Sport steering wheel:
  - Insert screwdriver through opening in rear of steering wheel and push against spring tension to release airbag unit lock.
  - Repeat procedure on other side of steering wheel.
  - Lift off airbag unit and detach electrical harness connectors.

WARNING!

- ***Store the removed airbag unit with the horn pad facing up. If stored facing down, accidental deployment could propel it violently into the air, causing injury.***
- ***Once an airbag is removed, the car must not be driven.***
- ***Do not connect the battery with the airbag disconnected. A fault code will be stored, setting off the airbag indicator light. Special tools are needed to reset the fault memory.***
- ***Once the airbag unit is installed and all other service procedures have been completed, start the engine and check that the airbag indicator light goes out. If***

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the indicator light stays on, the airbag system will not function as designed. Have the system diagnosed and repaired by an authorized BMW dealer.

- Installation is reverse of removal.

- MFL steering wheel: Torque airbag using specification listed below.

- Sport steering wheel: Press airbag unit mounting pins into spring locks in steering wheel until they snap in firmly.

CAUTION!

Do not pinch airbag harness in center of steering wheel when installing airbag.

Tightening torque	
Airbag to steering wheel (MFL)	8 Nm (71 in-lb)

Passenger airbag, removing and installing

- Disconnect negative (-) cable from battery and cover negative terminal with insulating material.

WARNING!

After disconnecting the battery, wait 5 seconds before beginning work on airbag components.

CAUTION!

Prior to disconnecting the battery, read the battery disconnection

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cautions given at the front of this manual on page viii.

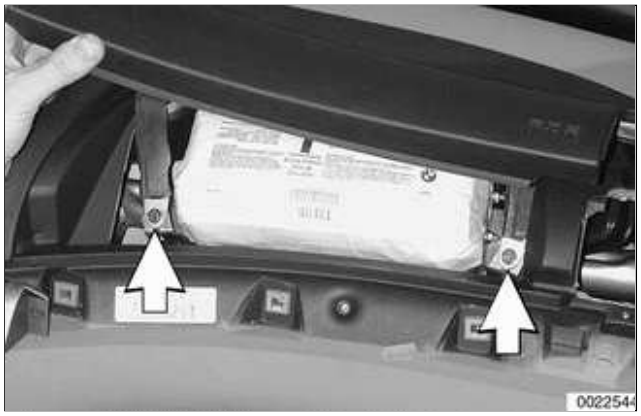


- Pry gently at right dashboard trim to remove.

CAUTION!

To avoid marring interior trim, work with a plastic prying tool.

  - Remove right dashboard fresh air outlet mounting screws and pull outlet out of dash.



- Lift cover from top of passenger side airbag on dashboard.

  - Remove cover strap retaining bolts (**arrows**) to detach cover completely from dashboard.

CAUTION!

The plastic retainer at the right end of the cover may snap during removal. Be sure to have extra retainers on hand for reassembly

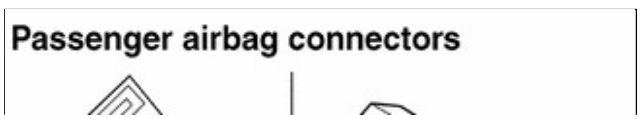


- Remove airbag mounting bolts (**arrows**).

  - Lift airbag and disconnect electrical harness connector. Remove airbag.

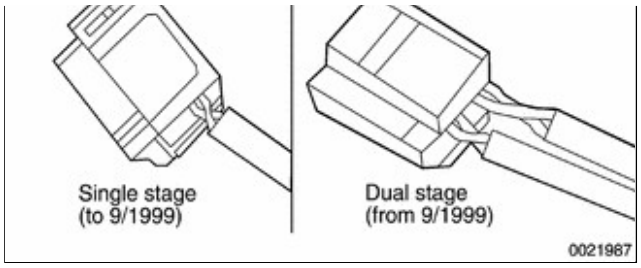
WARNING!

Store the removed airbag unit with the soft pad facing up. If stored facing down, accidental deployment could propel it violently into the air, causing injury.



- Early E46 cars (through production date 9/1999) were equipped with a

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single stage airbag, identified by having only one wire loom in the harness connector. Later production two stage airbags are supplied by two wire looms in the connector plug. The two kinds of airbags are NOT interchangeable.

- Installation is reverse of removal. Make sure wiring harness is not pinched when installing airbag unit in dashboard.

Tightening torques	
Airbag cover strap to dashboard (M6)	9 Nm (7 ft-lb)
Passenger air bag to dashboard (M8)	22 Nm (16 ft-lb)

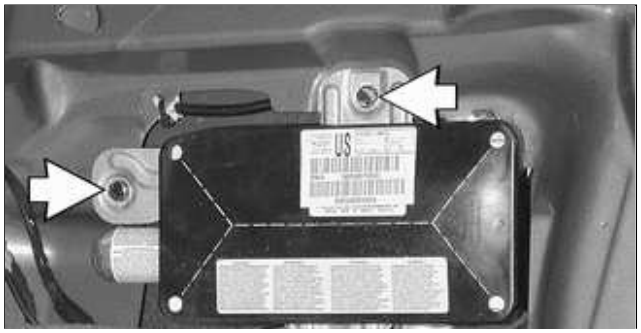
Door mounted side-impact airbag, removing and installing

- Disconnect negative (-) cable from battery and cover negative terminal with insulating material.

CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

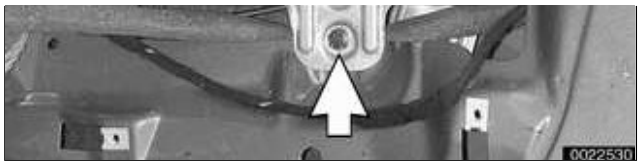
- Remove inside door panel as described in ⇒ 411 Doors.



Front door airbag:

- Remove airbag mounting bolts (**arrows**).
- Turn over airbag unit and cut off electrical harness wire tie.

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- Detach harness connector.

CAUTION!

When removing and installing the airbag unit, pay attention to the routing of the electrical harness to avoid kinks or breaks in the wire.

- Rear door airbag:

- Detach electrical harness connector.

- Remove mounting bolts and remove airbag from door.

- Installation is reverse of removal.

- Route electrical harnesses as they were before.

- Use new wire ties as necessary.

- Use new self-locking mounting bolts.

Tightening torque	
Side-impact airbag to door	8.5 Nm (75 in-lb)

Head protection airbag (HPS) components



Replacement of a head protection airbag (HPS) is an extensive operation. Replacement includes removal of the following components:

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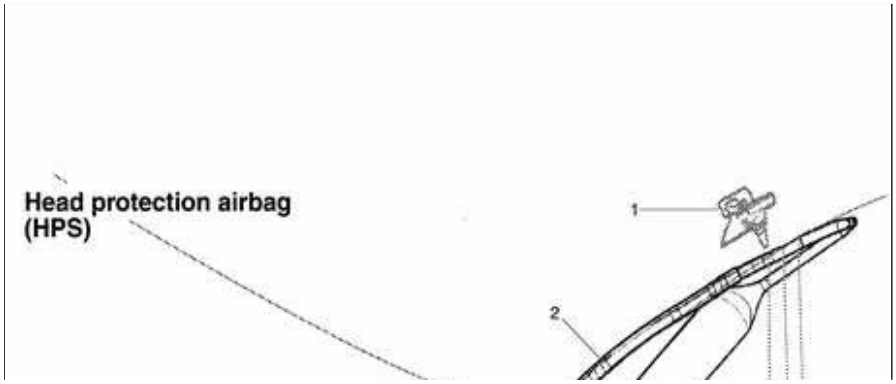
- Complete dashboard
- Complete headliner
- Windshield pillar (A-pillar) trim
- Door pillar (B-pillar) trim

- Before starting work on the HPS airbag, disconnect negative (-) cable from battery and cover negative terminal with insulating material.

CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

Tightening torque	
HPS airbag to body	11 Nm (8 ft-lb)
HPS airbag mounting bracket to A or B-pillar	2.5 Nm (22 in-lb)
HPS gas generator to dashboard reinforcement M6 self-tapping screw	4 Nm (35 in-lb)

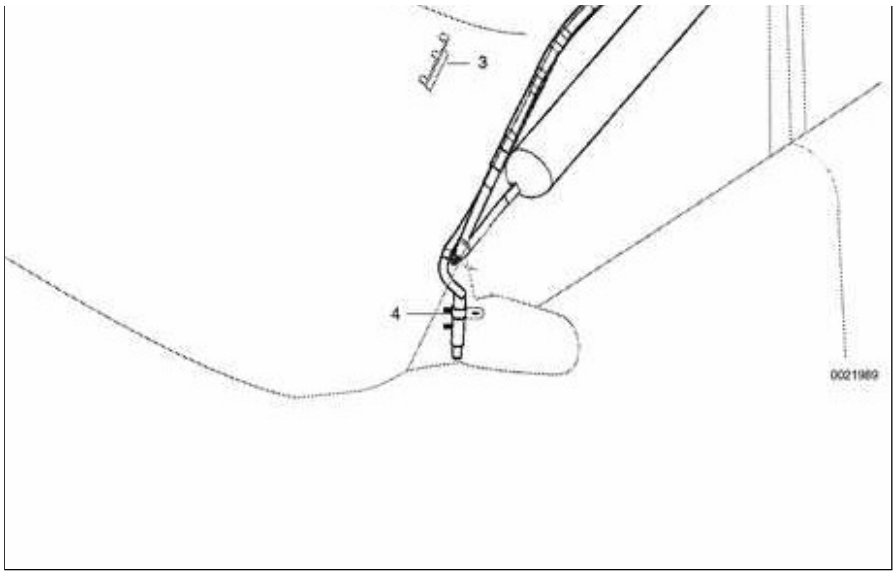


Head protection airbag (HPS)

1 - B-pillar deflection plate

2 - Head protection airbag

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3 - **Cable holder**

4 - **Gas generator**

5 - **Self-tapping screw M6**

♦ tighten to 4 Nm (35 in-lb)

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On-Board Diagnostics (OBD II)

OBD II is an acronym for On-Board Diagnostics II, the second generation of on-board self-diagnostic equipment requirements. These standards were originally mandated for California vehicles. Since 1996 they have been applied to all passenger vehicles sold in the United States.

On-board diagnostic capabilities are incorporated into the hardware and software of the engine control module (ECM) to monitor virtually every component that can affect vehicle emissions. OBD II works to ensure that the vehicles remain as clean as possible over their entire life.

Each emission-influencing component is checked by a diagnostic routine to verify that it is functioning properly. If a problem or malfunction is detected, the OBD II system illuminates a warning light on the instrument panel to alert the driver. This malfunction indicator light (MIL) will display the phrase "Check Engine" or "Service Engine Soon."

The OBD II system also stores important information about the detected malfunction so that a repair technician can accurately find and fix the problem.

Note:

- *Specialized OBD II scan tool equipment is needed to access the fault memory and OBD II data.*

- *The OBD II fault memory (including the MIL) can only be*

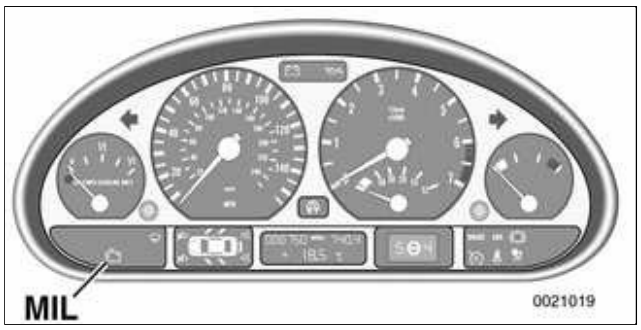
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reset using the special scan tool. Removing the connector from the ECM or disconnecting the battery will not erase the fault memory.

The extra hardware needed to operate the OBD II system consists mainly of the following:

- Additional oxygen sensors downstream of the catalytic converters
- Fuel tank pressure sensor and device to pressurize fuel storage system
- Several engine and performance monitoring devices
- Standardized 16-pin OBD II connector under the dash
- Upgraded components for the federally required 100,000 mile or 10 year reliability mandate

Malfunction Indicator Light (MIL)



The OBD II system is designed to illuminate the Malfunction Indicator Light (MIL) when emission levels exceed 1.5 times the Federal standards.

Note:

On model year 1999 and 2000 cars, the MIL is labeled Check Engine. On model year 2001 cars, the MIL is labeled Service Engine Soon.

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The MIL will come on under the following conditions.

- An engine management system fault is detected for two consecutive OBD II drive cycles.
- A catalyst damaging fault.
- A component malfunction (such as catalyst deterioration) causes emissions to exceed 1.5 times OBD II standards.
- Manufacturer-defined specifications are exceeded.
- An implausible input signal is generated.
- Misfire faults occur.
- A leak is detected in evaporative system.
- The oxygen sensors observe no purge flow from purge valve/evaporative system.
- The engine control module (ECM) fails to enter closed-loop operation within specified time.
- The engine control module (ECM) or automatic transmission control module (TCM) enters "limp home" operation mode.
- Key is in "ignition on" position before cranking (bulb check function).

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Additional information, MIL:

- A fault code is stored within the ECM upon the first occurrence of a fault in the system being checked.
- Two complete consecutive drive cycles with the fault present illuminate the MIL. The exception to the two-fault requirement is a catalyst damaging fault, which will turn the light on immediately.
- If the second drive cycle was not complete and the specific function was not checked as shown in the example, the ECM counts the third drive cycle as the next consecutive drive cycle. The MIL is illuminated if the function is checked and the fault is still present.
- Once the MIL is illuminated it will remain illuminated unless the specific function has been checked without fault through three complete consecutive drive cycles.
- The fault code will be cleared from memory automatically if the specific function is checked through 40 consecutive drive cycles without the fault being detected.

Note:

In order to automatically clear a catalyst damaging fault from memory, the condition under which the fault occurred must be evaluated for 80 consecutive drive cycles without the fault reoccurring.

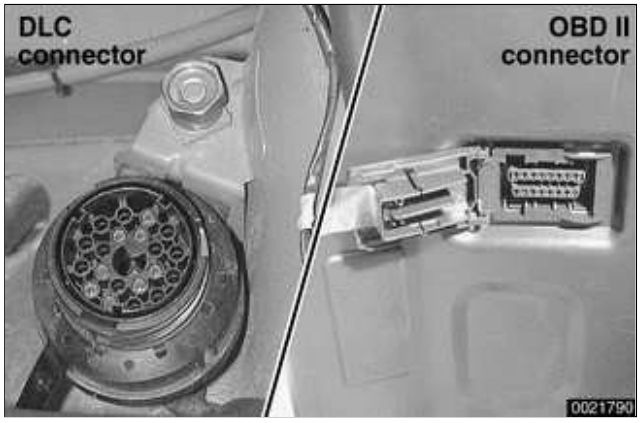
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With the use of a universal or 'generic' scan tool connected to the DLC (Diagnostic Link Connector), diagnostic trouble codes (DTCs) can be obtained, along with the conditions associated with the illumination of the engine service light. Using a more advanced or BMW-dedicated scan tool, additional 'proprietary' information is normally available.

Scan tool and scan tool display

Owing to the advanced nature of OBD II adaptive strategies, all diagnostics need to start with a scan tool. The aftermarket scan tools can be connected to either the 16-pin OBD II Data Link Connector (DLC) or the BMW 20-pin DLC in the engine compartment. Data from the OBD II DLC may be limited, depending on scan tool and vehicle.

OBD II standards mandate that the 16-pin DLC must be located within three (3) feet of the driver and must not require any tools to be exposed. The communication protocol used by BMW is ISO 9141.



Starting with June 2000 production, the 20-pin BMW diagnostic port (**Data Link Connector** or **DLC**) which was previously located in the engine compartment has been deleted. All diagnostic, coding and programming functions are incorporated into the **OBD II** diagnostic port, located under left side of dashboard.

Note:

- *On cars built up 06-2000: when accessing emissions related DTCs through the 16-pin OBD II DLC, the BMW 20-pin DLC cap must be*

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installed.

- *Professional diagnostic scan tools available at the time of this printing include the BMW factory tools (DISplus and MoDiC) and a small number of aftermarket BMW-specific tools. The CS2000 from Baum Tools Unlimited, the Retriever from Assenmacher Specialty Tools, and the MT2500 from Snap-On Tools are examples of quality OBD scan tools.*

- *In addition to the professional line of scan tools, inexpensive `generic' OBD II scan tool software programs and handheld units are readily available. These tools do have limited capabilities, but they are nonetheless powerful diagnostic tools. These tools read live data streams and freeze frame data as well as a host of other valuable diagnostic data.*

- *For the do-it-yourself owner, simple aftermarket DTC readers are also available. These inexpensive BMW-only tools are capable of checking for DTCs as well as turning off the illuminated MIL and resetting the service indicator lights.*

Diagnostic monitors

A diagnostic monitor is an operating strategy that runs internal tests and checks a specific system, component or function. This is similar to computer self tests.

Completion of a drive cycle ensures that all monitors have completed their

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required tests. The ECM must recognize the loss or impairment of the signal or component and determine if a signal or sensor is faulty based on 3 conditions:

- Signal or component shorted to ground
- Signal or component shorted to B+
- Signal or component missing (open circuit)

The OBD II system must monitor all emission control systems that are on-board. Not all vehicles have a full complement of emission control systems. For example, a vehicle may not be equipped with secondary air injection, so naturally no secondary air readiness/function code would be present.

OBD II requires monitoring of the following:

- Oxygen sensor monitoring
- Catalyst monitoring
- Misfire monitoring
- Evaporative system monitoring
- Secondary air monitoring
- Fuel system monitoring

Monitoring these emissions related functions is done using DME input sensors and output accouters based on preprogrammed data sets. If the

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ECM cannot determine the environment or engine operating conditions due to missing or faulty signals it will set a fault code and, depending on conditions, illuminate the MIL.

Oxygen sensor monitoring: When drive conditions allow, response rate and switching time of each oxygen sensor is monitored. In addition, the heater function is also monitored. The OBD II "diagnostic executive" knows the difference between upstream and downstream oxygen sensors and reads each one individually.

All oxygen sensors are monitored separately. In order for the oxygen sensor to be effectively monitored, the system must be in closed loop operation.

Catalyst monitoring: This strategy monitors the two heated oxygen sensors per bank of cylinders. It compares the oxygen content going into the catalytic converter to the oxygen leaving the converter.

The diagnostic executive knows that most of the oxygen should be used up during the oxidation phase and if it sees higher than programmed values, a fault will be set and the MIL will illuminate.

Misfire detection: This strategy monitors crankshaft speed fluctuations and determines if a misfire occurs by variations in speed between each crankshaft sensor trigger point. This strategy is so finely tuned that it can even determine the severity of the misfire.

The diagnostic executive must determine if misfire is occurring, as well as other pertinent misfire information.

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- Specific cylinder(s)
- Severity of the misfire event
- Emissions relevant or catalyst damaging

Misfire detection is an on-going monitoring process that is only disabled under certain limited conditions.

Secondary air injection monitoring: Secondary air injection is used to reduce HC and CO emissions during engine warm up. Immediately following a cold engine start (-10 to 40ï¿½C), fresh air/oxygen is pumped directly into the exhaust manifold. By injecting oxygen into the exhaust manifold, catalyst warm-up time is reduced.

System components:

- Electric air injection motor/pump
- Electric motor/pump relay
- Non-return valve
- Vacuum/vent valve
- Stainless steel air injection pipes
- Vacuum reservoir

The secondary air system is monitored via the use of the pre-catalyst oxygen sensors. Once the air pump is active and air is injected into the system, the signal at the oxygen sensor will reflect a lean condition. If the oxygen sensor signal does not change, a fault will be

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set and identify the faulty bank(s). If after completing the next cold start a fault is again present, the MIL will be illuminated.

Fuel system monitoring: This monitors receives high priority. It looks at the fuel delivery needed (long/short term fuel trim) for proper engine operation based on programmed data. If too much or not enough fuel is delivered over a predetermined time, a DTC is set and the MIL is turned on.

Note:

Fuel trim refers to adjustments to base fuel schedule. Long-term fuel trim refers to gradual adjustments to the fuel calibration adjustment as compared to short term fuel trim. Long term fuel trim adjustments compensate for gradual changes that occur over time.

Fuel system monitoring monitors the calculated injection time (ti) in relation to engine speed, load, and the pre-catalytic converter oxygen sensor(s) signals as a result of residual oxygen in the exhaust stream.

The diagnostic executive uses the precatalyst oxygen sensor signal as a correction factor for adjusting and optimizing the mixture pilot control under all engine operating conditions.

Evaporative system monitoring: This monitor checks the sealed integrity of the fuel storage system and related fuel lines.

This monitor has the ability to detect very small leaks anywhere in the system. A pressure test is be performed on the EVAP system on a continuous basis as the drive cycle allows.

On MS 42.0 cars, a leak detection pump (LDP) is used to pressurize and

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check system integrity. On MS 43.0 cars, a more sophisticated DMTL (Diagnostic Module - Leak Detection) pump is used.

Drive cycle

The OBD II drive cycle is an important concept in understanding OBD II requirements. The purpose of the drive cycle is to run all of the emission-related on-board diagnostics over on a broad range of driving conditions.

The drive cycle is considered completed when all of the diagnostic monitors have run their tests without interruption. For a drive cycle to be initiated, the vehicle must be started cold and brought up to 160ï¿½F and at least 40ï¿½F above its original starting temperature.

Once the drive cycle is completed, the system status or inspection/maintenance (I/M) readiness codes are set to "Yes."

System status codes will be set to "No" in the following cases:

- The battery or ECM is disconnected.
- The ECM's DTCs have been erased after completion of repairs and a drive cycle has not be completed.

A scan tool can be used to determine if on-board diagnosis is complete as well as the status of the I/M codes. All required tests must be completed before the I/M readiness codes will be set to "Yes".

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Readiness codes

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BMW Fault Codes (DTCs)

Below is a comprehensive listing of BMW DTCs and the corresponding SAE P-codes.

Table a. Diagnostic trouble codes (DTCs)

BMW code	P-code	Fault type and function	Signal type and range	Explanation
1		Ignition coil cyl.2	Input analog timing (100 mV)	DME initiates secondary ignition for each cylinder then looks for feedback through shunt resistor in harness to determine if ignition actually occurred.
2		Ignition coil cyl.4	Input analog timing (100 mV)	DME initiates secondary ignition for each cylinder then looks for feedback through shunt resistor in harness to determine if ignition actually occurred.
3		Ignition coil cyl.6	Input analog timing (100 mV)	DME initiates secondary ignition for each cylinder then looks for feedback through shunt resistor in harness to determine if ignition actually occurred.
5	P0202	Injector circuit cyl. 2	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
6	P0201	Injector circuit cyl. 1	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
8	P0101	Mass air flow circuit range/perf.	Input analog (0-5V)	Failed signal range check against predefined diagnostic limits.
10		Engine coolant temp. circuit range/perf.	Input analog (0-5V)	Signal range is checked against predefined diagnostic limits within specific engine operations.
11		Coolant temp. coolant outlet	Input analog (0-5V)	Signal range is checked against predefined diagnostic limits within specific engine operations.
14	P0111	Intake air temp. range/performance	Input analog (0-5V)	Signal range is checked against predefined diagnostic limits within specific engine operations.
18	P1397	Exhaust cam position sensor malfunction	Input analog phase shift (0-5V)	Internal check of phase shift from camshaft sensor - should change during every crankshaft revolution.Phase shift occurs due to 2:1 relationship between camshafts.
19	P1529	VANOS solenoid activation, exhaust	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
21	P1525	VANOS solenoid activation, intake	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
22	P0203	Injector circuit cyl. 3	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
23	P0206	Injector circuit cyl. 6	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
24	P0204	Injector circuit cyl. 4	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
25	P0135	Oxygen sensor heater pre-cat (Bank1)	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
27	P1550	Idle control valve closing coil	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
29		Ignition coil cyl.1	Input analog timing (100 mV)	DME initiates secondary ignition for each cylinder then looks for feedback through shunt resistor in harness to determine if ignition actually occurred.
30		Ignition coil cyl.3	Input analog timing (100 mV)	DME initiates secondary ignition for each cylinder then looks for feedback through shunt resistor in harness to determine if ignition actually occurred.
31		Ignition coil cyl.5	Input analog timing (100 mV)	DME initiates secondary ignition for each cylinder then looks for feedback through shunt resistor in harness to determine if ignition actually occurred.

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
33	P0205	Injector circuit cyl. 5	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
35	P1453	Secondary air injection pump	Output digital on/off (active low)	TDME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
36	MS 43	Main relay malfunction	Input analog (0-12V)	Signal range check between DME ignition analog input and main relay power circuit analog input.
38	MS 43	Clutch switch faulty	Input digital (0-12V)	Plausibility check of clutch switch and DME internal values such as load and engine speed.
39		Brake light switch, and brake light plausibility test	Input digital (0-12V)	When brake light switch is active, brake light test switch must be also active. If not, fault is stored.
40		Brake light switch, pedal sensor plausibility test	Input digital / analog (0-12V / 0-5V)	If pedal sensor is showing angle greater than "limp home angle" and additionally brake light switch is active, fault is stored.
42		Multi functional steering wheel, redundant code	Input binary stream (0-12V)	Every signal from cruise control switch is transferred redundantly. A fault is set whenever two redundant information paths are showing a different status.
43		Multi functional steering wheel, control switch	Input binary stream (0-12V)	When status from cruise control showing set/accelerate and deceleration are same time, fault is set.

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
45		Multi functional steering wheel, toggle-bit	Input binary stream (0-12V)	Every 0.5 sec. a message that includes a toggle bit (toggles between 0->1 and 1->0) is transmitted. Change bit is monitored to indicate proper function.
47	MS 43	Torque monitoring level 1	DME internal values logical	
48	MS 43	Internal control module	DME HW test memory	
49		ECU internal test	DME HW test	
50	P1145 MS 42	Running losses valve (3/2), final stage	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
	MS 43	ECU internal test	DME HW test	
51	MS 43	ECU internal test	DME HW test	
52		Rear exhaust valve flap	Output digital steady (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
53	P1509	Idle control valve opening coil	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
55	P0155	Oxygen sensor heater pre-cat (Bank 2)	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
56		Ignition feedback, interruption at	Input analog (32V)	Check for correct signal voltage. If voltage is 32V

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
		shunt resistor		(limitation voltage) then secondary ignition voltage is detected and shunt resistor may be faulty.
57	P0325	Knock sensor 1 circuit, (Bank 1) circuit continuity	Input analog amplitude (13-19kHz)	Plausibility check between knock sensor amplitude during knocking with internal knock detection mapped DME values.
59	P0330	Knock sensor 2 circuit, (Bank 2) circuit continuity	Input analog amplitude (13-19kHz)	Plausibility check between knock sensor amplitude during knocking with internal knock detection mapped DME values.
61	P0141	Oxygen sensor heater post-cat (Bank 2)	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
62	P0412	Secondary air injection system switching valve	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
65	P0340	Intake cam position sensor, malfunction	Input analog phase shift 0-5V	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
68		EVAP system, purge control valve circuit	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
69		Relay fuel pump	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
				transistor and component exists.
74		AC compressor relay	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
79	P0161	Oxygen sensor heater post-cat (Bank 1)	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
83	P0335	Crankshaft position sensor, malfunction	Input digital (0-12V)	Checks for correct signal pattern and correct number of expected flywheel teeth.
100	P0601	Internal control module, memory check sum or communication	DME internal values logical	Internal hardware test of RAM, ROM, and Flash Prom.
103	P1519	VANOS faulty reference value intake	DME internal values logical	Maximum VANOS adjustment angle, checked at every engine start must be within a specified limit.
104	P1520	VANOS faulty reference value exhaust	DME internal values logical	Maximum VANOS adjustment angle, checked at every engine start must be within a specified limit.
105	P1522	VANOS stuck (Bank 1) intake	DME internal values	Monitoring of a desired VANOS adjustment within a predefined diagnostic time limit.
106	P1523	VANOS stuck (Bank 2) exhaust	DME internal values	Monitoring of a desired VANOS adjustment within a predefined diagnostic time limit.
109	P1580	Motor throttle valve pulse width not plausible	Output digital pulse width (0-12V)	Throttle position control algorithm checks for problems with mechanical coupling

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
				spring within motor throttle body.
110	P1542	Pedal sensor potentiometer 1	Input analog (0-5V)	Failed signal range check against predefined diagnostic limits.
111	P1542	Pedal Sensor Potentiometer 2	Input analog (0-5V)	Failed signal range check against predefined diagnostic limits.
112	P0120 MS 42	Motor throttle valve potentiometer 1	Input analog (0-5V)	Failed signal range check against predefined diagnostic limits.
	MS 43	Throttle position sensor 1	Input analog (0-5V)	Failed signal range check against predefined diagnostic limits.
113	P0120	Motor throttle valve potentiometer 2	Input analog (0-5V)	Failed signal range check against predefined diagnostic limits.
114	P1580 MS 42	Motor throttle valve final stage	DME internal test	Final stage inside DME (special H-bridge), will set internal flag whenever a short to ground, a short to battery voltage or a disconnection occurs.
	MS 43	A second pedal sensor range check failure is determined	DME internal values logical	If pedal sensor malfunction is determined, followed by a second malfunction, a signal is sent.
115	P1623 MS 42	Output voltage 5V for potentiometer operation 1	DME internal (5V)	Check for proper 5 volts supply to potentiometers is possible within a predefined voltage limit.
	MS 43	Range check for throttle position adaptation	Input analog (0-5V)	Range check for closed position of throttle sensors.
116	P1623	Output voltage for potentiometer operation 2	DME internal (5V)	Check for proper 5 volts supply to potentiometers is possible within a predefined voltage limit.

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
117	P1542	Pedal sensor potentiometer plausibility	Input analog (0-5V)	If there is a difference greater than specified between two redundant signals from potentiometer, fault will be set.
118	P0120 MS 42	Motor throttle feedback potentiometer plausibility	Input analog (0-5V)	If there is a difference greater than specified between two redundant signals from potentiometer, fault will be set.
	MS 43	Throttle position sensor 1; plausibility check sensor 1 to mass air flow meter	DME internal values	Signal range is checked against predetermined diagnostic limits. Rationality check with mass air flow meter.
119	P1580 MS 42	MDK, throttle mechanical sticking	DME internal test	Throttle doesn't reach desired opening angle within a specified time.
	MS 43	Throttle position sensor 2; plausibility check sensor 1 to mass air flow meter	DME internal values	Signal range is checked against predetermined diagnostic limits. Rationality check with mass air flow meter.
120	P1542 MS 42	Pedal sensor/ motor throttle valve potentiometer not plausible	DME internal values logical motor	Signal from motor throttle valve potentiometer must be equal signal from pedal sensor potentiometer plus any adaptive values.
	MS 43	Plausibility check between brake switch and pedal sensor	Input digital / analog	Plausibility check between constant pedal value and brake switch. First pedal value must be constant and for next step brake switch must be active.
122	P1101	Oil temp. sensor malfunction	Input analog (0-5V)	Signal range is checked against predefined diagnostic limits and calculated temperature.
123	P1622	Electric thermostat control, final stage	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
				disconnection between output transistor and component exists.
124	P1593	DISA, range/perf.	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
125		Coolant fan, final stage	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
126	P1470 MS 42	LDP-magnetic valve	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
	MS 43	DMTL valve	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
127		Fuel pump	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
128		EWS signal not present or faulty	Input binary stream bit data (0-12V)	During time out check no signal was present within specific time or faulty information from serial interface (parity, overrun, etc.).
130		CAN time out (ASC1)	Input binary stream bit data (0-12V)	CAN message between DME/EGS not received within expected time.

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
131		CAN time out (instr 2)	Input binary stream bit data (0-12V)	CAN message between DME/EGS not received within expected time.
132		CAN time out (instr 3)	Input binary stream bit data (0-12V)	CAN message between DME/EGS not received within expected time.
133		CAN time out (ASC3)	Input binary stream bit data (0-12V)	CAN message between DME/EGS not received within expected time.
135	MS 43	Limp home position adaptation necessary	DME internal values logical	Limp home position must be in specified range. If range is exceeded, a fault is set.
136	MS 43	Motor throttle valve open / closing test failed	DME internal values logical	From limp home mode position, throttle valve will be open, afterwards it must fall back into limp home position. If fall back position is not in specified range, fault is set.
140	P1475	LDP reed-switch not closed	Input digital on/off (0-12V)	With shut off valve open and no pressure on system, reed contact should be closed, showing a "high signal". If not the case in beginning of every diagnostics check, a signal is sent.
140	MS 43	DMTL pump final stage	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
141	P1477	EVAP: reed switch not closed, doesn't open or doesn't close	Input digital on/off (0-12V)	Within predetermined time LDP reed switch signal must change from high to low or from low to high or LDP reed switch is "low" for longer than predetermined time.
142	P1477	EVAP: reed switch not closed, doesn't open or doesn't close	Input digital on/off (0-12V)	Within predetermined time LDP reed switch signal must change from high to low or from low to high or LDP reed

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
				switch is "low" for longer than predetermined time.
142	MS 43	DMTL module fault	DME internal values logical	
143	P1476	EVAP: clamped tube check	Input digital frequency (0-12V)	Frequency of LDP pumps reed switch is lower then predetermined limit. Volume of leak is determined to be too small (i.e. pinched or restricted hose)
146	MS 43	Range check voltage supply pedal sensor 2 and throttle position sensors	DME internal input analog	Supply voltage for sensors must be within a specified range.
147	MS 43	Range check voltage supply pedal sensor 2 and throttle position sensors	DME internal input analog	Supply voltage for sensors must be within a specified range.
149	P1140	Motor throttle feedback potentiometer and air mass sensor signal not plausible	Input analog (0-5V)	Signal from motor throttle valve potentiometer must be suitable to signal from air mass sensor. A fault is set if difference exceeds specified limit.
150	P0130	Oxygen sensor pre-cat (Bank 1), short to battery volt.	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical shorts exist on input line. Voltage signal has to be within a predetermined range (0.1V -1V) or a fault will set.
151	P0130	Oxygen sensor pre-cat (Bank 1), short to ground	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical shorts exist on input line. Voltage signal must be within a predetermined range (0.1V -1V) or fault will set.
152	P0130	Oxygen sensor pre-cat (Bank 1), disconnection	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical disconnection exist

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
				on input line.
153	P0150	Oxygen sensor pre-cat (Bank 2), short to battery volt.	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical shorts exist on input line. Voltage signal must be within a predetermined range (0.1V -1V) or fault will set.
154	P0150	Oxygen sensorpre-cat (Bank 2), short to ground	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical shorts exist on input line. Voltage signal must be within a predetermined range (0.1V -1V) or fault will set.
155	P0150	Oxygen sensor pre-cat (Bank 2), disconnection	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical disconnection exist on input line.
156	P0136	Oxygen sensor post-cat (Bank 1), short to battery volt.	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical shorts exist on input line. Voltage signal must be within a predetermined range (0.1V -1V) or fault will set.
157	P0136	Oxygen sensor Post Cat. (Bank 1), short to ground	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical shorts exist on input line. Voltage signal must be within a predetermined range (0.1V -1V) or fault will set.
159	P0156	Oxygen sensor Post Cat. (Bank 2), short to battery volt.	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical shorts exist on input line. Voltage signal must be within a predetermined range (0.1V -1V) or fault will set.
160	P0156	Oxygen sensor post-cat (Bank 2), short to ground	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical shorts exist on input line. Voltage signal must be within a predetermined range (0.1V -1V) or fault will set.

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
160	MS 43	Throttle valve position controller	DME internal values logical	
161	MS 43	Throttle valve position controller	DME internal values logical	
162	MS 43	Throttle valve position controller	DME internal values logical	
168	MS 43	Throttle valve position, throttle sticking	DME internal test calculated	
169		MDK final stage shut off	DME internal test	This fault indicates problem on pedal sensor, throttle potentiometer or throttle. A separately stored fault code indicates problem.
171	P0601	System has been shut down due to safety controller	DME internal test	Safety controller has shut down motor throttle valve function due to not plausible MDK input values.
172	P1542	Pedal sensor potentiometer short between two potentiometer paths	DME internal check	5 volts for potentiometers are switched on within a specific time pattern.
173	P0120	Motor throttle valve potentiometer contact short	Rationality check	Motor throttle valve potentiometer
174	P0120	Motor throttle valve potentiometer adaptation of idle end position	Input analog (0-5V)	Signal for idle position must be within a specified range. If range is exceeded, fault is set.
175		Pedal sensor potentiometer 1 adaptation of the idle end position	Input analog (0-5V)	Signal for idle position must be within a specified range. If range is exceeded, fault is set.
176	P1542	Pedal sensor potentiometer 2 adaptation of the idle end position	Input analog (0-5V)	Signal for idle position must be within a specified range. If range is exceeded, fault is set.

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
188	P1132	Oxygen sensor heater, pre-cat (Bank 1), insufficient	Output digital pulse width (active low)	DME internally calculated heater power is checked against predefined diagnostic limits.
189	P1133	Oxygen sensor heater, pre-cat (Bank 2), insufficient	Output digital pulse width (active low)	DME internally calculated heater power is checked against predefined diagnostic limits.
190	P1186	Oxygen sensor-heater, post-cat (Bank 1), insufficient	Output digital pulse width (active low)	DME internally calculated heater power is checked against predefined diagnostic limits.
191	P1187	Oxygen sensor heater, post-cat (Bank 2), insufficient	Output digital pulse width (active low)	DME internally calculated heater power is checked against predefined diagnostic limits.
197	MS 43	Signal range check	DME internal analog input	
202	P0170	Fuel trim (Bank 1), O2 control limit	DME internal values logical	Controller for lambda is too long beyond a min. or a max.
203	P0173	Fuel Trim (Bank 2), O2 control limit	DME internal values logical	Controller for lambda is too long beyond a min. or a max.
204	P0505	Idle control system, idle speed not plausible	DME internal values logical	Functional check between actual engine speed (RPM) and predetermined RPM exceeds maximum deviation of +200/-100 RPM.
208		EWS, engine speed check not ok	DME internal test	Engine speed signal is transferred by EWS to DME. Fault is set if transferred signal is not reflecting engine speed due to input problem in EWS.
209		EWS, content of message	Input binary stream bit data (0-12V)	Content of binary message received from EWS invalid.
210		Ignition feedback, faulty (>2 cylinders)	Input analog timing (100 mV)	Check for correct signal timing after each ignition has been initiated by feedback

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
				signal. If more than two ignition signals are not recognized than there might be a problem in feedback line.
211	P1510	Idle control valve stuck	DME internal values logical	Functional check against a calculated value by monitoring flow though air mass meter to determine if idle valve is mechanically stuck open. Tested during closed throttle.
214	P0500	Vehicle speed sensor	Input digital frequency (0-12V)	Signal range is checked against predefined diagnostic limits. No vehicle speed is observed after specific time when compared to engine speed and load equivalent to moving vehicle.
215	P0136	Oxygen sensor post-cat (Bank 1), disconnection	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical disconnection exist on input line.
216	P0136	Oxygen sensor post-cat (Bank 2), disconnection	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical disconnection exist on input line.
217	P0505	CAN time out (EGS1)	Input digital binary information(0-12V)	CAN message between DME/EGS was not received within expected time.
219		CAN-chip, bus off	Input digital binary information (0-12V)	Hardware test determines if CAN bus is off line. Data transmission is disturbed.
220	P1184	Oxygen sensor post-cat (Bank 1) slow response time	Input analog (high is lean) (0-5V)	Checks amount of time oxygen sensor stays in rich or lean state. If it remains there too long in either, fault will set.
221	P1185	Oxygen sensor post-cat (Bank 2) slow response time	Input analog (high is lean) (0-5V)	Checks amount of time oxygen sensor stays in rich or lean state. If it remains there too long in either fault will set.

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
222	P0125	Insufficient coolant temp. to permit closed loop operation	Input analog (0-5V)	Comparison of actual coolant temperature against calculated DME value which varies with load signal.
223	P1180	Oxygen sensor post-cat (Bank 1), switching time slow	Input analog (high is lean) (0-5V)	Checks amount of time oxygen sensor takes to switch from rich to lean and vice versa. If too long, fault will set.
224	P1181	Oxygen sensor post-cat (Bank 2), switching time slow	Input analog (high is lean) (0-5V)	Checks amount of time oxygen sensor takes to switch from rich to lean and vice versa. If too long, fault will set.
225	P1192	Post-cat sensor (Bank 1); trim control	Input analog (0-5V)	Rationality check for O2 control adaptation with post catalyst sensor bank 1.
226	P0193	Post-cat sensor (Bank 2); trim control	Input analog (0-5V)	Rationality check for O2 control adaptation with post catalyst sensor bank 2.
227	P0188	Fuel trim (Bank 1), O2 control adaptation limit	DME internal values logical	Range control of adaptation values.
228	P0189	Fuel trim (Bank 2), O2 control adaptation limit	DME internal values logical	Range control of adaptation values.
229	P0133	Oxygen sensor pre-cat (Bank 1, slow response time	Input analog (high is lean) (0-5V)	Checks amount of time oxygen sensor takes to switch from rich to lean and vice versa. If too long, fault will set.
230	P0153	Oxygen sensor pre-cat (Bank 2), slow response time	Input analog (high is lean) (0-5V)	Checks amount of time oxygen sensor stays in its rich or lean state. If it remains there too long in either fault will set.
231	P1178	Oxygen sensor pre-cat (Bank 1), switch time too slow	Input analog (high is lean) (0-5V)	Checks amount of time oxygen sensor takes to switch from rich to lean and vice versa. If it takes too long to

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
				switch fault will set.
232	P0179	Oxygen sensor pre-cat (Bank 2), switch time too slow	Input analog (high is lean) (0-5V)	Checks amount of time oxygen sensor takes to switch from rich to lean and vice versa. If it takes too long to switch fault will set.
233	P0420	Catalyst efficiency (Bank 1), below threshold	Input analog (0-5V)	Compares value of pre-cat oxygen sensor to value of post-cat oxygen sensor to measure oxygen storage capability / efficiency of catalytic converter. Post-cat oxygen sensor must be relatively lean.
234	P0430	Catalyst efficiency (Bank 2), below threshold	Input analog (0-5V)	Compares value of pre-cat oxygen sensor to value of post-cat oxygen sensor to measure oxygen storage capability / efficiency of catalytic converter. Post-cat oxygen sensor must be relatively lean.
235	P1190	Pre-cat sensor (Bank 1):trim control	Input analog (high is rich) (0-1V)	Rationality check for O2 control adaptation with pre-cat sensor bank 1
236	P1191	Pre-cat sensor (Bank 2):trim control	Input analog (high is rich) (0-1V)	Rationality check for O2 control adaptation with pre-cat sensor bank 2
238	P0301	Cyl. 1 misfire detected	DME internal values logical	Crankshaft speed/acceleration is monitored by crank sensor. Time for each cylinder combustion is compared against avg. of others. If time for cylinder 1 is longer, fault will set.
239	P0302	Cyl. 2 misfire detected	DME internal values logical	Crankshaft speed/acceleration is monitored by crank sensor. Time for each cylinder combustion is compared against avg. of others. If time

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
				for cylinder 2 is longer, fault will set.
240	P0303	Cyl. 3 misfire detected	DME internal values logical	Crankshaft speed/acceleration is monitored by crank sensor. Time for each cylinder combustion is compared against avg. of others. If time for cylinder 3 is longer, fault will set.
241	P0304	Cyl. 4 misfire detected	DME internal values logical	Crankshaft speed/acceleration is monitored by crank sensor. Time for each cylinder combustion is compared against avg. of others. If time for cylinder 4 is longer, fault will set.
242	P0305	Cyl. 5 misfire detected	DME internal values logical	Crankshaft speed/acceleration is monitored by crank sensor. Time for each cylinder combustion is compared against avg. of others. If time for cylinder 5 is longer, fault will set.
243	P0306	Cyl. 6 misfire detected	DME internal values logical	Crankshaft speed/acceleration is monitored by crank sensor. Time for each cylinder combustion is compared against avg. of others. If time for cylinder 6 is longer, fault will set.
244		Segment timing faulty, flywheel adaptation	Input analog (0-5V)	Flywheel segments are monitored during deceleration to establish baseline for misfire calculation. If segments are too long/short (bad flywheel) and exceed limit, fault will be set.

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BMW code	P-code	Fault type and function	Signal type and range	Explanation
245	P1423	Secondary air injection (Bank 1), flow too low	Input analog (0-5V)	Checks to see if oxygen sensor reacts to increase in unmetered airflow generated by secondary air pump operation. Oxygen sensor must sense lean condition or fault will set.
246	P1421	Secondary air injection (Bank 2), flow too low	Input analog (0-5V)	Checks to see if oxygen sensor reacts to increase in unmetered airflow generated by secondary air pump operation. Oxygen sensor must sense lean condition or fault will set.
247	P1432	Secondary air valve stuck open	Input analog (0-5V)	Checks to see if oxygen sensor reacts to increase in unmetered airflow generated by secondary air pump operation. Oxygen sensor must sense lean condition or fault will set.
248	P1184	Post-cat sensor; signal after decel phase not plausible; (Bank 1)	Input analog (0-5V)	Signal is checked for a lean signal in decel and a transition between lean to rich after decel
249	P1185	Post-cat sensor; signal after decel phase not plausible; (Bank 2)	Input analog (0-5V)	Signal is checked for a lean signal in decel and a transition between lean to rich after decel
250	P0440	Functional check purge valve	Input analog (0-5V)	This functional check looks for reaction of oxygen sensor signal during canister purging. Oxygen sensor, air flow meter and RPM values must react to purging of canister.

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