

311 Front Axle Differential

GENERAL	311-1
Front differential and drive axles	311-1
Front axle description	311-2
Warnings and Cautions	311-2
DRIVE AXLES	311-2
Front drive axle, removing and installing	311-2
Front drive axle flange seal, replacing	311-5
CV joint boots, replacing	311-6

FRONT DIFFERENTIAL	311-9
Front drive components	311-9
Front differential oil level, checking	311-10
Front differential oil, draining and filling	311-10
Front differential, removing and installing	311-11
Right axle bearing pedestal, removing and installing	311-14
Front differential input flange seal, replacing	311-15

TABLES

a. Differential fluid	311-9
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GENERAL

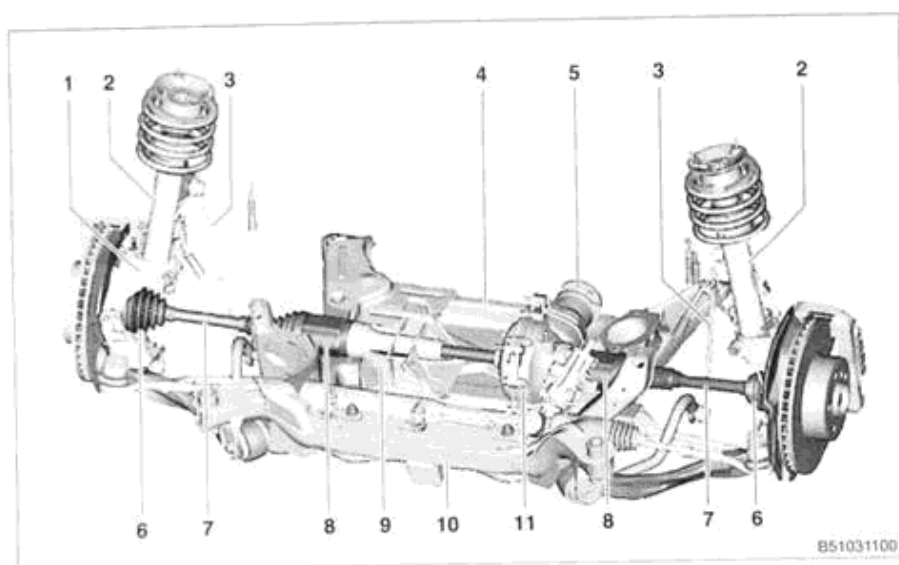
This repair group covers service and replacement of front drive axles and front differential. Front differential internal repair is not covered.

See **300 Suspension, Steering and Brakes-General** for a general description of the front suspension.

See also:

- **260 Driveshafts** for front driveshaft removal
- **310 Front Suspension**

Front differential and drive axles



1. Steering knuckle (swivel bearing)
2. Strut assembly
3. Stabilizer bar link
4. Front end reinforcement panel
5. Front driveshaft flange
6. Outer CV joint
7. Front drive axle
8. Inner CV joint
9. Right side bearing pedestal
10. Front subframe (axle carrier)
11. Front differential

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311-2 Front Axle Differential

Front axle description

Front axle description

The front axle differential and the right side bearing pedestal bolt to each side of the oil pan. Power is transmitted to the front differential from the xDrive transfer case via the front driveshaft, then to front drive hubs through two drive axles. The right drive axle inner constant velocity (CV) joint shaft extends through the right side bearing pedestal and the oil pan into the front differential.

Warnings and Cautions

WARNING—

- Do not reuse self-locking fasteners. They are designed to be used only once and may fail if reused. Replace with new.

CAUTION—

- Do not drive the vehicle with the front end reinforcement panel removed. See **310 Front Suspension**.
- When reinstalling the reinforcement panel after repairs, replace panel mounting fasteners with new.
- Due to the chemical and corrosion characteristics of aluminum, follow these precautions when working with aluminum components:
 - Do not bring into contact with battery acid.
 - Do not use wire brushes with brass or iron bristles. Only use brushes with stainless steel bristles.
 - Do not expose to flying sparks from grinding or cutting operations.
 - Do not subject to steel welding splashes.
 - Do not expose to temperatures over 80°C (176°F), even for short periods. Temperatures in painting facilities are not a problem.

DRIVE AXLES

Front drive axles use two different types of CV joint.

- Outer CV joint: Traditional ball-and-cage design allows power to be delivered from axle to wheel hub continuously while allowing suspension and steering motion.
- Inner joint: Triple roller bearing joint minimizes the amount of vibration and noise transmitted back through vehicle drivetrain while allowing axle to move in and out to compensate for suspension travel.

To replace a CV joint or boot, remove the drive axle from the vehicle.

Front drive axle, removing and installing

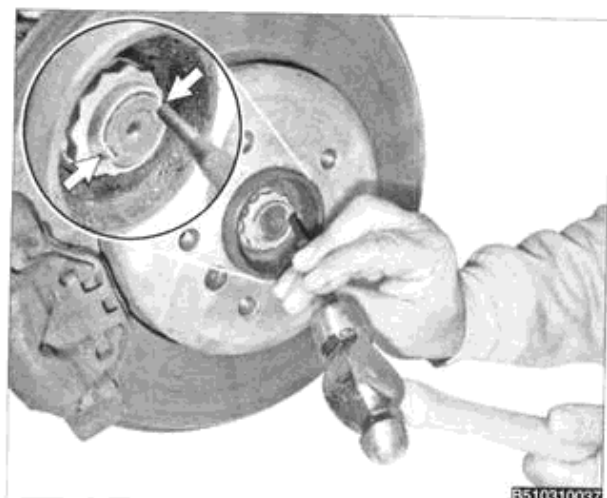
- Raise car and remove front wheel.

WARNING—

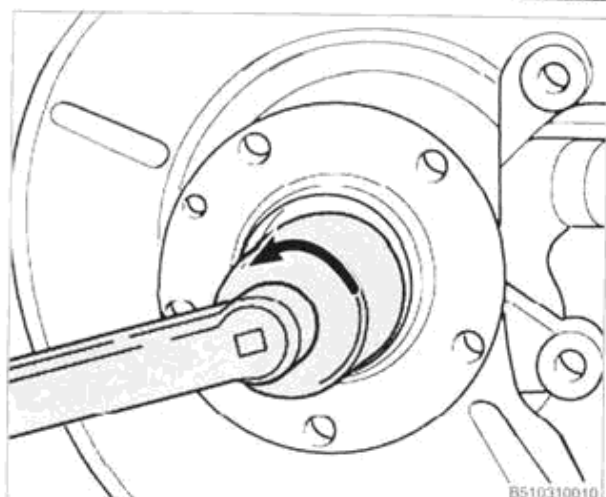
- Make sure the vehicle is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

Front Axle Differential 311-3

Front drive axle, removing and installing



- ◀ Using a suitable punch, straighten staked sides of wheel hub collar nut (arrows).



- ◀ With an assistant holding down brake pedal, remove collar nut and discard.

CAUTION—

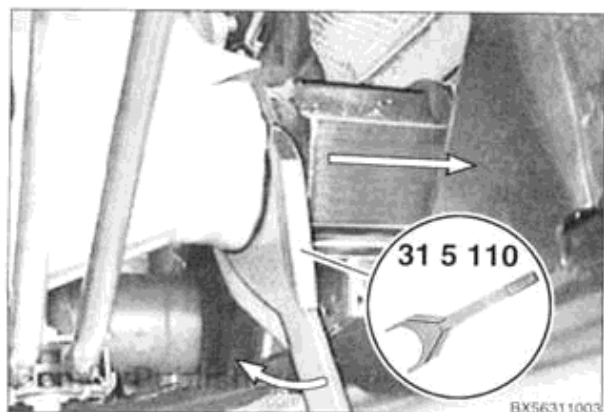
- The drive axle collar nut is tightened to a high torque. If necessary, reinstall road wheel and place vehicle on floor before breaking collar nut free.

- Detach front brake caliper from steering knuckle and suspend aside using stiff wire. Do not detach brake fluid hose. See **340 Brakes**.
- Remove brake disc. See **340 Brakes**.
- Remove ABS wheel speed sensor from steering knuckle. See **340 Brakes**. Detach sensor electrical harness from bracket on strut.
- Detach control arm and tension strut from steering knuckle. See **310 Front Suspension**.
- Detach tie rod end from steering knuckle. See **320 Steering and Wheel Alignment**.
- Detach stabilizer link from strut tube. Use Torx tool (T30) to counterhold shaft of stabilizer bar link ball joint while removing nut.
- Rotate steering knuckle to one side and use BMW special tools 32 2 200 or equivalent to press drive axle stub out of wheel bearing hub. Tie up drive axle end using stiff wire.

CAUTION—

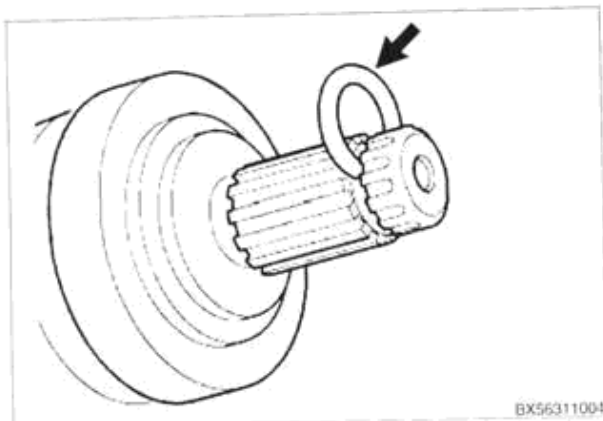
- In order to avoid damaging drive axle threads, do not drive out stub axle using impact tool.

- Remove splash shield and front end reinforcement panel. See **310 Front Suspension**.
- ◀ Use BMW special tool 31 5 110 or equivalent prying tool to force drive axle inner CV joint shaft out of front differential or right bearing pedestal output flange. Be prepared to catch dripping oil.
- Replace differential or bearing pedestal flange seal while axle is removed from vehicle. See **Front drive axle flange seal, replacing** in this repair group.



311-4 Front Axle Differential

Front drive axle, removing and installing



- Replace CV joint boots as necessary. See **CV joint boots, replacing** in this repair group.

◀ Replace inner CV joint locking circlip (arrow).

- When installing drive axle inner end:
 - Coat sealing lip of flange seal with transmission fluid.
 - Push inner CV joint shaft into differential or bearing pedestal flange until locking circlip snaps in place.
- Lightly oil drive axle spline teeth and insert drive axle into wheel hub.

CAUTION—

- Do not oil axle or collar nut threads.

- Installation is reverse of removal. Note the following:
 - Replace self-locking fasteners.
 - Use Torx tool (T30) to counterhold shaft of stabilizer bar link ball joint while tightening nut.
 - Clean ABS wheel speed sensor bore hole and lubricate with Staburags® NBU 12/K or equivalent grease.
 - Oil collar nut and wheel hub contact surfaces lightly. Do not allow oil to contaminate drive axle threads. Final tightening with wheel on ground. Stake collar nut after final tightening.
 - Check front differential oil level when job is complete. See **Front differential oil level, checking** in this repair group.
 - Install front end reinforcement panel using new fasteners. See **310 Front Suspension**.

Tightening torques

Brake caliper to steering knuckle (replace M12 x 1.5 x 43 mm ZNS bolts with new)	110 Nm (81 ft-lb)
Brake disc to wheel hub (replace M8 x 14 mm Allen bolt with new)	16 Nm (12 ft-lb)
Control arm to steering knuckle (replace M14 x 1.5 self-locking flange nut with new)	165 Nm (122 ft-lb)
Drive axle to wheel hub (replace M27 x 1.5 collar nut with new)	420 Nm (310 ft-lb)
Front end reinforcement panel to subframe (replace M10 x 35 mm 10.9 grade ZNS bolts with new): • Stage 1 • Stage 2	56 Nm (41 ft-lb) + additional 90°
Road wheel to hub	120 ± 10 Nm (89 ± 7 ft-lb)
Stabilizer link to strut tube (replace M10 ZNS3 nut with new)	65 Nm (48 ft-lb)
Tension strut to steering knuckle ball joint (replace M14 x 1.5 self-locking flange nut with new)	165 Nm (122 ft-lb)
Tie rod end to steering knuckle (replace M14 x 1.5 ZNS3 nut with new)	165 Nm (122 ft-lb)
Wheel speed sensor to steering knuckle	8 Nm (6 ft-lb)

Front drive axle flange seal, replacing

The left front drive axle is fitted to the front differential. The right front drive axle is fitted to the right bearing pedestal. See **Front drive components** in this repair group.

There is a flange seal on each side, in the differential and in the bearing pedestal. In case of flange seal oil leaks, follow this procedure to replace the seal(s).

- Raise front of vehicle and support safely.

WARNING —

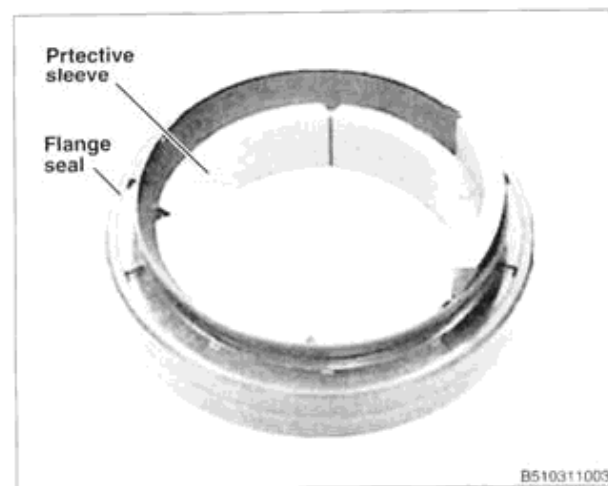
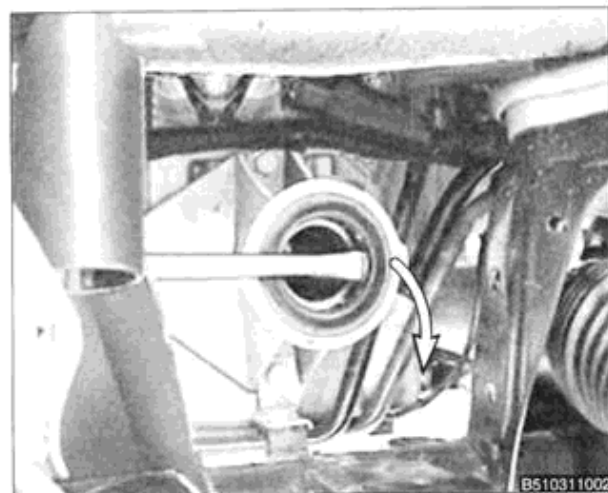
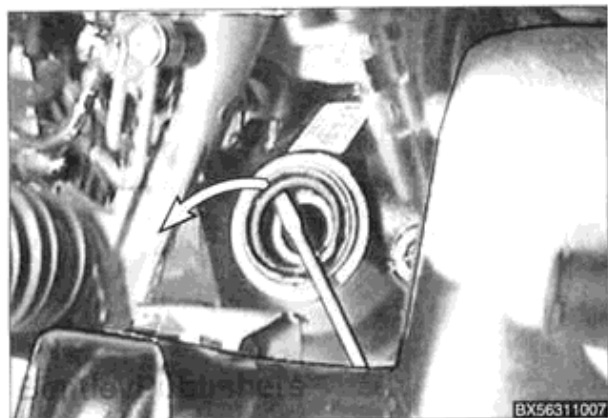
- Make sure the vehicle is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

- Remove front drive axle. See **Front drive axle, removing and installing** in this repair group.

- ◀ Left side flange: Use seal removal tool or screwdriver to pry (arrow) flange seal out of differential.

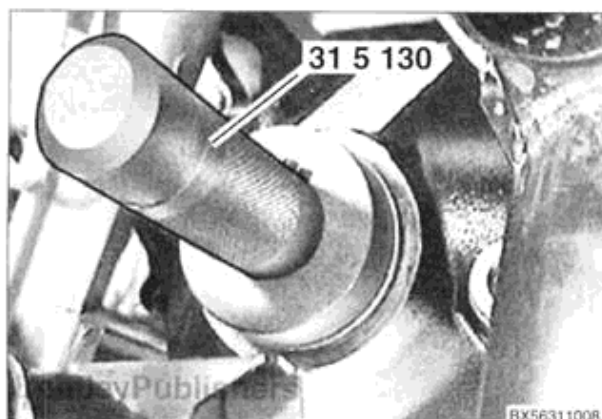
- ◀ Right side flange: Use seal removal tool or screwdriver to pry (arrow) flange seal out of right bearing pedestal.

- ◀ Remove protective sleeve from new flange seal and save for use during drive axle installation. Seal is equipped with protective sleeve to prevent sealing lip from damage during axle installation.



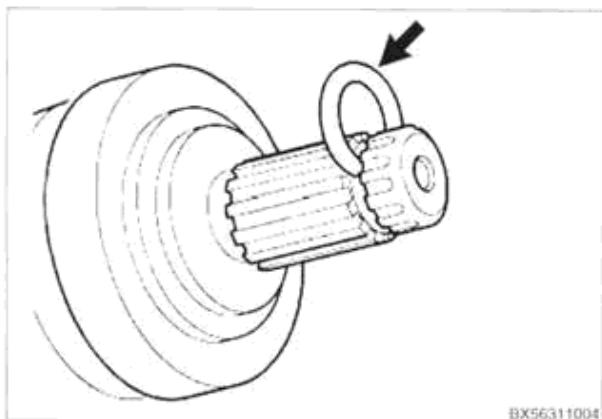
311-6 Front Axle Differential

CV joint boots, replacing



- Use BMW special tool 31 3 130 or equivalent seal driver to drive flange seal into differential or bearing pedestal as far as it will go.

- Coat sealing lip of flange seal with transmission fluid.
- Insert protective sleeve into seal.



- Replace inner CV joint locking circlip (arrow).

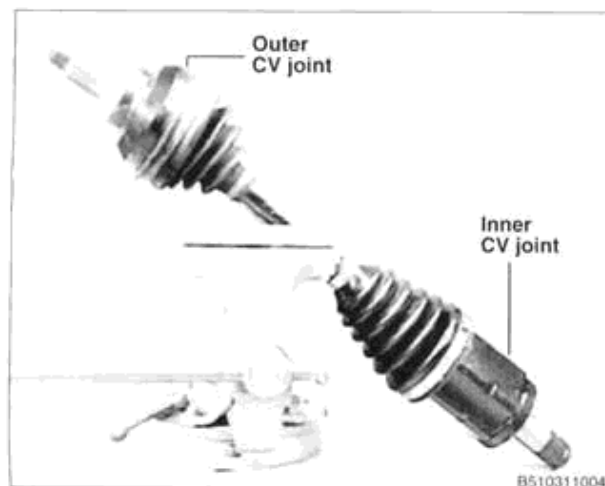
- Install drive axle:
 - Insert inboard end of drive axle partially into differential housing or bearing pedestal.
 - Withdraw protective sleeve from sealing lip, cut protective sleeve and remove.
 - Continue pressing drive axle in until spring clip snaps audibly into place.
- Installation is reverse of removal. Note the following:
 - Replace self-locking fasteners.
 - Reinstall drive axle stub in steering knuckle. See **Front drive axle, removing and installing** in this repair group.
 - Check front differential oil level when job is complete. See **Front differential oil level, checking** in this repair group.
 - Install front end reinforcement panel using new fasteners. See **310 Front Suspension**.

CV joint boots, replacing

When replacing CV boots, use a complete boot repair kit. The kit includes new boots, clamping bands, special lubricant and a new CV joint shaft circlip.

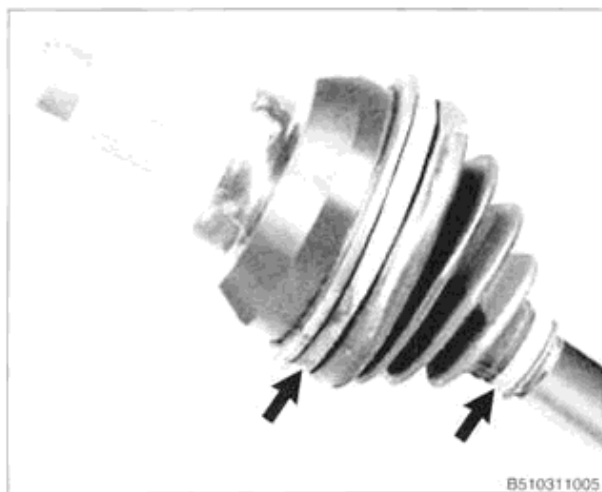
- Remove drive axle. See **Front drive axle, removing and installing** in this repair group.

- Place axle in shop vice with aluminum jaws.



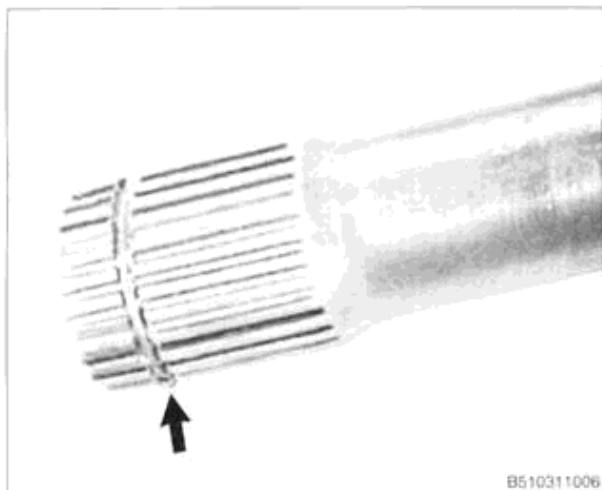
Front Axle Differential 311-7

CV joint boots, replacing



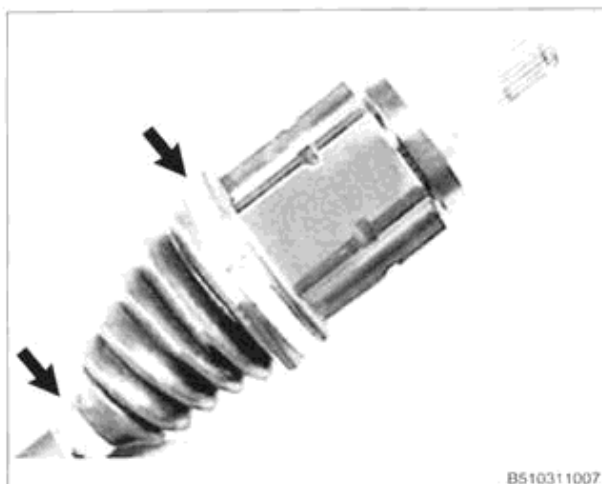
- Release retaining clamps (**arrows**) from both ends of outer CV boot. Cut off boot and discard.

- Using a soft-faced hammer, pound outer CV joint off drive axle.
- Inspect outer CV joint carefully.
 - 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 (overheating) of balls indicates lack of lubrication. Replace joint.



- Using a flat blade screwdriver, pry spring clip (**arrow**) off drive axle splines.

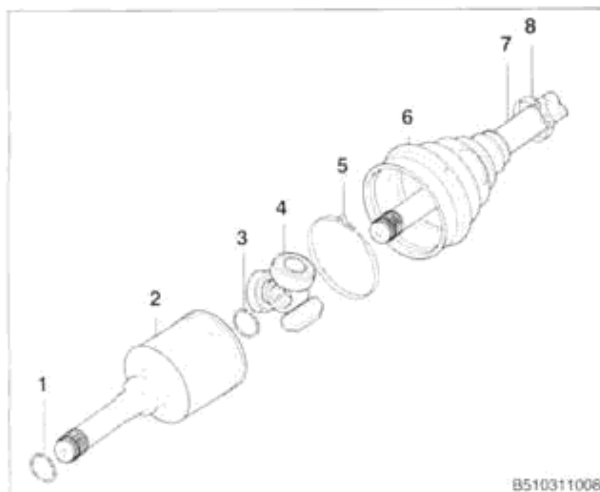
- Clean old lubricant off axle splines.



- Release retaining clamps (**arrows**) from both ends of inner CV boot. Cut off boot and discard.

311-8 Front Axle Differential

CV joint boots, replacing



Inner CV joint (triple-roller) components

1. Locking circlip
2. Inner CV joint housing
3. Circlip
4. Triple roller bearing
5. Clamp
6. Inner CV joint boot
7. Drive axle shaft
8. Clamp

- Slide housing (2) off triple-roller bearing.
- Clean old lubricant off axle and triple roller bearing.
- Pack triple roller bearing and boot with fresh CV joint grease.

CV joint lubricant capacity

Inner CV joint	80 grams (2.8 oz)
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- Install new inner CV joint boot over outer axle end.

If triple-roller bearing is removed from axle shaft, note that it is installed with flat side of joint facing retaining circlip.

- Insert triple roller bearing into inner CV joint housing.
- Secure boot to housing and axle shaft using clamps supplied with boot kit. Pinch clamps tight using special clamp pliers.
- Place new clamping bands and outer 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.

CAUTION—

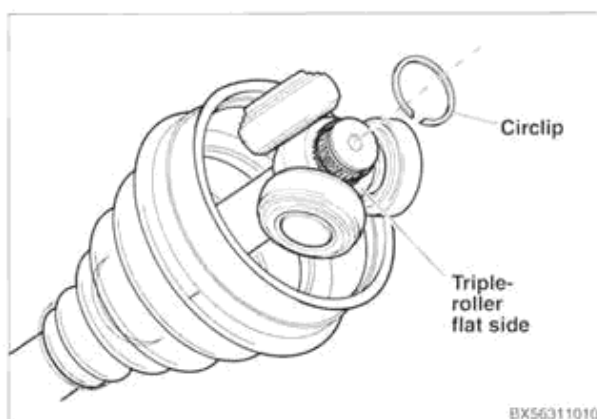
- Do not let locking compound contact balls in joint. Apply only a thin coat to cover splines.

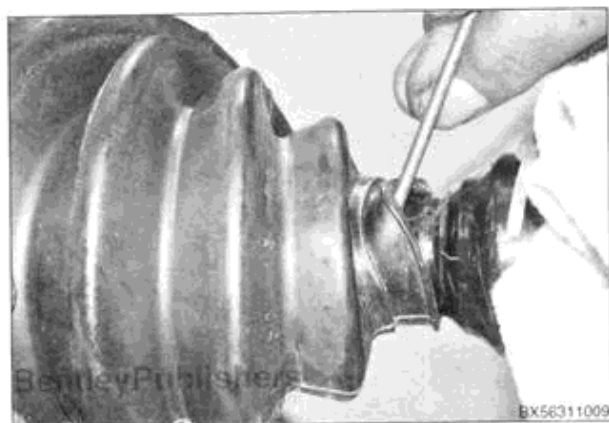
- Pack joint with fresh CV joint grease.

CV joint lubricant capacity

Outer CV joint	80 grams (2.8 oz)
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- Tap CV joint onto splined end of drive axle until spring clip snaps audibly into place.
- Using clamp pliers, secure retaining clamp into position tightly sealing large end of boot against CV joint.





- Before installing small boot clamp:
- Flex CV joint as far over as it will go.
 - Insert small screw-driver between boot and axle-shaft to "burp" air from boot.
- With outer boot full of grease and any air eliminated from boot, secure small end of boot on CV joint by pinching clamp with pliers.
 - Remainder of installation is reverse of removal. See **Front drive axle, removing and installing** in this repair group.
 - Check front differential oil level and top off if necessary. See **Front differential oil level, checking** in this repair group.

FRONT DIFFERENTIAL

The front differential, bolted to the left side of the engine oil pan, is filled with lifetime oil that ordinarily does not need to be changed. If service is required, BMW recommends using only a specially formulated synthetic gear oil (SAF-XO).

Axle flange seal replacement is covered in **Front drive axle flange seal, replacing** in this repair group.

Replacement of O-ring seal between engine oil pan and front differential is covered in **Front differential, removing and installing** in this repair group.

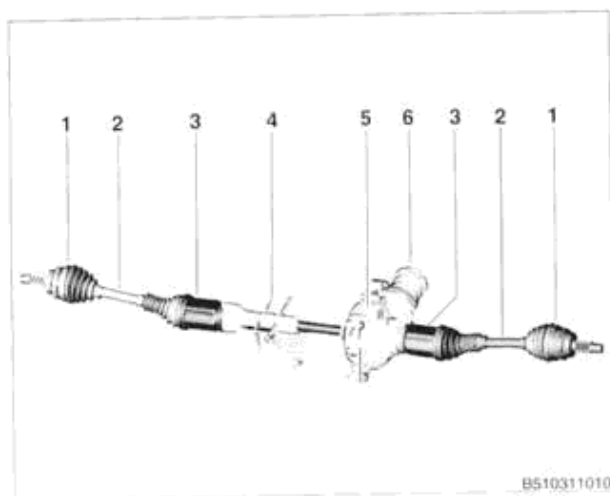
Replacement of O-ring seal between engine oil pan and right side bearing pedestal is covered in **Right axle bearing pedestal, removing and installing** in this repair group.

Table a. Differential fluid

Capacity	0.6 liter (0.63 US qt)
BMW specification	SAF-XO Synthetic

Front drive components

1. Outer CV joint
2. Drive axle shaft
3. Inner CV joint
4. Right side bearing pedestal
5. Front differential
6. Front driveshaft flange



311-10 Front Axle Differential

Front differential oil level, checking



Front differential oil level, checking

- Drive vehicle a short distance to warm differential oil.
- Raise vehicle and support safely.

WARNING—

- Make sure the vehicle 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 and front end reinforcement. See **310 Front Suspension**.

- ◀ With vehicle level, check oil at filler plug (arrow):

- Place a drain pan under oil filler plug before removing.
- Oil level is correct when it just reaches edge of filler hole.

- If necessary, top up fluid with synthetic gear oil (SAF-XO).
- Replace filler plug sealing ring.
- Install and tighten oil filler plug when oil level is correct.

Tightening torque

Oil drain / fill plug to differential	60 Nm (44 ft-lb)
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Front differential oil, draining and filling

- Drive vehicle a short distance to warm differential oil.
- Raise vehicle and safely support.

WARNING—

- Make sure the vehicle 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 and front end reinforcement panel. See **310 Front Suspension**.

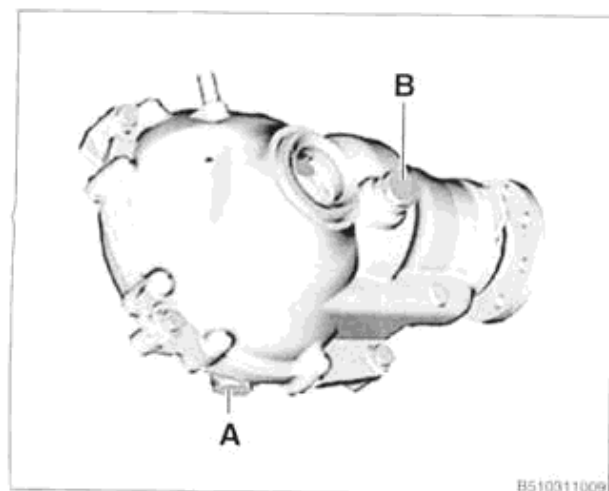
- ◀ With vehicle level:

- Place a drain pan under oil drain plug.
- Remove drain plug (A) and allow oil to drain into pan.

WARNING—

- Pull the loose plug away quickly to avoid being scalded by hot oil. Use gloves to protect your hands.

- When oil flow has diminished to an occasional drip, reinstall drain plug with new sealing ring.
- Remove filler plug (B). Add synthetic gear oil (SAF-XO) and check level. See **Front differential oil level, checking** in this repair group.



Tightening torque

Oil drain / fill plug to differential	60 Nm (44 ft-lb)
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Front Axle Differential 311-11

Front differential, removing and installing

Front differential, removing and installing

- Disconnect negative (-) battery cable.

CAUTION—

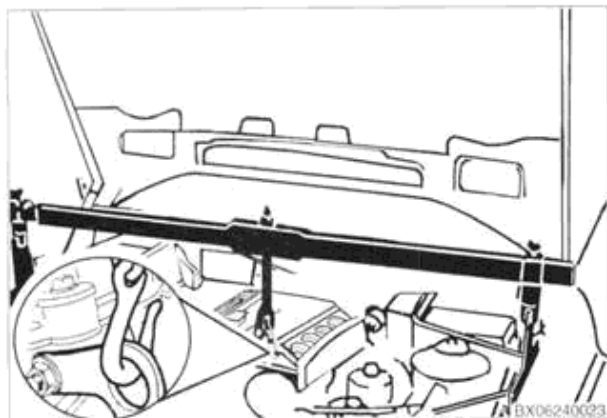
- Prior to disconnecting the battery, read the battery disconnection cautions in **001 Warnings and Cautions**.

- Raise engine hood to service position. See **410 Fender, Engine Hood**.
- Remove air filter housing. See **130 Fuel Injection**.
- Remove upper engine cover (ignition coil cover). See **020 Maintenance**.
- Raise vehicle and support safely.

WARNING—

- Make sure the vehicle 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.

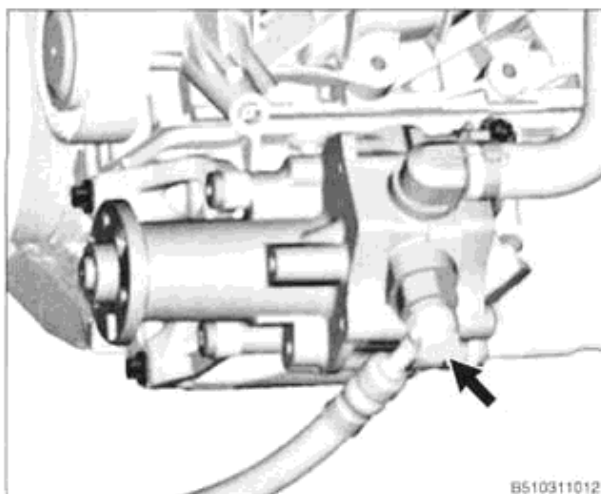
- Remove splash shield and front end reinforcement panel from under engine.
- Remove suspension side splash shields.
- Install engine support brace across engine bay.



- Working underneath engine, remove right and left engine mount upper nuts (**arrow**). Raise engine slightly ($\frac{1}{4}$ - $\frac{1}{2}$ in) to release load on engine mounts.
- Siphon out power steering fluid.

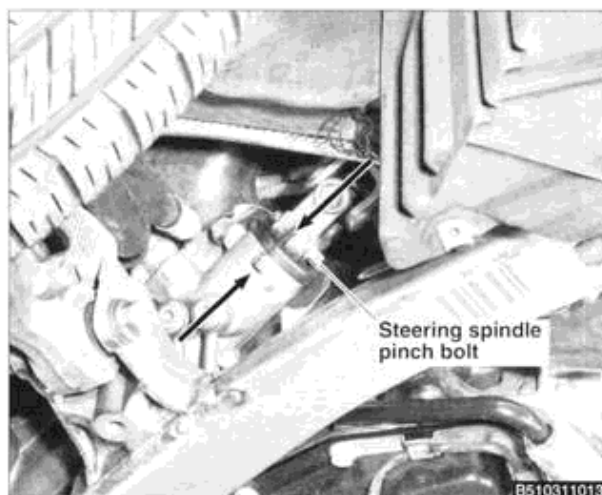
311-12 Front Axle Differential

Front differential, removing and installing



Working underneath engine, remove pressure line banjo bolt (**arrow**) from power steering pump and detach pressure line. Catch dripping fluid in a shop towel.

- Detach fluid line from transmission fluid cooler.
- Drain front differential oil. See **Front differential oil, draining and filling** in this repair group.
- Drive axles:
 - Remove left drive axle. See **Front drive axle, removing and installing** in this repair group.
 - Pull right drive axle approx. 6 to 7 cm (2½ - 3 in) out of front differential.
- Remove front driveshaft. See **260 Driveshafts**.



- Detach steering spindle from steering rack:
- Move steering wheel so that front wheels point straight ahead. Vehicle with steering lock: Remove ignition key and make sure steering locks in straight ahead position.
 - With front wheels pointing straight ahead, make sure steering spindle pointer and steering rack pointer line up (**arrows**). Remove lower steering spindle pinch bolt and detach steering universal joint from steering rack shaft.

CAUTION—

- While steering spindle is detached from steering rack, make sure steering wheel is not rotated. Rotating the wheel may damage the airbag and horn contact spring.



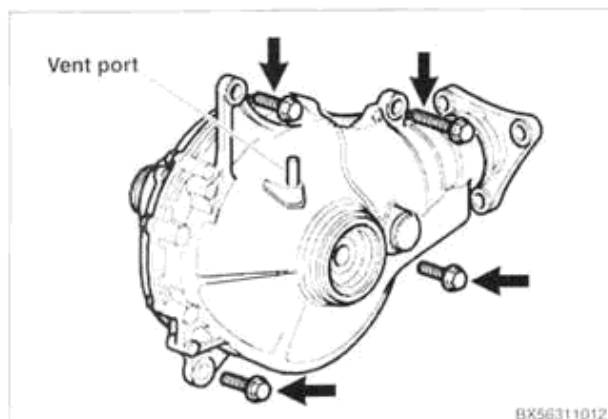
- Support front subframe with transmission jack. Remove subframe mounting bolts (**arrows**) and lower subframe sufficiently to allow access to front differential mounting bolts.

CAUTION—

- Do not bend or stretch fluid lines and hoses when lowering or raising subframe.
- Automatic transmission vehicle: Disconnect transmission fluid cooler lines from subframe.

Front Axle Differential 311-13

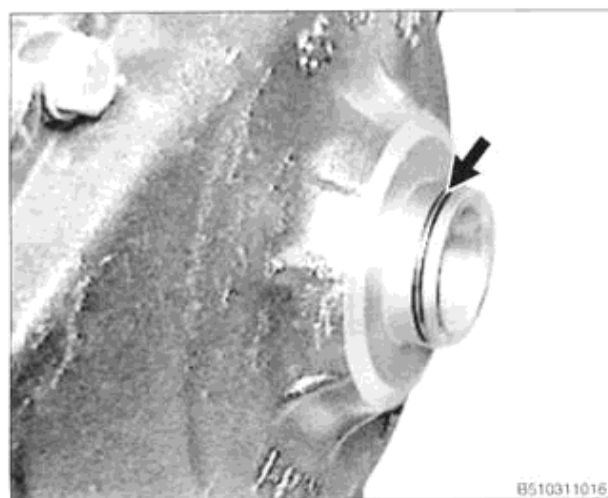
Front differential, removing and installing



- Remove bolts (**arrows**) and lower differential carefully, making sure that no lines, hoses or harnesses become snagged.

CAUTION—

- Support differential as last bolt is removed.



- Remove sealing O-ring (**arrow**) between oil pan and differential and replace with new.

- Install differential to oil pan.

Tightening torques

Front differential to oil pan	65 Nm (48 ft-lb)
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- Remainder of assembly is reverse of removal. Keep in mind:
 - Replace drive axle flange seal before installing left drive axle.
 - Replace power steering fluid line banjo bolt sealing rings.
 - Fill and bleed power steering. See **320 Steering and Wheel Alignment**.
 - Fill front differential with oil. See **Front differential oil level, checking** in this repair group.
 - Install front end reinforcement panel using new fasteners. See **310 Front Suspension**.
 - Use BMW scan tool to carry out steering angle sensor adjustment.

Tightening torques

Engine mount to engine bracket (replace M10 10.9 grade self-locking nuts with new)	56 Nm (41 ft-lb)
Front end reinforcement panel to subframe (replace M10 x 35 mm 10.9 grade ZNS bolts with new):	
• Stage 1	56 Nm (41 ft-lb)
• Stage 2	+ additional 90°
Front subframe to chassis (replace M12 x 1.5 10.9 grade bolts with new):	
• Stage 1	100 Nm (74 ft-lb)
• Stage 2	+ additional 90°
Steering fluid line banjo bolt to steering pump (M14 or M16, replace sealing O-rings)	33 - 35 Nm (24 - 25 ft-lb)
Steering spindle universal joint to steering rack (pinch bolt)	22 Nm (17 ft-lb)

311-14 Front Axle Differential

Right axle bearing pedestal, removing and installing

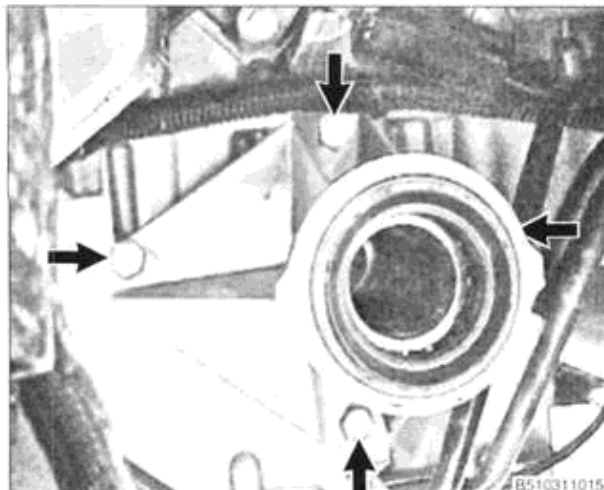
Right axle bearing pedestal, removing and installing

- Raise vehicle and support safely.

WARNING —

- Make sure the vehicle 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 and front end reinforcement panel. See **310 Front Suspension**.
- Remove right front drive axle. See **Front drive axle, removing and installing** in this repair group.
- Remove bearing pedestal mounting bolts (arrows) at side of oil pan. Lift off pedestal.



- Replace sealing O-ring (arrow). Coat O-ring with assembly fluid.
- Replace drive axle flange seal before installing drive axle. See **Front drive axle flange seal, replacing** in this repair group.
- Installation is reverse of removal. Remember to replace front end reinforcement panel fasteners with new.



Tightening torques

Bearing pedestal to oil pan	21 Nm (16 ft-lb)
Front end reinforcement panel to subframe (replace M10 x 35 mm 10.9 grade ZNS bolts with new):	56 Nm (41 ft-lb) + additional 90°
• Stage 1	
• Stage 2	

Front differential input flange seal, replacing

- Raise vehicle and support safely.

WARNING—

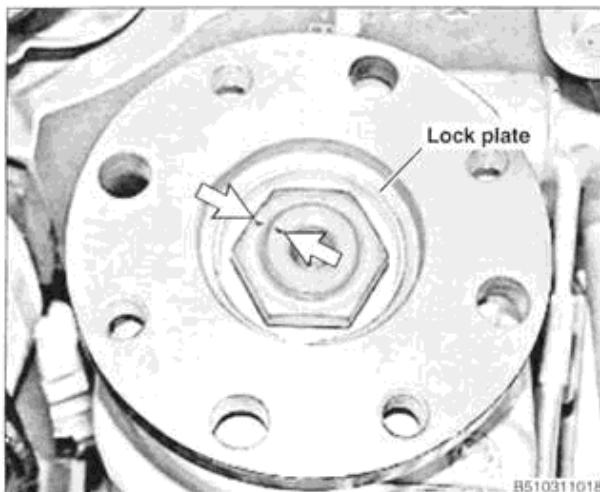
- Make sure the vehicle is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

- Remove splash shield and front end reinforcement panel. See **310 Front Suspension**.

- Remove front driveshaft. See **260 Driveshafts**.

- Pry out input flange retaining nut lock plate.

- Using a center punch, mark relation of input flange retaining nut to shaft (**arrows**).

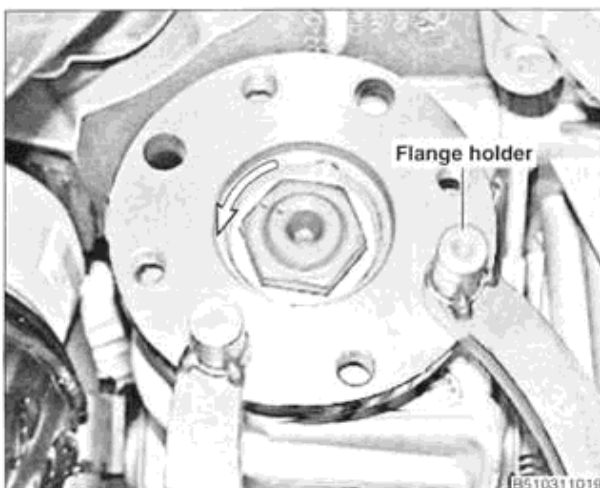


- Counterhold input flange using BMW special tool 23 0 020 and remove nut.

CAUTION—

- Do not place flange holder pins in threaded holes of flange.

- Remove input flange using hub puller. Be prepared to catch dripping oil.

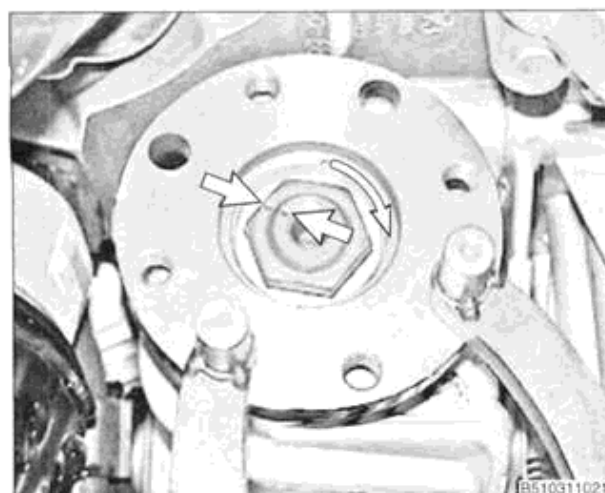


311-16 Front Axle Differential

Front differential input flange seal, replacing



- Using seal puller or flat screwdriver, pry (**arrow**) seal out of differential housing.
- Coat sealing edges of new seal with transmission fluid and drive into differential housing using seal installer (BMW special tool 31 5 130 or equivalent).
- Clean input flange and install into differential housing.



- Install flange nut. Counterhold flange and tighten down nut until punch marks (**arrows**) align. Install new input flange retaining nut locking plate.

CAUTION—

- Do not torque input flange retaining nut beyond match marks. Over-torquing can damage differential internals.
- Do not replace input flange or input flange locking nut.

- Remainder of installation is reverse of removal. Keep in mind:
 - Check front differential oil level and top off if necessary. See **Front differential oil level, checking** in this repair group.
 - Install front end reinforcement panel using new fasteners. See **310 Front Suspension**.

Tightening torque

Front driveshaft to differential (replace M8 ZNS bolts with new)	20 Nm (15 ft-lb) + additional 45°
Oil drain / fill plug to differential	60 Nm (44 ft-lb)

