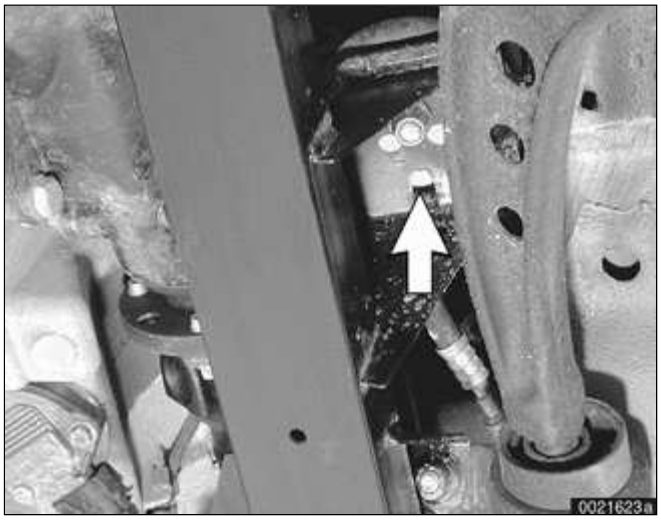
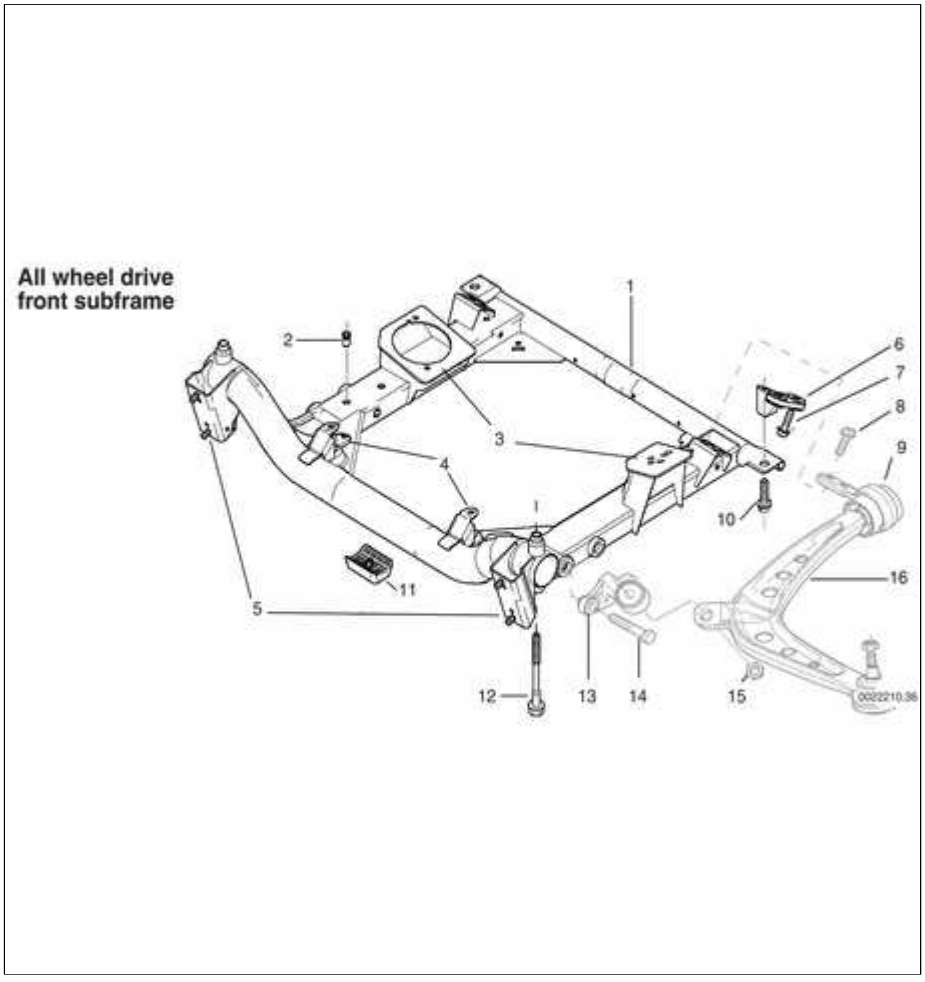


Installation is reverse of removal, noting the following:

- 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)

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)

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**

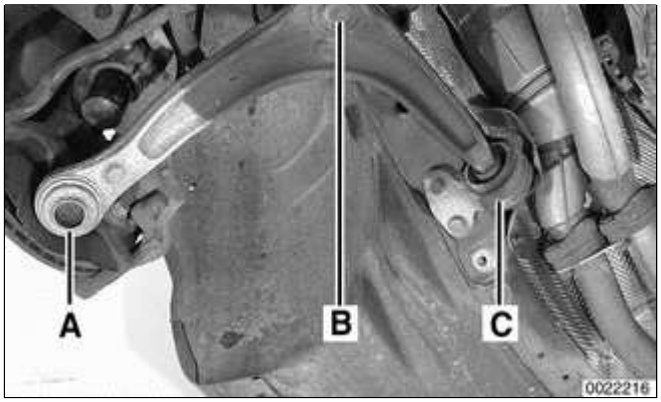
- tighten to 77 Nm (57 ft-lb)

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:



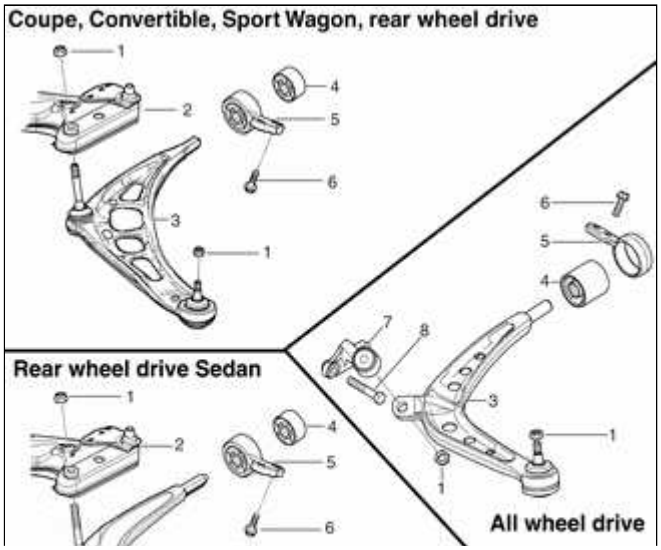
- **A** Outer ball joint attached to steering arm
- **B** Inner ball joint attached to front subframe
- **C** Bushing and bracket attached to the frame rail (rear wheel drive models) or front subframe (all wheel drive models)

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

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)

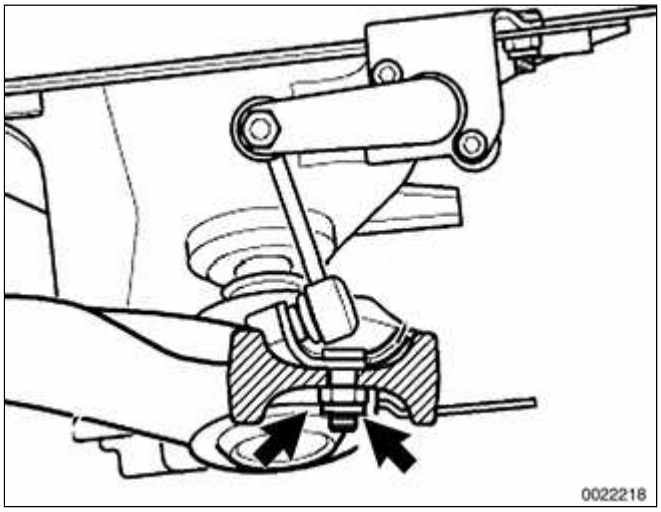
- Raise car and remove wheel.

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.

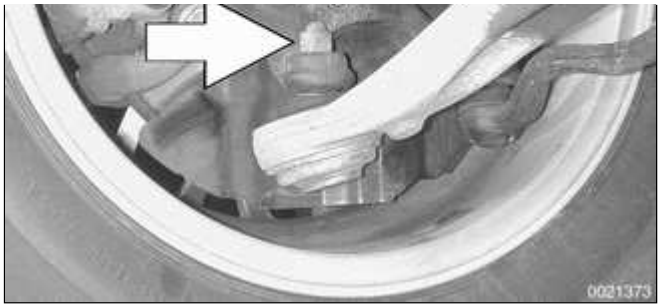
- Remove splash shield under engine compartment.

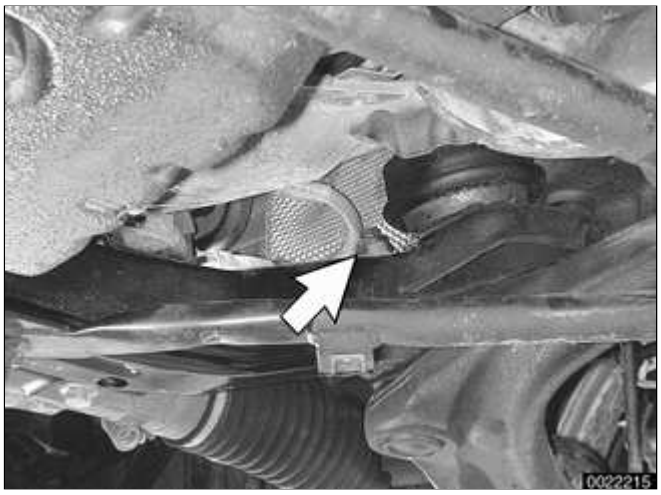
- Remove front end reinforcement.



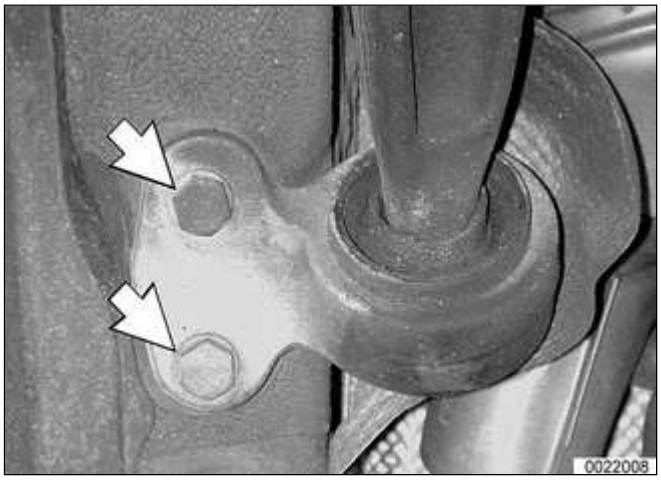
➢ On cars equipped with xenon headlights: Remove self levelling headlight sensor mounting nuts (**arrows**) from right control arm.

➢ 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.





- 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.***

- ***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)

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)

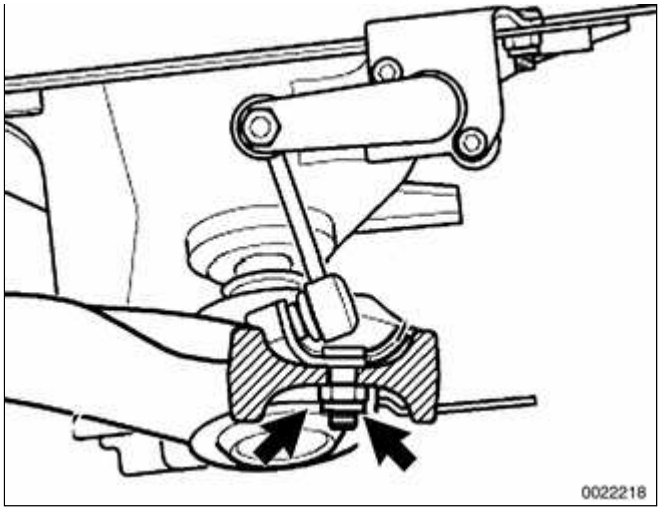
Control arm, removing and installing (all wheel drive models)

- Raise car and remove wheel.

WARNING!

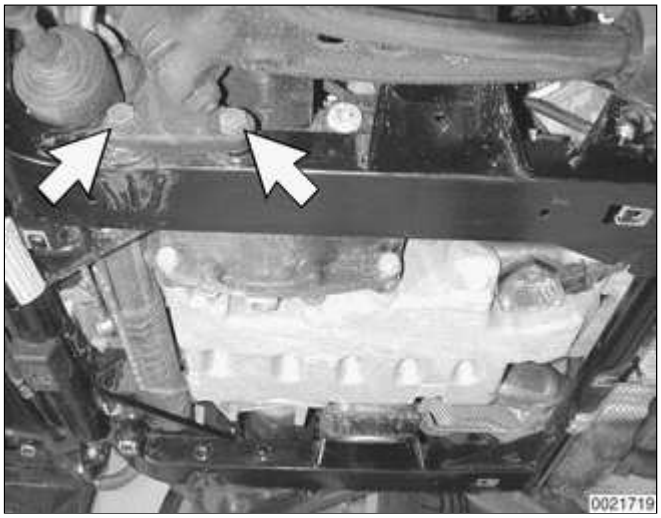
Make sure that the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.

- Remove splash shield under engine compartment.

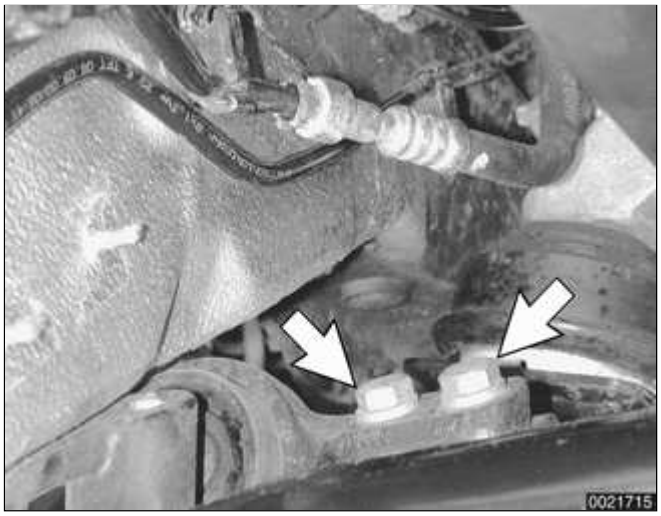


➢ On cars equipped with xenon headlights: Remove headlight vertical aim sensor mounting nuts (**arrows**) from right control arm.

➢ 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.



- 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:

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)

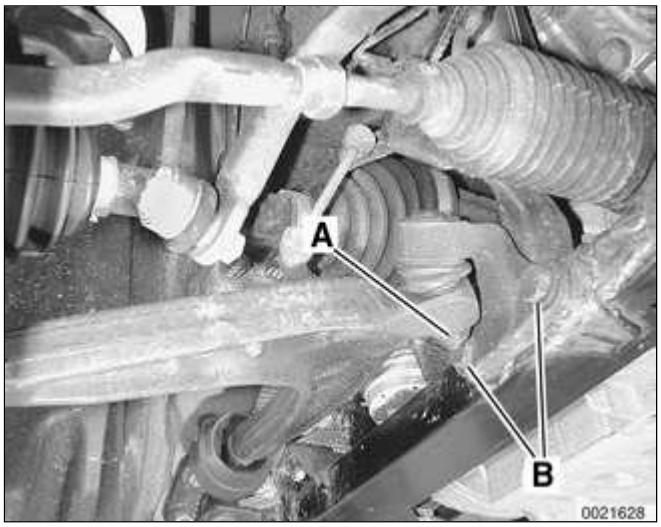
Inner ball joint, replacing (all wheel drive models)

- Raise car and support safely

WARNING!

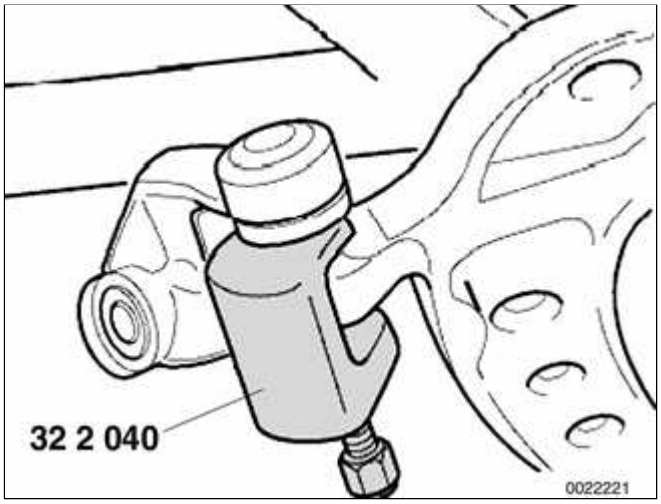
Make sure that the car is firmly supported on jack stands designed for the purpose. Place the jack stands beneath a structural chassis point. Do not place jack stands under suspension parts.

- 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)

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!

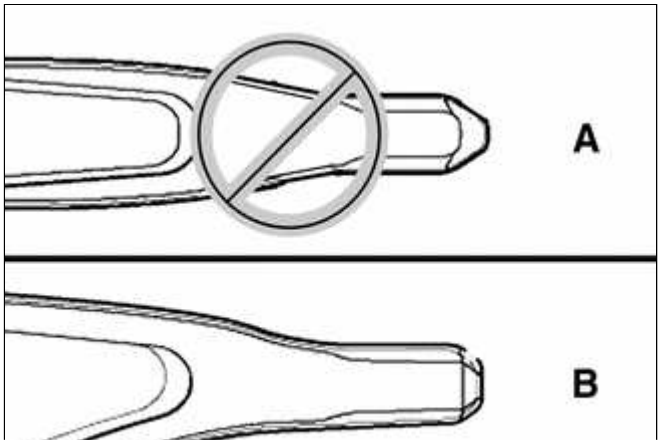
- ***Never reuse a rubber bushing that has been pulled off the control arm. The rubber coated inner sleeve is destroyed when it is pulled off dry.***

- ***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.

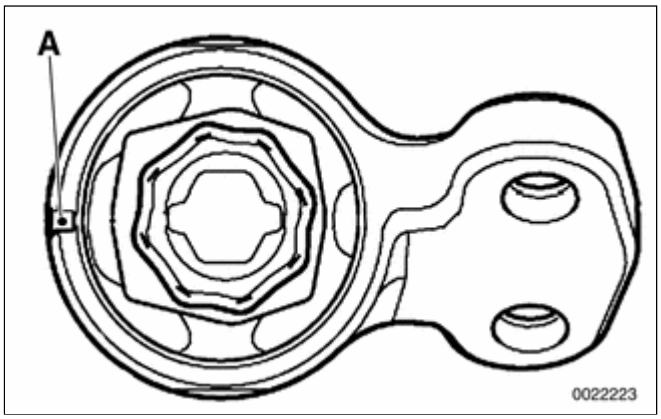
- Use puller to remove rear bracket and bushing from control arm.



Inspect pin (rubber bushing) end of control arm. Replace control arm with end **A**.

Note:

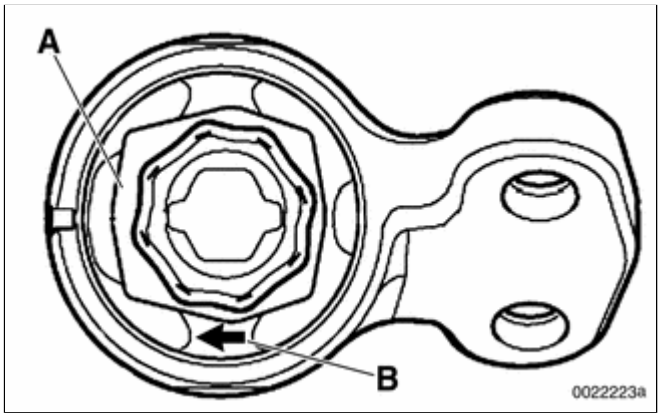
*Control arms with pin shape **A** have been superseded by parts with pin shape **B**.*



- 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.



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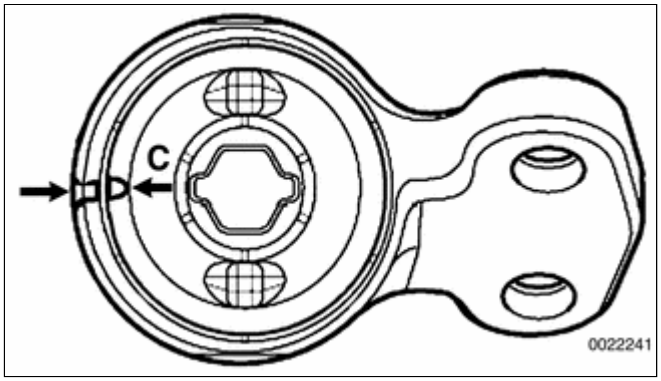
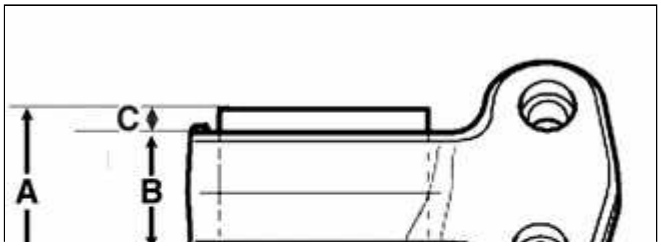
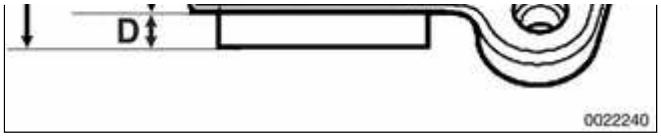


- Use press tools to remove old bushing and press in new. Be sure to line up marks on new bushing with boss on bracket. Depending on manufacturer, mark on bushing may consist of:
  - Extra buffer on inner part of bushing (**A**)
  - Arrow on rubber webbing of bushing (**B**)
  - Indent on outer casing of bushing (**C**)

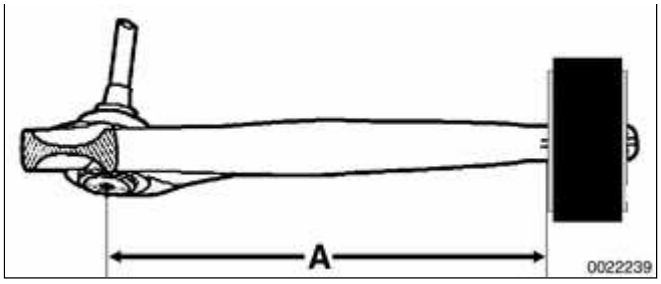


- New bushing must be pressed in so that it protrudes the correct distance from edges of bracket. See ⇒ Table a.

Table a. Control arm bushing



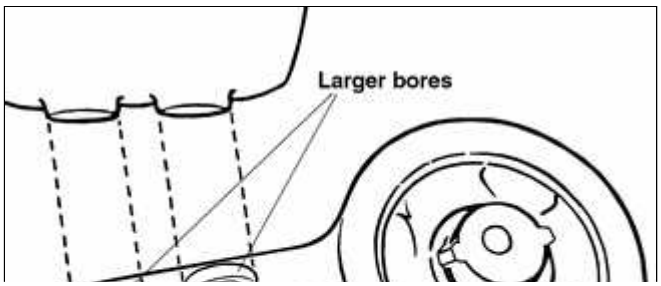
protrusion (rear wheel drive models)		
Dimension	**60 mm bushing**	**66 mm bushing**
A = Total bushing length (nominal)	50.5 mm (1.99 in.)	53.5 mm (2.11 in.)
B = Bracket width (nominal)	34.0 mm (1.36 in.)	
C = Fixed measurement	8.5 mm (0.33 in.)	12.0 mm (0.47 in.)
D = Protrusion	8.0 mm (0.31 in)	7.5 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)

Tightening torque	
bracket to frame rail M10 bolt (always replace)	

Control arm bushings, all wheel drive

CAUTION!

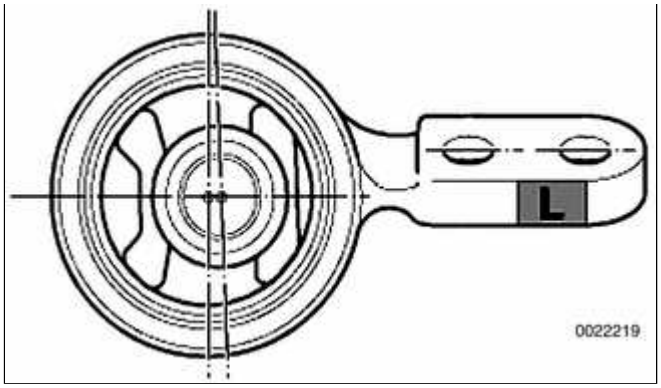
- ***Never reuse a rubber bushing that has been pulled off the control arm. The rubber coated inner sleeve is destroyed when it is pulled off dry.***

- ***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.

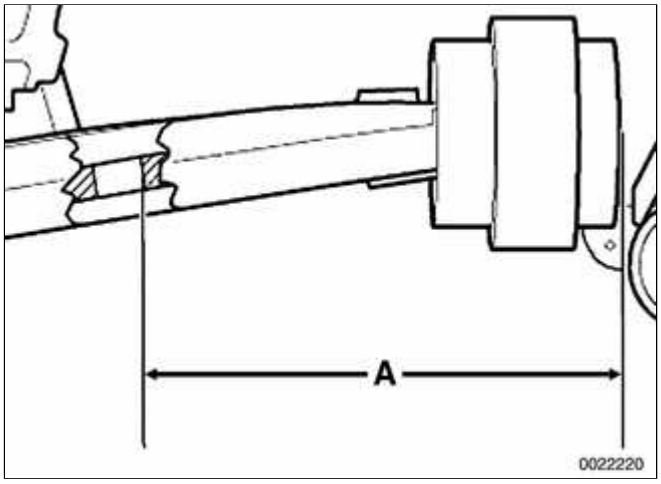
- Align bushing with bracket as shown in accompanying illustration.

Note:

Brackets are marked L or R for left or right.

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.

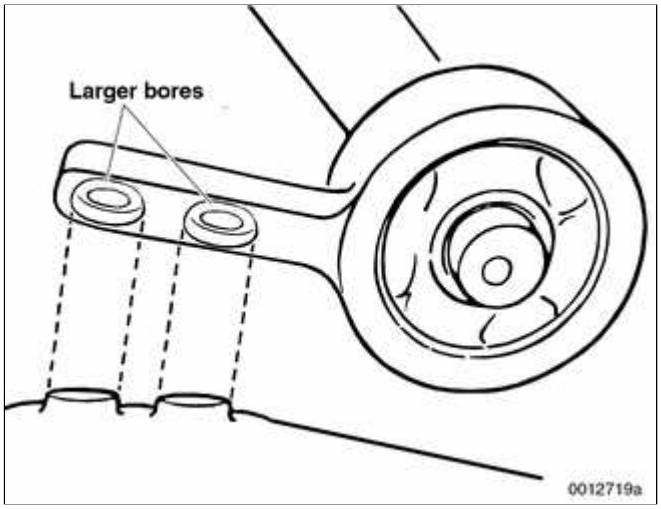


- When installing bushing on control arm:
  - Coat control arm pin and rubber mount with appropriate lubricant to facilitate installation.
  - Make sure dimension **A**(distance from first bore in control arm to outer edge of control arm bushing) is correct after assembly. See ⇒ Table c.

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)

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.***

Stabilizer Bar

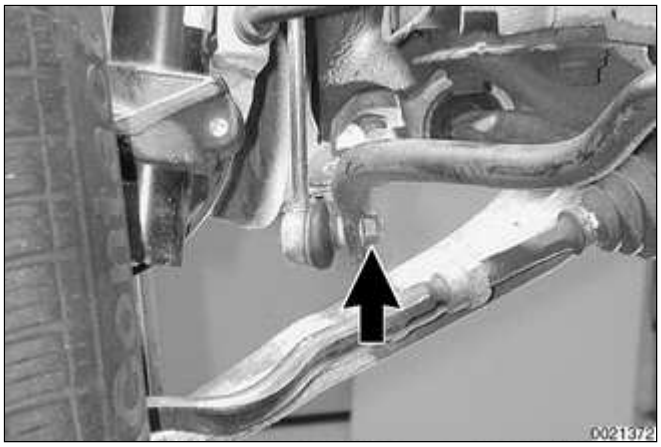
Stabilizer bar, removing and installing

On E46 models the stabilizer bar links attach to the strut assemblies.

- Raise car and support safely.

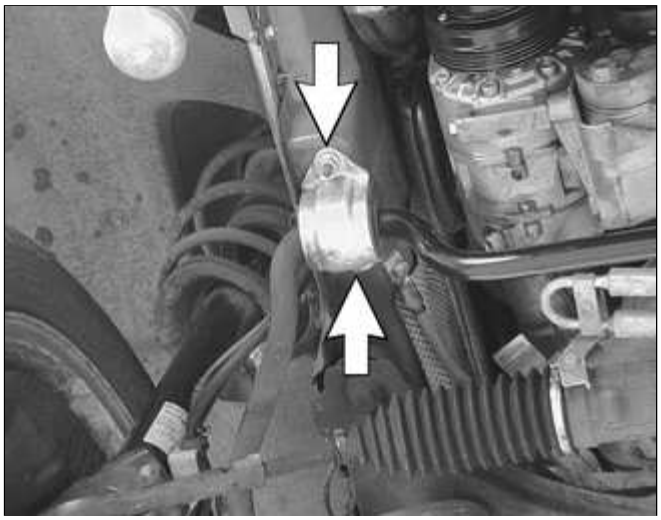
WARNING!

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.)

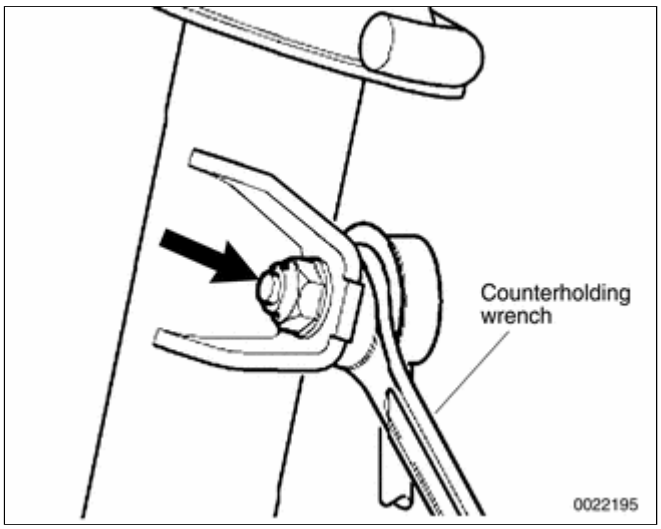
- Repeat on left side.



- Remove stabilizer bar bushing anchor nuts (**arrows**) on right side.

- Repeat on left side.

- Remove bar.



- 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.

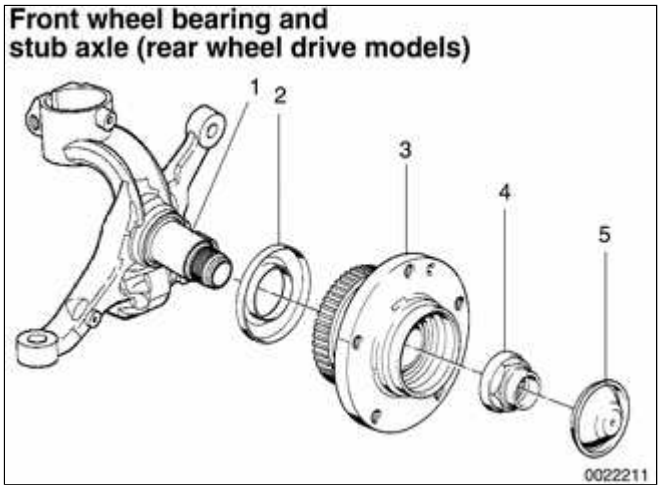
- When attaching stabilizer link to strut or bar, use a thin wrench to counterhold ball joints on link while tightening nut.

- 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)

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.

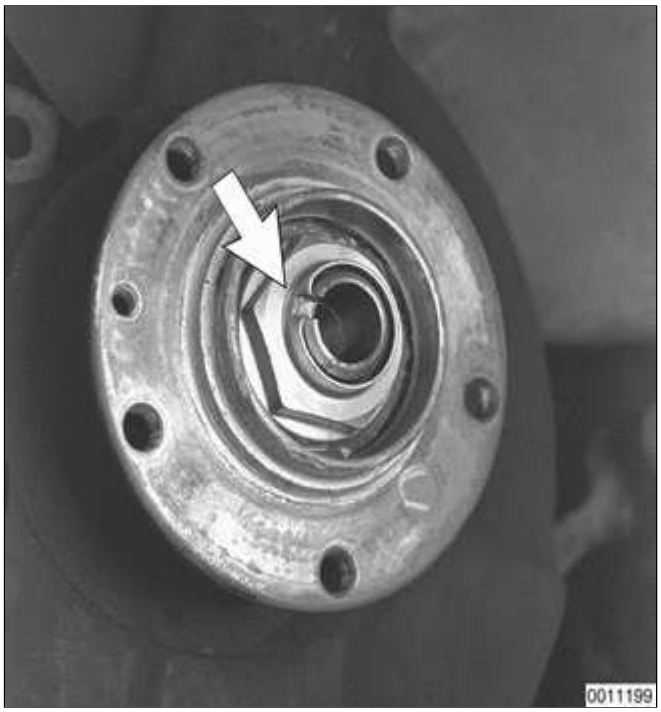
Front wheel bearing, replacing (rear wheel drive models)

- Raise car and remove front wheel.

WARNING!

Make sure that the car is firmly

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.

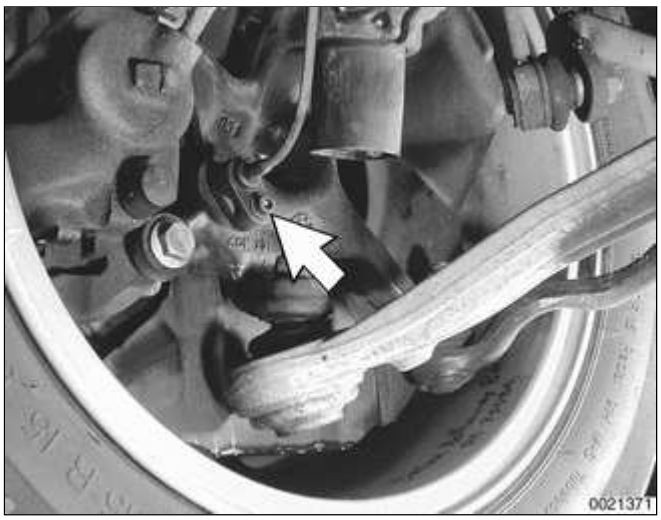
  - Remount wheel and lug bolts.

  - 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.

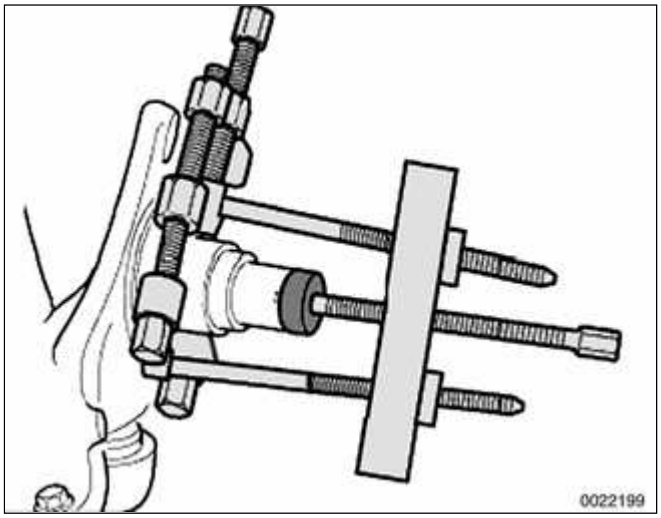
  - Remove wheel hub collar nut.

- 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.

- 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.

- 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)

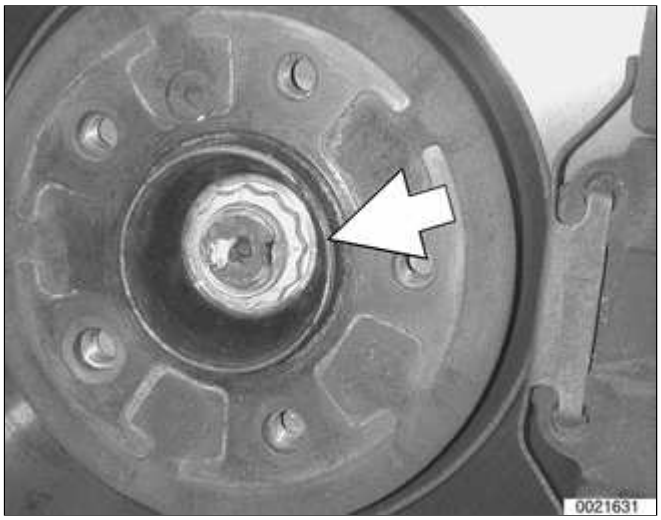
Removal and installation of the all wheel drive front wheel bearing is best

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**).

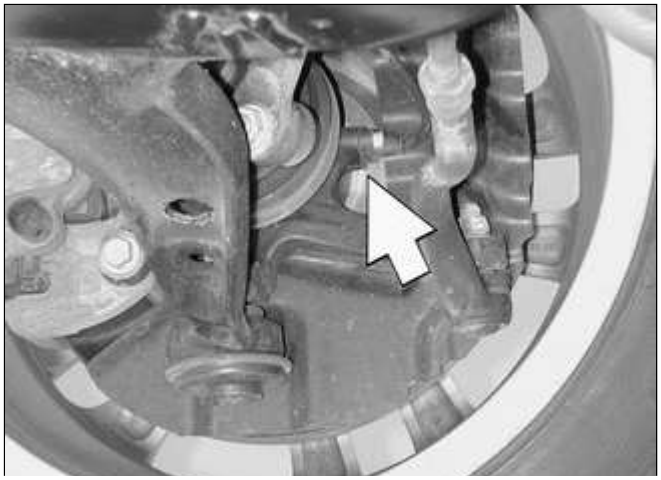
- Remount wheel and lug bolts.

- Lower car to ground. With an assistant applying brakes, loosen collar nut. Do not remove completely.

CAUTION!

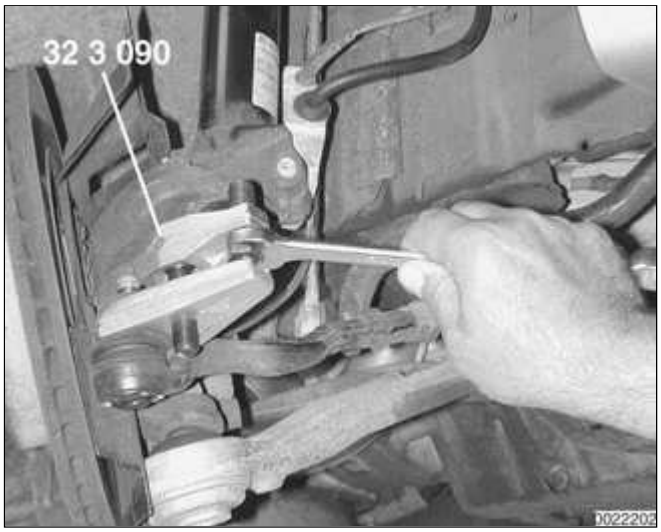
The wheel hub collar nut is tightened to a torque of 420 Nm (310 ft-lb). Make sure the car is firmly on the ground.

- Raise car and remove front wheel.

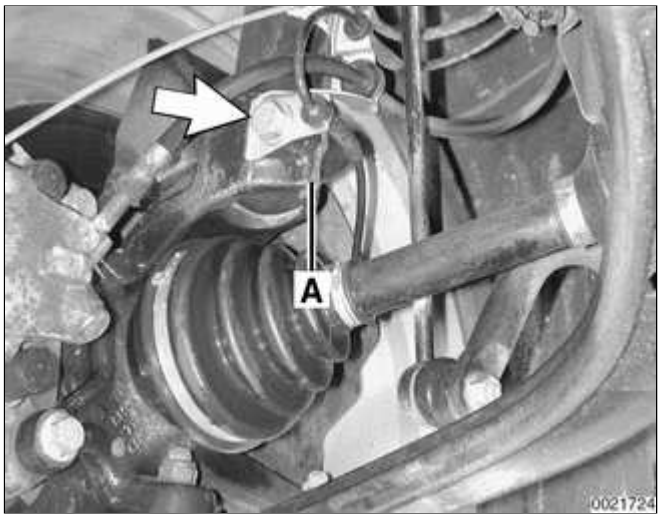


➢ Remove ABS wheel speed sensor (**arrow**).

- 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.



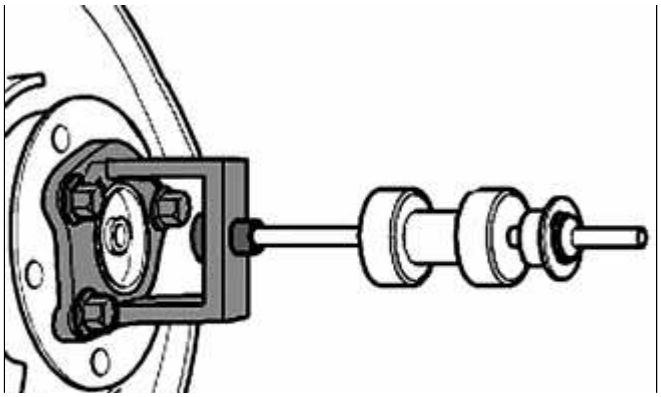
- Remove tie rod outer end nut. Use BMW special tool 32 3 090 or equivalent to press tie rod end off steering arm.
  - Detach control arm from front axle subframe as described earlier.
  - Remove outer ball joint nut. Use BMW special tool 32 3 090 or equivalent to separate steering arm and strut assembly 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.

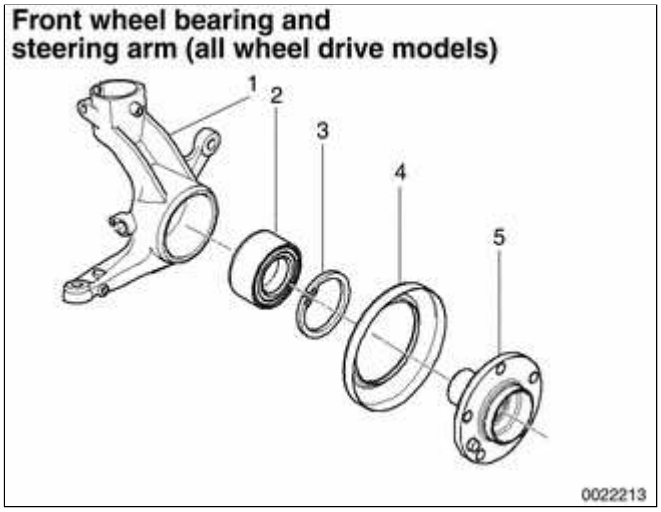
CAUTION!

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.

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.*

- 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)

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)

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.

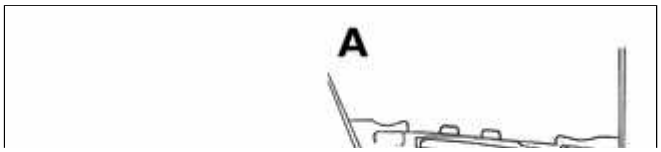
Some procedures will require you to also refer to the following repair groups:

- ⇒ 260 Driveshaft
- ⇒ 270 Transfer Case
- ⇒ 310 Front Suspension
- ⇒ 340 Brakes

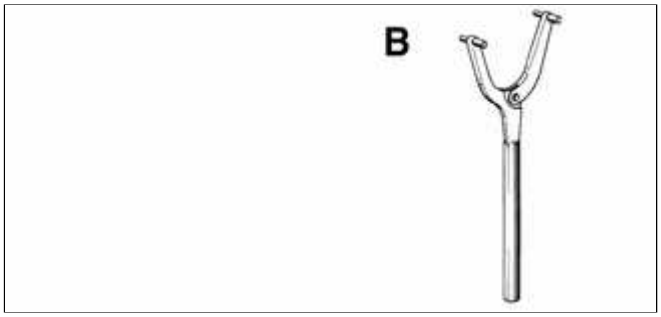
Procedures involving the internal repairs of the front differential are not included in this manual.

Special tools

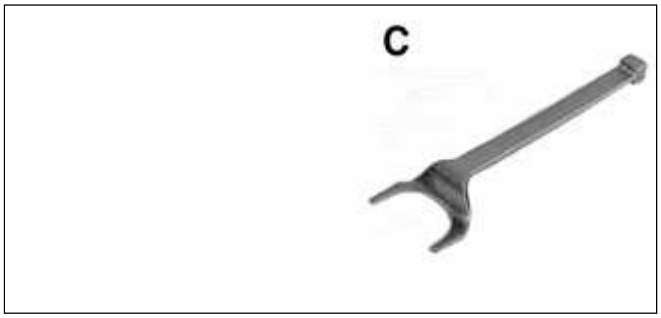
BMW recommends special tools for the removal of the drive axles as well as the installation of the front differential input drive flange seal. Commonly available pullers and drifts can often be substituted for the specified tools. Read the procedures through before beginning any job.



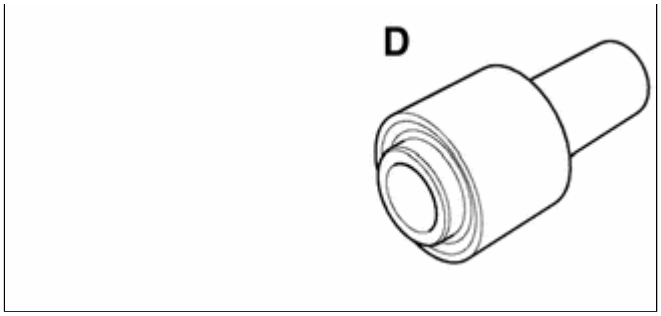
Engine support bracket BMW 00 0 200



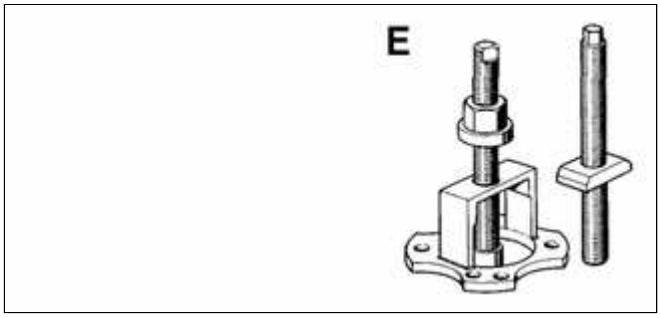
- Transmission flange holder BMW 23 0 020



- Inner CV joint puller BMW 31 1 170



- Impact drift BMW 31 5 130

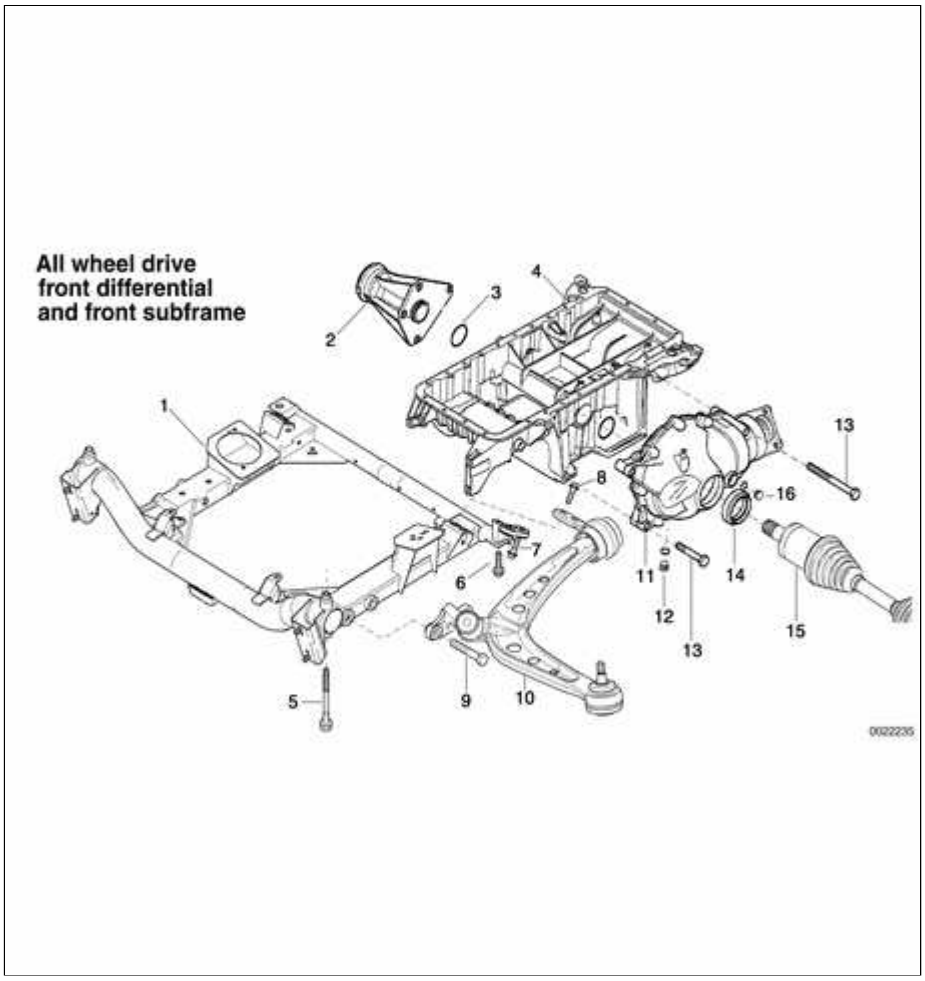


- Outer CV joint removal tool BMW 33 2 111/116/117

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

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)

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)

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.

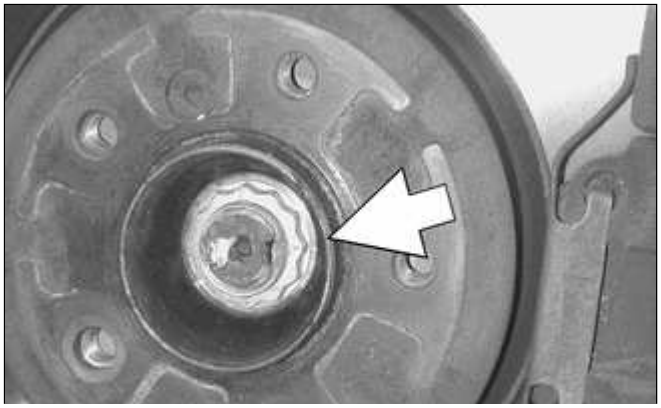
To replace a CV joint or dust boot, the drive axle must be removed from the car.

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.

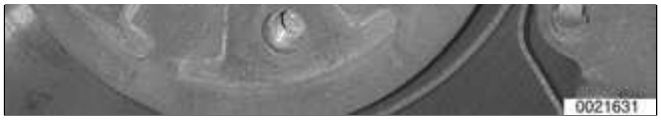


➢ Break free staked collar nut (**arrow**) at steering arm.

- Lift vehicle and support safely.

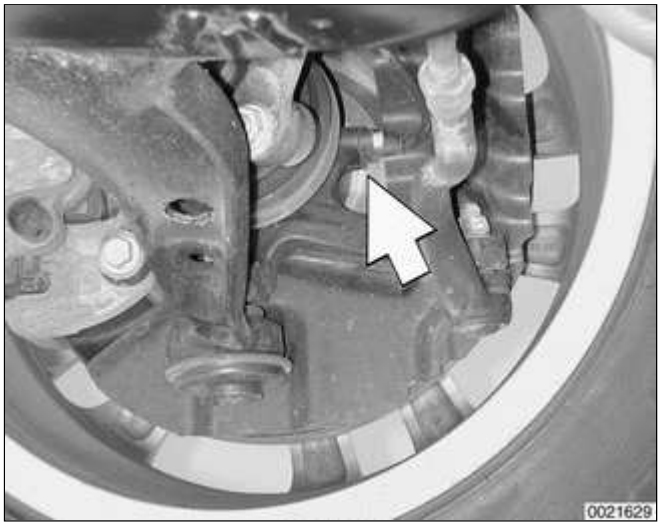
WARNING!

Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack



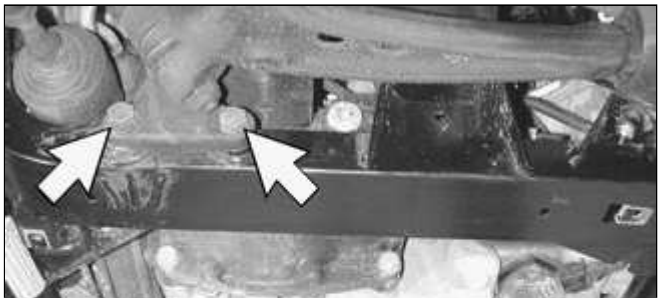
stands designed for the purpose. A floor jack is not adequate support.

- Remove front wheel.
- Remove splash shield from below engine compartment.
- If working on right side, remove right side heat shield from front axle support.

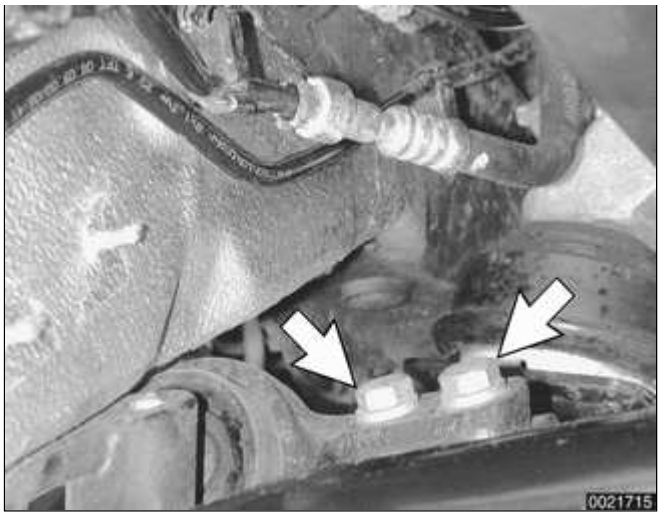


➢ Remove ABS sensor (**arrow**) from steering arm.

- 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.



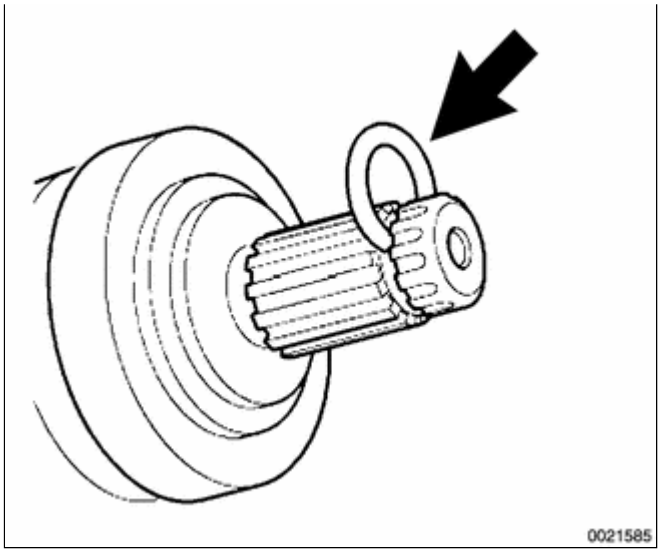
➢ Remove inner ball joint mounting bracket bolts (**arrows**) from subframe.



- 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.

- 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:

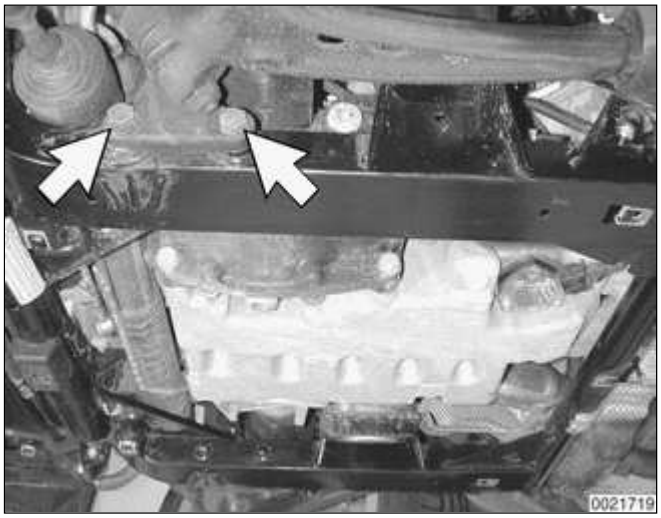
If only replacing drive axle radial seal, the axle does not need to be completely removed from the vehicle. Only the inboard CV joint needs to be removed from either the front axle differential or the right axle bearing pedestal. The front suspension may be partially disassembled for radial seal replacement.

- Lift vehicle and support safely.

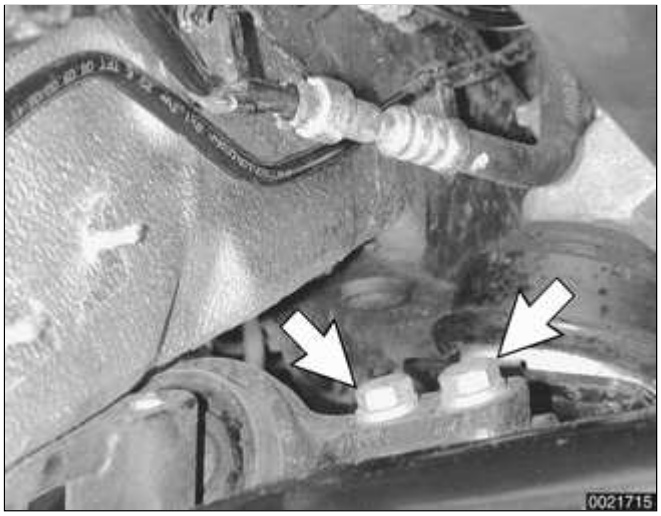
WARNING!

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.



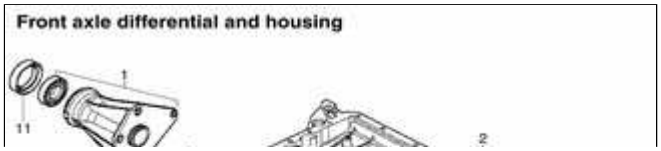
➢ Support control arm. Working at rear of subframe, remove control arm rear bracket mounting bolts (**arrows**).

- Tilt steering arm to one side, out of the way.

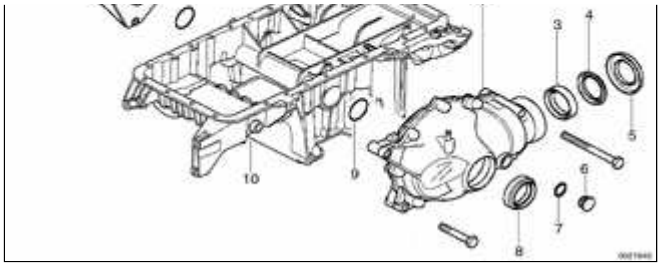
- Using BMW special tool 31 1 170 or equivalent pry bar, pry inboard CV joint out of front differential or bearing pedestal.

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.



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.

- 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)

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.

- 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.

- 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.

- 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.

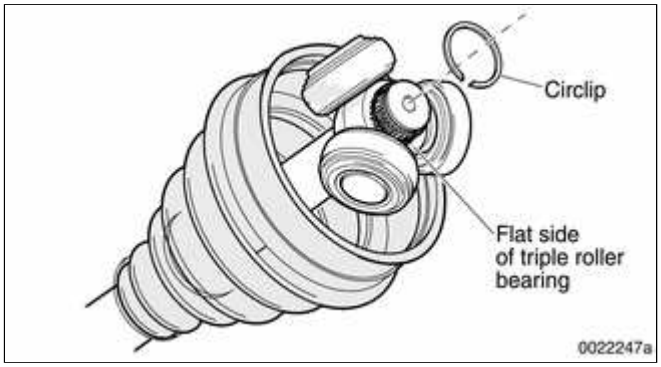
- Clean all old lubricant off axle splines and triple roller bearing splines.

- 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

boot kit.

- Installation is reverse of removal, noting the following:

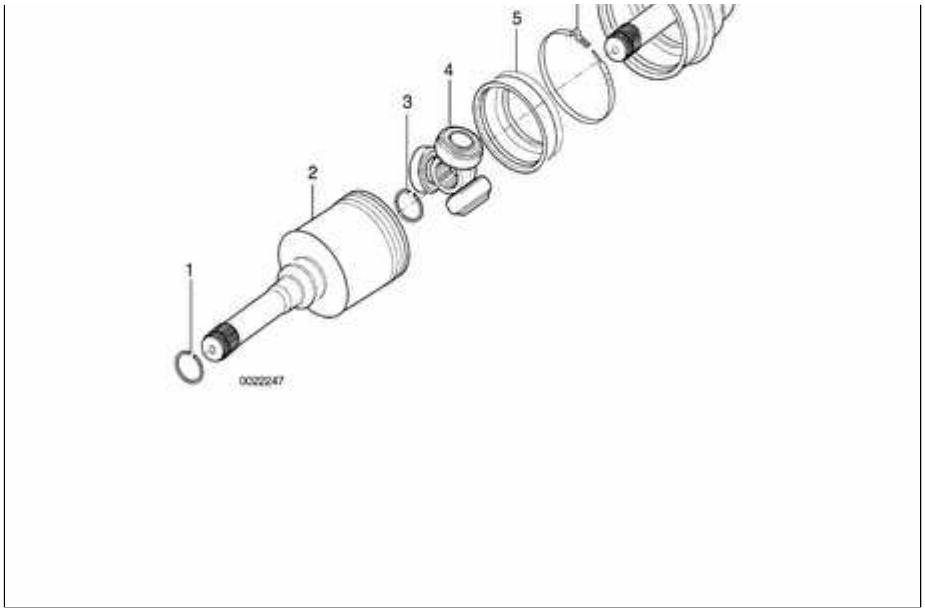
- Make sure inboard end of drive axle audibly snaps into place.
- Replace control arm bracket bolts.
- Be sure to restake new collar nut at outboard end of drive axle after tightening to correct torque specifications. Caulk axle threads.
- Top up differential fluid. See ⇒ Front differential oil, checking 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



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**

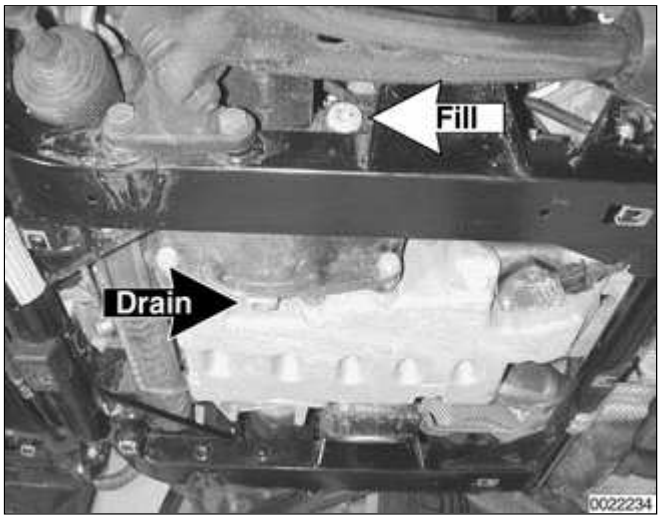
Front Differential

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

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!

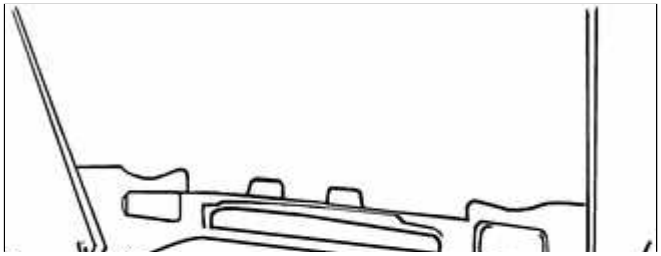
Prior to disconnecting battery, read battery disconnection cautions given at front of this manual on page viii.

- Lift vehicle and support safely.

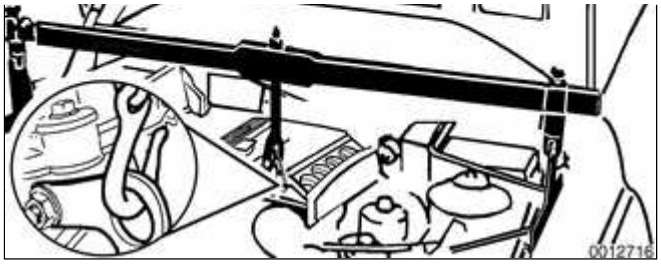
WARNING!

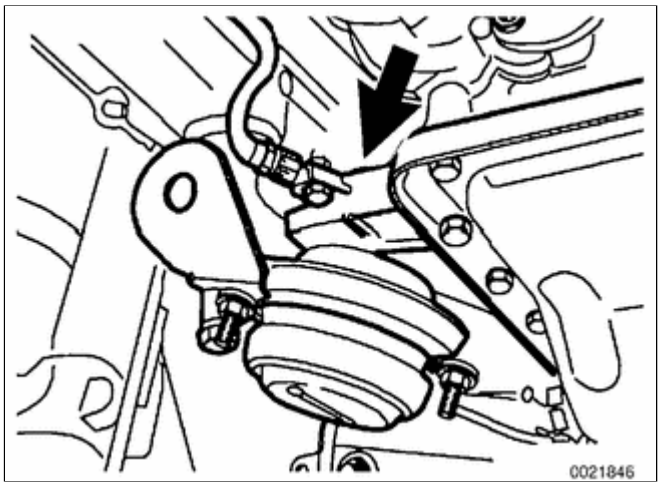
Make sure car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for purpose. A floor jack is not adequate support.

- Remove splash shield from below engine compartment.

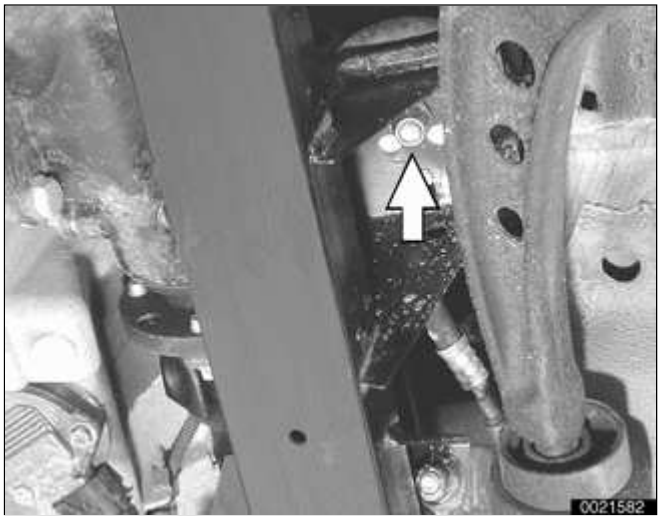


➢ Support engine using appropriate lifting device.

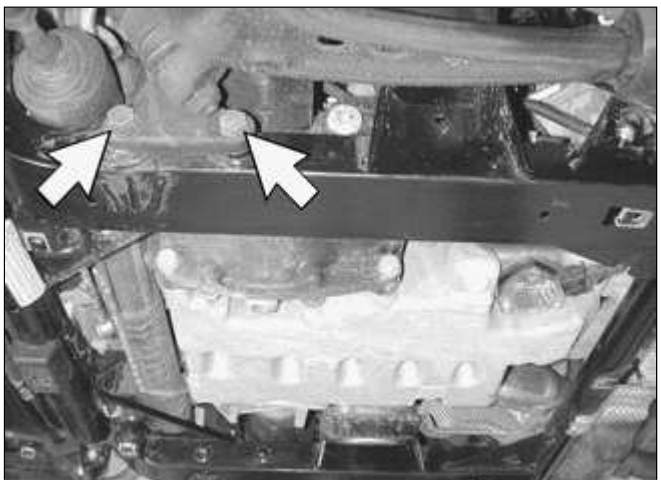




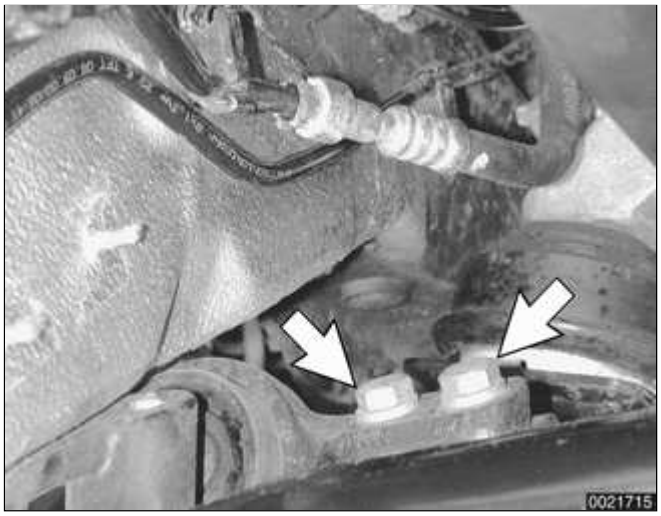
- Release nut at top on right engine mount (**arrow**).



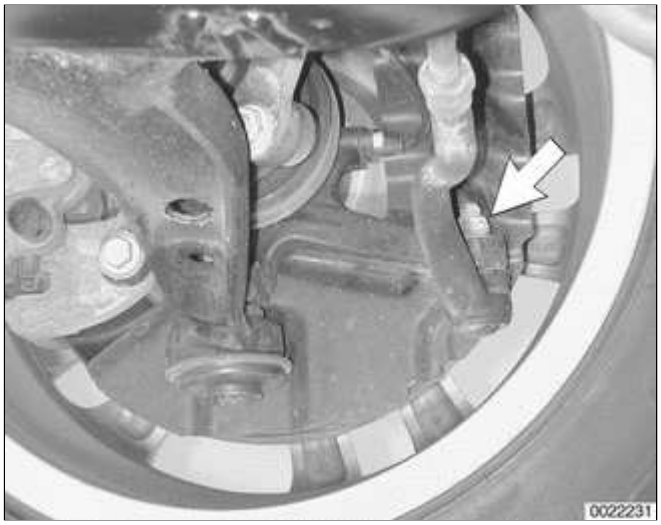
- Remove nut (**arrow**) at bottom on left engine mount.
  - Raise engine approximately 10 mm (0.4 in.).
  - Remove front wheels. Unbolt brake calipers and suspend from body using stiff wire. See ⇒ 340 Brakes.
  - Remove front driveshaft. See ⇒ 260 Driveshaft.



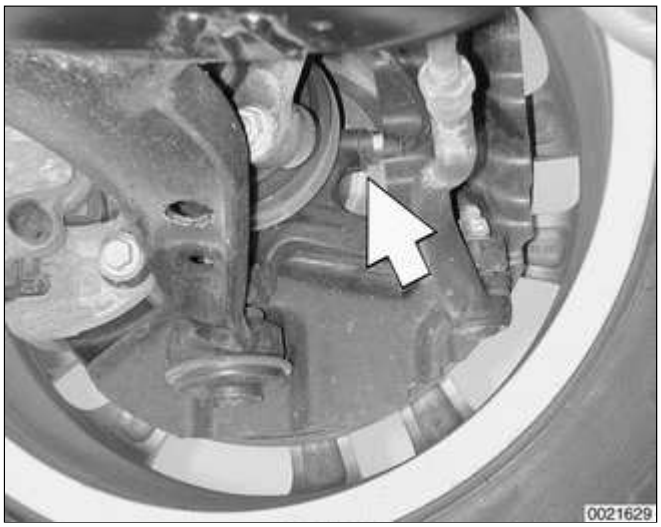
- Remove left inner ball joint mounting bracket bolts (**arrows**) from subframe.
  - Repeat for right side.



- Support left control arm. Working at rear of subframe, remove control arm rear bracket mounting bolts (**arrows**).
  - Repeat for right side.



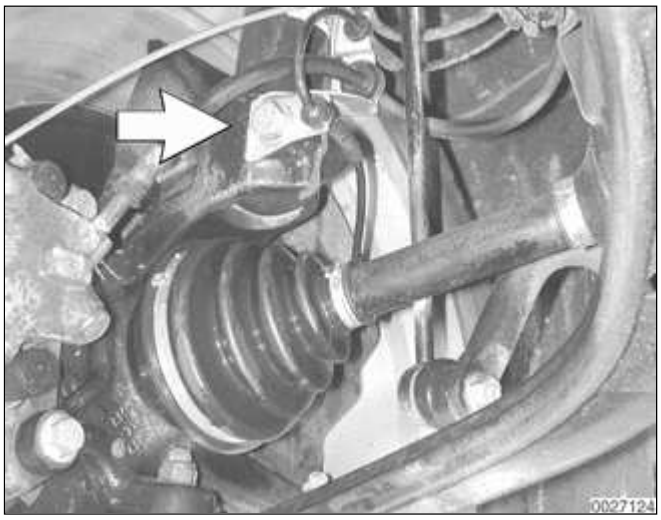
- Remove left tie rod outer end nut (**arrow**). Use BMW special tool 32 3 090 or equivalent to press tie rod end off steering are.
  - Repeat for right side.



- 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.

Note:

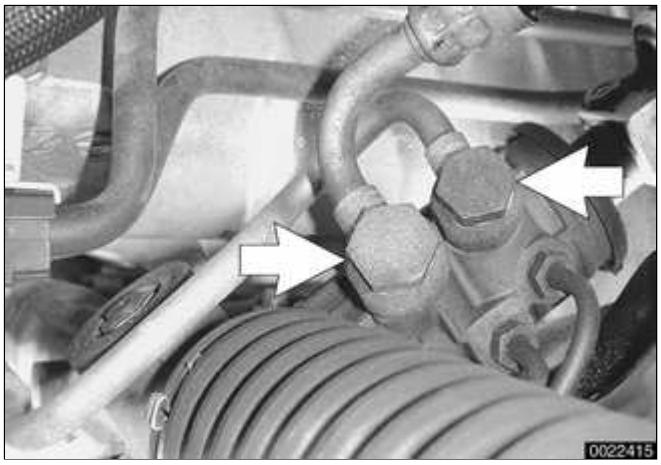
Be prepared to catch oil drips from differential or right side bearing pedestal.



- 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.

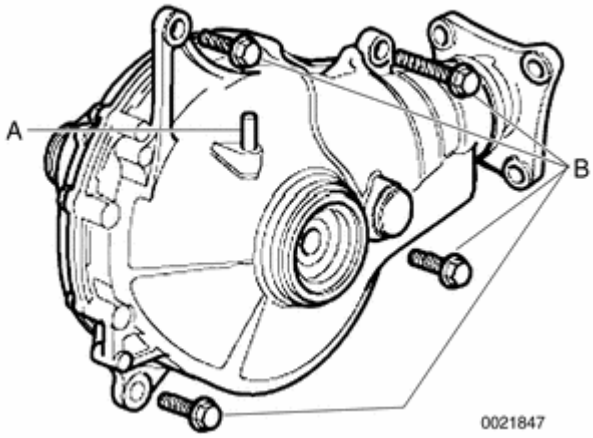
- Remove front axle subframe and steering rack from frame rails. See ⇒ 310 Front Suspension

Note:

Make sure heat shields, wiring

harnesses and other under body components are clear during removal.

Front differential mounting bolts



- 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.

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)

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!

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.

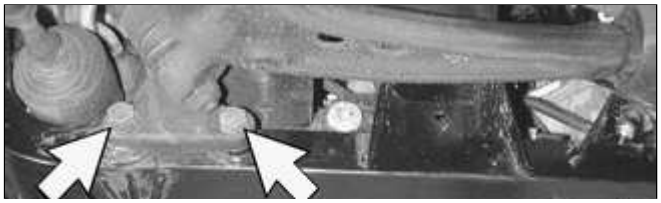
- Remove right front wheel.

- Release nut and remove tie rod end from right steering arm assembly.

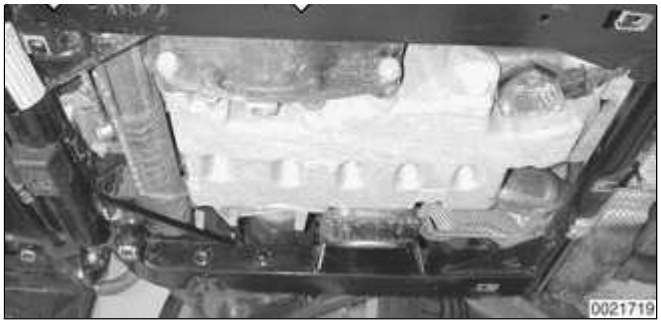
- Remove ABS sensor from steering arm.

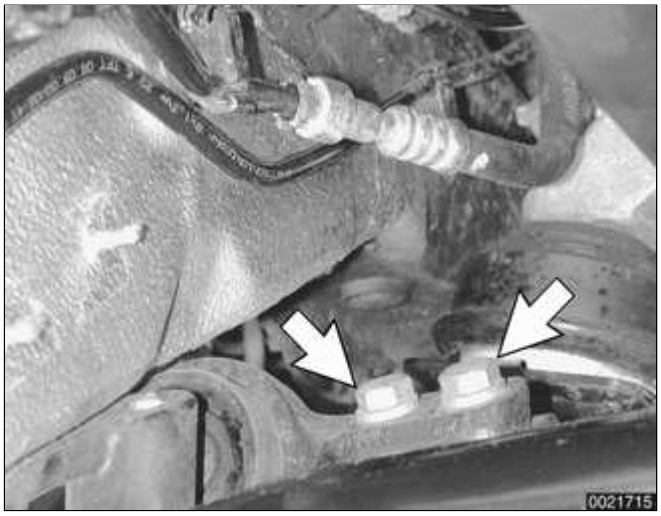
- Unclip brake hose from mounting bracket.

- Unbolt brake caliper and suspend from body using stiff wire.



➢ Remove inner ball joint mounting bracket bolts (**arrows**) from subframe.





- 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*

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

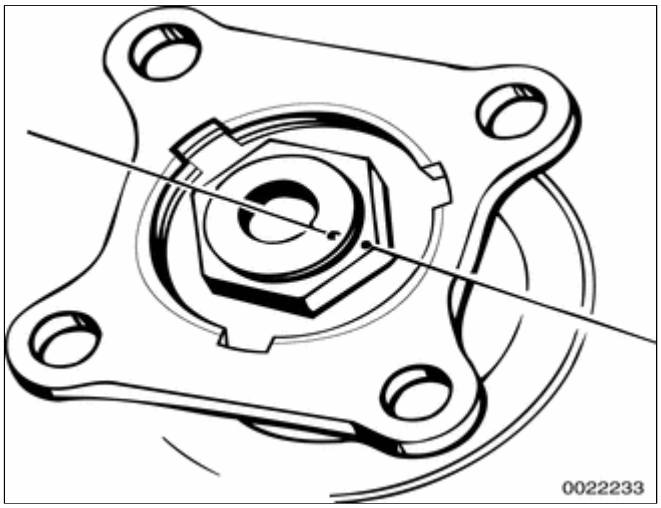
- Lift vehicle and support safely.

WARNING!

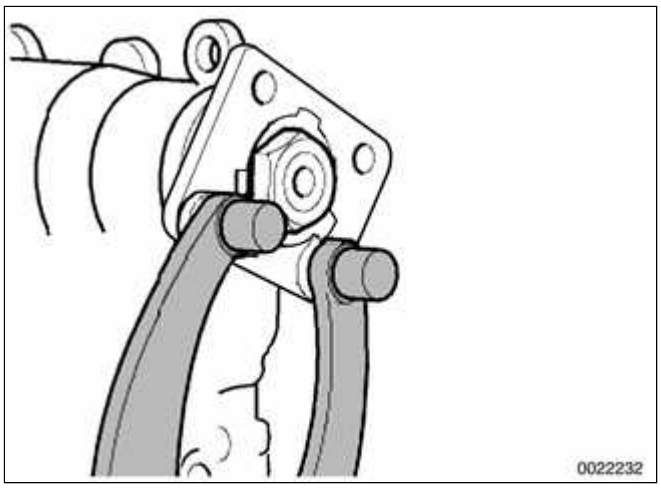
Make sure car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for purpose. A floor jack is not adequate support.

- 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

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

General

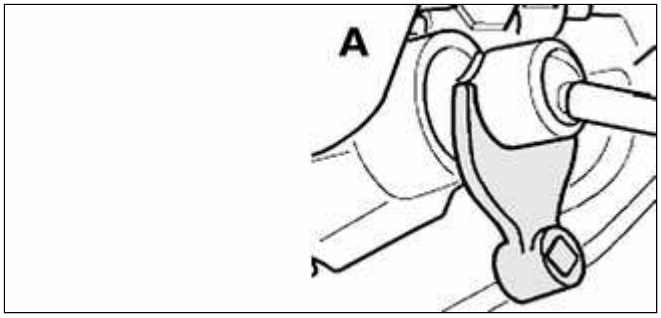
This repair group covers steering wheel and column removal and steering system service, including wheel alignment information.

Note:

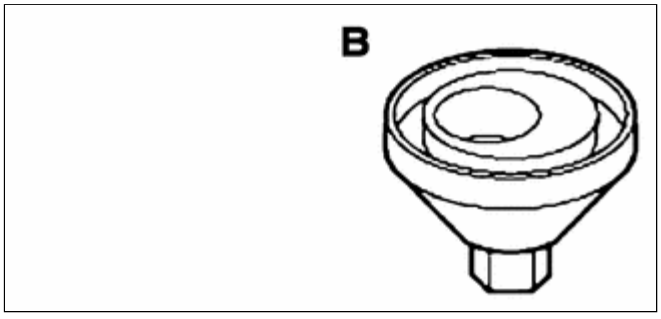
- *Ignition lock cylinder replacement is covered in this section.*
- *For information on steering column mounted switches including the ignition switch, see ⇒ 612 Switches*

Special tools

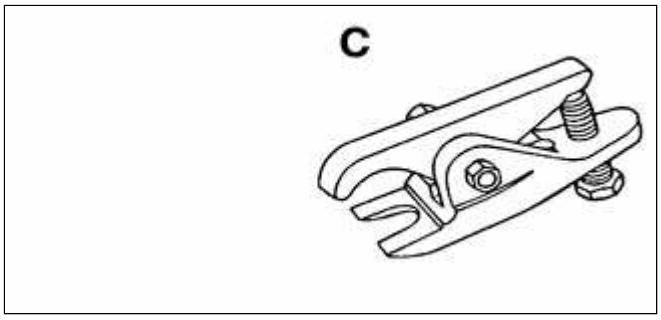
Some special tools are necessary to carry out the repairs and adjustments required for steering service and wheel alignment. Be sure to read the procedures through before starting work on the vehicle.



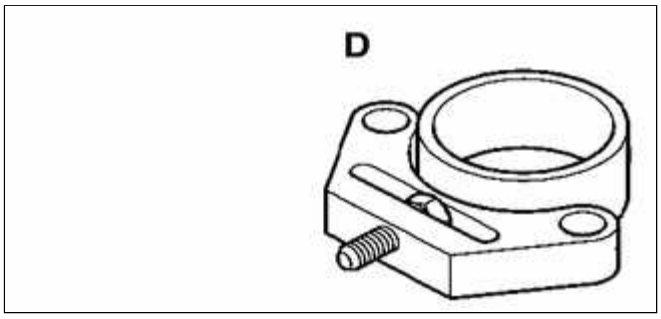
- Inner tie rod removal tool BMW 32 2 110



- Rear toe adjusting tool BMW 32 3 030



- Tie rod end removal tool BMW 32 3 090



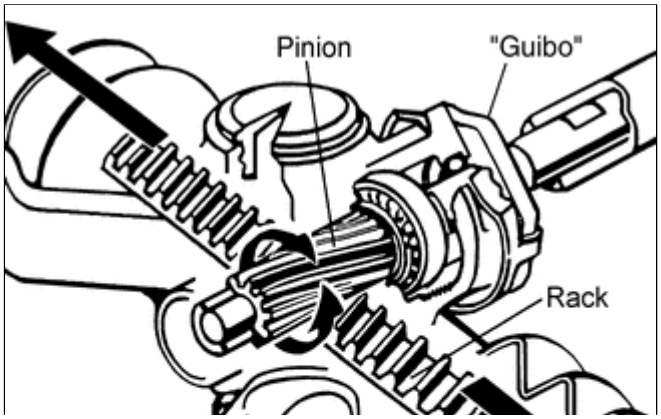
- Front camber adjusting tool BMW 32 3 140

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