- 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)

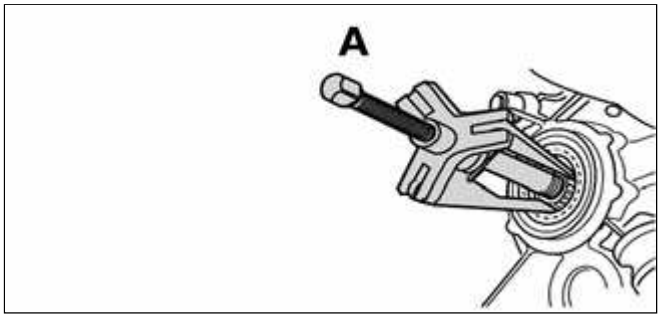
General

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.

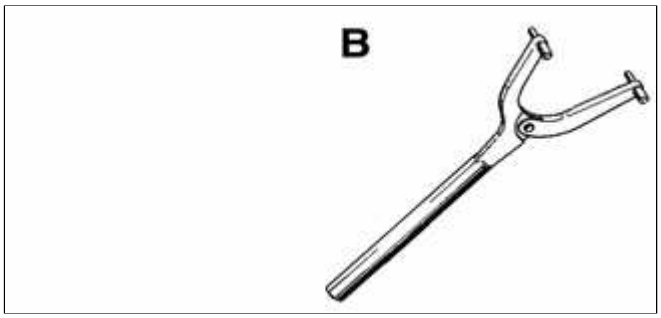
Internal repairs of the differential assembly are not covered in this manual.

Special tools

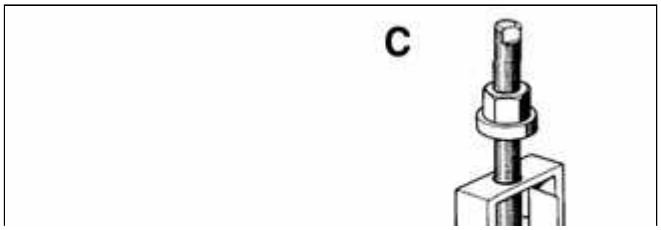
BMW recommends some special tools for the removal of the drive axles as well as the installation of rear differential input and output drive flange seals. Some common pullers and drifts can often be substituted for these tools.



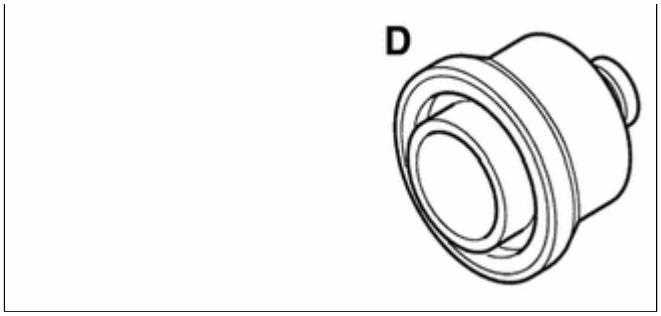
- Radial seal puller BMW 00 5 010



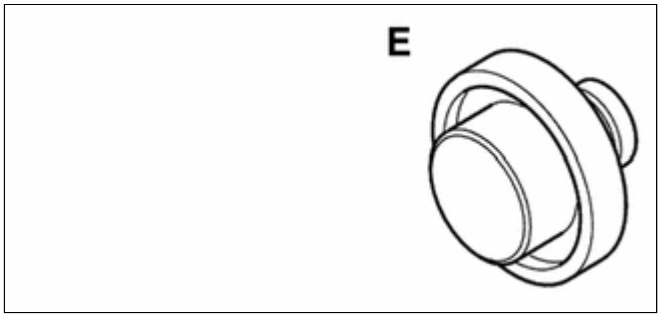
- Flange counterhold tool BMW 23 0 020



- Drive axle puller BMW 33 2 110

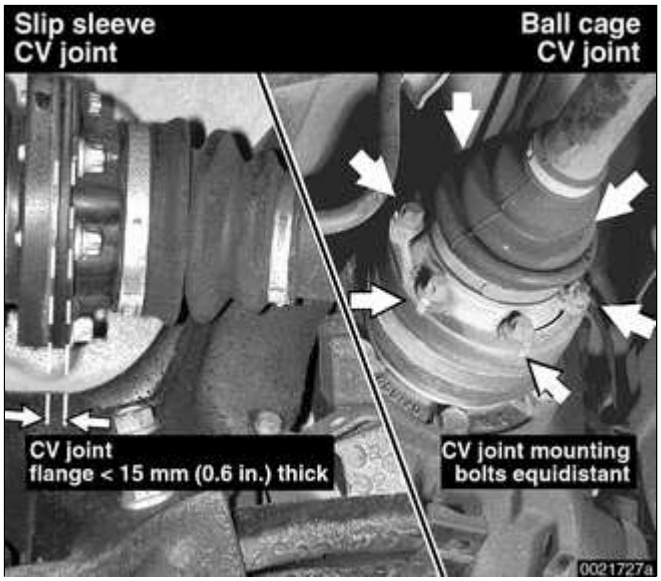


- Output flange seal drift BMW 33 3 400



- Input flange seal drift BMW 33 3 430

Drive Axles



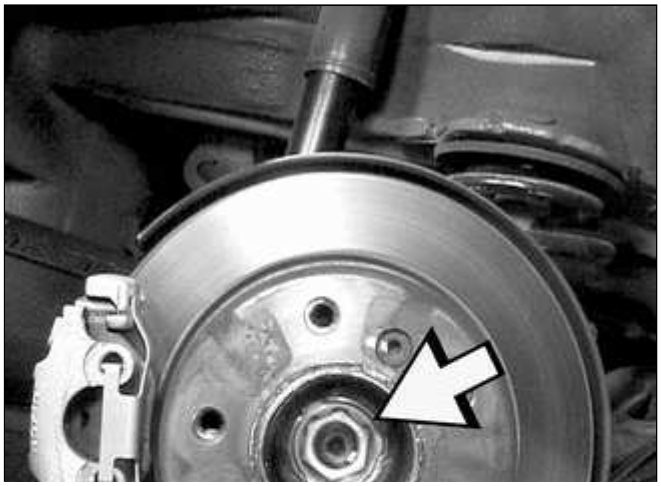
The drive axles use constant-velocity (CV) joints on both ends. Two different styles of CV joints have been supplied with E46 vehicles. Refer to the accompanying illustration:

- 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.

- Raise rear of car. Remove rear wheel.

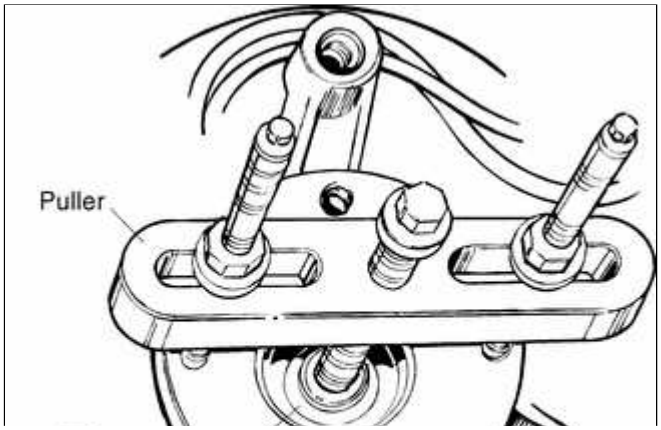
WARNING!

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.

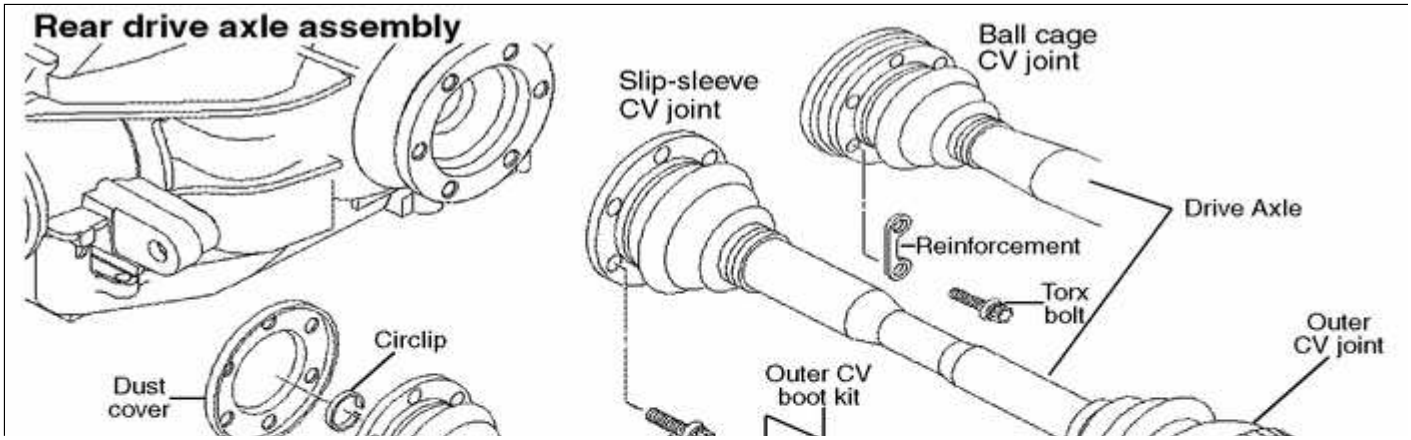
- Installation is reverse of removal.

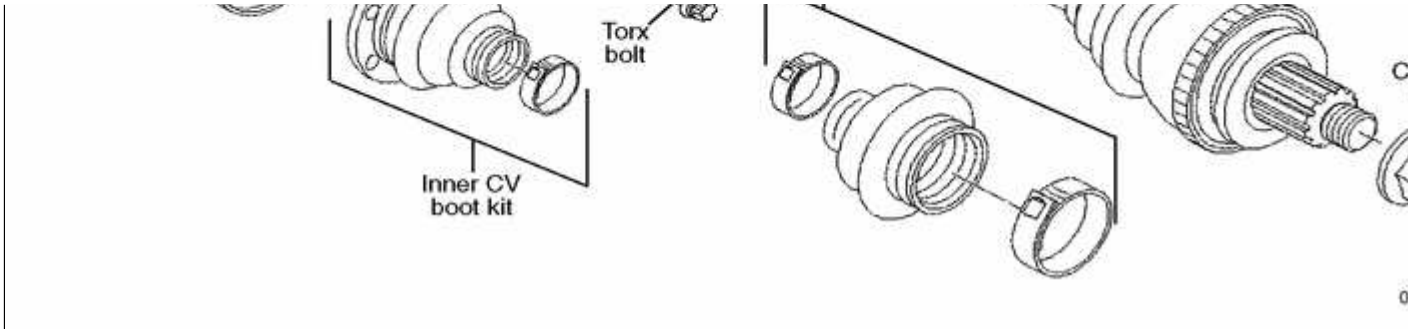
♦ Apply a light coating of oil to contact face of collar nut and install it loosely.

- 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





CV joint boots

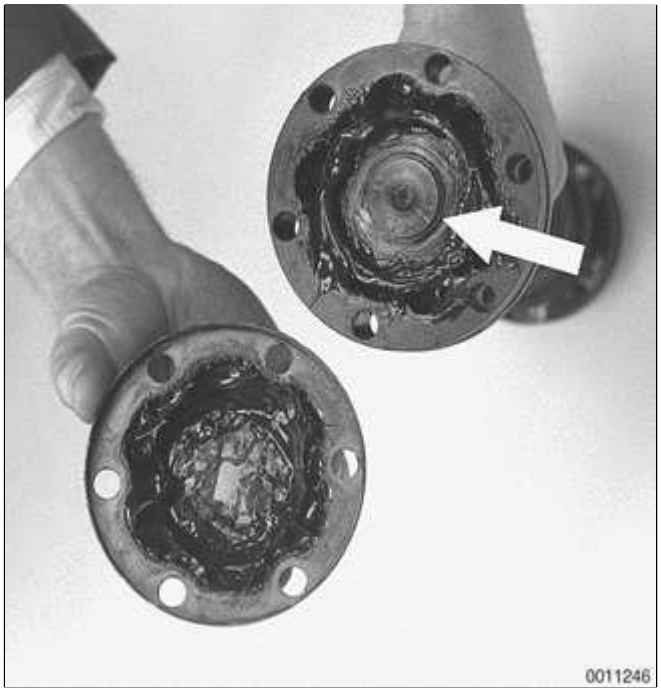
Note:

- *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.*

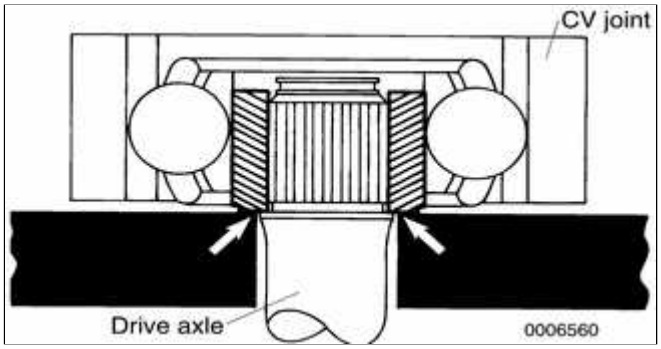
Working with axle shaft at bench, cut off old boot clamps and remove boots. Clean old grease off joints and shafts. Use new grease from CV joint boot kit.

Ball cage CV joint boot

Lift off dust cover from inner CV joint and remove circlip (**arrow**) retaining joint



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

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.

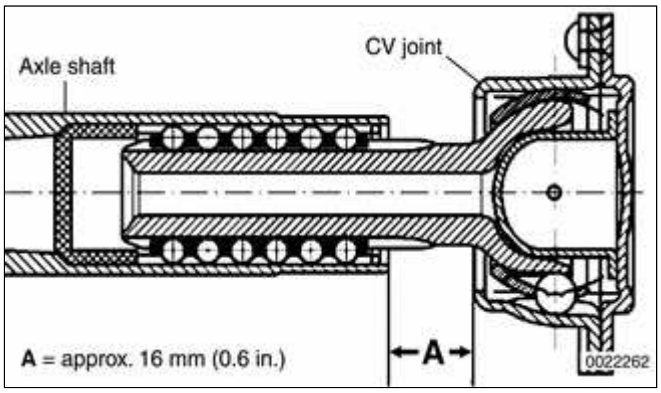
Slip sleeve CV joint boot

- Pull CV joint partially out of axle shaft. Matchmark relative position of

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°.*

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.

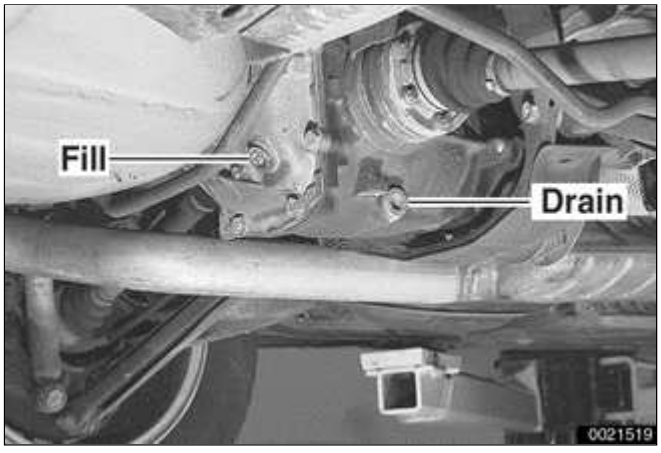
Note:

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:

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.

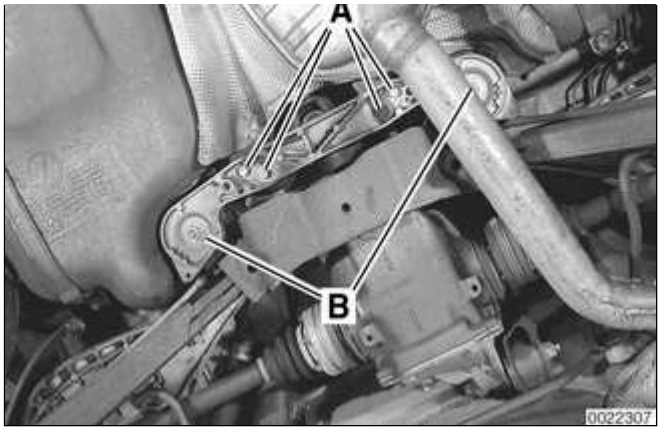
WARNING!

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:



- 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:

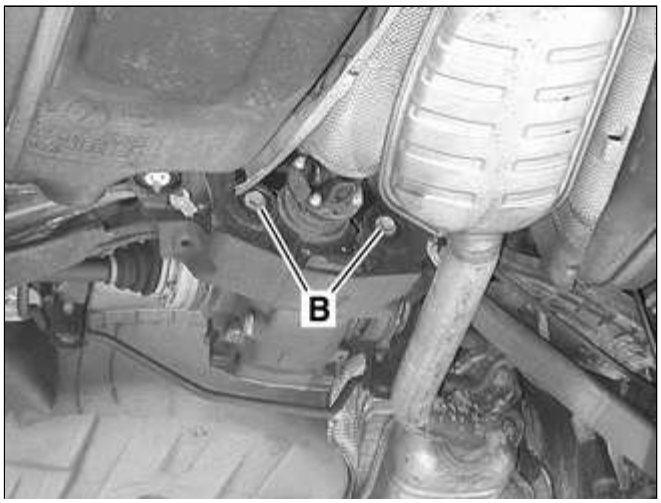
If necessary, tilt rear half of exhaust system down. Support exhaust system securely.

- 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.

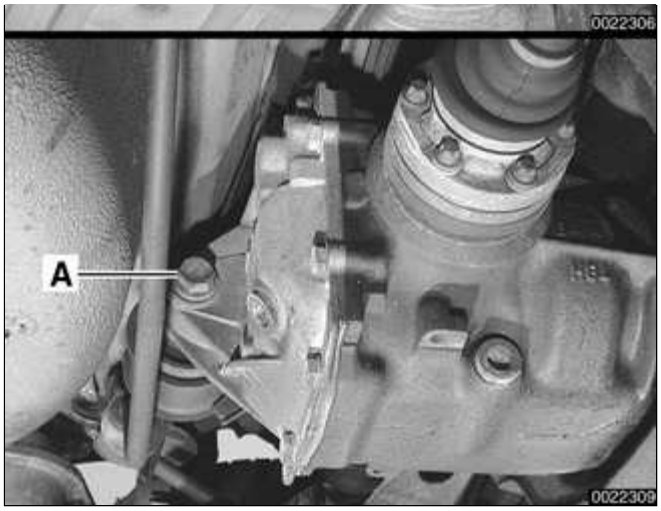
- Remove rear stabilizer bar.



- 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



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.

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.

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.

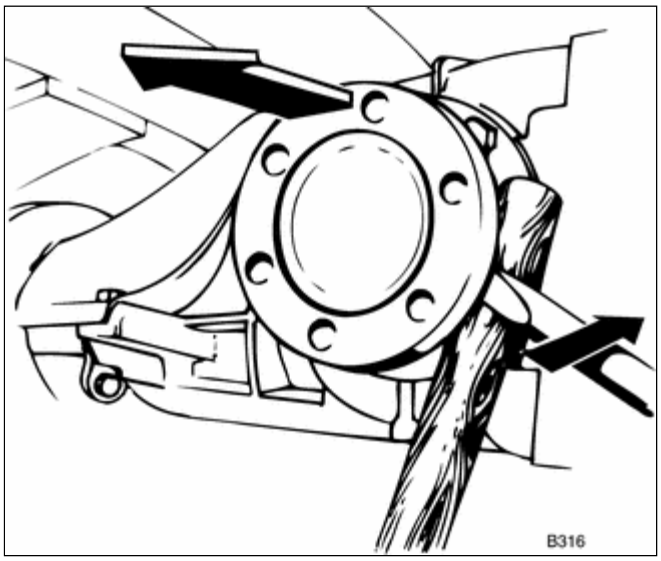
- If working on left side: Detach rear of exhaust system and tilt down. Support rear muffler securely.

- Detach stabilizer bar from rear subframe.

- Detach drive axle from differential as described earlier.

CAUTION!

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:

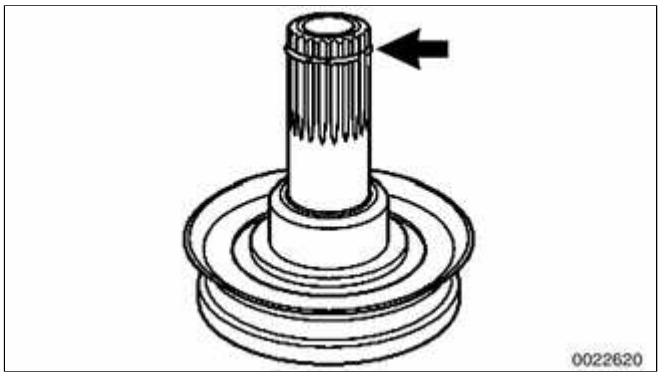
- *Be prepared to catch dripping oil in a pan.*
- *Inspect flange at the point where the oil seal rides on the shaft. Replace the flange if there is a groove worn in the shaft.*

- 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.

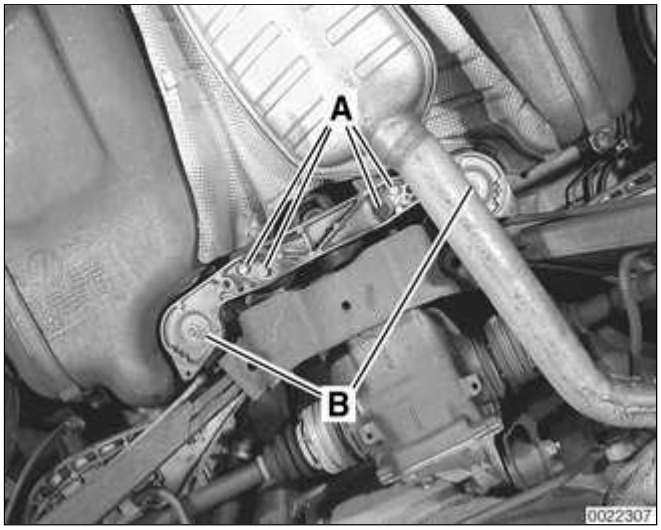
- Attach drive axle and tighten bolts.

- Top off differential with oil.

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:

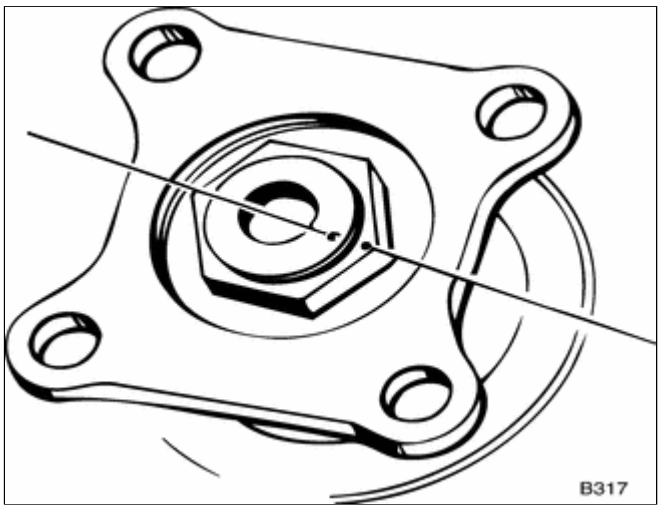
- Remove heat shield between reinforcement brace and exhaust pipe.
- Remove bolts (**A**) mounting brace to undercarriage.
- Remove nuts (**B**) mounting brace and front of rear subframe to undercarriage.
- Lower and remove reinforcement.

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

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.

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)

General

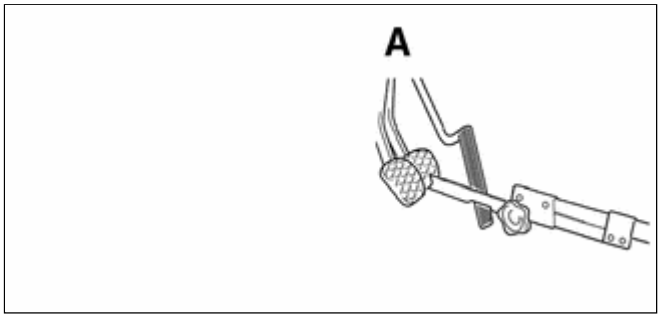
This repair group covers brake service:

- Brake pads, calipers, and disks
- Master cylinder, brake booster, and parking brake
- ABS/ASC and ABS/DSC component replacement

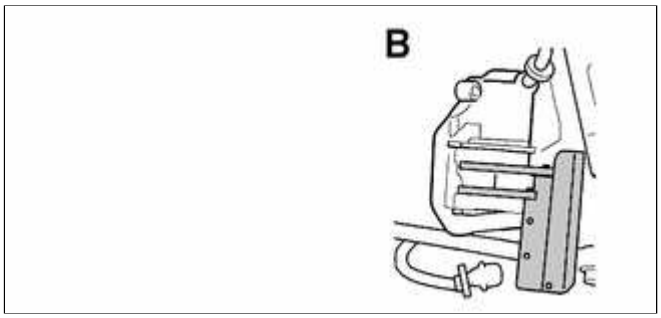
ABS/ASC and ABS/DSC system descriptions are covered in ⇒ 300 Suspension, Steering and Brakes-General.

Special tools

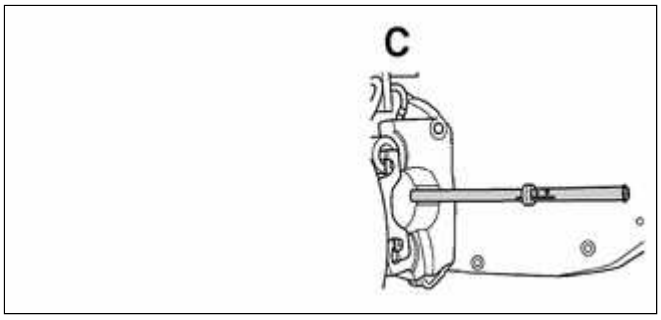
BMW requires the use of either the DIS or the MoDiC diagnostic tool to safely and completely bleed the braking and traction control systems. Read all procedures through before beginning a job.



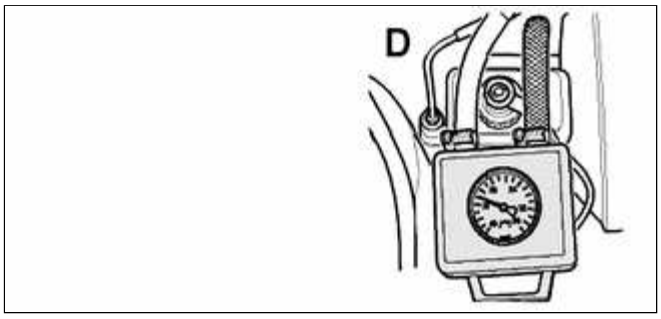
➢ Pedal prop



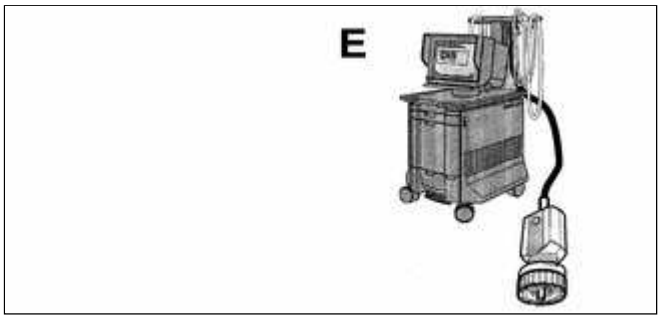
➢ Brake caliper piston tool BMW 34 1 050



- 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

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

	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

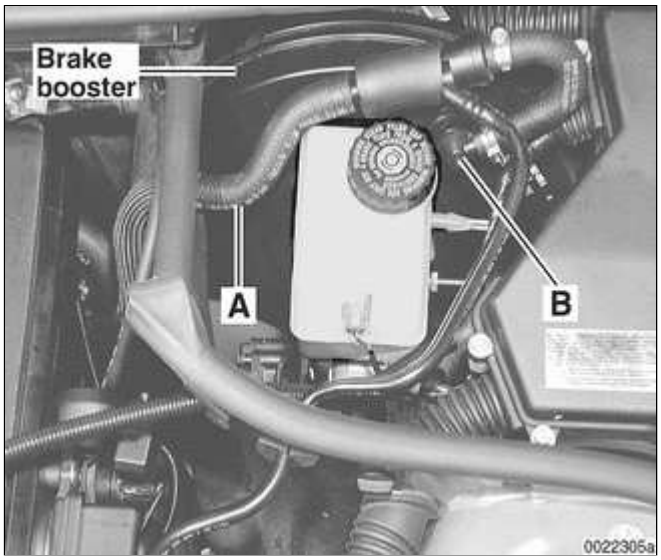
Brake performance is mainly affected by three things:

- 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

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.

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***

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.

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.

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

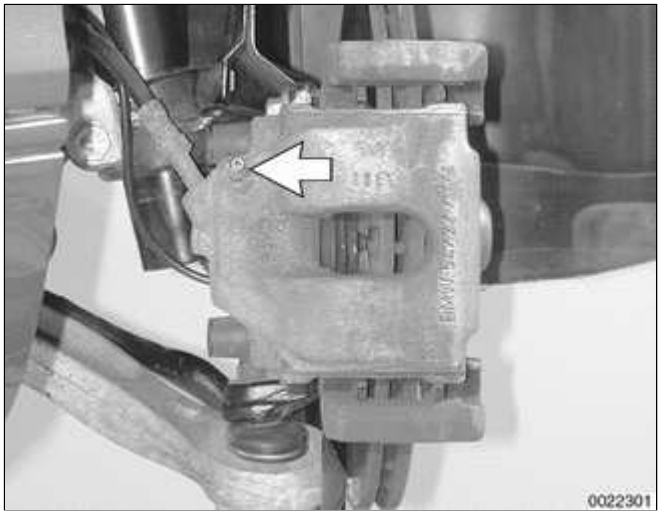
- Top off brake fluid in reservoir and

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.

- 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)

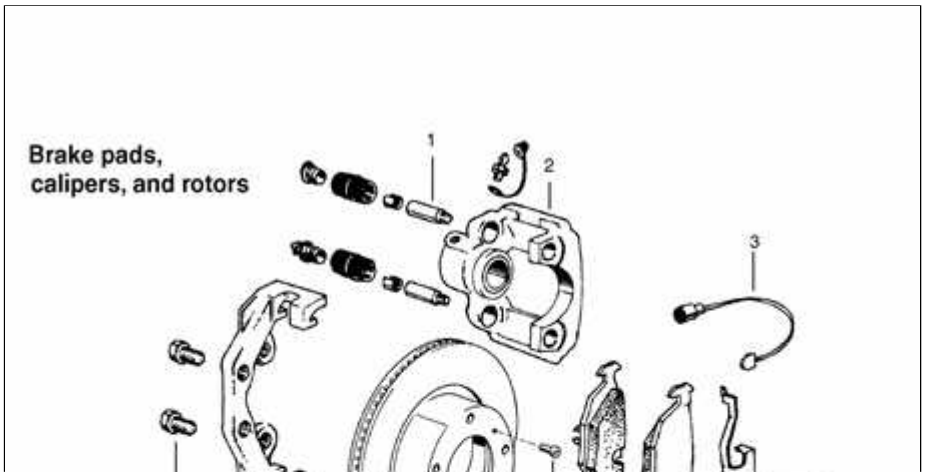
Brake Pads, Calipers, and Rotors

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!

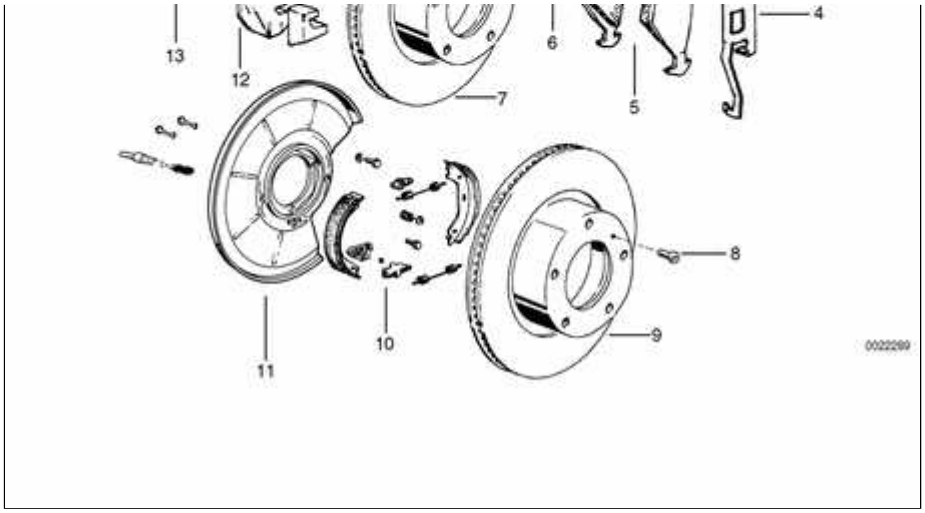
- ***Although semi-metallic and metallic brake friction materials in brake pads or shoes no longer contain asbestos, they produce dangerous dust.***
- ***Treat all brake dust as a hazardous material.***
- ***Do not create dust by grinding, sanding, or cleaning brake friction surfaces with compressed air.***



Brake pads, calipers and rotors, assembly

1 - **Brake caliper guide bolts**

- 7 mm Allen head



- 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

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**

- Make sure contact surfaces are clean and free from grease

- See Brake pad carrier

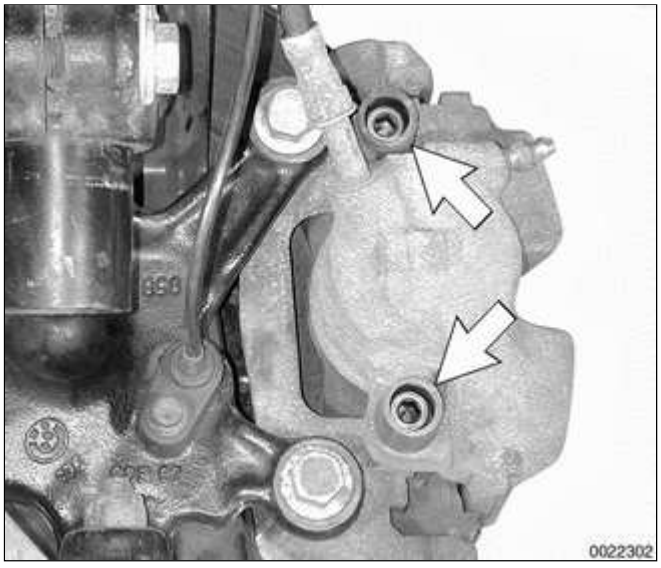
13 - **Brake pad carrier retaining bolts**

- 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,

caliper piston will have to be pressed back into caliper before caliper can be removed.

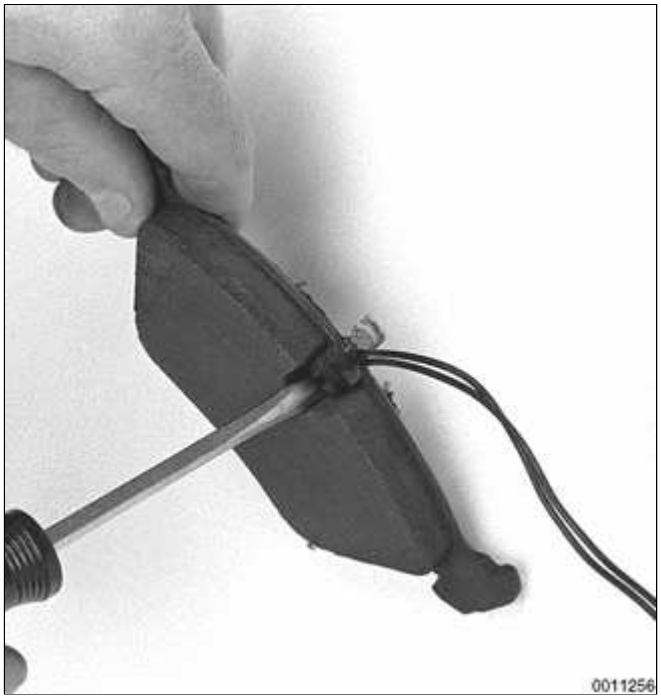
CAUTION!

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.

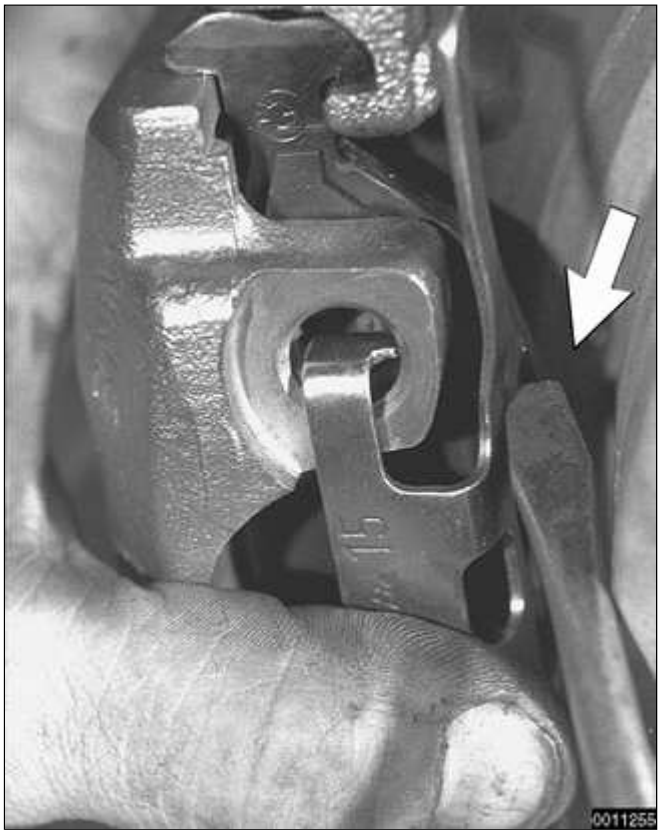
Tightening torque	
Caliper to brake pad carrier mounting bolts	30 Nm (22 ft-lb)

Brake pad wear sensor



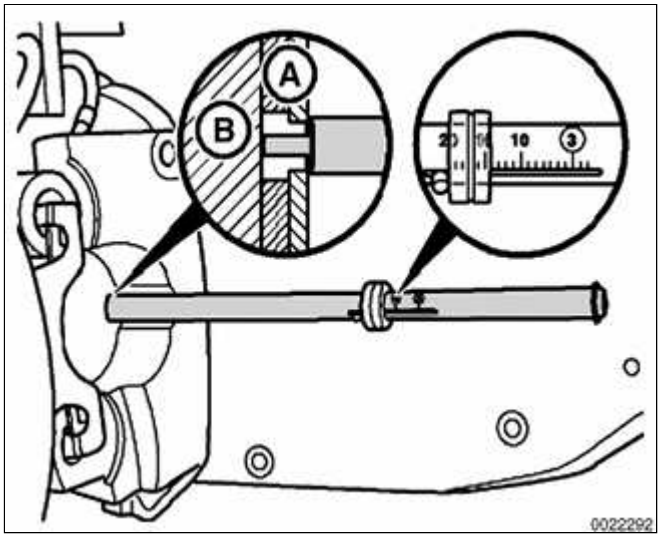
- Carefully pry pad wear sensor from brake pad.
- Insert brake pad wear sensor into cutout in new pad where applicable.
- If brake lining indicator light illuminated prior to brake pad replacement, replace wear sensor.
- Route pad wear sensor wiring through caliper opening and bleeder dust cap.

Brake pad anti-rattle clip



Remove anti-rattle clip by unhooking at top and bottom. Use screwdriver as an aid (**arrow**).

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

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.)

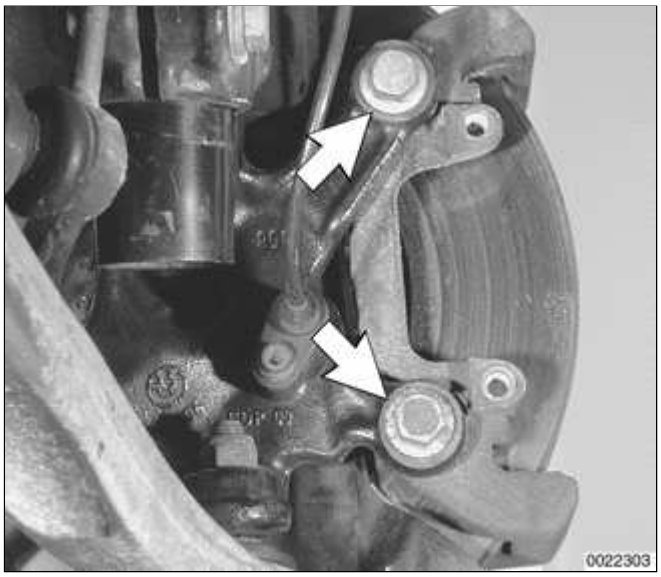
- Brake rotors should always be replaced in pairs.
- Clean rotor with brake cleaner

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)

Master cylinder

The brake master cylinder is mounted to the front of the vacuum booster on the driver side bulkhead.

CAUTION!

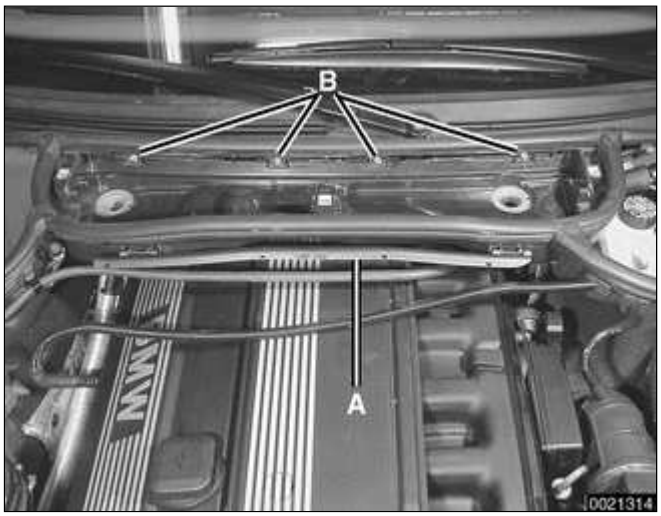
All U.S. market E46 vehicles are equipped with Antilock Braking System (ABS) and either Automatic Stability Control (ASC) or Dynamic Stability Control (DSC). Replacing the master cylinder requires that the braking system be properly bled by an authorized BMW repair facility. This procedure is necessary for the braking and stability controls to function properly.

Master cylinder, removing and installing

- Using a clean syringe, empty brake fluid reservoir.

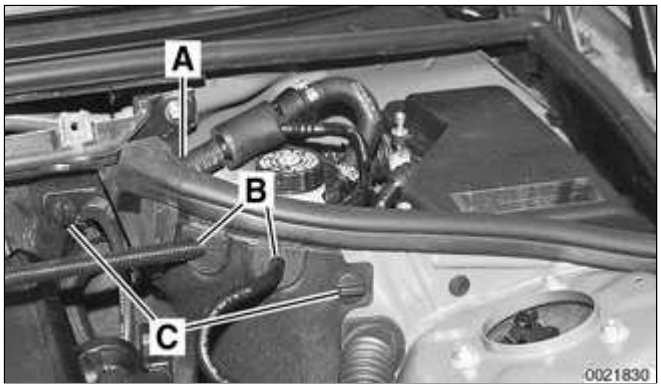
WARNING!

Brake fluid is highly corrosive and dangerous to the environment. Dispose of it properly.

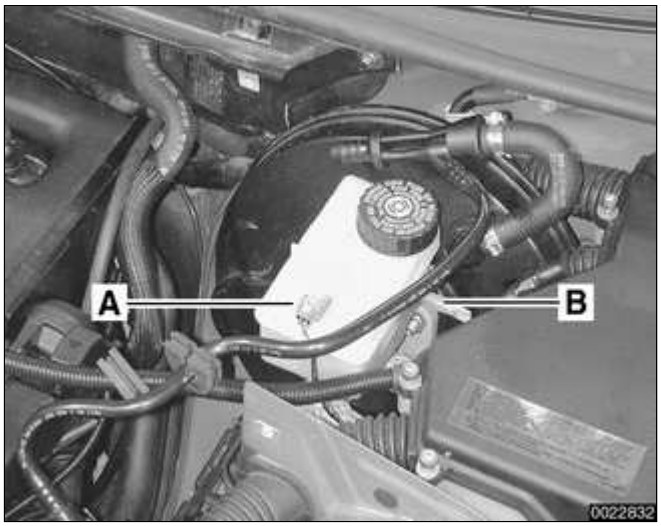


➢ Remove interior ventilation microfilter housing:

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



- 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.

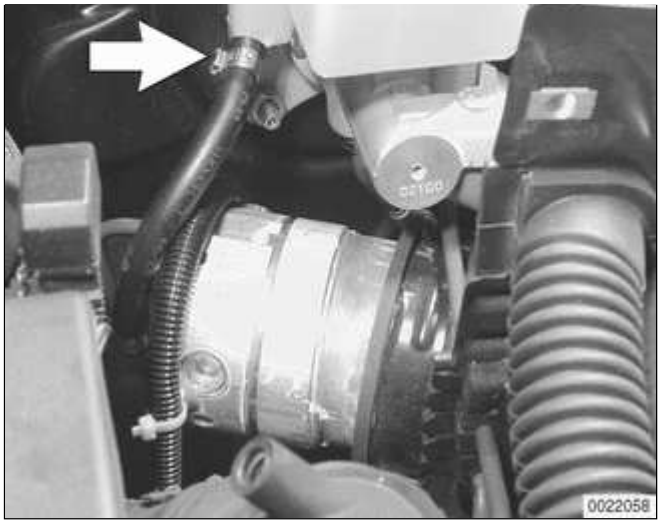


- Working at brake master cylinder:
  - Disconnect brake fluid level sensor connector (**A**) from fluid reservoir.
  - Disconnect hydraulic clutch system supply line (**B**) if applicable. Plug open brake fluid ducts to prevent fluid leakage or contamination.

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



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***

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.

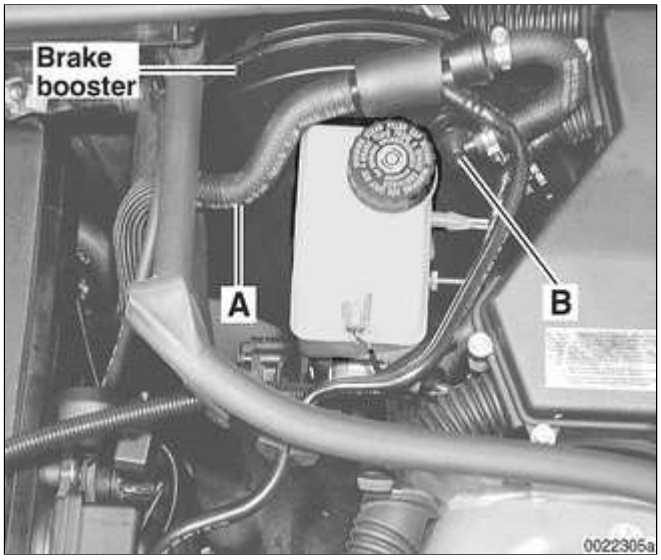
- Reconnect supply hose of brake system precharge pump to brake fluid reservoir, if applicable

- Connect hydraulic clutch hose to brake fluid reservoir, if applicable.

- Remainder of installation is reverse of removal. Bleed entire brake system as described earlier.

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***

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.

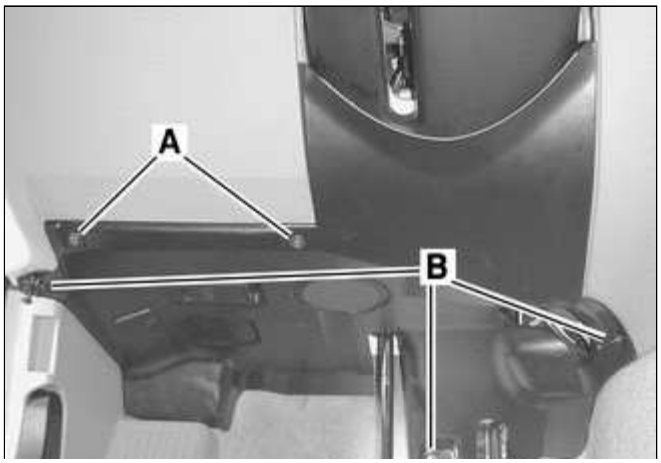
WARNING!

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.

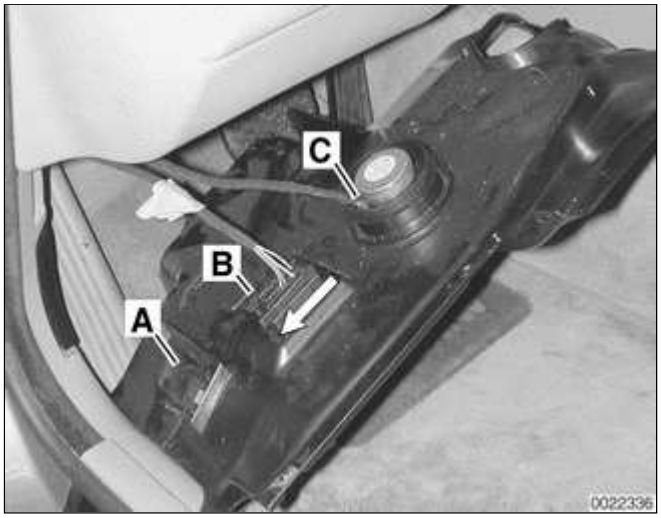
- Remove hydraulic unit or precharge pump below master cylinder as described later in this repair group.



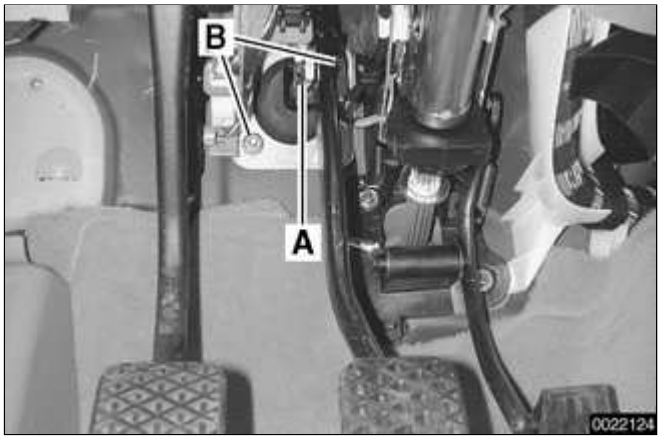
➢ Working in interior, remove left footwell (pedal cluster) trim panel.

- Remove screws (**A**).

- Remove fasteners (**B**).



- 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

mounting nuts.

- Replace sealing O-ring between master cylinder and brake booster.

- Bleed brake system as described earlier.

CAUTION!

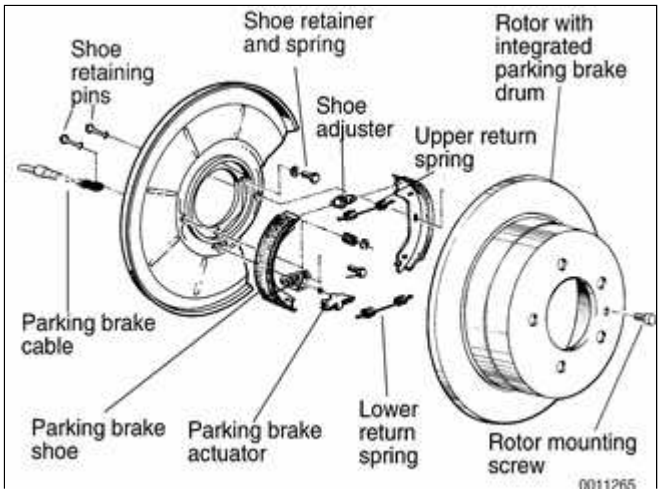
Do not over-torque the master cylinder mounting bolts. This could damage the brake booster and prevent proper vacuum build-up.

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.

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.

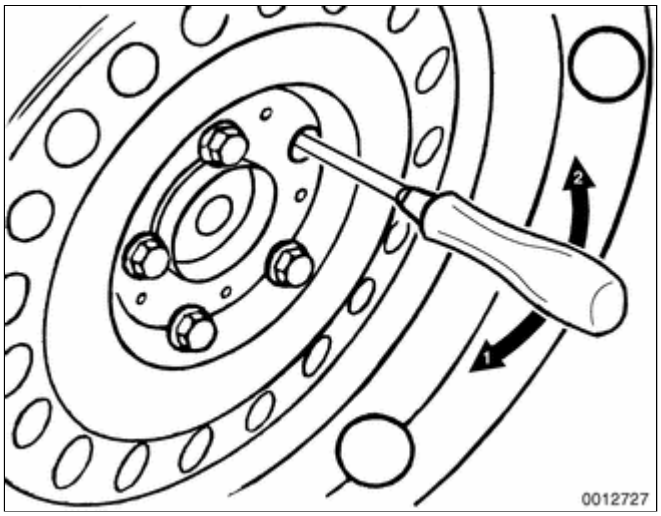
- Raise rear of car.

WARNING!

Make sure the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point.

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

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

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.

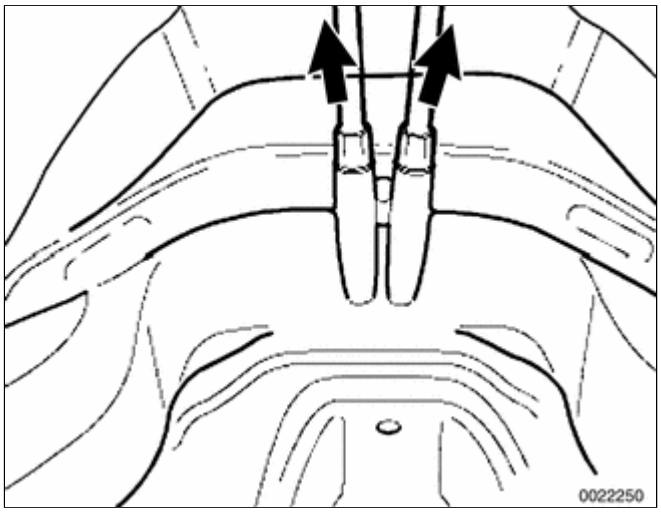
- Raise rear of car.

WARNING!

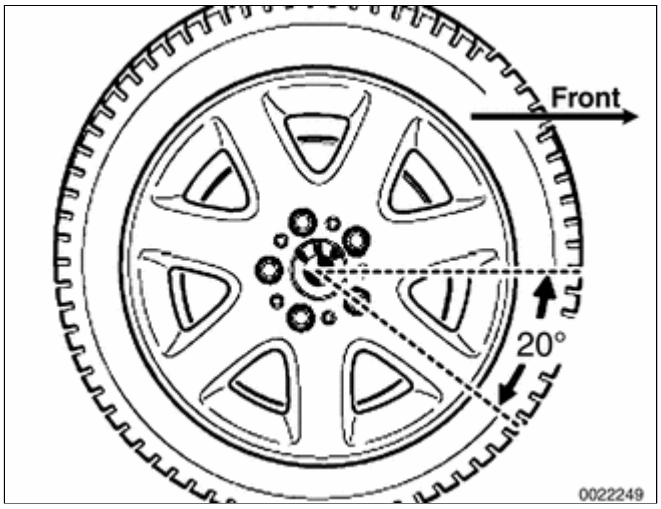
Make sure the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.

- Remove complete exhaust system as described in ⇒ 180 Exhaust System.

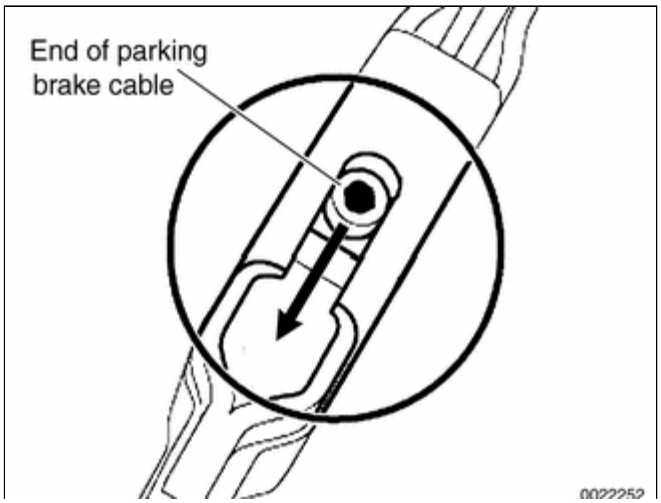
- Remove center tunnel heat shield.



- 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.

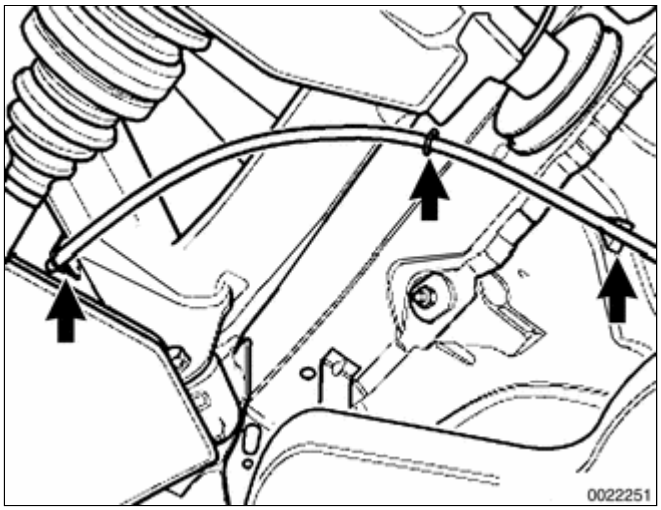
  - Poke thin screwdriver through lug bolt hole and pry end of parking brake cable downward (**arrow**).

- 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.

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

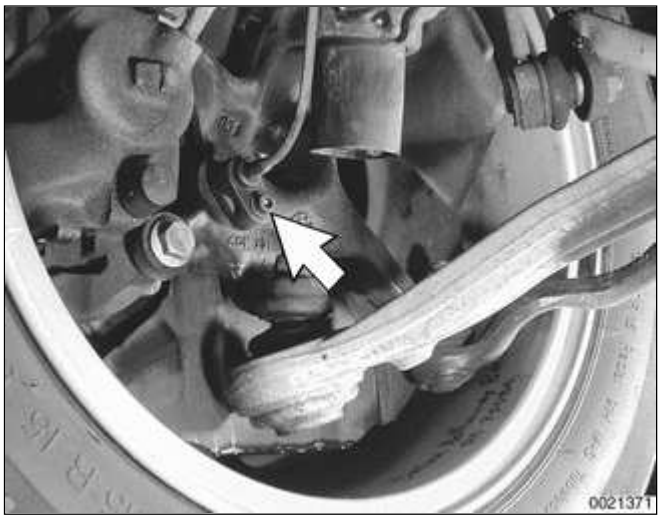
CAUTION!

Magnetoresistive & Hall effect wheel speed sensors can be interchanged physically in the rear wheels, but function is not similar.

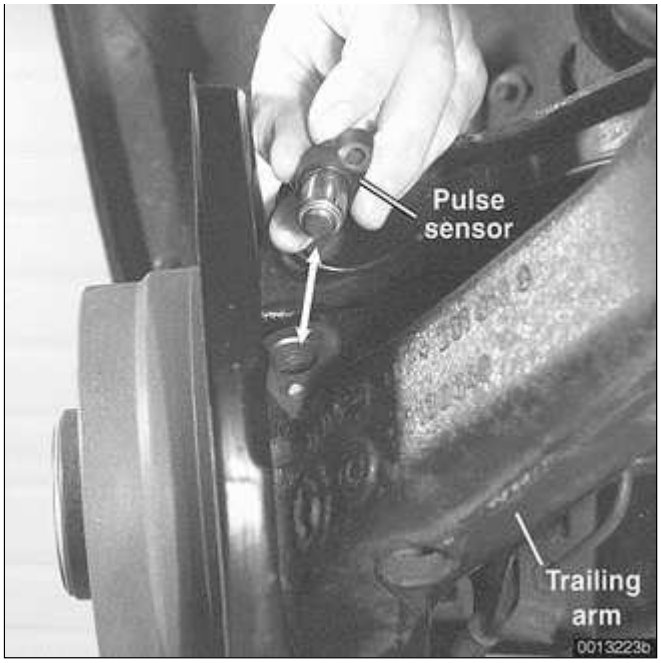
- Raise applicable end of car.

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.



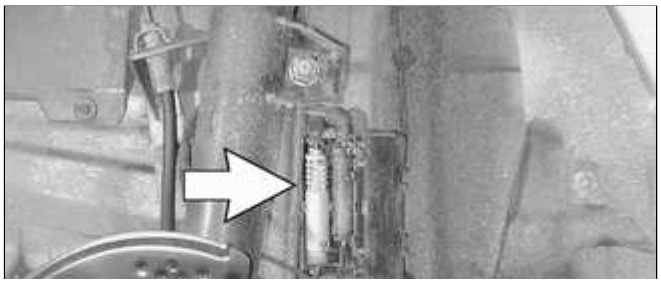
- Front sensor: Unscrew mounting bolt at steering arm (**arrow**).



- 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

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

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

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)