

1991-2002 STEERING

Power Rack & Pinion - E36

IDENTIFICATION

1991-2002 Chassis & Engine Identification

Model (Chassis Code)	Engine Size (Code)
1991-1995	
318i & 318is (E36)	1.8L (M42)
1992-1995	
325i & 325is (E36)	2.5L (M50)
1995	
318ti (E36)	1.8L (M42)
M3 (E36)	3.0L (S50)
1996-1997	
318is (E36)	1.9L (M44)
1996-1998	
318i (E36)	1.9L (M44)
Z3 (E36)	1.9L (M44)
1996-1999	
318ti (E36)	1.9L (M44)
328i & 328is (E36)	2.8L (M52)
M3 (E36)	3.2L (S52)
1997-1998	
Z3 (E36)	2.8L (M52)
1998-1999	
323i & 323is (E36)	2.5L (M52)
M Roadster (E36)	3.2L (S52)
1999	
M Coupe (E36)	3.2L (S52)
1999-2000	
Z3 (E36)	2.5L (M52TU)
Z3 (E36)	2.8L (M52TU)
2000-2002	
M Coupe (E36)	3.2L (S54)
M Roadster (E36)	3.2L (S54)
2001-2002	
Z3 (E36)	2.5L (M54)
Z3 (E36)	3.0L (M54)

DESCRIPTION

E36 vehicles are equipped with rack and pinion steering. They are equipped with either a ZF or a LuK/Vickers vane power steering pump.

Some vehicles are equipped with quick-release couplings on hydraulic lines. For use of these lines see [HYDRAULIC LINE WITH QUICK-RELEASE COUPLING](#) under REMOVAL & INSTALLATION.

LUBRICATION

CAPACITY

Fluid capacity is 1.3 qts. (1.2L).

FLUID TYPE

NOTE: The hydraulic fluid reservoirs are marked on the rim of the reservoir and/or the reservoir cap to show which type of oil can be used: ATF oil or Pentosin CHF oil.

The ZF rack-and-pinion steering has lifetime lubrication and is thus maintenance-free.

For topping up/filling hydraulic system:

POWER STEERING OIL

Trade name	BMW part number	Container size	Oil color
BMW automatic transmission fluid (ATF)	81 22 9 400 272	1-liter	Red
Pentosin CHF 11S	83 29 0 429 576	1-liter	Green

NOTE: Vehicles with AFS/ARS (Dynamic Drive / Active Steering / Active Roll Stabilization) are filled as standard with Pentosin CHF 11S.

In case of repair, the affected steering components must be lubricated with the following grease:

COMPONENT GREASE

Trade name	BMW part number	Container size
Calypsol SF-3-131-TMM 3	83 23 9 407 857	100 g tube

NOTE: Calypsol D 4024-OK is a sodium-saponified, cold-resistant grease whose lubricity ranges from -30 Å°C to +75 Å°C.

BLEEDING POWER STEERING SYSTEM

CAUTION: Before removing the oil tank cap, clean the tank and its immediate vicinity thoroughly. No dirt is allowed to enter the system.

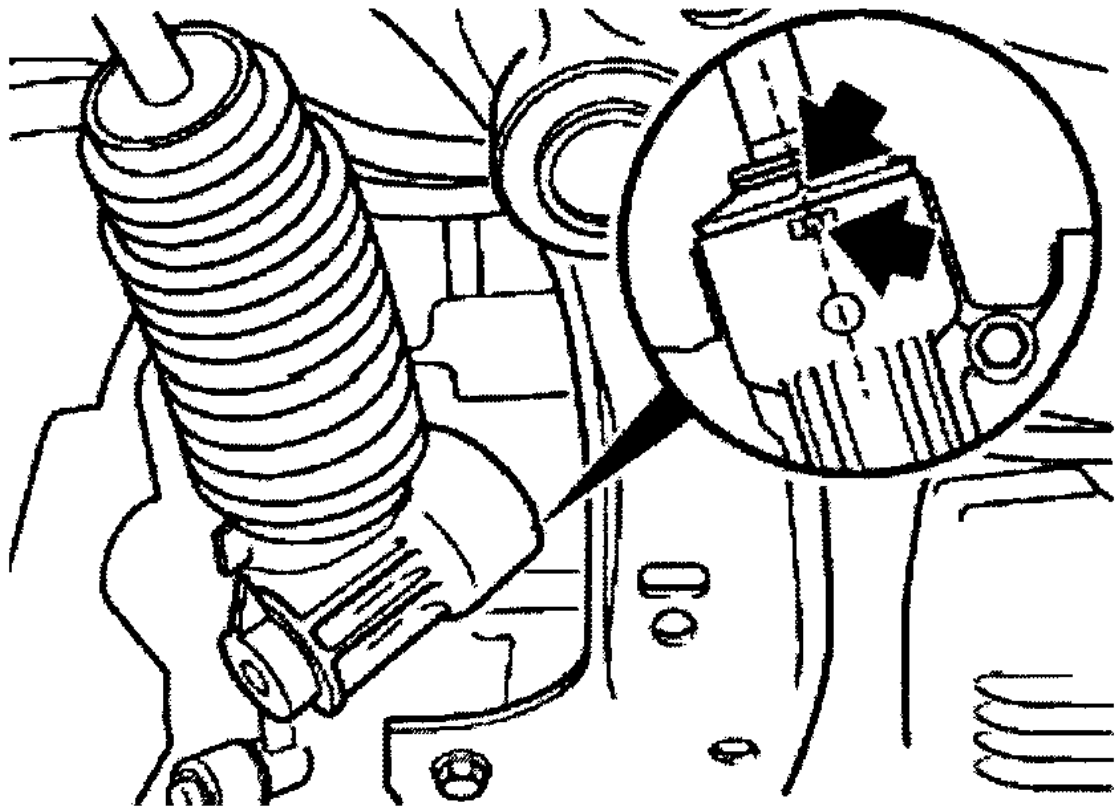
1. Turn off engine and fill oil tank until level reaches "MAX" mark on dipstick.
2. Start engine. Turn steering wheel twice each as far as left and right lock.
3. Turn off engine and top off hydraulic fluid again to "MAX".

Refer to [OPERATING FLUIDS](#)

ADJUSTMENTS

ADJUSTING FRONT AXLE (WITH KDS)

1. Adjust toe and toe-difference angle. Set steering gear to straight ahead position. Marking on case and steering shaft must be aligned. See [Fig. 1](#).
2. Loosen nut on tie rod. Adjust wheel toe-in by rotating steering tie rod. See [Fig. 2](#). For toe-in specifications, see [SPECIFICATIONS & PROCEDURES](#) article in WHEEL ALIGNMENT.
3. Ensure that ball joint is not twisted. Tighten tie rod clamping nut to specification. See [TORQUE SPECIFICATIONS](#).



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[Fig. 1: Locating Marking On Case](#)

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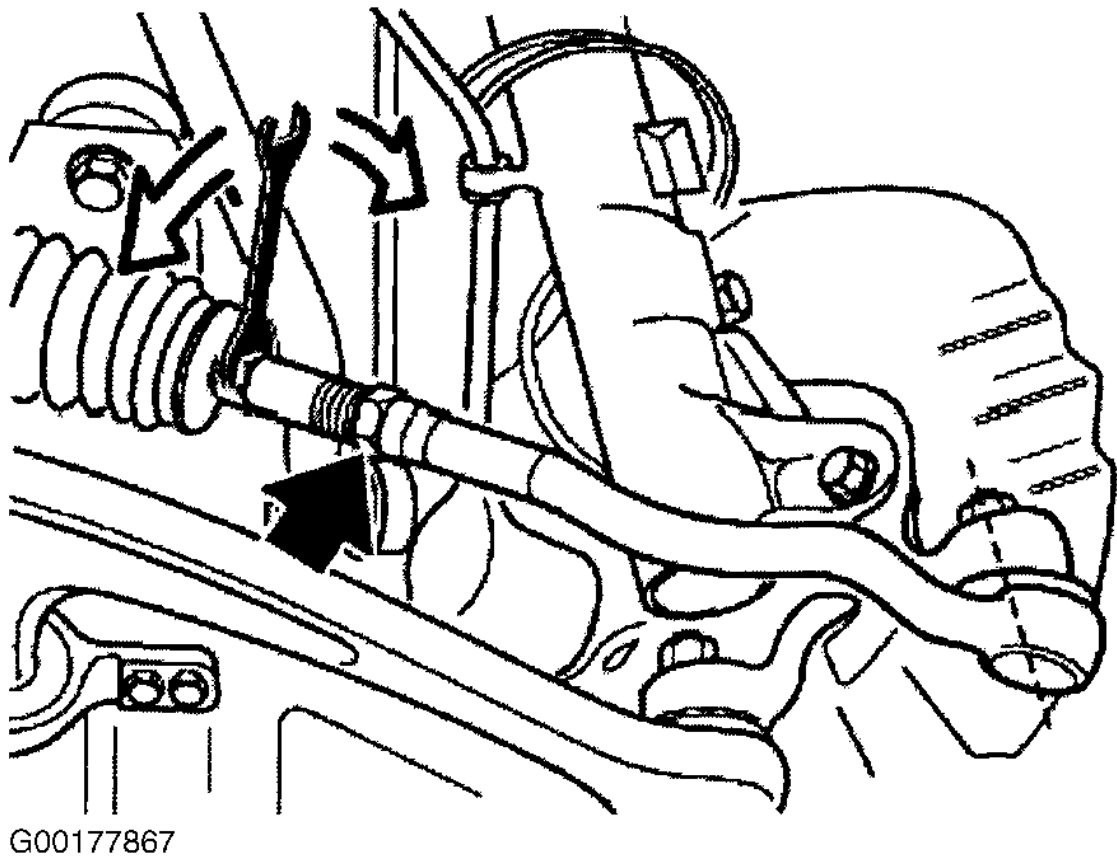


Fig. 2: Adjusting Wheel Toe-In

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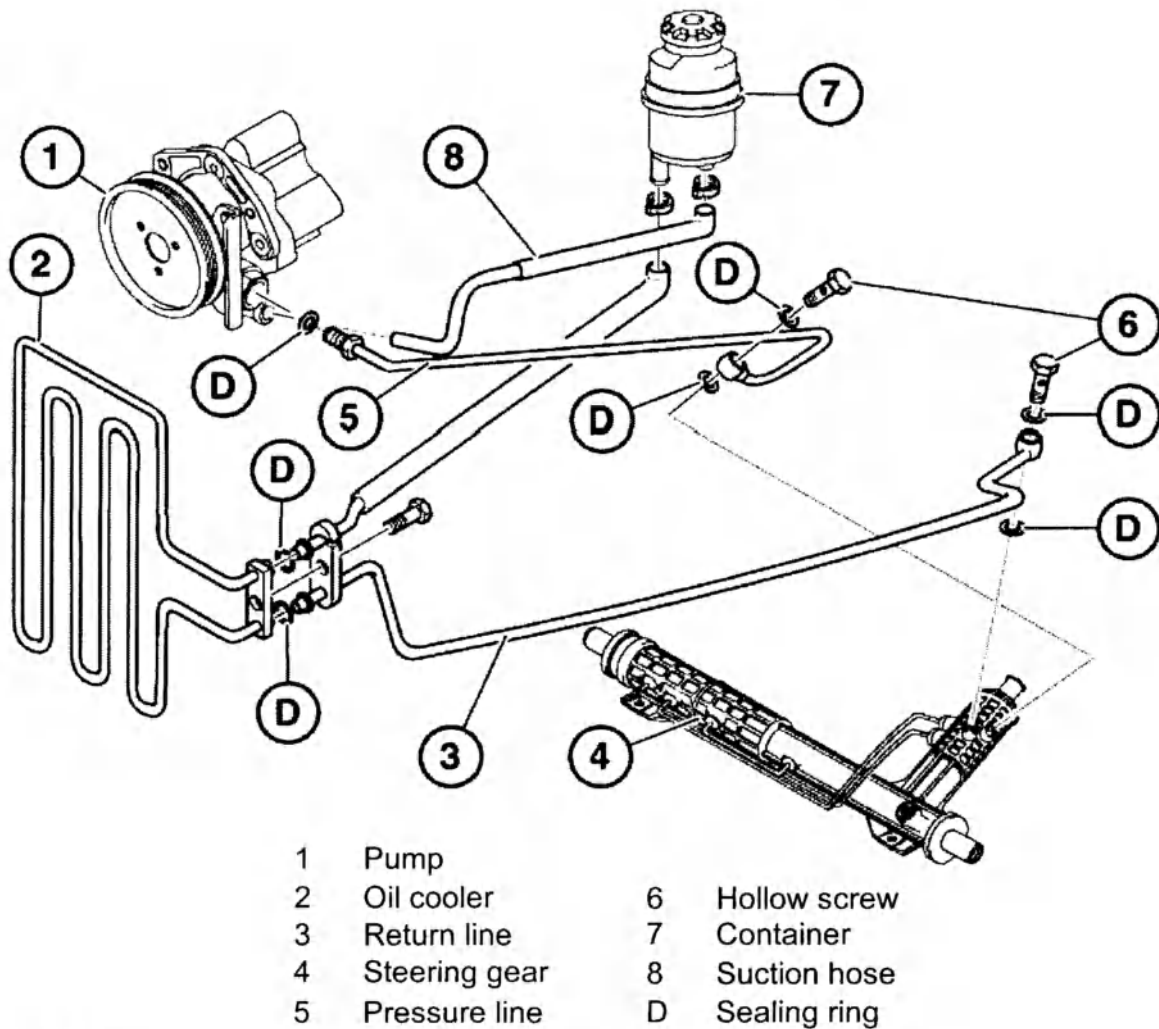
DIAGNOSIS & TESTING

CHECKING FOR DAMAGE & WEAR

Check steering sleeves, flexible disk and axle and tie rod sleeves for damage (e.g. cracks, holes) for leaks or missing clamping bands on gaiters.

CHECKING FOR LEAKS

Check all visible connections, hoses, lines and steering gear for traces of fluid. See [Fig. 3](#).



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[Fig. 3: Power Steering Components & Lines](#)

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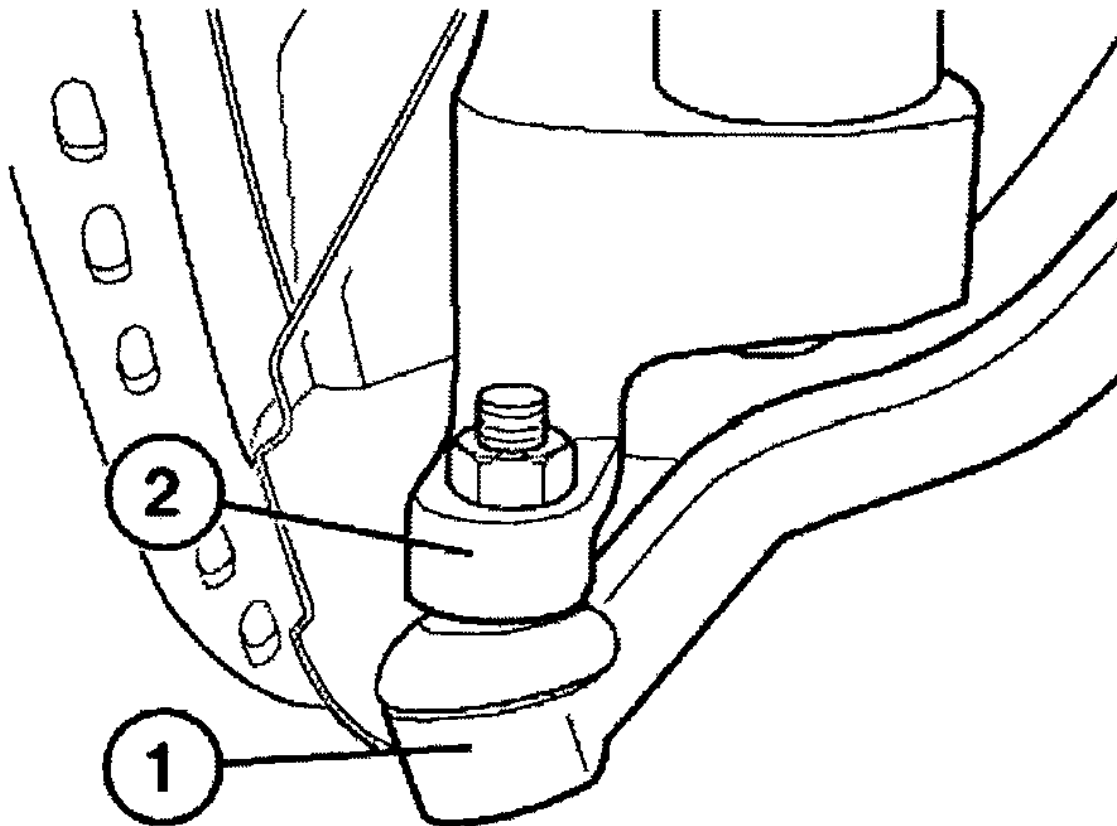
CHECKING FOR ZERO CLEARANCE

Steering Wheel

Move steering wheel back and forth and check for zero clearance.

Tie Rod Joint

There must be no clearance between tie rod arm (2) and tie rod joint (1). See [Fig. 4](#).



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[Fig. 4: Identifying Tie Rod Assembly](#)

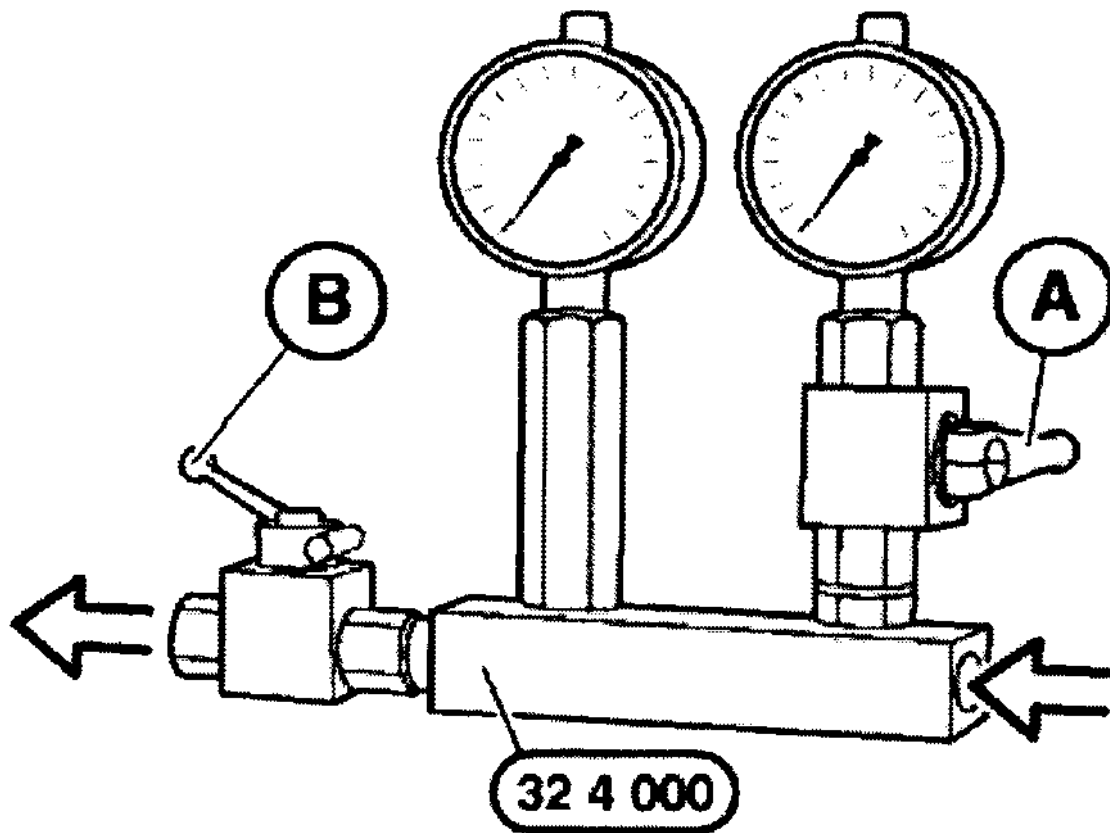
Courtesy of BMW OF NORTH AMERICA, INC.

CHECKING FUNCTION OF POWER STEERING PUMP

CAUTION: Ensure utmost cleanliness. No dirt is allowed to enter the system.

Checking Vane Pump

1. Detach pressure line from pump and connect special tool (32 4 000). See [USING SPECIAL TOOL \(32 4 000\)](#).
2. Close valve (A) and open valve (B). See [Fig. 5](#).
3. Start engine. Ensure correct hydraulic fluid level in tank.
4. Heat hydraulic fluid to approximately 122°F (50°C) by moving steering wheel at increased engine speed.
5. Close valve (B) for a maximum 10 seconds and read off pressure. If pressure exceeds 1595 psi (110-120 bar) by more than 10 percent replace vane pump. If pressure is 10 percent less than 1595 psi (110-120 bar), check V belt tension. If V belt tension is OK, replace vane pump.



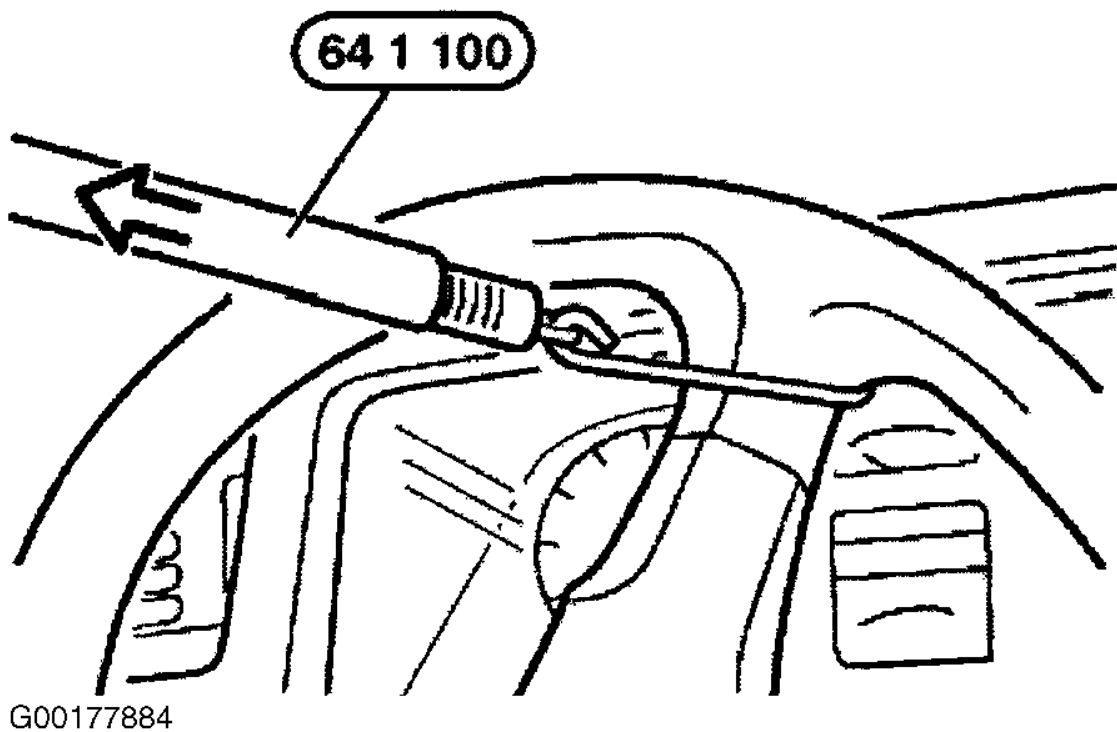
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Fig. 5: Checking Vane Pump

Courtesy of BMW OF NORTH AMERICA, INC.

Power Steering Test

1. Open valve (B) and close valve (A). Start engine.
2. Pull steering wheel against left lock with 22.5 Lbs. (100 N) force with special tool (64 1 100) for approximately 5 seconds and read off pressure. See [Fig. 6](#).
3. Repeat with steering wheel against right lock. The steering gear must be replaced if the pressures are below the previously determined pump pressure.
4. After removing special tool (32 4 000), replace sealing rings on hollow bolts and connect pressure line. Tighten to specification. See [TORQUE SPECIFICATIONS](#).



[Fig. 6: Using Special Tool \(64 1 100\)](#)

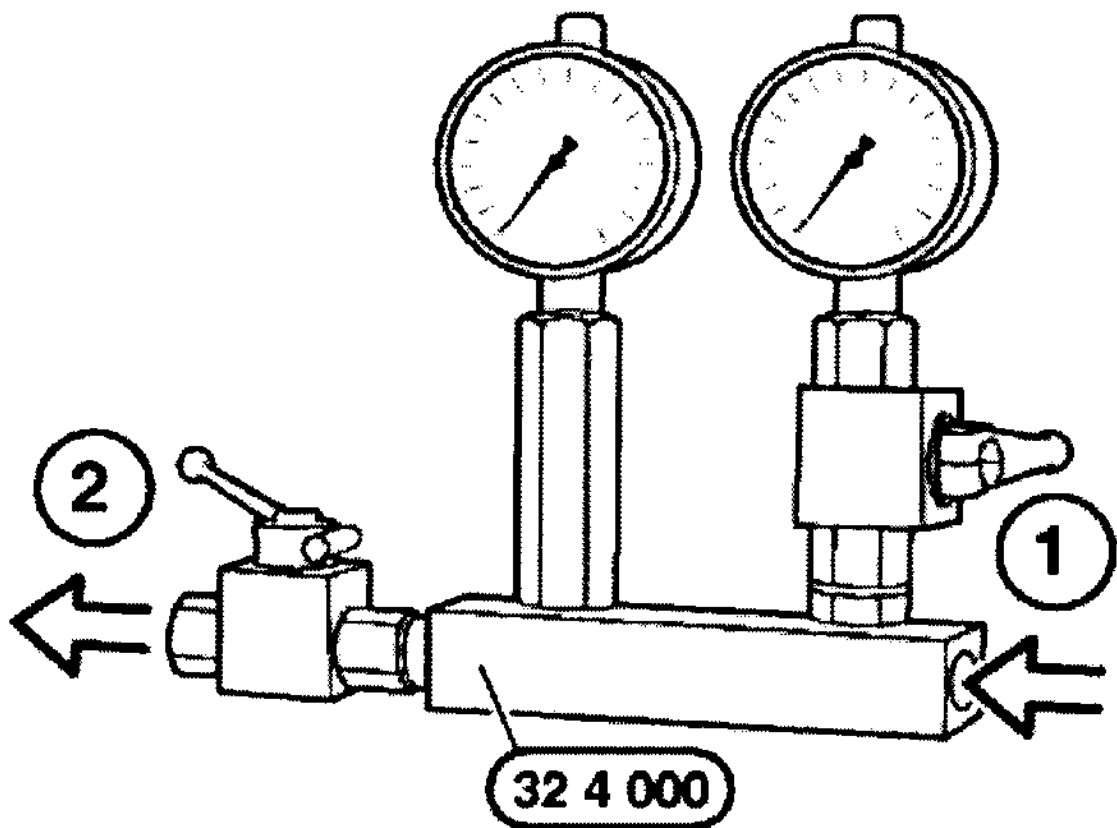
Courtesy of BMW OF NORTH AMERICA, INC.

USING SPECIAL TOOL (32 4 000)

NOTE: Depending on the pressure hose connection on the pump, the special tool (32 4 000) must be assembled. See [Fig. 7](#).

Pressure Hose Connection To Pump With 14 x 1.5 mm Banjo Bolt

1. Screw special tool (32 4 004) with 14 x 1.5 mm banjo bolt (1) and 2 sealing rings to special tool (32 4 000). See [Fig. 8](#).
2. Screw special tool (32 4 011) onto pump and connect special tool (32 4 004).
3. Screw special tools (32 4 006/012) onto special tool (32 4 000) and connect pressure hose with 14 x 1.5 mm banjo bolts and 2 sealing rings.



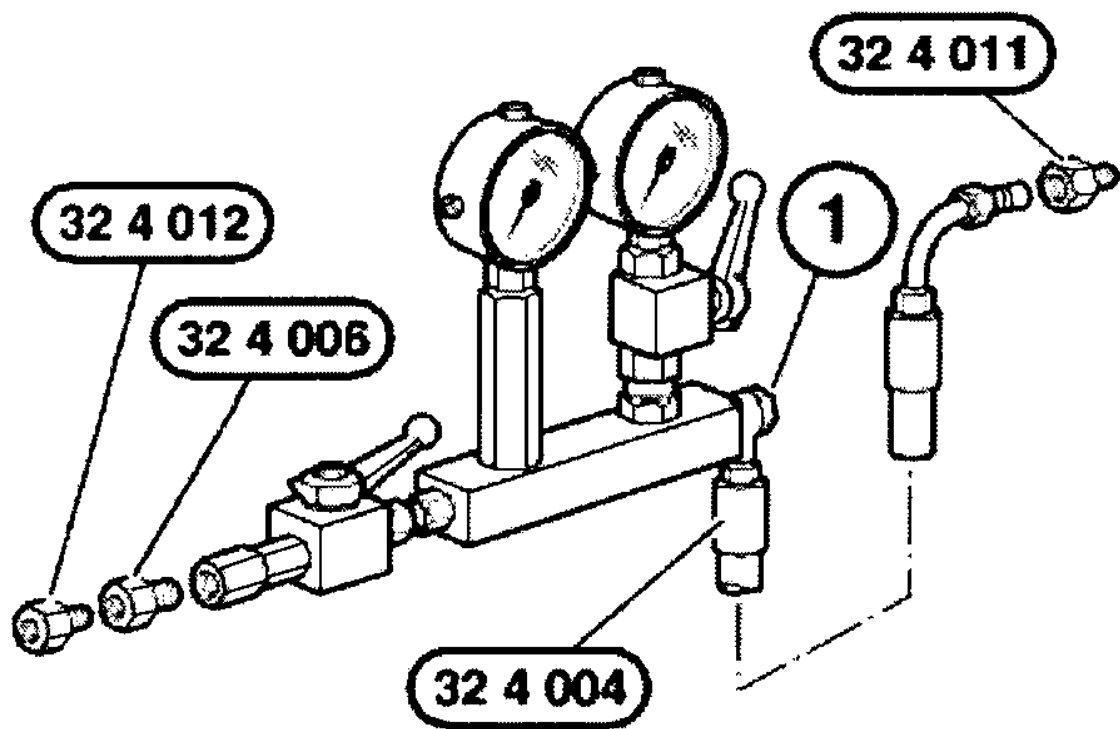
1 = Connection, pump

2 = Connection, steering gear

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[Fig. 7: Identifying Special Tool \(32 4 000\) Component](#)

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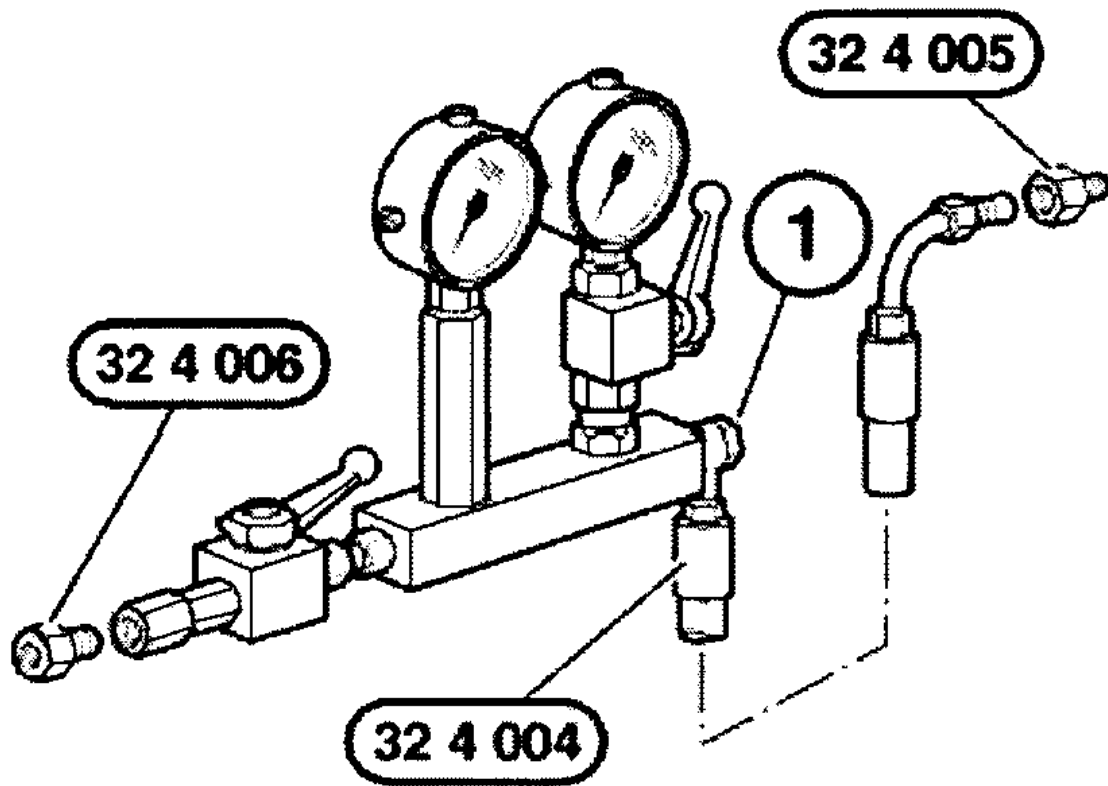
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Fig. 8: Connecting Pressure Hose To Pump With 14 x 1.5 mm Banjo Bolt

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Pressure Hose Connection To Pump With 16 x 1.5 mm Banjo Bolt

1. Screw special tool (32 4 004) with 14 x 1.5 mm banjo bolt (1) and 2 sealing rings to special tool (32 4 000). See [Fig. 9](#).
2. Screw special tool (32 4 005) onto pump and connect special tool (32 4 004).
3. Screw special tools (32 4 006) onto special tool (32 4 000) and connect pressure hose with 16 x 1.5 mm banjo bolts and 2 sealing rings.

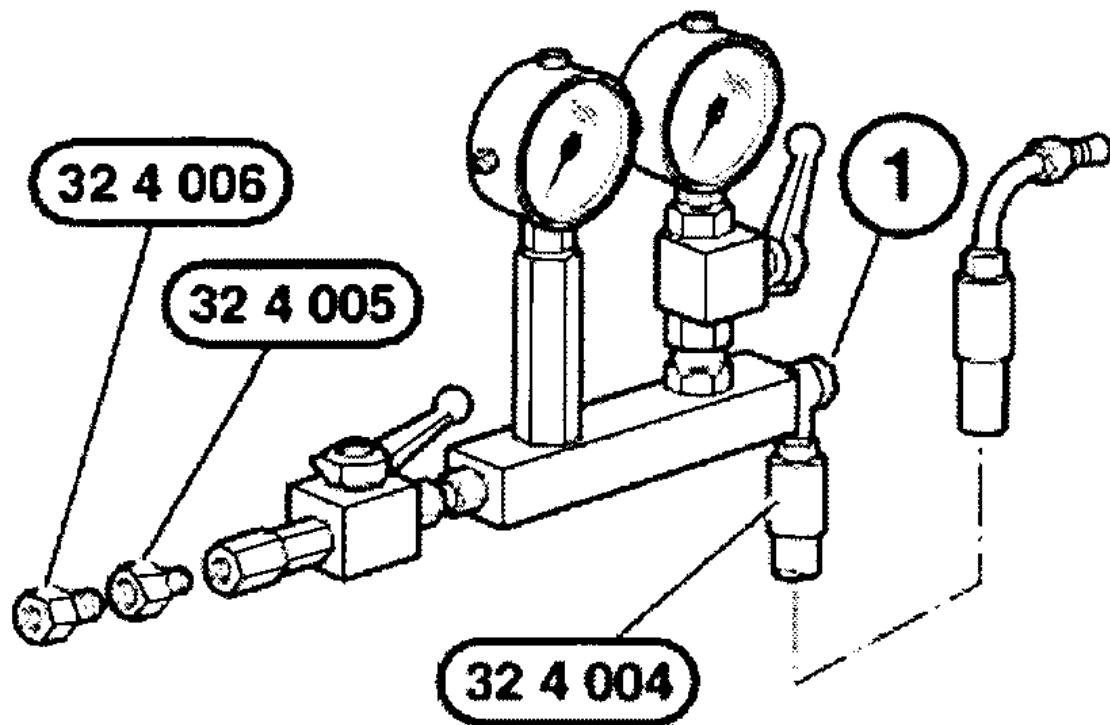


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Fig. 9: Connecting Pressure Hose To Pump With 16 x 1.5 mm Banjo Bolt
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Pressure Hose Connection To Pump With 16 x 1.5 mm Union Screw

1. Screw special tool (32 4 004) with 14 x 1.5 mm banjo bolt (1) and 2 sealing rings to special tool (32 4 000). See [Fig. 10](#).
2. Connect special tool (32 4 004) to pump.
3. Screw special tools (32 4 006/005) onto special tool (32 4 000) and connect pressure hose.



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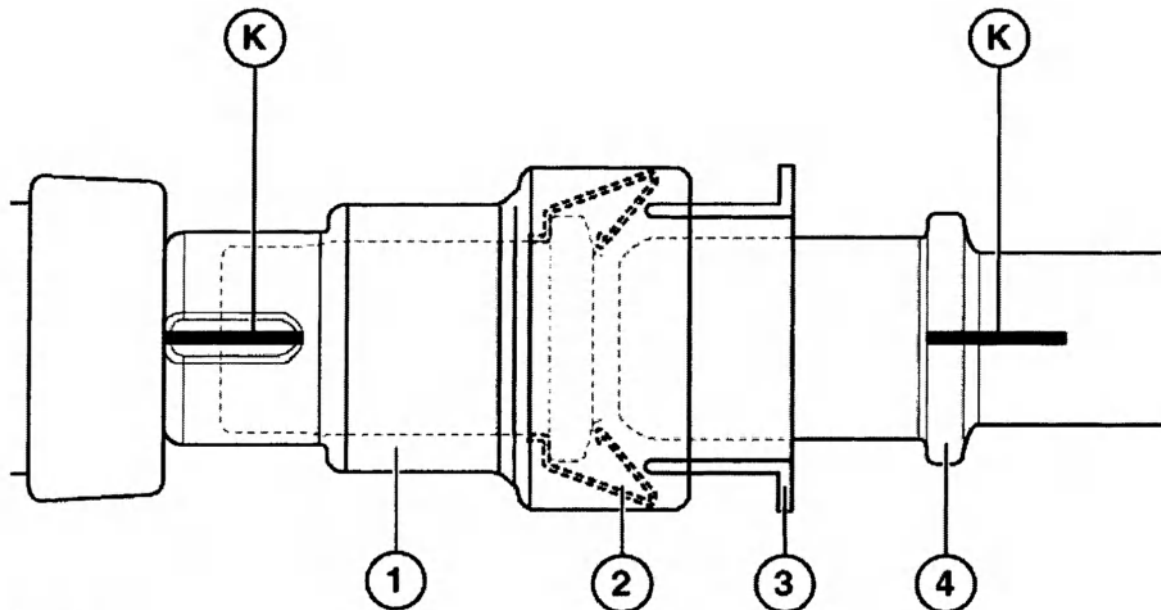
Fig. 10: Connecting Pressure Hose To Pump With 16 x 1.5 mm Union Bolt
 Courtesy of BMW OF NORTH AMERICA, INC.

REMOVAL & INSTALLATION

HYDRAULIC LINE WITH QUICK-RELEASE COUPLING

Removal & Installation of Quick-Release Coupling with ID Marking

1. Push quick-release coupling (1) against pipe (4) thereby relieving strain on spring (2). Press plastic ring (3) into quick-release coupling (1) and remove coupling (1). See [Fig. 11](#).
2. To install, markings (K) on coupling and pipe (4) must be flush. Push quick-release coupling (1) onto pipe (4) until a "click" can be heard. To check that quick-release coupling has been installed correctly, pull it back forcefully.



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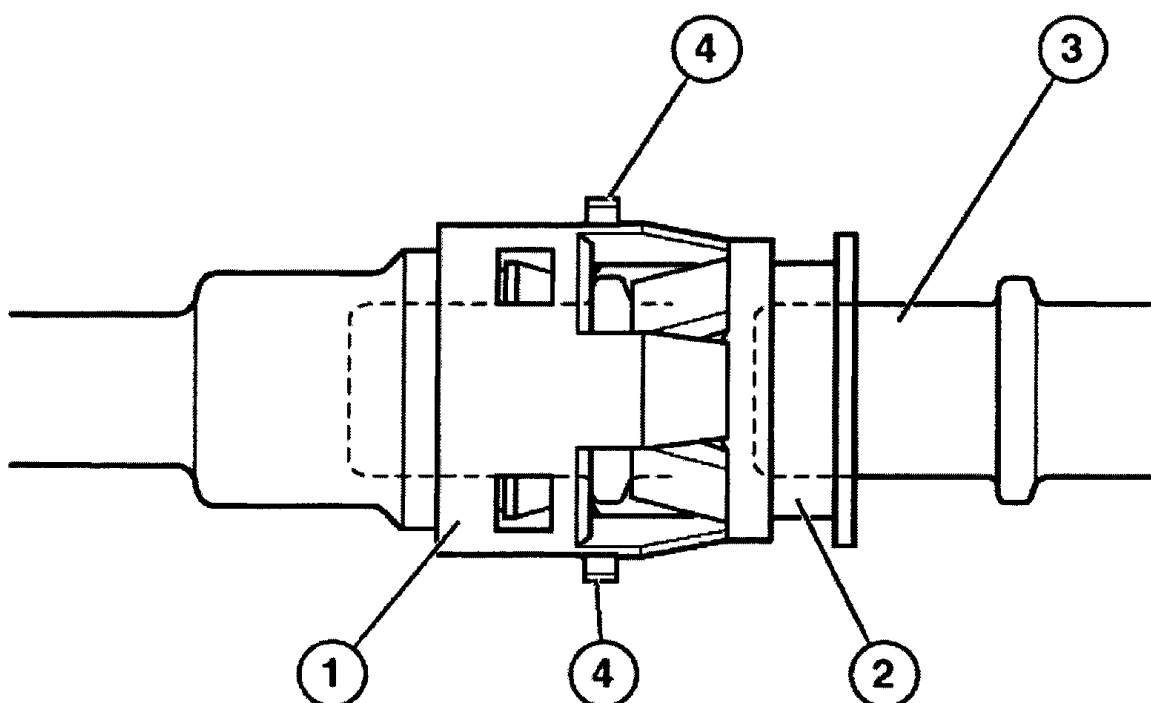
Fig. 11: Identifying Quick Release Coupling With ID Marking

Courtesy of BMW OF NORTH AMERICA, INC.

Removal & Installation of Quick-Release Coupling with Indication Pins

CAUTION: Coupling is not correctly engaged if both indication pins (4) fail to protrude from housing. Leakage will occur. See [Fig. 12](#).

1. Press plastic ring (2) into quick-release coupling (1) and remove coupling (1). See [Fig. 12](#).
2. To install, push quick-release coupling (1) onto connector (3) until both indication pins (4) can be seen and felt to point outwards at outside diameter of housing. To check that quick-release coupling (1) has been correctly fitted, feel indication pins (4) at outside diameter of housing. When correctly seated, indication pins (4) cannot be pressed into housing.



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Fig. 12: Identifying Quick Release Coupling With Indication Pins

Courtesy of BMW OF NORTH AMERICA, INC.

POWER STEERING COOLING LOOP (Z3)

NOTE: Observe all waste disposal regulations.

Removal & Installation

1. Draw hydraulic fluid out of tank and do not re-use.
2. Remove cover on radiator at bottom. Release both hose clamps on cooling loop and detach hoses. Remove cooling loop from front panel. See [Fig. 13](#).
3. To install, reverse removal procedure. Bleed power steering system. See [BLEEDING POWER STEERING SYSTEM](#).

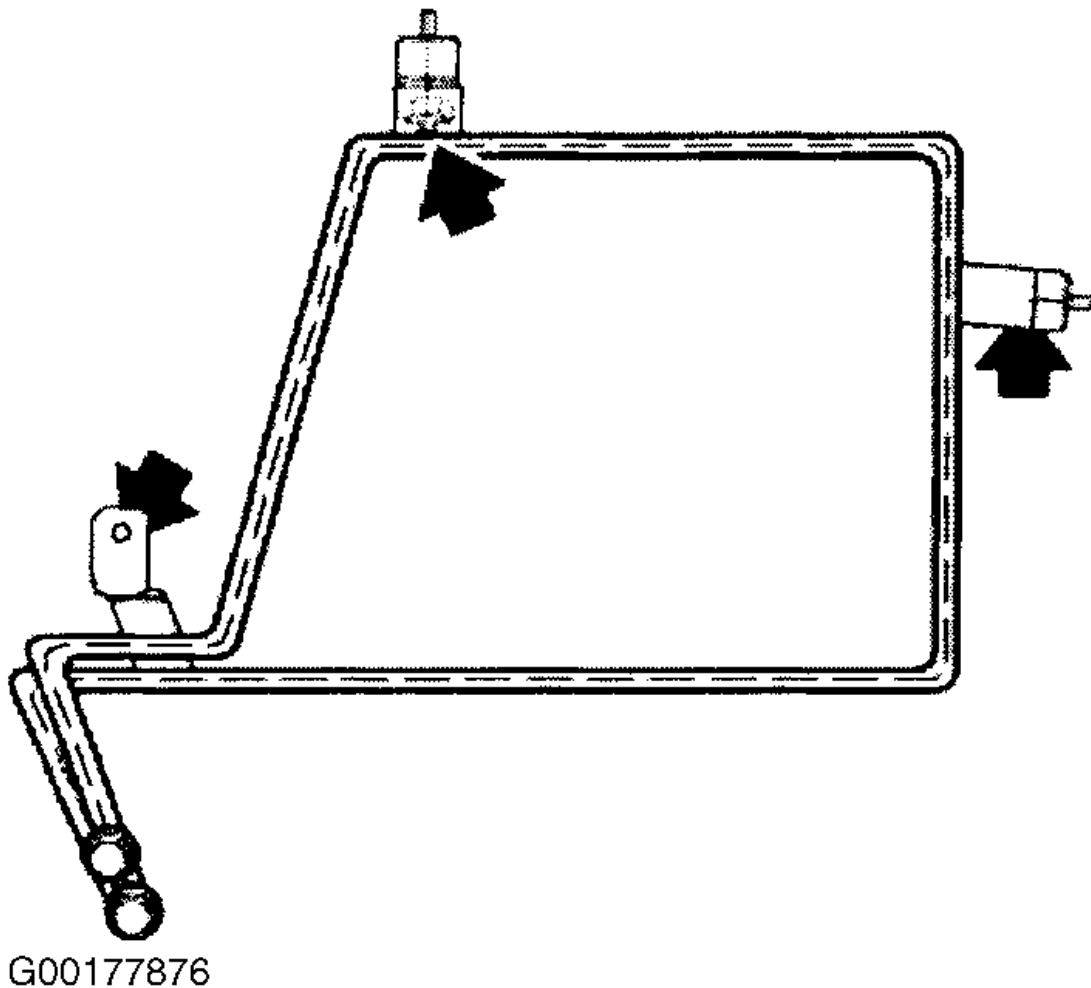


Fig. 13: Removing Cooling Loop

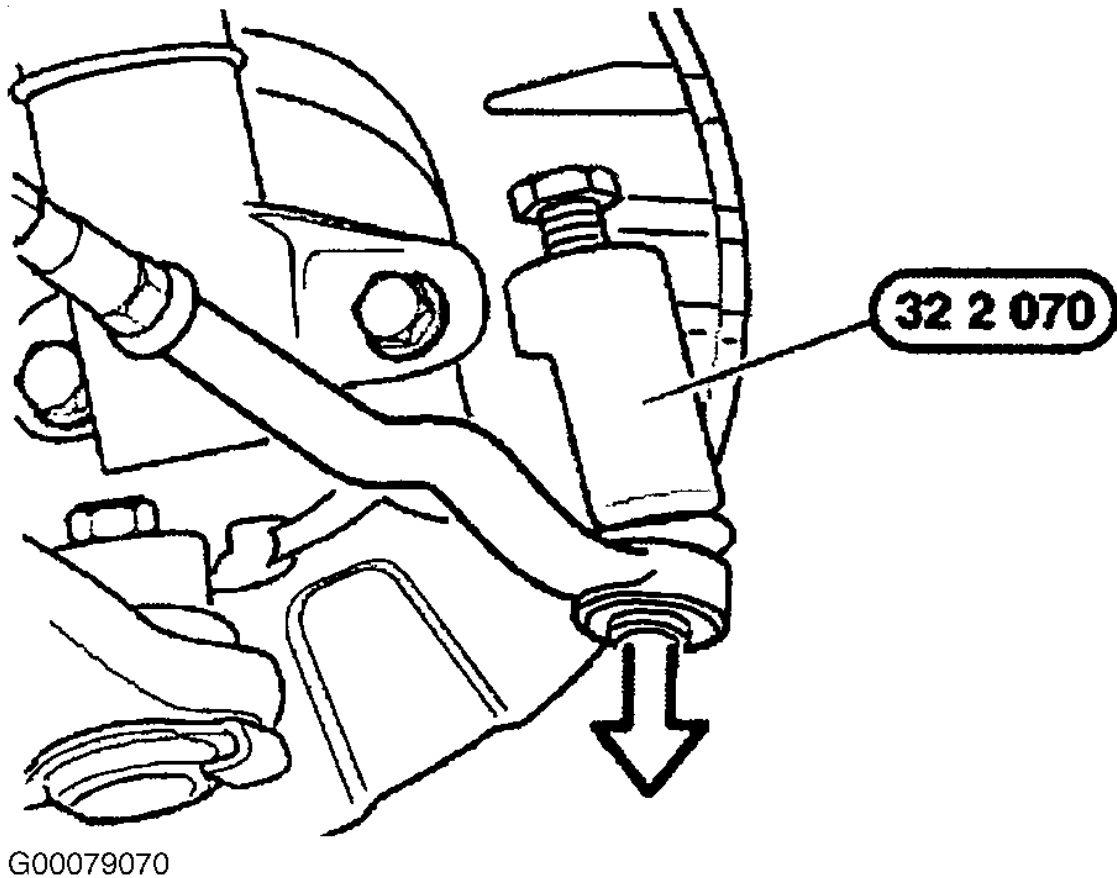
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POWER STEERING GEAR

Removal

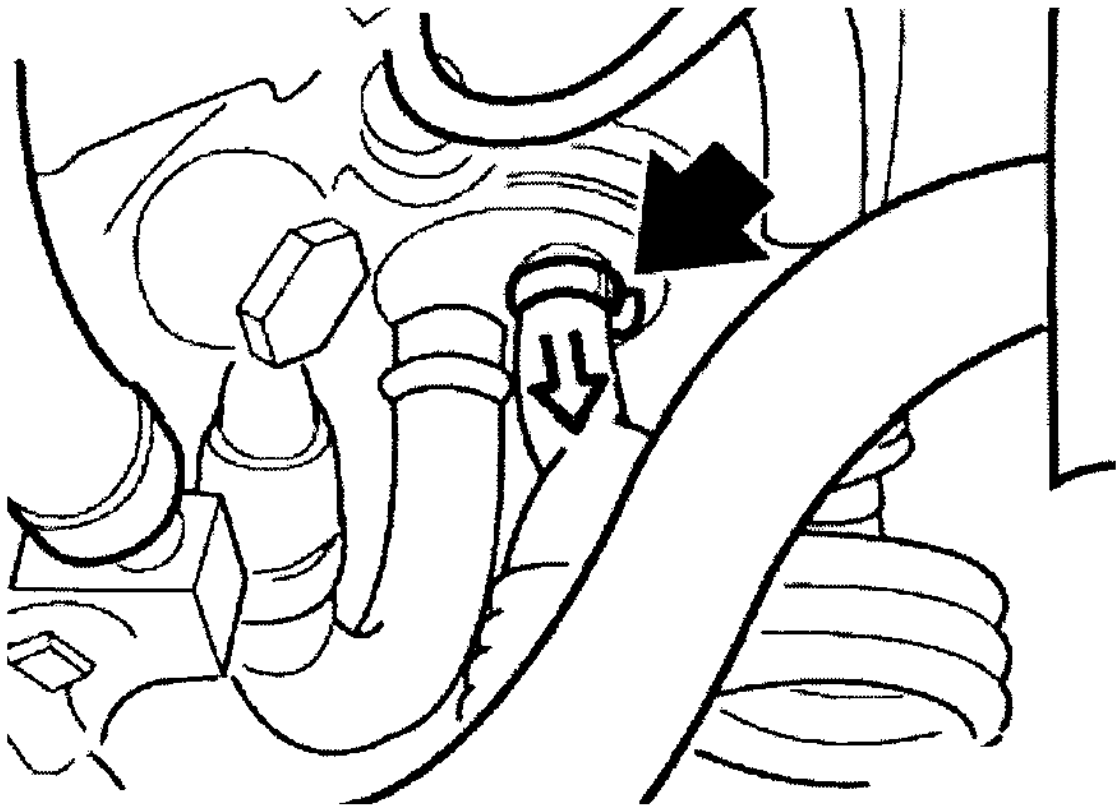
NOTE: Observe all waste disposal regulations.

1. Draw hydraulic fluid out of tank and do not re-use.
2. Remove front wheels.
3. Remove steering wheel.
4. Remove left and right tie rod with special tool (32 2 070). See [Fig. 14](#).
5. Disconnect hose on tank. See [Fig. 15](#).
6. Unscrew hollow union bolt. See [Fig. 16](#).
7. Remove bolt and separate universal joint from steering gear. See [Fig. 17](#).
8. Unscrew bolts and take off steering gear in forward direction. See [Fig. 18](#).



[Fig. 14: Removing Tie-Rod End](#)

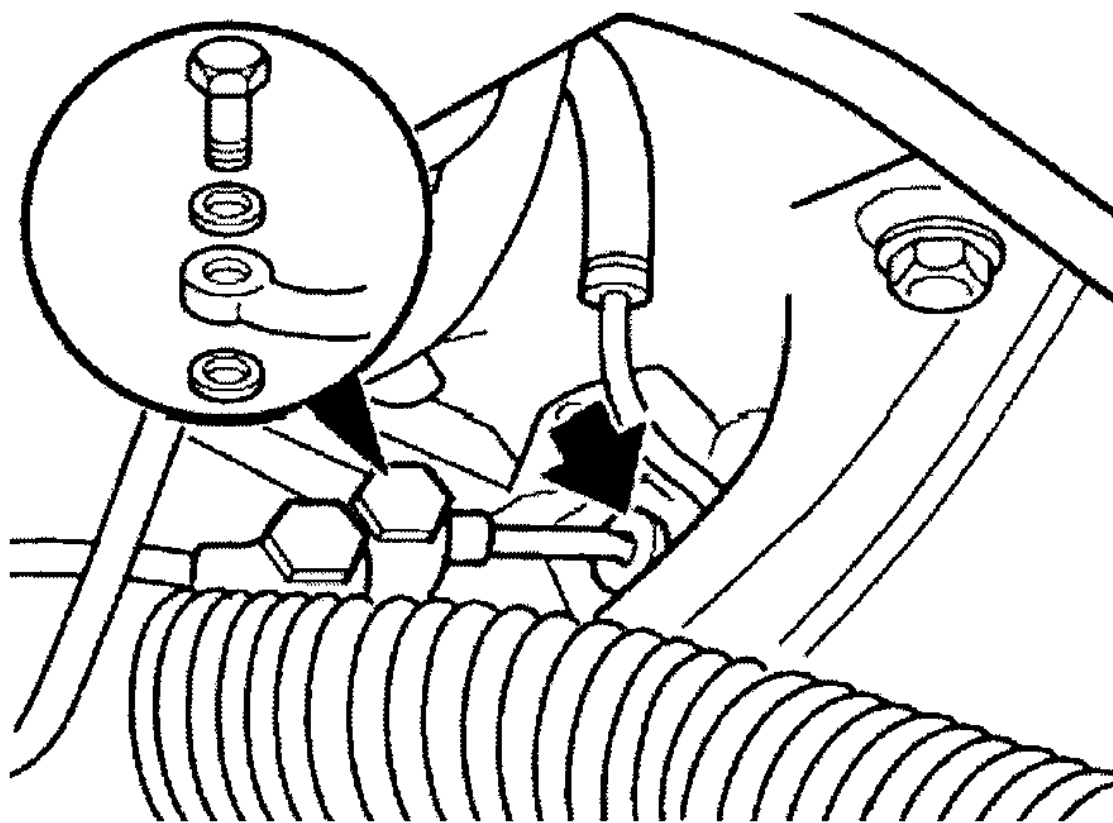
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[Fig. 15: Disconnecting Hose On Tank](#)

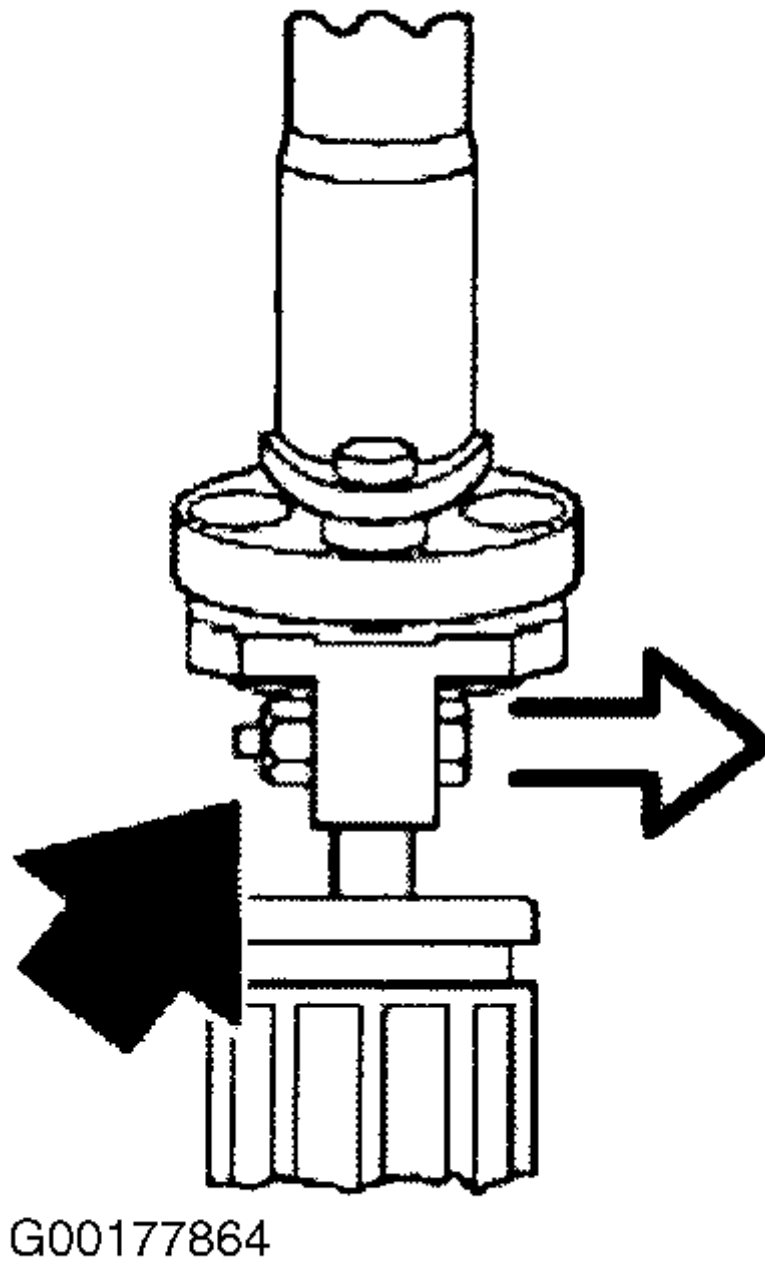
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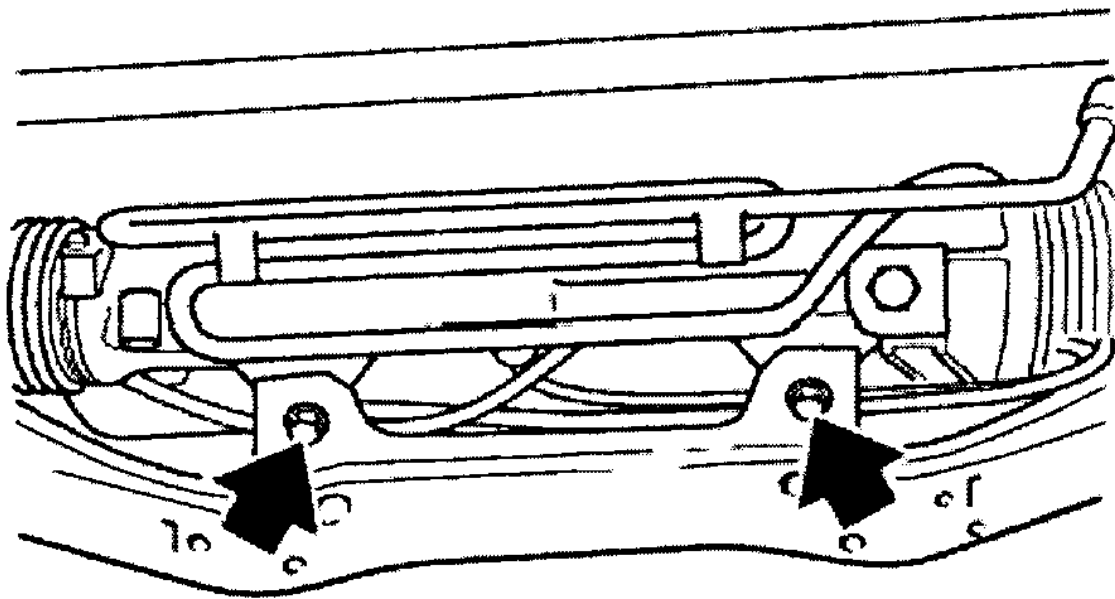
[Fig. 16: Removing Hollow Union Bolt](#)

Courtesy of BMW OF NORTH AMERICA, INC.



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[Fig. 17: Separating Universal Joint From Steering Gear](#)
Courtesy of BMW OF NORTH AMERICA, INC.



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Fig. 18: Removing Steering Gear

Courtesy of BMW OF NORTH AMERICA, INC.

Installation

1. To install, reverse removal procedure. Replace self-locking nuts and tighten to specification. See [TORQUE SPECIFICATIONS](#).
2. Note position of steering spindle. See [Fig. 17](#).
3. Replace sealing rings. Install line with rubber grommet in bracket. Tighten to specification. See [TORQUE SPECIFICATIONS](#).
4. Install tie rod. Replace self-locking nuts and tighten to specification. See [TORQUE SPECIFICATIONS](#).
5. Bleed power steering system. See [BLEEDING POWER STEERING SYSTEM](#).
6. If the steering gear is replaced, adjust the front axle after installation. See [ADJUSTING FRONT AXLE \(WITH KDS\)](#) under ADJUSTMENTS.

POWER STEERING VANE PUMP (M52/M54 ENGINE)

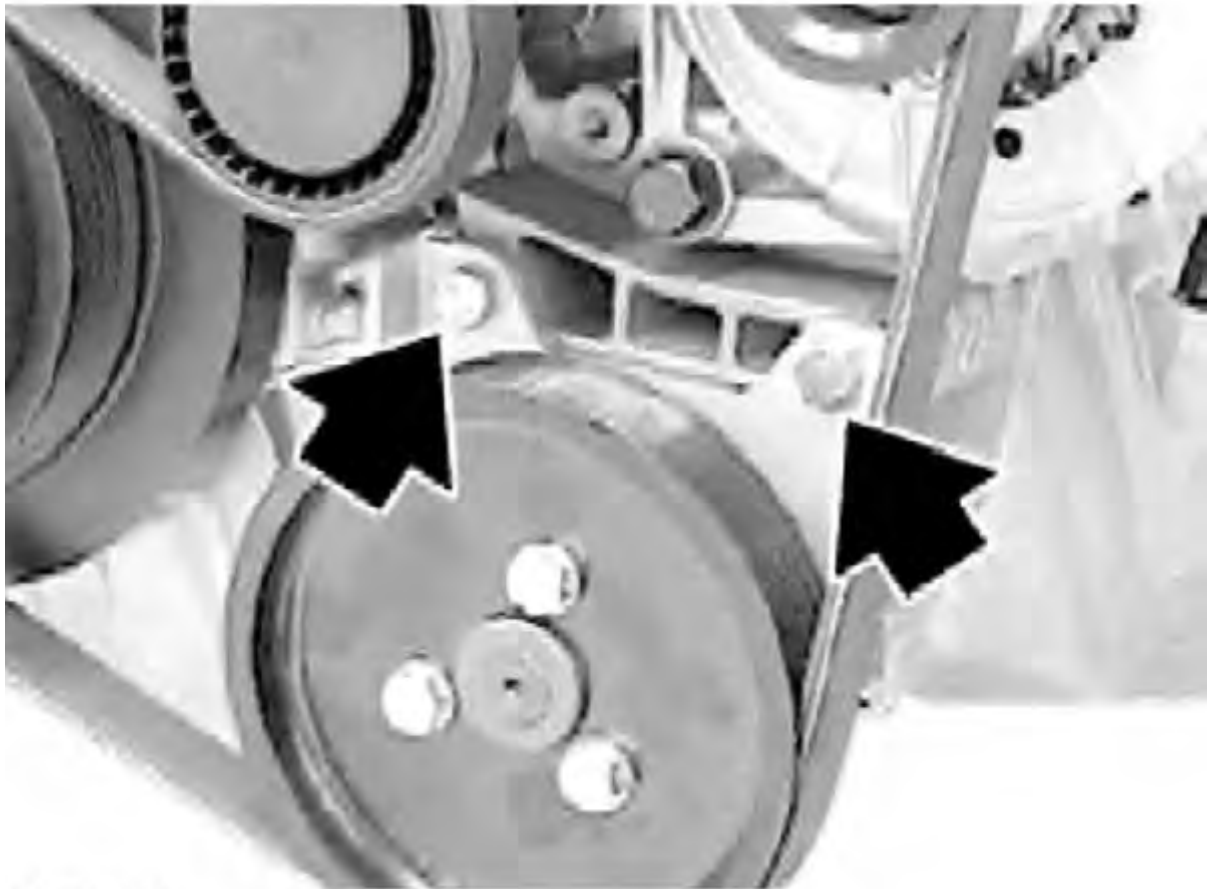
CAUTION: Make sure all parts are absolutely clean. No dirt is allowed to enter the system. Seal off pipe connections with plugs.

NOTE: Observe all waste disposal regulations.

Removal & Installation

1. Draw hydraulic fluid out of tank. Do not re-use.
2. Remove engine underguard.
3. Remove drive belt.
4. Disconnect suction and pressure lines from pump.
5. Unfasten screws and remove pump. See [Fig. 19](#).
6. To install, reverse removal procedure. Tighten suction and pressure lines to specification. See [TORQUE SPECIFICATIONS](#).

7. Fill hydraulic system. See [BLEEDING POWER STEERING SYSTEM](#).



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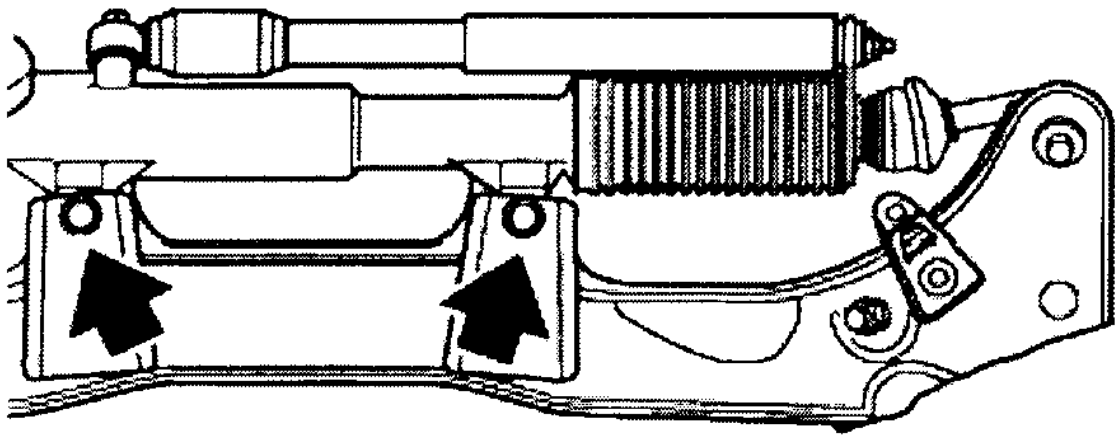
[Fig. 19: Removing Vane Pump](#)

Courtesy of BMW OF NORTH AMERICA, INC.

STEERING GEAR

Removal

1. Remove front wheels.
2. Remove steering wheel. See appropriate STEERING COLUMNS article.
3. Remove left and right tie rod with special tool (32 2 070). See [Fig. 14](#).
4. Remove clamping screw and pull universal joint off steering gear. See [Fig. 17](#).
5. Unscrew bolts and take off steering gear in forward direction. See [Fig. 20](#).



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Fig. 20: Removing Steering Gear

Courtesy of BMW OF NORTH AMERICA, INC.

Installation

1. To install, reverse removal procedure. Replace self-locking nuts and tighten to specification. See [TORQUE SPECIFICATIONS](#).
2. Set steering gear to straight ahead position (marking on case). Turn steering spindle until bolt (1) of upper universal joint is vertical. Place lower universal joint on steering gear. Bolt must be located in groove of steering gear spindle. See [Fig. 21](#). Replace self-locking nut and tighten to specification. See [TORQUE SPECIFICATIONS](#).
3. Replace self-locking nuts on tie rod and tighten to specification. See [TORQUE SPECIFICATIONS](#).
4. After assembly, align front axle. See [SPECIFICATIONS & PROCEDURES](#).

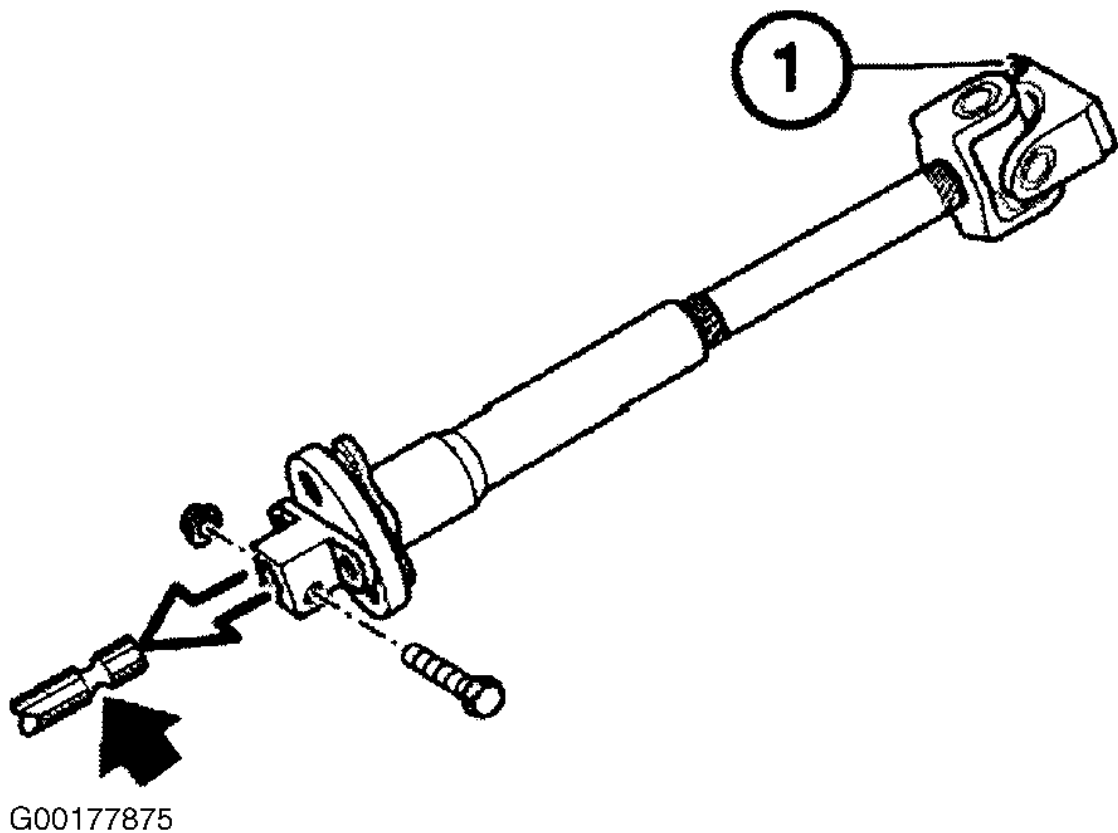


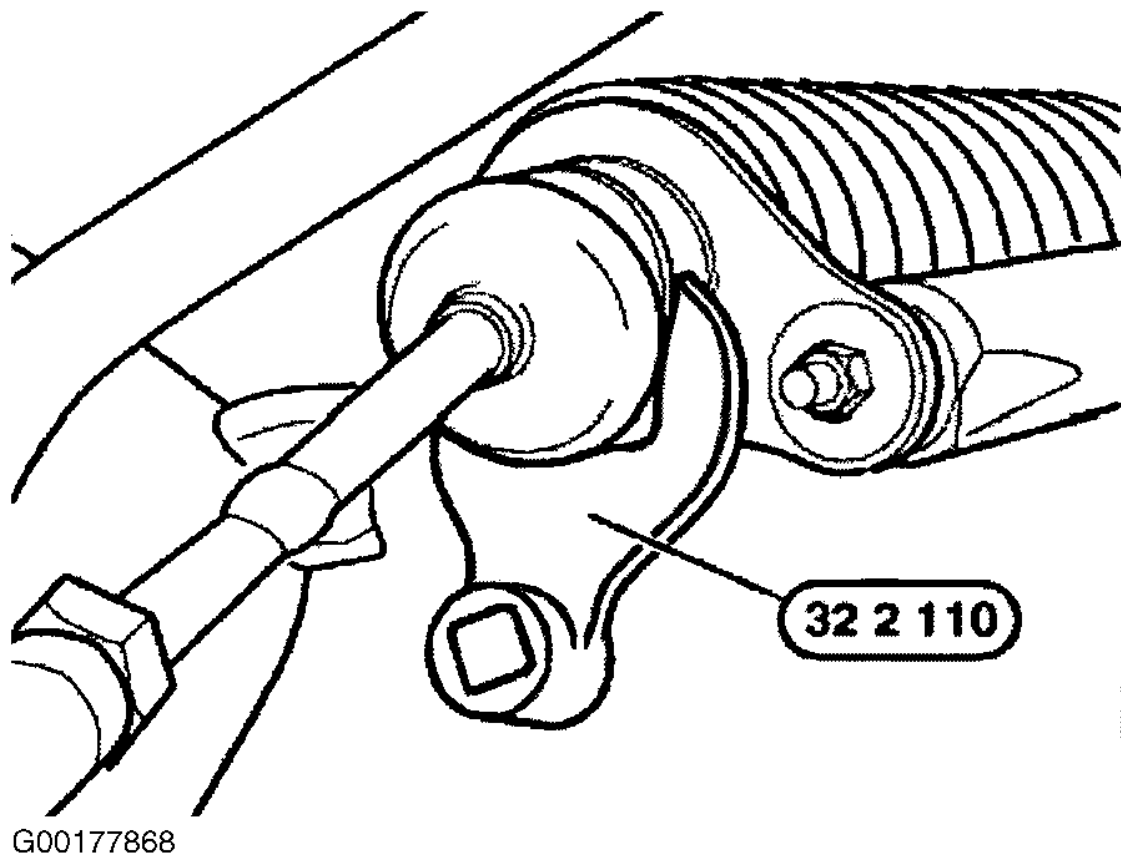
Fig. 21: Installing Lower Universal Joint
 Courtesy of BMW OF NORTH AMERICA, INC.

STEERING GEAR BELLOWS

CAUTION: Clean rack and steering tie rod. Grease toothed area of rack. If polished surface of rack is damaged (rust), replace steering gear. See [STEERING GEAR](#).

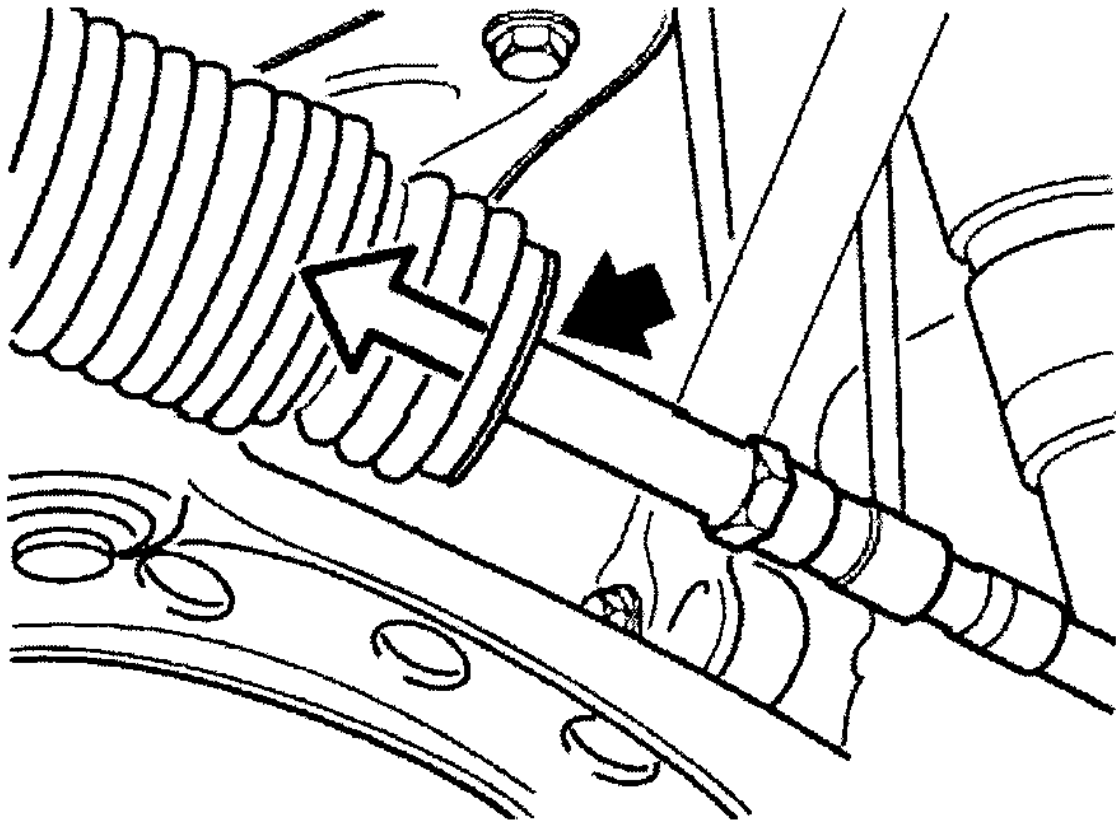
Removal

1. On vehicles with steering damper, unbend lockplate with pliers (never with hammer) in order to avoid damaging rack and bearing. Insert rack as far as possible. Unscrew tie rod using special tool (32 2 110). See [Fig. 22](#).
2. On vehicles with steering damper, remove damper holder. Loosen both clamping straps and remove sleeve.
3. On vehicles without steering damper, loosen clamping straps and pull off bellows. See [Fig. 23](#).
4. On vehicles without steering damper, unbend lockplate with pliers (never with hammer) in order to avoid damaging rack and bearing. Insert rack as far as possible. Unscrew tie rod using special tool (32 2 110). See [Fig. 24](#).



[Fig. 22: Unscrewing Tie Rod](#)

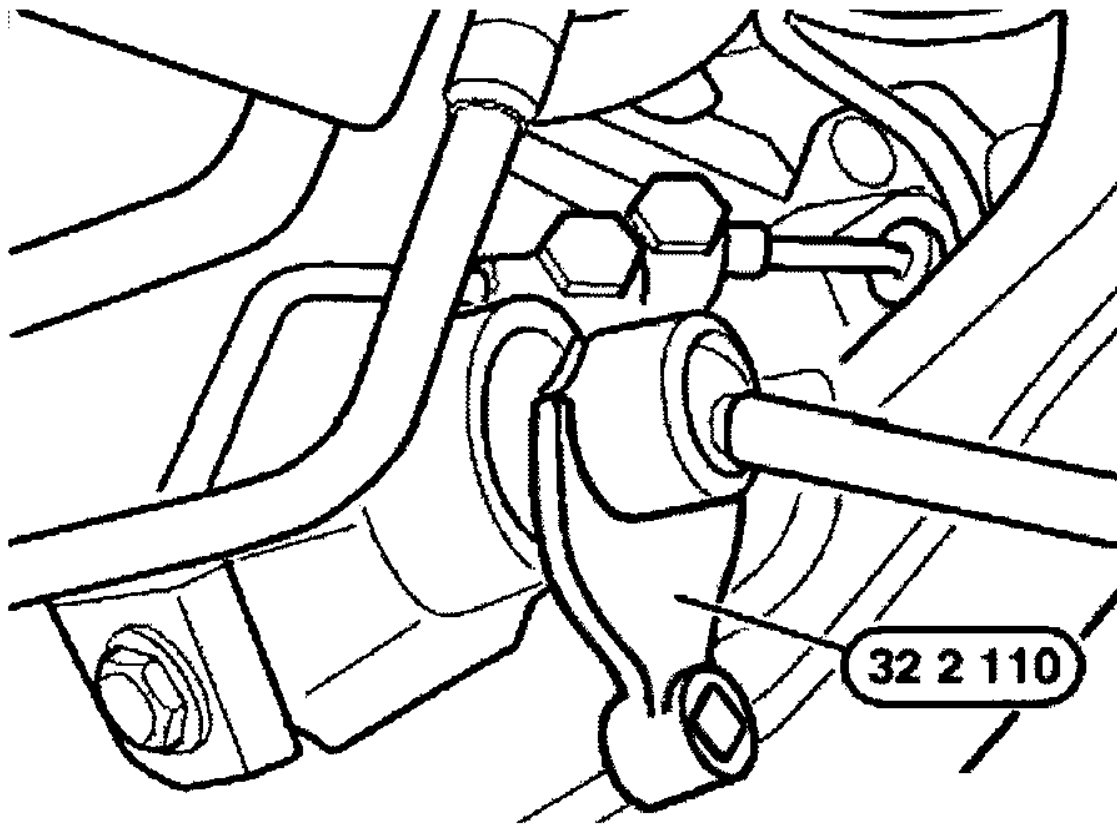
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[Fig. 23: Pulling Off Bellows](#)

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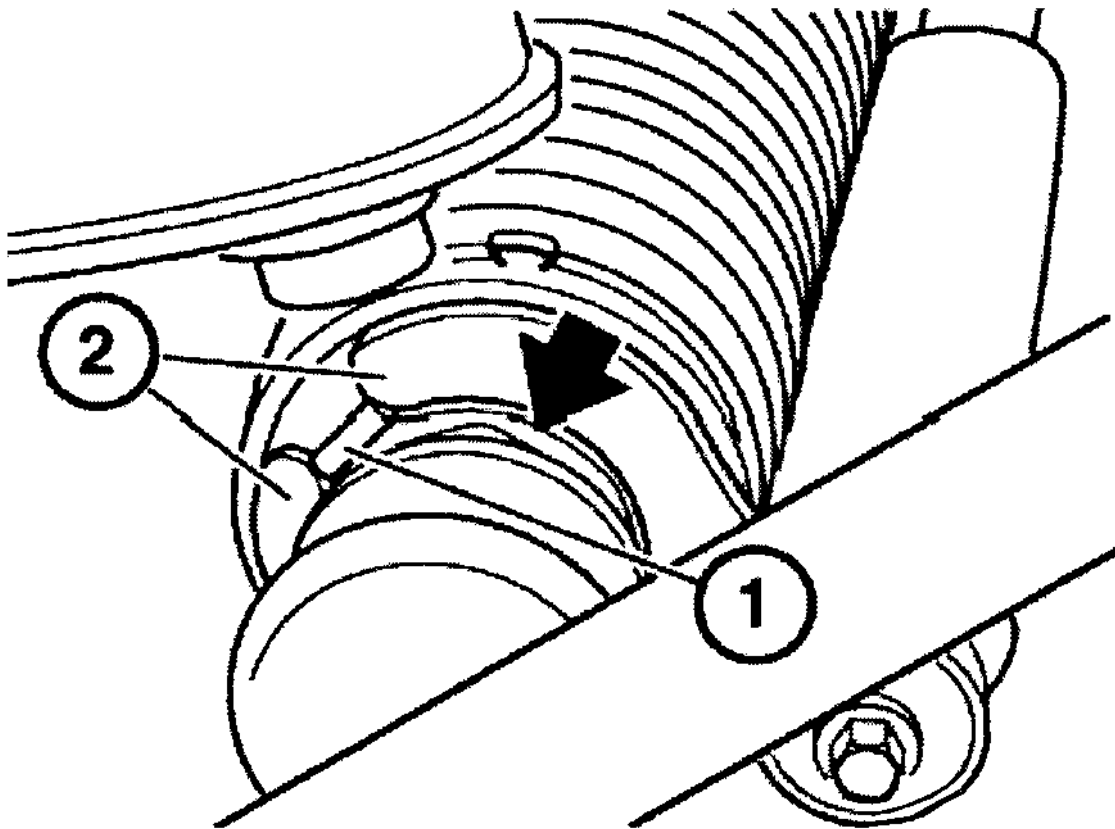
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[Fig. 24: Unscrewing Tie Rod](#)

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Installation

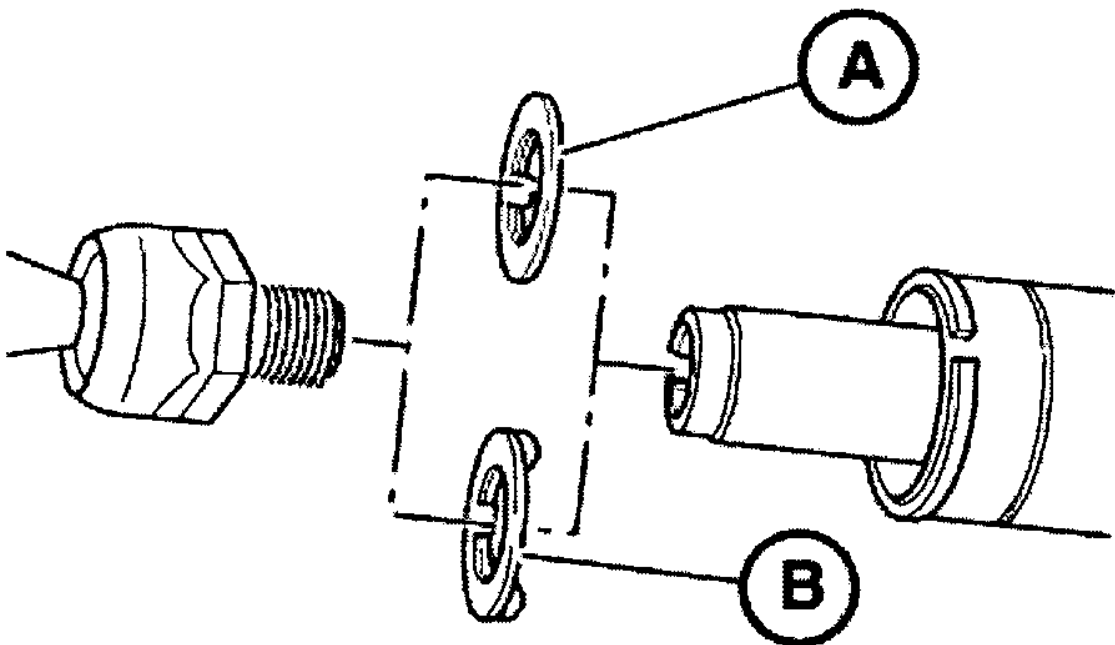
1. On vehicles with steering damper, mount new sleeve with new clamping straps. Replace lockplate. Turning lock (1) must engage in groove (2) of damper holder. See [Fig. 25](#). Bend lockplate with pliers and tighten to specification. See [TORQUE SPECIFICATIONS](#).
2. On vehicles without steering damper, replace lockplate (A or B). If lockplate (B) (with spacer to limit steering angle) is installed, new lockplate must also be fitted with a spacer. See [Fig. 26](#).
3. On vehicles without steering damper, turning lock (1) must engage in groove (2) of rack. See [Fig. 27](#). Tighten to specification. See [TORQUE SPECIFICATIONS](#).
4. On vehicles without steering damper, bend lockplate with pliers.



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[Fig. 25: Replacing Lockplate](#)

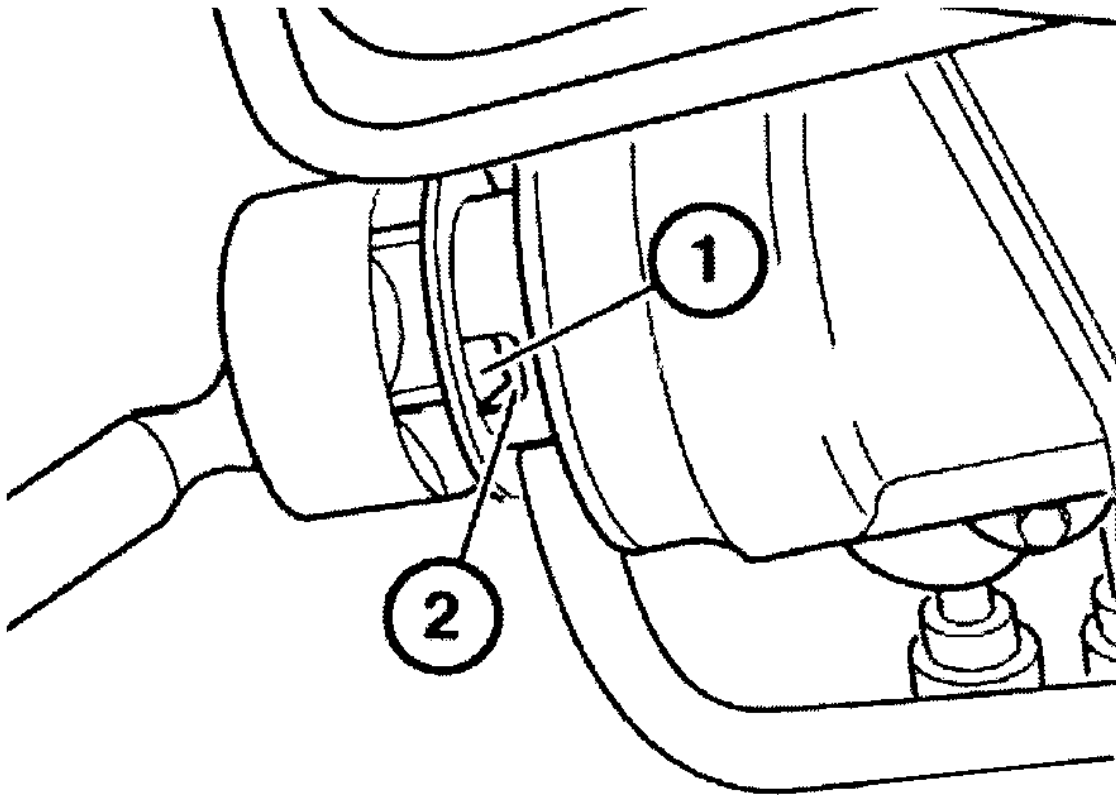
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[Fig. 26: Replacing Lockplate](#)

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[Fig. 27: Engaging Turning Lock](#)

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OVERHAUL

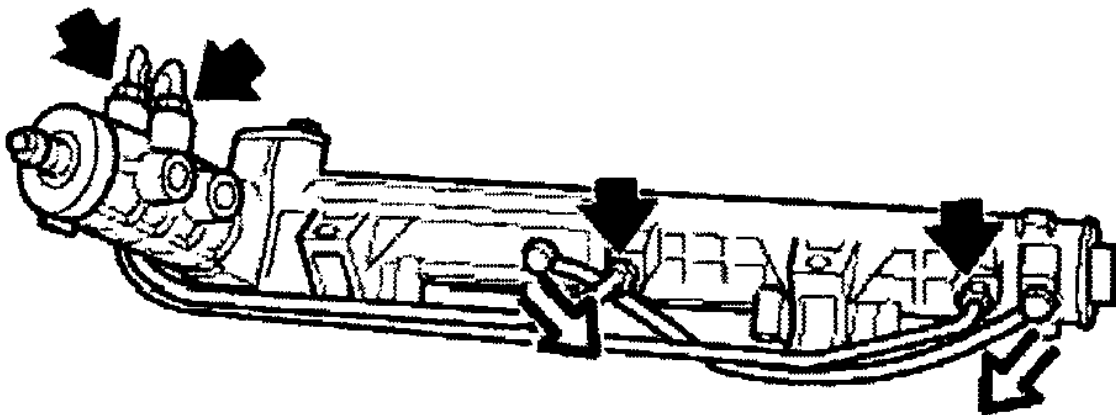
POWER STEERING GEAR

CAUTION: When working on steering gear, always work carefully in clean conditions. All use of force is prohibited during assembly and disassembly. This can otherwise give rise to damage and culminate in failure of the steering unit.

Disassembly

1. Remove power steering gear. See [POWER STEERING GEAR](#).
2. Remove tie rods.
3. Remove leakage oil line. Remove pressure lines and remove O-rings from threaded bores or from lines. See [Fig. 28](#).
4. Mark position of adjusting screw (1) relative to case with peening marks. Determine installation depth of adjusting screw (1) in case with a depth gauge and note down the result. Loosen adjusting screw (1). Remove spring (2), O-ring (3) and pressure piece (4). See [Fig. 29](#).
5. Unscrew and remove screw cap. See [Fig. 30](#).
6. Center steering gear by halving total number of turns. In this setting marks on steering spindle, cap and case all match. Add marks if necessary.
7. Determine dimension (A) of rack with a depth gauge and note down result. This measurement is required

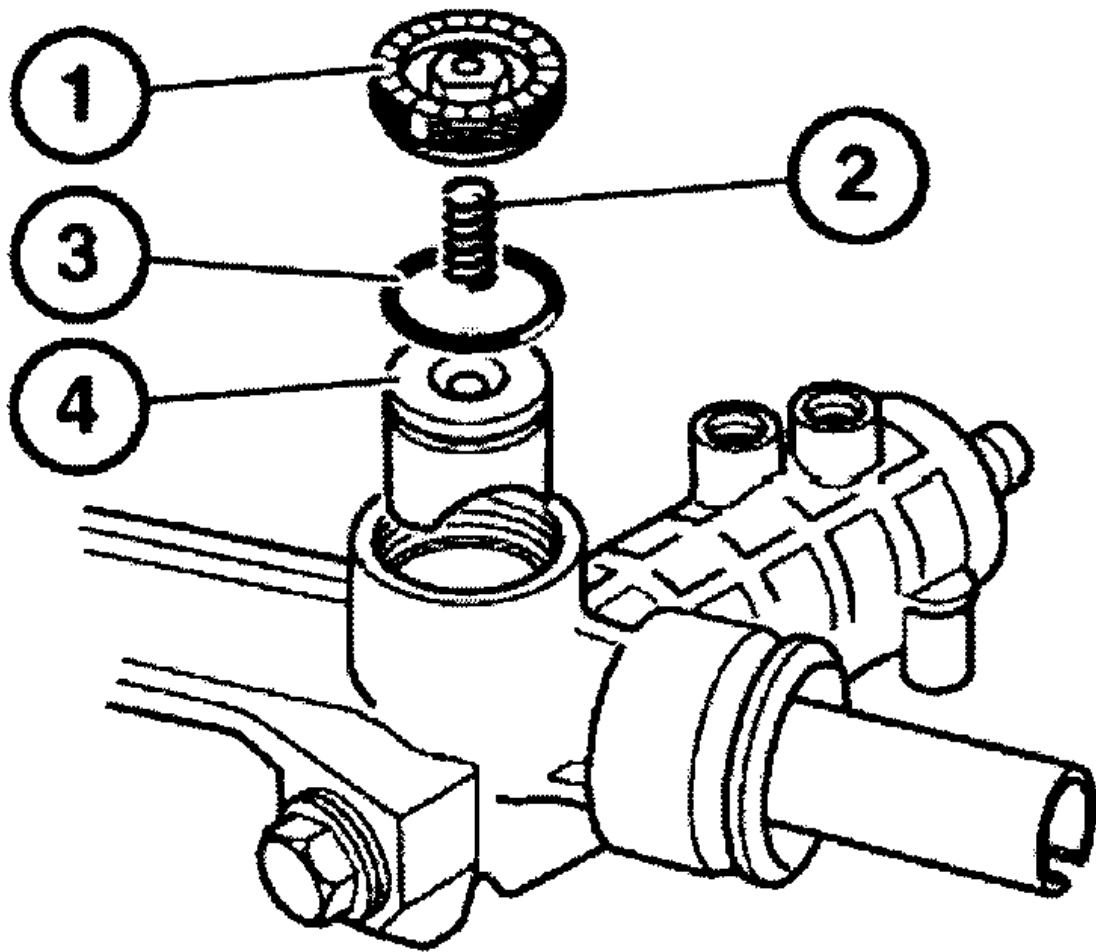
- for checking during installation. See [Fig. 31](#).
8. Remove protective cap (1) from steering spindle. Unfasten nut. Brace against square nut on steering spindle. See [Fig. 32](#).
 9. Remove circlip. Withdraw steering spindle from case. See [Fig. 33](#).
 10. Remove bearing bush (1). See [Fig. 34](#).
 11. Drive radial shaft seal (2) and bearing (3) out of bearing bush (1) with special tool (32 1 140/250). See [Fig. 35](#).
 12. Remove connection for leakage oil line. See [Fig. 36](#).
 13. Insert retaining ring through bore in leakage oil line and remove from case. See [Fig. 37](#).
 14. Pull rack and bearing bush (1) out of pipe. See [Fig. 38](#).
 15. Drive radial shaft out of bearing bush (1) with special tool (32 1 140) and (33 3 331). See [Fig. 39](#).
 16. Drive radial shaft seal out of pipe with special tool (32 1 140/210). See [Fig. 40](#).
 17. Carefully drive bearing out of steering spindle housing with a punch. This improves access to radial shaft seal. See [Fig. 41](#).
 18. Carefully drive radial shaft seal (1) out of steering spindle housing with a punch. Do not damage polished cylinder bore. See [Fig. 42](#).
 19. Thoroughly clean all parts. Coat new seals with hydraulic fluid and fill radial shaft seals between edge and sealing lip with grease.



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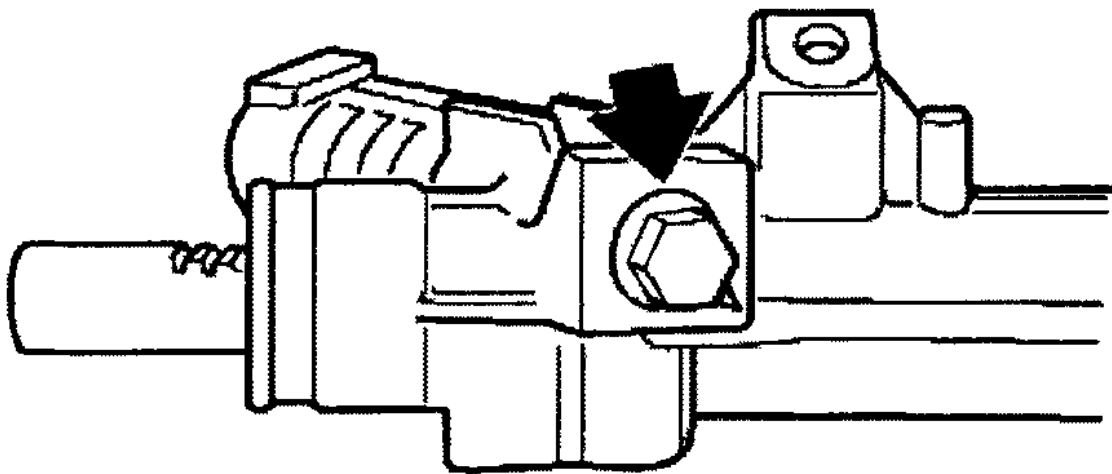
[Fig. 28: Locating Lines & O-Rings](#)

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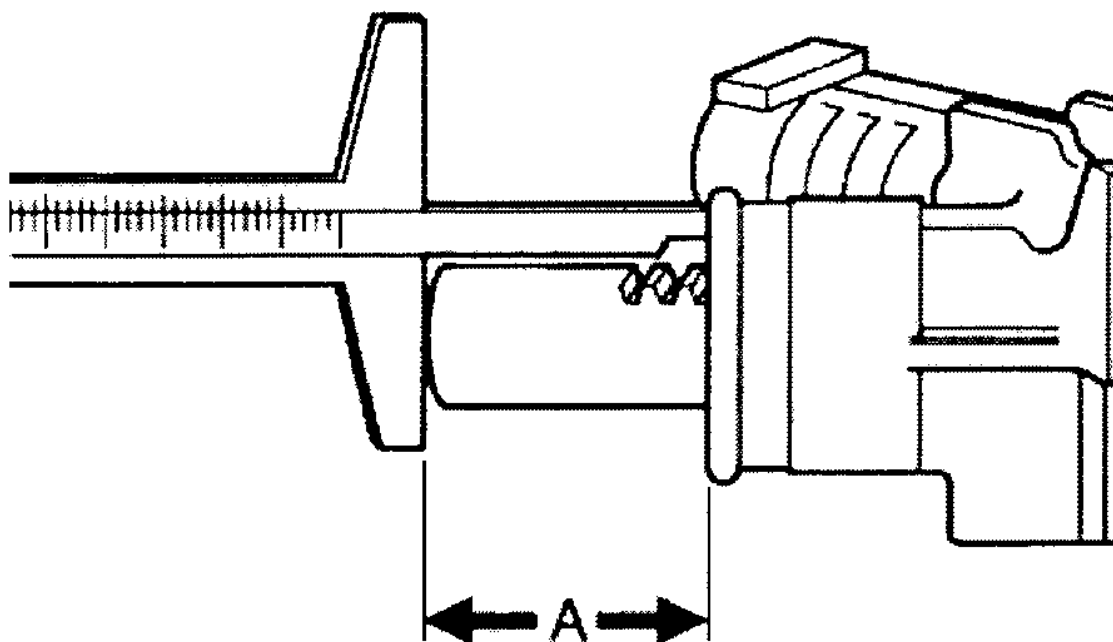
Fig. 29: Removing Spring, O-Ring & Pressure Piece
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[Fig. 30: Removing Screw Cap](#)

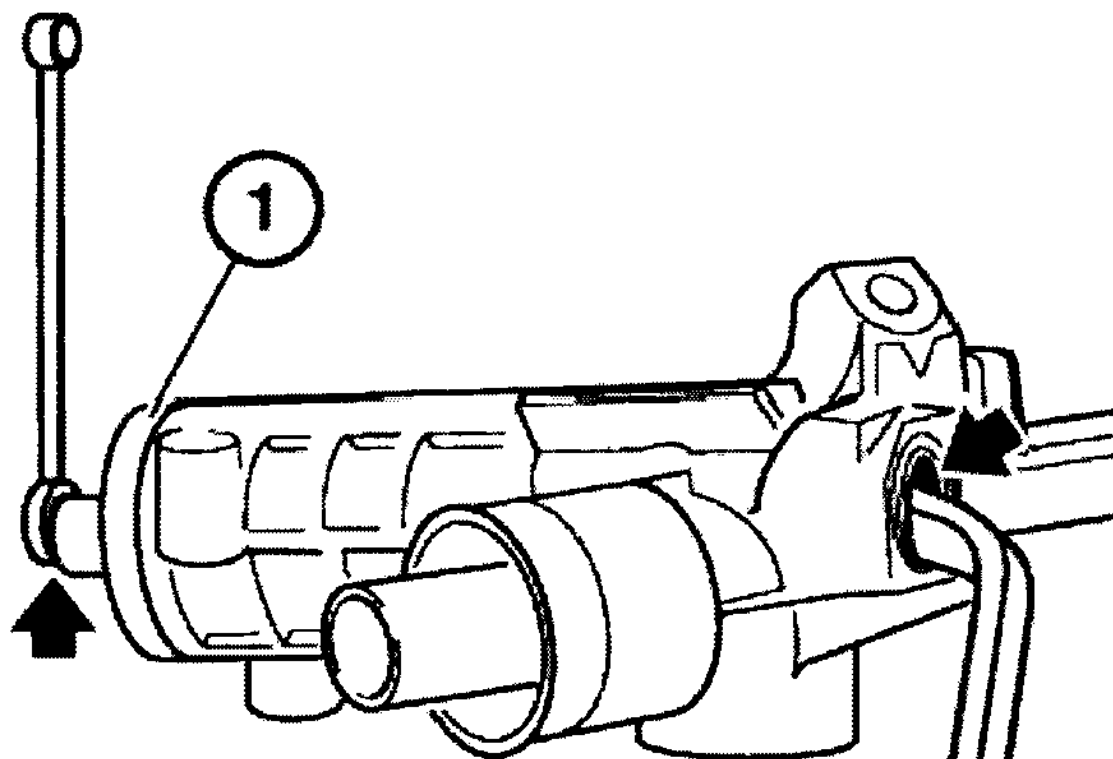
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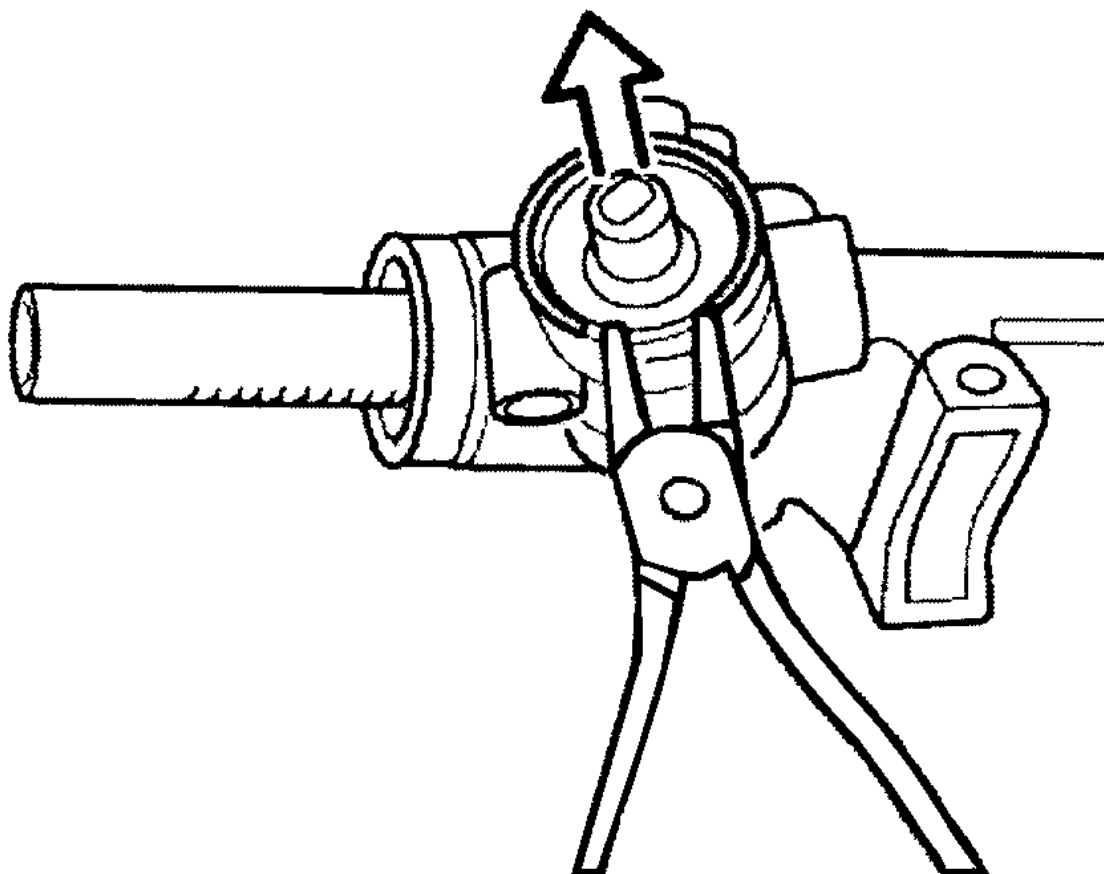
[Fig. 31: Measuring Rack](#)

Courtesy of BMW OF NORTH AMERICA, INC.



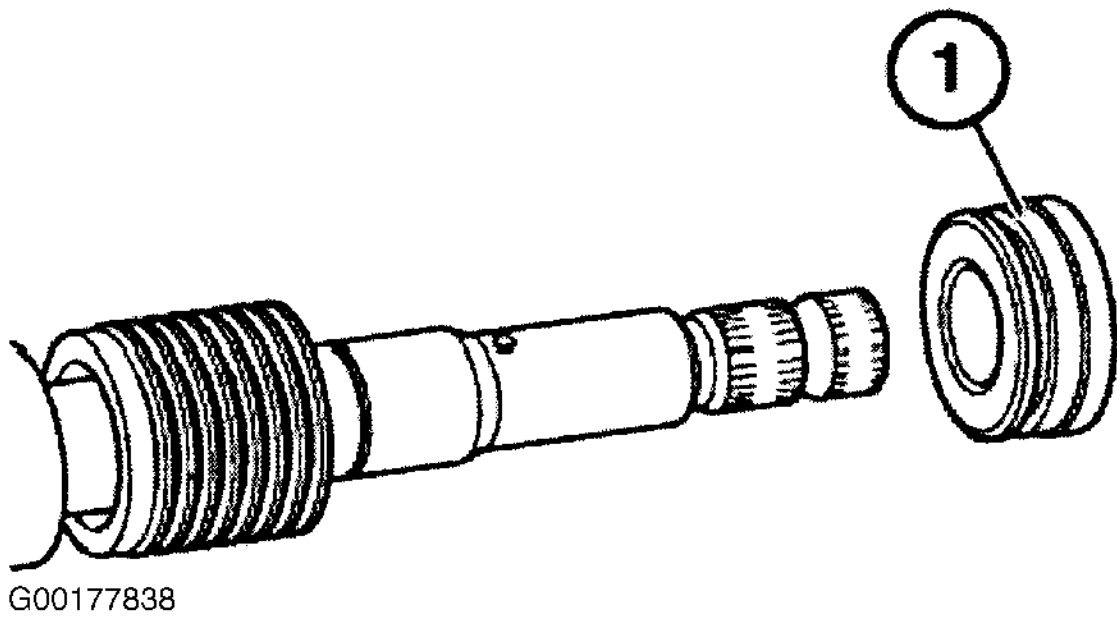
G00177836

[Fig. 32: Removing Protective Cap From Steering Spindle](#)
Courtesy of BMW OF NORTH AMERICA, INC.

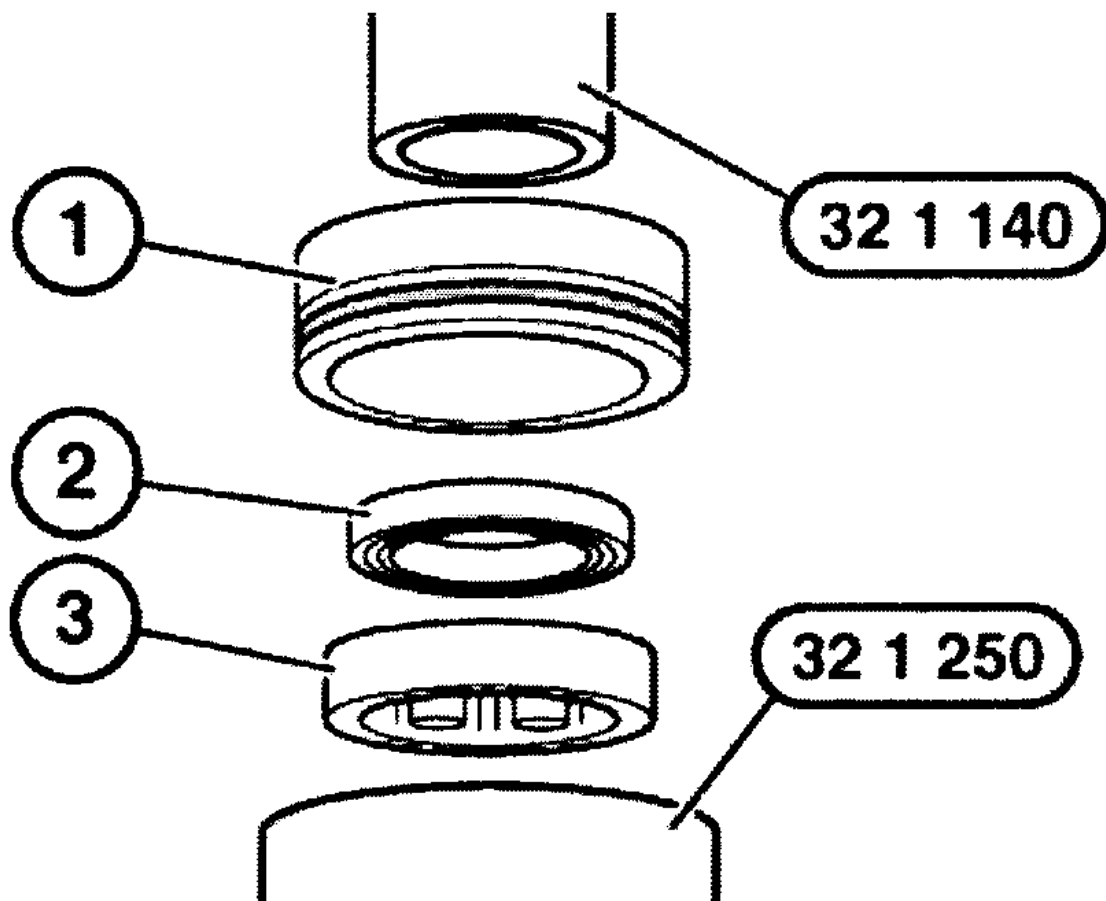


G00177837

[Fig. 33: Removing Circlip](#)
Courtesy of BMW OF NORTH AMERICA, INC.

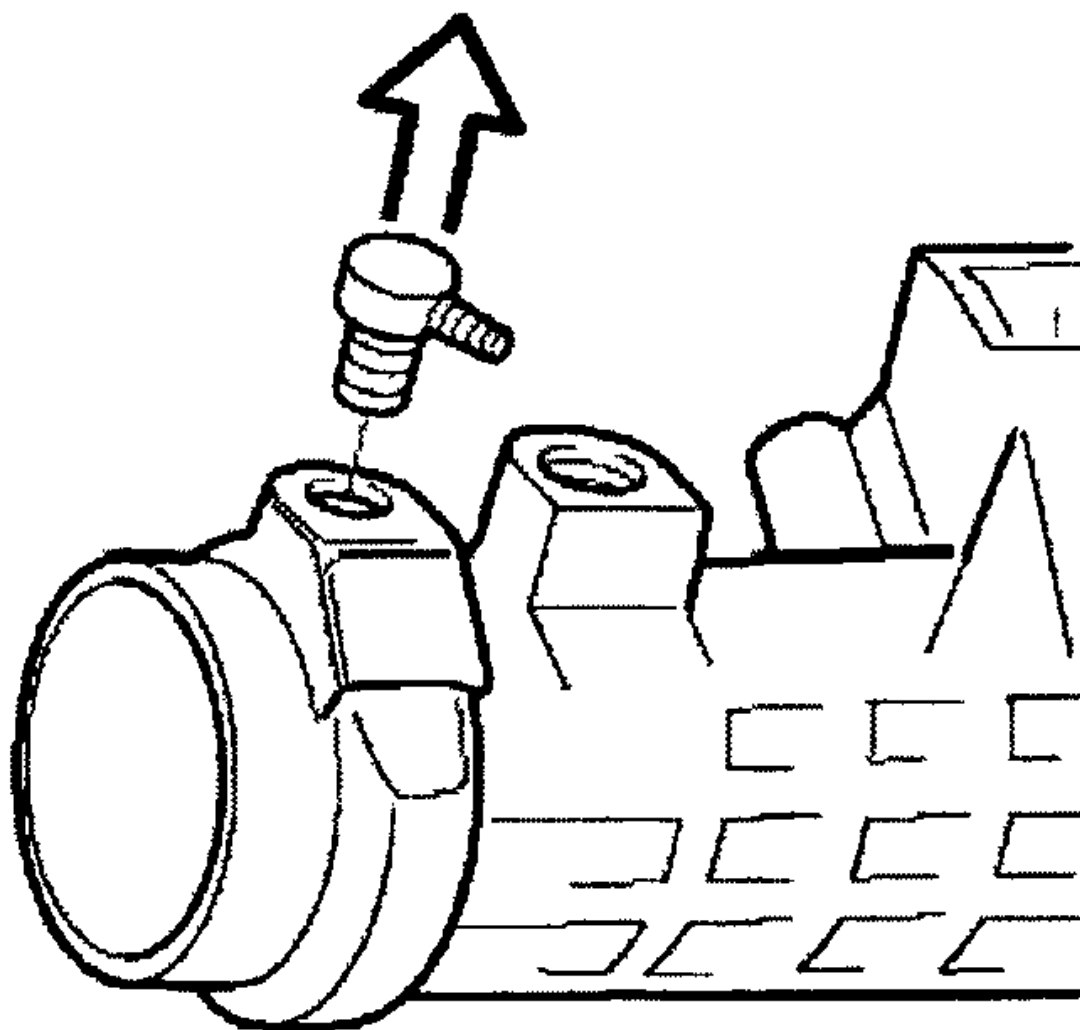


[Fig. 34: Removing Bearing Bush](#)
 Courtesy of BMW OF NORTH AMERICA, INC.



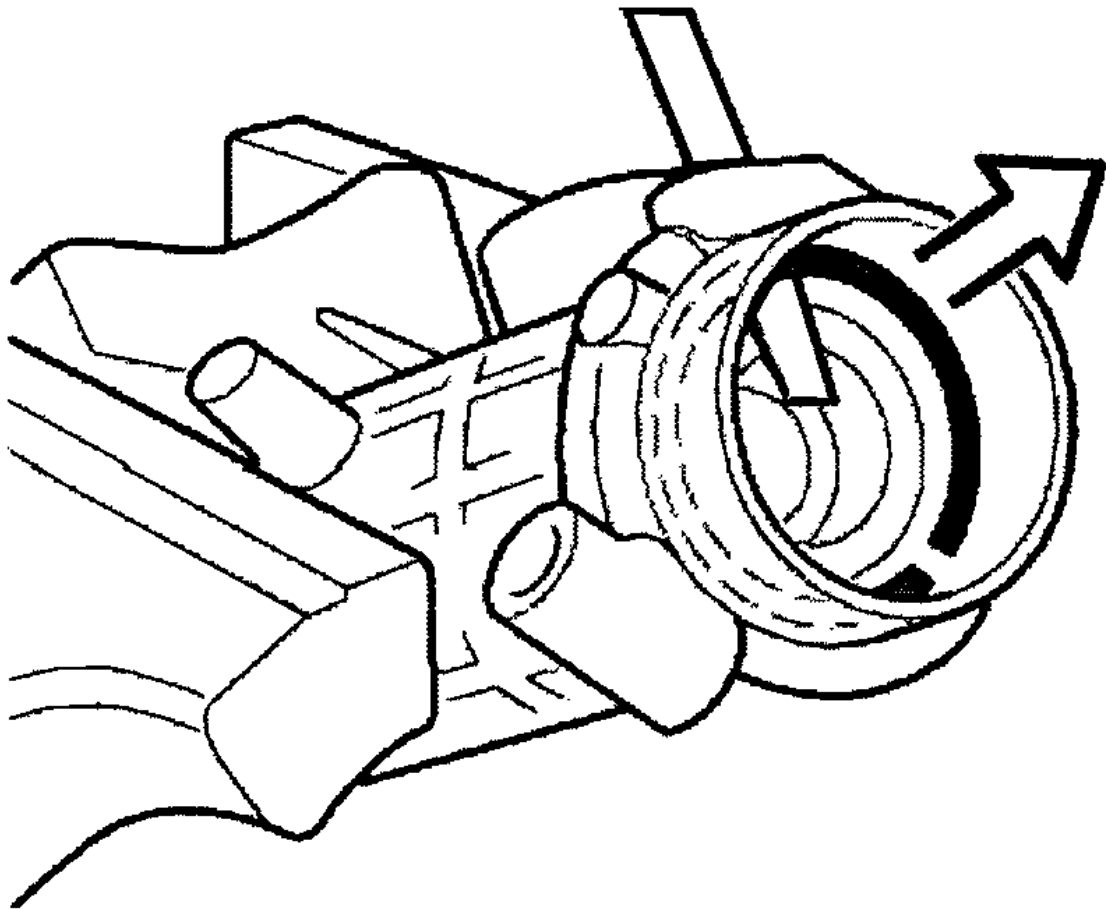
G00177839

Fig. 35: Driving Out Radial Shaft Seal & Bearing
Courtesy of BMW OF NORTH AMERICA, INC.



G00177840

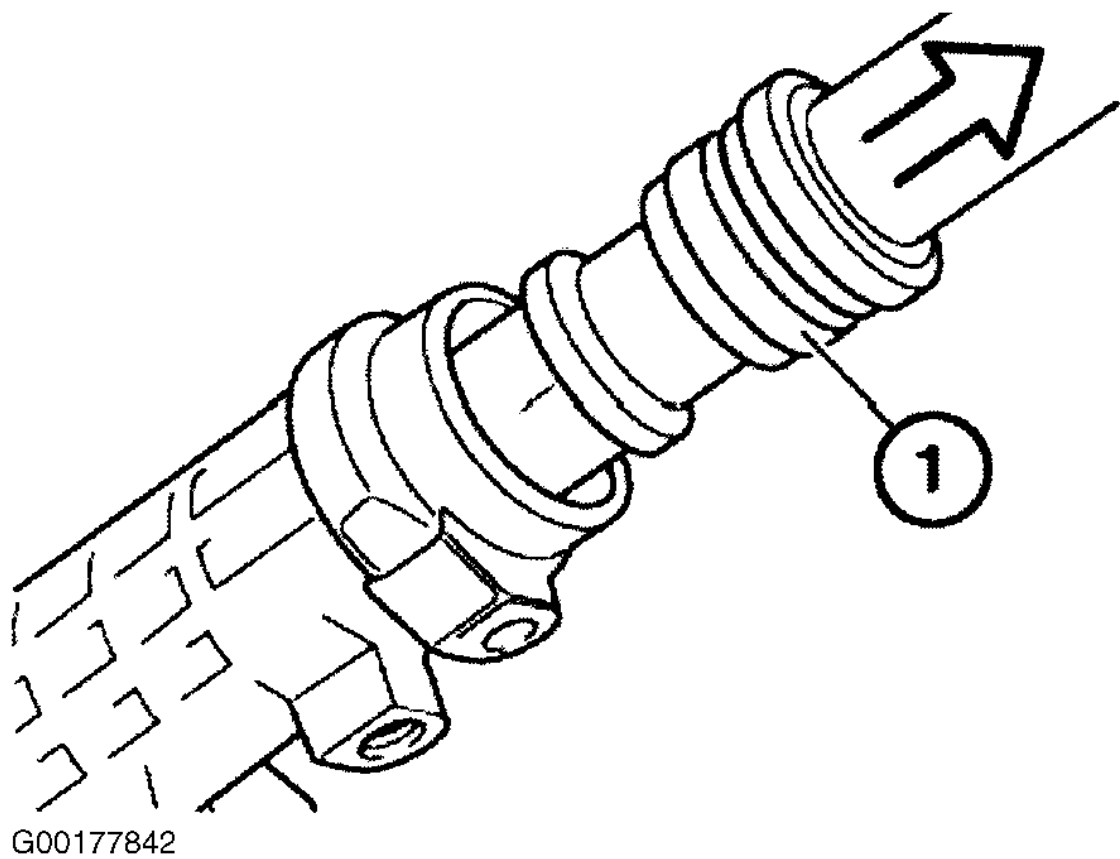
Fig. 36: Removing Connection For Leakage Oil Line
Courtesy of BMW OF NORTH AMERICA, INC.



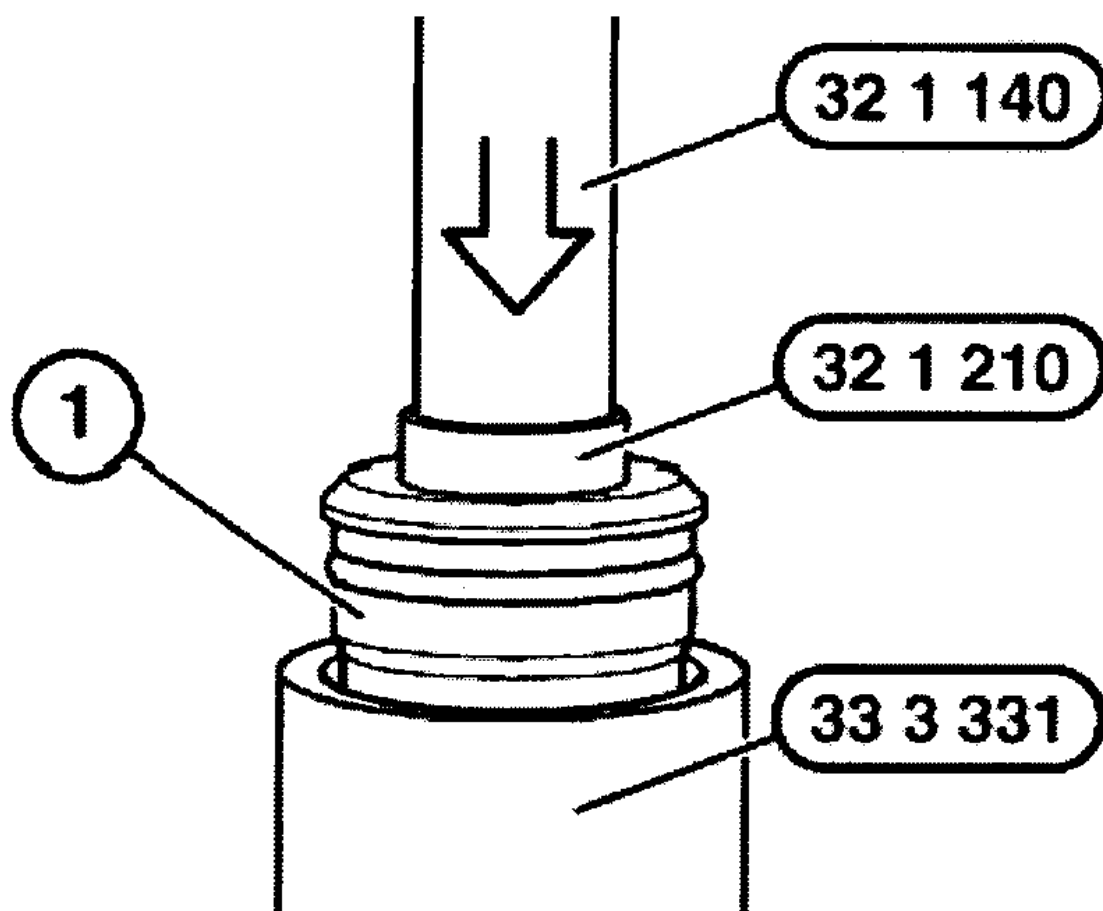
G00177841

[Fig. 37: Inserting Retaining Ring](#)

Courtesy of BMW OF NORTH AMERICA, INC.



[Fig. 38: Pulling Out Rack & Bearing Bush](#)
Courtesy of BMW OF NORTH AMERICA, INC.



G00177843

[Fig. 39: Driving Radial Shaft Seal Out Of Bush](#)
 Courtesy of BMW OF NORTH AMERICA, INC.

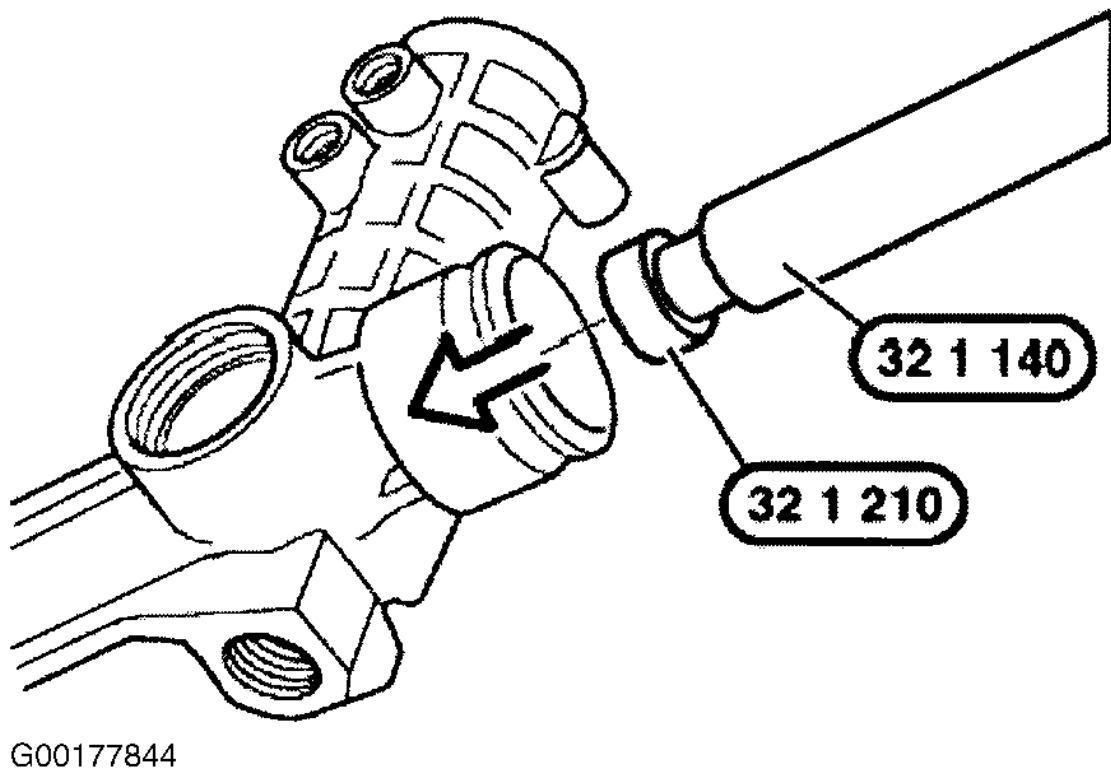


Fig. 40: Driving Radial Shaft Seal Out Of Pipe
 Courtesy of BMW OF NORTH AMERICA, INC.

Fig. 41: Driving Bearing Out Of Steering Spindle Housing
 Courtesy of BMW OF NORTH AMERICA, INC.

Fig. 42: Driving Radial Shaft Seal Out Of Steering Spindle
 Courtesy of BMW OF NORTH AMERICA, INC.

Assembly

1. Replace O-ring (1). Insert plastic bush (2) and thrust shim (3) in bearing sleeve. Insert radial shaft seal (4). See [Fig. 43](#).
2. Drive new radial shaft seal (4) firmly home in bearing bush. The open side should be facing special tool (32 1 140/220). See [Fig. 44](#).
3. Insert plastic bush (1) and thrust shim (2) in pipe. Drive new radial shaft seal (3) firmly home in pipe. The open side should be facing special tool (32 1 140/220). See [Fig. 45](#).
4. Grease bearings (refer to [OPERATING FLUIDS](#)) and drive firmly home in steering spindle housing with special tool (32 1 140/120). See [Fig. 46](#).
5. Drive new radial shaft seal firmly home in steering spindle housing. The open side should be facing special tool (32 1 140/230). See [Fig. 47](#).
6. Replace O-ring (1) and piston ring (2). See [Fig. 48](#).
7. Carefully insert rack in pipe to avoid damage to the internal radial shaft seal by the spline and the piston race (2). Fit bearing bush to rack and slide into pipe. See [Fig. 49](#).
8. Fit circlip with open side opposite to leakage oil bore. See [Fig. 50](#).
9. Replace piston rings (1) and O-rings (2) beneath them. See [Fig. 51](#).
10. Insert new radial shaft seal (3), open side upwards, in bearing bush (1) and drive firmly home with

- special tool (32 1 140/240/250. Replace O-ring (2). See [Fig. 52](#).
11. Drive bearing (2) firmly home, lettering upwards, into bearing bush (1) with special tool (32 1 140/240/250). See [Fig. 53](#).
 12. Slide bearing bush (1), radial shaft seal outermost, onto the steering spindle. See [Fig. 34](#).
 13. Grease rack and pinion (refer to [OPERATING FLUIDS](#)). Pull out rack to recorded dimension (A). Carefully insert steering spindle into case and install retaining ring. Check that marks are aligned. See [Fig. 54](#).
 14. Push on protective cap in this position, whereby marking of housing, steering spindle and protective cap must align. See [Fig. 55](#).
 15. Replace self-locking nut. See [Fig. 32](#). Tighten to specification. See [TORQUE SPECIFICATIONS](#).
 16. Install screw cap. See [Fig. 30](#). Tighten to specification. See [TORQUE SPECIFICATIONS](#). Secure by peening.
 17. Insert foil insert (1) and replace O-ring (2). See [Fig. 56](#).

CAUTION: The rack must be able to move freely over the entire range of travel.

18. Grease and install pressure piece (4), spring (2) and O-ring (3). Tighten adjusting screw (1) down to determine screw-in depth and align all the marks. Secure adjusting screw by peening. See [Fig. 29](#).

Grease: refer to [OPERATING FLUIDS](#) .

19. Fit connections for leakage oil line. Fit leakage oil line and attach pressure lines with new O-rings. See [Fig. 57](#). Tighten to specification. See [TORQUE SPECIFICATIONS](#).
20. Install tie rods. See appropriate FRONT article in SUSPENSION.
21. Install power steering gear. See [POWER STEERING GEAR](#) under REMOVAL & INSTALLATION.

[Fig. 43: Installing Components In Bearing Sleeve](#)
Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 44: Driving In Radial Shaft Seal](#)
Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 45: Inserting Plastic Bush In Pipe](#)
Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 46: Installing Bearings](#)
Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 47: Installing Radial Shaft Seal In Steering Spindle Housing](#)
Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 48: Replacing O-Ring & Piston Ring](#)
Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 49: Inserting Rack In Pipe](#)
Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 50: Fitting Circlip](#)
Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 51: Replacing Piston Rings & O-Rings](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 52: Inserting Radial Shaft Seal In Bearing Bush](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 53: Driving Bearing Into Bearing Bush](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 54: Inserting Spindle Into Case](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 55: Installing Protective Cap](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 56: Inserting Foil Insert & O-Ring](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 57: Installing Leakage Oil Lines & Pressure Lines](#)

Courtesy of BMW OF NORTH AMERICA, INC.

VANE PUMP (LUK/VICKERS)

CAUTION: Absolute cleanliness is essential when working on power steering pump.

Disassembly

1. Remove pump. On M52 and M54 engines see [POWER STEERING VANE PUMP \(M52/M54 ENGINE\)](#) under REMOVAL & INSTALLATION. On other engines, procedure is not available from manufacturer.
2. Clamp pump in vise with pulley flange. Mark components relative to one another. See [Fig. 58](#).
3. Unfasten screws. Remove case half (3) with spring (6) and valve spool (7). See [Fig. 59](#).
4. Remove pressure plate (8) with rotor ring (9) and cylinder pins (10). See [Fig. 60](#).
5. Unclip retaining ring (11). Remove vane blades (12) and O-ring (13). See [Fig. 61](#).
6. Remove rotor (14) and pressure plate (15). See [Fig. 62](#).
7. Remove front case section from the shaft. Pry out radial shaft seal (16). See [Fig. 63](#).
8. Thoroughly clean all parts.

[Fig. 58: Identifying LuK/Vickers Pump Components](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 59: Removing Case Half](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 60: Removing Pressure Plate](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 61: Removing Vane Blades](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 62: Removing Rotor](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 63: Prying Out Radial Shaft Seal](#)

Courtesy of BMW OF NORTH AMERICA, INC.

Assembly

1. Coat new O-rings with hydraulic fluid prior to installation.
2. Fill new radial shaft between dust and sealing lip with grease. Drive radial shaft seal (16) firmly home in case section (open side facing inwards) with special tool (32 1 140/240). See [Fig. 64](#).
3. Fit bracket (5) and case section (4) on shaft. Clamp pulley flange in vise. See [Fig. 65](#).
4. Install new O-rings (13 & 17). See [Fig. 66](#).
5. Install pressure plate (15) with groove facing upwards and cylindrical pins (10). See [Fig. 67](#).
6. Fit rotor (14) to shaft and install new retaining ring (11). Install all blades (12) with rounded side facing outwards. Check that impeller moves easily. See [Fig. 68](#).
7. Fit rotor ring (9) and pressure plate (8) to cylindrical pins (10). See [Fig. 69](#).
8. Install new O-rings (18). See [Fig. 70](#).
9. Fit valve piston (7) and spring (6) and join together the case sections. Note installation location of bore (B). See [Fig. 71](#).
10. Fit washers (S). See [Fig. 72](#). Tighten screws to specification. See [TORQUE SPECIFICATIONS](#).
11. Install vane pump. On M52 and M54 engines see [POWER STEERING VANE PUMP \(M52/M54 ENGINE\)](#) under REMOVAL & INSTALLATION. On other engines, procedure is not available from manufacturer.

[Fig. 64: Driving In Radial Shaft Seal](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 65: Clamping Pulley Flange In Vise](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 66: Installing O-Rings](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 67: Installing Pressure Plate](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 68: Fitting Rotor To Shaft](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 69: Fitting Rotor Ring](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 70: Installing New O-Rings](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 71: Fitting Valve Piston](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 72: Fitting Washers](#)

Courtesy of BMW OF NORTH AMERICA, INC.

VANE PUMP (ZF)

CAUTION: Absolute cleanliness is essential when working on power steering pump.

Disassembly

1. Remove pump. On M52 and M54 engines see [POWER STEERING VANE PUMP \(M52/M54 ENGINE\)](#) under REMOVAL & INSTALLATION. On other engines, procedure is not available from manufacturer.
2. Remove pulley.
3. Mark bracket on pump housing. Unscrew bolts and take off body. See [Fig. 73](#).
4. Remove face plate (3). See [Fig. 74](#).
5. Press rotor (4) on shaft (5) in downward direction. Remove circlip (6) and pull shaft out of body. Remove rotor (4). See [Fig. 75](#).
6. Clean all parts thoroughly.

[Fig. 73: Taking Off Pump Body](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 74: Removing Face Plate](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 75: Removing Rotor](#)

Courtesy of BMW OF NORTH AMERICA, INC.

Assembly

1. Coat new O-rings with hydraulic fluid prior to installation.
2. Replace radial sealing ring (7), install with sealing lip facing inwards and fill space between sealing and dust lips with grease. See [Fig. 76](#).
3. Guide shaft (5) into body. Insert rotor (4) with recess for circlip facing upwards and install circlip (6) in radial groove of shaft. See [Fig. 77](#).
4. Install impeller with polished, rounded off outside surfaces facing cam ring. Check that impeller moves easily. See [Fig. 78](#).
5. Place sealing ring (8), wide side facing downwards, and guide (9) in face plate (3). See [Fig. 79](#).
6. Position face plate (3) on dowel pins. Replace O-ring (10). See [Fig. 80](#).
7. Mount body, watching position of bores, and bolt on holder. See [Fig. 81](#). Tighten to specification. See [TORQUE SPECIFICATIONS](#).
8. Install vane pump. On M52 and M54 engines see [POWER STEERING VANE PUMP \(M52/M54 ENGINE\)](#) under REMOVAL & INSTALLATION. On other engines, procedure is not available from manufacturer.

[Fig. 76: Locating Radial Sealing Ring](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 77: Installing Shaft & Rotor](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 78: Installing Impeller](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 79: Placing Sealing Ring](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 80: Positioning Face Plate](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 81: Mounting Body On Holder](#)

Courtesy of BMW OF NORTH AMERICA, INC.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Hydraulic Line Connections To Vane Pump & Steering Gear	
10 mm	9 (12)
14 mm	26 (35)
16 mm	30 (40)
18 mm	33 (45)
Cap Screw	27 (36)
Protective Cap Nut	13 (17)
Screw Cap	24 (32)
Steering Gear To Front Axle Carrier	31 (42)
Tie Rod/Axial Joint To Rack	52 (71)
Tie Rod Clamping Nut	33 (45)
Tie Rod End Nut	24-29 (33-40)
LuK/Vickers Vane Pump Screws	22 (30)
ZF Vane Pump Screws	12-14 (16-19)
	Inch Lbs. (N.m)
Leakage Oil Line & Pressure Lines	71 (8)

SPECIAL TOOLS

[Fig. 82: Identifying Drift \(32 1 120\)](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 83: Identifying Drift \(32 1 210\)](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 84: Identifying Drift \(32 1 220\)](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 85: Identifying Drift \(32 1 230\)](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 86: Identifying Drift \(32 1 240\)](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 87: Identifying Fixture \(32 4 000\)](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 88: Identifying Handle \(32 1 140\)](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 89: Identifying Holder \(32 1 250\)](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 90: Identifying Open Ended Wrench WAF 32 \(32 2 110\)](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 91: Identifying Precision Spring Balance \(64 1 100\)](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 92: Identifying Removal Tool \(32 2 070\)](#)

Courtesy of BMW OF NORTH AMERICA, INC.

[Fig. 93: Identifying Set Of Tools \(33 3 330\)](#)

Courtesy of BMW OF NORTH AMERICA, INC.

Article GUID: A00152291

OPERATING FLUIDS

Operating Fluids - Steering - All Models

ZF GEMMER STEERING

The ZF Gemmer steering is permanently filled with oil. There is no drain plug.

ZF RACK AND PINION STEERING

NOTE: The hydraulic fluid reservoirs are marked on the rim of the reservoir and/or the reservoir cap to show which type of oil can be used: ATF oil or Pentosin CHF oil.

The ZF rack-and-pinion steering has lifetime lubrication and is thus maintenance-free.

For topping up/filling hydraulic system:

POWER STEERING OIL

Trade name	BMW part number	Container size	Oil color
BMW automatic transmission fluid (ATF)	81 22 9 400 272	1-liter	Red
Pentosin CHF 11S	83 29 0 429 576	1-liter	Green

NOTE: Vehicles with AFS/ARS (Dynamic Drive / Active Steering / Active Roll Stabilization) are filled as standard with Pentosin CHF 11S.

In case of repair, the affected steering components must be lubricated with the following grease:

COMPONENT GREASE

Trade name	BMW part number	Container size
Calypsol SF-3-131-TMM 3	83 23 9 407 857	100 g tube

NOTE: Calypsol D 4024-OK is a sodium-saponified, cold-resistant grease whose lubricity ranges from -30 Å°C to +75 Å°C.

BALL AND NUT OR RACK AND PINION POWER STEERING

Only reputable brand Automatic Transmission Fluid (ATF) of Dexron® III formulation may be used for the power steering and power steering pump.

In case of brief hydraulic noise after starting at low outside temperatures, we recommend replacing the red ATF with green CHF or LHM oil (see below).

ZF BALL AND NUT POWER STEERING WITH H31 SYSTEM

The approved oils for BMW models with power steering and the H31 brake booster system are identical with those oils approved for power steering without the H31 system except for the following:

E32 models with self-leveling rear suspension and mutual oil supply tank in the engine compartment (see [INTEGRATED SUSPENSION SYSTEMS](#)).

Countries with very low outside temperatures (e.g. Canada) had their power steering systems filled at the factory with Pentosin CHF 7.1 since 9/87 through 9/91. This is also to be used on vehicles built before 9/87.

Since 9/91, vehicles now use Pentosin CHF 11S instead of CHF 7.1.

STEERING FLUID SPECIFICATION

Pentosin CHF 7.1	BMW Part No. 81 22 1 468 879
Pentosin CHF 11S	BMW Part No. 83 29 0 429 576

These cars are marked with a pertinent label located close to the oil tank.

LHM oils (green color) of the following manufacturers may also be used instead of Pentosin (CHF 7.1):

Shell LHM

Castrol LHM

Exxon LHM

The mixing of CHF, LHM oils and ATF is not permitted.

Pentosin CHF 4548 was used on vehicles built before 9/87 but is no longer available. However, mixing of Pentosin CHF 7.1 with residual quantities of Pentosin CHF 4548 are permitted in these earlier vehicles. Mixing of these two oils is not permitted for E32 / E38 vehicles.

The hydraulic system for power steering and power-assisted brakes must be drained as completely as possible when changing from one type of oil to the other.

All oil supply reservoirs are marked with the type of oil being used - ATF or CHF.

HORN SLIP RINGS

Approved grease is a copper paste (former BMW Part No. 81 22 9 400 794).

GREASE SPECIFICATION

3M	Part No. 8945
CRC	Part No. 3046 010

Article GUID: A00217934