1991-2002 SUSPENSION

Front - E36

IDENTIFICATION

WARNING: Vehicles are equipped with air bag supplemental restraint system. Before attempting any repairs involving steering column, instrument panel or related components, see SERVICE PRECAUTIONS and DISABLING & ACTIVATING AIR BAG SYSTEM in appropriate AIR BAG RESTRAINT SYSTEMS article.

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	
M3 (E36)	3.0L (S50)
318ti (E36)	1.8L (M42)
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)
1998-2002	
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)

DESCRIPTION

All models use MacPherson strut type front suspension systems, which consist of vertically mounted strut assemblies directly attached to steering knuckles. Steering knuckles are connected to the axle carriers through control arms. See Fig. 1 . A stabilizer bar is attached through links to the strut assembly and the control arm.

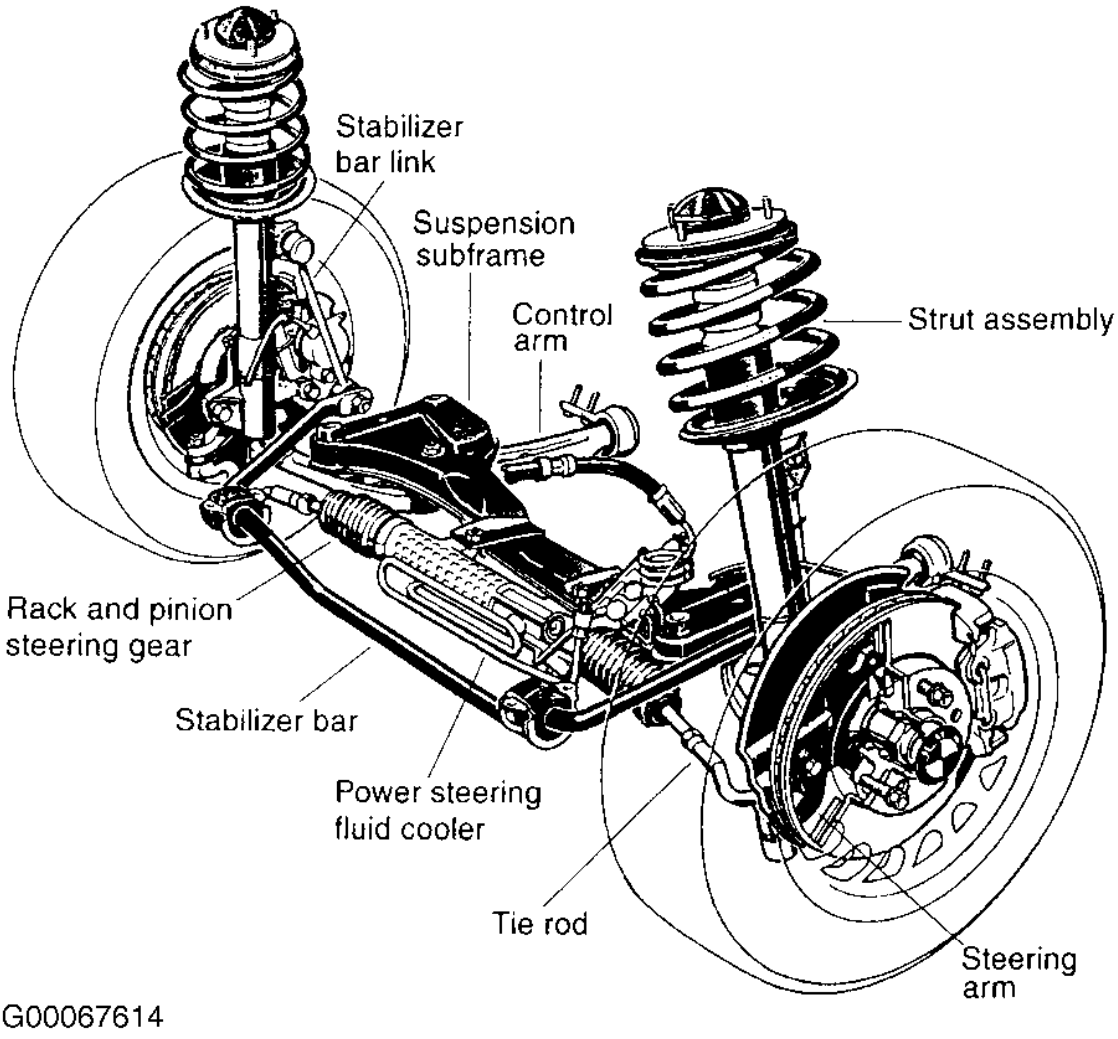


Fig. 1: Identifying Front Suspension Components
Courtesy of BMW OF NORTH AMERICA, INC.

ADJUSTMENTS

NOTE: Vehicle must be loaded with a full tank of gas, 150 lbs. (68 kg) in each seat, and 31 lbs. (14 kg) in the trunk, prior to measuring riding height. Ensure tires are properly inflated to manufacturers specification.

NOTE: It is not possible to correct vehicle ride level height by installing spring rings of different thicknesses.

RIDE HEIGHT (UP TO 9/93)

1. Measure actual ride-level height from wheel-house lower edge to rim flange at height of wheel center. Determine average value of each wheel after lifting and lowering vehicle body and then average value of axle from these values.
2. Ride height measurement must be within .04" (10 mm) on each side. For proper ride height, see RIDE HEIGHT SPECIFICATIONS (UP TO 9/93) .
3. Identify installed spring. Installed spring is identified by referring to parts microfiche, contacting BMW Parts Dept. or by removing spring and finding BMW number on end of spring. Springs are allocated by vehicle type and, where applicable, by special equipment such as air conditioning, sports suspension, etc.

and by date of production launch.

4. Find correction springs in table. For example: Vehicle is equipped with coil springs (BMW No. 1 139 266) and its ride level height is 8 mm too low due to amount of optional extra equipment. Nominal ride level height setting is obtained by installing spring (BMW No. 1 139 267). See CORRECTION SPRINGS .

RIDE HEIGHT SPECIFICATIONS (UP TO 9/93)

Application	In. (mm)
Standard Suspension	
15" Rim	22.6 (576)
16" Rim	23.1 (589)
17" Rim	23.8 (604)
Sports Suspension	
15" Rim	22 (561)
16" Rim	22.6 (574)
17" Rim	23.1 (589)
Rough Road Package	
15" Rim	23.5 (596)
16" Rim	24 (609)
17" Rim	24.5 (624)

CORRECTION SPRINGS

Application	Refer To
Standard Suspension Up To 6/92	
318	Fig. 2
325	Fig. 3
Sport Suspension Up To 6/92	
318	Fig. 4
325	Fig. 5
Standard Suspension From 6/92	Fig. 6
Sport Suspension From 6/92	Fig. 7

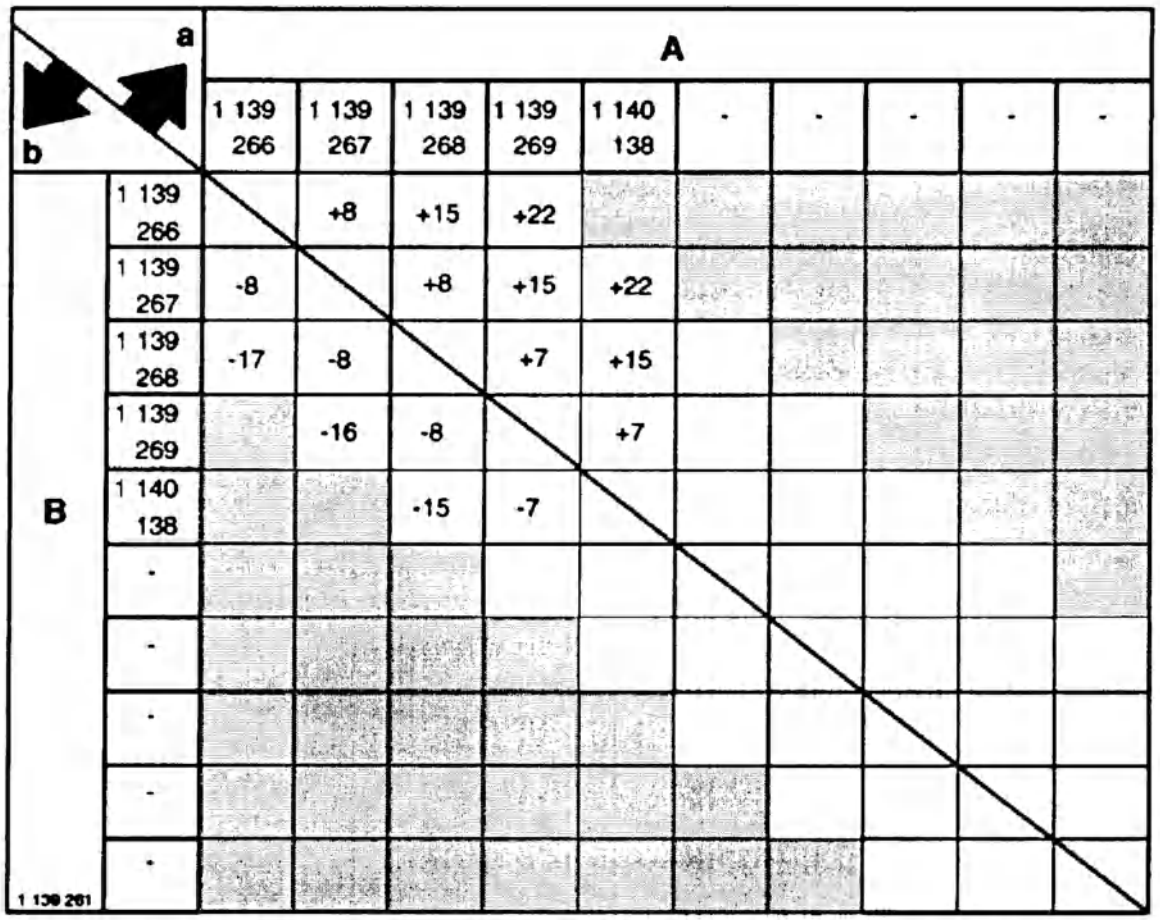


Fig. 2: Identifying Correction Spring For Standard Suspension (318 Up To 6/92)
Courtesy of BMW OF NORTH AMERICA, INC.

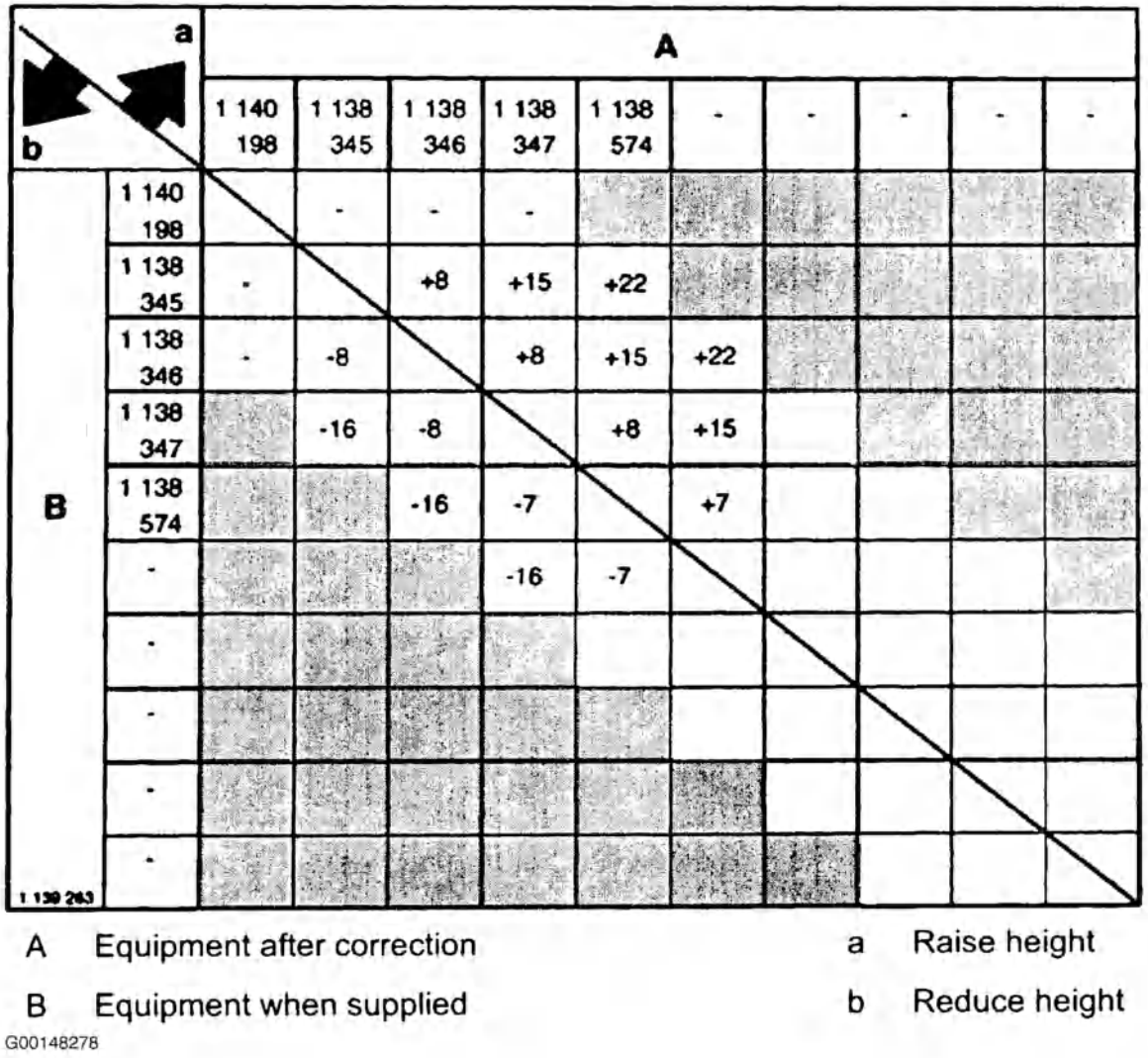


Fig. 3: Identifying Correction Spring For Standard Suspension (325 Up To 6/92)
Courtesy of BMW OF NORTH AMERICA, INC.

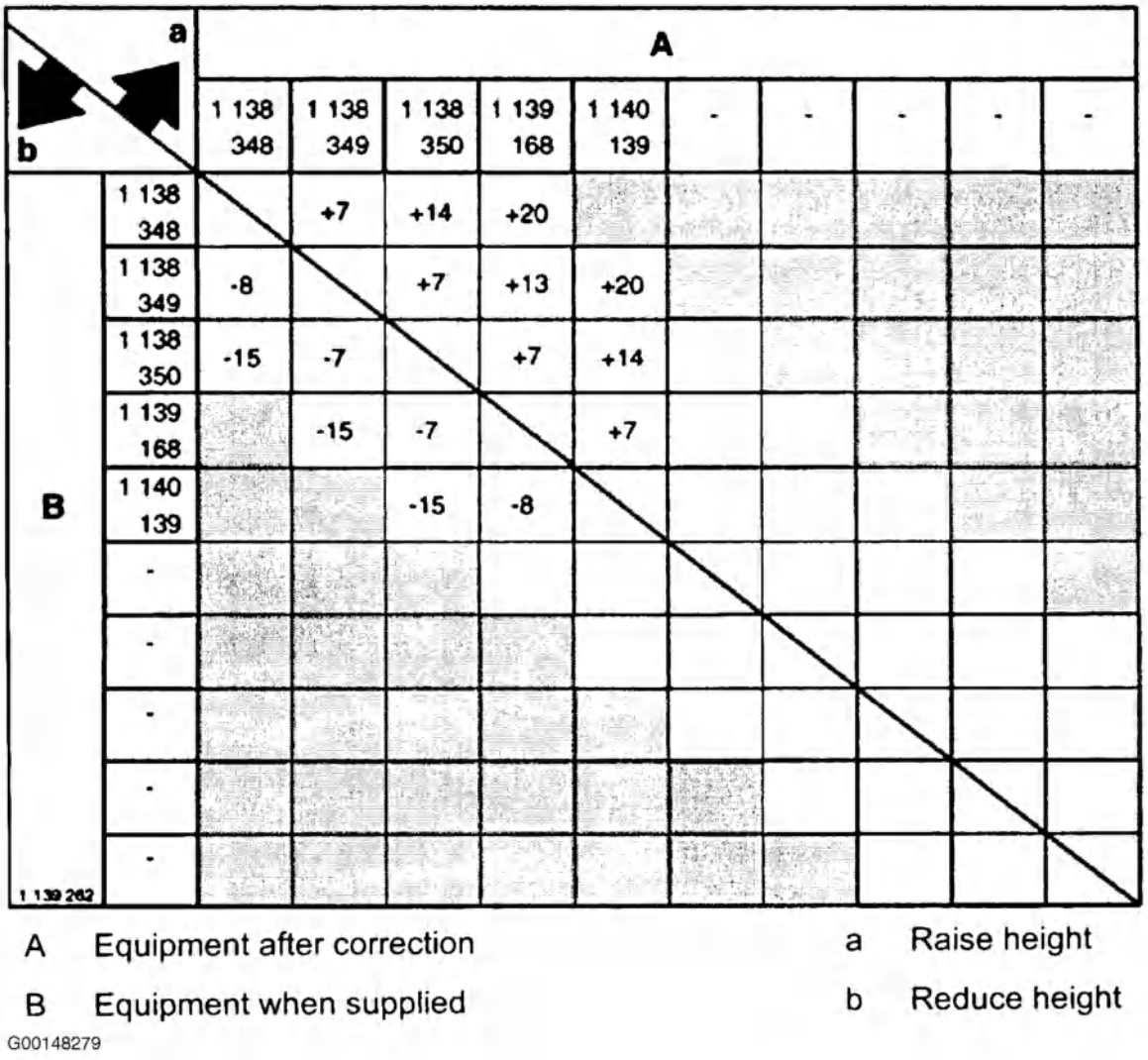


Fig. 4: Identifying Correction Spring For Sport Suspension (318 Up To 6/92)
Courtesy of BMW OF NORTH AMERICA, INC.

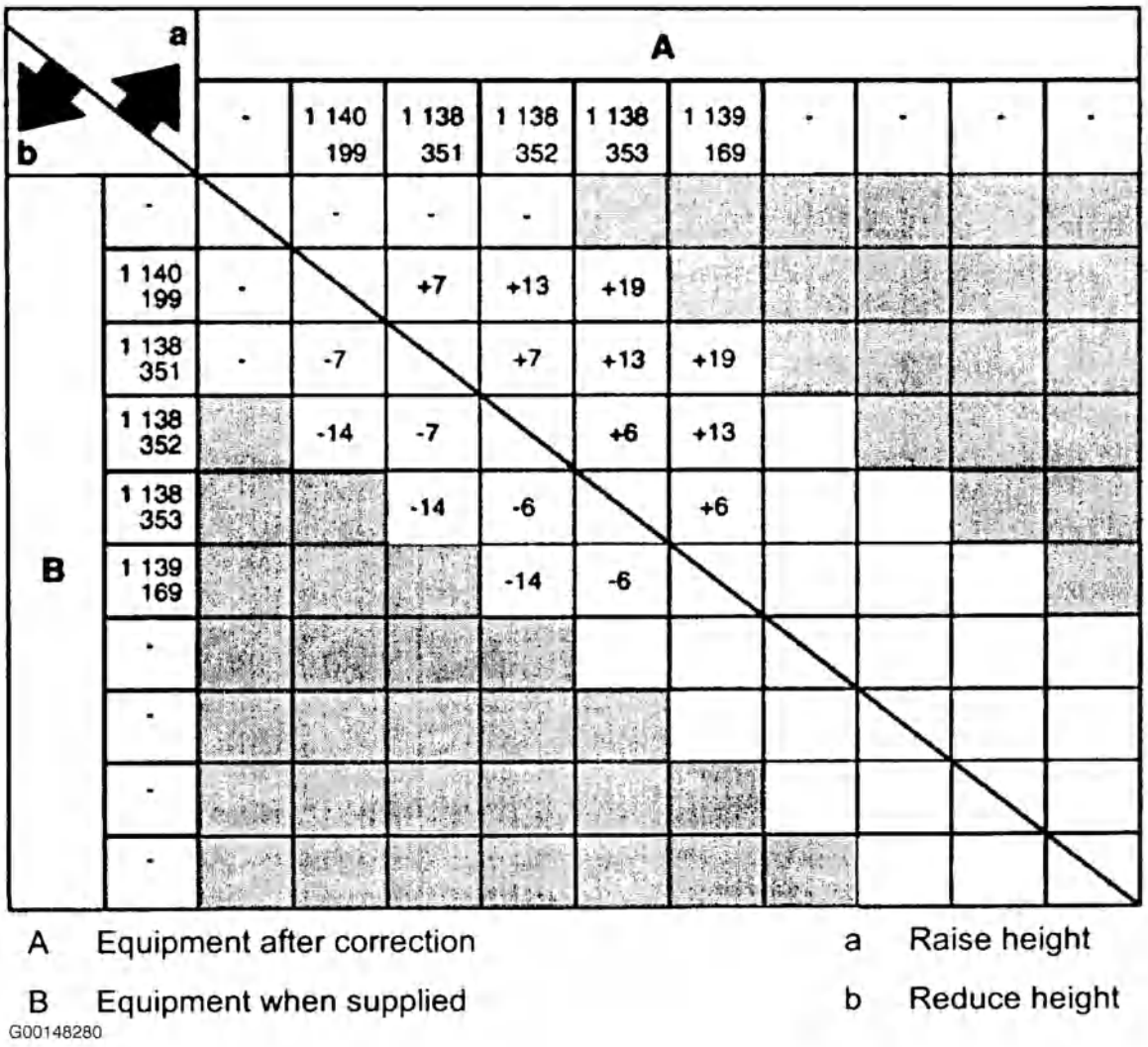


Fig. 5: Identifying Correction Spring For Sport Suspension (325 Up To 6/92)
Courtesy of BMW OF NORTH AMERICA, INC.

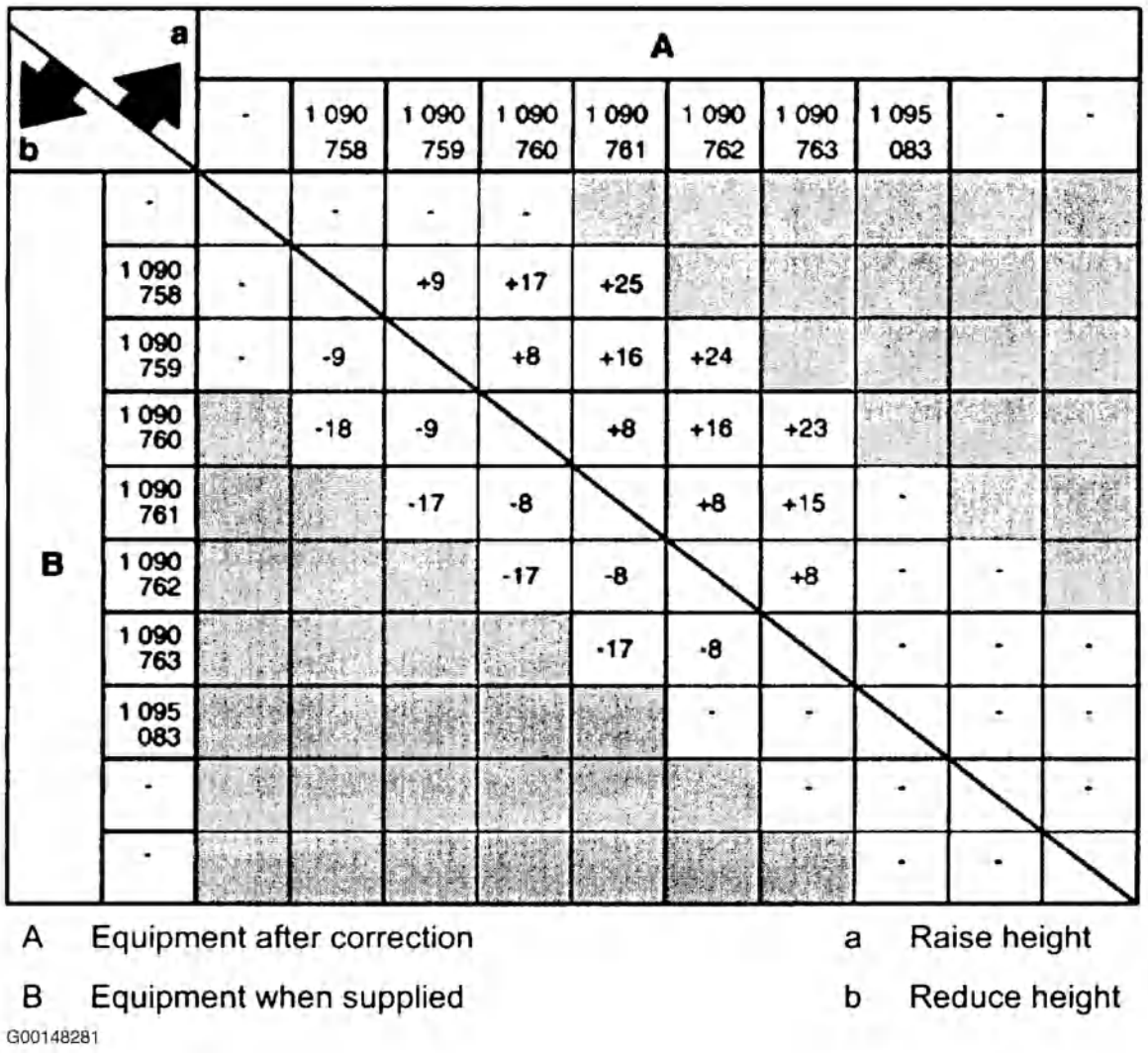


Fig. 6: Identifying Correction Spring For Standard Suspension (From 6/92)
Courtesy of BMW OF NORTH AMERICA, INC.

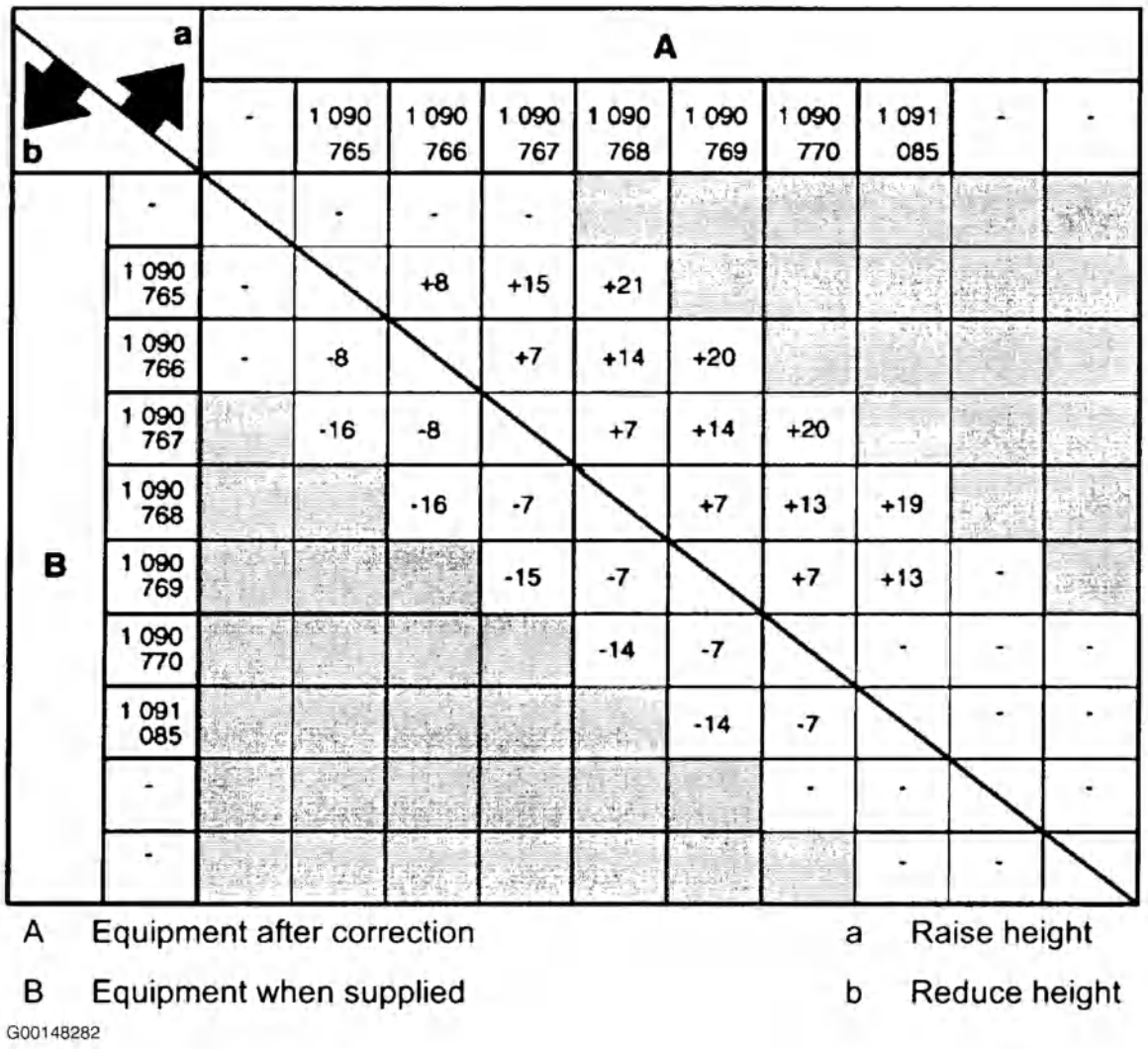


Fig. 7: Identifying Correction Spring For Sport Suspension (From 6/92)
Courtesy of BMW OF NORTH AMERICA, INC.

RIDE HEIGHT (FROM 9/93)

Except Z3

1. Measure actual ride-level height from wheel-house lower edge to rim flange at height of wheel center. Determine average value of each wheel after lifting and lowering vehicle body and then average value of axle from these values.
2. Ride height measurement must be within .04" (10 mm) of each side. For proper ride height, see RIDE HEIGHT SPECIFICATIONS (FROM 9/93 - EXCEPT Z3) .
3. Identify installed spring. Installed spring is identified by referring to parts microfiche, contacting BMW Parts Dept. or by removing spring and finding BMW number on end of spring. Springs are allocated by vehicle type and, where applicable, by special equipment such as air conditioning, sports suspension, etc. and by date of production launch.
4. Replace both springs, even though only one may be defective, to bring ride height back to specification.

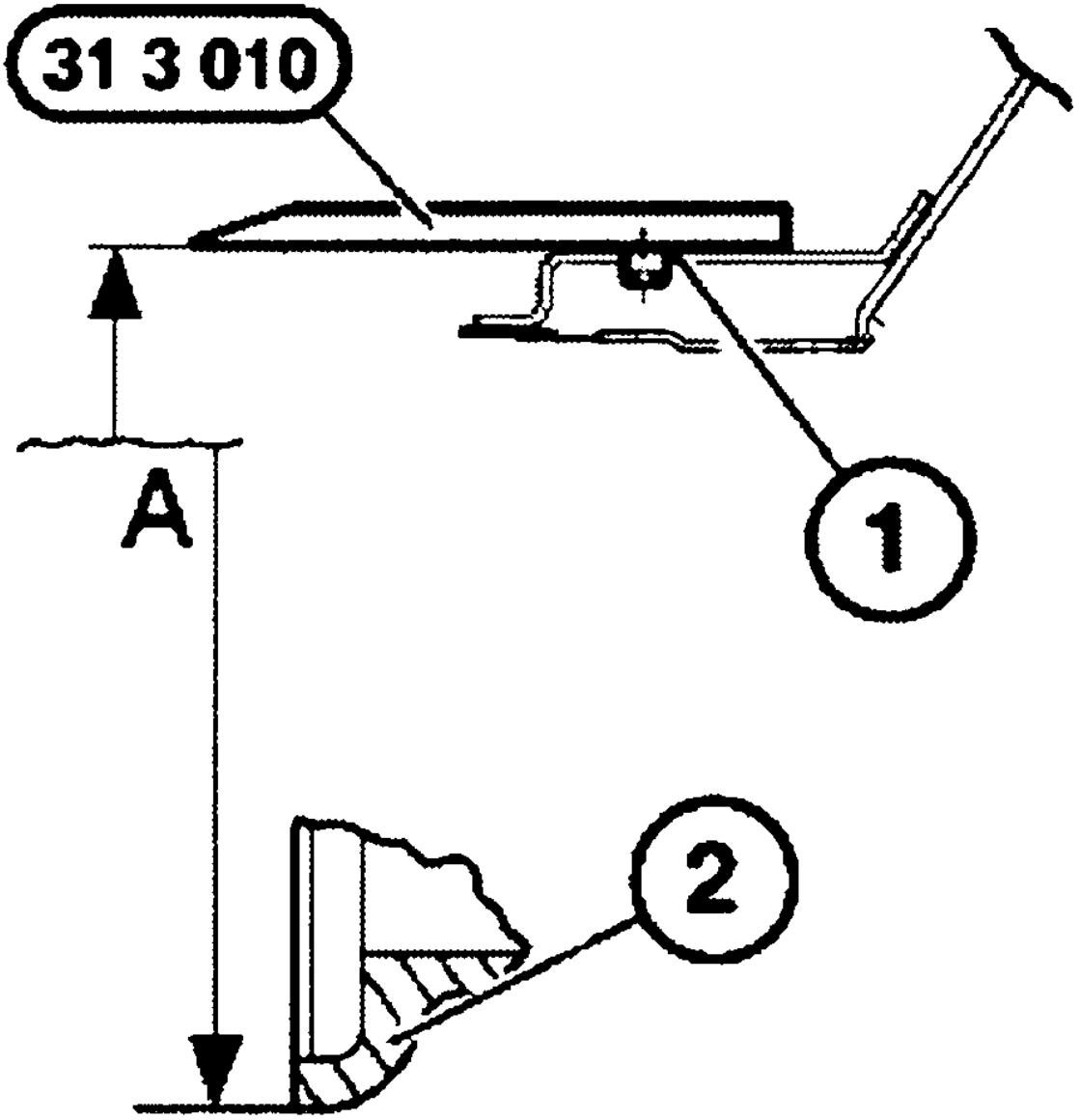
RIDE HEIGHT SPECIFICATIONS (FROM 9/93 - EXCEPT Z3)

Application	In. (mm)
Standard Suspension	
15" Rim	20.4 (518)
16" Rim	20.9 (531)
17" Rim	21.5 (546)

M Roadster	23.1 (588)
M3	23 (585)
M Coupe	26.1 (664)
Sports Suspension	
15" Rim	19.9 (507)
16" Rim	20.5 (520)
17" Rim	21 (535)
Rough Road Package	
15" Rim	21.2 (538)
16" Rim	21.7 (551)
17" Rim	22.3 (566)

Z3

1. Open hood. Insert Measuring Tool (31-3-010) in bore in wheel arch. Measure distance "A" from bottom center flange of wheel rim (2) to Measuring Tool (1). See Fig. 8 .
2. Ride height measurement must be within .04" (10 mm) of each side. For proper ride height, see RIDE HEIGHT SPECIFICATIONS (FROM 9/93 - Z3) .
3. Identify installed spring. Installed spring is identified by referring to parts microfiche, contacting BMW Parts Dept. or by removing spring and finding BMW number on end of spring. Springs are allocated by vehicle type and, where applicable, by special equipment such as air conditioning, sports suspension, etc. and by date of production launch.
4. Replace both springs, even though only one may be defective, to bring ride height back to specification.



1. Bore In Wheel Arch
2. Wheel Rim Flange

G00079041

Fig. 8: Measuring Ride Height
Courtesy of BMW OF NORTH AMERICA, INC.

RIDE HEIGHT SPECIFICATIONS (FROM 9/93 - Z3)

Application	In. (mm)
Z3 Coupe	
15" Rim	25.28 (642)
16" Rim	25.80 (655)
17" Rim	26.38 (670)
Z3 Roadster	
Standard Suspension	
15" Rim	25.47 (647)
16" Rim	25.98 (660)
17" Rim	26.57 (675)

Sports Suspension	
15" Rim	24.88 (632)
16" Rim	25.40 (645)
17" Rim	25.98 (660)
Z3 Sedan	
Standard Suspension	
15" Rim	22.25 (565)
16" Rim	22.75 (578)
17" Rim	23.35 (593)
Sports Suspension	
15" Rim	21.65 (550)
16" Rim	22.17 (563)
17" Rim	22.75 (578)

WHEEL ALIGNMENT SPECIFICATIONS & PROCEDURES

NOTE: See SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

TROUBLE SHOOTING

TROUBLE SHOOTING

Fault	Cause	Remedy
Body Swinging Long After Driving Over Rough Road	Shock Absorber Effect Insufficient	Replace Shock Absorbers
Excessive Tire Wear	Wheel Alignment Not OK	Measure Wheel Alignment, Adjust & Replace Faulty Parts
Grinding Noise (Louder When Cornering)	Wheel Bearings Faulty	Replace Wheel Bearings
Flattened Areas On Tire Profile	Shock Absorber Faulty	Replace Shock Absorbers
Poor Handling	Shock Absorber Effect Weak	Replace Shock Absorbers
Rattling Noise	Ball Joints Of Control Arms Worn	Replace Control Arm Or Ball Joint
Rattling Noise	Stabilizer Rubber Mounts Worn	Replace Rubber Mount
Rattling Noise	Ball Joints Of Push Rod Worn	Replace Push Rod
Rattling Noise	Steering Knuckle To Spring-Strut Bolts Loose	Tighten Bolts (Check Threads)
Rising Of Body When Accelerating	Shock Absorber Effect Insufficient	Replace Shock Absorbers
Shock Absorbers Bottoming	Rubber Damper Faulty	Check/Replace Rubber Damper
Shock Absorbers Bottoming	Shock Absorber Effect Insufficient	Replace Shock Absorbers
Shock Absorber Noise	Shock Absorber Faulty	Replace Shock Absorbers
Skidding In Bends Due To Poor Track Holding	Shock Absorber Effect Insufficient	Replace Shock Absorbers
Steering Wheel Shake	Wheels Out Of Balance	Balance Wheels
Steering Wheel Shake	Rims Have Lateral/Radial Runout	Replace Rims If Necessary
Steering Wheel Shake	Shock Absorber Effect Insufficient	Replace Shock Absorbers
Steering Wheel Shake	Control-Arm Rubber Mounts Faulty	Replace Control-Arm Rubber Mounts
Vehicle Skidding When Braking	Shock Absorber Effect Insufficient	Replace Shock Absorbers
Vibration	Wheels Out Of Balance	Balance Wheels
Vibration	Rims Have Lateral/Radial Runout	Replace Rims If Necessary

Vibration	Tires Have Radial Runout	Match Or Replace Tires
Whipping Of Body When Driving Over Successive Rough Road Surfaces	Shock Absorber Effect Insufficient	Replace Shock Absorbers

REMOVAL & INSTALLATION

BALL JOINT

Removal

1. Raise and support front of vehicle. Remove front wheel assembly. Disconnect stabilizer bar link from control arm. See Fig. 9 .
2. Loosen control arm-to-steering knuckle ball joint nut (1) until it contacts strut. See Fig. 10 .
3. Using a hammer and special tool (31 1 430), with slant of fork (2) facing downward, separate control arm from steering knuckle. See Fig. 10 .
4. Mark ball joint installation position for installation purposes. See Fig. 11 .
5. Remove nut and discard.
6. Pull axle assembly outward and place a bar or similar device in place to hold assembly out for ball joint access. See Fig. 12 .
7. Using Ball Joint Remover/Installer (31 1 441/443/445/446), remove ball joint. See Fig. 13 .

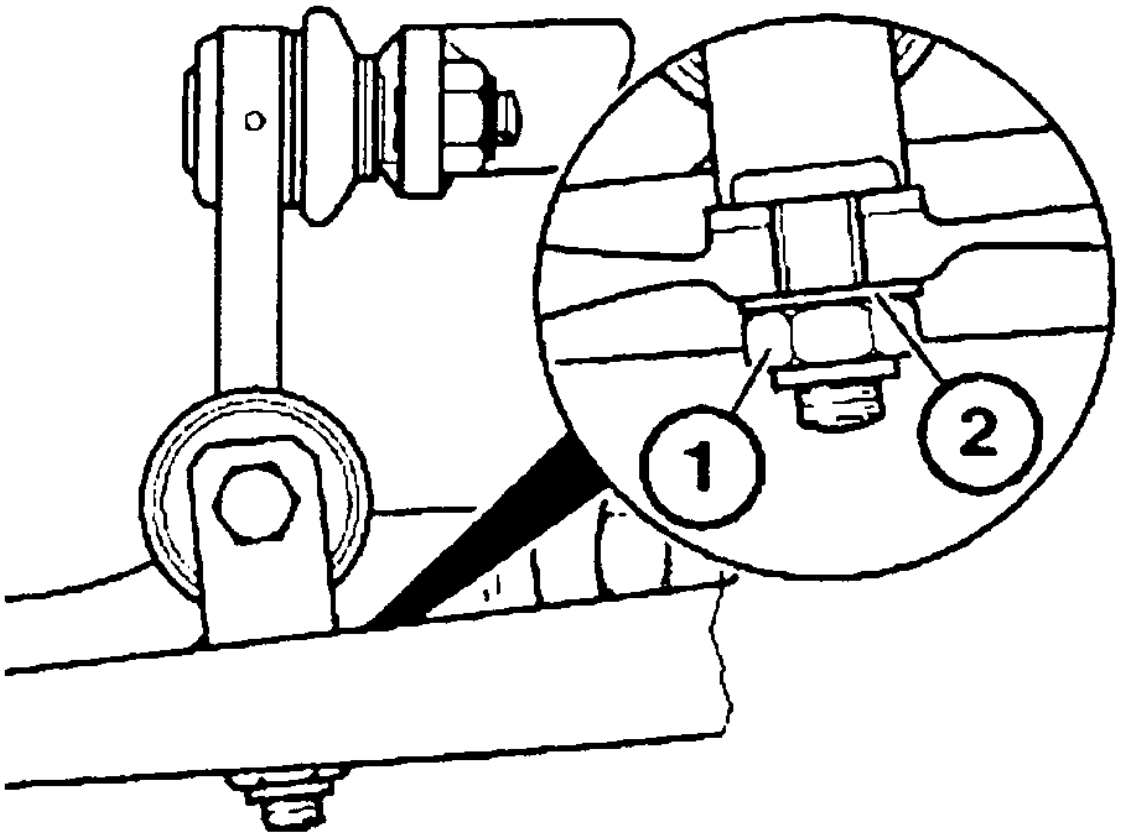


Fig. 9: Exploded View Of Stabilizer-To-Control Arm
Courtesy of BMW OF NORTH AMERICA, INC.

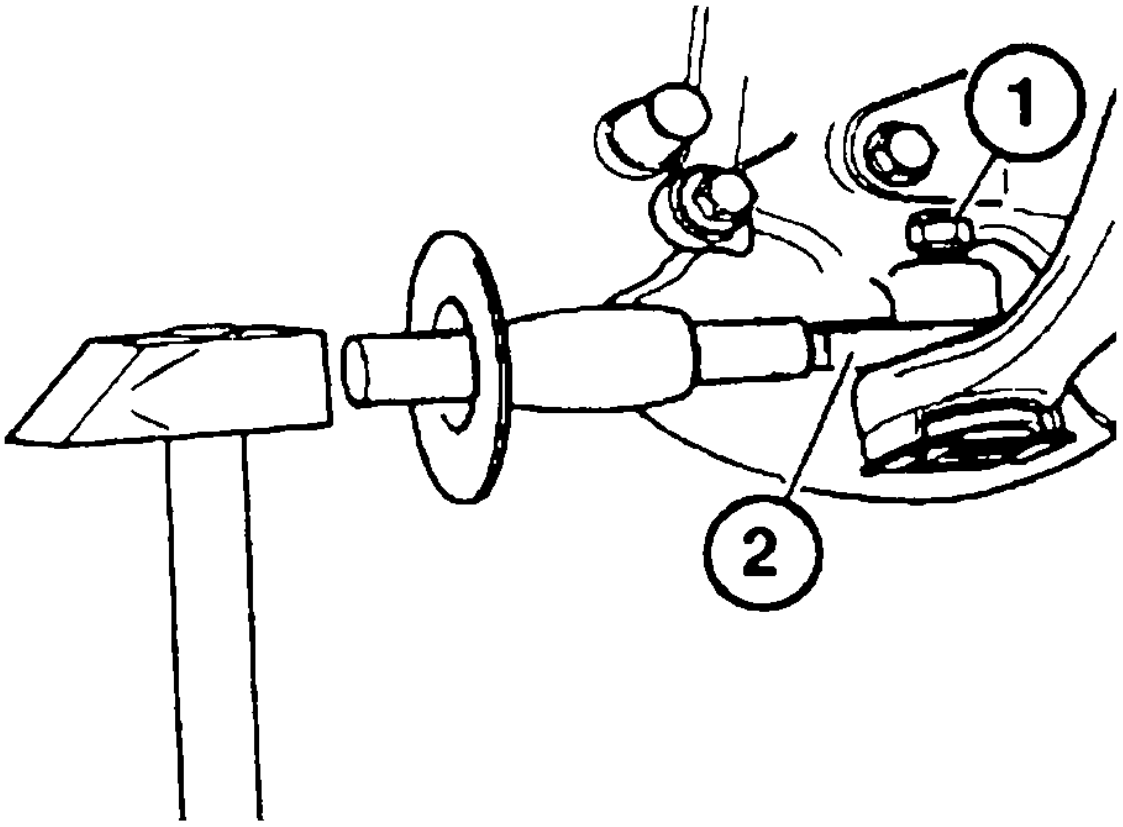


Fig. 10: Separating Control Arm From Steering Knuckle
Courtesy of BMW OF NORTH AMERICA, INC.

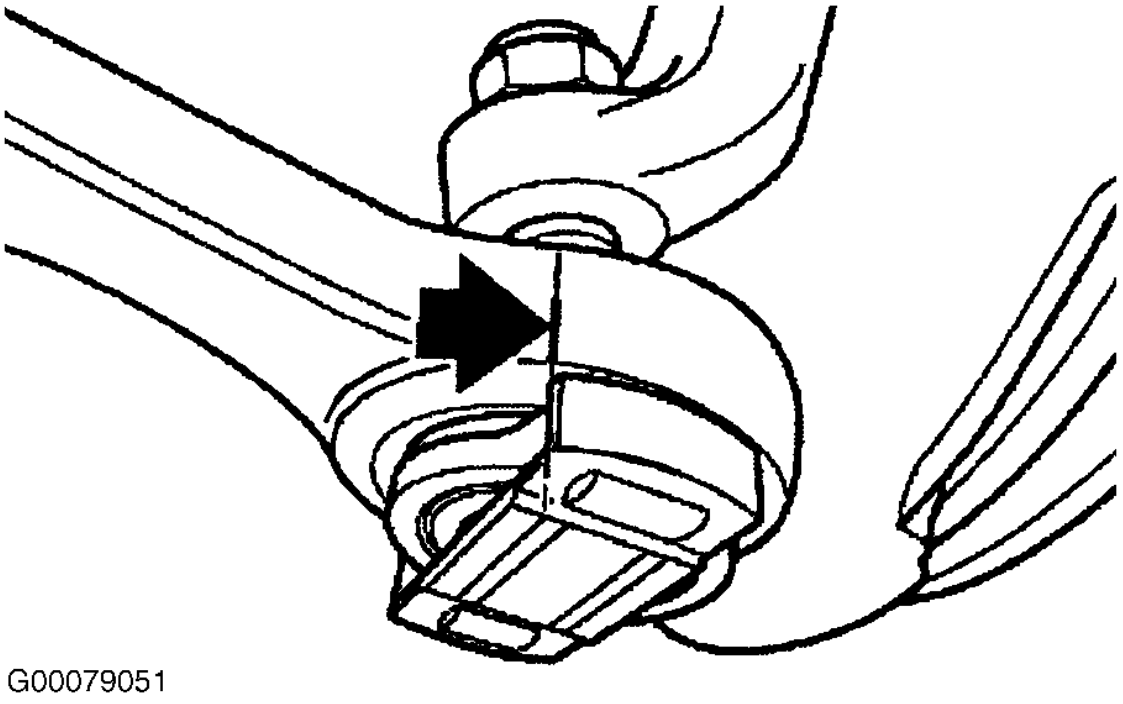


Fig. 11: Marking Ball Joint Installation Position
Courtesy of BMW OF NORTH AMERICA, INC.

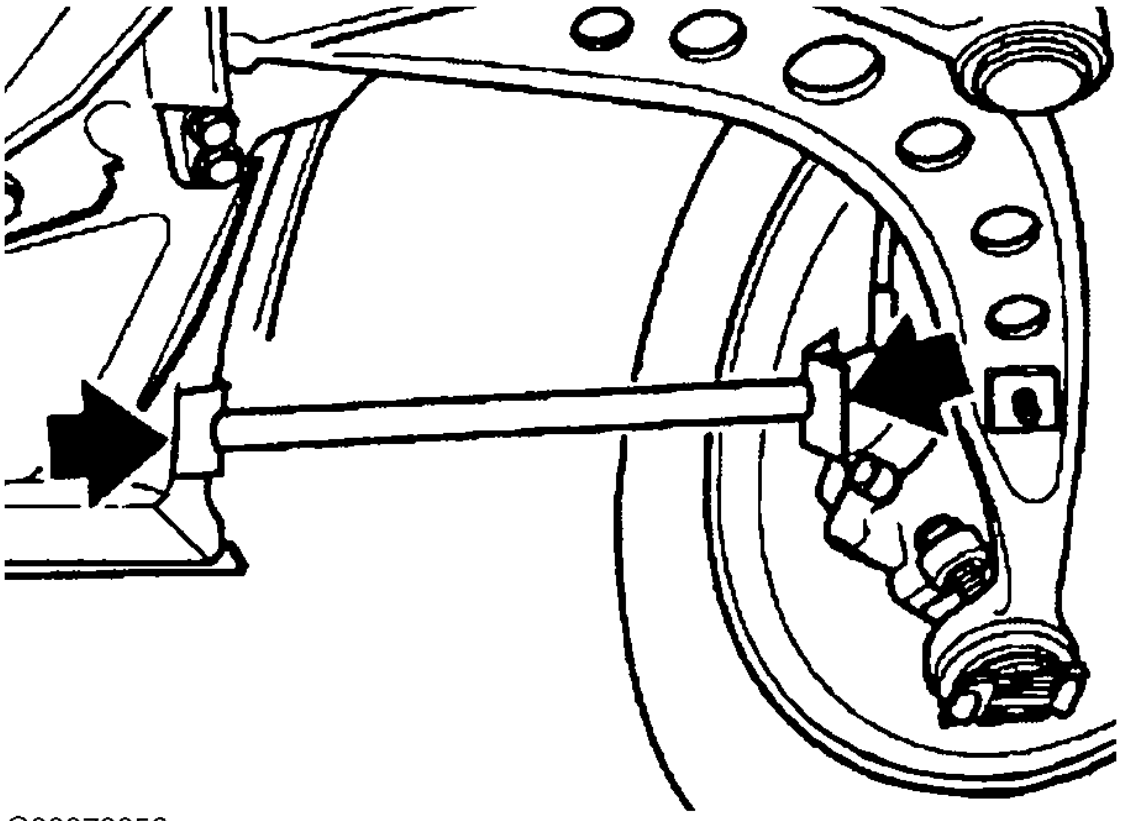


Fig. 12: Inserting Bar
Courtesy of BMW OF NORTH AMERICA, INC.

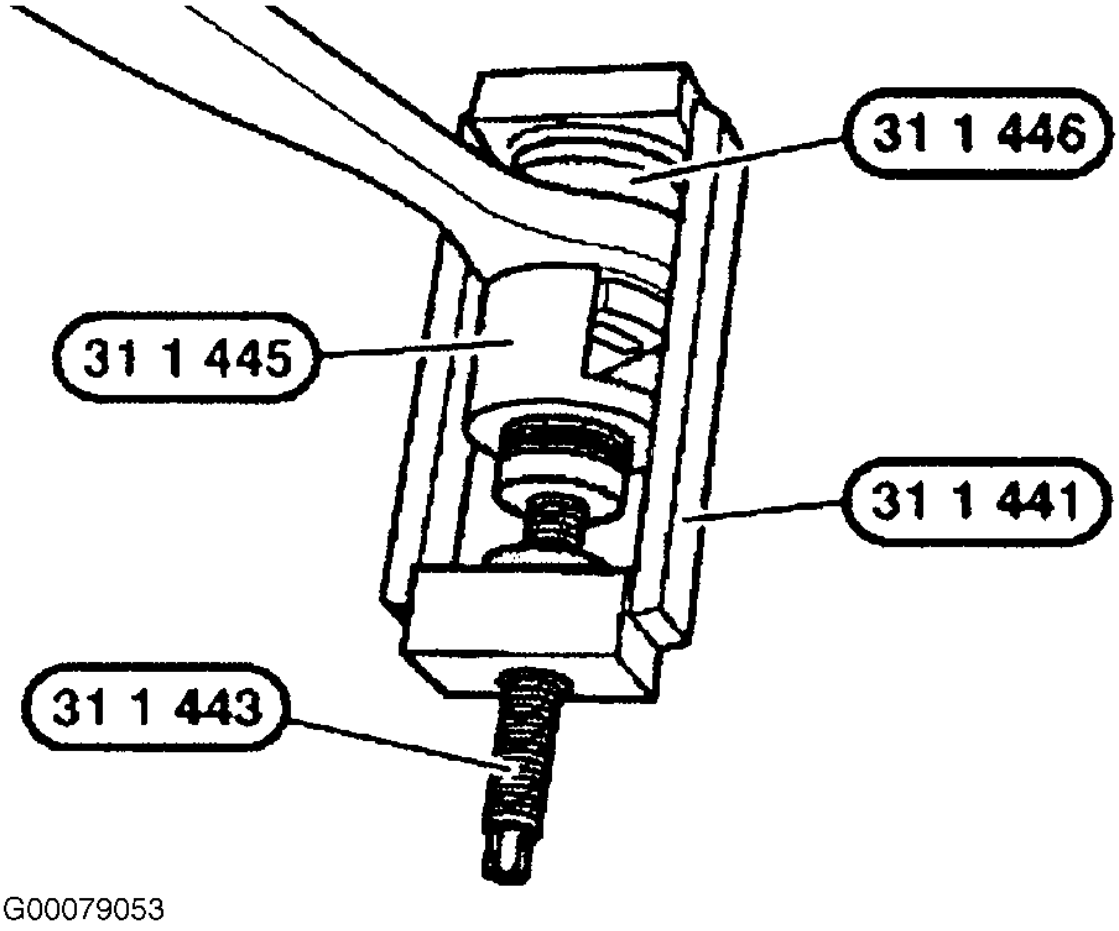


Fig. 13: Removing Ball Joint
Courtesy of BMW OF NORTH AMERICA, INC.

Installation

1. Using a scraper or wire brush, clean rust from ball joint lower mating face of control arm. Clean ball joint bore in control arm.
2. Screw Ball Joint Guide (31 1 448) onto NEW ball joint as far as it will go. See Fig. 14 .
3. Align match marks and insert ball joint in control arm. Ensure turning lock points toward middle of vehicle. See Fig. 15 .
4. Using Ball Joint Remover/Installer (31 1 441/443/447), install ball joint. See Fig. 16 .
5. To complete installation, reverse removal procedure. Force wheel guide joint upwards using a transmission lifter and base. This simplifies the tightening down of the nut. Replace all lock nuts. Use washer (2) for stabilizer connection on control arm. See Fig. 9 .
6. Tighten fastener and wheel lug bolts to specification. See TORQUE SPECIFICATIONS .

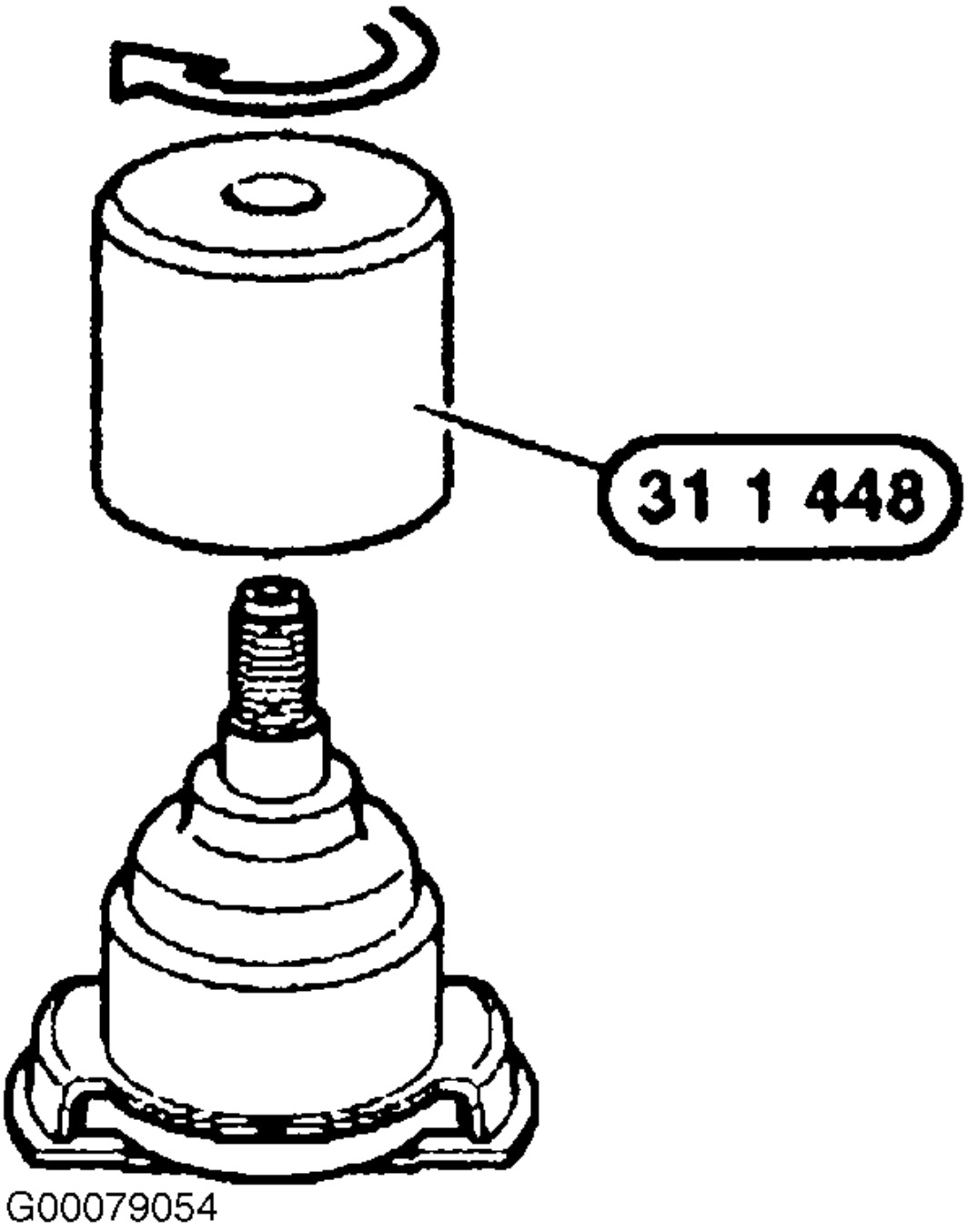
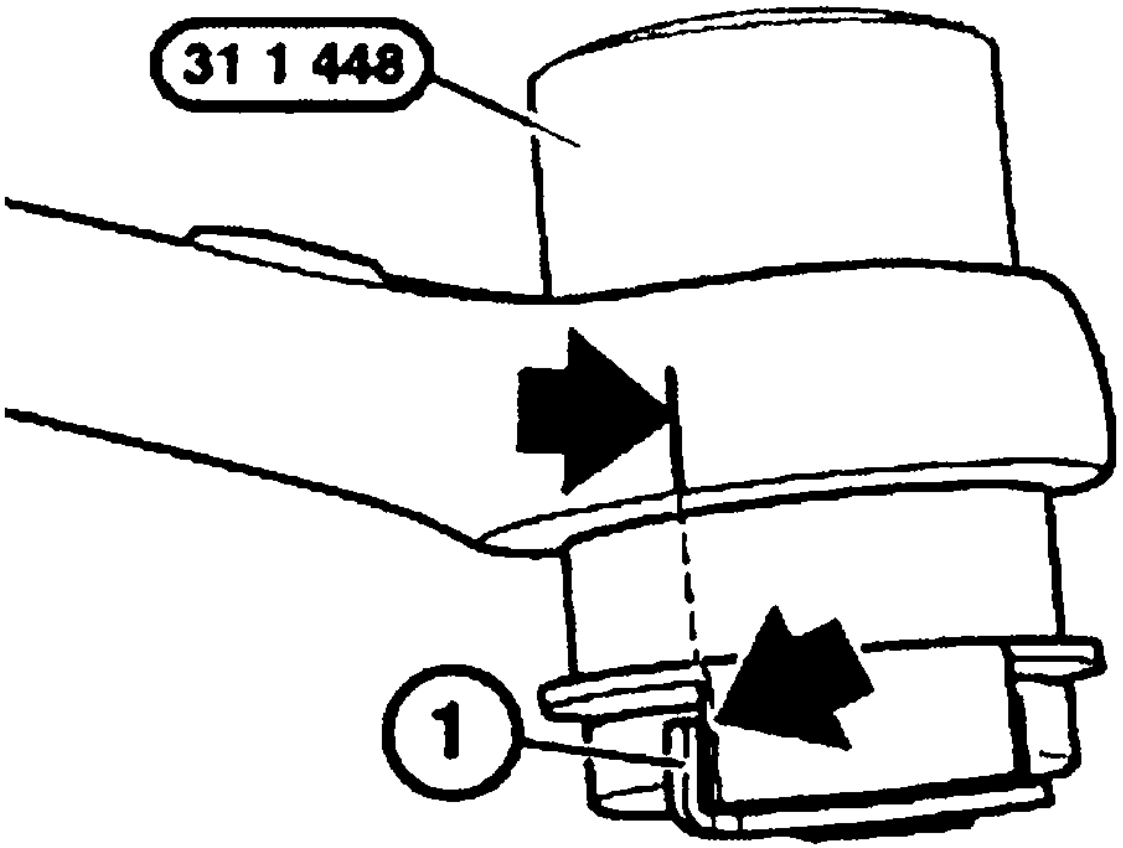


Fig. 14: Installing Ball Joint Guide
Courtesy of BMW OF NORTH AMERICA, INC.



1. Turning Lock

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Fig. 15: Aligning Ball Joint
Courtesy of BMW OF NORTH AMERICA, INC.

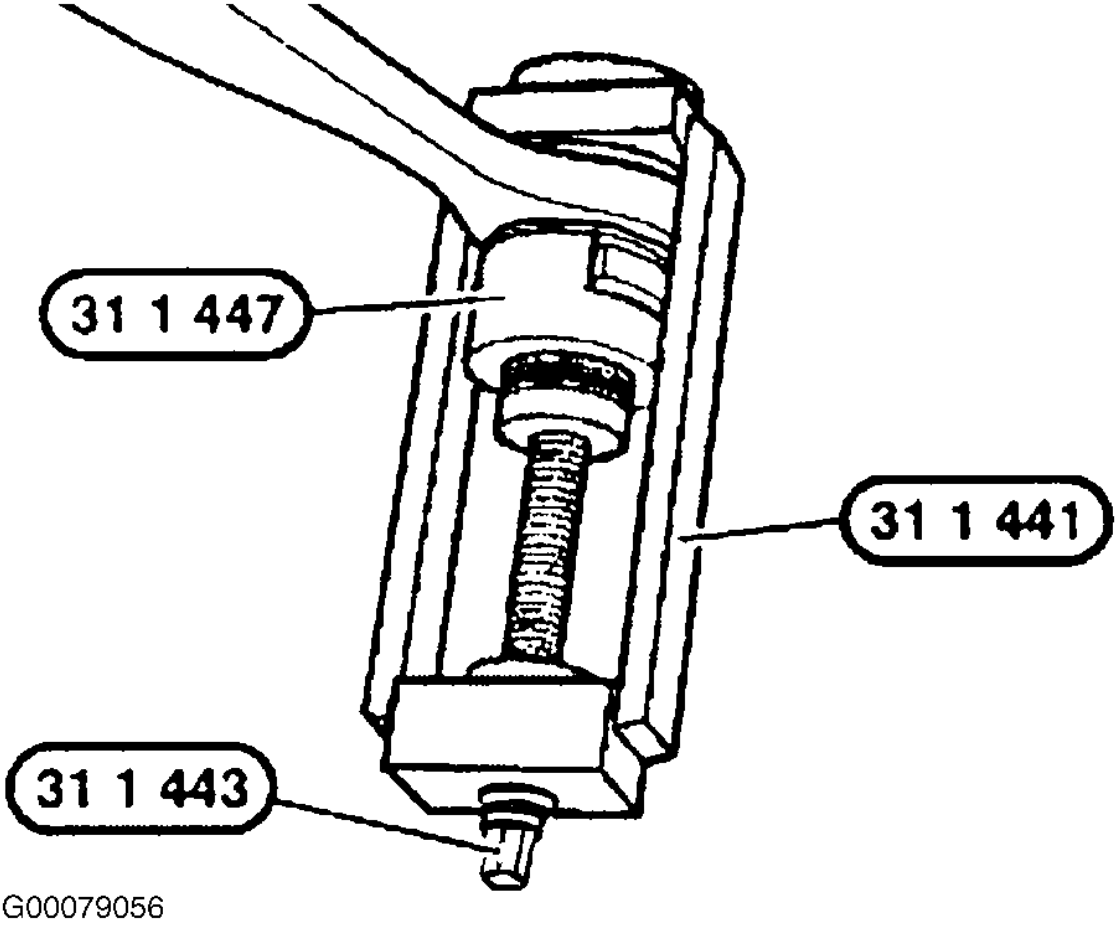


Fig. 16: Installing Ball Joint
Courtesy of BMW OF NORTH AMERICA, INC.

COIL SPRING

NOTE: Only use pairs of springs with the same BMW number (located on end of spring) on one axle. Springs are allocated by vehicle type and by special equipment, e.g. air conditioning, sports, etc. and by date of production launch.

Procedures are identical with those for replacing spring-strut shock absorber. See STRUT ASSEMBLY .

CONTROL ARM

Removal

1. Raise and support front of vehicle. Remove front wheel.
2. Disconnect stabilizer bar link from control arm. Release nut (1). See Fig. 9 .
3. Install one wheel lug bolt and install a piece of wire from lug bolt to coil spring to prevent brake hose damage. See Fig. 17 .
4. Loosen nut until it contacts spring strut. See Fig. 18 .
5. Remove 2 strut-to-steering knuckle bolts and discard. See Fig. 19 .
6. Remove upper strut-to-steering knuckle bolt and lock nut. Remove control arm-to-steering knuckle ball joint nut and discard. See Fig. 20 .
7. Using Ball Joint Separator (31-2-160), separate control arm-to-steering knuckle ball joint. Remove grease from bore and pin. See Fig. 21 .

8. Remove tie-rod from control arm and suspend tie-rod aside. Remove control arm bracket-to-subframe bolts. See Fig. 32 .
9. Unscrew nut and knock ball joint loose with a plastic hammer. Remove control arm. See Fig. 22 .
10. Remove grease from bore and pin.

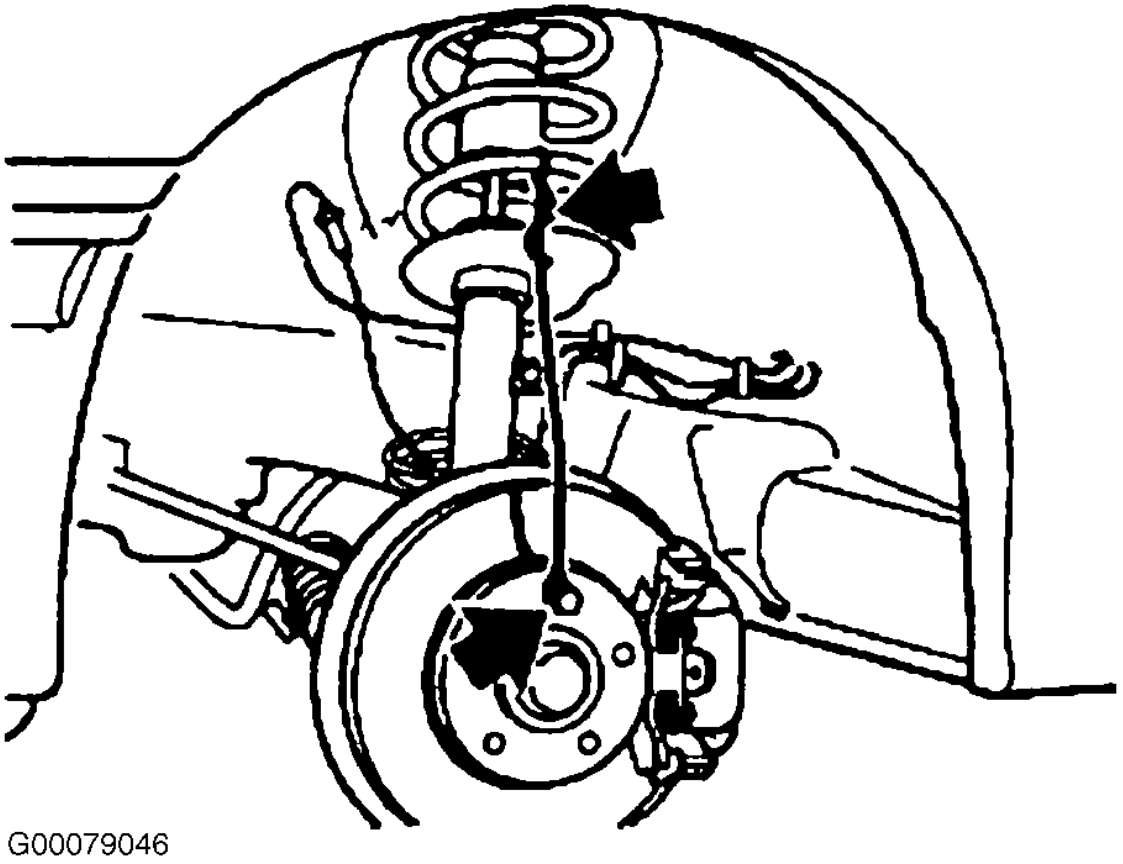


Fig. 17: Suspending Spindle
Courtesy of BMW OF NORTH AMERICA, INC.

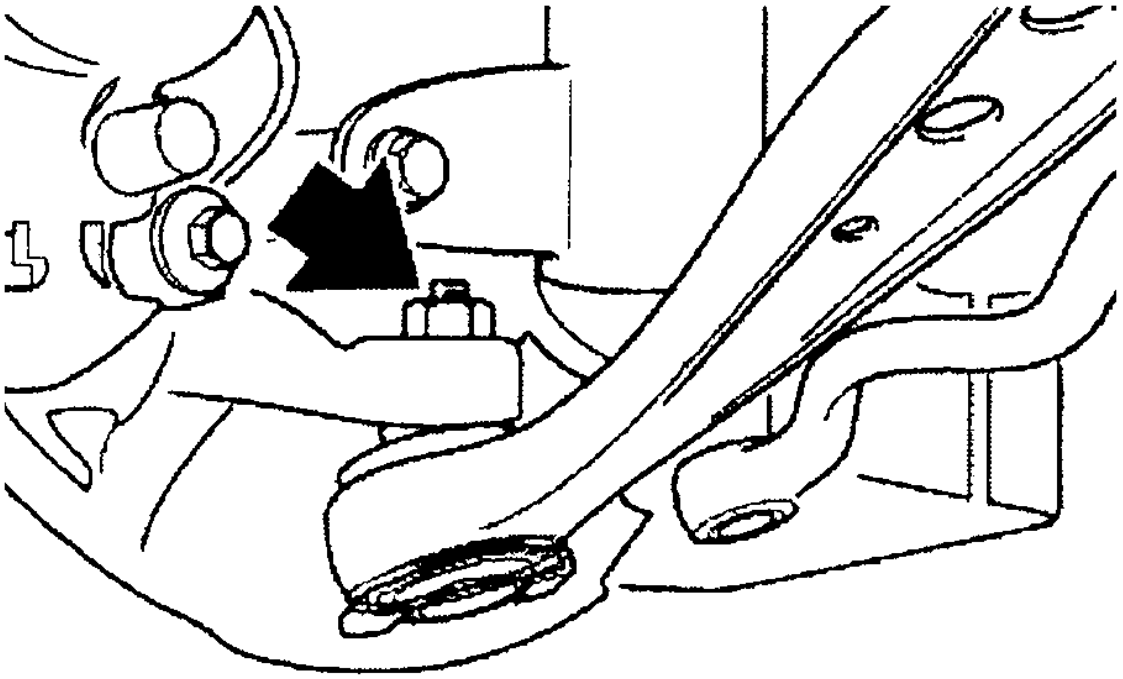


Fig. 18: Locating Control Arm-To-Steering Knuckle Ball Joint
Courtesy of BMW OF NORTH AMERICA, INC.

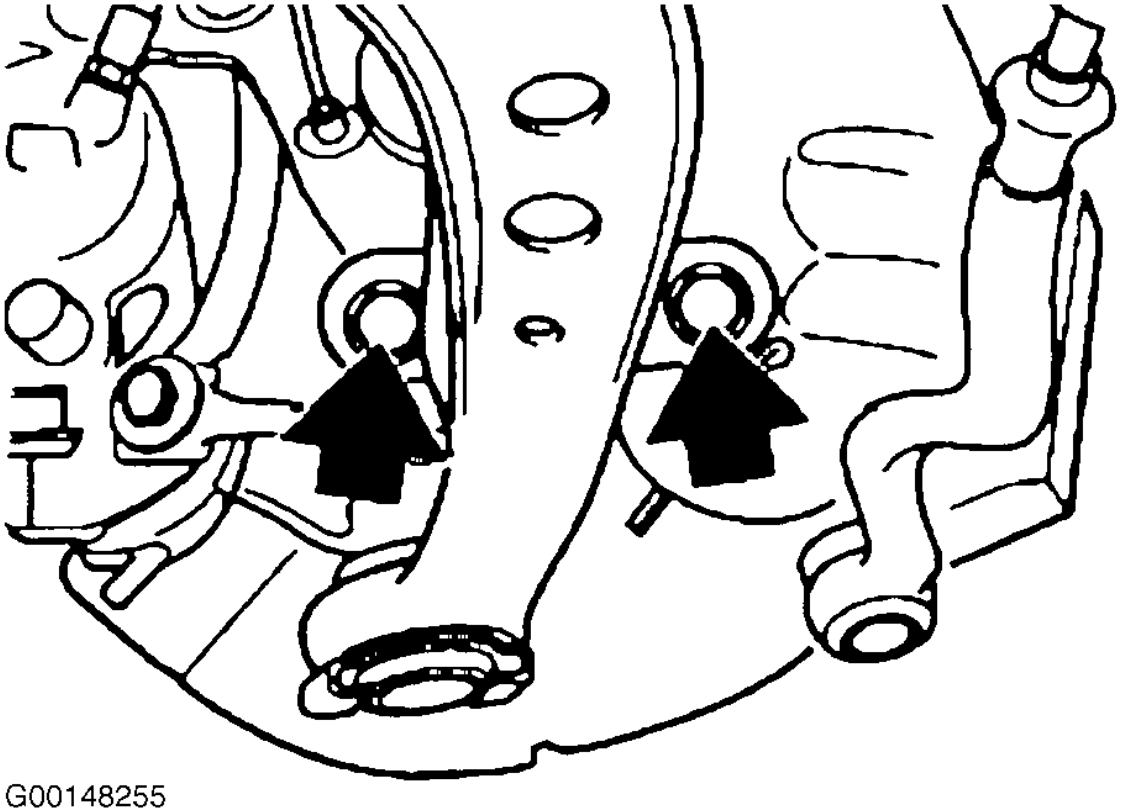


Fig. 19: Removing Bolts In Steering Knuckle

Courtesy of BMW OF NORTH AMERICA, INC.

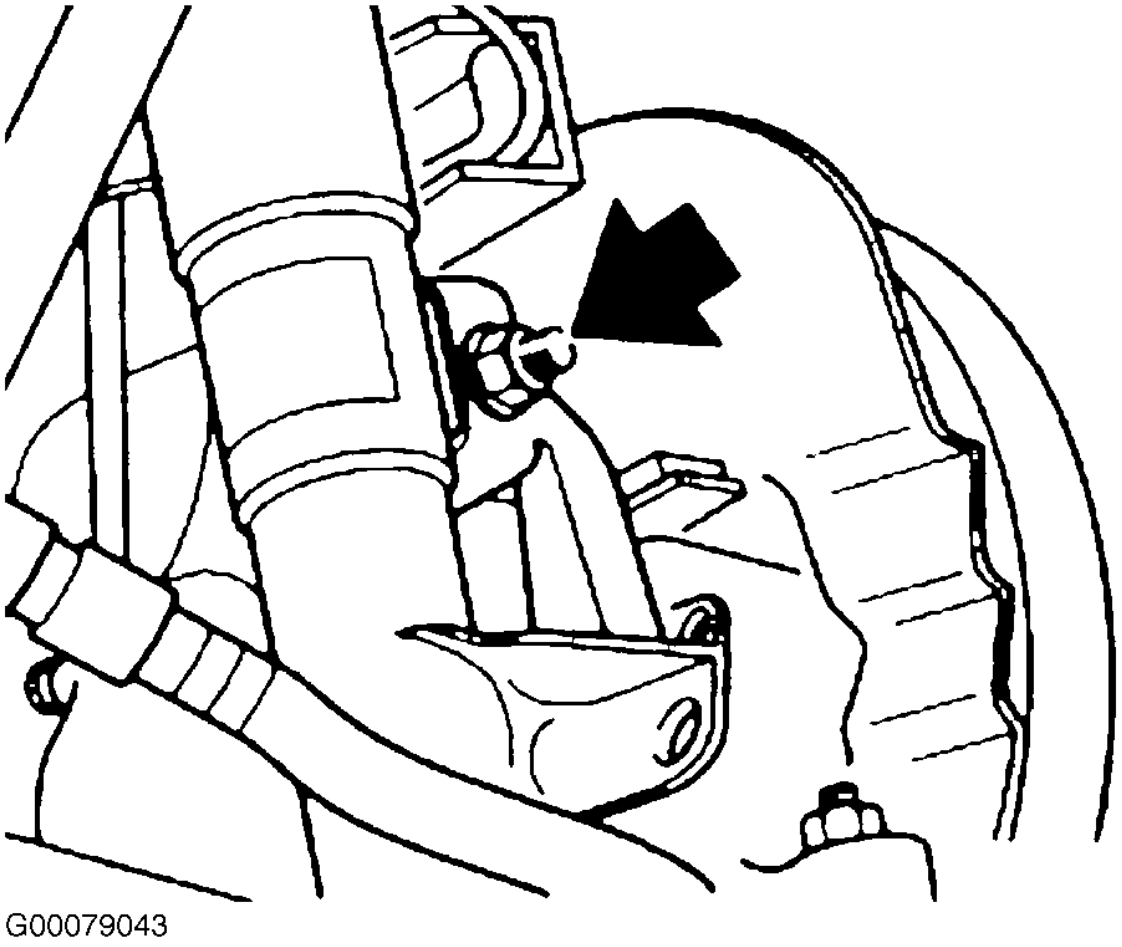


Fig. 20: Locating Upper Strut-To-Steering Knuckle Bolt
Courtesy of BMW OF NORTH AMERICA, INC.

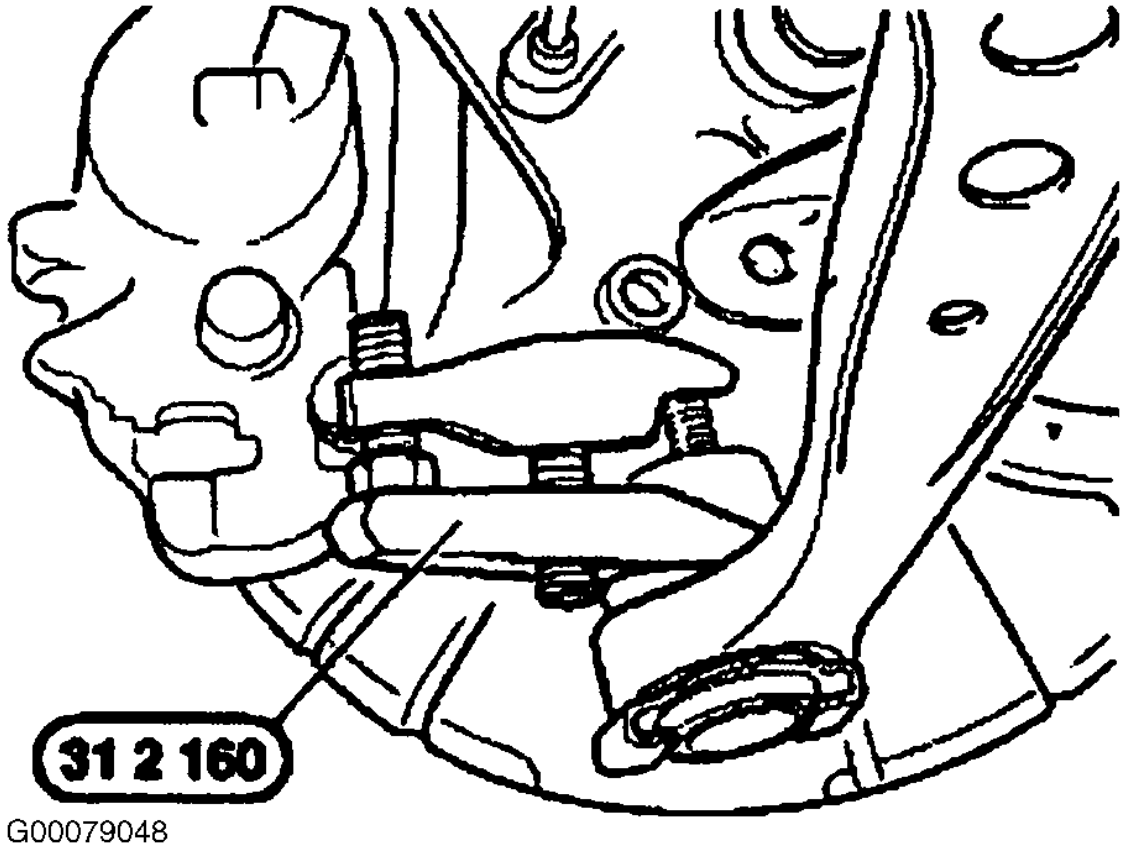


Fig. 21: Separating Control Arm-To-Steering Knuckle Ball Joint
Courtesy of BMW OF NORTH AMERICA, INC.

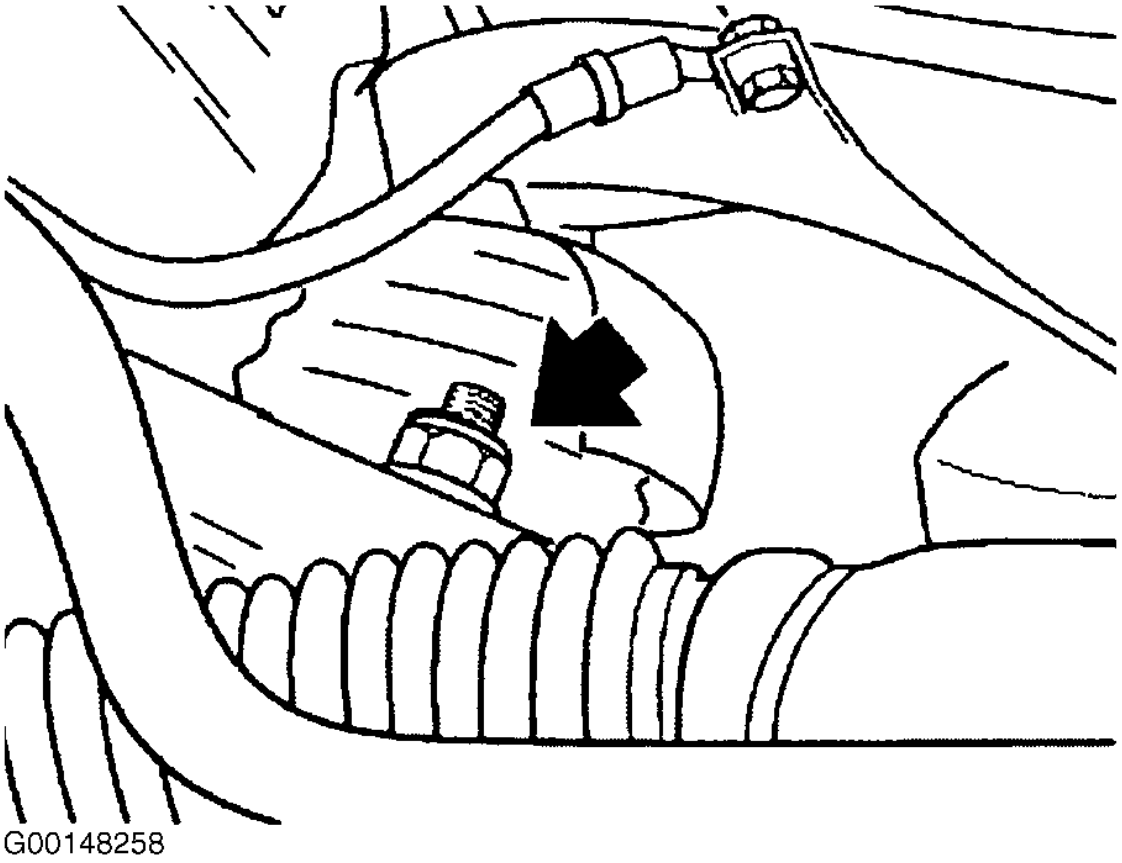


Fig. 22: Locating Control Arm Nut
Courtesy of BMW OF NORTH AMERICA, INC.

Installation

1. Force ball joint upwards using a transmission lifter and base. On vehicles with S52 engine, remove shield plates between manifold and wheel housing, if necessary. This simplifies the tightening down of the nut. Tighten to specification. See TORQUE SPECIFICATIONS .
2. Install control arm bracket-to-subframe bolts using washers and tighten to specification. See TORQUE SPECIFICATIONS .
3. Replace self-locking nut and install ball joint.
4. Replace self-locking nut and, using a shim on both sides, install upper strut-to-steering knuckle bolt.
5. Install 2 new strut-to-steering knuckle bolts.
6. Derust stub axle in area of contact face of rubber sleeve. Tighten nut to specification. See TORQUE SPECIFICATIONS .
7. Remove wire and wheel lug bolt.
8. Replace self-locking nut (1) and fit shim (2) for stabilizer connection on control arm.
9. Tighten nut to specification. See TORQUE SPECIFICATIONS .
10. Replace front wheel and tighten wheel lug bolts to specification. See TORQUE SPECIFICATIONS .

CONTROL ARM BUSHINGS

Removal

1. Remove control arm. See CONTROL ARM .
2. Center punch control arm pin. See Fig. 23 .

3. Unfasten bolts. See Fig. 24 .
4. Mark, measure and note bracket/bushing installation position for installation purposes. See Fig. 25 .
5. Using Puller (00-7-500) and Adapter (31 2 151), remove control arm bracket with bushing. See Fig. 26 .
6. Using a press and Adapter (31 2 130), press bushing out of bracket. See Fig. 27 .

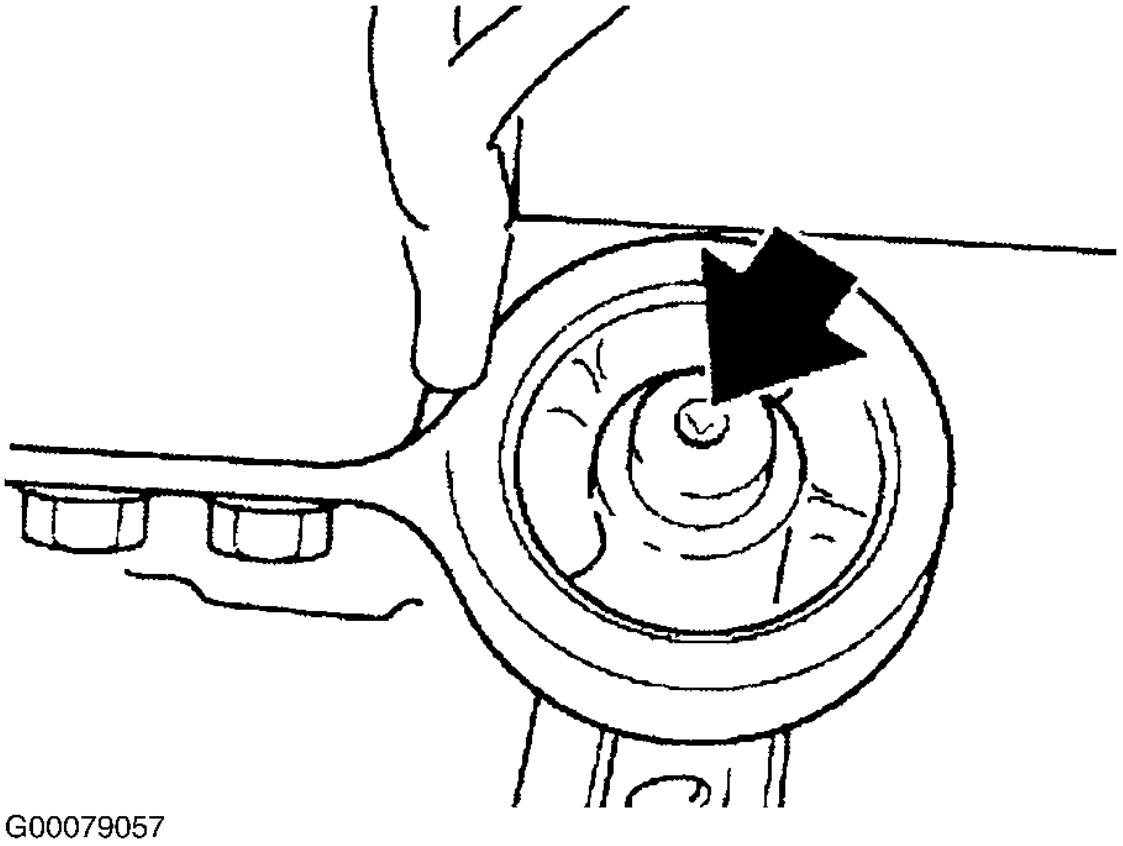


Fig. 23: Center Punching Control Arm Pin
Courtesy of BMW OF NORTH AMERICA, INC.

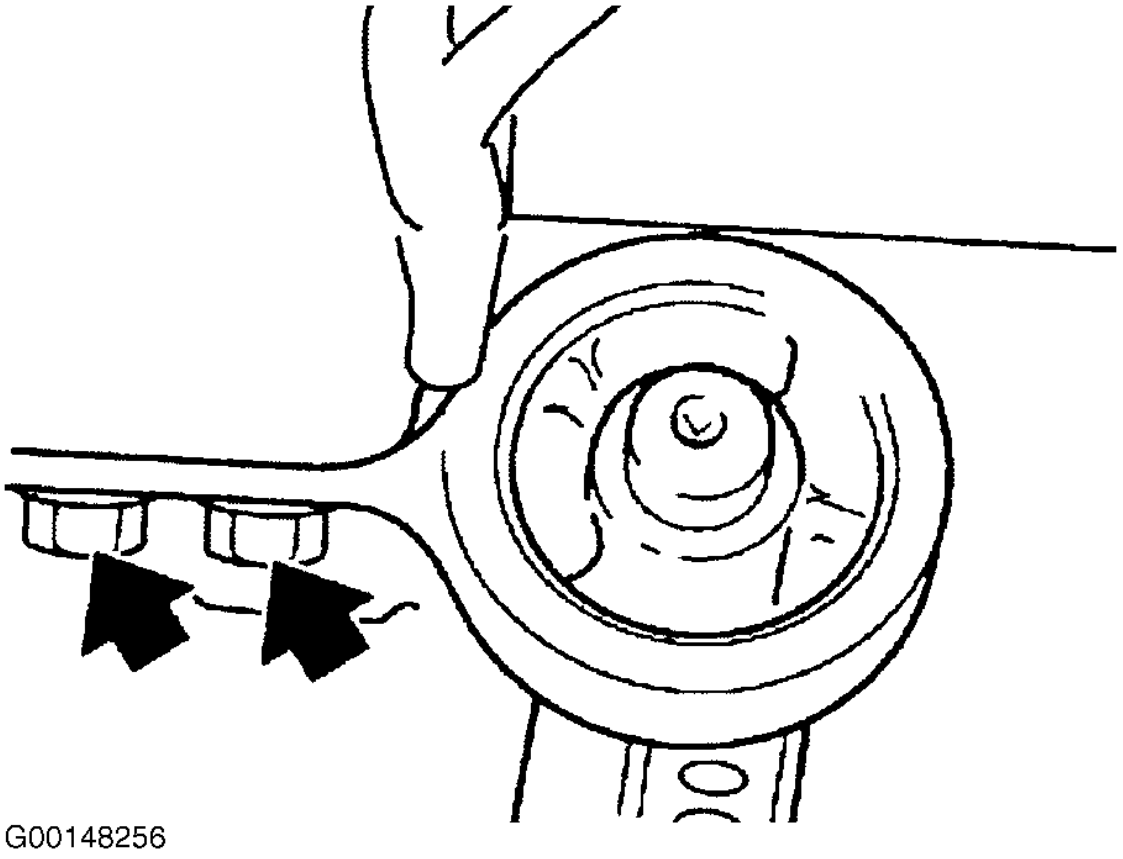


Fig. 24: Locating Bushing Bracket Bolts
Courtesy of BMW OF NORTH AMERICA, INC.

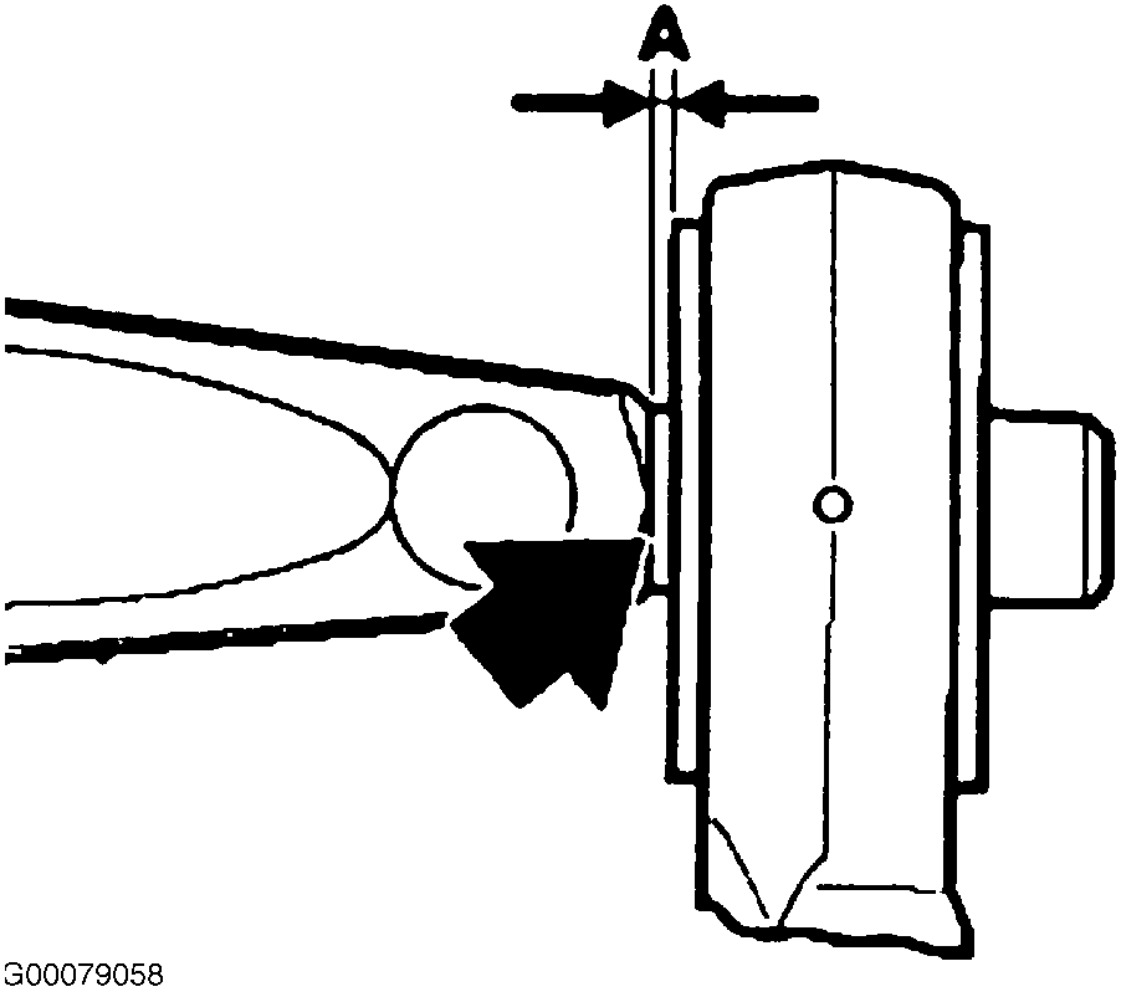


Fig. 25: Measuring Bushing Installation Position
Courtesy of BMW OF NORTH AMERICA, INC.

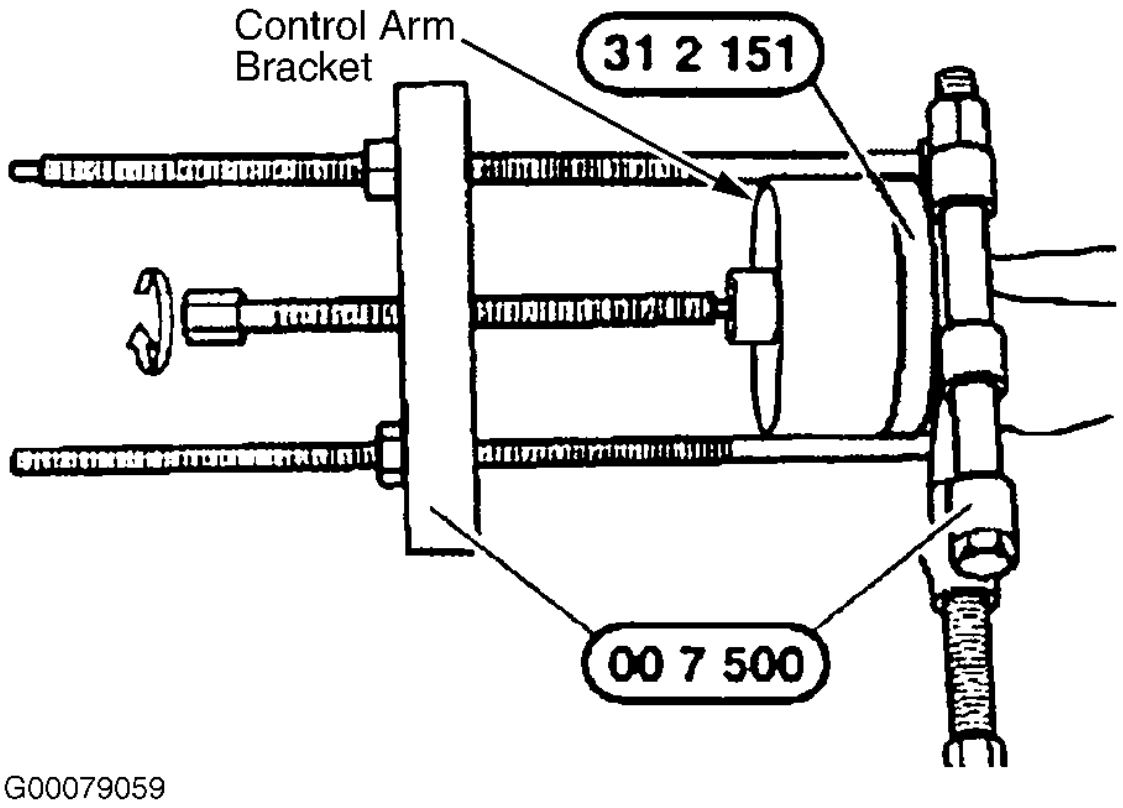


Fig. 26: Removing Control Arm Bracket
Courtesy of BMW OF NORTH AMERICA, INC.

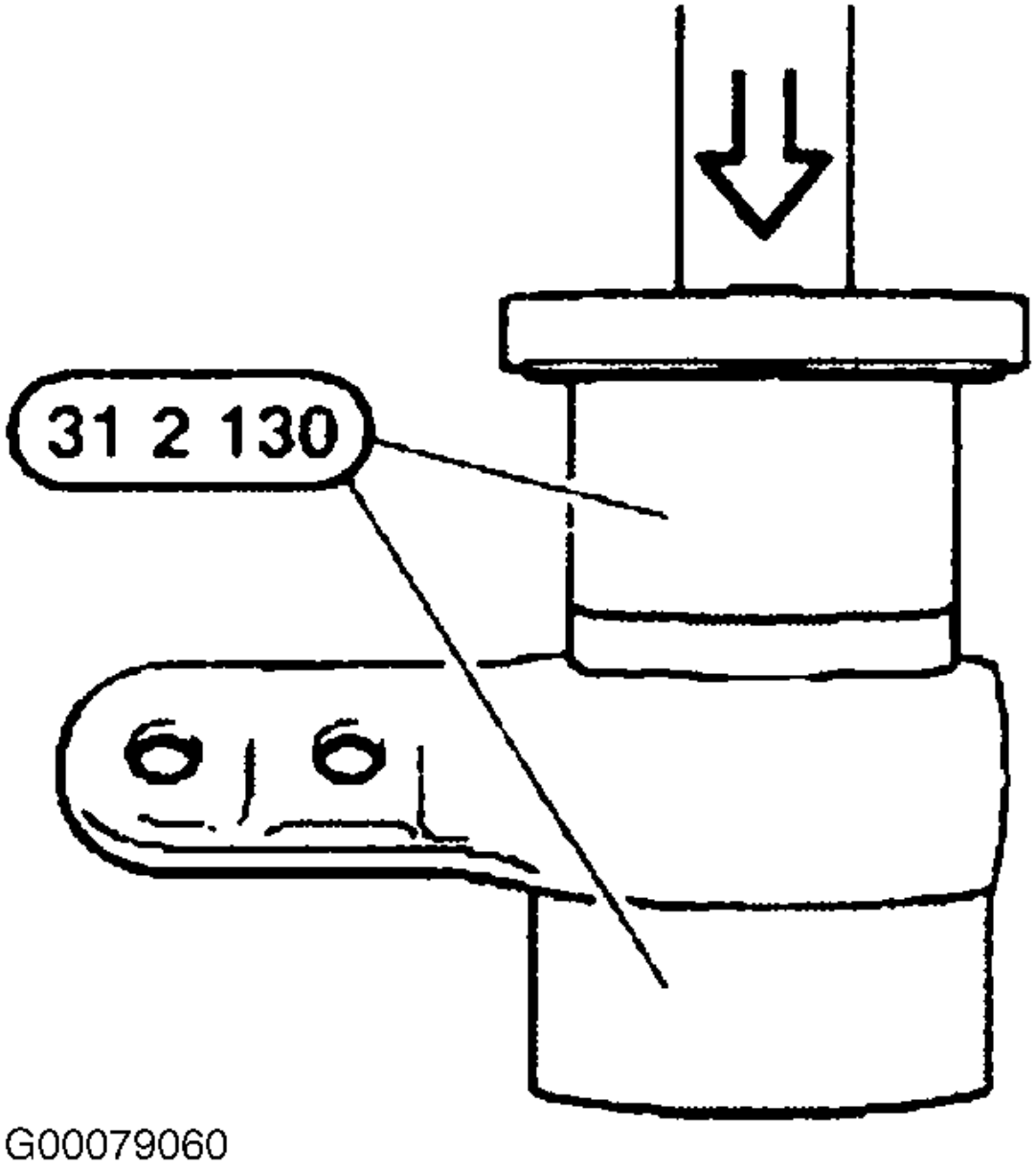


Fig. 27: Removing Control Arm Bushing
Courtesy of BMW OF NORTH AMERICA, INC.

Installation

1. Clean bushing bore in bracket. Align arrow on bushing with mark on bracket and press bushing into beveled bore in bracket using a press and Adapter (31 2 130). See Fig. 28 .
2. Ensure bushing protrusion is equal on both sides of bracket.
3. Check rubber mounts (except M3). With vehicle in normal position and using a feeler gauge, measure gap in bushing. If gap "A" is not .01-.05" (0.3-1.3 mm), replace bushing. See Fig. 29 .
4. Coat control arm pin with anti-friction agent (turpentine substitute). Using Installer (31 2 152/153/154 and 00 7 501), install bracket and bushing onto control arm pin to previously measured position. See Fig. 30 .
5. Ensure bracket centering bores point toward engine carrier. See Fig. 31 .

CAUTION: Use washers, tighten control arm bracket bolts and lower vehicle to normal position immediately to prevent serious impairment of handling.

6. Install control arm to vehicle, tighten control arm bracket bolts to specification and immediately lower vehicle to normal position. Leave vehicle in normal position for at least 30 minutes. After 30 minutes, anti-friction agent will be evaporated and control arm will fit tightly and be correctly positioned.
7. To complete installation, reverse removal procedure. Tighten fasteners to specification. See TORQUE SPECIFICATIONS .

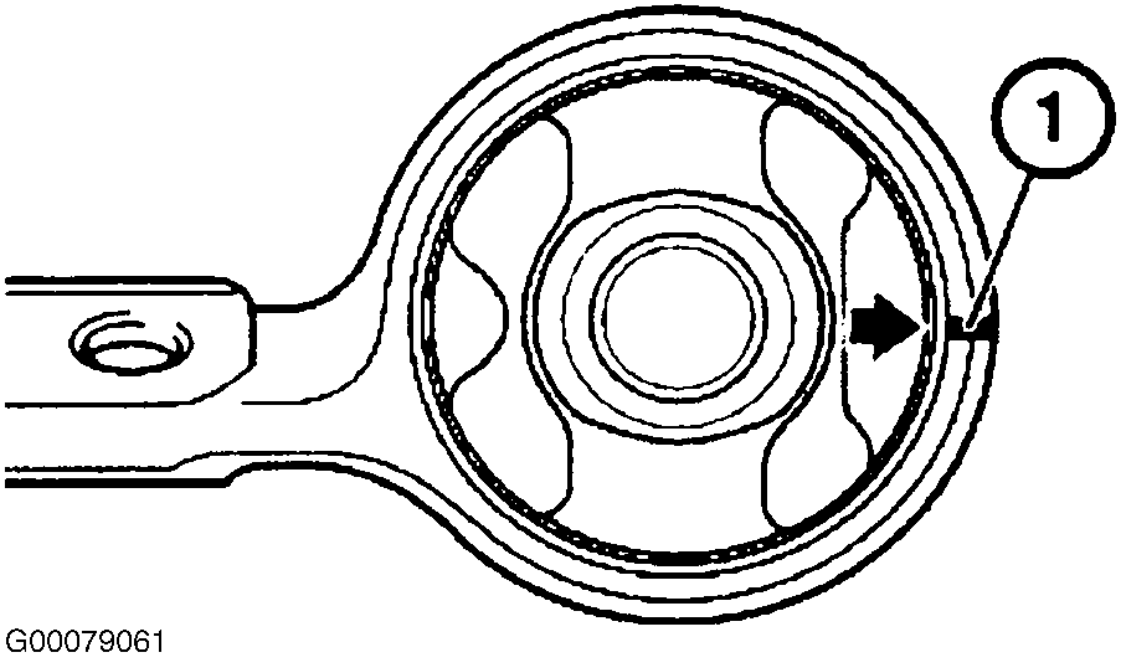


Fig. 28: Aligning Bushing & Bracket
Courtesy of BMW OF NORTH AMERICA, INC.

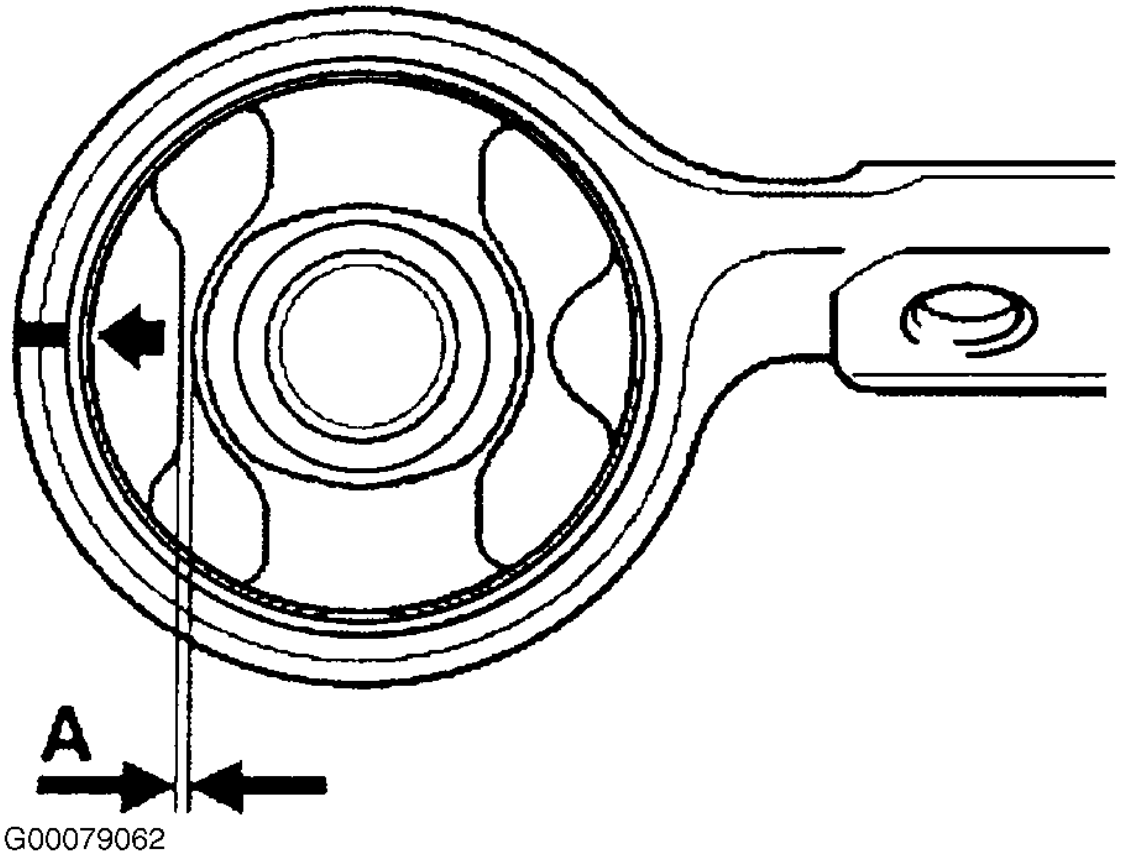


Fig. 29: Measuring Bushing Gap
Courtesy of BMW OF NORTH AMERICA, INC.

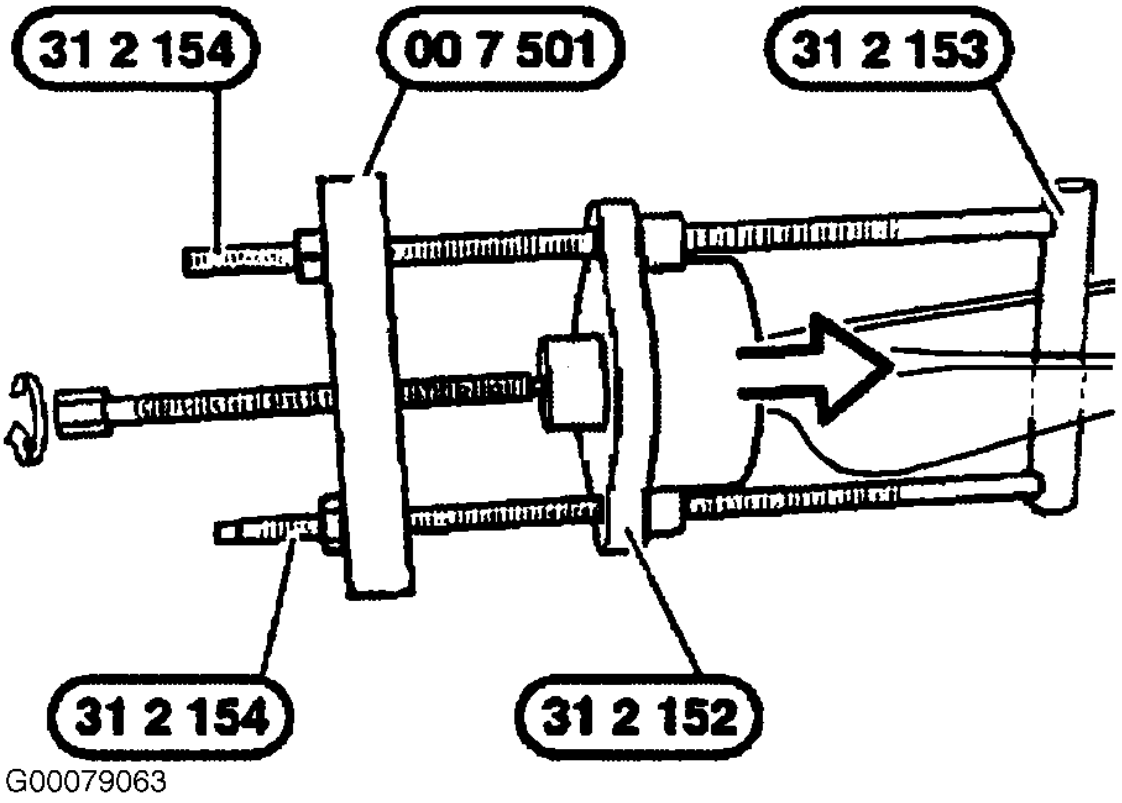


Fig. 30: Installing Control Arm Bracket
Courtesy of BMW OF NORTH AMERICA, INC.

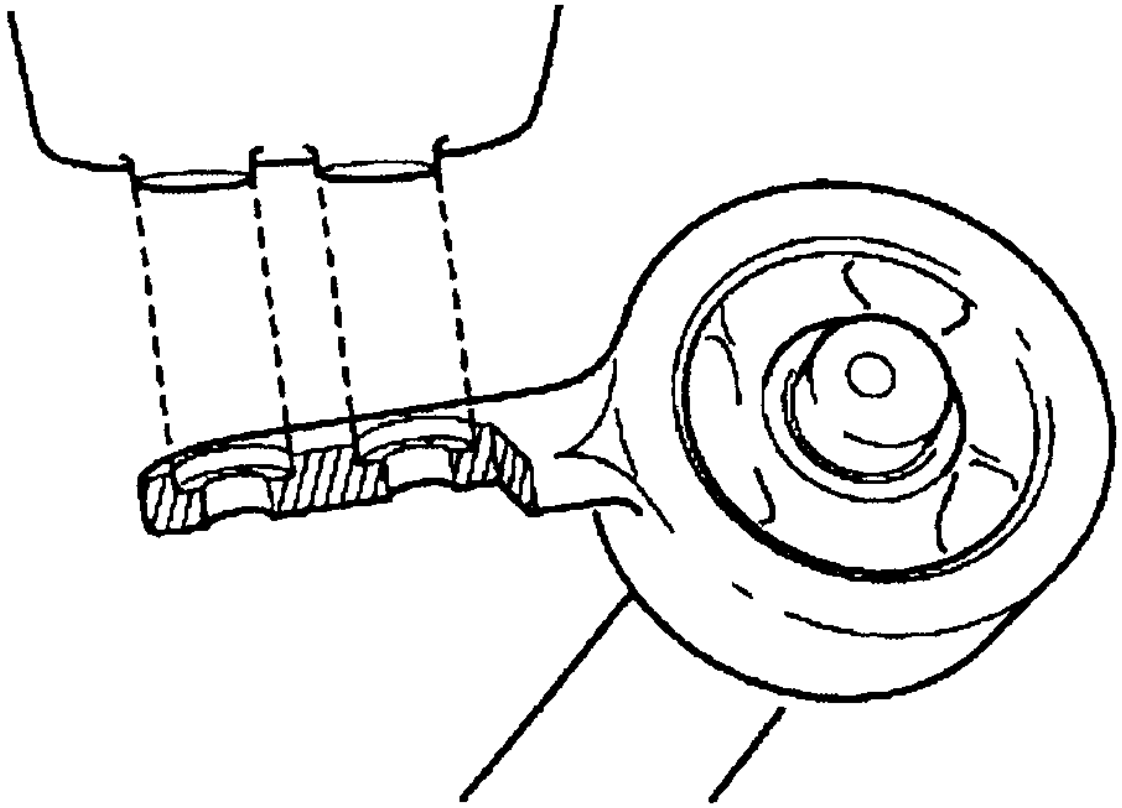


Fig. 31: Aligning Bracket Centering Bores
Courtesy of BMW OF NORTH AMERICA, INC.

FRONT SUSPENSION ASSEMBLY

CAUTION: Properly support engine before removing front suspension assembly. DO NOT allow strut assemblies to tilt or drop during front suspension assembly removal, as ball joint sockets could be damaged.

NOTE: Front suspension assembly is also referred to as subframe crossmember.

Removal

NOTE: Hydraulic fluid cannot be re-used. Observe all waste-disposal regulations.

1. Draw hydraulic fluid out of container and unfasten return line on container.
2. Unscrew pressure pipe on steering gear.
3. Remove steering spindle from steering gear.
4. Remove air bag/steering wheel assembly. See appropriate AIR BAG RESTRAINT SYSTEM article in ACCESSORIES & EQUIPMENT. Raise and support front of vehicle. Remove front wheels.
5. Disconnect wire connectors from brake pad wear indicator and ABS sensors. Remove wiring and hoses from holders on strut. Remove brake calipers and secure to body using wire. See appropriate article in BRAKES.
6. Unscrew left and right nuts holding stabilizer connection on spring strut and hold supports on spring struts with adhesive tape.
7. Unscrew left and right nuts (1) holding stabilizer connection on control arm. See Fig. 9 .

8. Remove control arm bracket bolts. See Fig. 32 .
9. Using a suitable lifting device, support engine. Remove left and right engine mount nuts.
10. If necessary, remove the reinforcing cross struts (Convertible/Roadster). Unscrew left and right bolts. See Fig. 33 .

CAUTION: Spring struts must not tilt outwards or sag. Ball joints could be damaged.

11. Unscrew left and right nuts and lower trolley jack slowly. See Fig. 34 .

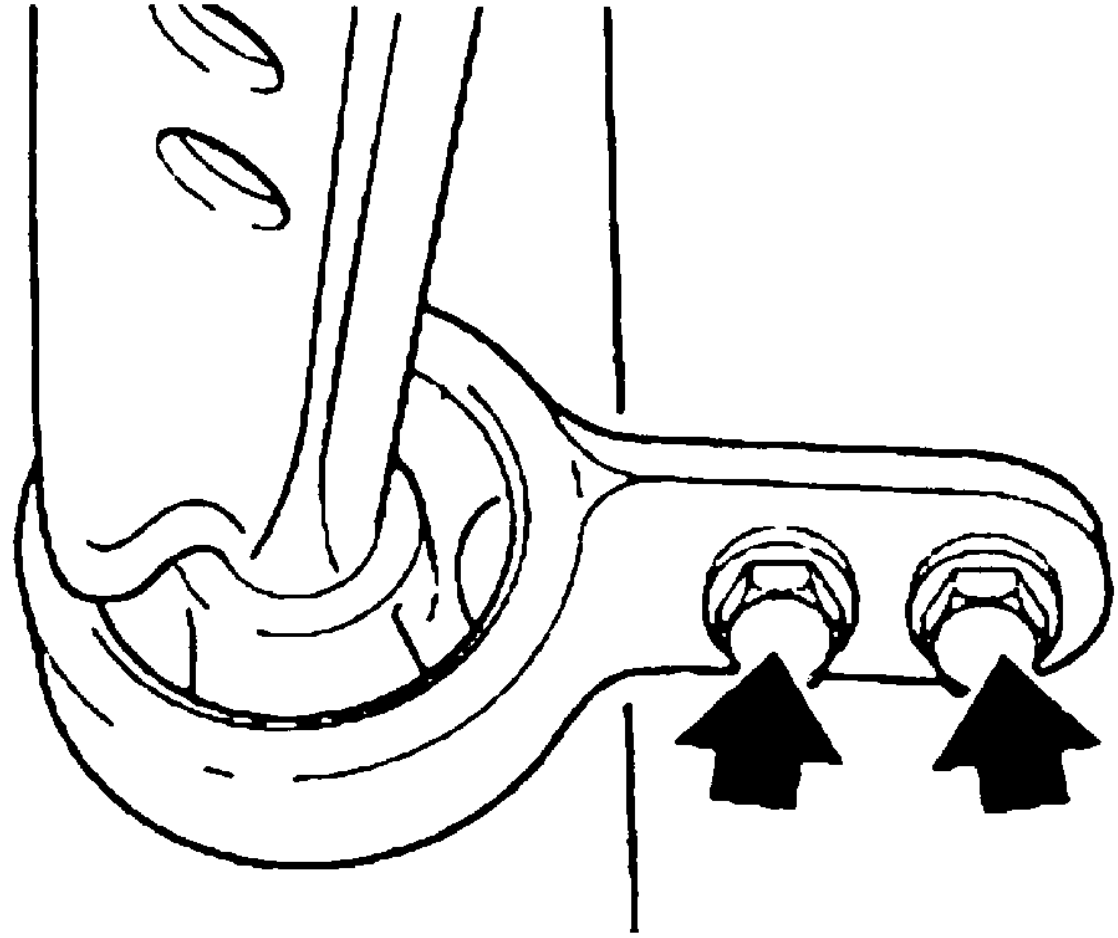


Fig. 32: Locating Control Arm-To-Subframe Bolts
Courtesy of BMW OF NORTH AMERICA, INC.

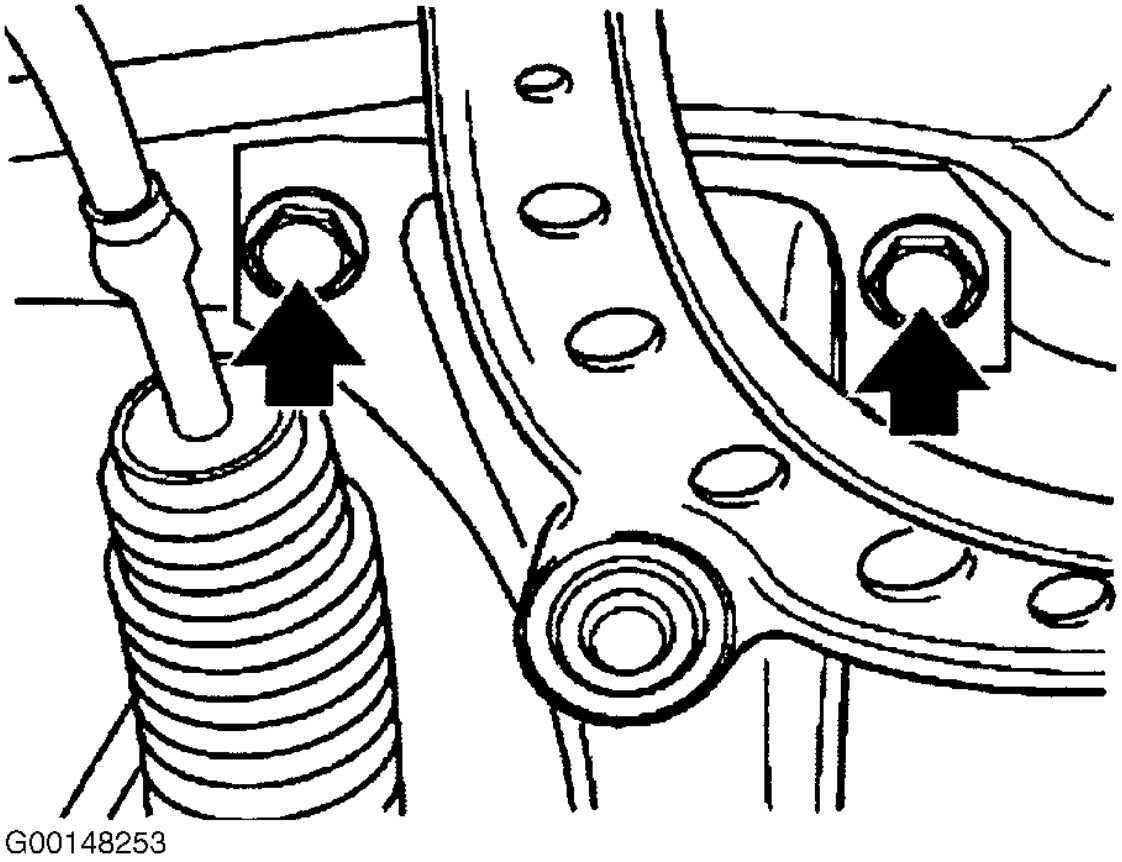


Fig. 33: Removing Reinforcing Cross Struts
Courtesy of BMW OF NORTH AMERICA, INC.

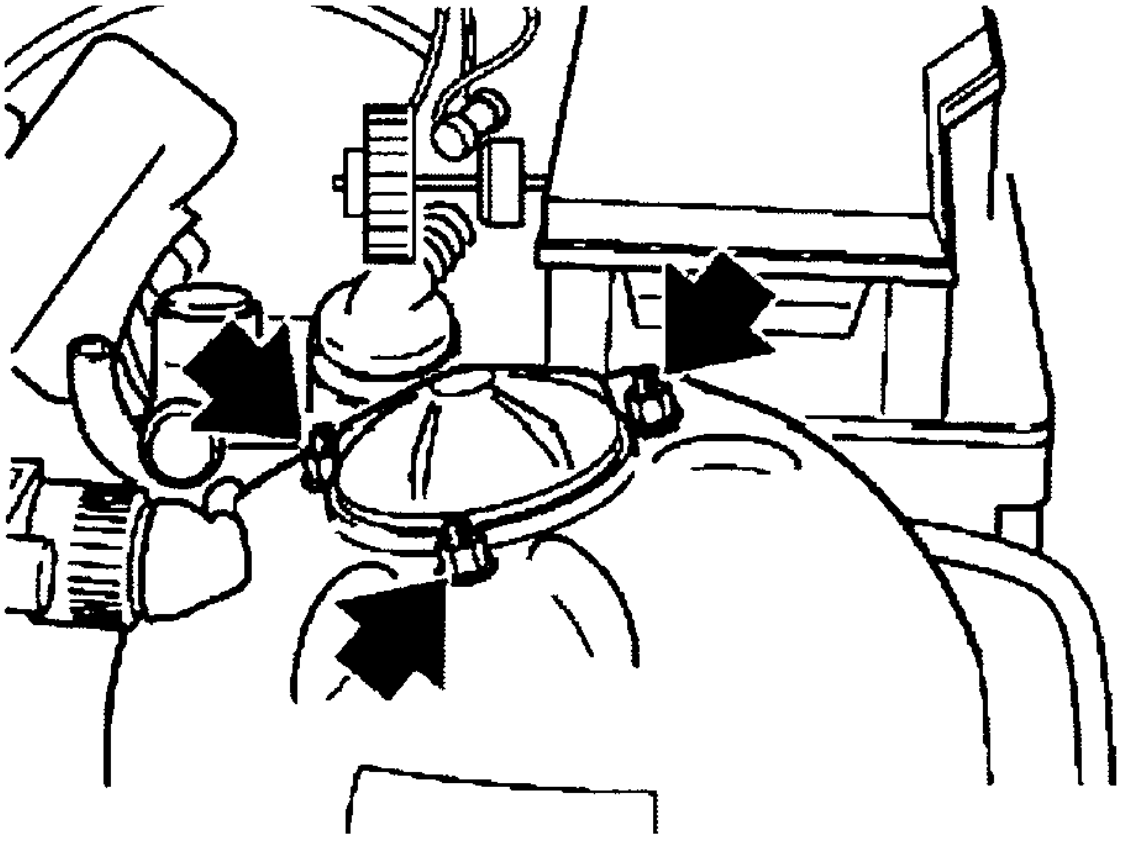


Fig. 34: Locating Trolley Jack Nuts
Courtesy of BMW OF NORTH AMERICA, INC.

Installation

CAUTION: On M3, long sheet metal flange on thrust bearing must be pointed in forward direction.

1. To install, reverse removal procedure. Replace all self-locking nuts. Tighten to specification. See TORQUE SPECIFICATIONS .
2. Damaged threads in engine support should be repaired with Helicoil thread inserts 12 x 1.5 mm.
3. On models up to 93, remove paint from contact surfaces of front axle and engine supports. Replace 4 screws. Coat screws on thread and head contact with assembly paste LM48 or equivalent. Lubrication is not necessary when bolts 1 141 214 are used. Install 4 new toothed ring discs between front axle and engine carrier, even if there were no toothed ring discs fitted previously.
4. On models from 1993, four ring-type lock washers are omitted due to tapered connection at both rear mounting points. Screws are 12 mm x 1.5 x 95 9.8.
5. Ensure flat wrench surface (1) on stabilizer bar links are parallel to strut axis. See Fig. 35 .
6. Replace self-locking nut (1) and fit shim (2). See Fig. 9 .
7. Install wheel and tighten lug to specification. See TORQUE SPECIFICATIONS .
8. Check and adjust front wheel alignment. See SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.
9. Fill power steering system.

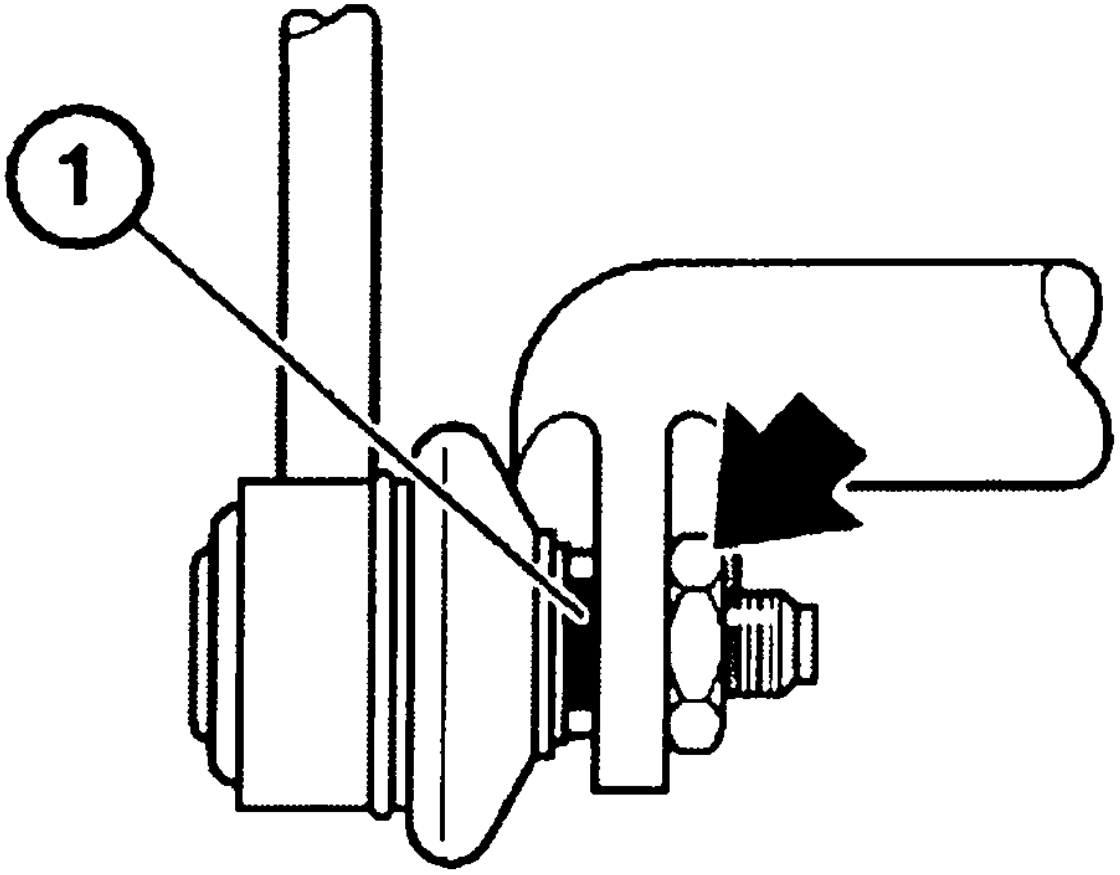


Fig. 35: Exploded View Of Stabilizer Link Connection
Courtesy of BMW OF NORTH AMERICA, INC.

STABILIZER BAR

Removal & Installation

1. Raise and support front of vehicle.
2. Unscrew left and right nuts at stabilizer connection on spring strut. See Fig. 35 .
3. Unscrew left and right nuts on control arm. See Fig. 36 .
4. Remove stabilizer bar bracket bolts and remove stabilizer bar. See Fig. 37 .
5. Remove grease from rubber mounts and stabilizer.
6. To install, reverse removal procedure. Open end of rubber mount faces downwards.

NOTE: Wrench surface (1) on ball pin must be parallel to absorber axis. See Fig. 35 .

7. With vehicle in normal position, replace self-locking nuts and tighten to specification. See TORQUE SPECIFICATIONS .

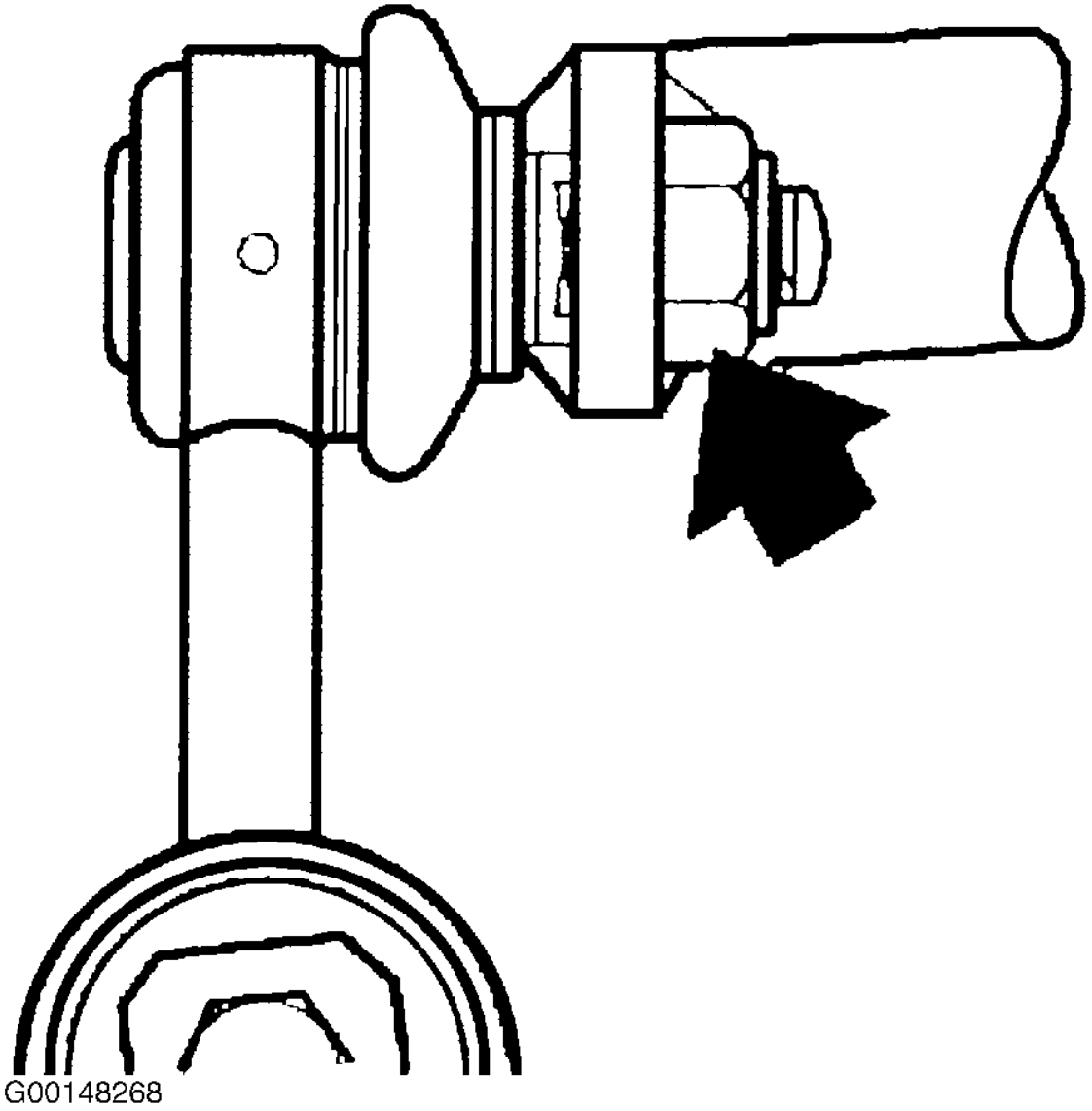


Fig. 36: Identifying Stabilizer Connection On Control
Courtesy of BMW OF NORTH AMERICA, INC.

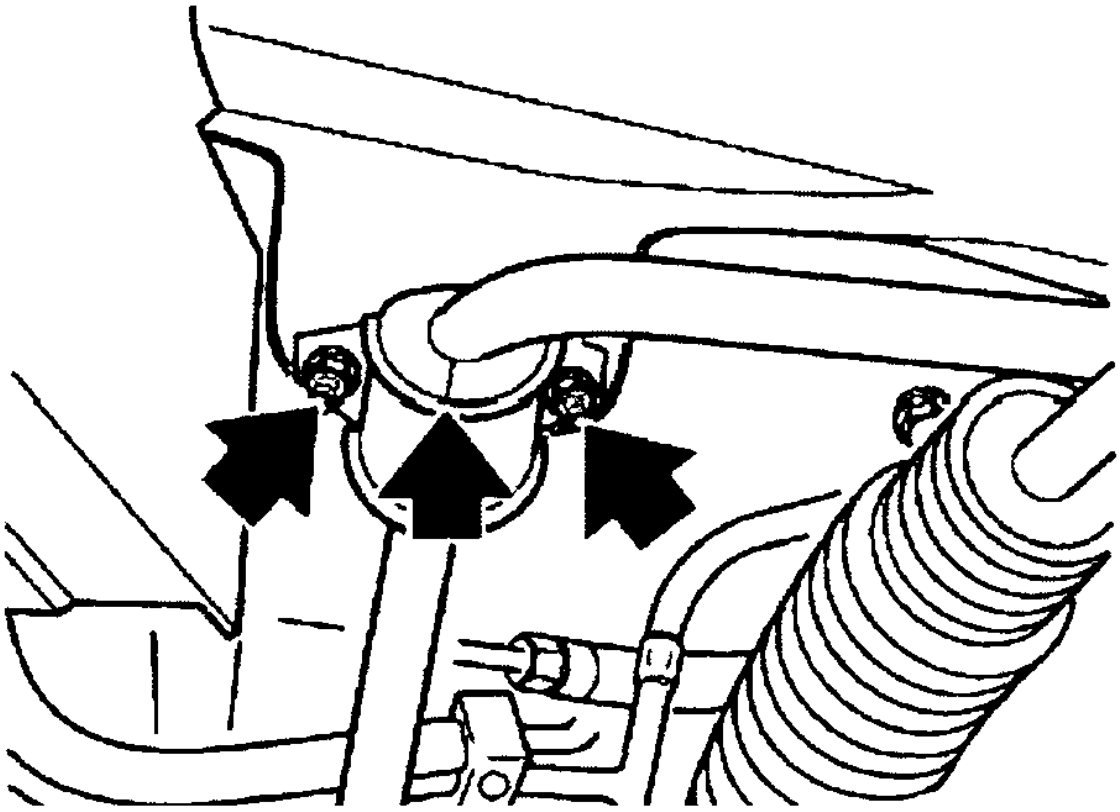


Fig. 37: Locating Stabilizer Clamp Components
Courtesy of BMW OF NORTH AMERICA, INC.

STEERING KNUCKLE

Removal & Installation

1. Raise and support vehicle. Remove front wheel assembly.
2. Remove front hub assembly. See WHEEL BEARING .
3. Remove tie-rod-to-steering knuckle nut and discard. Using Tie-Rod Remover (32 2 070), remove tie-rod from steering knuckle. See Fig. 38 .
4. Remove dust guard plate. See Fig. 39 .
5. Remove 2 strut-to-steering knuckle bolts and discard. See Fig. 19 .
6. Remove upper strut-to-steering knuckle bolt and lock nut. See Fig. 20 .
7. Remove control arm-to-steering knuckle ball joint nut and discard. See Fig. 18 .
8. Using Ball Joint Separator (31 2 160), separate control arm-to-steering knuckle ball joint. See Fig. 21 .
9. Remove steering knuckle.
10. Ensure new steering knuckle has matching code (K) to old. See Fig. 40 .
11. To install, reverse removal procedure. Clean tapped bores. Replace all lock nuts and strut bolts. Tighten fasteners to specification. See TORQUE SPECIFICATIONS .

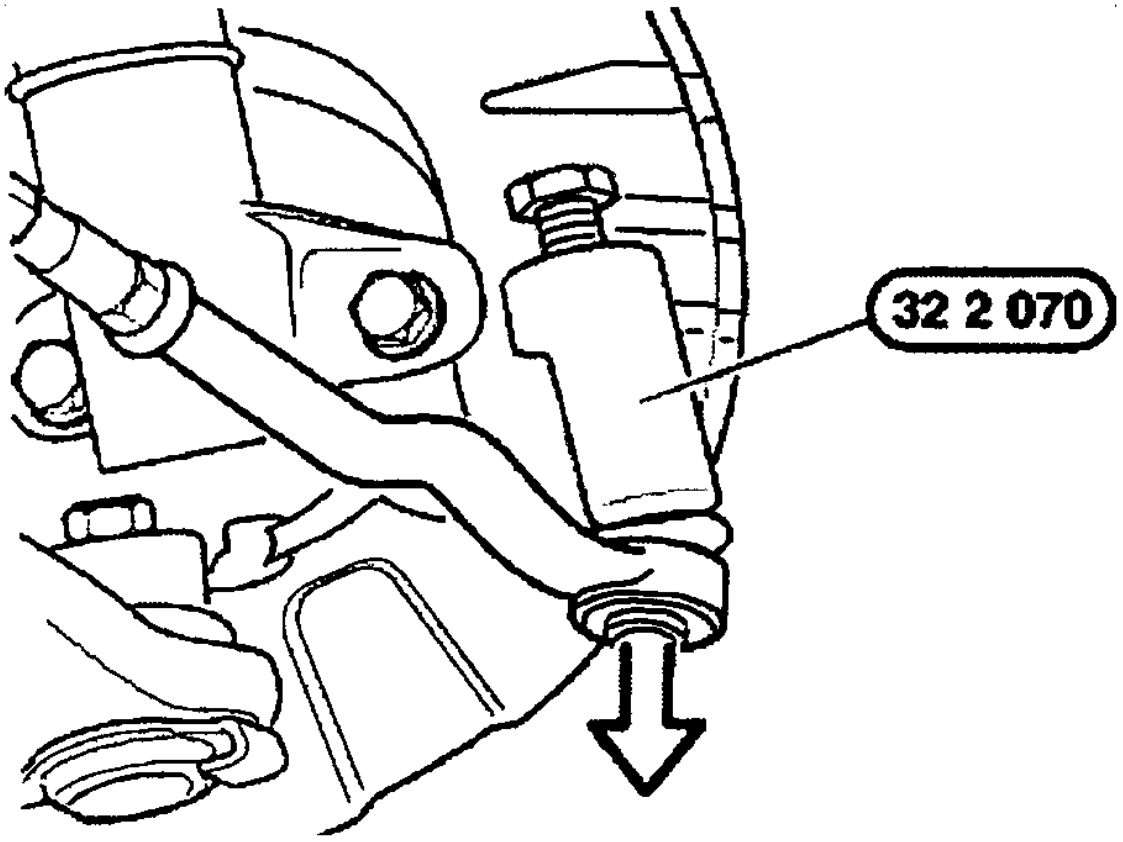


Fig. 38: Removing Tie-Rod End
Courtesy of BMW OF NORTH AMERICA, INC.

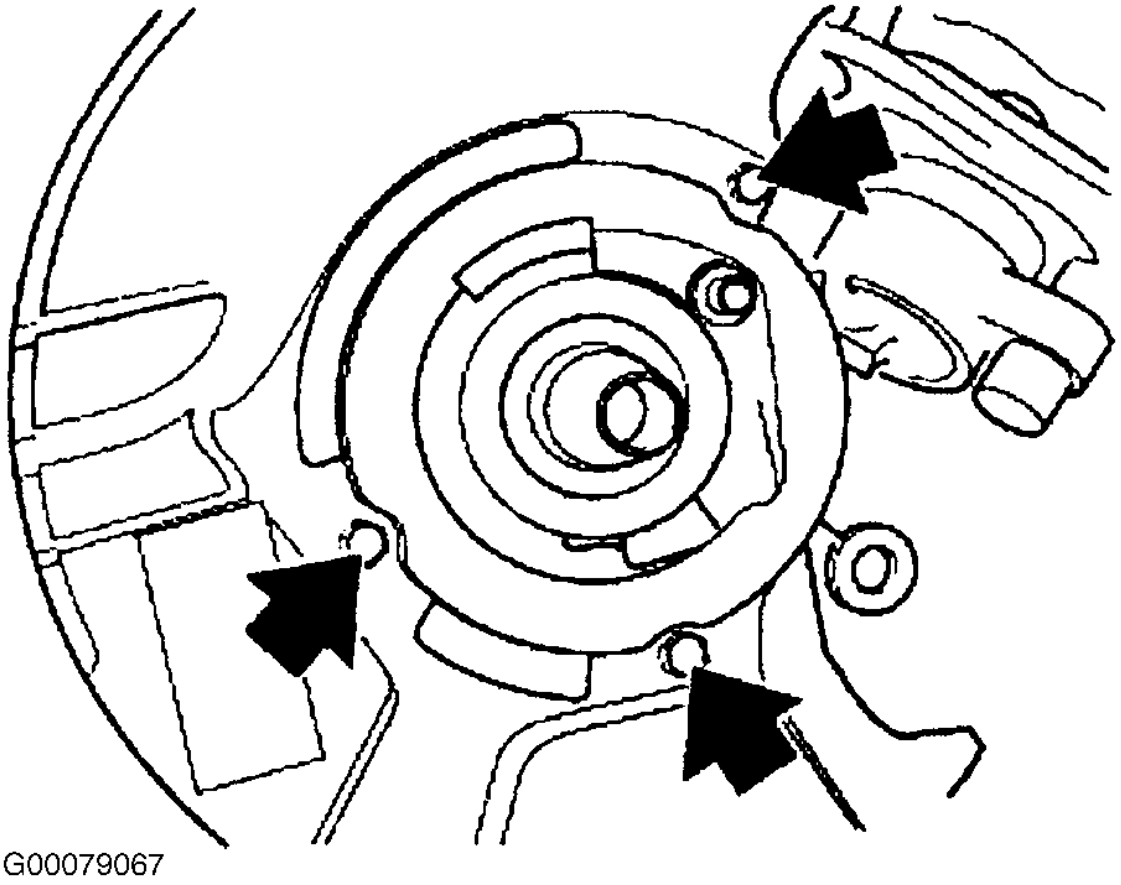


Fig. 39: Locating Dust Guard Plate Bolts
Courtesy of BMW OF NORTH AMERICA, INC.

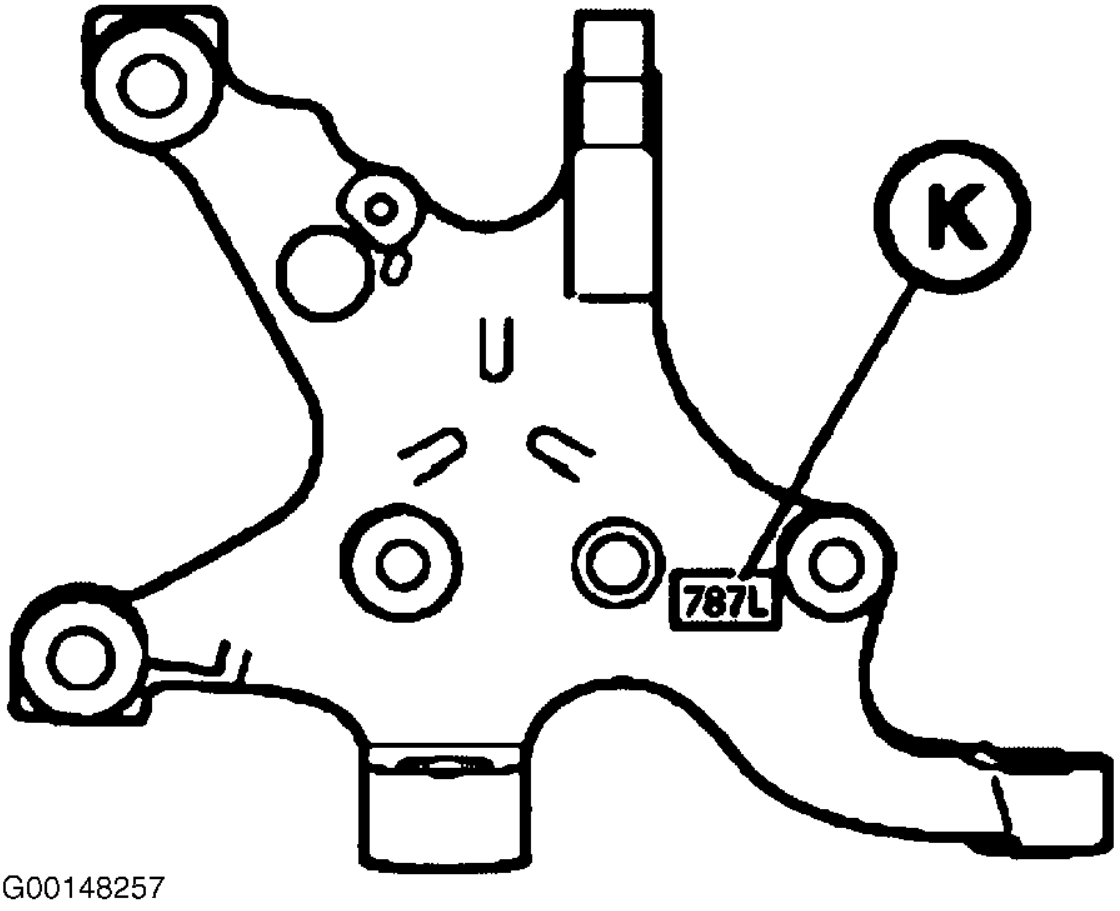


Fig. 40: Locating Identification Code For Steering Knuckle
Courtesy of BMW OF NORTH AMERICA, INC.

STRUT ASSEMBLY

NOTE: Always store strut assembly standing upright. DO NOT allow strut assembly to lie horizontally or upside down for any length of time. If incorrect storage has occurred, place strut assembly upright with strut rod fully extended for at least 24 hours.

Removal

NOTE: When replacing strut, ensure replacement strut is marked with the same code (K) as the old strut. See Fig. 41 .

1. Raise and support vehicle. Remove front wheel assembly.
2. Remove wire harness and brake lines from strut assembly.
3. Screw in a wheel lug bolt and suspend wheel bearing assembly from body with wire.
4. Disconnect stabilizer bar link from strut. See Fig. 42 .
5. Remove 2 strut-to-steering knuckle bolts and discard. See Fig. 19 .
6. Remove upper strut-to-steering knuckle bolt and lock nut. See Fig. 20 .
7. Remove 3 strut retaining nuts from top of strut tower. See Fig. 34 .
8. Remove strut assembly.

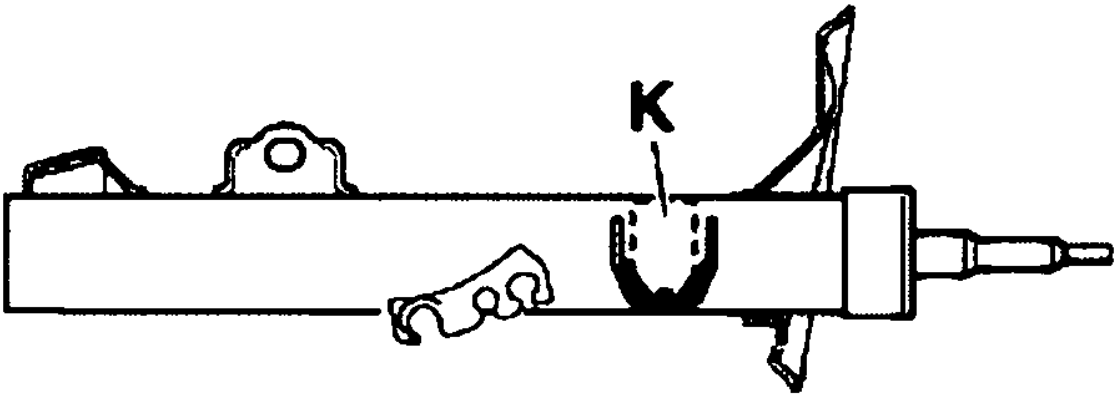


Fig. 41: Identifying Strut
Courtesy of BMW OF NORTH AMERICA, INC.

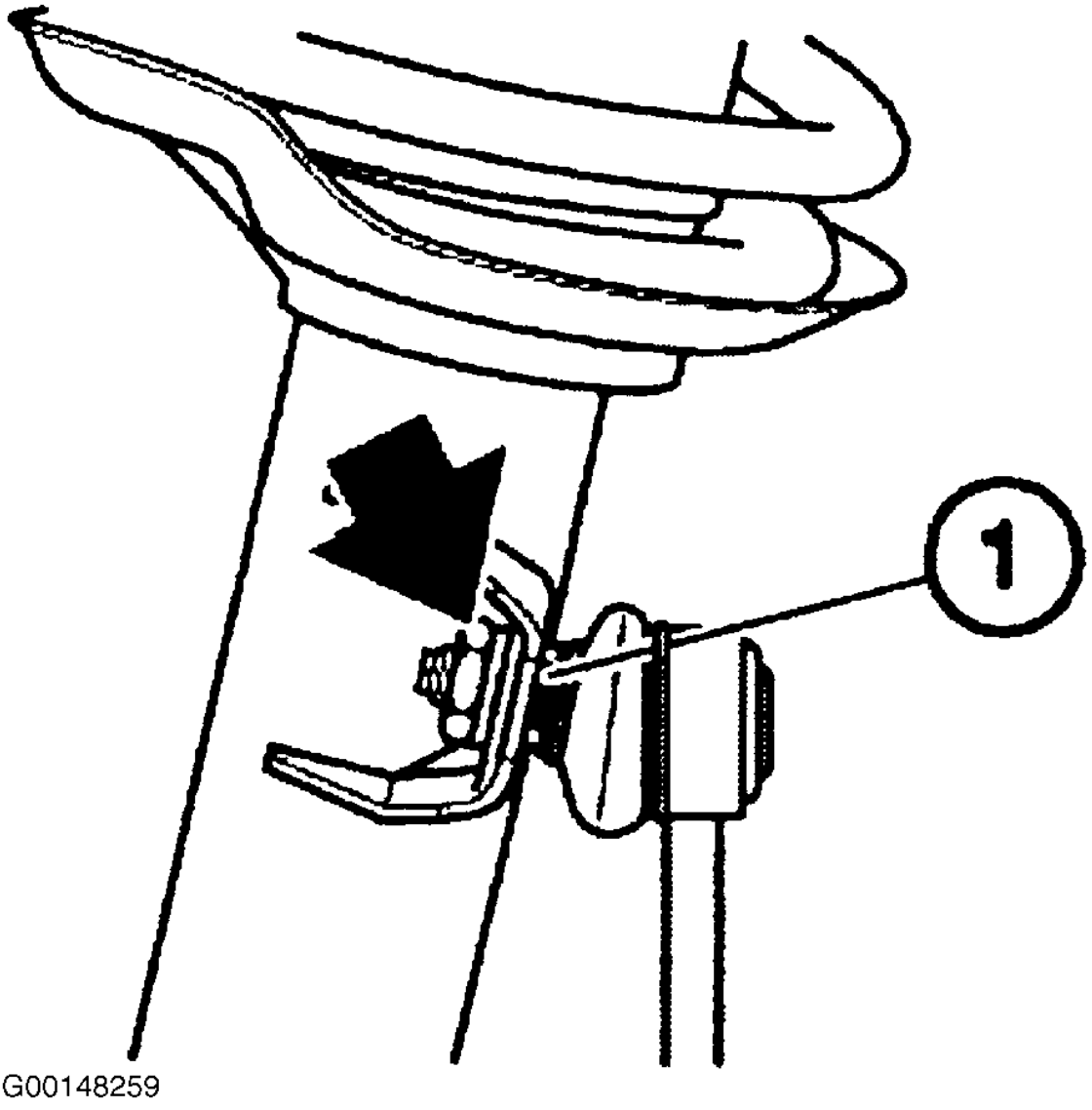


Fig. 42: Disconnecting Stabilizer Bar Link
Courtesy of BMW OF NORTH AMERICA, INC.

Disassembly & Reassembly

WARNING: Locking pins must be felt and heard snapping into place. Keep special tools completely dry and free from grease.

1. Clamp special tool (31 3 341) at guide (1) in a vise. On M model, use special tool (31 3 351) in place of 352/354. Ensure spring retainer locking pins (2) on spring compressor are securely locked in position. See Fig. 43 .
2. Spring retainers must each be inserted from chamfer (1) of special tool (31 3 341). See Fig. 44 .
3. Support coil spring with upper and lower coil between spring retainers. See Fig. 45 .
4. Only compress coil spring until spring force on upper mount is relieved.
5. Replace nut with special tool (31 3 170/210). If necessary, replace wrench insert. Unfasten and remove spring strut shock absorber. See Fig. 46 .
6. Check rubber damper with protective tube and rings. Auxiliary spring for standard suspension distance (A) is 16 mm. For low-slung sports suspension distance (A) is 8 mm. See Fig. 47 .
7. Spacer ring (A) is fitted in vehicles with "rough road package" version. See Fig. 48 .
8. If necessary, replace rubber damper.
9. To assemble, place coil spring in spring compressor with one coil of spring outside of spring retainers at both ends. Compress coil spring and install strut using a NEW lock nut. Tighten lock nut to specification. See TORQUE SPECIFICATIONS .

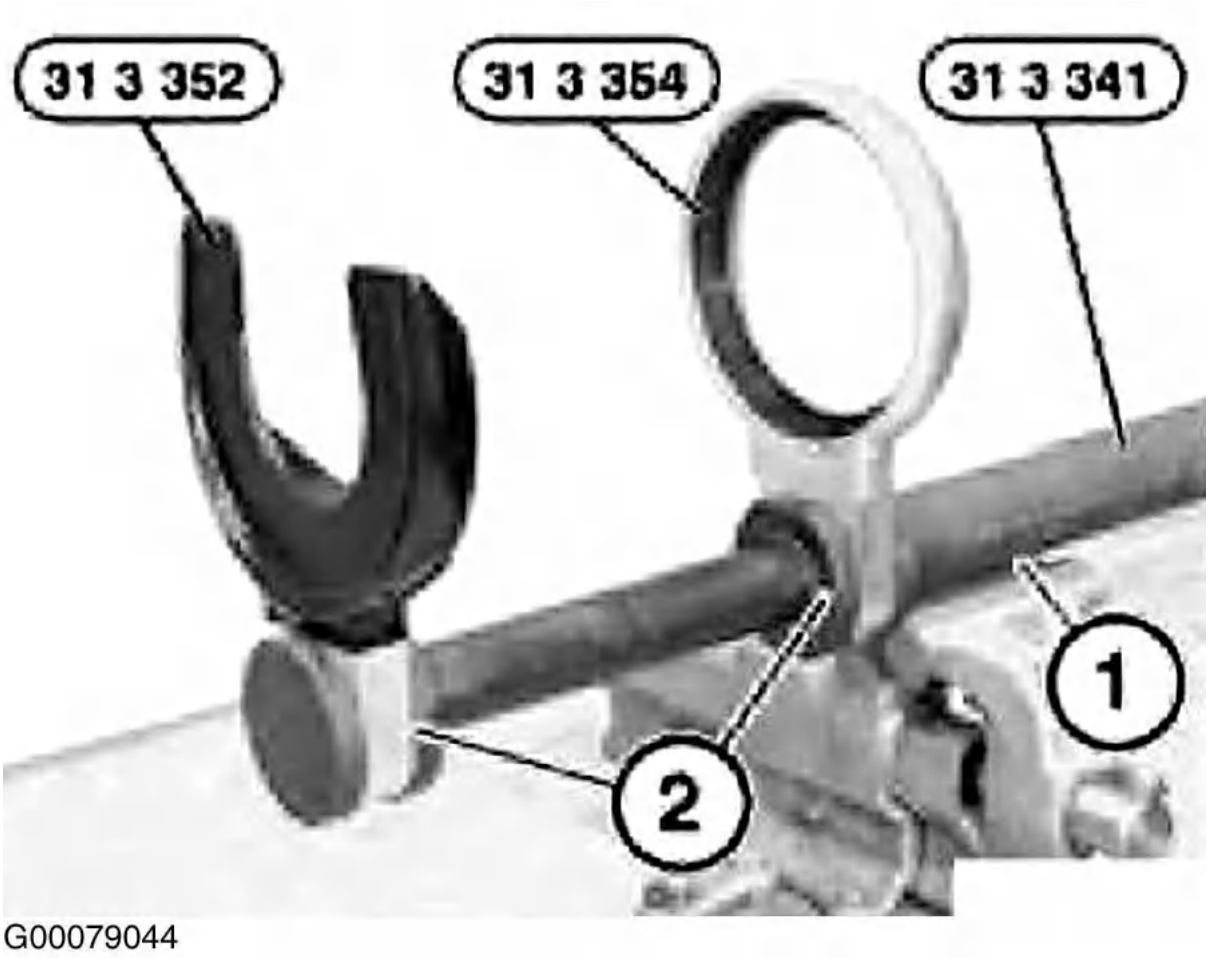


Fig. 43: Identifying Spring Compressor
Courtesy of BMW OF NORTH AMERICA, INC.

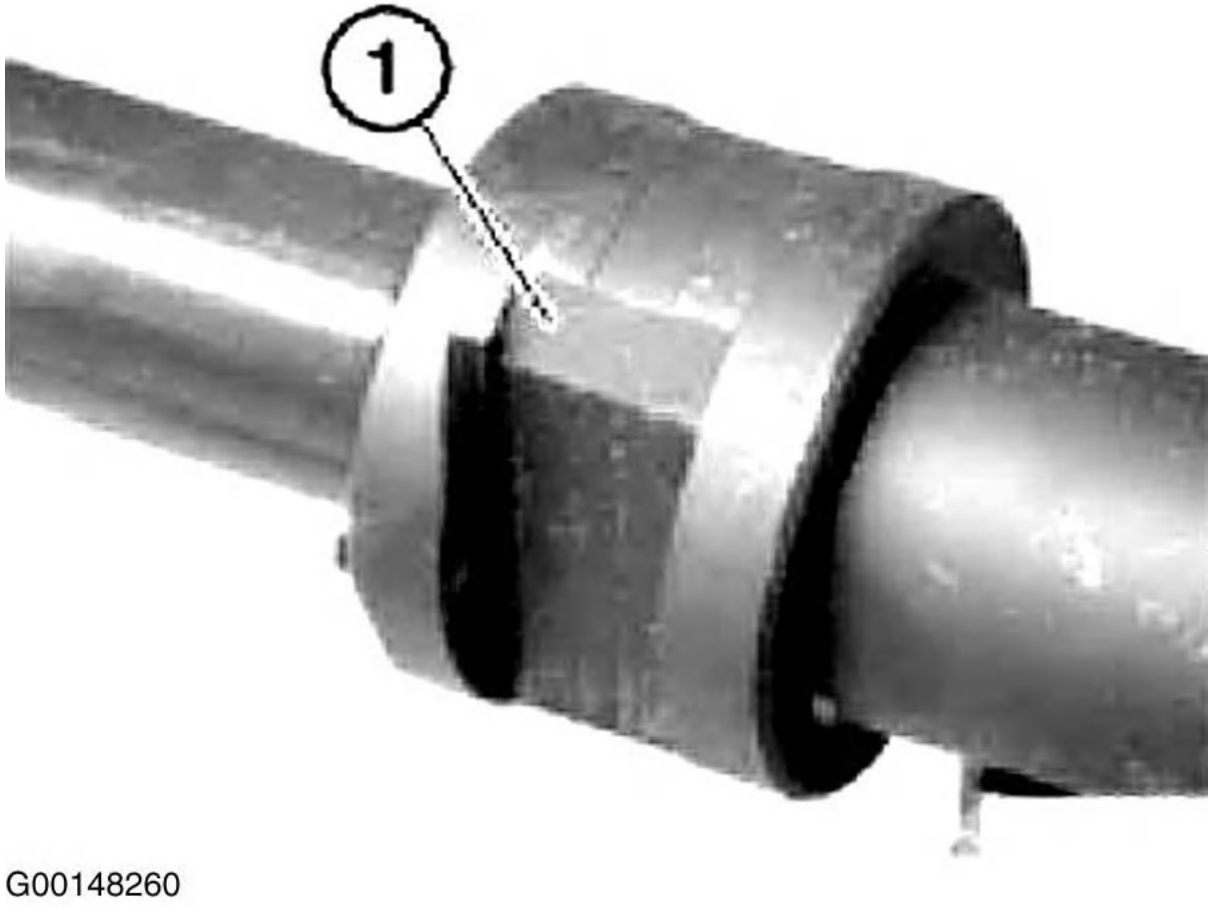


Fig. 44: Locating Chamfer
Courtesy of BMW OF NORTH AMERICA, INC.

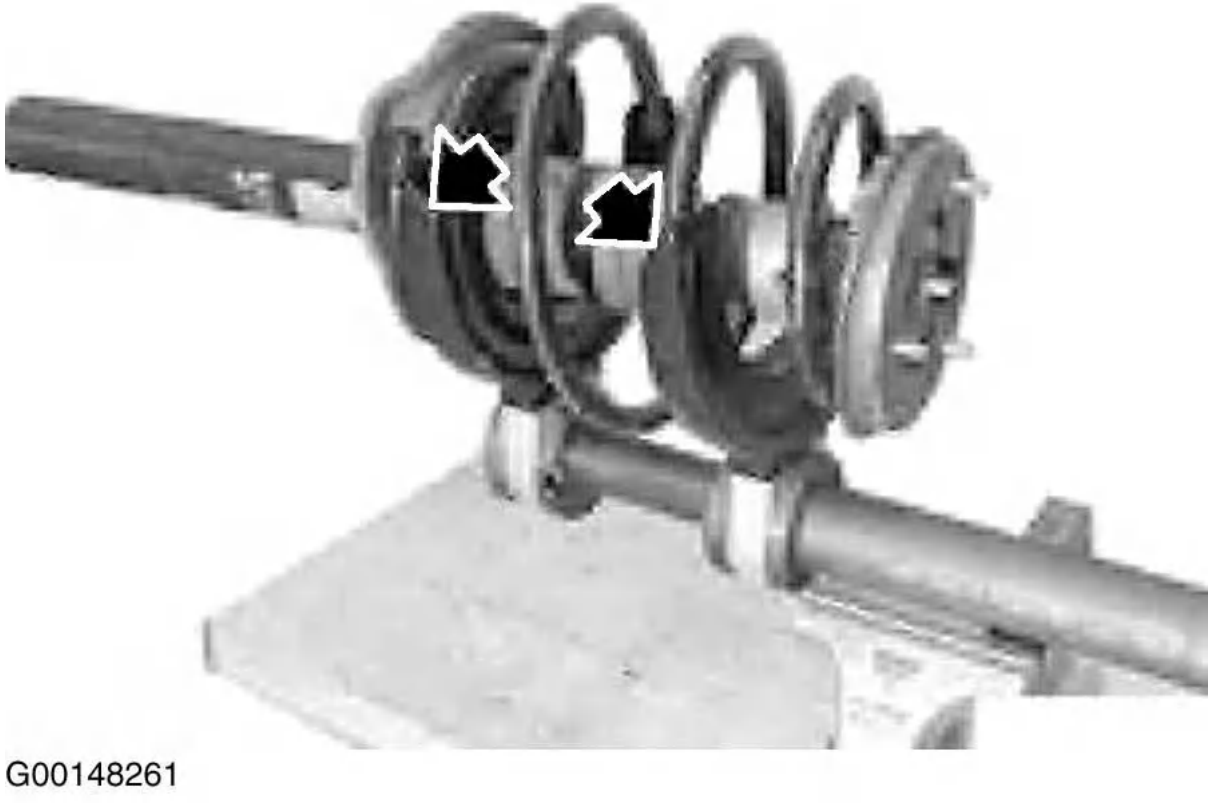


Fig. 45: Installing Spring In Special Tool
Courtesy of BMW OF NORTH AMERICA, INC.

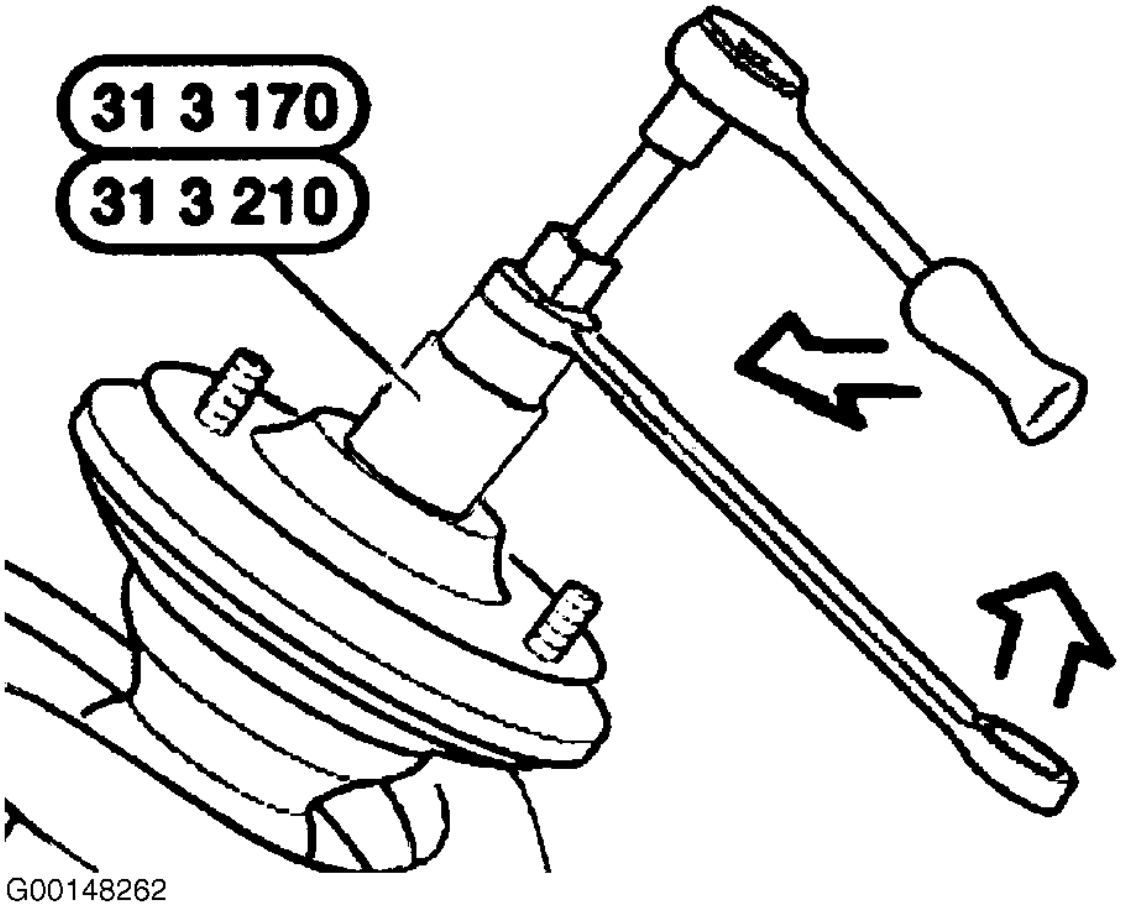


Fig. 46: Using Special Tool (31 3 170/210)
Courtesy of BMW OF NORTH AMERICA, INC.

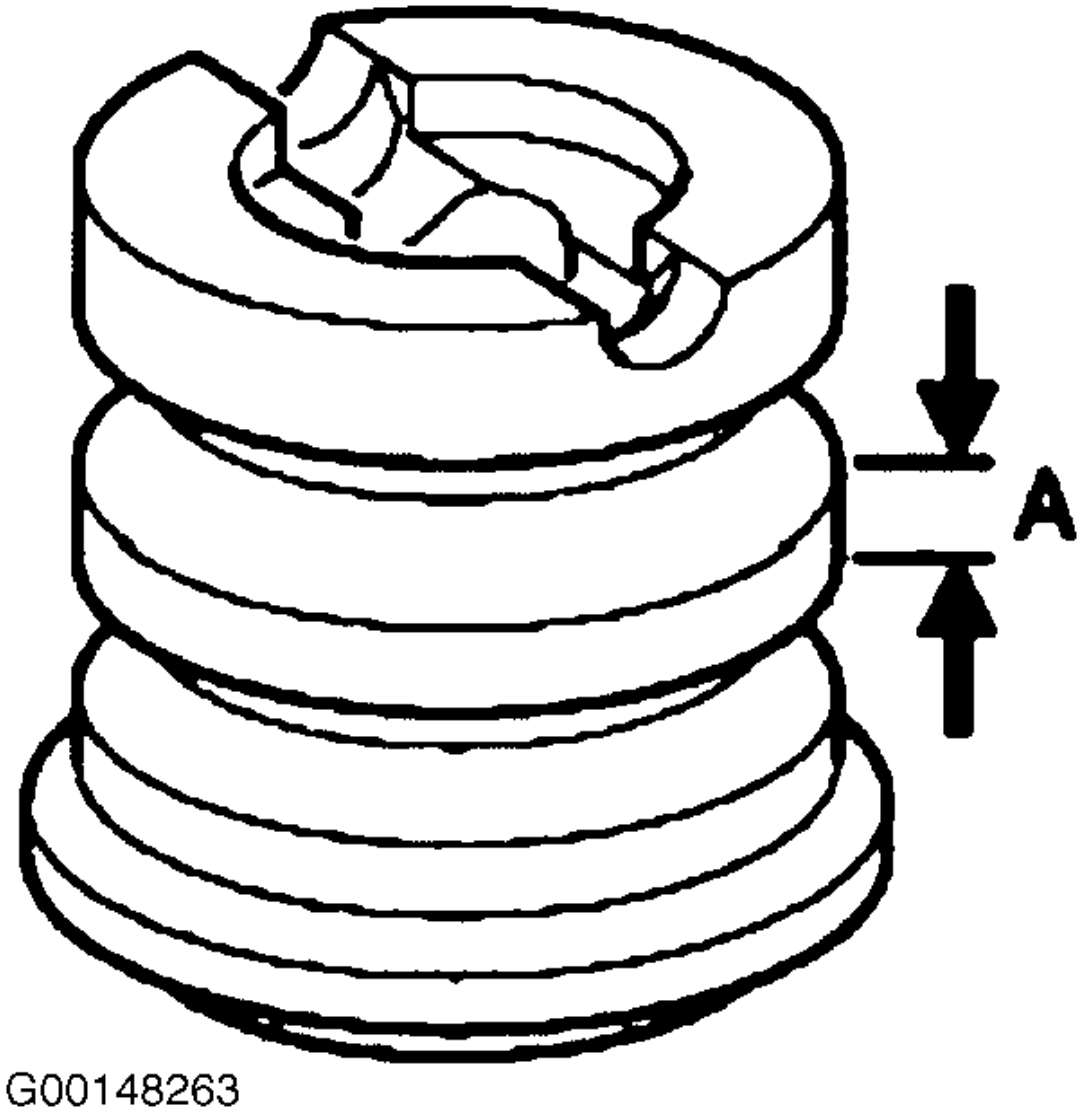


Fig. 47: Identifying Rubber Damper
Courtesy of BMW OF NORTH AMERICA, INC.

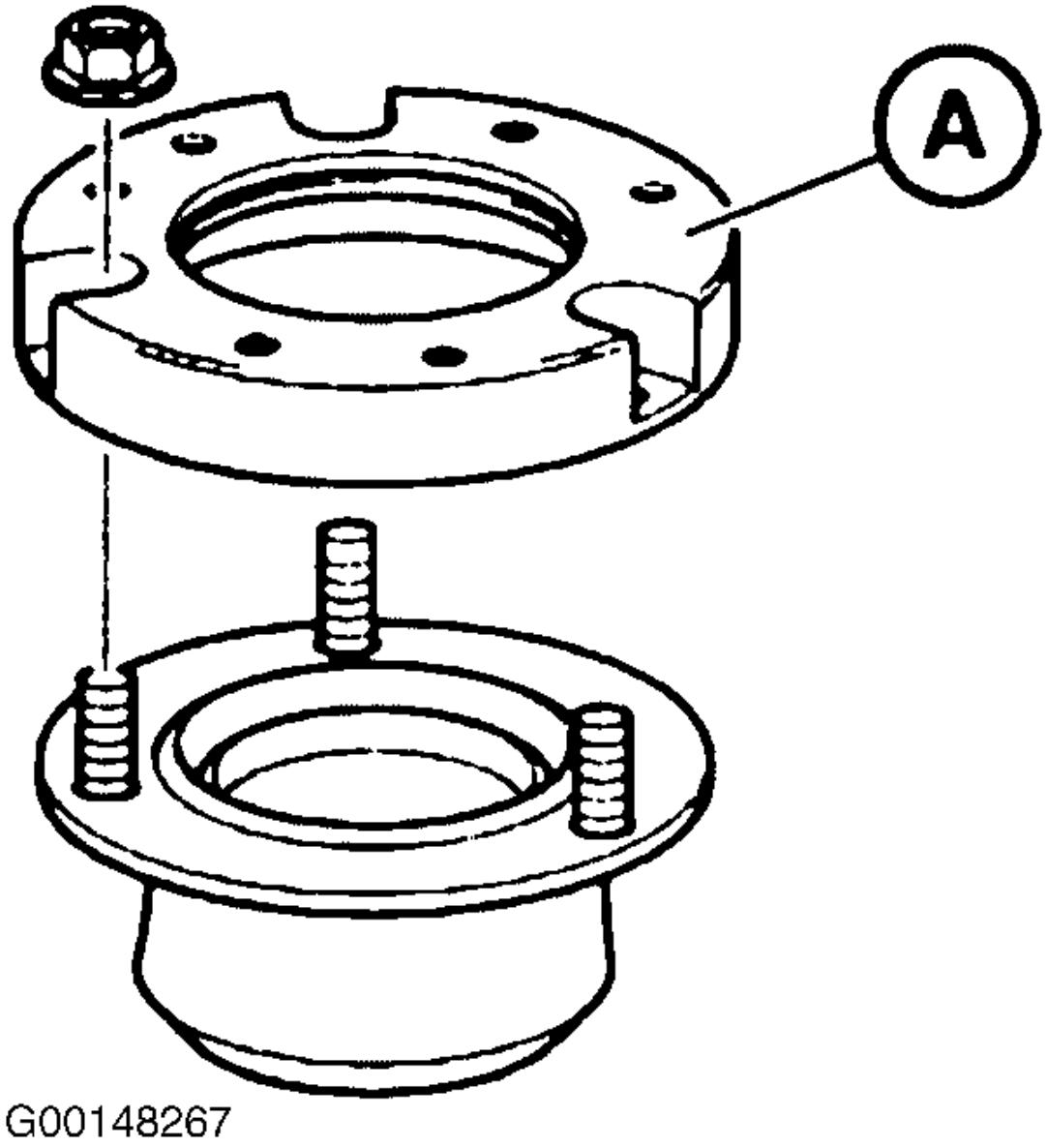


Fig. 48: Identifying Spacer Ring
Courtesy of BMW OF NORTH AMERICA, INC.

Installation

CAUTION: On M3 and M Roadster, long sheet metal flange on thrust bearing must point in forward direction.

1. To install, reverse removal procedure.
2. Replace all lock nuts and strut-to-steering knuckle bolts. Tighten fasteners to specifications. See TORQUE SPECIFICATIONS .

WHEEL BEARING

Removal

1. Raise and support front of vehicle. Remove wheel assembly.

2. Remove brake caliper and wire aside.
3. Remove ABS sensor and brake rotor. See appropriate article in BRAKES.
4. Remove hub grease cap and discard. See Fig. 49 .
5. Unlock axle hub collar nut stakes using a hammer and chisel. See Fig. 50 .
6. Using Socket (31 2 080), remove collar nut and discard. See Fig. 51 .
7. Using wheel lug bolts, attach Fixture (33 2 116) to front hub. Attach Puller (33 4 201/202/203) to fixture and remove hub assembly. See Fig. 52 .
8. When inner bearing race remains on stub axle, remove dust guard plate. See Fig. 39 .
9. Using Puller (00 7 500) and Adapter (31 2 106), pull inner bearing race off stub axle. See Fig. 53 .

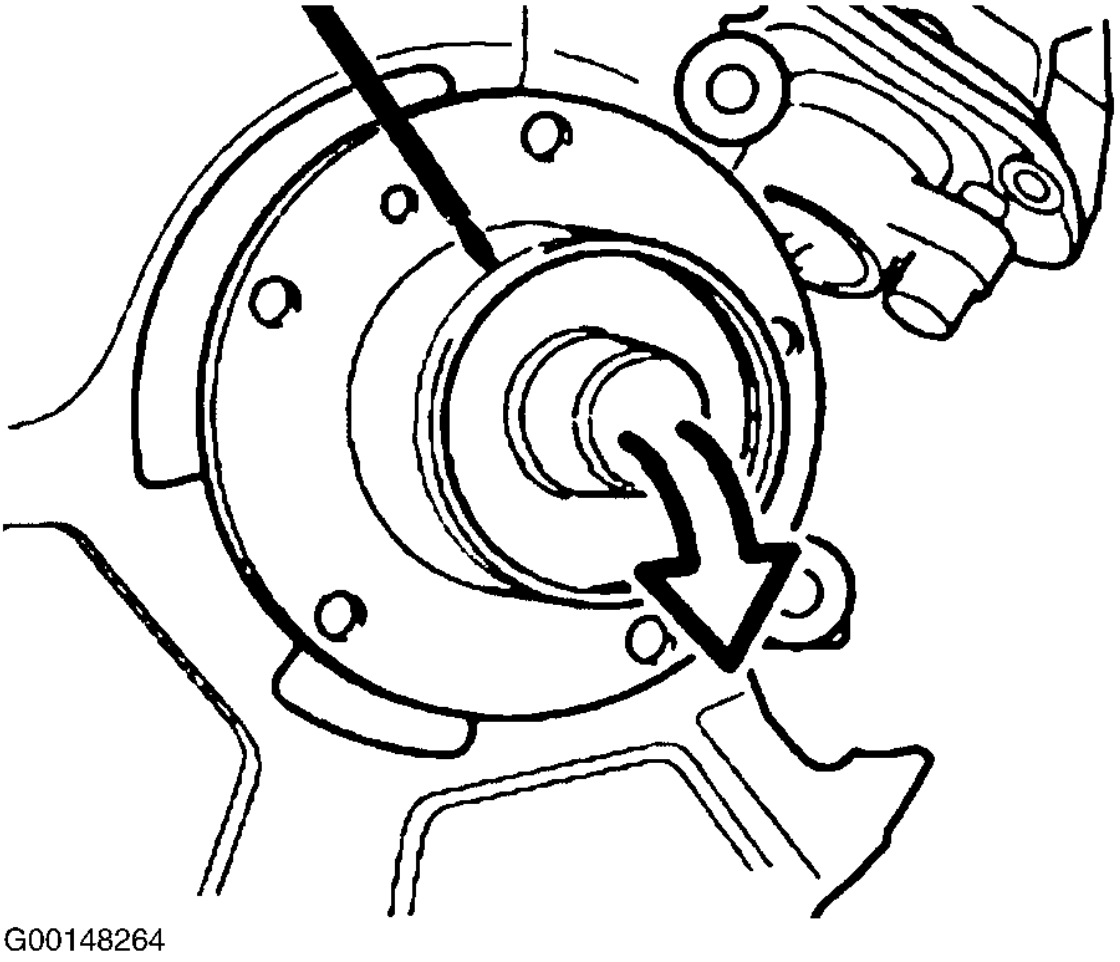


Fig. 49: Removing Grease Cap
Courtesy of BMW OF NORTH AMERICA, INC.

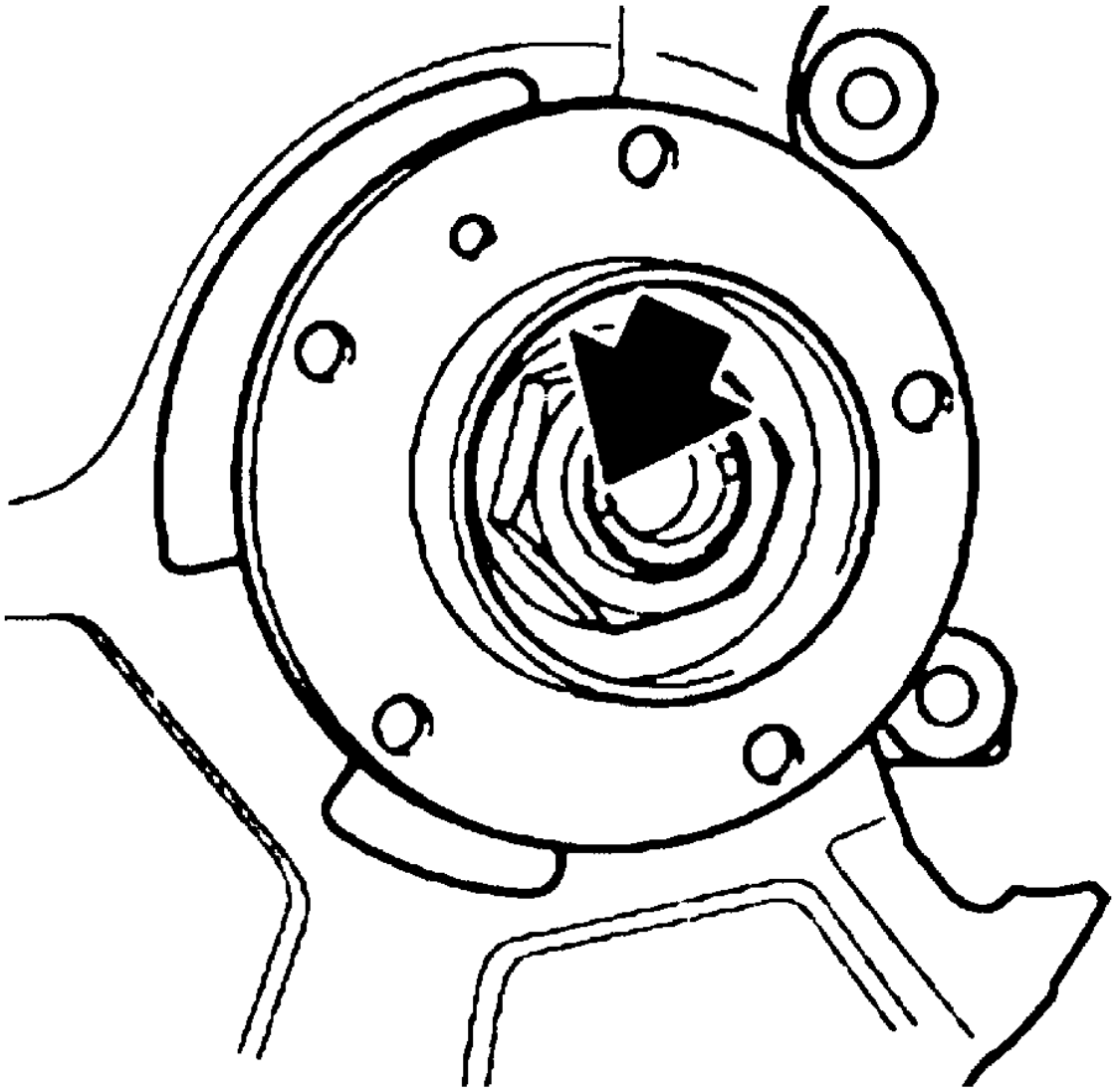


Fig. 50: Unlocking Collar Nut
Courtesy of BMW OF NORTH AMERICA, INC.

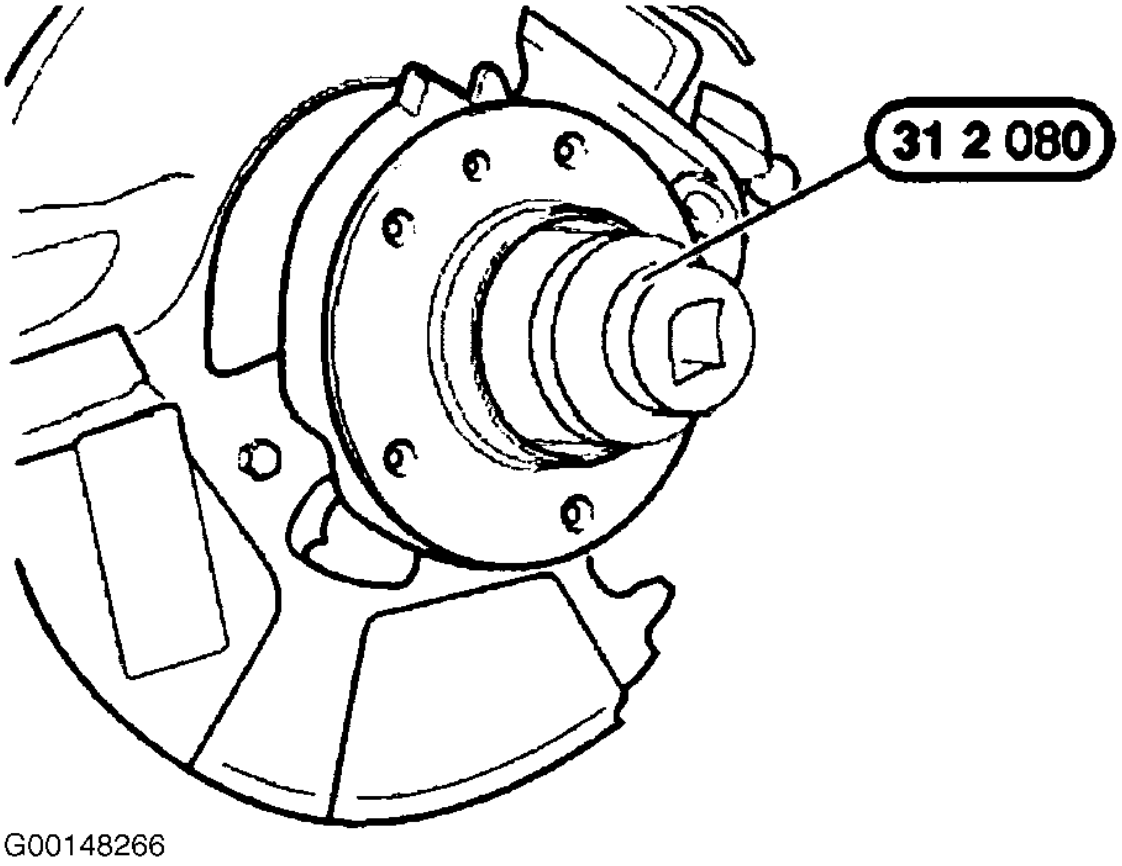


Fig. 51: Unscrewing Collar Nut
Courtesy of BMW OF NORTH AMERICA, INC.

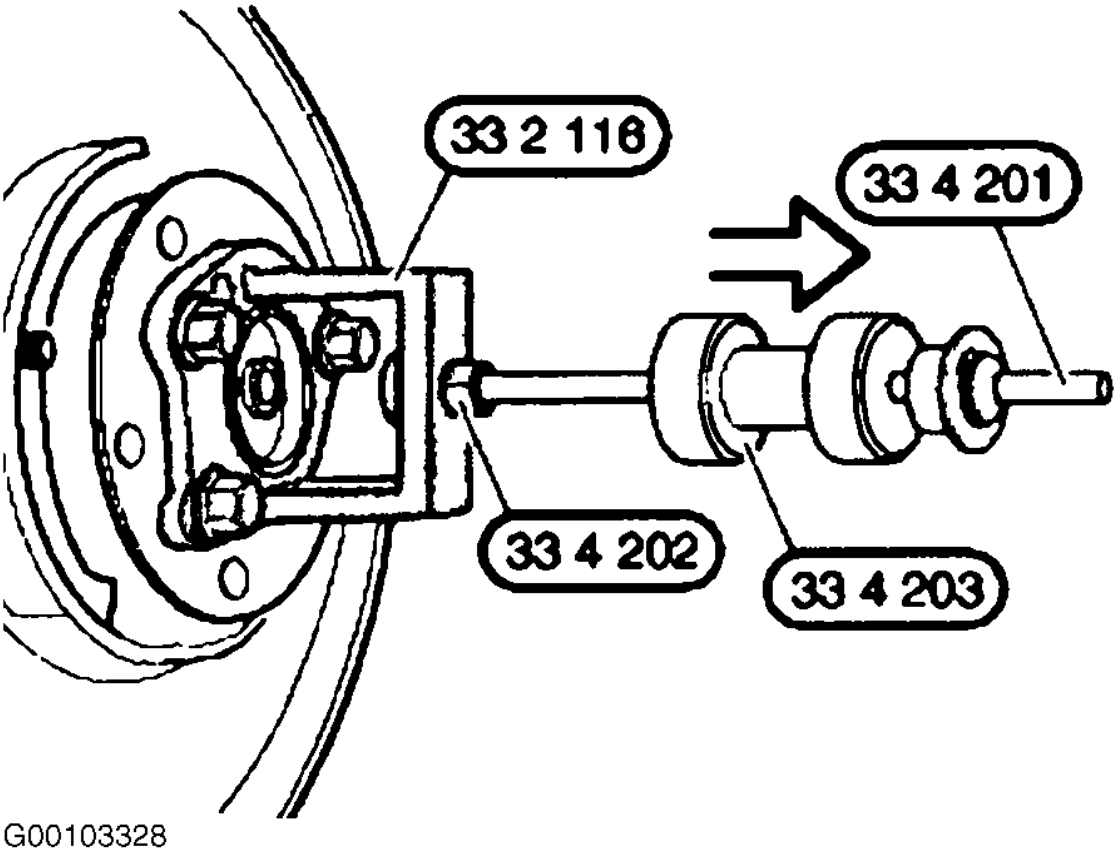
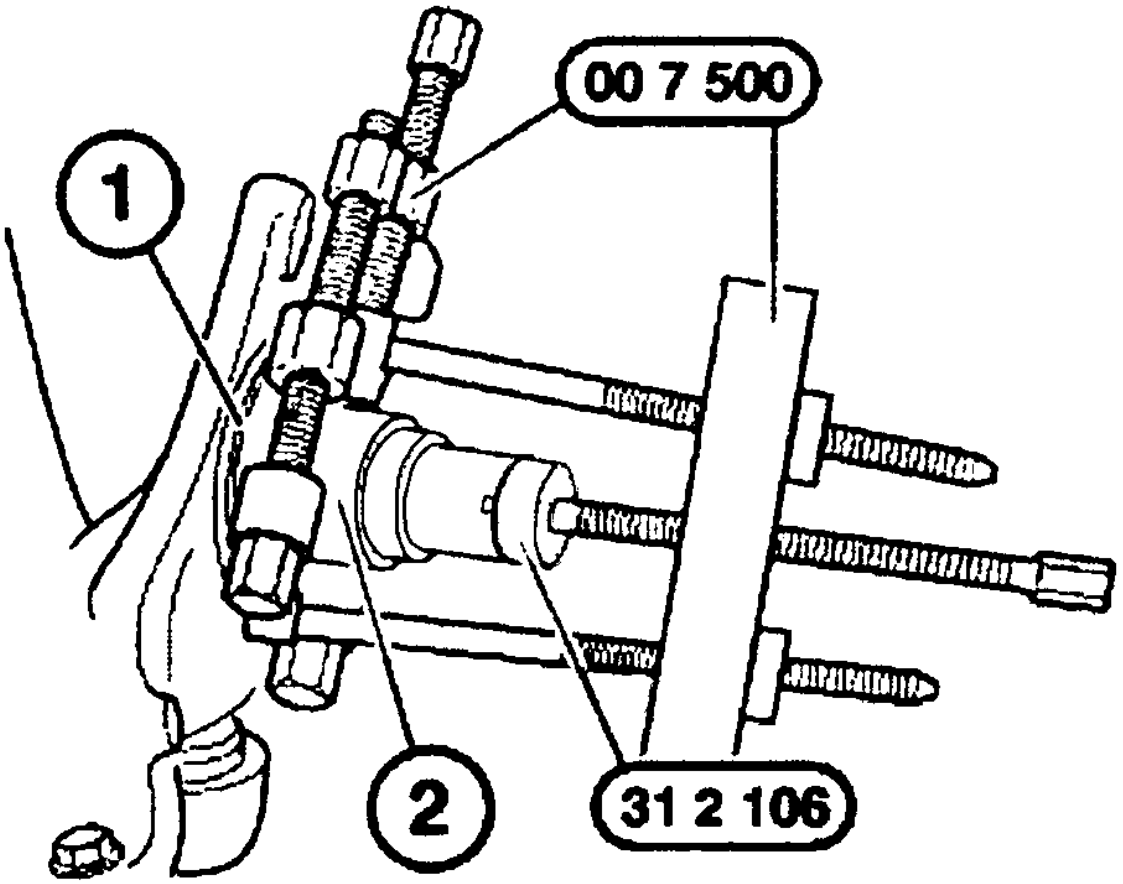


Fig. 52: Removing Drive Flange
Courtesy of BMW OF NORTH AMERICA, INC.



1. Dust Guard Plate
2. Bearing Race

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Fig. 53: Removing Inner Bearing Race
Courtesy of BMW OF NORTH AMERICA, INC.

Installation

1. Reverse removal procedure to complete installation.
2. Screw in guide sleeve (1) of special tool (31 2 110) onto stub axle for entire length of threads, and press NEW bearing race onto stub axle. See Fig. 54 .
3. If applicable, install guard plate. See Fig. 39 .
4. Use installer to press NEW hub/wheel bearing assembly onto stub axle. Install NEW collar nut and tighten to specification. See TORQUE SPECIFICATIONS .
5. Stake collar nut.
6. Apply sealing compound on a NEW hub grease cap, and install cap.

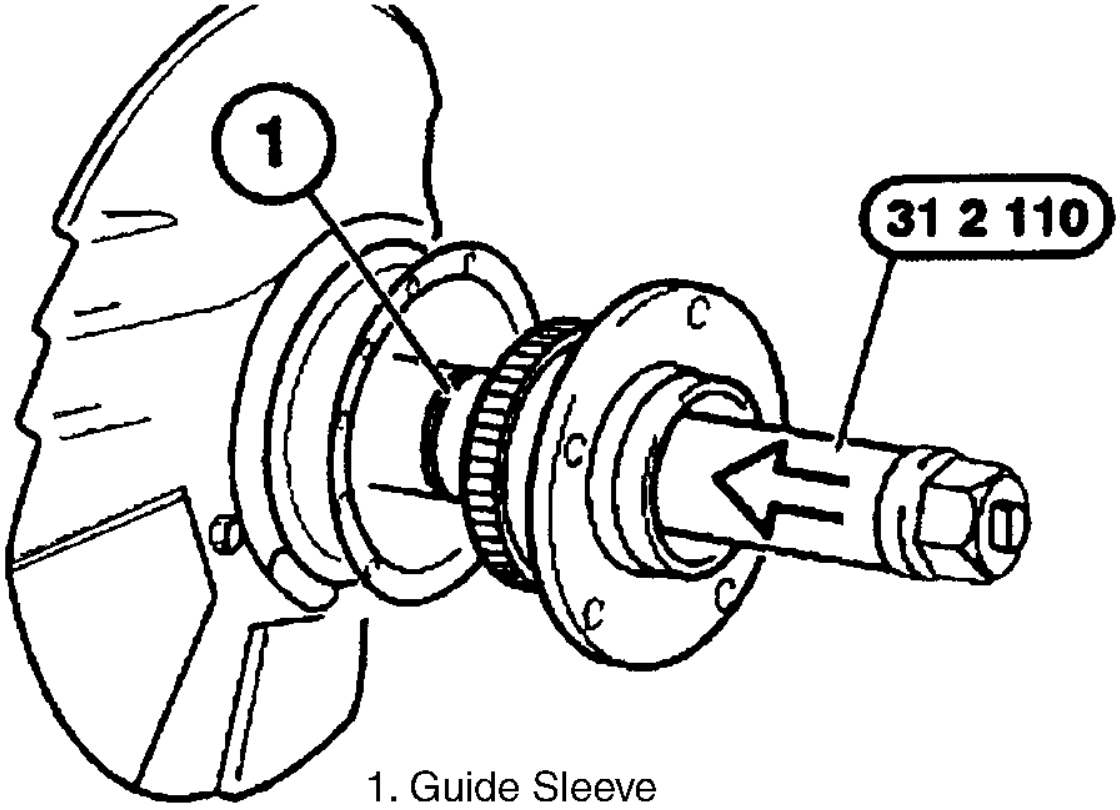


Fig. 54: Installing Inner Bearing Race
Courtesy of BMW OF NORTH AMERICA, INC.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Brake Caliper Bolts	81 (110)
Collar Nut	214 (290)
Control Arm Ball Joint-To-Steering Knuckle Nut	66 (90)
Control Arm Bracket Bolts	35 (47)
Control Arm-To-Steering Knuckle Bolts	48 (65)
Front Suspension Assembly Bolts	
10 mm Bolts	35 (47)
12 mm Bolts	77 (105)
Shock Absorber Piston Rod On Thrust Bearing	47 (64)
Stabilizer Bracket Bolts	16 (22)
Stabilizer Link On Spring Strut Shock Absorber & Stabilizer	44 (59)
Stabilizer Link-To-Control Arm Nut	31 (42)
Steering Gear To Front Axle Carrier	31 (42)
Strut Shaft Nut	48 (65)
Strut-To-Steering Knuckle	79 (107)
Strut-To-Strut Tower Nuts	
18 mm Nut	17 (24)
21 mm Nut	25 (34)

Tie Rod End Nut	24-29 (33-40)
Wheel Lug Bolts	81-96 (110-130)

SPECIAL TOOLS

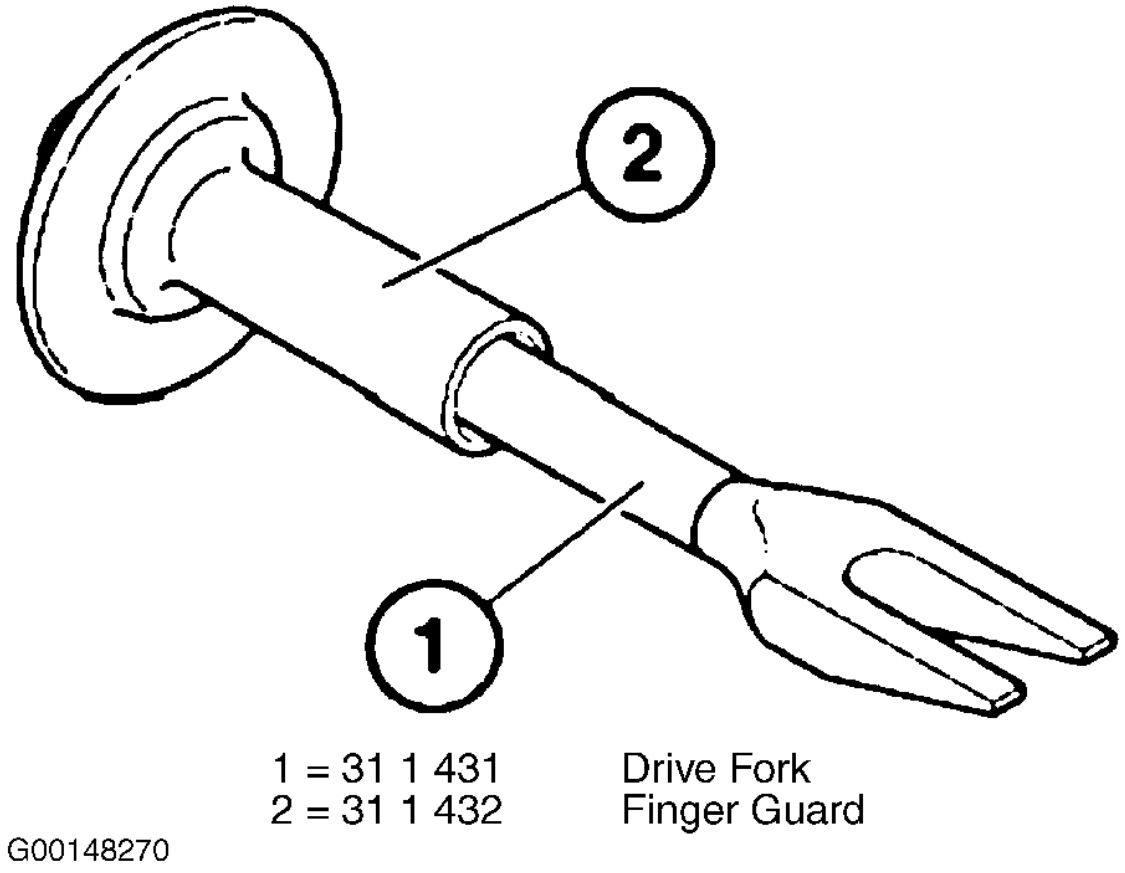
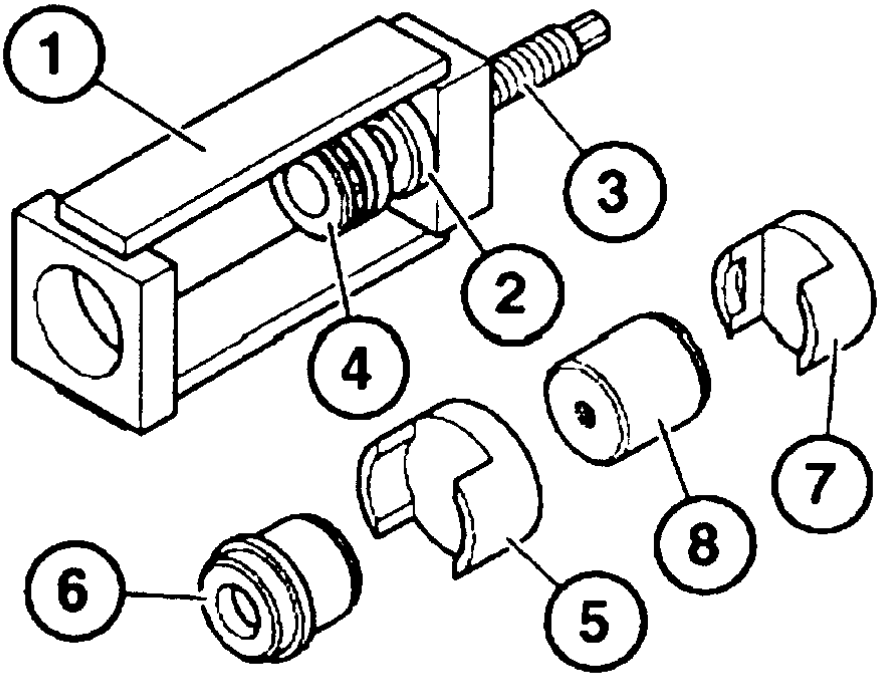


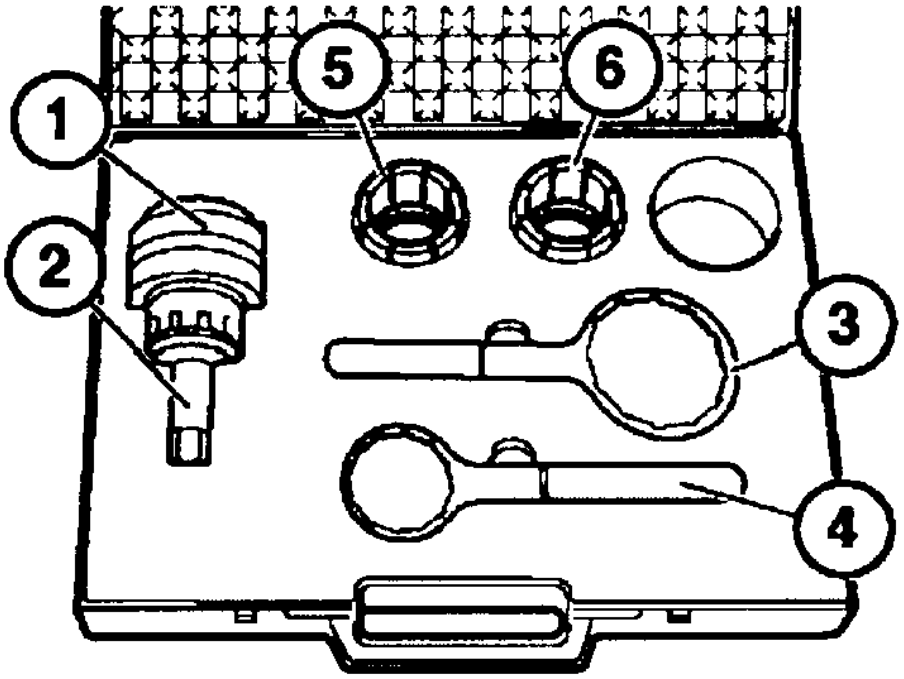
Fig. 55: Identifying Drive Fork (31 1 430)
Courtesy of BMW OF NORTH AMERICA, INC.



1	= 31 1 441	Basic body
2	= 31 1 442	Threaded bush
3	= 31 1 443	Spindle
4	= 31 1 444	Thrust bearing
5	= 31 1 445	Countersupport
6	= 31 1 446	Thrust piece
7	= 31 1 447	Thrust piece
8	= 31 1 448	Guide tube

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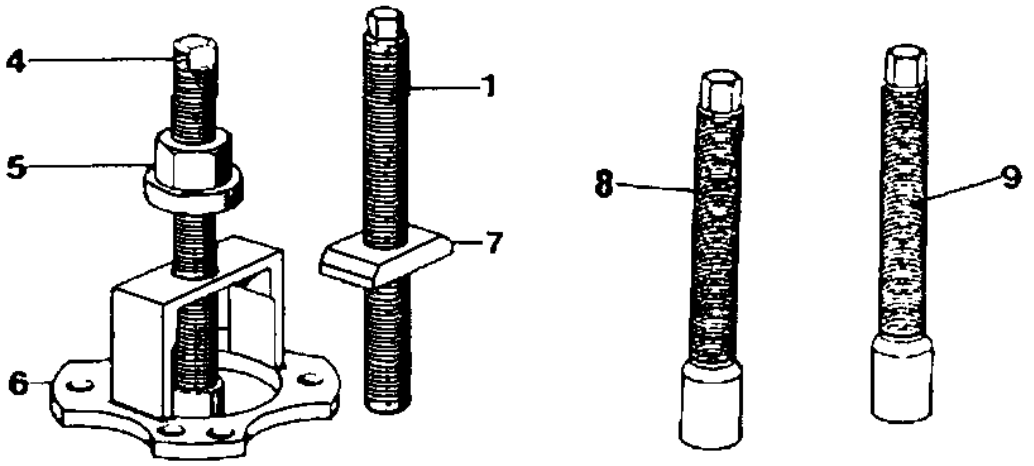
Fig. 56: Identifying Fixture (31 1 440)
Courtesy of BMW OF NORTH AMERICA, INC.



1	= 33 4 401	Basic body
2	= 33 4 402	Spindle
3	= 33 4 403	Wrench, large
4	= 33 4 404	Wrench, small
5	= 33 4 405	Clamping pliers (45...51 mm)
6	= 33 4 406	Clamping pliers (50...55 mm)

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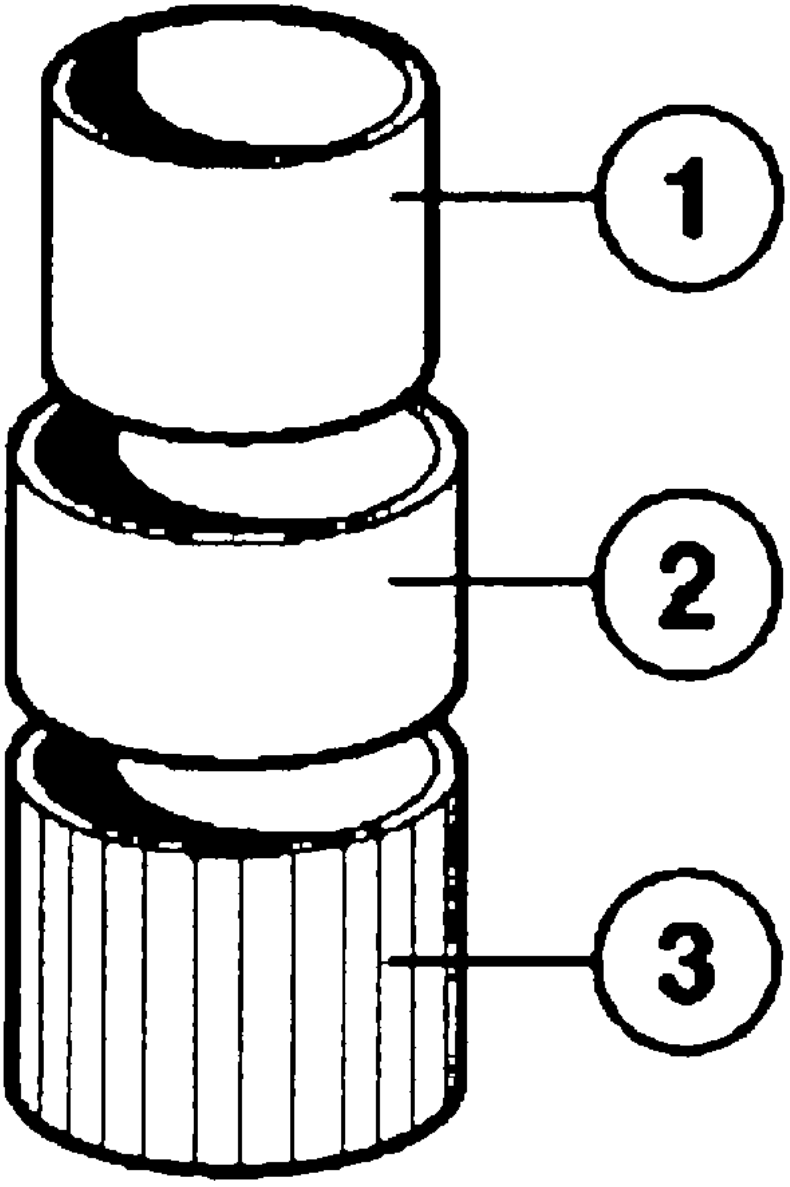
Fig. 57: Identifying Puller Fixture (33 4 400)
Courtesy of BMW OF NORTH AMERICA, INC.



1	= 33 2 111	Pressure spindle	7	= 33 2 117	Threaded piece
4	= 33 2 114	Spindle	8	= 33 2 118	Spindle for fitting
5	= 33 2 115	Nut with bearing	9	= 33 2 119	Spindle
6	= 33 2 116	Bridge			

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Fig. 58: Identifying Removal & Installation Tool (33 2 110)
Courtesy of BMW OF NORTH AMERICA, INC.

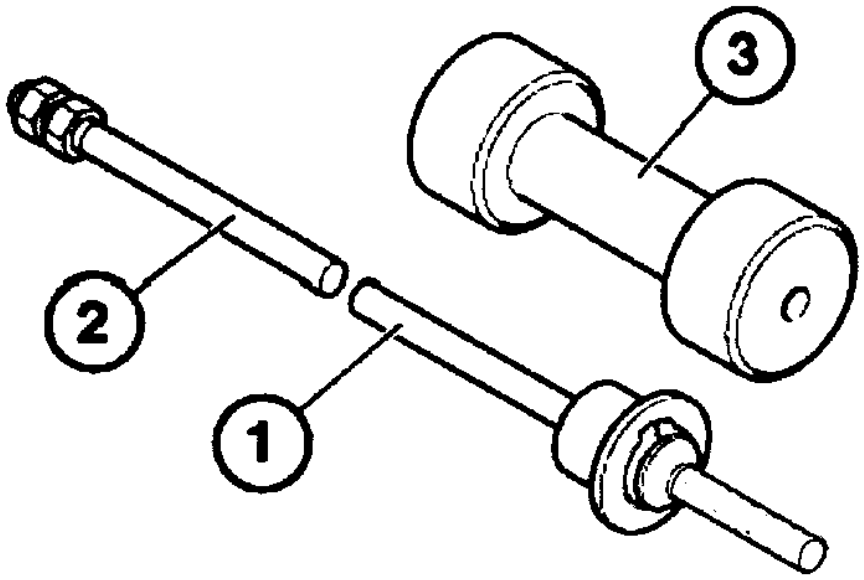


1 = 31 2 131 Pressure sleeve

3 = 31 2 133 Pressure sleeve

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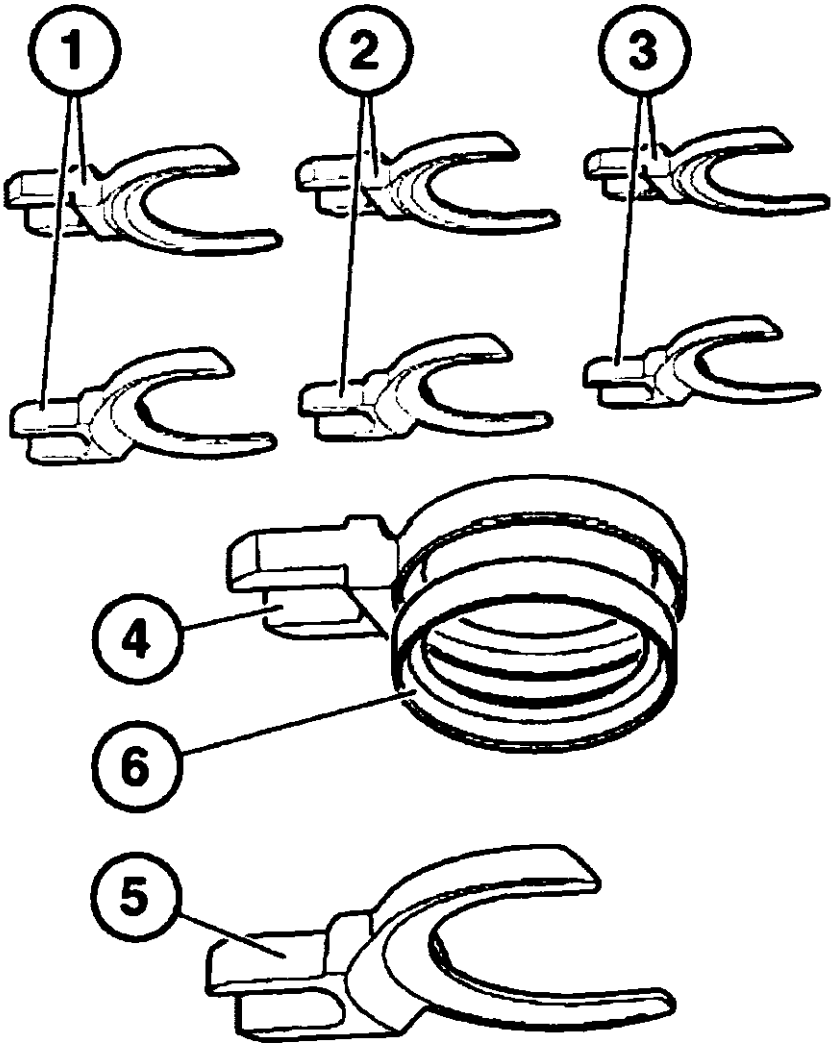
Fig. 59: Identifying Removal & Installation Tool (31 2 130)
Courtesy of BMW OF NORTH AMERICA, INC.



1	= 33 4 201	Striker rod with grip
2	= 33 4 202	Striker rod
		Note: With end piece and nut
3	= 33 4 203	Weight
4	= 33 4 205	Adapter

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Fig. 60: Identifying Set Of Tools (33 4 200)
Courtesy of BMW OF NORTH AMERICA, INC.



1 = 31 3 351 Spring holder (2 x)
2 = 31 3 352 Spring holder (2 x)
3 = 31 3 353 Spring holder (2 x)
4 = 31 3 354 Spring retaining ring
5 = 31 3 355 Spring holder
6 = 31 3 356 Centering ring
7 = 31 3 357 Spring holder (2 x)

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Fig. 61: Identifying Spring Holder Set (31 3 350)
Courtesy of BMW OF NORTH AMERICA, INC.

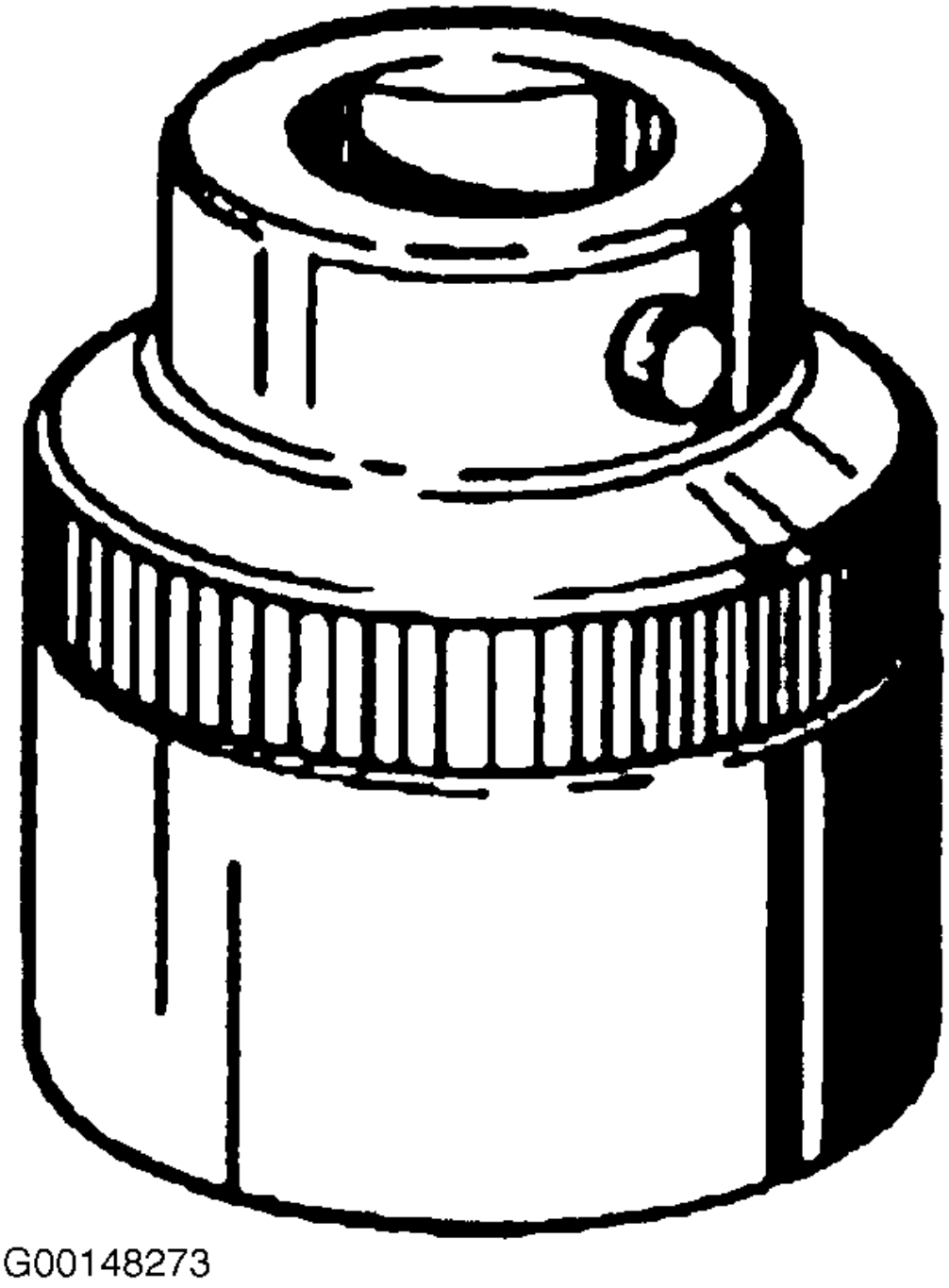


Fig. 62: Identifying Wrench Socket (31 2 080)
Courtesy of BMW OF NORTH AMERICA, INC.

Article GUID: A00136273

1991-2002 WHEEL ALIGNMENT

Specifications & Procedures

IDENTIFICATION

1991-2002 CHASSIS & ENGINE IDENTIFICATION (E36)

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)

1997-2002 CHASSIS & ENGINE IDENTIFICATION (E39)

Model (Chassis Code)	Engine Size (Code)
1997-2000	
528i (E39)	2.8L (M52)
1997-2002	
540i (E39)	4.4L (M62)
2000-2002	
M5 (E39)	5.0L (S62)
2001-2002	
525i (E39)	2.5L (M54)

530i (E39)	3.0L (M54)

1999-2002 CHASSIS & ENGINE IDENTIFICATION (E46)

Model (Chassis Code)	Engine Size (Code)
1999	
323is (E46)	2.5L (M52TU)
328i (E46)	2.8L (M52TU)
1999-2000	
323i (E46)	2.5L (M52TU)
2000	
323Ci (E46)	2.5L (M52TU)
328Ci (E46)	2.8L (M52TU)
2001-2002	
325i, 325Ci & 325xi (E46)	2.5L (M54)
330i, 330Ci & 330xi (E46)	3.0L (M54)
M3 (E46)	3.2L (S54)

2000-2002 CHASSIS & ENGINE IDENTIFICATION (E52)

Model (Chassis Code)	Engine Size (Code)
2000-2002	
Z8 (E52)	5.0L (S62)

2000-2002 CHASSIS & ENGINE IDENTIFICATION (E53)

Model (Chassis Code)	Engine Size (Code)
2000-2002	
X5 (E53)	4.4L (M62)
2001-2002	
X5 (E53)	3.0L (M54)
2002	
X5 (E53)	4.6L (M62)

2002 CHASSIS & ENGINE IDENTIFICATION (E65)

Model (Chassis Code)	Engine Size (Code)
2002	
745i & 745Li (E65)	4.4L (N62)

RIDING HEIGHT ADJUSTMENT

CAUTION: On vehicles with air springs, pull fuse of air supply system so there is no regulation.

NOTE: On vehicles with electronic chassis controls, all systems should be functional before attempting riding height or wheel alignment adjustment.

EXCEPT Z3

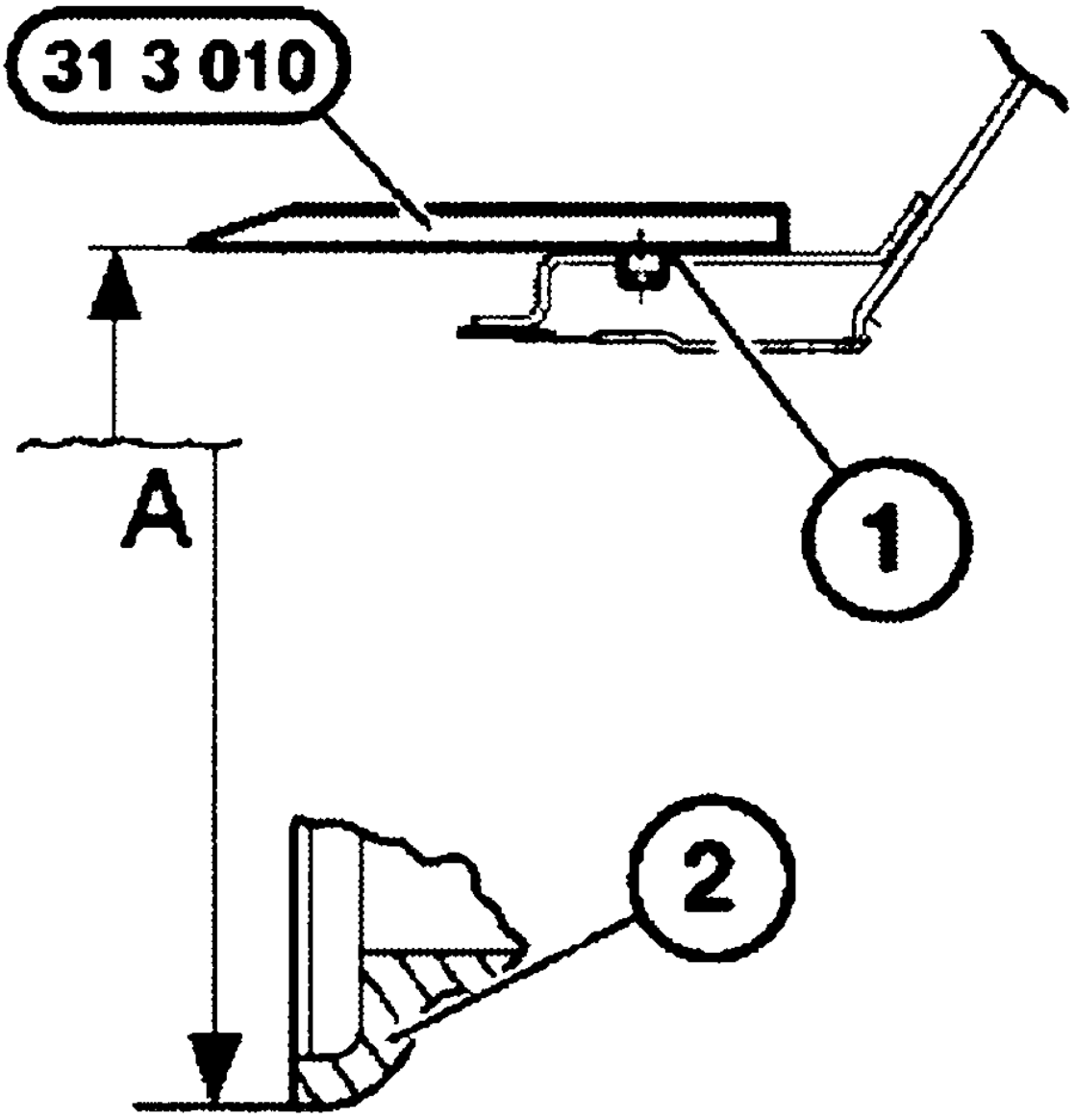
Before adjusting alignment, check riding height. Riding height must be checked with vehicle on level floor and tires properly inflated. Load front seats with 150 Lbs. (68 kg) each. On vehicles with back seats, load center of back seat with 150 Lbs. (68 kg). Load 31 Lbs. (14 kg) in center of trunk and fill fuel tank.

Measure actual ride-level height from wheel-house lower edge to rim flange at height of wheel center. Determine average value of each wheel after lifting and lowering vehicle body and then average value of axle

from these values. Ride height measurement must be within .04" (10 mm) of each side. For specifications, see RIDE HEIGHT SPECIFICATIONS. If ride height is not correct, see appropriate FRONT article.

Z3

For Z3 no extra loading is necessary. Open hood, insert measuring tool (31 3 010) in bore in wheel arch and measure distance "A" from bottom center flange of wheel rim (2) to Measuring Tool (1). See Fig. 1. Determine average value of each wheel after lifting and lowering vehicle body and then average value of axle from these values. Ride height measurement must be within .04" (10 mm) of each side. For specifications, see RIDE HEIGHT SPECIFICATIONS. If ride height is not correct, see appropriate FRONT article.



1. Bore In Wheel Arch
2. Wheel Rim Flange

G00079041

Fig. 1: Measuring Front Ride Height (Z3)
Courtesy of BMW OF NORTH AMERICA, INC.

RIDE HEIGHT SPECIFICATIONS

E36 (Up To 9/93)

RIDE HEIGHT SPECIFICATIONS - E36 (UP TO 9/93)

Application	In. (mm)
Standard Suspension	
15" Rim	22.6 (576)
16" Rim	23.1 (589)
17" Rim	23.8 (604)
Sports Suspension	
15" Rim	22 (561)
16" Rim	22.6 (574)
17" Rim	23.1 (589)
Rough Road Package	
15" Rim	23.5 (596)
16" Rim	24 (609)
17" Rim	24.5 (624)

E36 (From 9/93 - Except Z3)

RIDE HEIGHT SPECIFICATIONS - E36 (FROM 9/93 - EXCEPT Z3)

Application	In. (mm)
Standard Suspension	
15" Rim	20.4 (518)
16" Rim	20.9 (531)
17" Rim	21.5 (546)
M Roadster	23.1 (588)
M3	23 (585)
M Coupe	26.1 (664)
Sports Suspension	
15" Rim	19.9 (507)
16" Rim	20.5 (520)
17" Rim	21 (535)
Rough Road Package	
15" Rim	21.2 (538)
16" Rim	21.7 (551)
17" Rim	22.3 (566)

E36 (Z3)

RIDE HEIGHT SPECIFICATIONS - E36 (Z3)

Application	In. (mm)
Z3 Coupe	
15" Rim	25.28 (642)
16" Rim	25.80 (655)
17" Rim	26.38 (670)
Z3 Roadster	
Standard Suspension	
15" Rim	25.47 (647)
16" Rim	25.98 (660)
17" Rim	26.57 (675)
Sports Suspension	

15" Rim	24.88 (632)
16" Rim	25.40 (645)
17" Rim	25.98 (660)
Z3 Sedan	
Standard Suspension	
15" Rim	22.25 (565)
16" Rim	22.75 (578)
17" Rim	23.35 (593)
Sports Suspension	
15" Rim	21.65 (550)
16" Rim	22.17 (563)
17" Rim	22.75 (578)

E39 (M5 & 540i)

RIDE HEIGHT SPECIFICATIONS - E39 (M5 & 540i)

Application	In. (mm)
540i	
Standard Suspension	
15" Rim	22.8 (579)
16" Rim	23.3 (592)
17" Rim	23.9 (607)
18" Rim	24.4 (620)
Low-Slung Sport Suspension	
15" Rim	22.0 (559)
16" Rim	22.5 (572)
17" Rim	23.1 (587)
18" Rim	23.6 (600)
Rough Road Package	
15" Rim	23.6 (599)
16" Rim	24.1 (612)
17" Rim	24.7 (627)
18" Rim	25.2 (640)
M Sports Package	
15" Rim	22.1 (562)
16" Rim	22.6 (575)
17" Rim	23.2 (590)
18" Rim	23.7 (603)
M5	
17" Rim	22.1 (592)
18" Rim	23.8 (605)

E39 (525i, 528i & 530i)

RIDE HEIGHT SPECIFICATIONS - E39 (525i, 528i & 530i)

Application	In. (mm)
Standard Suspension	
15" Rim	22.8 (579)
16" Rim	23.3 (592)
17" Rim	23.9 (607)
18" Rim	24.4 (620)

Low-Slung Sport Suspension	
15" Rim	22.0 (559)
16" Rim	22.5 (572)
17" Rim	23.1 (587)
18" Rim	23.6 (600)
Rough Road Package	
15" Rim	23.6 (599)
16" Rim	24.1 (612)
17" Rim	24.7 (627)
18" Rim	25.2 (640)
M Sports Package	
15" Rim	22.0 (559)
16" Rim	22.5 (572)
17" Rim	23.1 (587)
18" Rim	23.6 (600)

E46 (Except 325xi & 330xi)

RIDE HEIGHT SPECIFICATIONS - E46 (EXCEPT 325xi & 330xi)

Application	In. (mm)
Standard Suspension	
15" Rim	21.3 (542)
16" Rim	21.9 (555)
17" Rim	22.4 (570)
18" Rim	22.9 (583)
Low-Slung Sport Suspension	
15" Rim	20.7 (526)
16" Rim	21.2 (539)
17" Rim	21.8 (554)
18" Rim	22.3 (567)
Rough Road Package	
15" Rim	22.1 (562)
16" Rim	22.6 (575)
17" Rim	23.2 (590)
18" Rim	23.7 (603)

E46 (325xi & 330xi)

RIDE HEIGHT SPECIFICATIONS - E46 (325xi & 330xi)

Application	In. (mm)
Standard Suspension	
15" Rim	21.3 (542)
16" Rim	21.9 (555)
17" Rim	22.4 (570)
18" Rim	22.9 (583)
Low-Slung Sport Suspension	
15" Rim	20.7 (526)
16" Rim	21.2 (539)
17" Rim	21.8 (554)
18" Rim	22.3 (567)
Rough Road Package	

15" Rim	22.1 (562)
16" Rim	22.6 (575)
17" Rim	23.2 (590)
18" Rim	23.7 (603)

E52 (Z8)

RIDE HEIGHT SPECIFICATIONS - E52 (Z8)

Application	In. (mm)
18" Rim	25 (633)

E53 (X5)

RIDE HEIGHT SPECIFICATIONS - E53 (X5)

Application	In. (mm)
Steel Spring	
17" Rim	27 (687)
18" Rim	27.5 (700)
19" Rim	28 (713)
20" Rim	28.5 (726)
Air Spring	
17" Rim	27 (695)
18" Rim	27.9 (708)
19" Rim	28.3 (721)
20" Rim	28.9 (734)
2 Axle Air Spring	
17" Rim	27 (687)
18" Rim	27.5 (700)
19" Rim	28 (713)
20" Rim	28.5 (726)

E65 (745i & 745Li)

RIDE HEIGHT SPECIFICATIONS - E65 (745i & 745Li)

Application	In. (mm)
17" Rim	25.2 (640)
18" Rim	25.7 (653)
19" Rim	26.2 (666)
20" Rim	26.7 (679)

JACKING & HOISTING

FRAME & UNDERBODY

NOTE: Fig. 2 is not intended to represent the exact structure of each vehicle's frame, underbody or body outline. It is presented only to provide reference points.

The following illustration indicate areas (parts) of the underbody and frame which may be used to raise and support the vehicle, using either floor jack or hoist. These points are indicated by shaded areas on the frame. See Fig. 2.

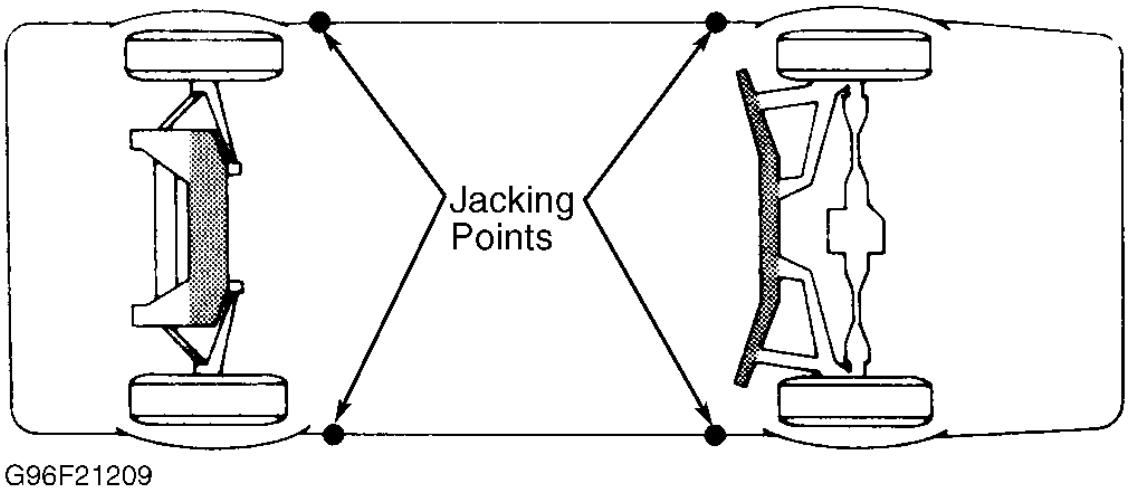


Fig. 2: Locating Jacking & Hoisting Points
Courtesy of BMW OF NORTH AMERICA, INC.

OUTERBODY

Those points designated on the outline of the body were specifically designed to facilitate the use of the vehicle's own jack. These jacking points are indicated by circular dots on the outline of the body. See Fig. 2. If using floor jack or hoist, exercise extreme care to avoid damaging outer body shell.

WHEEL ALIGNMENT PROCEDURES

CAUTION: On vehicles with air springs, pull fuse of air supply system so there is no regulation.

CAUTION: On cars equipped with Electronic Damper Control, it is essential after wheel alignment to perform a "steering angle check/adjustment" with the BMW Diagnosis System.

NOTE: Prior to performing wheel alignment, perform preliminary visual and mechanical inspection of wheels, tires, riding height and suspension components. See PRE-ALIGNMENT INSTRUCTIONS in WHEEL ALIGNMENT THEORY & OPERATION article in GENERAL INFORMATION.

CAMBER ADJUSTMENT

Front (E36, E39 & E52)

NOTE: Camber is defined by design and cannot be adjusted except by correcting components which may be damaged or faulty.

1. Check if rubber mount in control arm is faulty and replace if necessary.
2. Check if control arm is deformed and replace if necessary.
3. Check if spring strut is deformed and replace if necessary.
4. Check if guide joint is badly worn and replace control arms if necessary.
5. Check if spring force is insufficient and replace coil springs if necessary.
6. Check if front axle carrier is deformed and replace if necessary.
7. Check if spring strut mount holder is deformed and repair front end if necessary.

8. Check if there is distortion in floor assembly (engine carrier) and repair body if necessary.

Front (E46)

CAUTION: Changes in axle geometry caused by accidents must under no circumstances be corrected by camber adjustment.

1. If necessary, drive out centering pin (1) towards bottom. unscrew M3 centering pin (1) and discard. Centering pin is no longer needed. See Fig. 3.
2. Remove dirt in area of support bearing in wheel arch from below with compressed air. Remove nut (2) and slacken nuts (3) approximately 1 1/2 turns. See Fig. 3.
3. Insert special tool (32 3 140) in opening of wheel arch and over nuts. See Fig. 4. Adjust camber by turning nut to specification. See E46 under WHEEL ALIGNMENT SPECIFICATIONS.
4. Replace nut (2). See Fig. 5. Tighten to specification. See E46 under TORQUE SPECIFICATIONS.
5. Remove special tool.
6. Replace nuts (3). See Fig. 3. Tighten to specification. See E46 under TORQUE SPECIFICATIONS.
7. A change in camber also means a change in toe. After adjusting camber, check and adjust toe-in. See FRONT (E46) under TOE-IN ADJUSTMENT.

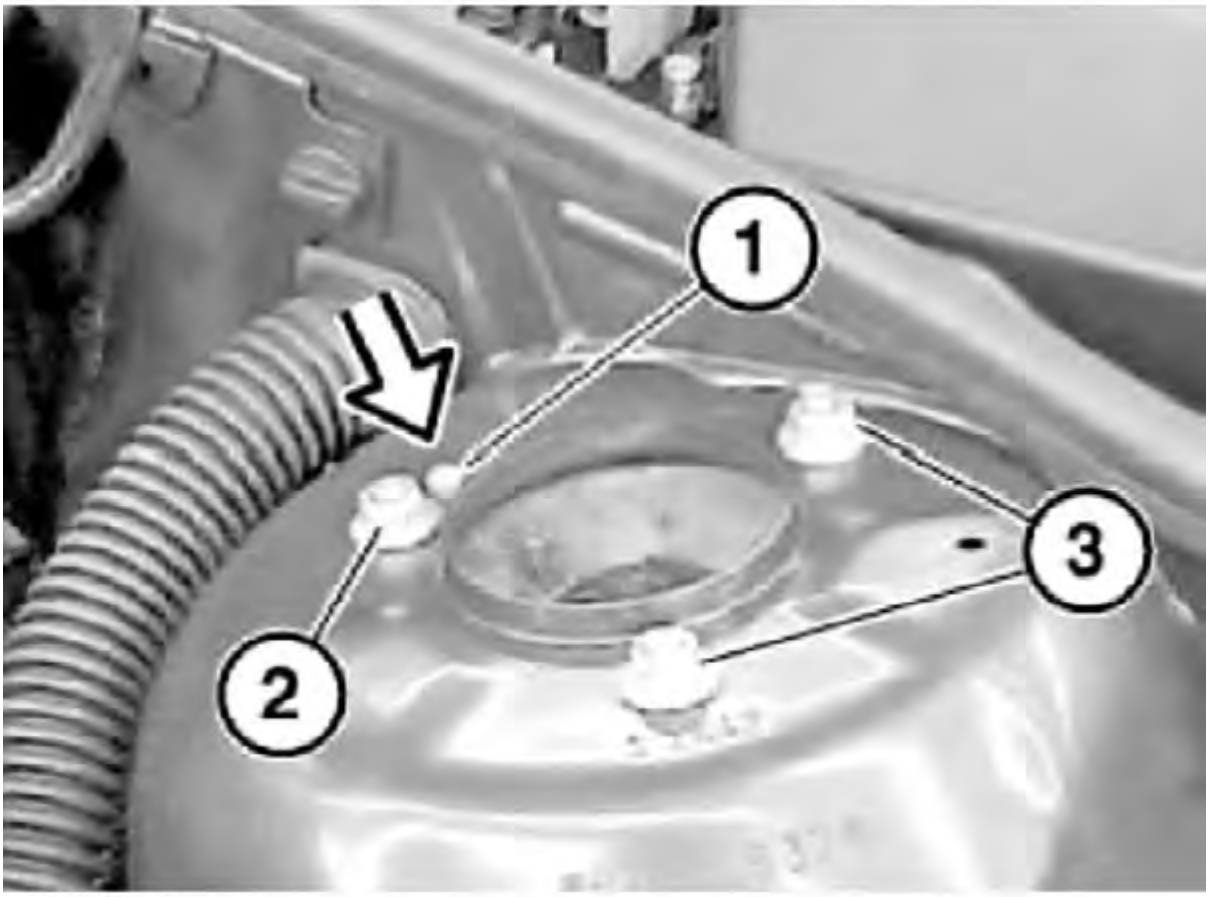
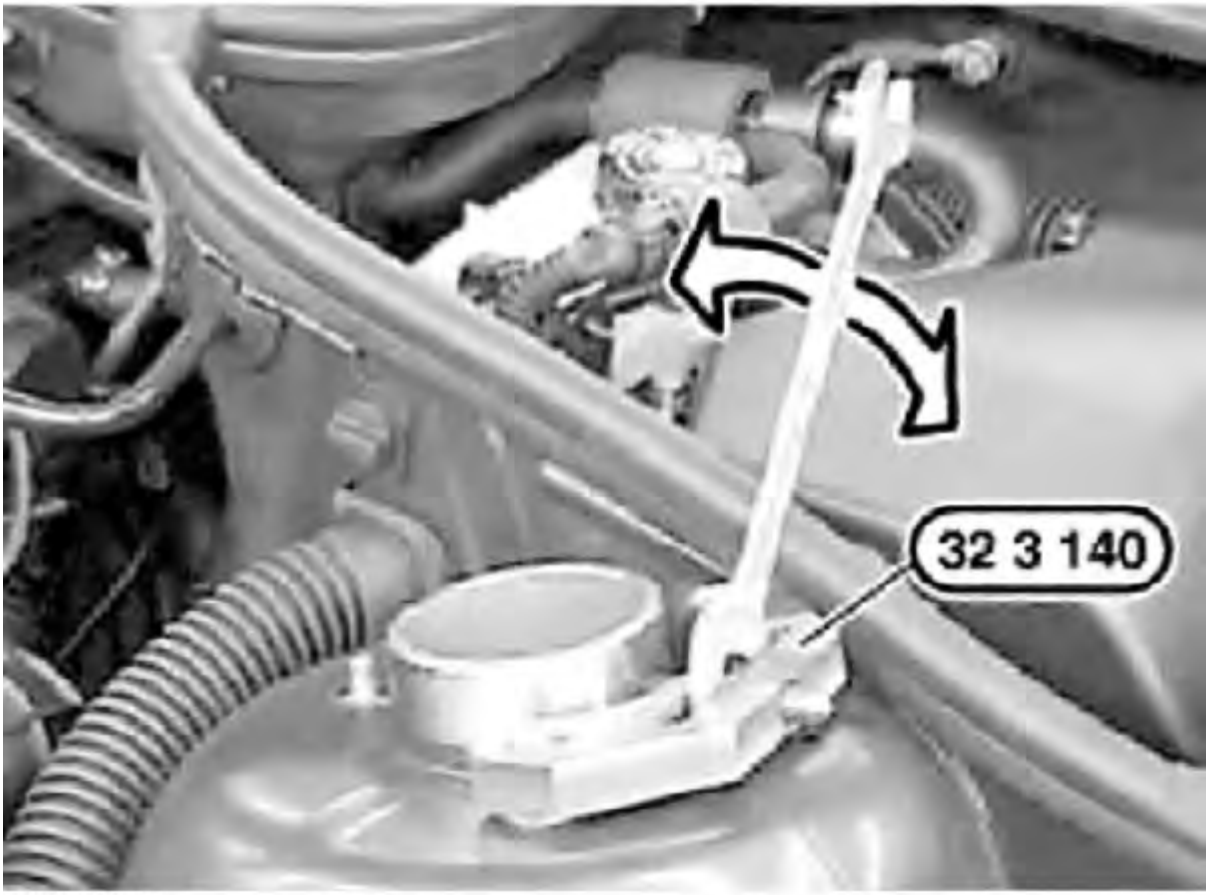


Fig. 3: Locating Centering Pin
Courtesy of BMW OF NORTH AMERICA, INC.



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Fig. 4: Adjusting Camber (E46)
Courtesy of BMW OF NORTH AMERICA, INC.



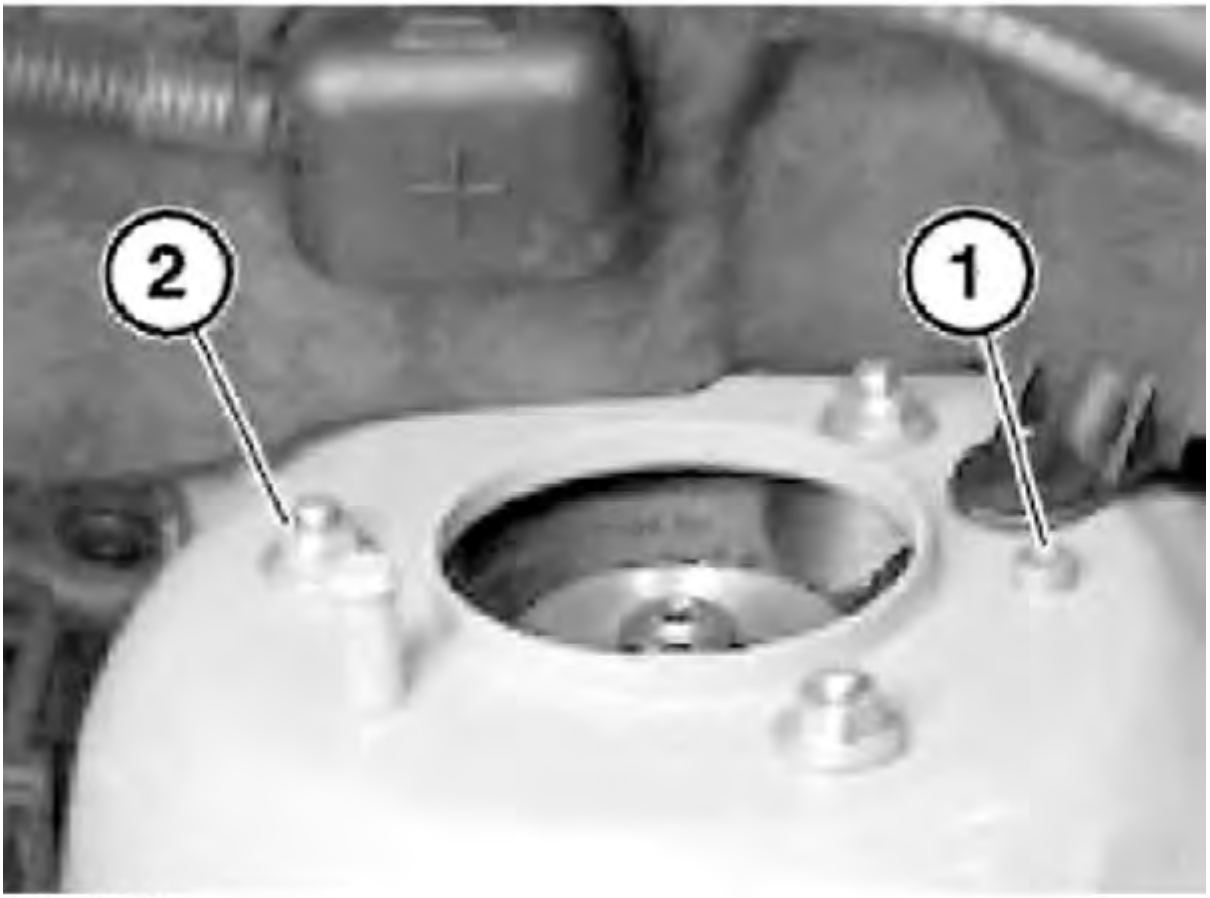
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Fig. 5: Locating Nut (2)
Courtesy of BMW OF NORTH AMERICA, INC.

Front (E53)

CAUTION: Changes in axle geometry caused by accidents must never be rectified by camber adjustment.

1. Detach reservoir for windshield washer system on right side if necessary.
2. Detach cap from wheel arch. Remove centering pin (1) with Allen key. this pin is no longer needed. Remove dirt in area of support bearing in wheel arch from below with compressed air. Slacken nut (2) approximately 1 1/2 turns. See Fig. 6.
3. Insert special tool (32 3 144/145) into opening of wheel arch and over nuts. Replace nuts (3) and screw on but do not tighten down fully. Adjust camber by turning nut in special tool. See Fig. 7. Adjust camber to specification. See E53 under WHEEL ALIGNMENT SPECIFICATIONS.
4. Tighten down nuts (3) to specification. See E53 under TORQUE SPECIFICATIONS.
5. Remove special tool. Replace and tighten down nut (2) to specification. See E53 under TORQUE SPECIFICATIONS.
6. Perform toe-in adjustment. See FRONT (E53) under TOE-IN ADJUSTMENT.



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Fig. 6: Locating Wheel Arch Components (E53)
Courtesy of BMW OF NORTH AMERICA, INC.

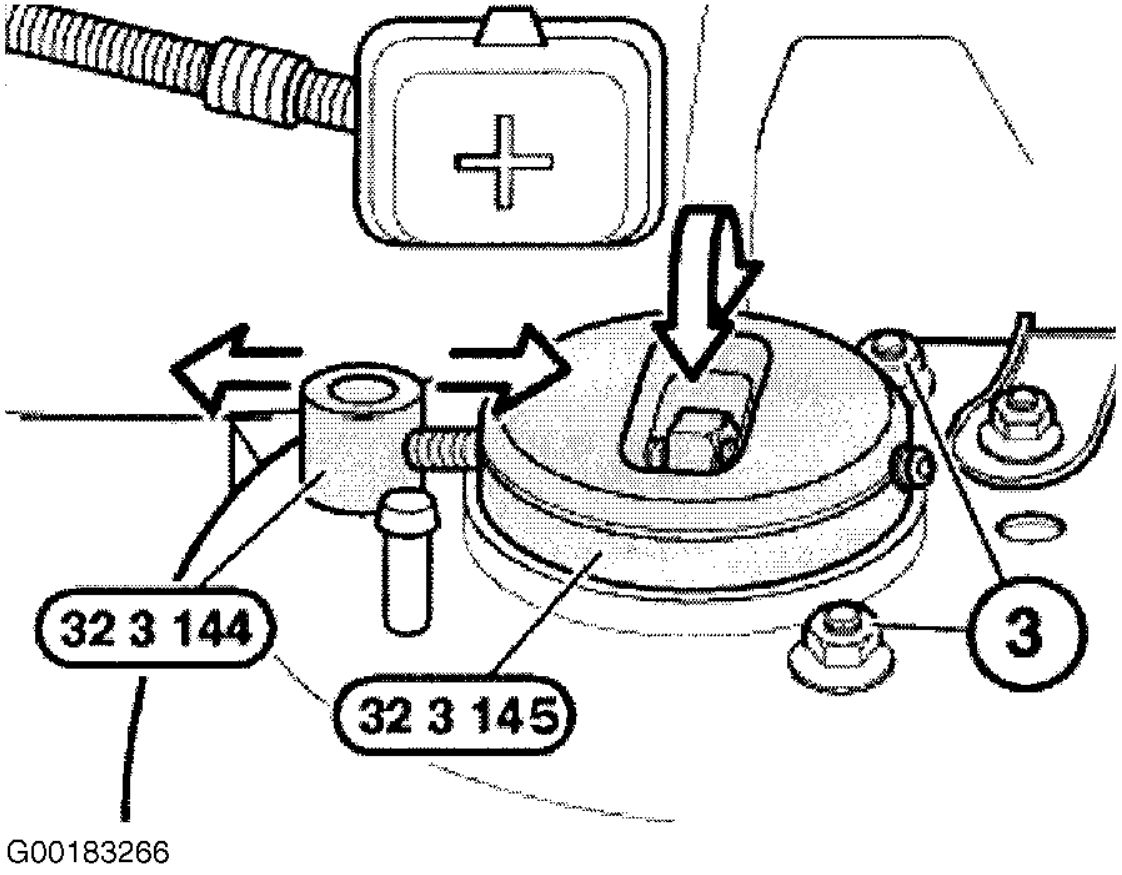
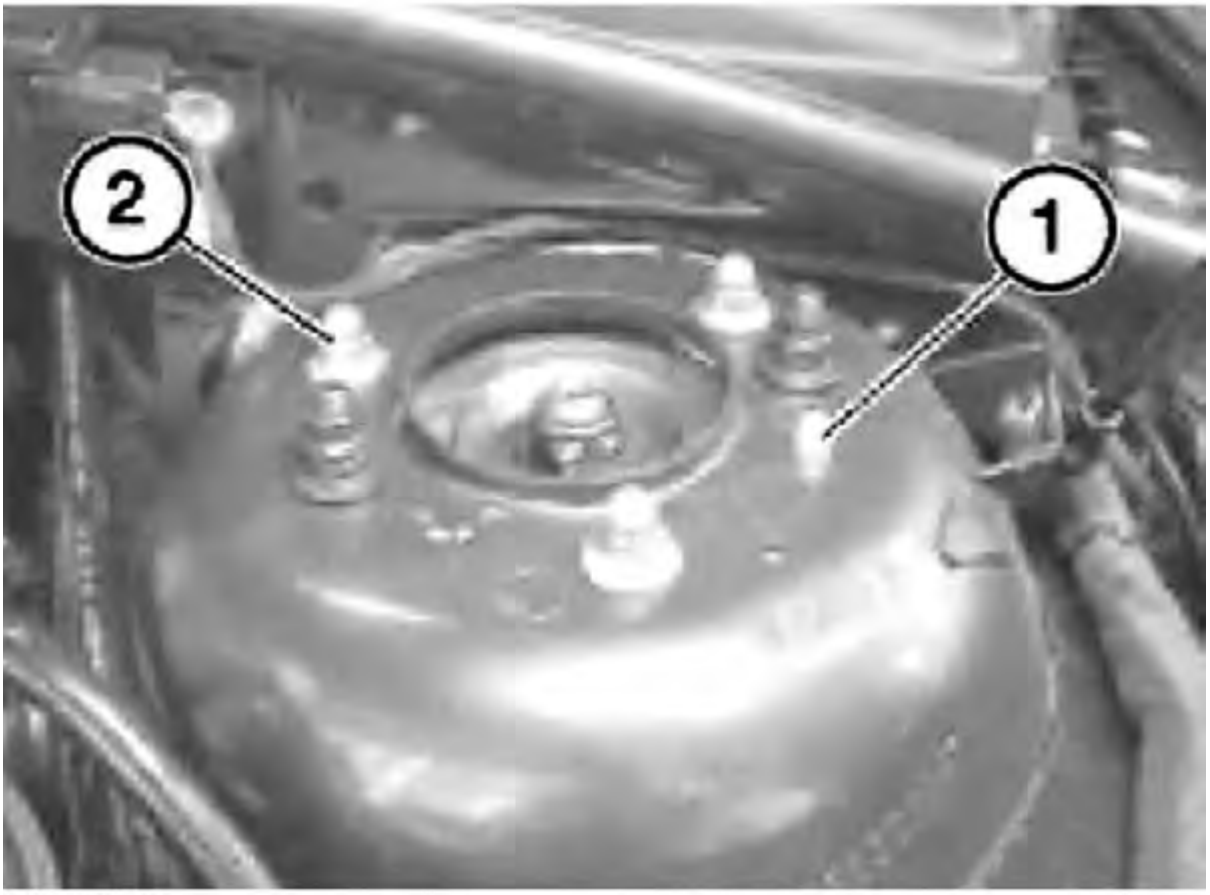


Fig. 7: Adjusting Front Camber (E53)
Courtesy of BMW OF NORTH AMERICA, INC.

Front (E65)

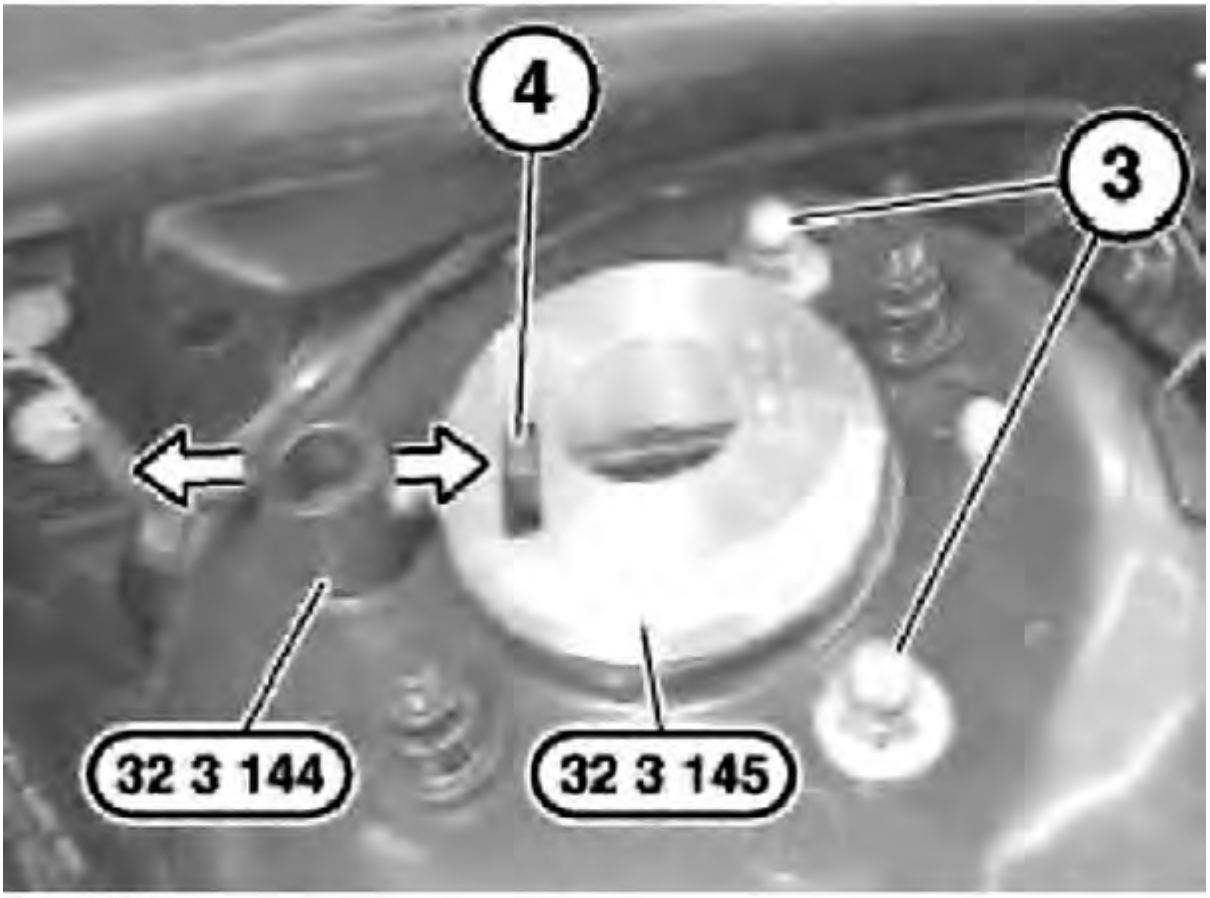
CAUTION: Changes in axle geometry caused by accidents must never be rectified by camber adjustment.

1. Detach cap from wheel arch. Remove centering pin (1) with hexagon socket screw key. this pin is no longer needed. Remove dirt in area of support bearing in wheel arch from below with compressed air. Slacken nut (2) approximately 1 1/2 turns. See Fig. 8.
2. Insert special tool (32 3 144/145) into opening of wheel arch and over nut. Replace nuts (3) and screw on but do not tighten down fully. Adjust camber by turning nut (4) in special tool. See Fig. 9.
3. Adjust camber to specification. See E65 under WHEEL ALIGNMENT SPECIFICATIONS.
4. Tighten down nuts (3) to specification. See E65 under TORQUE SPECIFICATIONS.
5. Remove special tool. Replace nut (2). See Fig. 8. Tighten to specification. See E65 under TORQUE SPECIFICATIONS.
6. Adjust toe-in. See FRONT (E65) under TOE-IN ADJUSTMENT.



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Fig. 8: Locating Wheel Arch Components (E65)
Courtesy of BMW OF NORTH AMERICA, INC.



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Fig. 9: Adjusting Front Camber (E65)
Courtesy of BMW OF NORTH AMERICA, INC.

Rear (E36)

NOTE: A change in camber also means a change in toe. This means that camber must be adjusted first.

1. Replace and tighten down hexagon collar nut. The eccentric washer must be located between the support cams. Tighten collar nut to specification. See E36 under TORQUE SPECIFICATIONS.
2. Slacken hexagon collar nut approximately 1/2 turn. See Fig. 10. Turn eccentric screw and adjust camber to specification. See E36 under WHEEL ALIGNMENT SPECIFICATIONS.

CAUTION: If the hexagon collar nut is tightened down more than 10 times during adjustment, it must be replaced. The self-locking effect becomes too slight.

3. Tighten hexagon collar nut again to specification. See E36 under TORQUE SPECIFICATIONS.

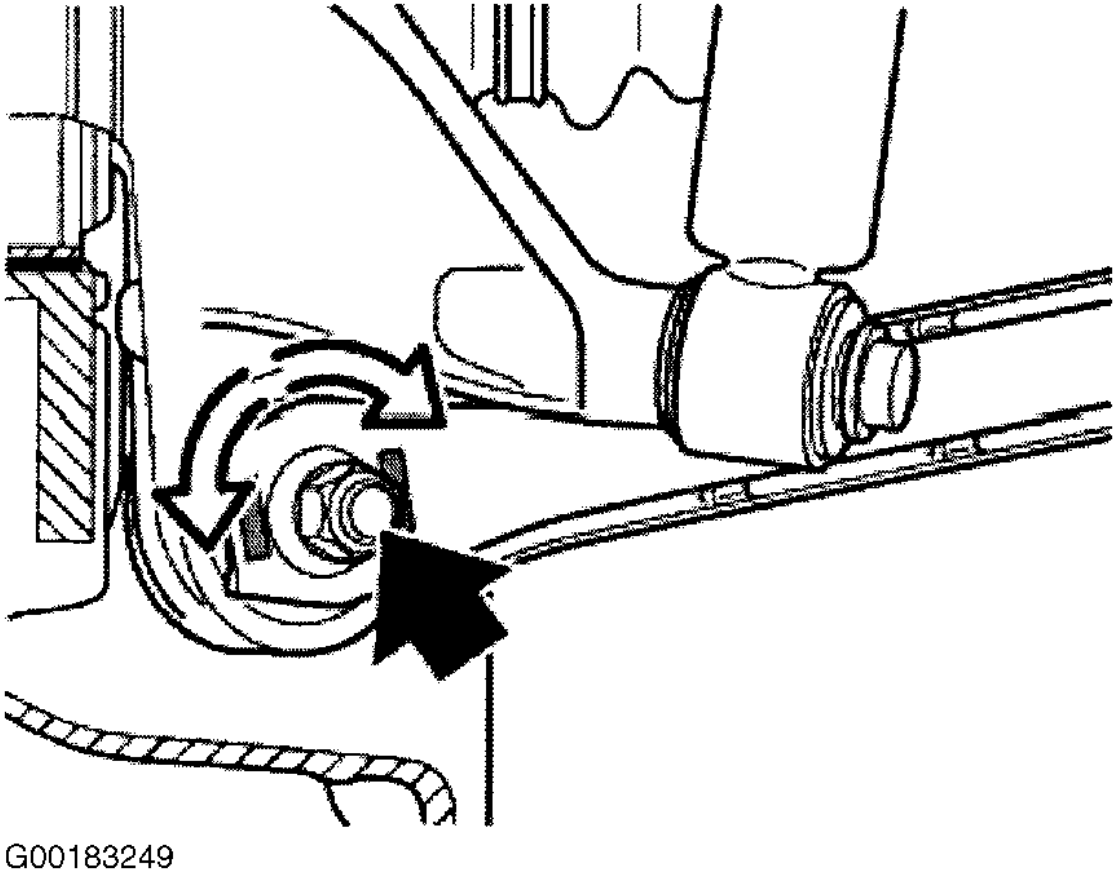


Fig. 10: Locating Hexagon Collar Nut
Courtesy of BMW OF NORTH AMERICA, INC.

Rear (E39)

NOTE: A change in camber also means a change in toe. This means that camber must be adjusted first.

1. Before adjusting, replace disc collar nut (1) and ensure eccentric washer (2) is correctly located. See Fig. 11. Tighten disc collar nut to specification. See E39 under TORQUE SPECIFICATIONS.
2. Loosen disc collar nut 1/2 to 1 complete turn.
3. Using the eccentric screw, adjust camber precisely to specification. See E39 under WHEEL ALIGNMENT SPECIFICATIONS.

CAUTION: If the hexagon collar nut is tightened down more than 10 times during adjustment, it must be replaced. The self-locking effect becomes too slight.

4. Tighten down disc collar nut (1). Ensure that eccentric washer (2) is correctly located. See Fig. 11. Tighten disc collar nut to specification. See E39 under TORQUE SPECIFICATIONS.

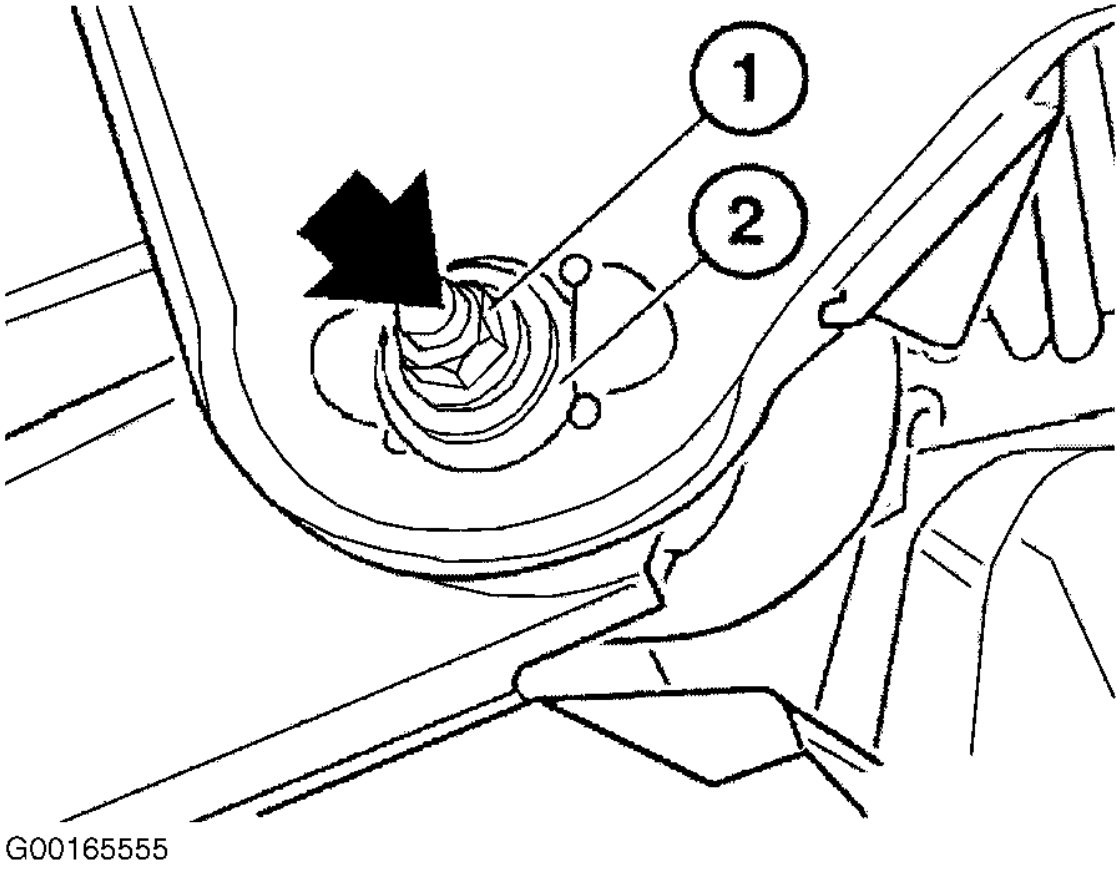


Fig. 11: Locating Disc Collar Nut
Courtesy of BMW OF NORTH AMERICA, INC.

Rear (E46)

1. Replace hexagon collar nut (1). Ensure eccentric washer is correctly located (2). See Fig. 12.
2. Tighten hexagon collar (1) to specification. See E46 under TORQUE SPECIFICATIONS.
3. Release hexagon collar nut (1) approximately 1/2 turn.
4. Adjust camber with eccentric screw precisely to specification. See E46 under WHEEL ALIGNMENT SPECIFICATIONS.
5. Locate the eccentric screw between the stops (1). See Fig. 13.

CAUTION: If the hexagon collar nut is tightened down more than 10 times during

adjustment, it must be replaced again. The self-locking effect becomes too slight.

6. Tighten hexagon collar nut to specification. See E46 under TORQUE SPECIFICATIONS.

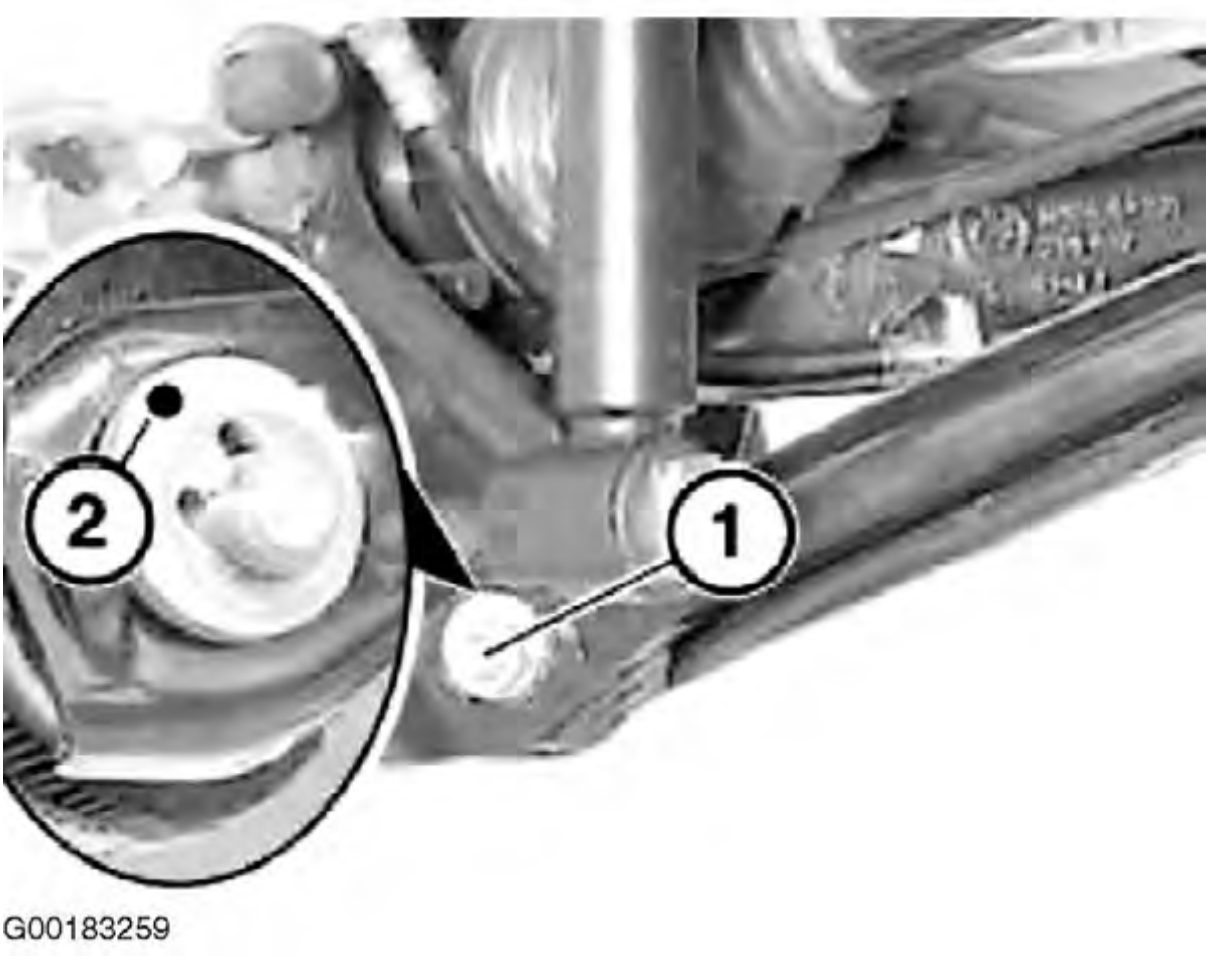


Fig. 12: Locating Hexagon Collar Nut (E46)
Courtesy of BMW OF NORTH AMERICA, INC.

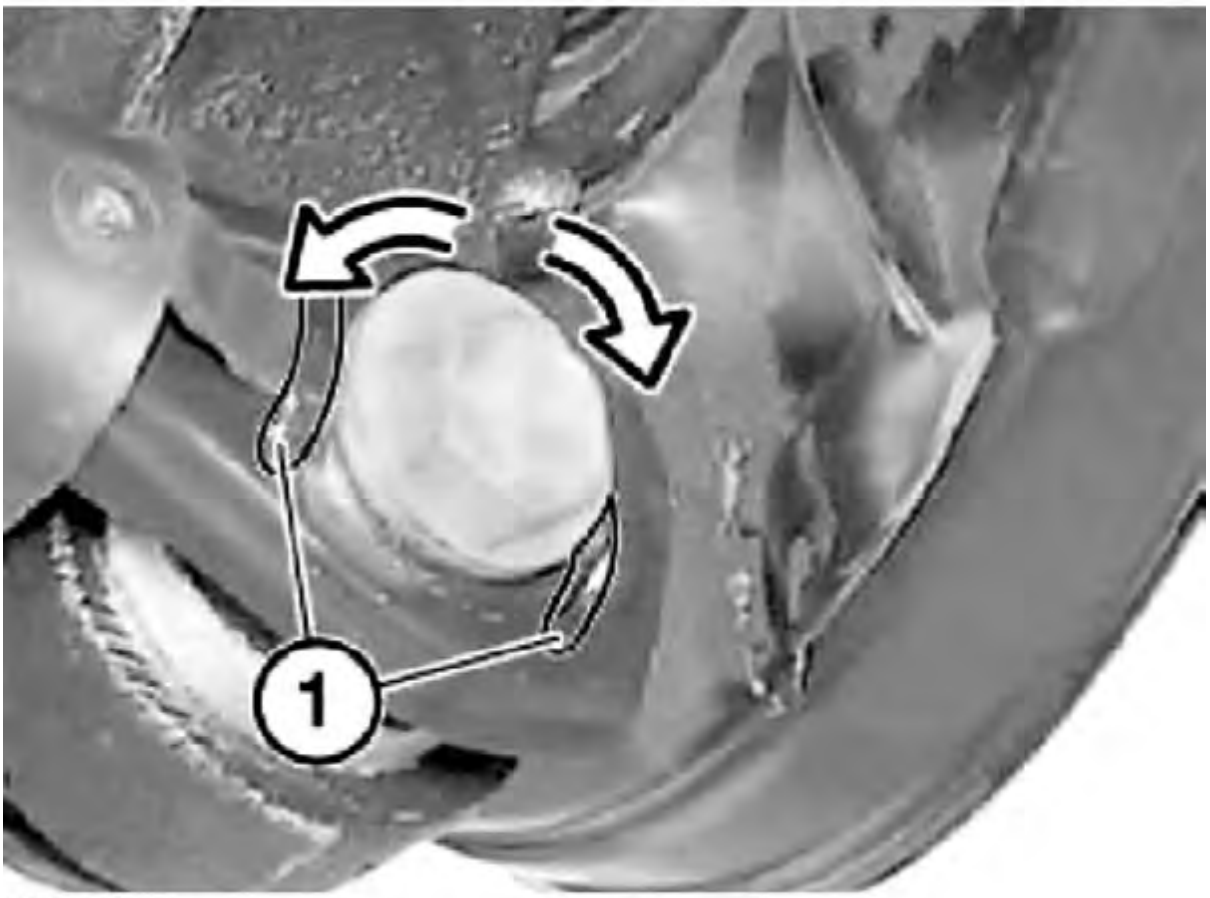


Fig. 13: Locating Eccentric Screw
Courtesy of BMW OF NORTH AMERICA, INC.

Rear (E52)

1. Replace and tighten down disk collar nut. See Fig. 14.
2. Tighten disk collar nut to specification. See E52 under TORQUE SPECIFICATIONS.
3. Release disk collar nut again by 1/2 to 1 turn.
4. Adjust camber with eccentric screw. See Fig. 15. Adjust camber to specification. See E52 under WHEEL ALIGNMENT SPECIFICATIONS.

CAUTION: If the disk collar nut is tightened down more than 10 times during adjustment, it must be replaced again. The self-locking effect becomes too slight.

5. Tighten down disk collar nut to specification. See E52 under TORQUE SPECIFICATIONS.
6. Adjust toe-in. See Rear (E52) under TOE-IN ADJUSTMENT.

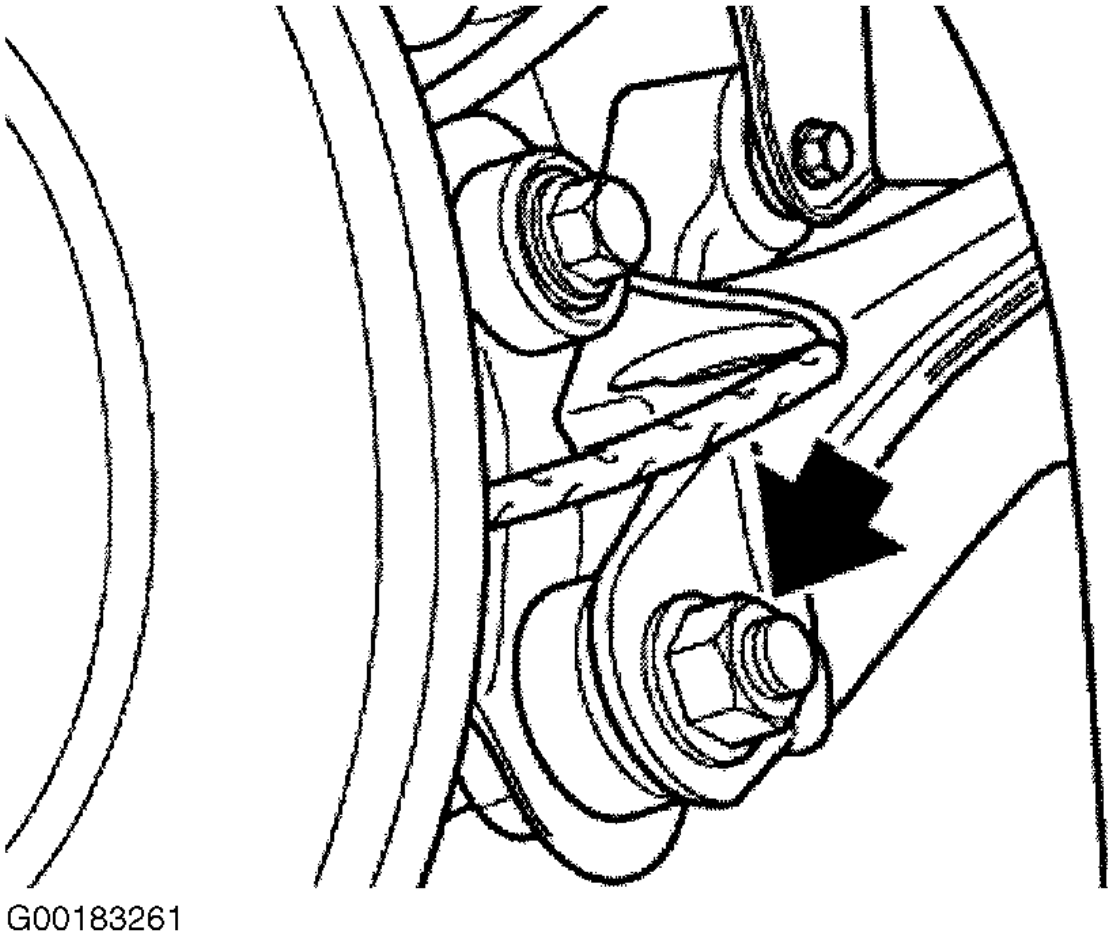


Fig. 14: Locating Disk Collar Nut (E52)
Courtesy of BMW OF NORTH AMERICA, INC.

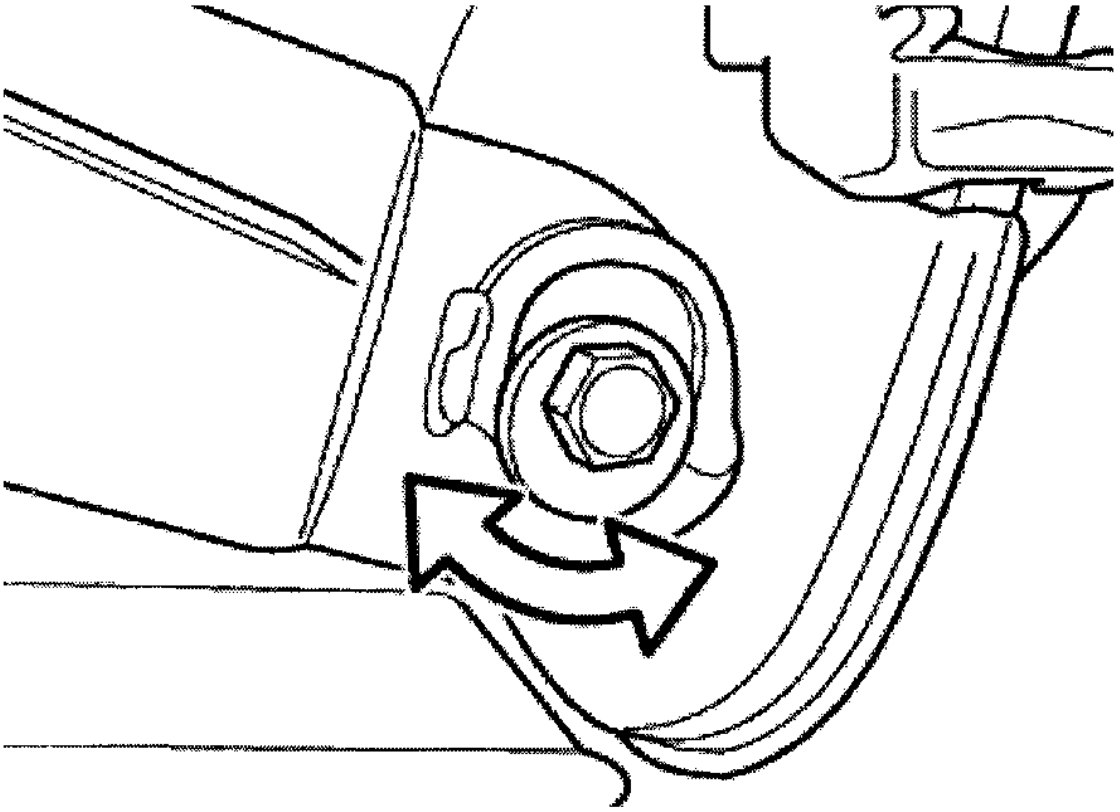


Fig. 15: Adjusting Camber (E52)
Courtesy of BMW OF NORTH AMERICA, INC.

Rear (E53)

1. Replace nut (1). Eccentric screw (2) must be located between stops (3). See Fig. 16.
2. Tighten down new nut (1) to specification. See E53 under TORQUE SPECIFICATIONS.
3. Slacken nut (1) approximately 3/4 turn.
4. Turn eccentric screw and adjust camber to specification. See E53 under WHEEL ALIGNMENT SPECIFICATIONS.
5. Position eccentric screw between the stops (3). See Fig. 16.

   CAUTION: If the nut is tightened down more than 4 times during adjustment, it must be replaced again. The self-locking effect becomes too slight.

6. Tighten down nut to specification. See E53 under TORQUE SPECIFICATIONS.

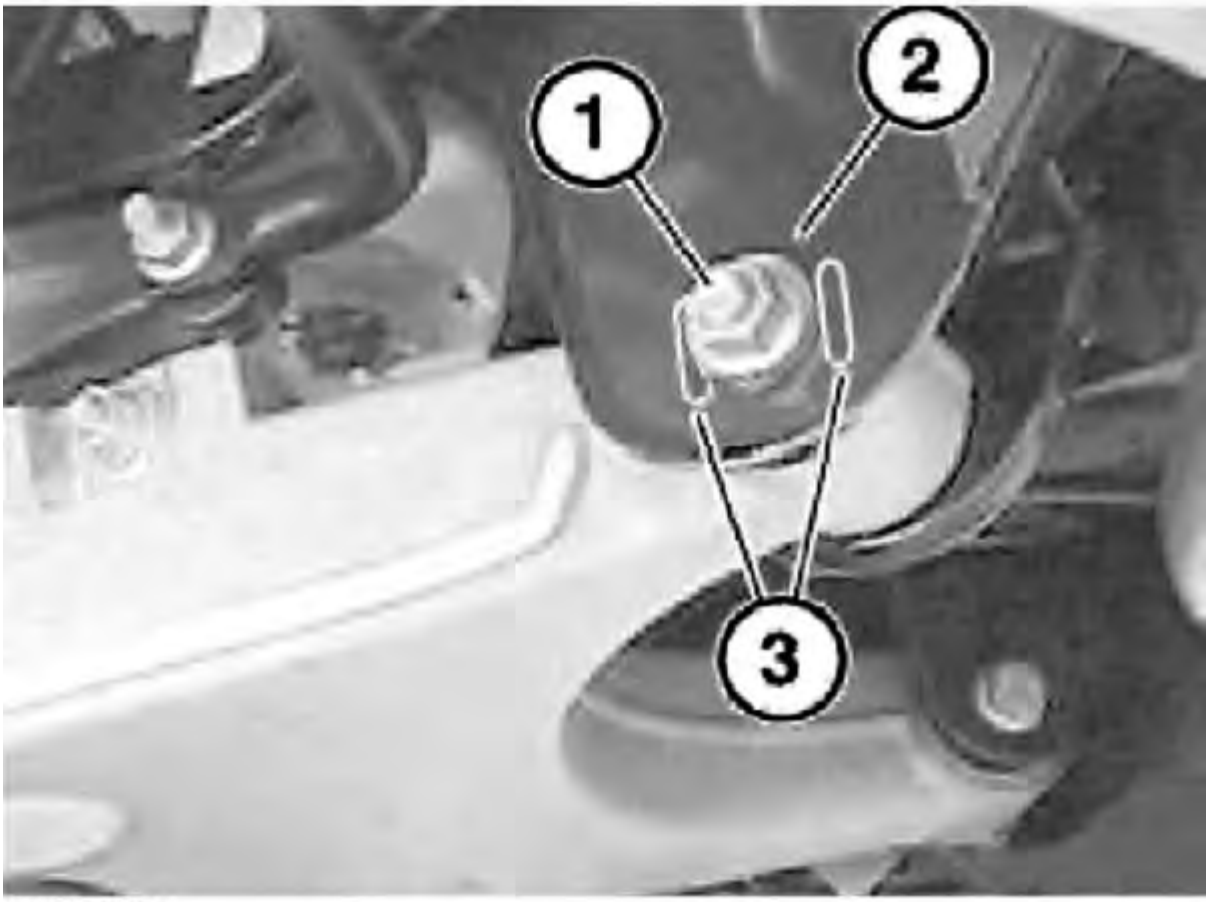


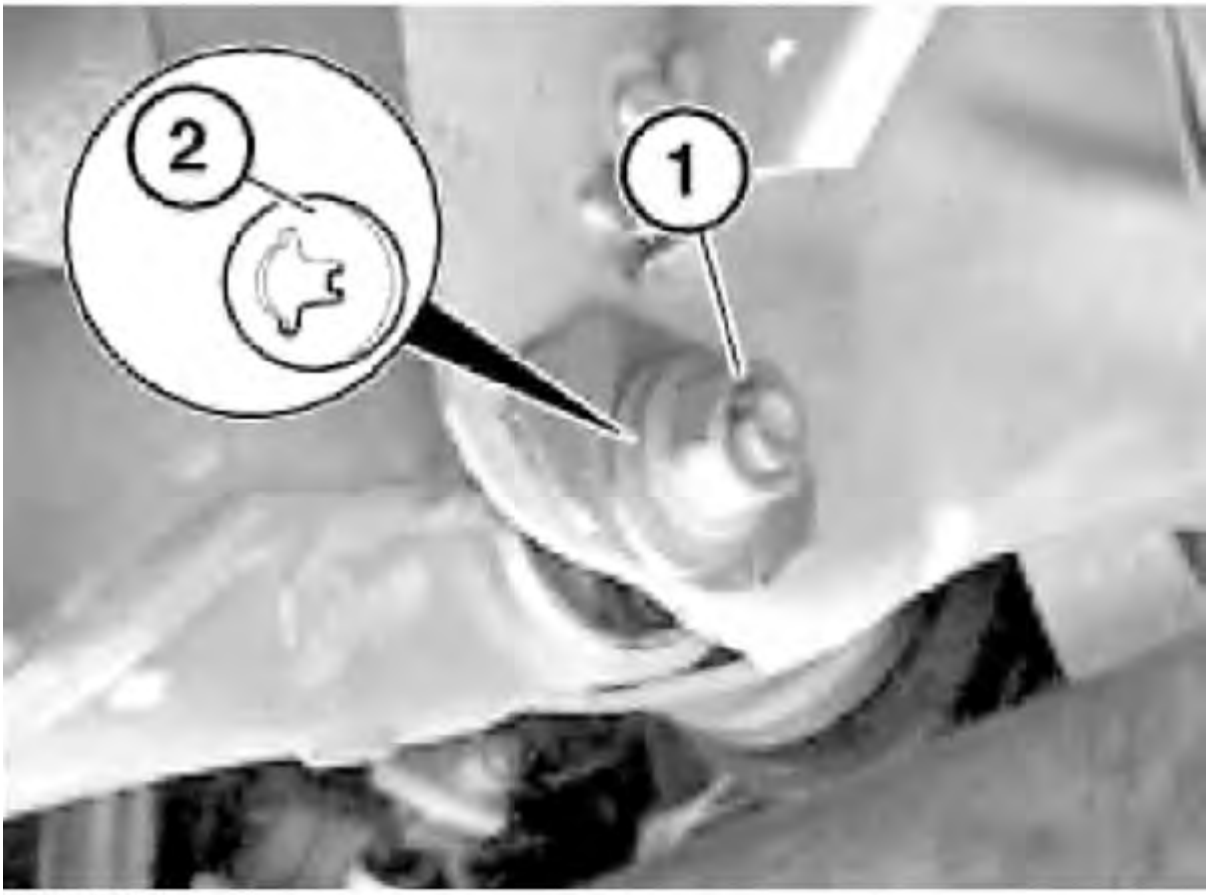
Fig. 16: Adjusting Camber (E53 Rear)
Courtesy of BMW OF NORTH AMERICA, INC.

Rear (E65)

1. Replace nut (1) and tighten down. Ensure eccentric washer is correctly located (2). See Fig. 17. Tighten nut (1) to specification. See E65 under TORQUE SPECIFICATIONS.
2. Release nut (1) again by 1/2 to 1 turn.
3. Adjust camber with eccentric screw. See Fig. 18. Adjust to specification. See E65 under WHEEL ALIGNMENT SPECIFICATIONS.

CAUTION: If the nut (1) is tightened down more than 10 times during adjustment, it must be replaced again. The self-locking effect becomes too slight.

4. Tighten nut (1). Ensure eccentric washer is correctly located (2). See Fig. 17. Tighten to specification. See E65 under TORQUE SPECIFICATIONS.
5. Adjust toe-in. See REAR (E65) under TOE-IN ADJUSTMENT.



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Fig. 17: Locating Nut & Eccentric Washer
Courtesy of BMW OF NORTH AMERICA, INC.


G00183274

Fig. 18: Adjusting Camber (E65 Rear)
Courtesy of BMW OF NORTH AMERICA, INC.

CASTER ADJUSTMENT

NOTE: Information for E53 and E65 is not available from manufacturer.

E36, E39, E46 & E52

NOTE: Caster is defined by design and cannot be adjusted except by correcting components which may be damaged or faulty.

1. On E39 and E52, check if rubber mounts for tension/traction strut are defective and replace if necessary.
2. On E39 and E52, check if tension/traction strut is misshaped and replace if necessary.
3. On all vehicles, check if control arm is deformed and replace if necessary.
4. On all vehicles, check if spring strut shock absorber is deformed and replace if necessary.
5. On all vehicles, check if wheel house (spring strut mount) is deformed and repair front end if necessary.
6. On all vehicles, check if there is distortion in floor assembly (engine carrier) and repair body if necessary.

TOE-IN ADJUSTMENT

Front (E36 & E39 - Except M5 & 540i)

1. Position steering gear to straight-ahead position. Alignment marks on case and steering shaft should align. See Fig. 19.
2. Loosen lock nut on tie rod. See Fig. 20. Adjust wheel toe-in to specified value by rotating steering tie rod. See E36 or E39 under WHEEL ALIGNMENT SPECIFICATIONS.
3. Ensure that ball joint is not twisted. Tighten tie rod clamping nut to specification. See E36 or E39 under TORQUE SPECIFICATIONS.
4. On cars equipped with Electronic Damper Control, it is essential after wheel alignment to perform a "steering angle check/adjustment" with the BMW Diagnosis System.

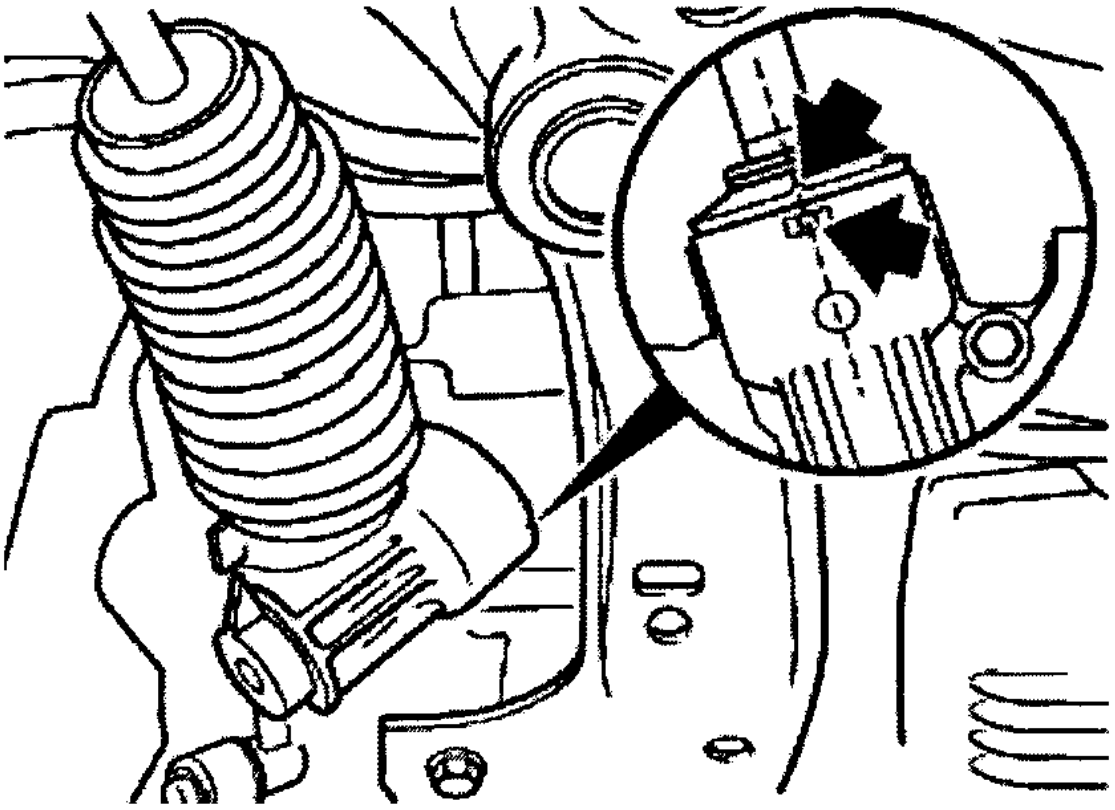


Fig. 19: Locating Marking On Case
Courtesy of BMW OF NORTH AMERICA, INC.

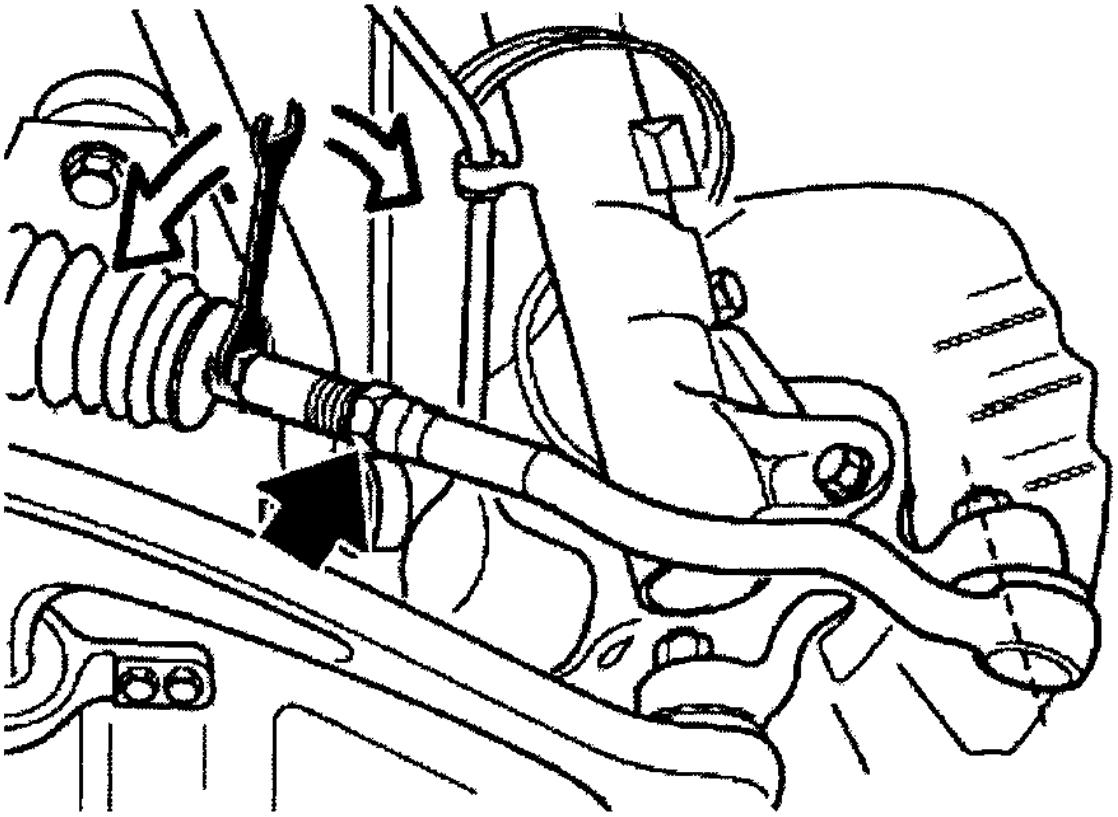


Fig. 20: Adjusting Wheel Toe-In
Courtesy of BMW OF NORTH AMERICA, INC.

Front (E39 - M5 & 540i)

1. Move steering wheel gear into straight ahead setting Marks on housing and steering shaft must line up. See Fig. 21.
2. Loosen clamping screws on tie rods. Adjust toe-in of wheel by turning the tie rod precisely to specification. See Fig. 22. For alignment specification, see E39 under WHEEL ALIGNMENT SPECIFICATIONS.
3. Ensure that the ball joints are not twisted and tighten clamping screws to specification. See E39 under TORQUE SPECIFICATIONS.

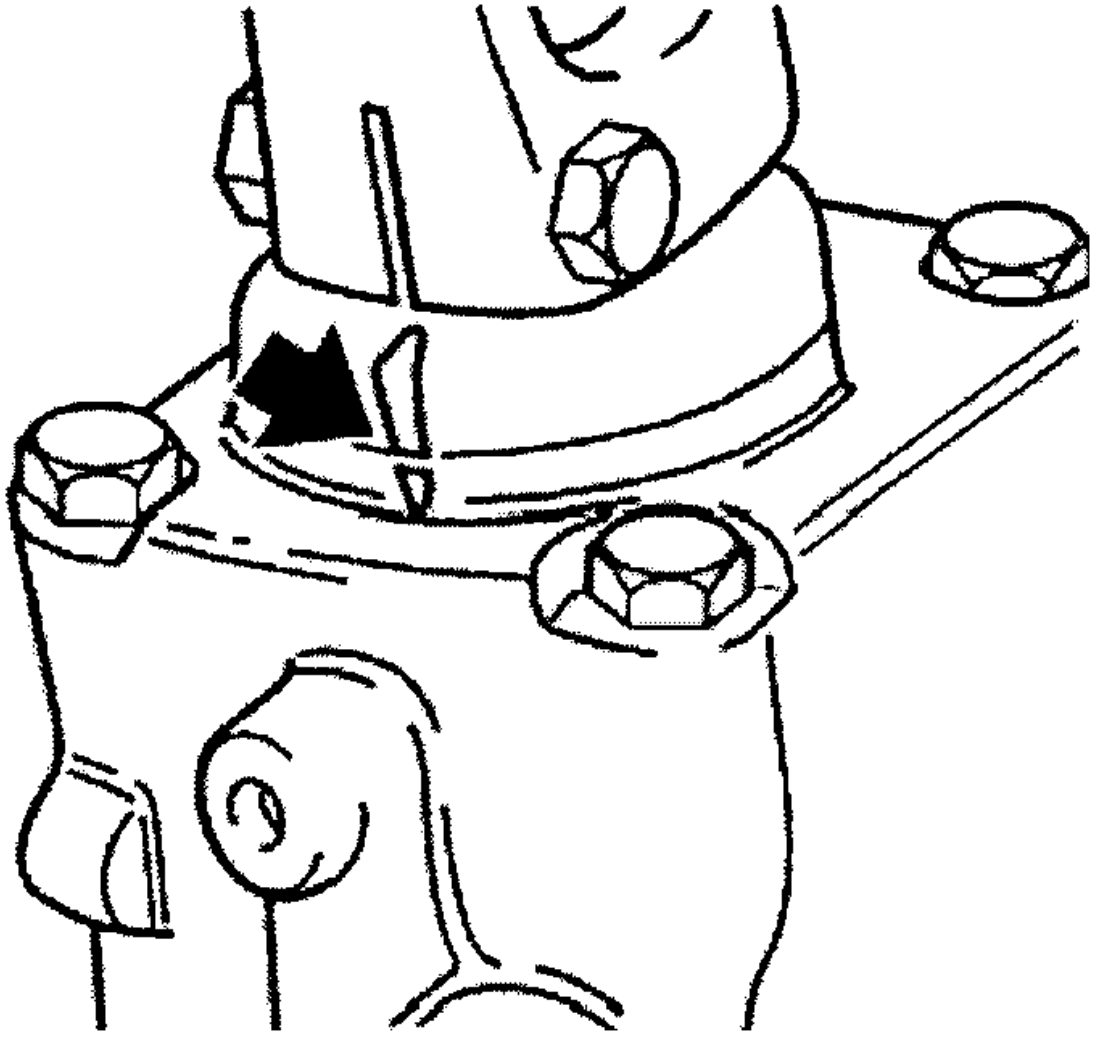


Fig. 21: Matching Marks On Housing
Courtesy of BMW OF NORTH AMERICA, INC.

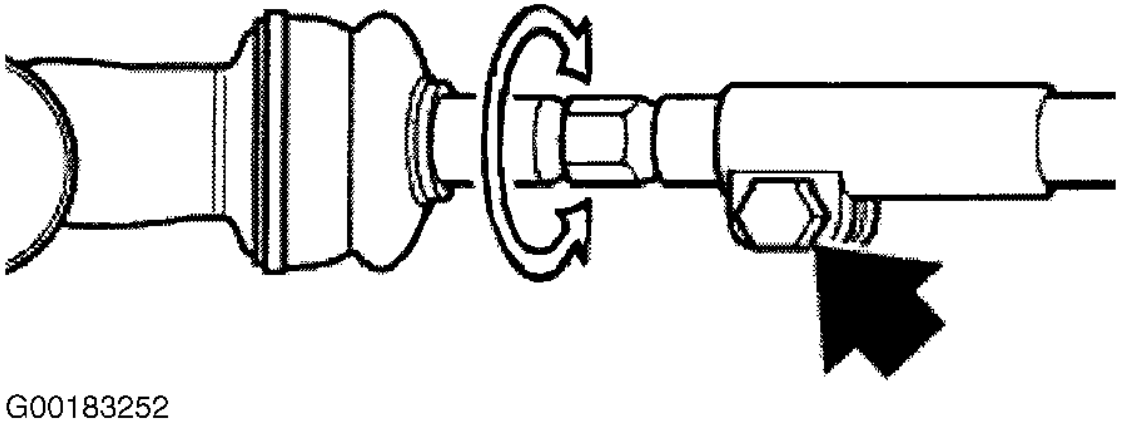


Fig. 22: Adjusting Toe-In
Courtesy of BMW OF NORTH AMERICA, INC.

Front (E46)

NOTE: A change in camber also means a change in toe. This means that camber must be adjusted first. See FRONT (E46) under CAMBER ADJUSTMENT.

1. Move wheels and steering gear to straight ahead position. Markings on cap (1) and on housing (2) must line up. See Fig. 23.
2. Slacken clamping nut (1) on steering tie rod. Adjust wheel toe-in by turning tie rod at hexagon head (2). See Fig. 24. For specification, see E46 under WHEEL ALIGNMENT SPECIFICATIONS.
3. Make sure steering packing is not turned. Tighten clamping nut to specification. See E46 under TORQUE SPECIFICATIONS.

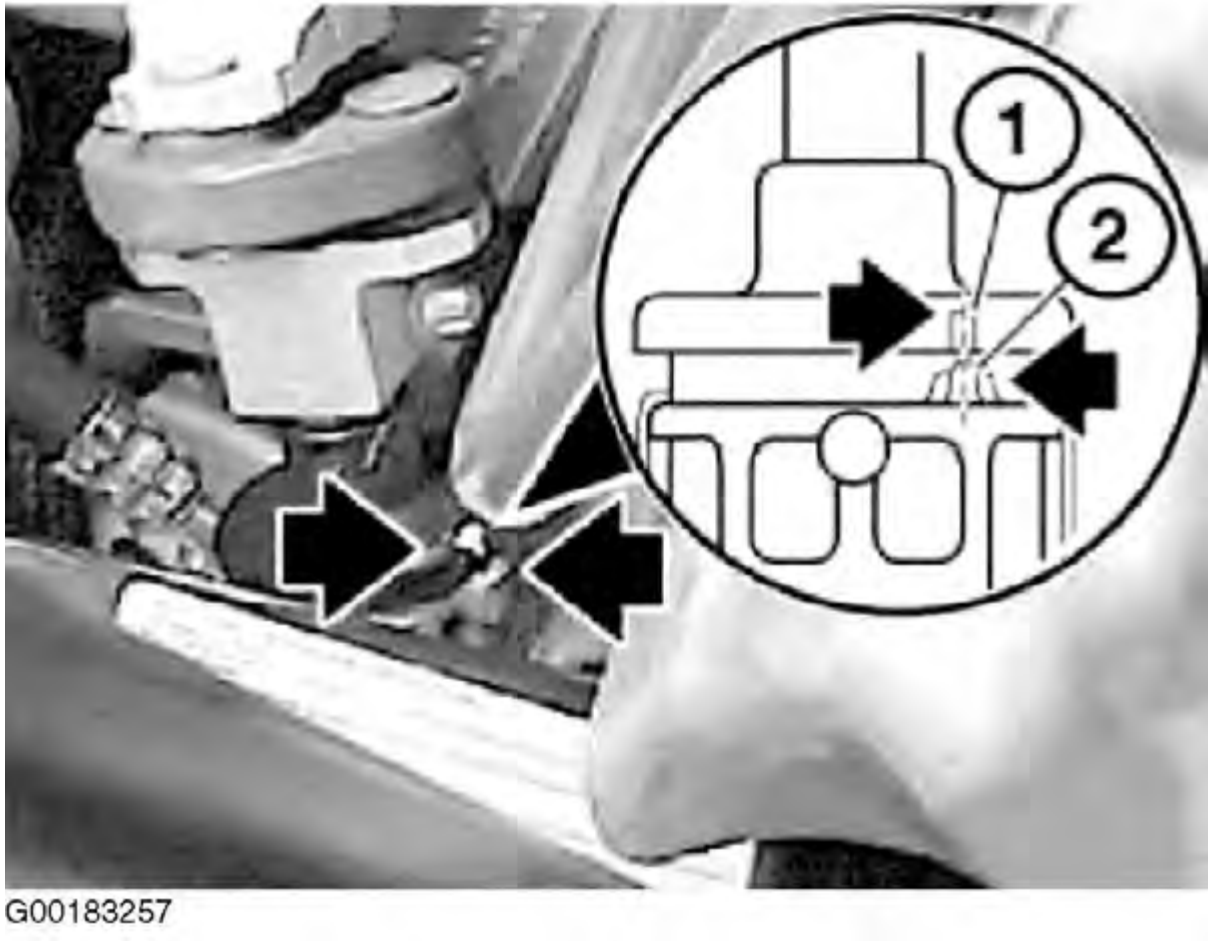


Fig. 23: Locating Marks On Cap & Housing
Courtesy of BMW OF NORTH AMERICA, INC.

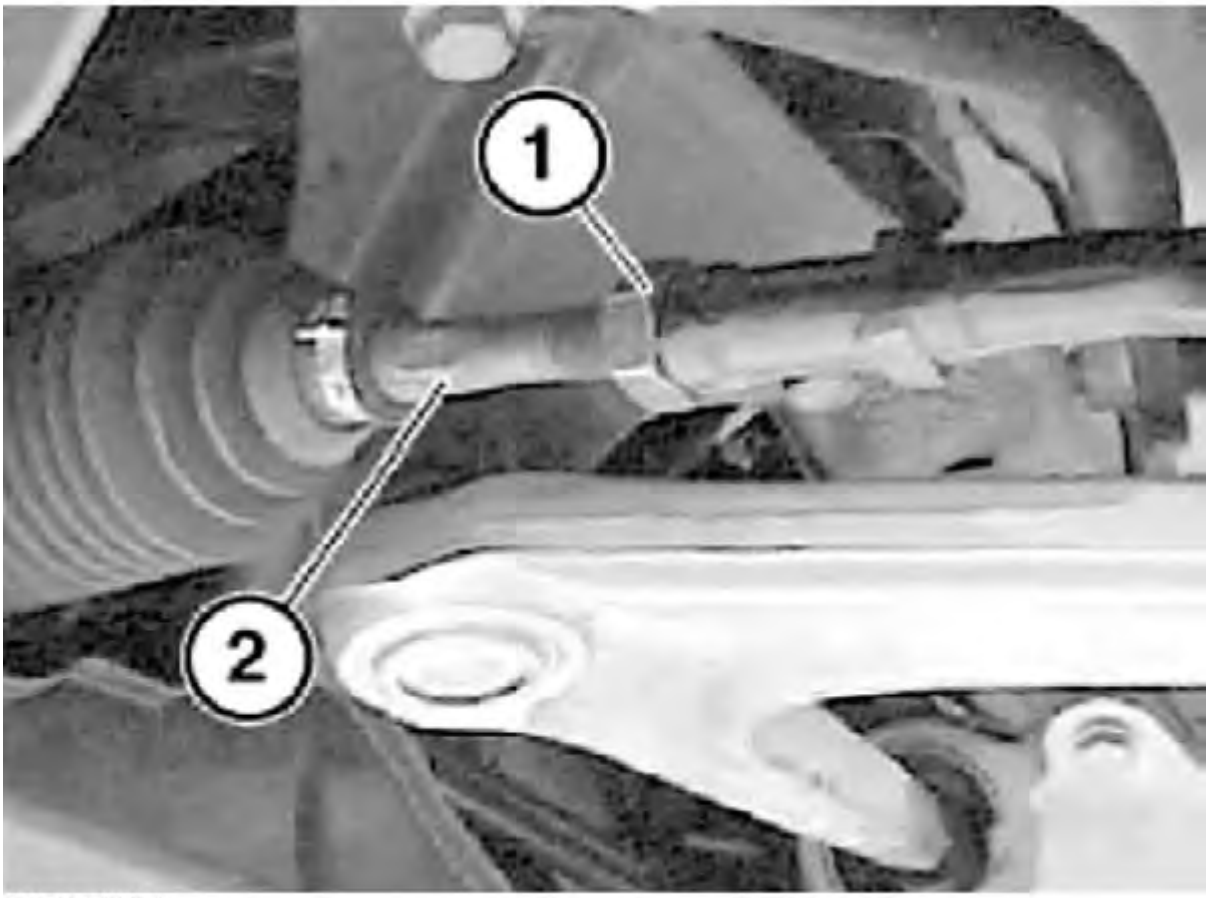


Fig. 24: Adjusting Toe-In (E46)
Courtesy of BMW OF NORTH AMERICA, INC.

Front (E52)

1. Move steering wheel gear into straight ahead setting. Marks on housing and steering shaft must line up. See Fig. 25.
2. Slacken lock nut (1) on steering tie rod, gripping outer tie rod in so doing. Adjust wheel toe-in by turning tie rod (2). See Fig. 26. Adjust wheel toe-in to specification. See E52 under WHEEL ALIGNMENT SPECIFICATIONS.
3. Grip outer tie rod and tighten lock nut to specification. See E52 under TORQUE SPECIFICATIONS.

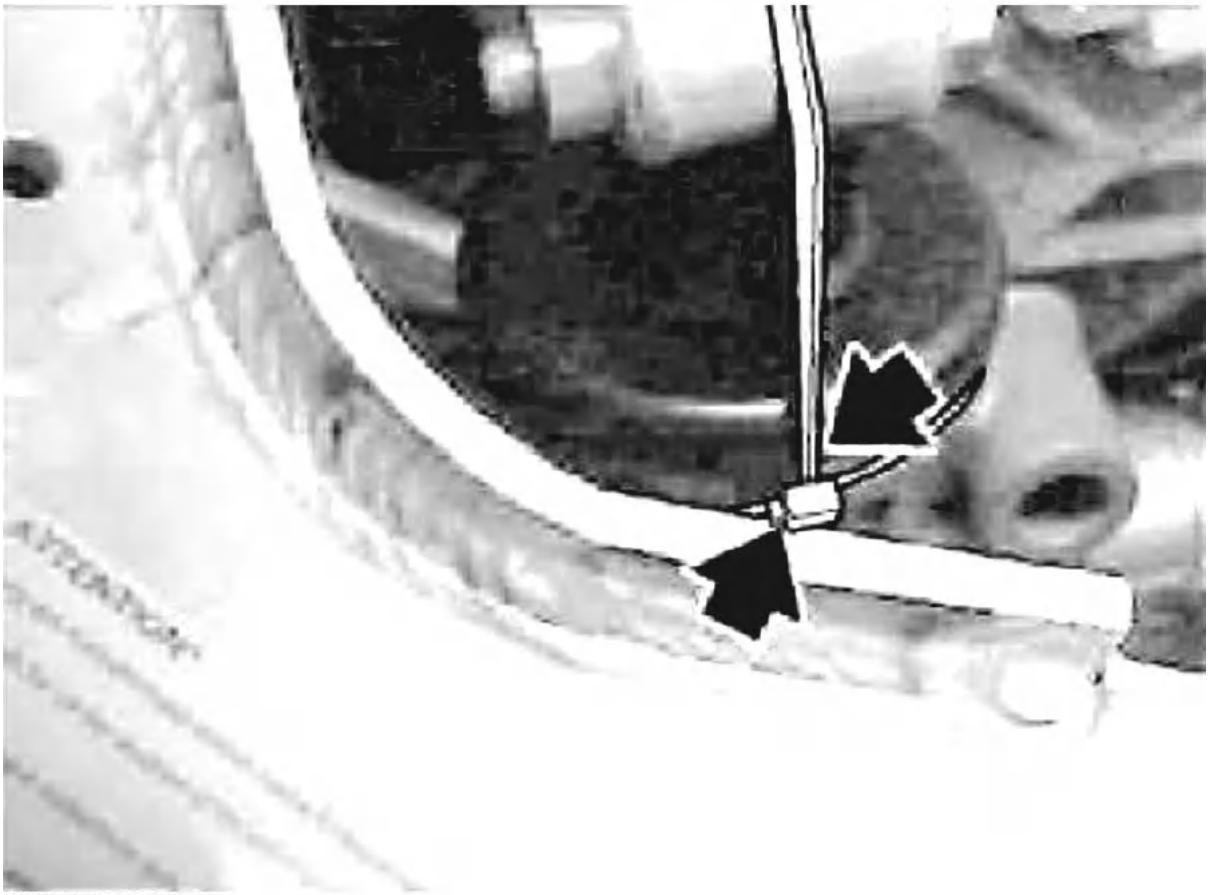


Fig. 25: Locating Mark On Housing & Steering Shaft
Courtesy of BMW OF NORTH AMERICA, INC.

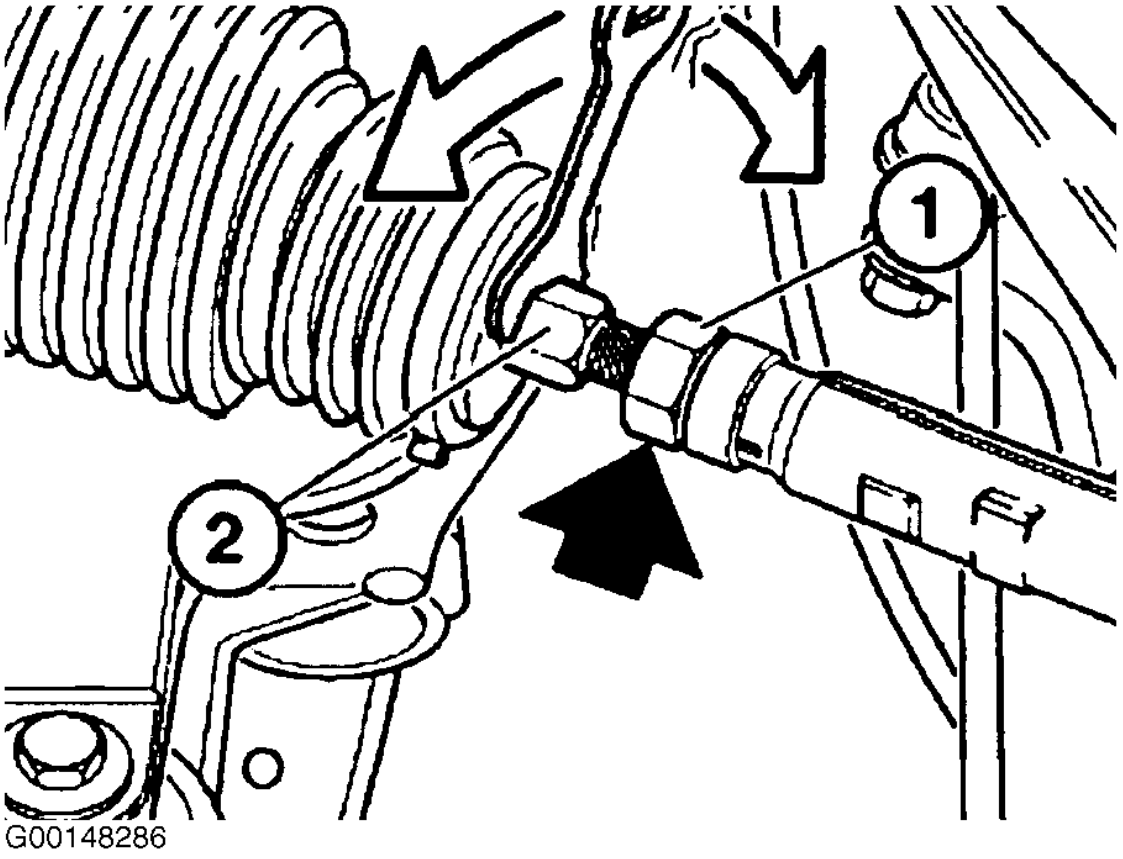


Fig. 26: Adjusting Wheel Toe-In
Courtesy of BMW OF NORTH AMERICA, INC.

Front (E53)

NOTE: The camber must be adjusted first. See FRONT (E53) under CAMBER ADJUSTMENT.

1. Move wheels and steering gear to straight ahead position. Markings on cap (1) and on housing (2) must be aligned. See Fig. 27.
2. Loosen lock nut (1) on tie rod. Adjust wheel toe-in by turning tie rod at hexagon head (2). See Fig. 26. Adjust to specification. See E53 under WHEEL ALIGNMENT SPECIFICATIONS.
3. Make sure steering pack is not turned. Tighten lock nut (1) to specification. See E53 under TORQUE SPECIFICATIONS.

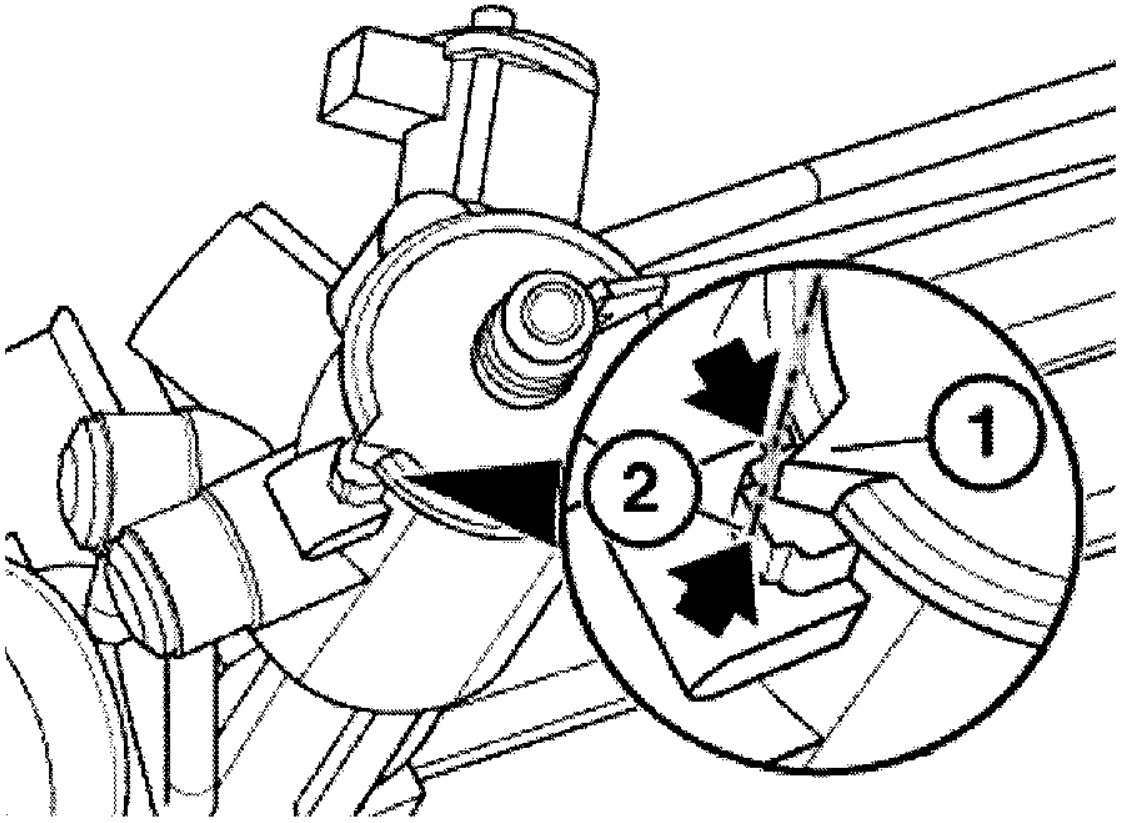


Fig. 27: Locating Markings On Cap & Housing (E53)
Courtesy of BMW OF NORTH AMERICA, INC.

Front (E65)

NOTE: The camber must be adjusted first. See FRONT (E65) under CAMBER ADJUSTMENT.

1. Move steering gear and wheels to straight ahead position. Markings on cap (1) and on housing (2) must match up on steering gear. See Fig. 28.
2. Loosen lock nut (1) on tie rod, gripping tie rod in so doing. Adjust wheel toe-in by turning tie rod axial joint at hexagon head (2). See Fig. 26. Adjust to specification. See E65 under WHEEL ALIGNMENT SPECIFICATIONS.
3. Make sure steering sleeve is not twisted. Grip tie rod and tighten down lock nut (1) to specification. See E65 under TORQUE SPECIFICATIONS.

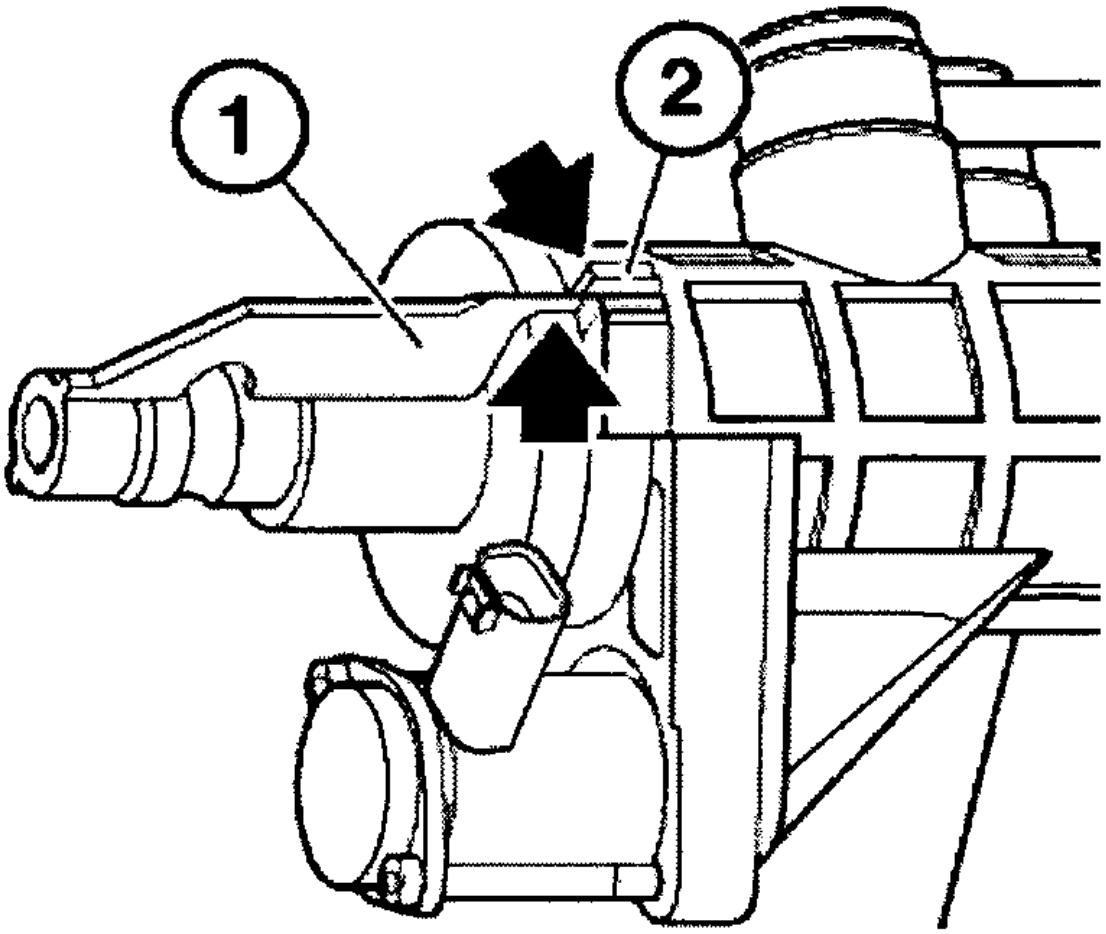


Fig. 28: Aligning Steering Gear
Courtesy of BMW OF NORTH AMERICA, INC.

Rear (E36)

Release bolts approximately 1 1/2 turns on bearing support. Apply special tool (32 3 080) on bolt head between stops (1). See Fig. 29. If bearing support has a pin or notch, attach special tool (32 3 030) to bolt head and pin/notch (1). See Fig. 30. Rotate special tool and adjust toe-in of left/right wheel to specification. See E36 under WHEEL ALIGNMENT SPECIFICATIONS.

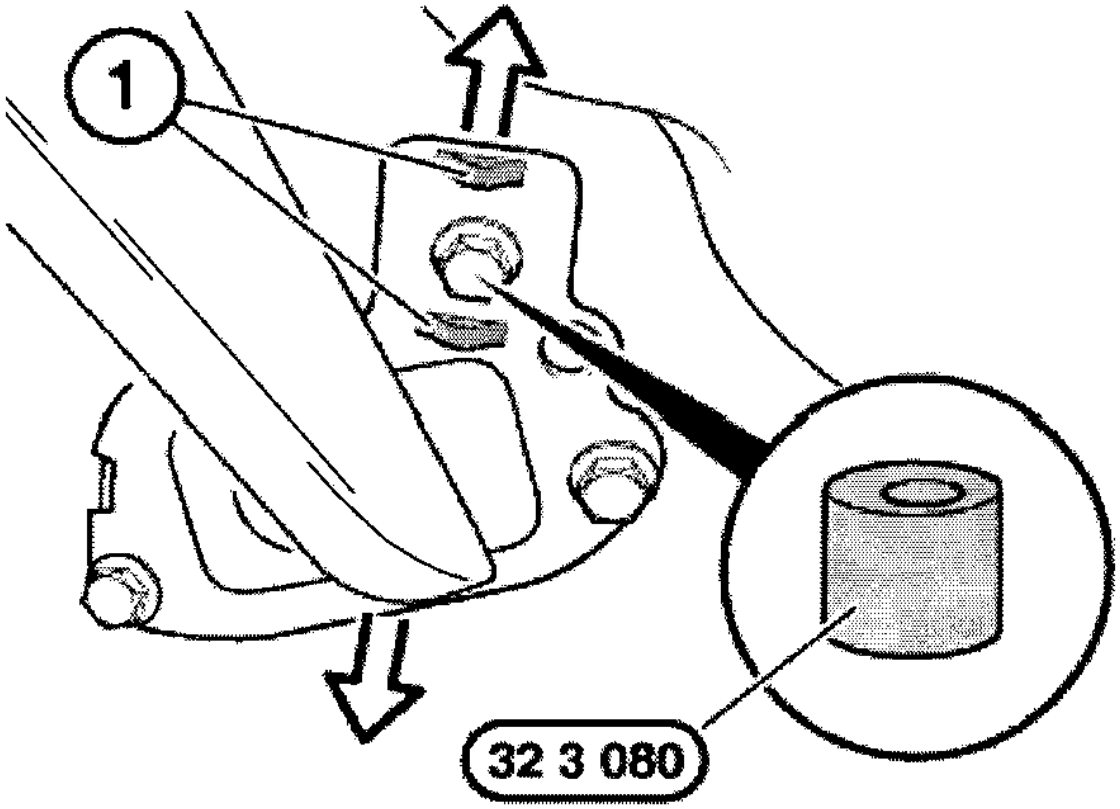


Fig. 29: Adjusting Toe-In
Courtesy of BMW OF NORTH AMERICA, INC.

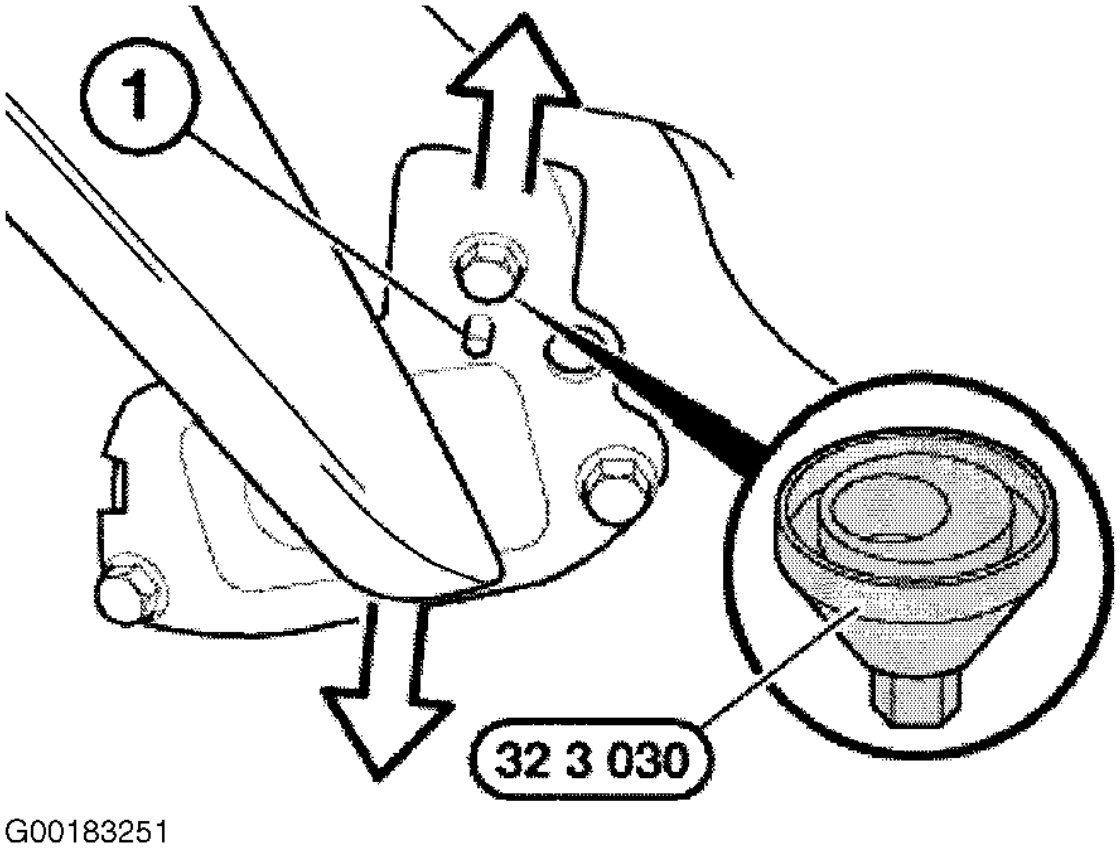


Fig. 30: Identifying Bearing Support With Pin Or Notch
Courtesy of BMW OF NORTH AMERICA, INC.

Rear (E39)

1. Unfasten screws and remove trim. See Fig. 31.
2. Before adjusting, replace disk collar nut (1) and ensure eccentric washer (2) is correctly located. See Fig. 32. Tighten disk collar nut to specification. See E39 under TORQUE SPECIFICATIONS.
3. Unfasten disk collar nut 1/2 to 1 complete turn.
4. Adjust toe-in using the eccentric screw. See Fig. 33. Adjust precisely to specification. See E39 under WHEEL ALIGNMENT SPECIFICATIONS.

CAUTION: If the disk collar nut is tightened down more than 10 times during adjustment, it must be replaced. The self-locking effect becomes too slight.

5. Ensure that eccentric washer (2) is correctly located. See Fig. 32. Tighten down disk collar nut (1) to specification. See E39 under TORQUE SPECIFICATIONS.

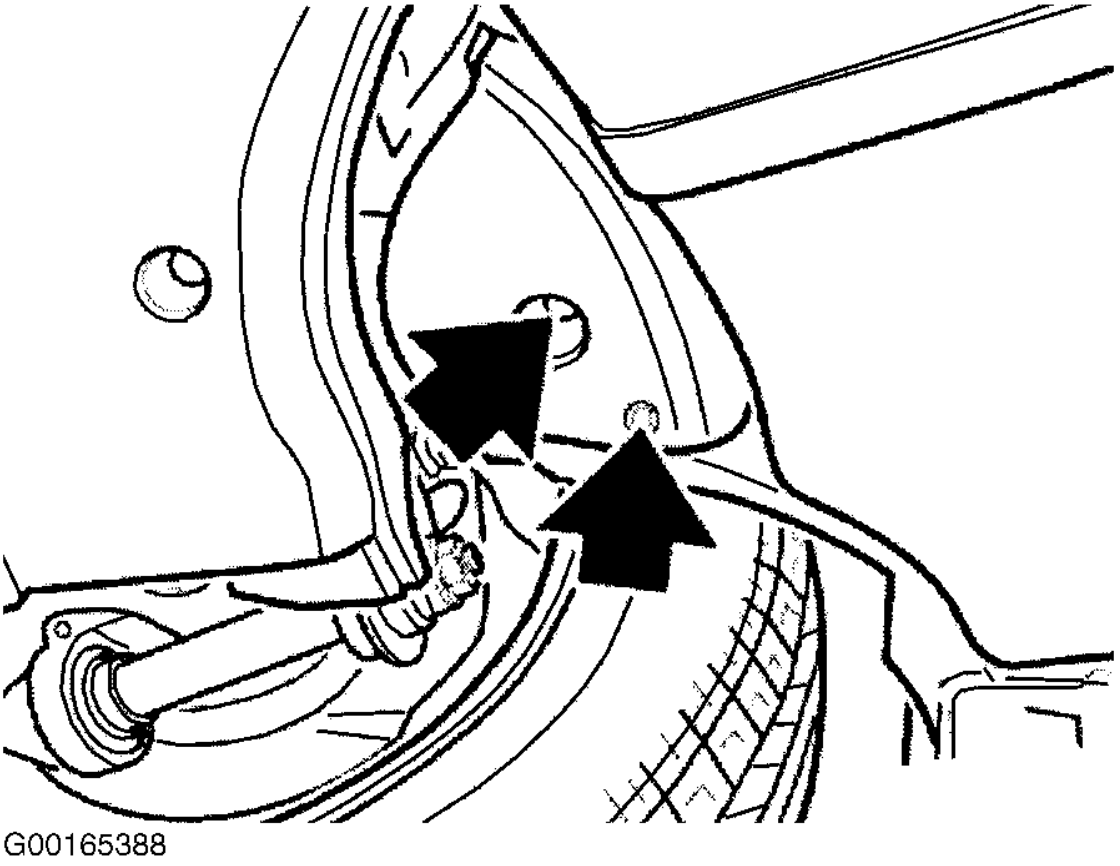


Fig. 31: Removing Trim
Courtesy of BMW OF NORTH AMERICA, INC.

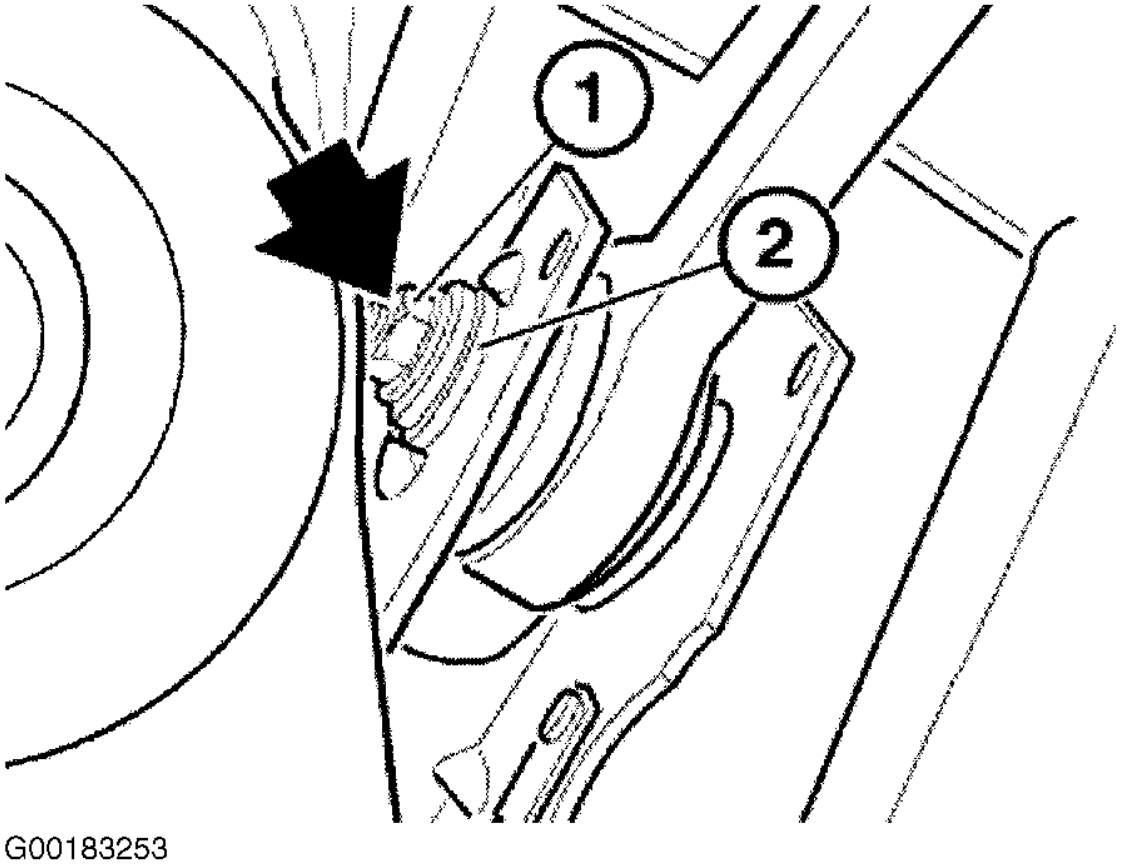


Fig. 32: Locating Disk Collar Nut (E39)
Courtesy of BMW OF NORTH AMERICA, INC.

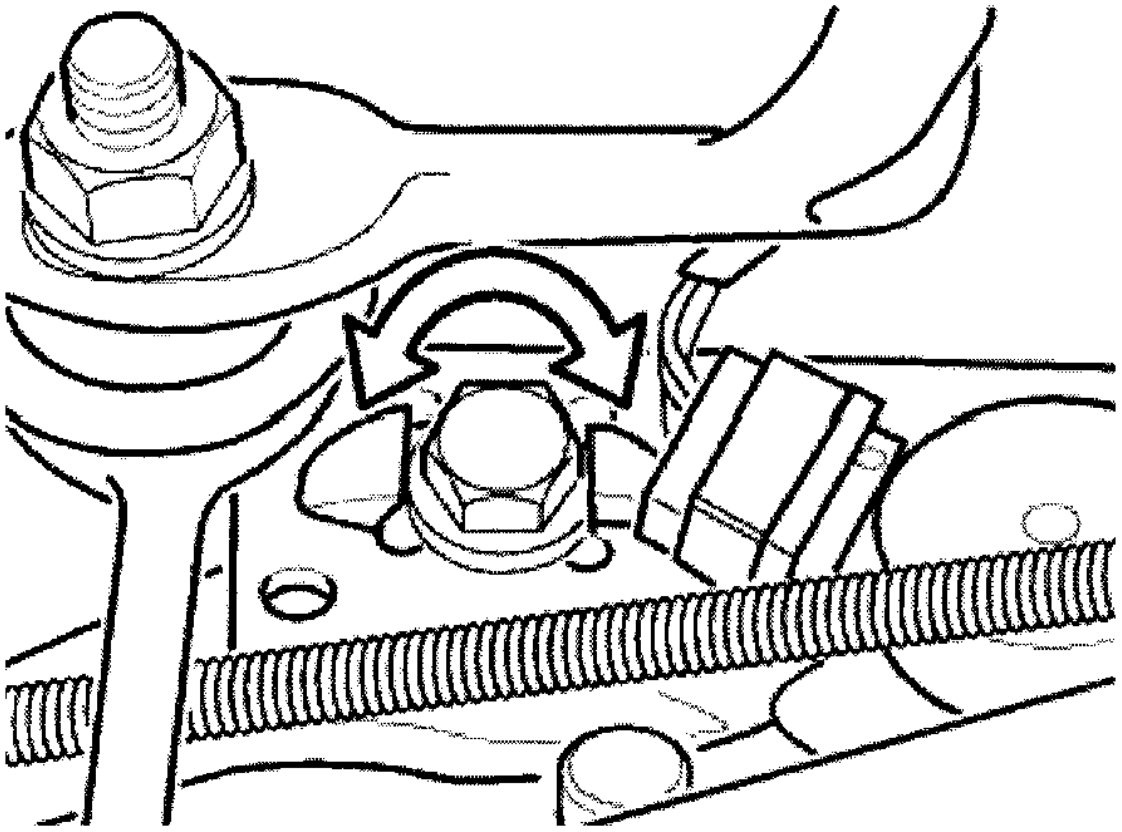


Fig. 33: Adjusting Toe-In (E53 Rear)
Courtesy of BMW OF NORTH AMERICA, INC.

Rear (E46)

1. Release screws approximately 1 1/2 turns at bearing pedestal. Attach special tool (32 3 030) to screw head and to notch (1). See Fig. 30.
2. Turn special tool and adjust toe-in to specification. See E46 under WHEEL ALIGNMENT SPECIFICATIONS.
3. Tighten screws at bearing pedestal to specification. See E46 under TORQUE SPECIFICATIONS.

Rear (E52)

NOTE: Any change in camber always involves a change in toe. The camber must always be adjusted first. See REAR (E52) under CAMBER ADJUSTMENT.

1. Replace and tighten down disk collar nut. See Fig. 34.
2. Tighten disk collar nut to specification. See E52 under TORQUE SPECIFICATIONS.
3. Release disk collar nut again by 1/2 to 1 turn.
4. Adjust toe-in with eccentric screw. See Fig. 35. Adjust to specification. See E52 under WHEEL ALIGNMENT SPECIFICATIONS.

CAUTION: If the disk collar nut is tightened down more than 10 times during adjustment, it must be replaced. The self-locking effect becomes too slight.

5. Tighten down disk collar nut to specification. See E52 under TORQUE SPECIFICATIONS.

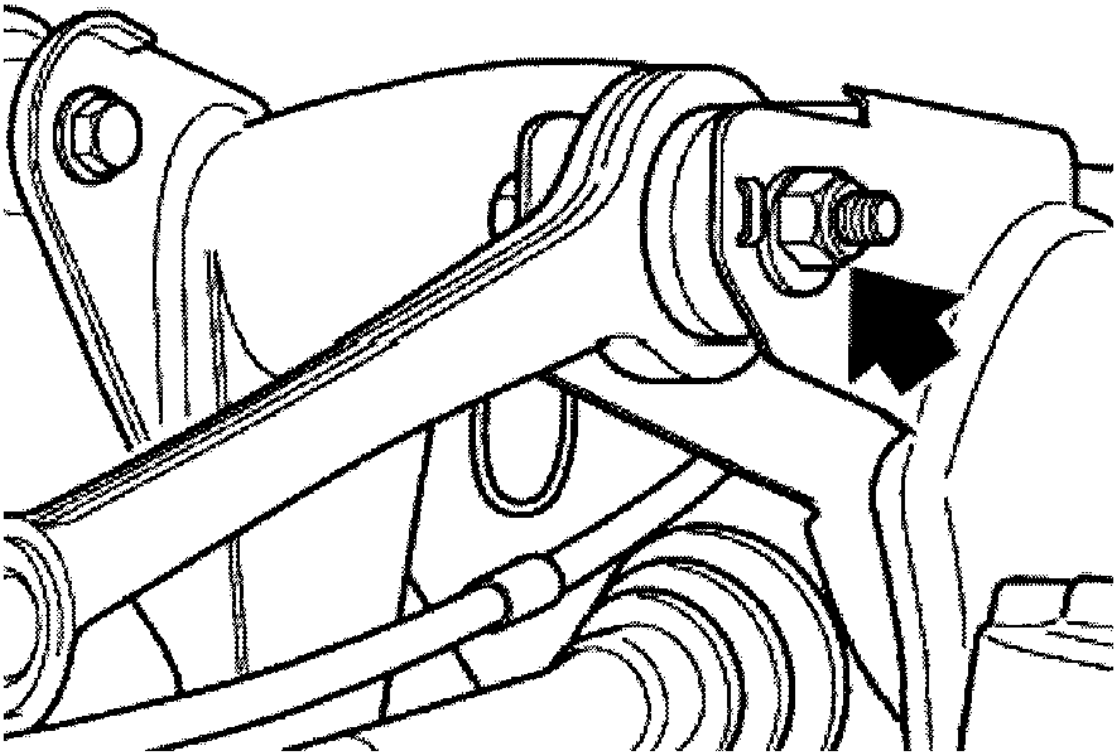


Fig. 34: Locating Rear Disk Collar Nut (E52)
Courtesy of BMW OF NORTH AMERICA, INC.

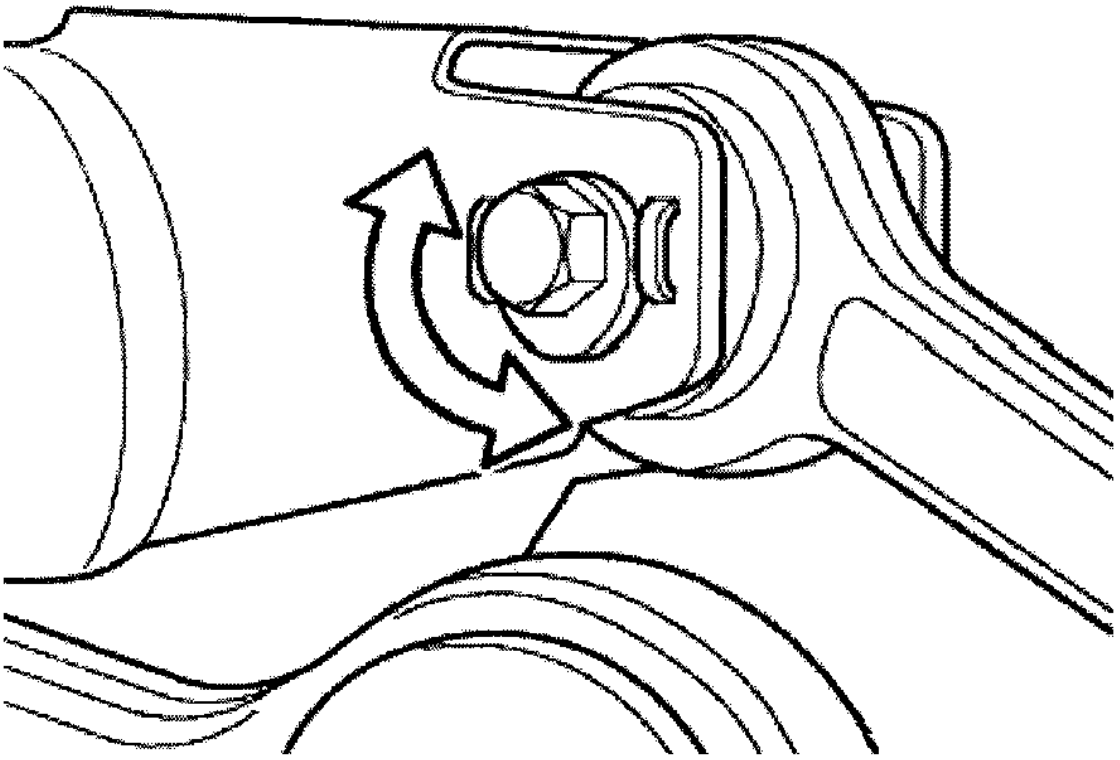


Fig. 35: Adjusting Toe-In (Rear E52)
Courtesy of BMW OF NORTH AMERICA, INC.

Rear (E53)

NOTE: Unscrew a stubborn nut with special tool (32 3 152).

1. Release nut (1) with special tool (32 3 151/152) and remove. See Fig. 36.
2. Replace nut (1). Eccentric washer (2) must be located between stops. See Fig. 32.
3. Tighten down new nut (1) with special tool (32 3 151/152) to specification. See E53 under TORQUE SPECIFICATIONS.
4. Slacken nut (1) approximately 3/4 turn.
5. Adjust toe-in by turning eccentric screw. See Fig. 33. Tighten to specification. See E53 under WHEEL ALIGNMENT SPECIFICATIONS.

   CAUTION: If the nut is tightened down more than 4 times during adjustment, it must be replaced again. The self-locking effect becomes too slight.

6. Tighten down nut with special tool (32 3 151/152) to specification. See E53 under TORQUE SPECIFICATIONS.

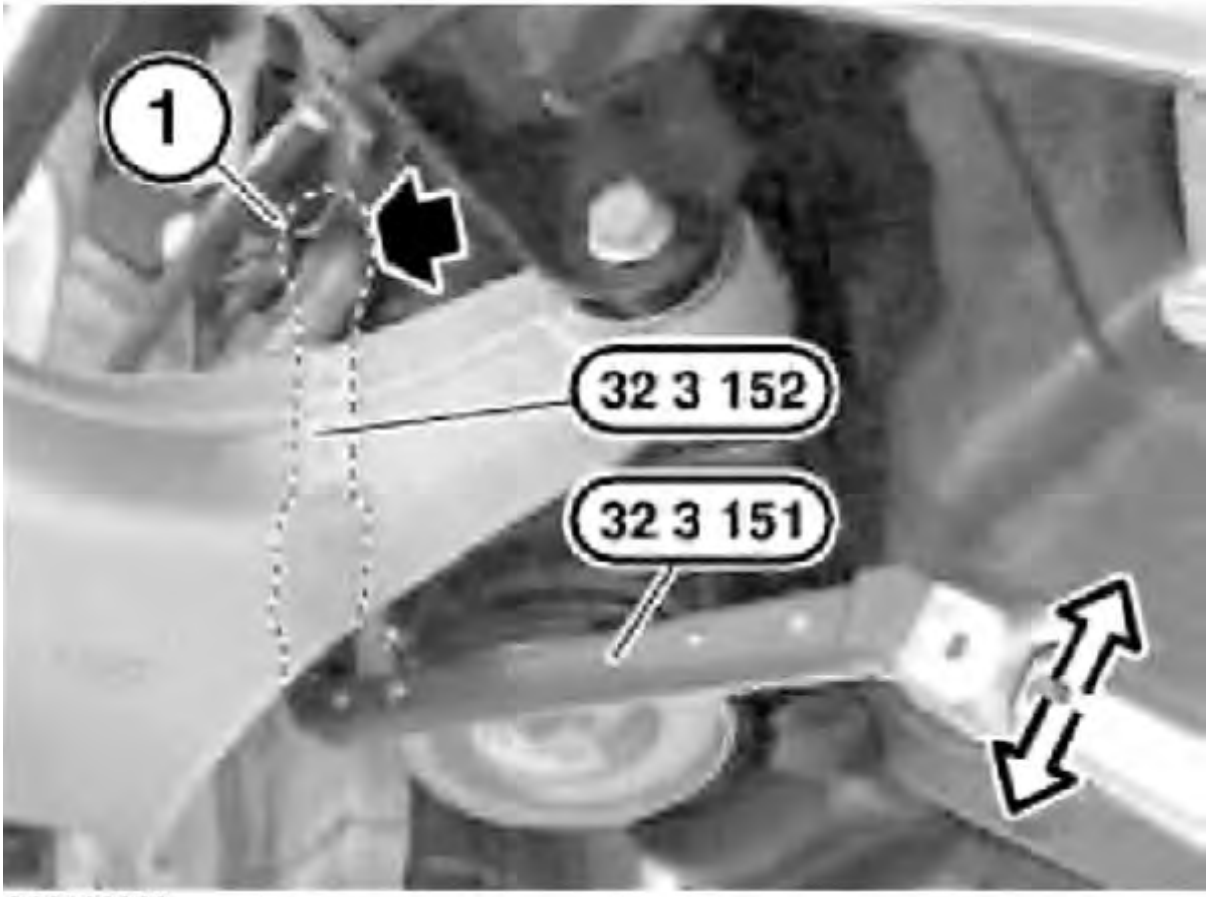


Fig. 36: Releasing Nut (E53 Rear)
Courtesy of BMW OF NORTH AMERICA, INC.

Rear (E65)

NOTE: A change of camber always involves a change of toe. Adjust camber first. See REAR (E65) under CAMBER ADJUSTMENT.

1. Replace nut (1). Ensure eccentric washer (2) is correctly located. See Fig. 37. Tighten nut (1) to specification. See E65 under TORQUE SPECIFICATIONS.
2. Release nut (1) again by 1/2 to 1 turn.
3. Adjust toe with eccentric screw (3) precisely to specification. See E65 under WHEEL ALIGNMENT SPECIFICATIONS.

CAUTION: If the nut is tightened down more than 10 times during adjustment, it must be replaced again. The self-locking effect becomes too slight.

4. Ensure eccentric washer is correctly located (2). See Fig. 37. Tighten nut (1) to specification. See E65 under TORQUE SPECIFICATIONS.

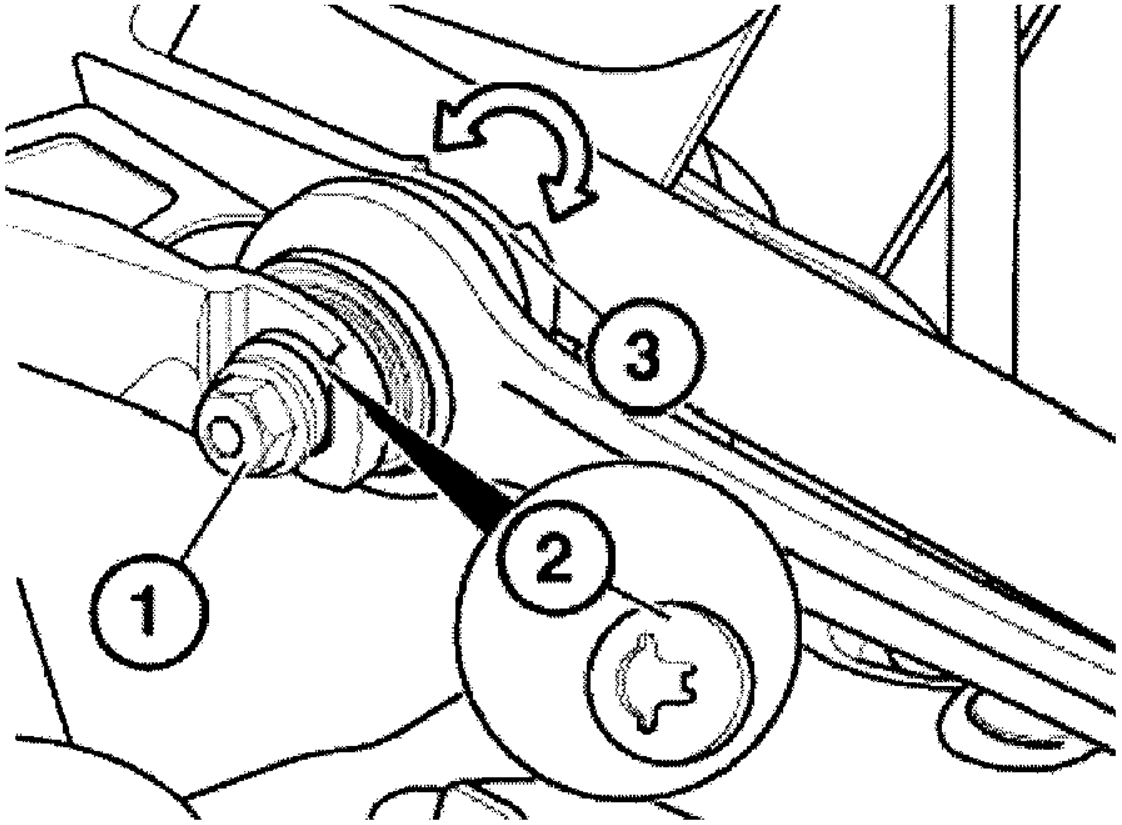


Fig. 37: Locating Nut & Eccentric Washer (E65 Rear)
Courtesy of BMW OF NORTH AMERICA, INC.

TORQUE SPECIFICATIONS

E36

TORQUE SPECIFICATIONS (E36)

Application	Ft. Lbs. (N.m)
Tie Rod Clamping Nut	33 (45)
Trailing Arm Console To Body	57 (77)
Upper/Lower Control Arms To Trailing Arm	81 (110)
Wheel Lug Nuts	81-96 (110-130)

E39

TORQUE SPECIFICATIONS (E39)

Application	Ft. Lbs. (N.m)
Control Arm To Rear Axle Support	44 (60)
Swinging Arm To Rear Axle Support Camber Adjustment Except Touring/M5	85 (115)
Swinging Arm To Rear Axle Support Camber Adjustment Touring/M5	128 (174)
Tie Rod Clamping Screw	20 (27)

E46

TORQUE SPECIFICATIONS (E46)

Application	Ft. Lbs. (N.m)
Spring Strut Mount To Wheel House	
18 mm	18 (24)
21 mm	25 (34)
Tie Rod Clamping Nut	33 (45)
Trailing Arm Console To Body	57 (77)
Upper/Lower Control Arms To Trailing Arms	81 (110)

E52

TORQUE SPECIFICATIONS (E52)

Application	Ft. Lbs. (N.m)
Disk Collar Nut Front	174 (236)
Disk Collar Nut Rear	44 (60)

E53

TORQUE SPECIFICATIONS (E53)

Application	Ft. Lbs. (N.m)
Control Arm To Rear Axle Support Toe-In Adjustment	44 (59)
Spring Strut Mount To Wheel House	
18 mm	18 (24)
21 mm	25 (34)
Swinging Arm To Rear Axle Support Camber Adjustment	122 (165)
Tie Rod Clamping Nut	38 (51)

E65

TORQUE SPECIFICATIONS (E65)

Application	Ft. Lbs. (N.m)
Control Arm To Rear Axle Support Toe-In Adjustment	48 (65)
Spring Strut Mount To Wheel House	25 (34)
Swinging Arm To Rear Axle Support Camber Adjustment	122 (165)
Tie Rod Clamping Nut	38 (51)

WHEEL ALIGNMENT SPECIFICATIONS

E36

WHEEL ALIGNMENT SPECIFICATIONS (318i, 318is, 323i, 323is, 325i, 325is, 328i & 328is)

Application	Preferred	Range
Standard Suspension		
Total Toe		
Front	.3Â°	.17 To .43Â°
Rear	.4Â°	.3 To .5Â°
Camber		
Front (Up To 95) (1)	-.67Â°	-1.17 To -.17Â°
Front (From 95) (1)	-.5Â°	-1 To 0Â°
Rear (2)	-1.67Â	-1.92 To

	°	-1.42Â°
Toe Difference Angle With 20Â° Inside Wheel Lock [(1)]	-1.57Â°	-2.07 To -1.07Â°
		Caster [(1)]
With 0 To 20Â° Wheel Lock	3.73Â°	3.23 To 4.23Â°
With 0 To 40Â° Wheel Lock	3.87Â°	3.37 To 4.37Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.05 To .05Â°
Maximum Wheel Lock		
Inside Wheel	About 44Â°	N/A
Outside Wheel	About 36Â°	N/A
Turning Circle	34.1 Ft. (10.4 M)	N/A
Low Slung Sports Suspension		
Total Toe		
Front	.3Â°	.17 To .43Â°
Rear	.4Â°	.3 To .5Â°
Camber		
Front (Up To 95) [(1)]	-.97Â°	-1.47 To -.47Â°
Front (From 95) [(1)]	-.85Â°	-1.18 To .35Â°
Rear [(2)]	-2Â°	-2.25 To -1.75Â°
Toe Difference Angle With 20Â° Inside Wheel Lock [(1)]	-1.34Â°	-2.07 To -1.07Â°
Caster [(1)]		
With 0 To 20Â° Wheel Lock	3.83Â°	3.33 To 4.33Â°
With 0 To 40Â° Wheel Lock	3.95Â°	3.45 To 4.45Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.05 To .05Â°
Maximum Wheel Lock		
Inside Wheel	About 44Â°	N/A
Outside Wheel	About 36Â°	N/A
Turning Circle	34.1 Ft. (10.4 M)	N/A
Rough Road Package		
Total Toe		
Front	.3Â°	.17 To .43Â°
Rear	.4Â°	.3 To .5Â°
Camber		
Front (Up To 95) [(1)]	.12Â°	-.38 To .62Â°
Front (From 95) [(1)]	.05Â°	-.45 To .55Â°

Rear (2)	-1Â°	-1.25 To -.75Â°
Toe Difference Angle With 20Â° Inside Wheel Lock (1)	-1.57Â°	-2.07 To -1.07Â°
Caster (1)		
With 0 To 20Â° Wheel Lock	3.43Â°	2.93 To 3.93Â°
With 0 To 40Â° Wheel Lock	3.55Â°	3.05 To 4.05Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.05 To .05Â°
Maximum Wheel Lock		
Inside Wheel	About 44Â°	N/A
Outside Wheel	About 36Â°	N/A
Turning Circle	34.1 Ft.(10.4 M)	N/A

(1) Difference between left and right is a maximum .5Â°

(2) Difference between left and right is a maximum .25Â°

WHEEL ALIGNMENT SPECIFICATIONS (M3)

Application	Preferred	Range
Except 3.2L		
Standard Suspension		
Total Toe		
Front	.17Â°	.08 To .25Â°
Rear	.5Â°	.42 To .58Â°
Camber		
Front (1)	-.92Â°	-1.42 To -.42Â°
Rear (2)	-1.75Â°	-2.33 To -1.33Â°
Toe Difference Angle With 20Â° Inside Wheel Lock (1)	-1.83Â°	-2.07 To -1.07Â°
Caster (1)		
With 0 To 20Â° Wheel Lock	6.63Â°	6.13 To 7.13
With 0 To 40Â° Wheel Lock	6.87Â°	6.37 To 7.37Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.05 To .05Â°
Maximum Wheel Lock		
Inside Wheel	About 38Â°	N/A
Outside Wheel	About 32Â°	N/A
Turning Circle	38 Ft. (11.6 M)	N/A
Sports Suspension		
Total Toe		
Front		.25 To

	.33Â°	.42Â°
Rear	.5Â°	.42 To .58Â°
Camber		
Front (1)	-2Â°	-2.5 To -1.5Â°
Rear (2)	-2.68Â°	-2.85 To -2.52Â°
Toe Difference Angle With 20Â° Inside Wheel Lock (1)	-.97Â°	-1.47 To -.47Â°
Caster (1)		
With 0 To 20Â° Wheel Lock	6.97Â°	7.47 To 6.47
With 0 To 40Â° Wheel Lock	7.2Â°	6.7 To 7.7Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.05 To .05Â°
Maximum Wheel Lock		
Inside Wheel	About 38Â°	N/A
Outside Wheel	About 32Â°	N/A
Turning Circle	38 Ft. (11.6 M)	N/A
3.2 Liter		
Total Toe		
Front	.33Â°	.25 To .42Â°
Rear	.33Â°	.25 To .42Â°
Camber		
Front (1)	-.77Â°	-1.27 To -.27Â°
Rear (2)	-1.75Â°	-2.33 To -1.33Â°
Toe Difference Angle With 20Â° Inside Wheel Lock (1)	-1.4Â°	-1.9 To -.9Â°
Caster (1)		
With 0 To 20Â° Wheel Lock	7.58Â°	7.08 To 8.08
With 0 To 40Â° Wheel Lock	7.84Â°	7.33 To 8.33Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.05 To .05Â°
Maximum Wheel Lock		
Inside Wheel	About 38Â°	N/A
Outside Wheel	About 32Â°	N/A
Turning Circle	38 Ft. (11.6 M)	N/A
(1) Difference between left and right is a maximum .5Â°		
(2) Difference between left and right is a maximum .25Â°		

Application	Preferred	Range
Standard Suspension		
Total Toe		
Front	.3Â°	.17 To .43Â°
Rear	.5Â°	.28 To .72Â°
Camber		
Front (1)	-.5Â°	-1 To -0Â°
Rear (1)	-2Â°	-1.92 To -1.42Â°
Track Differential Angle With 20Â° Lock On Inside Wheel	-1.55Â°	-2.05 To -1.05Â°
Caster (1)		
With 0 To 20Â° Wheel Lock	3.73Â°	3.23 To 4.23Â°
With 0 To 40Â° Wheel Lock	3.87Â°	3.37 To 4.37Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.25 To .25Â°
Maximum Wheel Lock		
Inside Wheel	About 44Â°	N/A
Outside Wheel	About 36Â°	N/A
Turning Circle	34.1 Ft. (10.4 M)	N/A
Low-Slung Sports Suspension		
Total Toe		
Front	.3Â°	.17 To .43Â°
Rear	.6Â°	.38 To .82Â°
Camber (1)		
Front	-.85Â°	-1.35 To -.35Â°
Rear	-2.5Â°	-3 To -2Â°
Track Differential Angle With 20Â° Lock On Inside Wheel	-1.55Â°	-2.05 To -1.05Â°
Caster (1)		
With 0 To 20Â° Wheel Lock	3.83Â°	3.33 To 4.33Â°
With 0 To 40Â° Wheel Lock	3.95Â°	3.45 To 4.45Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Geometrical Axis Deviation	0Â°	-.25 To .25Â°
Maximum Wheel Lock		
Inside Wheel	About 44Â°	N/A
Outside Wheel	About 36Â°	N/A
Turning Circle	34.1 Ft. (10.4 M)	N/A
Rough Road Package		
Total Toe		

Front	.3Â°	.17 To .43Â°
Rear	.4Â°	.18 To .61Â°
Camber (1)		
Front	.12Â°	-.38 To .62Â°
Rear	-1.37Â°	-1.87 To -.8Â°
Track Differential Angle With 20Â° Lock On Inside Wheel	-1.55Â°	-2.05 To -1.05Â°
Caster (1)		
With 0 To 20Â° Wheel Lock	3.43Â°	2.73 To 3.93Â°
With 0 To 40Â° Wheel Lock	3.95Â°	3.55 To 4.05Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.25 To .25Â°
Maximum Wheel Lock		
Inside Wheel	About 44Â°	N/A
Outside Wheel	About 36Â°	N/A
Turning Circle	34.1 Ft. (10.4 M)	N/A
(1) Difference between left and right is a maximum .5Â°		

WHEEL ALIGNMENT SPECIFICATIONS (M ROADSTER & M COUPE)

Application	Preferred	Range
Standard Suspension		
Total Toe		
Front	.33Â°	.25 To .42Â°
Rear	.5Â°	.28 To .72Â°
Camber (1)		
Front	-.77Â°	-1.27 To -.27Â°
Rear	-1.75Â°	-2.25 To -1.25Â°
Track Differential Angle With 20Â° Lock On Inside Wheel	-1.4Â°	-1.9 To -.9Â°
Caster (1)		
With 0 To 20Â° Wheel Lock	7.58Â°	7.08 To 8.08Â°
With 0 To 40Â° Wheel Lock	7.83Â°	7.33 To 8.33Â°
Front Wheel Displacement	0Â°	-.17 To .17Â°
Rear Geometrical Axis Deviation	0Â°	-.25 To .25Â°
(1) Difference between left and right is a maximum .5Â°		

WHEEL ALIGNMENT SPECIFICATIONS (Z3)

Application	Preferred	Range

Except Coupe		
4 Cylinder		
Standard Suspension		
Total Toe		
Front	.3Â°	.17 To .43Â°
Rear	.57Â°	.35 To .78Â°
Camber [(1)]		
Front	-.73Â°	-1.23 To -.23Â°
Rear	-2.33Â°	-3.02 To -2.02Â°
Track Differential Angle With 20Â° Lock On Inside Wheel	-1.57Â°	-2.83 To -1.83Â°
Caster [(1)]		
With 0 To 20Â° Wheel Lock	3.68Â°	3.18 To 4.18Â°
With 0 To 40Â° Wheel Lock	3.8Â°	3.3 To 4.3Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.25 To .25Â°
Maximum Wheel Lock		
Inside Wheel	About 41Â°	N/A
Outside Wheel	About 34Â°	N/A
Low Slung Sport Suspension		
Total Toe		
Front	.3Â°	.17 To .43Â°
Rear	.73Â°	.52 To .97Â°
Camber [(1)]		
Front	-1.07Â°	-1.57 To -.57Â°
Rear	-2.83Â°	-3.33 To -2.33Â°
Track Differential Angle With 20Â° Lock On Inside Wheel	-1.57Â°	-2.83 To -1.83Â°
Caster [(1)]		
With 0 To 20Â° Wheel Lock	3.8Â°	3.3 To 4.3Â°

With 0 To 40Â° Wheel Lock	3.93Â°	3.43 To 4.43Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.25 To .25Â°
Maximum Wheel Lock		
Inside Wheel	About 40Â°	N/A
Outside Wheel	About 33Â°	N/A
6 Cylinder		
Standard Suspension		
Total Toe		
Front	.3Â°	.17 To .43Â°
Rear	.33Â°	.12 To .55Â°
Camber (1)		
Front	-.73Â°	-1.23 To -.23Â°
Rear	-2.33Â°	-2.83 To -1.83Â°
Track Differential Angle With 20Â° Lock On Inside Wheel	-1.57Â°	-2.83 To -1.83Â°
Caster (1)		
With 0 To 20Â° Wheel Lock	3.68Â°	3.18 To 4.18Â°
With 0 To 40Â° Wheel Lock	3.8Â°	3.3 To 4.3Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.25 To .25Â°
Maximum Wheel Lock		
Inside Wheel	About 41Â°	N/A
Outside Wheel	About 34Â°	N/A
Low Slung Sports Suspension		
Total Toe		
Front	.3Â°	.17 To .43Â°
Rear	.5Â°	.28 To .72Â°
Camber (1)		
Front	-1.07Â°	-1.57 To -.57Â°
Rear	-2.83Â°	-3.33

		To -2.33Â°
Track Differential Angle With 20Â° Lock On Inside Wheel	-1.57Â°	-2.83 To -1.83Â°
Caster (1)		
With 0 To 20Â° Wheel Lock	3.8Â°	3.3 To 4.3Â°
With 0 To 40Â° Wheel Lock	3.93Â°	3.43 To 4.43Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.25 To .25Â°
Maximum Wheel Lock		
Inside Wheel	About 41Â°	N/A
Outside Wheel	About 34Â°	N/A
Coupe		
Standard Suspension		
Total Toe		
Front	.3Â°	.17 To .43Â°
Rear	.63Â°	.42 To .85Â°
Camber (1)		
Front	-.85Â°	-1.35 To -.35Â°
Rear	-2.52Â°	-3.02 To -2.02Â°
Track Differential Angle With 20Â° Lock On Inside Wheel	-1.57Â°	-2.07 To -1.07Â°
Caster (1)		
With 0 To 20Â° Wheel Lock	3.83Â°	3.33 To 4.33Â°
With 0 To 40Â° Wheel Lock	3.95Â°	3.45 To 4.45Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.25 To .25Â°
Maximum Wheel Lock		
Inside Wheel	About 41Â°	N/A
Outside Wheel	About 34Â°	N/A

(1) Difference between left and right is a maximum .5Â°

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WHEEL ALIGNMENT SPECIFICATIONS (6-CYLINDER MODELS)

Application	Preferred	Range
Sedan		
Standard Suspension		
Total Toe		
Front	.08Â°	-.08 To .25Â°
Rear Alignment Check	.27Â°	.1 To .43Â°
Rear Adjustment	.37Â°	.3 To .43Â°
Camber		
Front (1)	-.22Â°	-.77 To .28Â°
Rear Alignment Check (2)	-2.17Â°	-2.5 To -1.83Â°
Rear Adjustment	-2.07Â°	-2.15 To -1.98Â°
Track Differential Angle With 20Â° Lock On Inside Wheel	-1.93Â°	-2.43 To -1.43Â°
Caster (3)		
With -10 To 10Â° Wheel Lock	6.47Â°	5.97 To 6.97Â°
With -20 To 20Â° Wheel Lock	6.7	6.2 To 7.2Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.2 To .2Â°
Maximum Wheel Lock		
Inside Wheel	About 42Â°	N/A
Outside Wheel	About 33.5Â°	N/A
Low Slung Sports Suspension		
Total Toe		
Front	.08Â°	-.08 To .25Â°
Rear Alignment Check	.27Â°	.07 To .47Â°
Rear Adjustment	.37Â°	.3 To .43Â°
Camber		
Front (1)	-.6Â°	-1.1 To -.1Â°
Rear Alignment Check (2)	-2.17Â°	-2.58 To -1.75Â°
Rear Adjustment (2)	-2.07Â°	-2.15 To -1.98Â°
Track Differential Angle With 20Â° Lock On Inside Wheel	-1.93Â°	-2.43 To -1.43Â°
Caster (3)		
With -10 To 10Â° Wheel Lock	6.68Â°	6.18 To 7.18Â°

With -20 To 20Â° Wheel Lock	6.92	6.42 To 7.42Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.2 To .2Â°
Maximum Wheel Lock		
Inside Wheel	About 41.5Â°	N/A
Outside Wheel	About 33Â°	N/A
Rough Road Package		
Total Toe		
Front	.08Â°	-.08 To .25Â°
Rear Alignment Check	.27Â°	.07 To .47Â°
Rear Adjustment	.37Â°	.3 To .43Â°
Camber		
Front (1)	.22Â°	-.28 To .72Â°
Rear Alignment Check (2)	-2.17Â°	-2.58 To -1.75Â°
Rear Adjustment (2)	-2.07Â°	-2.15 To -1.98Â°
Track Differential Angle With 20Â° Lock On Inside Wheel	-1.93Â°	-2.43 To -1.43Â°
Caster (3)		
With -10 To 10Â° Wheel Lock	6.25Â°	5.75 To 6.75Â°
With -20 To 20Â° Wheel Lock	6.47Â°	5.97 To 6.97Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.2 To .2Â°
Maximum Wheel Lock		
Inside Wheel	About 43Â°	N/A
Outside Wheel	About 34Â°	N/A
Air Suspension		
Total Toe		
Front	.08Â°	-.08 To .25Â°
Rear Alignment Check	.27Â°	.07 To .47Â°
Rear Adjustment	.37Â°	.3 To .43Â°
Camber		
Front (1)	.22Â°	-.28 To .72Â°
Rear Alignment Check (2)	-2.17Â°	-2.58 To -1.75Â°
Rear Adjustment (2)	-2.07Â°	-2.15 To -1.98Â°
Track Differential Angle With 20Â° Lock On Inside Wheel	-1.93Â°	-2.43 To -1.43Â°

Caster (3)		
With -10 To 10Â° Wheel Lock	6.47Â°	5.97 To 6.97Â°
With -20 To 20Â° Wheel Lock	6.7Â°	6.2 To 7.2Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.2 To .2Â°
Maximum Wheel Lock		
Inside Wheel	About 42Â°	N/A
Outside Wheel	About 33.5Â°	N/A
M Sports Package		
Total Toe		
Front	.08Â°	-.08 To .25Â°
Rear Alignment Check	.27Â°	.07 To .47Â°
Rear Adjustment	.37Â°	.3 To .43Â°
Camber		
Front (1)	-.6Â°	-1.1 To -.1Â°
Rear Alignment Check (2)	-2.17Â°	-2.58 To -1.75Â°
Rear Adjustment (2)	-2.07Â°	-2.15 To -1.98Â°
Track Differential Angle With 20Â° Lock On Inside Wheel	-1.93Â°	-2.43 To -1.43Â°
Caster (3)		
With -10 To 10Â° Wheel Lock	6.68Â°	6.18 To 7.18Â°
With -20 To 20Â° Wheel Lock	6.92Â°	6.42 To 7.42Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.2 To .2Â°
Maximum Wheel Lock		
Inside Wheel	About 41.5Â°	N/A
Outside Wheel	About 33Â°	N/A
Touring Models		
Standard Suspension		
Total Toe		
Front	.08Â°	-.08 To .25Â°
Rear	.27Â°	.1 To .43Â°
Camber		
Front (1)	-.22Â°	-.72 To .28Â°
Rear (2)	-1.83Â°	-2.17 To -.17Â°
Track Differential Angle With 20Â° Lock On Inside Wheel	-1.93Â°	-2.43 To -1.43Â°

Caster [3]		
With -10 To 10Â° Wheel Lock	6.47Â°	5.97 To 6.97Â°
With -20 To 20Â° Wheel Lock	6.7Â°	6.2 To 7.2Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.2 To .2Â°
Maximum Wheel Lock		
Inside Wheel	About 42Â°	N/A
Outside Wheel	About 33.5Â°	N/A
Low Slung Sports Suspension		
Total Toe		
Front	.08Â°	-.08 To .25Â°
Rear	.27Â°	.1 To .43Â°
Camber		
Front [1]	-.6Â°	-1.6 To -.1Â°
Rear [2]	-1.83Â°	-2.17 To -.17Â°
Track Differential Angle With 20Â° Lock On Inside Wheel	-1.93Â°	-2.43 To -1.43Â°
Caster [3]		
With -10 To 10Â° Wheel Lock	6.68Â°	6.18 To 7.18Â°
With -20 To 20Â° Wheel Lock	6.92Â°	6.42 To 7.42Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.2 To .2Â°
Maximum Wheel Lock		
Inside Wheel	About 41.5Â°	N/A
Outside Wheel	About 33Â°	N/A
Rough Road Package		
Total Toe		
Front	.08Â°	-.07 To .47Â°
Rear	.27Â°	.1 To .43Â°
Camber		
Front [1]	.22Â°	-.28 To -.72Â°
Rear [2]	-1.83Â°	-2.25 To -1.42Â°
Track Differential Angle With 20Â° Lock On Inside Wheel	-1.93Â°	-2.43 To -1.43Â°
Caster [3]		
With -10 To 10Â° Wheel Lock	6.25Â°	5.75 To 6.75Â°
With -20 To 20Â° Wheel Lock	6.47Â°	5.97 To 6.97

Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.2 To .2Â°
Maximum Wheel Lock		
Inside Wheel	About 43Â°	N/A
Outside Wheel	About 34Â°	N/A

(1) Difference between left and right is maximum .67Â°.

(2) Difference between left and right is maximum .25Â°.

(3) Difference between left and right is maximum .5Â°.

WHEEL ALIGNMENT SPECIFICATIONS (8-CYLINDER MODELS)

Application	Preferred	Range
Except M5		
Standard Suspension		
Total Toe		
Front	.23Â°	-.07 To .4Â°
Rear Alignment Check	.27Â°	.1 To .43Â°
Rear Adjustment	.37Â°	.3 To .43Â°
Camber		
Front (1)	-.22Â°	-.72 To .28Â°
Rear Alignment Check (2)	-2.17Â°	-2.5 To -1.83Â°
Rear Adjustment (2)	-2.07Â°	-2.15 To -1.98Â°
Track Differential Angle With 20Â° Lock On Inside Wheel	-1.58Â°	-2.08 To -1.08Â°
Caster (3)		
With -10 To 10Â° Wheel Lock	6.3Â°	5.2 To 6.8
With -20 To 20Â° Wheel Lock	6.6Â°	6.1 To 7.1Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.2 To .2Â°
Maximum Wheel Lock		
Inside Wheel	About 42Â°	N/A
Outside Wheel	About 32.6Â°	N/A
Low Slung Sports Suspension		
Total Toe		
Front	.23Â°	-.07 To .4Â°
Rear Alignment Check	.27Â°	.07 To .47Â°
Rear Adjustment	.37Â°	.3 To .43Â°
Camber		
Front (1)	-.62Â°	-1.12 To -.12Â°
Rear Alignment Check (2)	-2.17Â°	-2.58 To -1.75Â°

Rear Adjustment (2)	-2.07Â°	-2.15 To -1.98Â°
Track Differential Angle With 20Â° Lock On Inside Wheel	-1.73Â°	-2.23 To -1.23Â°
Caster (3)		
With -10 To 10Â° Wheel Lock	6.57Â°	6.07 To 7.07
With -20 To 20Â° Wheel Lock	6.83Â°	6.33 To 7.33Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.2 To .2Â°
Maximum Wheel Lock		
Inside Wheel	About 42Â°	N/A
Outside Wheel	About 31.8Â°	N/A
Rough Road Package		
Total Toe		
Front	.23Â°	-.07 To .4Â°
Rear Alignment Check	.27Â°	.06 To .47Â°
Rear Adjustment	.37Â°	.3 To .43Â°
Camber		
Front (1)	-.22Â°	-.72 To .28Â°
Rear Alignment Check (2)	-2.17Â°	-2.58 To -1.75Â°
Rear Adjustment (2)	-2.07Â°	-2.15 To -1.98Â°
Track Differential Angle With 20Â° Lock On Inside Wheel	-1.43Â°	-1.93 To -.93Â°
Caster (3)		
With -10 To 10Â° Wheel Lock	6.08Â°	5.58 To 6.58
With -20 To 20Â° Wheel Lock	6.35Â°	5.85 To 6.85Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.2 To .2Â°
Maximum Wheel Lock		
Inside Wheel	About 42Â°	N/A
Outside Wheel	About 33.5Â°	N/A
Air Spring		
Total Toe		
Front	.23Â°	-.07 To .4Â°
Rear Alignment Check	.27Â°	.1 To .6Â°
Rear Adjustment	.37Â°	.3 To .43Â°
Camber		
Front (1)	-.22Â°	-.72 To .28Â°

Rear Alignment Check [2]	-2.17Â°	-2.58 To -1.75Â°
Rear Adjustment [2]	-2.07Â°	-2.15 To -1.98Â°
Track Differential Angle With 20Â° Lock On Inside Wheel	-1.58Â°	-2.08 To -1.08Â°
Caster [3]		
With -10 To 10Â° Wheel Lock	6.3Â°	5.8 To 6.8
With -20 To 20Â° Wheel Lock	6.6Â°	6.1 To 7.1Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.2 To .2Â°
Maximum Wheel Lock		
Inside Wheel	About 42Â°	N/A
Outside Wheel	About 32.6Â°	N/A
M Sports Package		
Total Toe		
Front	.17Â°	0 To .33Â°
Rear Alignment Check	.17Â°	0 To .33Â°
Rear Adjustment	.17Â°	.03 To .3Â°
Camber		
Front [3]	-.5Â°	-1 To 0Â°
Rear Alignment Check [2]	-1.83Â°	-2.08 To -1.58Â°
Rear Adjustment [2]	-1.82Â°	-1.9 To -1.73Â°
Track Differential Angle With 20Â° Lock On Inside Wheel	-1.72Â°	-2.22 To -1.22Â°
Caster [3]		
With -10 To 10Â° Wheel Lock	6.45Â°	5.95 To 6.95Â°
With -20 To 20Â° Wheel Lock	6.82Â°	6.32 To 7.32Â°
Front Wheel Displacement	0Â°	-.17 To .17Â°
Rear Geometrical Axis Deviation	0Â°	-.2 To .2Â°
Maximum Wheel Lock		
Inside Wheel	About 41.5Â°	N/A
Outside Wheel	About 32Â°	N/A
M5		
Total Toe		
Front	.17Â°	0 To .33Â°
Rear Alignment Check	.17Â°	0 To .33Â°
Rear Adjustment	.17Â°	.03 To .3Â°
Camber		
Front [3]	-.5Â°	-1 To 0Â°
Rear Alignment Check [2]	-1.83Â°	-2.08 To -1.58Â°

Rear Adjustment (2)	-1.82Â°	-1.9 To -1.73Â°
Track Differential Angle With 20Â° Lock On Inside Wheel	-1.72Â°	-2.22 To -1.22Â°
Caster (3)		
With -10 To 10Â° Wheel Lock	6.45Â°	5.95 To 6.95Â°
With -20 To 20Â° Wheel Lock	6.82Â°	6.32 To 7.32Â°
Front Wheel Displacement	0Â°	-.17 To .17Â°
Rear Geometrical Axis Deviation	0Â°	-.2 To .2Â°
Maximum Wheel Lock		
Inside Wheel	About 41.5Â°	N/A
Outside Wheel	About 32Â°	N/A

(1) Difference between left and right is maximum .67Â°.

(2) Difference between left and right is maximum .25Â°.

(3) Difference between left and right is maximum .5Â°.

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WHEEL ALIGNMENT SPECIFICATIONS (EXCEPT M3, 325xi & 330xi)

Application	Preferred	Range
Standard Suspension		
Total Toe		
Front	.23Â°	.1 To .37Â°
Rear	.27Â°	.17 To .37Â°
Camber		
Front (1)	-.33Â°	-.67 To 0Â°
Rear (2)	-1.5Â°	-1.75 To -1.25Â°
Track Differential Angle with 20Â° Lock On Inside Wheel	-1.57Â°	-2..07 To -1.07Â°
Caster (1)		
With -10 To 10Â° Wheel Lock	5.43Â°	4.93 To 5.93Â°
With -20 To 20Â° Wheel Lock	5.62Â°	5.12 To 6.12Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.1 To .1Â°
Maximum Wheel Lock		
Inside Wheel	About 43.6Â°	N/A
Outside Wheel	About 35.6Â°	N/A
Low Slung Sports Suspension		
Total Toe		
Front	.23Â°	.1 To .37Â°
Rear	.27Â°	.17 To .37Â°
Camber		

Front (1)	-.72Â°	-1.05 To .38Â°
Rear (2)	-2.07Â°	-2.32 To -1.82Â°
Track Differential Angle with 20Â° Lock On Inside Wheel	-1.57Â°	-2..07 To -1.07Â°
Caster (1)		
With -10 To 10Â° Wheel Lock	5.6Â°	5.1 To 6.1Â°
With -20 To 20Â° Wheel Lock	5.78Â°	5.28 To 6.28Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.1 To .1Â°
Maximum Wheel Lock		
Inside Wheel	About 43.6Â°	N/A
Outside Wheel	About 35.6Â°	N/A
Rough Road Package		
Total Toe		
Front	.23Â°	.1 To .37Â°
Rear	.27Â°	.17 To .37Â°
Camber		
Front (1)	-.13Â°	-.2 To .47Â°
Rear (2)	-.77Â°	-1.02 To -.52Â°
Track Differential Angle with 20Â° Lock On Inside Wheel	-1.57Â°	-2..07 To -1.07Â°
Caster (1)		
With -10 To 10Â° Wheel Lock	5.28Â°	4.78 To 5.78Â°
With -20 To 20Â° Wheel Lock	5.45Â°	4.95 To 5.95Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.1 To .1Â°
Maximum Wheel Lock		
Inside Wheel	About 43.6Â°	N/A
Outside Wheel	About 35.6Â°	N/A
Compact		
Total Toe		
Front	.23Â°	.1 To .37Â°
Rear	.27Â°	.17 To .37Â°
Camber		
Front (1)	-.72Â°	-1.05 To -.38Â°
Rear (2)	-1.5Â°	-1.75 To

		-1.25Â°
Track Differential Angle with 20Â° Lock On Inside Wheel	-1.57Â°	-2..07 To -1.07Â°
Caster (1)		
With -10 To 10Â° Wheel Lock	5.6Â°	5.1 To 6.1Â°
With -20 To 20Â° Wheel Lock	5.78Â°	5.28 To 6.28Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.1 To .1Â°
Maximum Wheel Lock		
Inside Wheel	About 43.6Â°	N/A
Outside Wheel	About 35.6Â°	N/A
(1) Difference between left and right is maximum .5Â°.		
(2) Difference between left and right is maximum .25Â°.		

WHEEL ALIGNMENT SPECIFICATIONS (M3, 325xi & 330xi)

Application	Preferred	Range
325xi & 330xi		
Total Toe		
Front	.23Â°	.1 To .37Â°
Rear	.27Â°	.17 To .37Â°
Camber		
Front (1)	-.83Â°	-1.17 To -.5Â°
Rear (2)	-1.25Â°	-1.5 To -1Â°
Track Differential Angle with 20Â° Lock On Inside Wheel	-.88Â°	-1.55 To -.38Â°
Caster (1)		
With -10 To 10Â° Wheel Lock	5.45Â°	4.95 To 5.95Â°
With -20 To 20Â° Wheel Lock	5.62Â°	5.12 To 6.12Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.1 To .1Â°
Maximum Wheel Lock		
Inside Wheel	About 39Â°	N/A
Outside Wheel	About 35.8Â°	N/A
M3		
Total Toe		
Front	.27Â°	.15 To .38Â°
Rear	.37Â°	.27 To .47Â°
Camber		
Front (1)	-1Â°	-1.33 To -.67Â°
Rear (2)	-1.75Â°	-2 To -1.5Â°

	Â°	
Track Differential Angle with 20Â° Lock On Inside Wheel	-1.53Â°	-2.03 To -1.03Â°
Caster (1)		
With -10 To 10Â° Wheel Lock	7.42Â°	6.92 To 7.92Â°
With -20 To 20Â° Wheel Lock	7.67Â°	7.17 To 8.17Â°
Front Wheel Displacement	0Â°	-.17 To .17Â°
Rear Geometrical Axis Deviation	0Â°	-.07 To .07Â°
Maximum Wheel Lock		
Inside Wheel	About 40.9Â°	N/A
Outside Wheel	About 33.81Â°	N/A
(1) Difference between left and right is maximum .5Â°.		
(2) Difference between left and right is maximum .25Â°.		

E52

WHEEL ALIGNMENT SPECIFICATIONS (Z8)

Application	Preferred	Range
Total Toe		
Front	.13Â°	.03 To .23Â°
Rear	.4Â°	.23 To .57Â°
Camber		
Front (1)	-.5Â°	-1 To 0Â°
Rear (2)		
Alignment Check	-1.5Â°	-1.83 To -1.17Â°
Adjustment	-1.45Â°	-1.53 To -1.37Â°
Track Differential Angle With 20Â° Lock On Inside Wheel (3)	-1.92Â°	-2.42 To -1.42Â°
Caster (3)		
With -10 To 10Â° Wheel Lock	6.42Â°	5.92 To 6.92Â°
With -20 To 20Â° Wheel Lock	6.73Â°	6.23 To 7.23Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.2 To .2Â°
Maximum Wheel Lock		
Inside Wheel	About 34.3Â°	N/A
Outside Wheel	About 38.6Â°	N/A
(1) Difference between left and right is maximum .67Â°		
(2) Difference between left and right is maximum .25Â°		
(3) Difference between left and right is maximum .5Â°		

E53

WHEEL ALIGNMENT SPECIFICATIONS (X5)

Application	Preferred	Range
Total Toe		
Front	.3Â°	.17 To .43Â°
Rear	.3Â°	.13 To .47Â°
Camber (1)		
Front	-.2Â°	-.62 To .22Â°
Rear	-1.83Â°	-2.17 To -1.17Â°
Track Differential Angle With 20Â° Lock On Inside Wheel (1)	-1.58Â°	-2.08 To -1.08Â°
Caster (1)		
With -10 To 10Â° Wheel Lock	6.83Â°	6.33 To 7.33Â°
With -20 To 20Â° Wheel Lock	7.1Â°	6.6 To 7.6Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.2 To .2Â°
Maximum Wheel Lock		
Inside Wheel	About 37.1Â°	N/A
Outside Wheel	About 31.1Â°	N/A
Turning Circle	About 39.7 Ft. (12.1 M)	N/A
(1) Difference between left and right is maximum .5Â°.		

E65/66

WHEEL ALIGNMENT SPECIFICATIONS (745i & 745Li)

Application	Preferred	Range
Total Toe		
Front	.17Â°	.03 To .3Â°
Rear	.3Â°	.13 To .47Â°
Camber (1)		
Front	-.1Â°	-.52 To .32Â°
Rear	-1.5Â°	-1.83 To -1.17Â°
Track Differential Angle With 20Â° Lock On Inside Wheel (1)	-1.45Â°	-1.95 To -.95Â°
Caster (1)		
With -10 To 10Â° Wheel Lock	7.65Â°	7.15 To 8.15Â°
With -20 To 20Â° Wheel Lock	7.93Â°	7.43 To 8.43Â°
Front Wheel Displacement	0Â°	-.25 To .25Â°
Rear Geometrical Axis Deviation	0Â°	-.2 To .2Â°
Maximum Wheel Lock		
Inside Wheel	About 40.7Â°	N/A
Outside Wheel	About 33.5Â°	N/A
Turning Circle		
745i	About 39.9 Ft. (12.13 M)	N/A
745Li	About 41.3 Ft. (12.6	N/A

	M)	
(1) Difference between left and right is maximum .5Â°.		

SPECIAL TOOLS

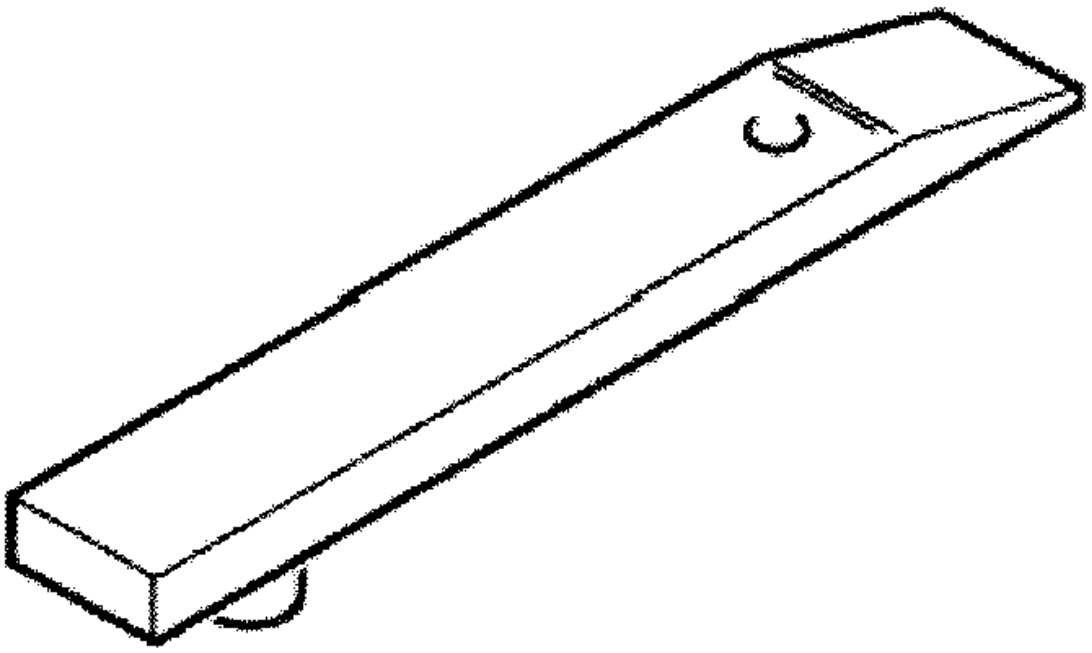


Fig. 38: Identifying Measuring Aid (2) (31 3 010)
Courtesy of BMW OF NORTH AMERICA, INC.

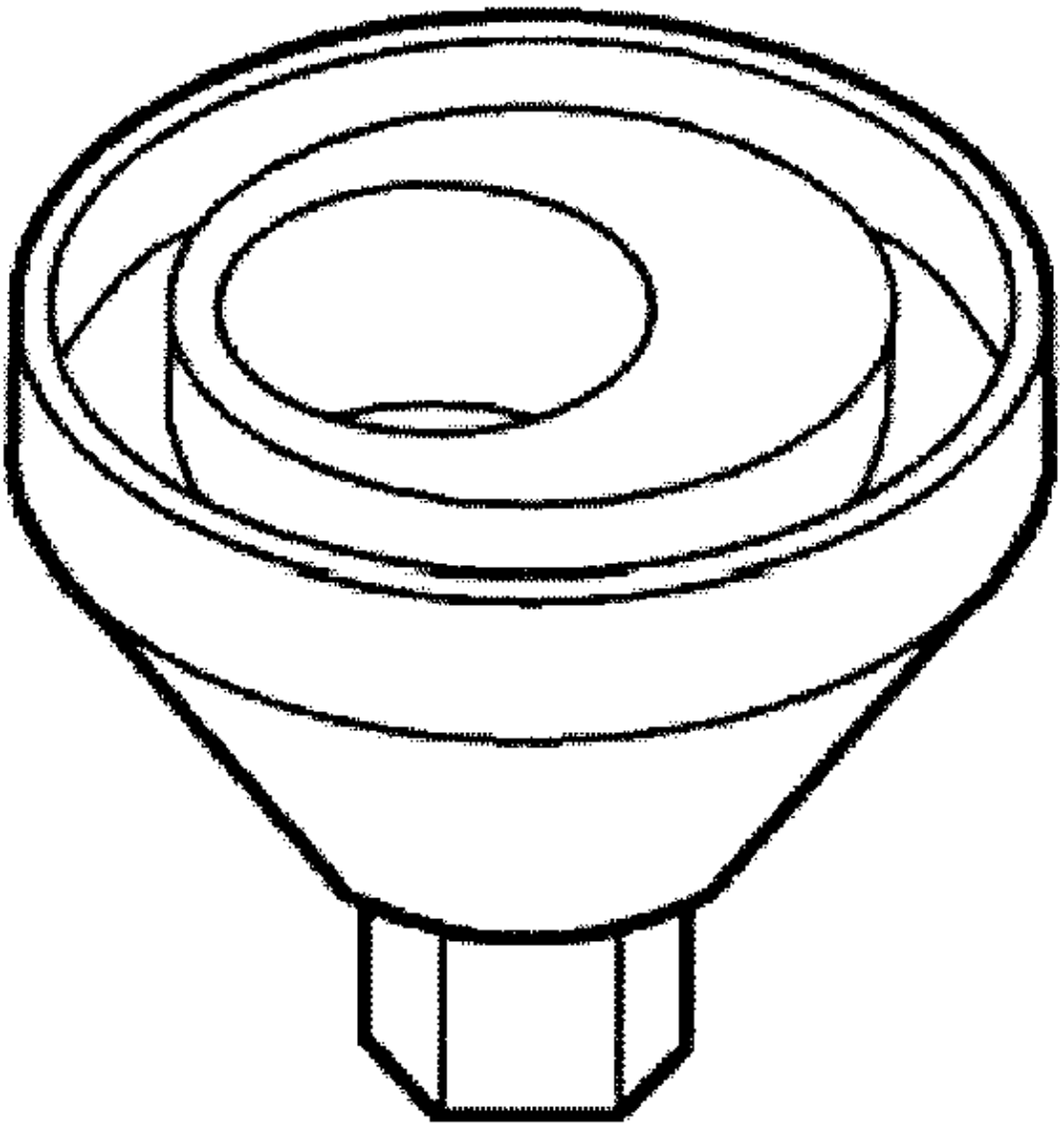


Fig. 39: Identifying Setting Tool (32 3 030)
Courtesy of BMW OF NORTH AMERICA, INC.

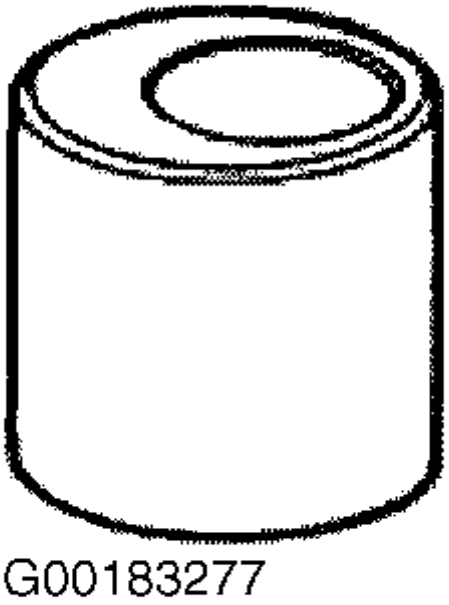


Fig. 40: Identifying Setting Tool (32 3 080)
Courtesy of BMW OF NORTH AMERICA, INC.

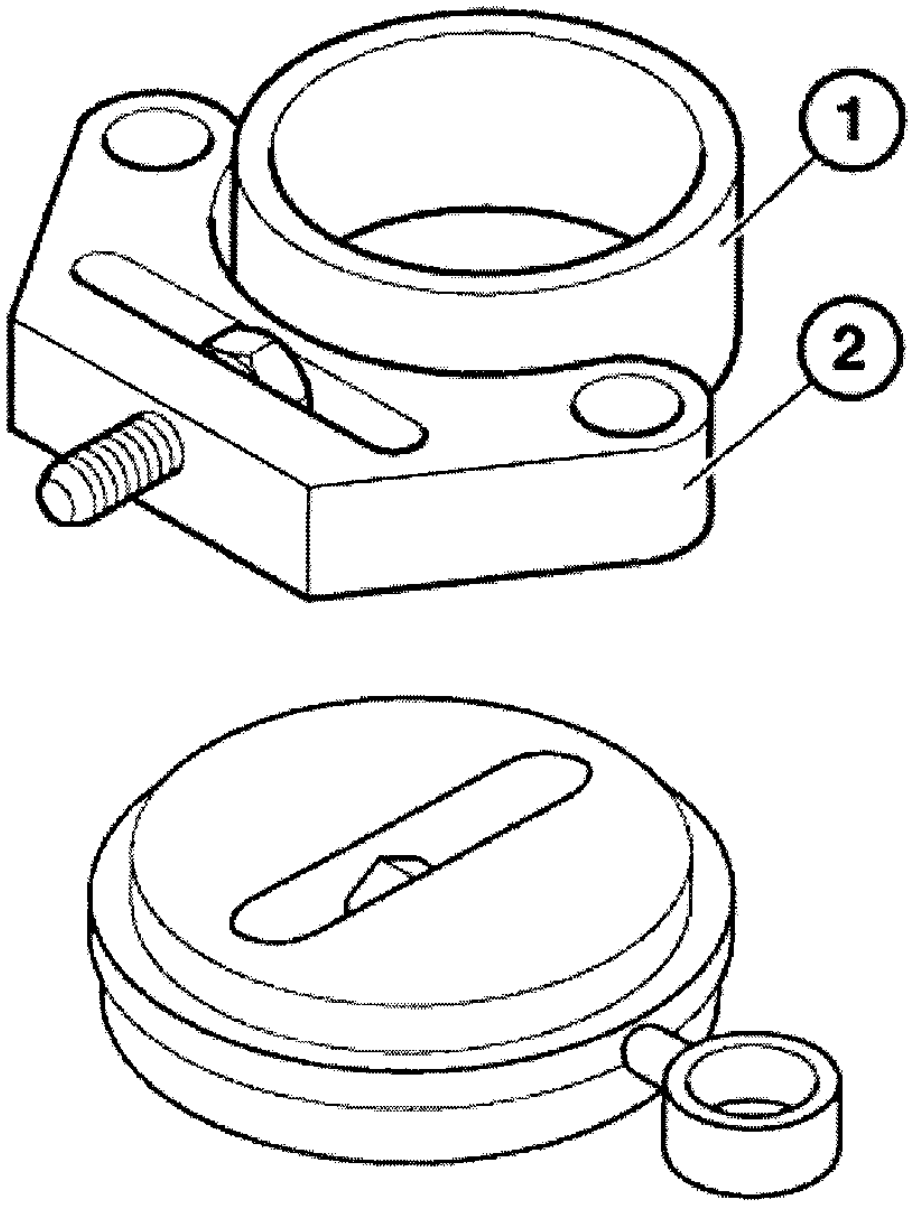
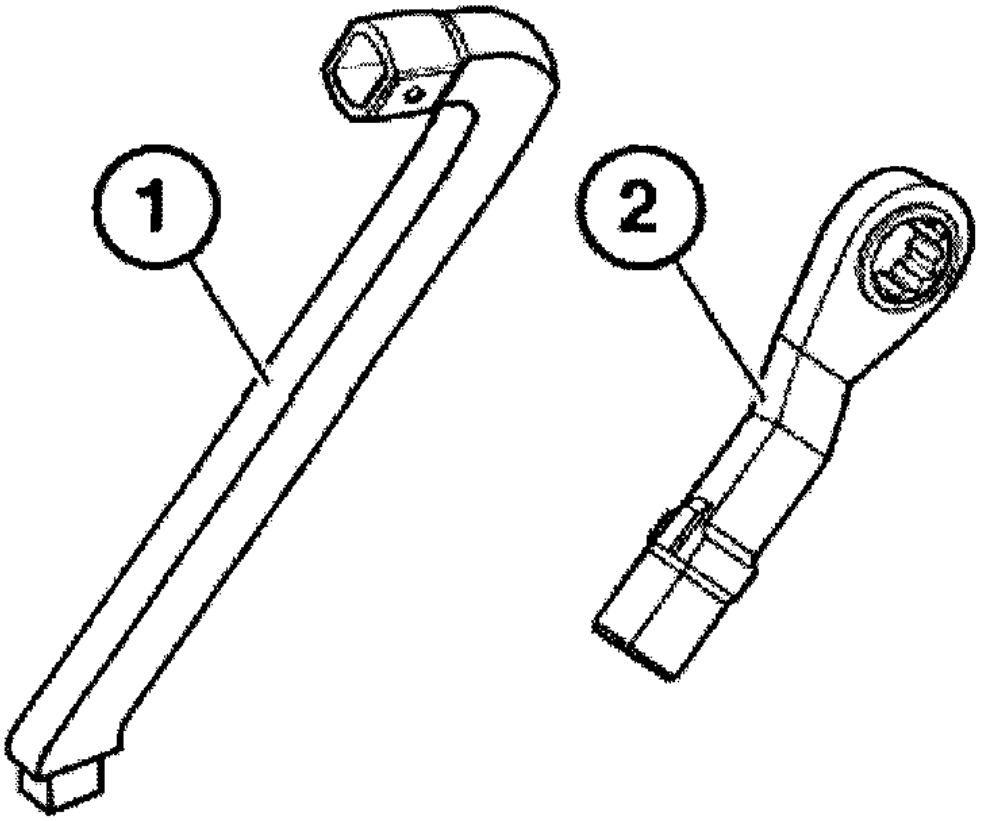


Fig. 41: Identifying Setting Tool (32 3 140)
Courtesy of BMW OF NORTH AMERICA, INC.



1 = 32 3 151 Extension piece
Note: For torque wrench
2 = 32 3 152 Socket tool WAF 18

G00183280

Fig. 42: Identifying Setting Tool (32 3 150)
Courtesy of BMW OF NORTH AMERICA, INC.

Article GUID: A00005193

SUSPENSION SYSTEMS

PURPOSE OF THE SYSTEM

The safety, stability, handling and performance of a vehicle depends on many factors. One of the most important aspects of these characteristics is the design of the suspension and steering systems. BMW vehicles are known for their superior handling and road performance. The design of the BMW suspension systems is a key factor in achieving these goals.

Suspension geometry is defined as: "The angular relationship between the suspension, the steering linkage and the wheels - relative to the road surface."

There are several alignment geometry angles which relate to the suspension components and steering linkages including:

- Caster
- Camber
- Toe-In/Toe-Out
- Steering Roll Radius (steering offset)
- Steering Axis Inclination (SAI) and Included Angle (IA)
- Toe Out on Turns
- Thrust Line and Thrust Angle

All of these angles influence:

- The ease with which the vehicle can be steered
- The steering stability (handling, tracking and safety)
- Tire wear

The suspension geometry for any given vehicle is a result of the design engineers development of the vehicle and the design criteria for that particular vehicle.

BASIC SUSPENSION GEOMETRY

Caster

Caster is the forward or rearward tilt of the steering axis centerline, as viewed from the side of the vehicle, and is measured in degrees from a vertical. It is a directional control geometry angle that helps keep the vehicle moving straight ahead.

If the steering axis is tilted rearward, it is called "Positive Caster". A forward tilt is called "Negative Caster".

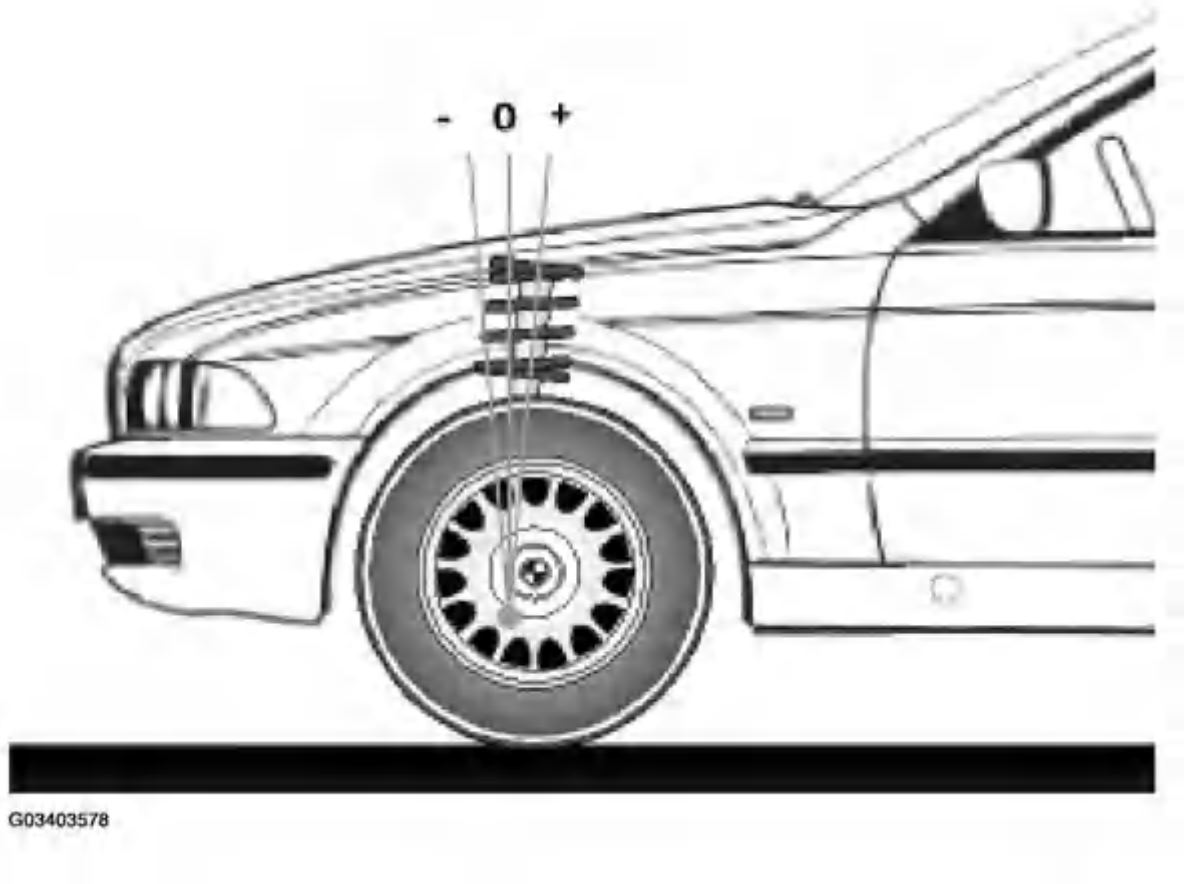


Fig. 1: Identifying Caster
Courtesy of BMW OF NORTH AMERICA, INC.

On BMW vehicles, Caster is always positive. Positive Caster increases stability at high speeds. Positive Caster also causes increased steering effort at low speeds. Systems such as Servotronic help minimize this negative effect. In addition to increased high speed stability, cornering is enhanced and steering wheel returnability is improved by positive Caster.

Caster is measured in degrees. On BMW vehicles, Caster is a non-adjustable angle. But Caster is influenced by damaged suspension components. When performing a wheel alignment, always check Caster to insure there is no hidden damage.

Cross Caster

Cross Caster is the difference in the Caster measurement from left to right. Excessive Cross Caster can cause the vehicle to pull to the side with the least positive caster.

Camber

Camber is the inward or outward tilt of the wheels when viewed from the front of the vehicle. The amount of tilt is measured in degrees from the vertical and is called the camber angle.

If the wheel tilts out at the top, the camber angle is positive and if the wheel tilts in at the top it is negative.

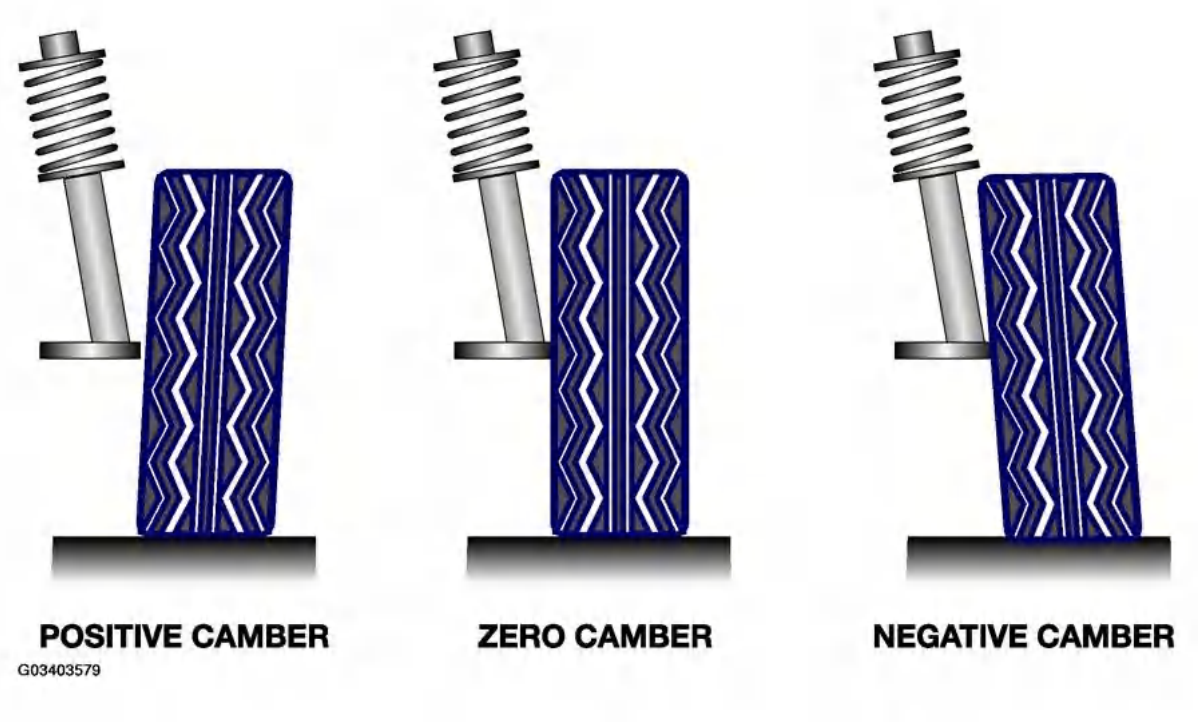


Fig. 2: Identifying Positive Camber Zero Camber Negative Camber
Courtesy of BMW OF NORTH AMERICA, INC.

Excessive Positive Camber will cause abnormal wear on the outer edge of the tire.

Excessive Negative Camber will cause abnormal wear on the inner edge of the tire.

Camber is measured in Degrees and Minutes and is measured at the front and rear of the vehicle. Camber is adjustable on some BMW models.

Cross Camber

Cross Camber is the difference between camber angles from left to right. If Cross Camber is excessive, the vehicle will pull to the side with the most positive Camber.

Toe In/Toe Out

Toe is the difference in length by which the wheels of each axle differ from each other, front to rear, in the straight ahead position. The rear wheels are also subject to toe measurement.

Toe is measured at the center of the wheels from one wheel rim to the other. When the distance is greater at the rear of the wheels, it is called toe-in.

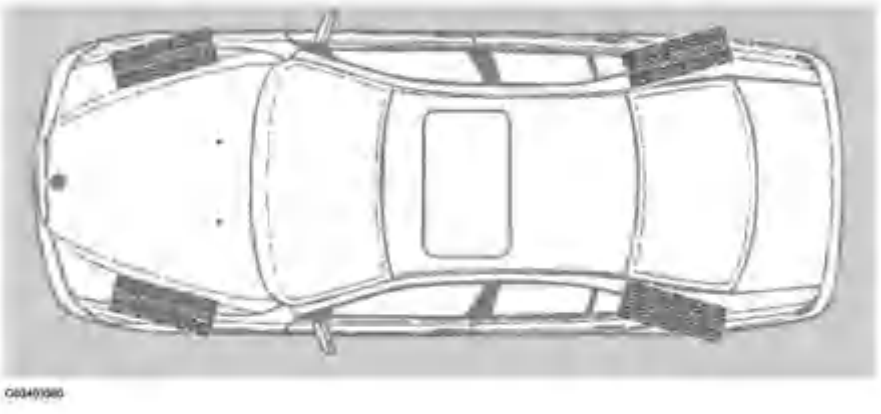


Fig. 3: Identifying Toe In

Courtesy of BMW OF NORTH AMERICA, INC.

When the distance is greater at the front of the wheels, it is called toe-out.

Rear wheel drive vehicles generally will have a small amount of toe-in at the front wheels. This will allow the wheels to toe out when rolling to achieve a zero running toe.

Toe is measured in Degrees when using BMW specifications. Front toe is adjustable on all BMW vehicles. Rear toe is only adjustable on some models.

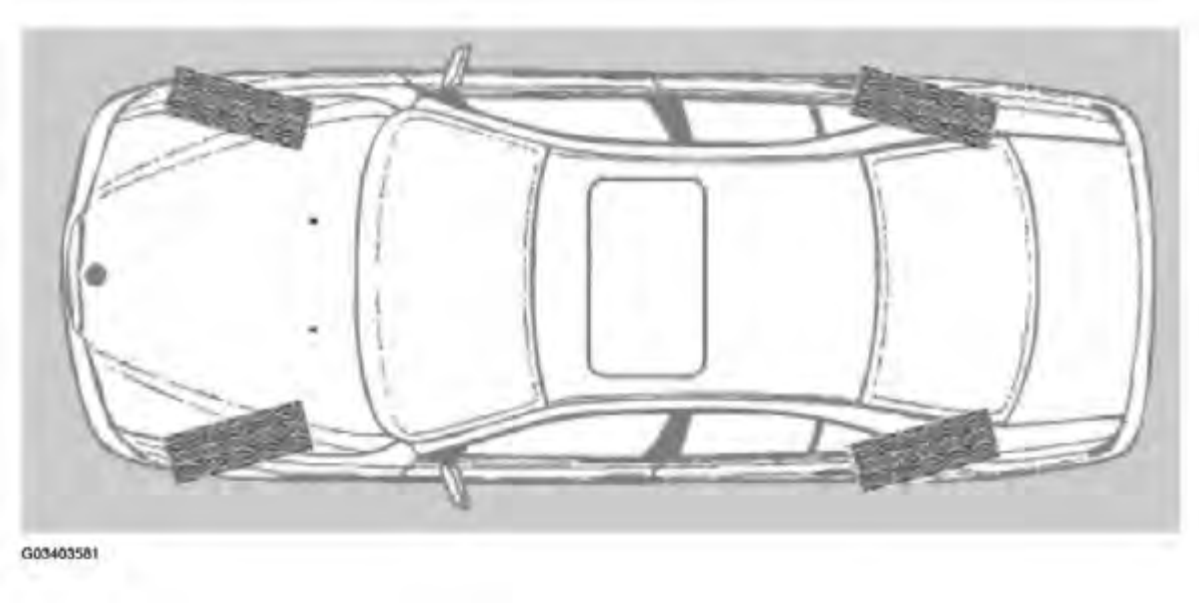


Fig. 4: Identifying Toe Out
Courtesy of BMW OF NORTH AMERICA, INC.

Steering Roll Radius (Steering Offset)

The steering offset is the distance between the point of contact of the projected line drawn through the steering axis to the road surface and the center point of the tire contact area (foot print). The roll radius is the distance between these two lines.

- A positive roll radius exists when the steering axis line is inside the center line of the tire.
- A negative roll radius exists when the steering axis line is outside of the tire center line.

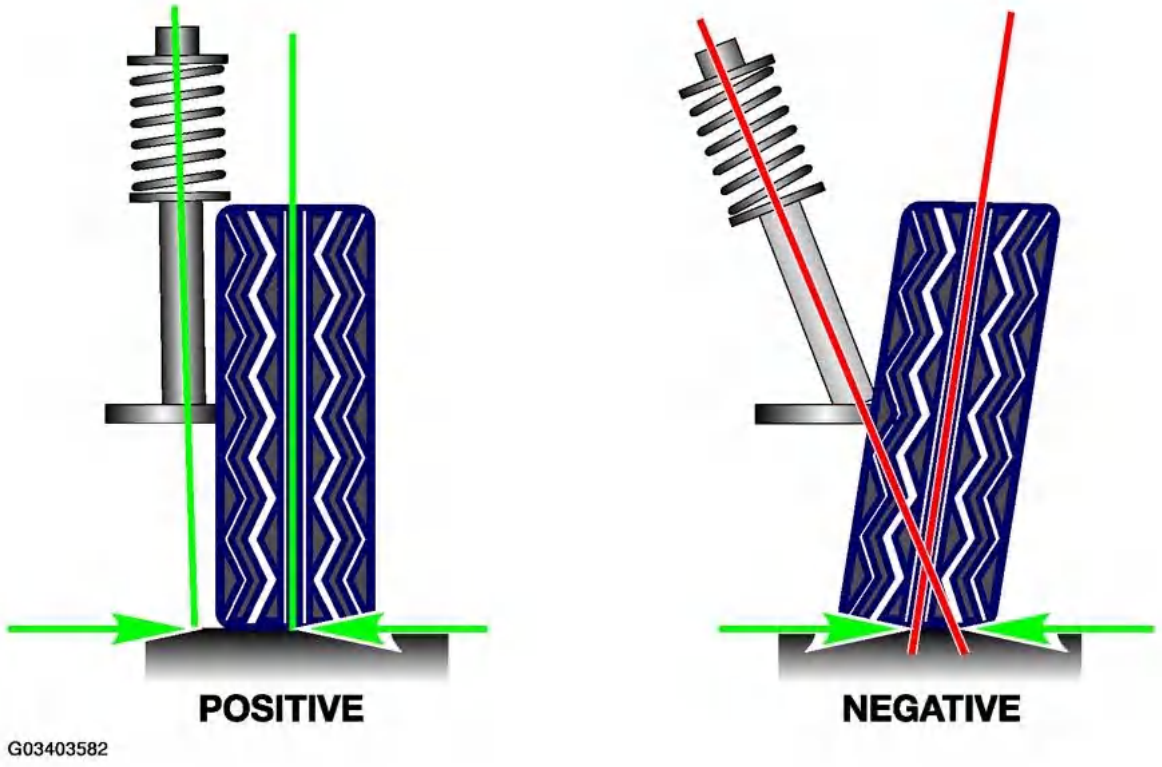


Fig. 5: Identifying Steering Roll Radius
Courtesy of BMW OF NORTH AMERICA, INC.

When the Steering Roll Radius is excessively positive, stability during braking is reduced. When the Steering Roll Radius is excessively negative, the directional stability is reduced and there is reduced feedback to the driver through the steering wheel. BMW vehicles are designed with a slightly positive Steering Roll Radius. This gives the driver a better "road feel" without compromising braking stability.

Steering Roll Radius is not adjustable, but can be influenced by improper tire and wheel combinations. Wheels with incorrect offsets can compromise handling characteristics. Scrub Radius is another term used to describe Steering Roll Radius.

Steering Axis Inclination (SAI)

Steering Axis Inclination is the inward tilt (angle) of the strut assembly with respect to a vertical line to the road surface.

SAI results in self-correcting forces that cause the front wheels and steering wheel to return to a straight ahead position after cornering.

SAI is not adjustable, but is affected by damaged suspension components. Most current alignment equipment can measure SAI and can aid in the diagnosis of damaged parts. Bent strut or spindle assemblies are common causes of incorrect SAI readings.

Included Angle (IA)

Included angle is the Camber angle and SAI combined. IA is also helpful when trying to diagnose bent suspension components. Knowing the IA and SAI is helpful when adjusting Camber. If the desired Camber angle cannot be achieved, then looking at SAI and IA could help determine the cause.

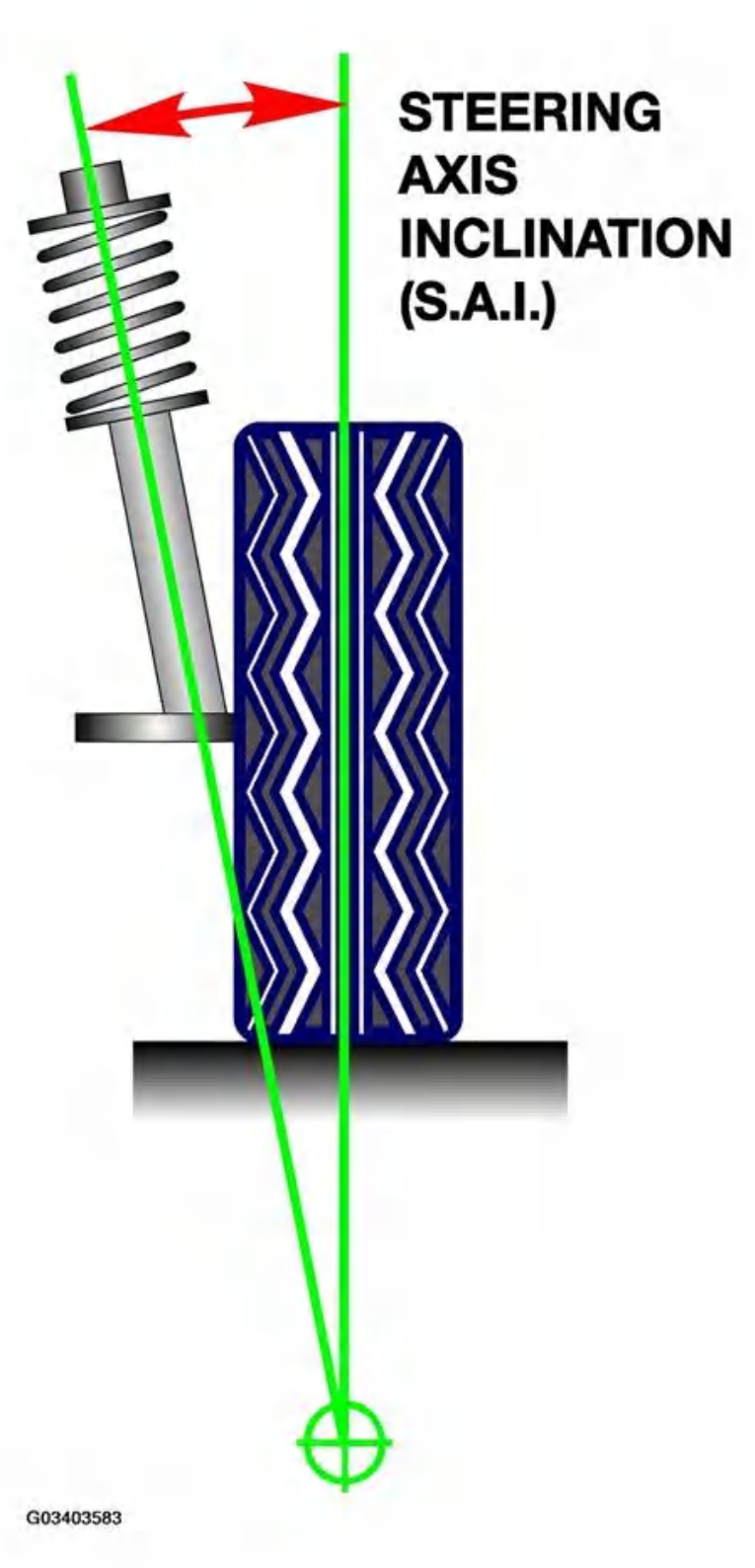


Fig. 6: Identifying Steering Axis Inclination (S.A.I.)
Courtesy of BMW OF NORTH AMERICA, INC.

Toe Out On Turns

Also referred to as "Turning Angle", Toe out on turns results from the different angles (arcs) taken by the front wheels when driving through a corner. When turning a corner, the outside wheel must travel a greater distance than the inside wheel. The additional toe angle is determined by the steering arm design. Deviations from the specified value could indicate possible bent steering linkage. A typical complaint that would be associated with this condition would be excessive tire squeal or "scrubbing" on turns.

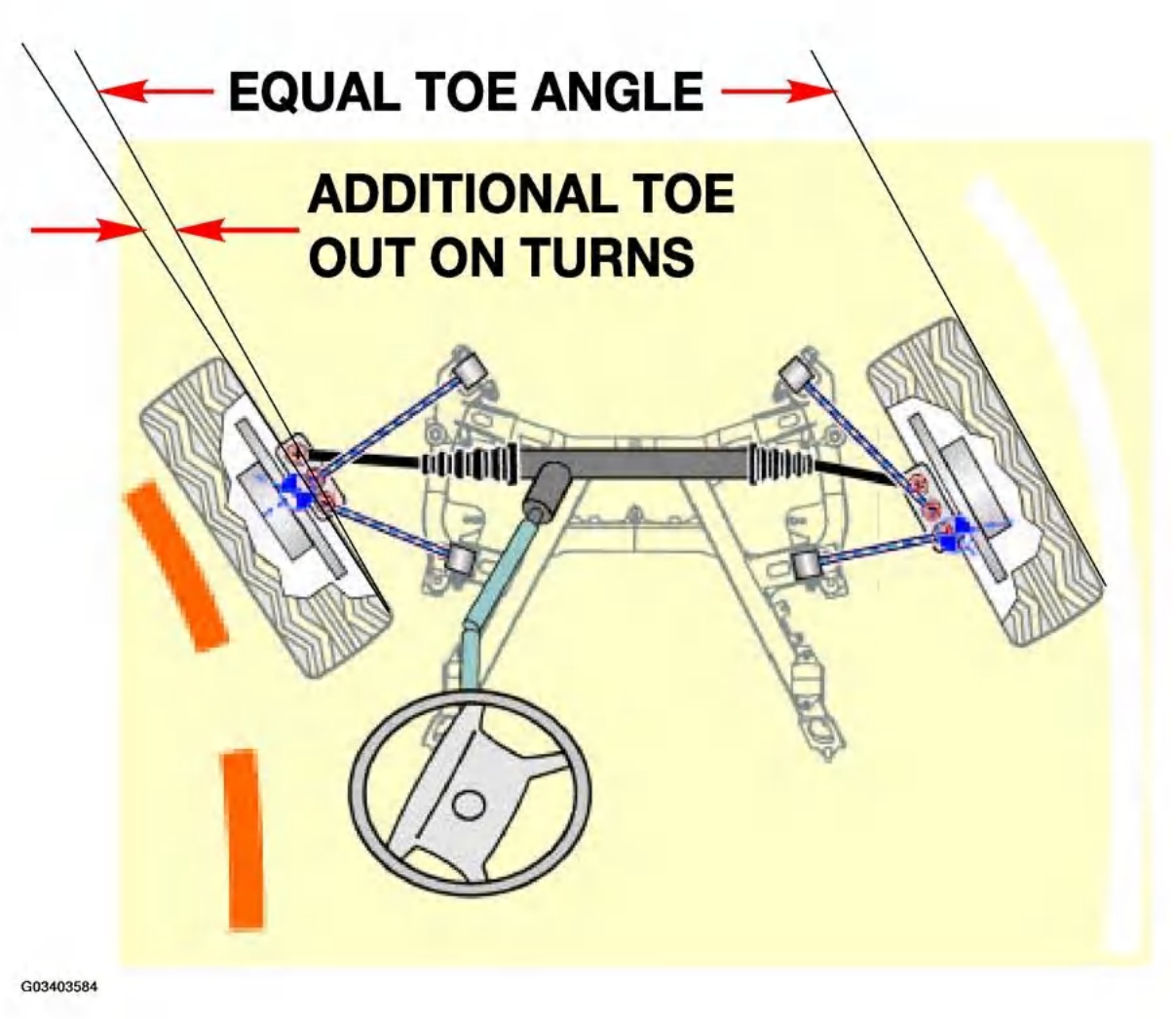


Fig. 7: Identifying Toe Out At Turns
Courtesy of BMW OF NORTH AMERICA, INC.

Geometric Axis

The Geometric Axis (Centerline) is an imaginary line that is drawn between the midpoints of both front and rear wheels. The Axis is perpendicular to front and rear axles at 90 degrees. This is an imaginary angle that is not adjustable.

Thrust Line/Thrust Angle

The Thrust Line is represented by an imaginary line that bisects the rear toe angle. This angle represents the overall "direction" in which the rear wheels are pointing. The Thrust Angle is the difference between the Geometric Axis and the Thrust Line. The optimum Thrust Angle is Zero Degrees, any deviation from this will affect the position of the steering wheel.

Positive Thrust Angle - is formed when the Thrust Line is to the right of the Geometric Axis (Centerline). When this situation occurs, the steering wheel position will be off to the right as well. The rear of the vehicle will tend to move to the right which will cause the front of the vehicle to steer left, the driver will move the steering wheel to the right to compensate.

Negative Thrust Angle - is formed when the Thrust Line is to the left of the Geometric Axis (Centerline). When this situation occurs, the steering wheel position will be off to the left as well. The rear of the vehicle will tend to move to the left which will cause the front of the vehicle to steer right, the driver will move the steering wheel to the left to compensate.

Alignment Procedures

When performing a wheel alignment, make sure that the thrust angle is as close to zero as possible. Failure to do so can result in a steering wheel that is not centered.

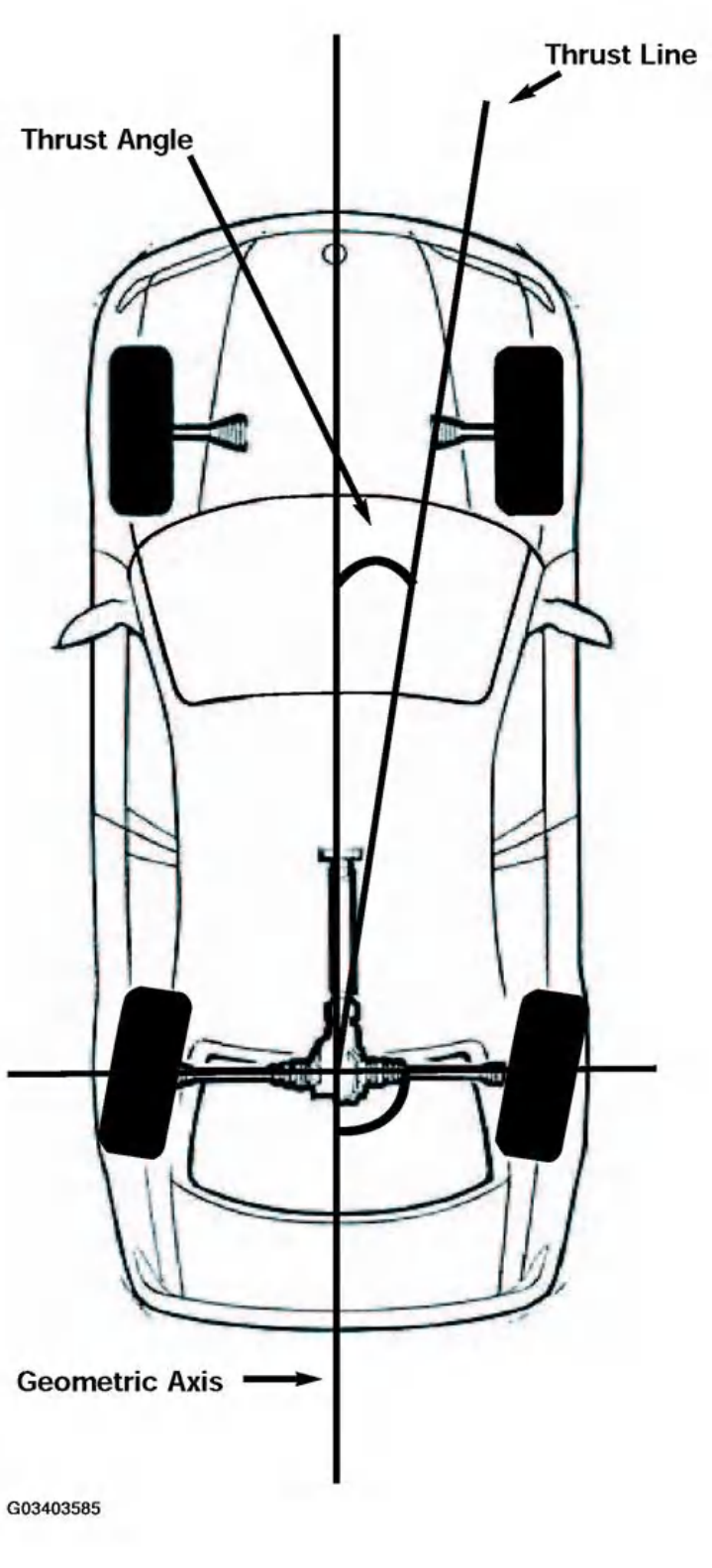


Fig. 8: Identifying Thrust Angle
Courtesy of BMW OF NORTH AMERICA, INC.

SUSPENSION SYSTEMS

Front Axles

Two basic design front axles are used on BMW vehicles including:

- Single-Joint Spring Strut Axle

- Double Pivot Spring Strut Axle

Single Joint Spring Strut Axle

The single-joint spring strut axle is used on E30, E36 (all incl Z3 and 318ti) and E85 models. The axle beam is bolted to the body through four locating bushings. It supports the engine mounts, steering rack, anti-roll bar and lower control arm mount.

The "C" shape lower control arm is additionally mounted through a rubber bushing to the body and serves as the lower pivot for the steering system.

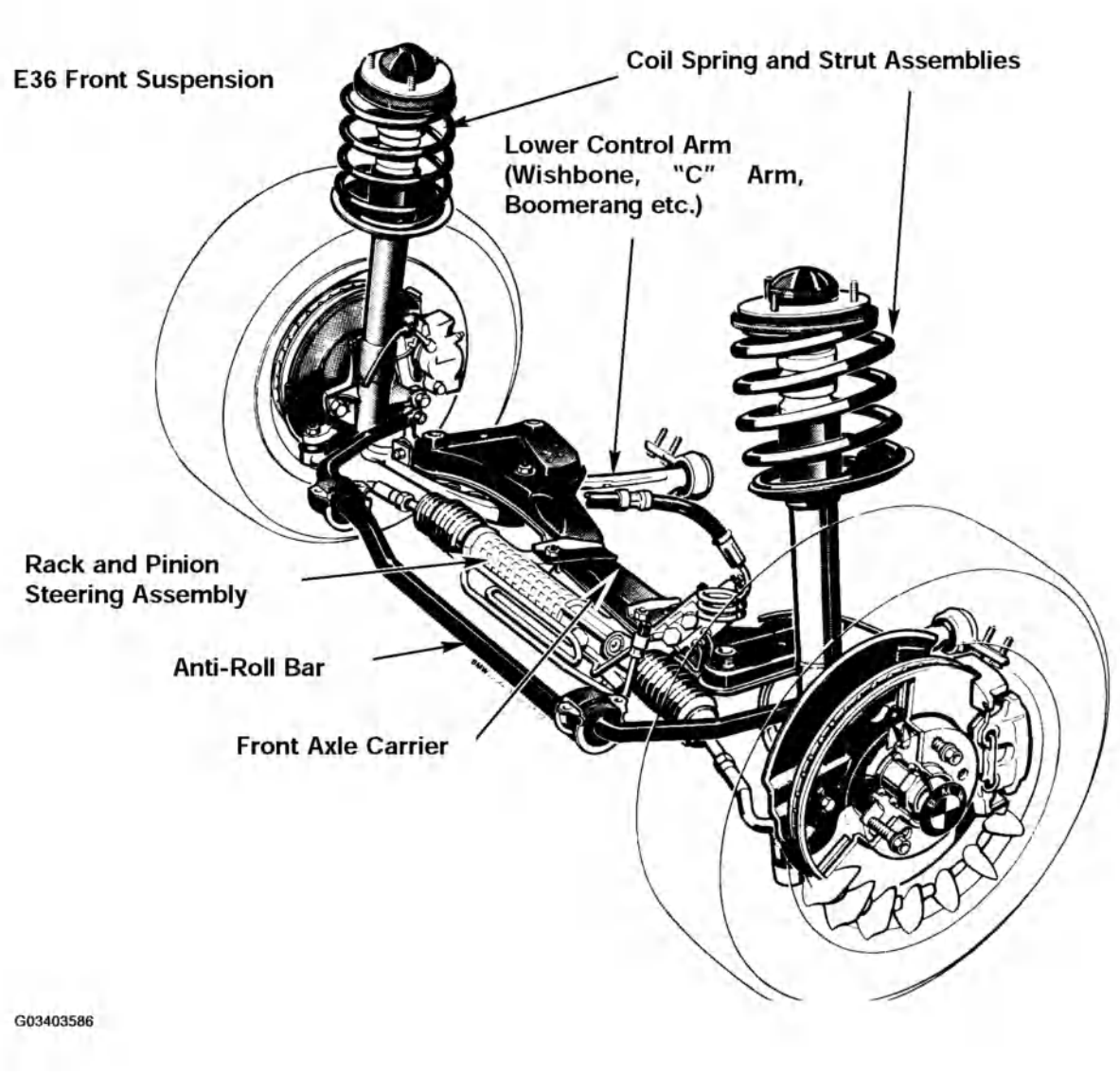


Fig. 9: Identifying Single Joint Spring Strut Axle
Courtesy of BMW OF NORTH AMERICA, INC.

E46 Front Suspension

The E46 front suspension is based on the E36 design. There have been some design changes to improve ride quality and handling characteristics. The following changes were incorporated into the E46 front suspension system:

- A new forged aluminum lower control arm is used (Except all-wheel drive). If offers the advantages of weight reduction and lower unsprung mass.
- Hydraulic bushings are used for the rear lower control arm support.
- Hollow strut piston rods are used to reduce weight.
- The steering knuckles are press fit into the strut tubes which reduce the tolerances of the front suspension

geometry.

- The Caster has been increased to improve straight line stability.
- The track has been widened for improved cornering
- Aluminum brake dust shields are used for weight reduction.

Altogether there is 5.72 lbs. less unsprung weight in the front suspension which enhances ride comfort and handling.

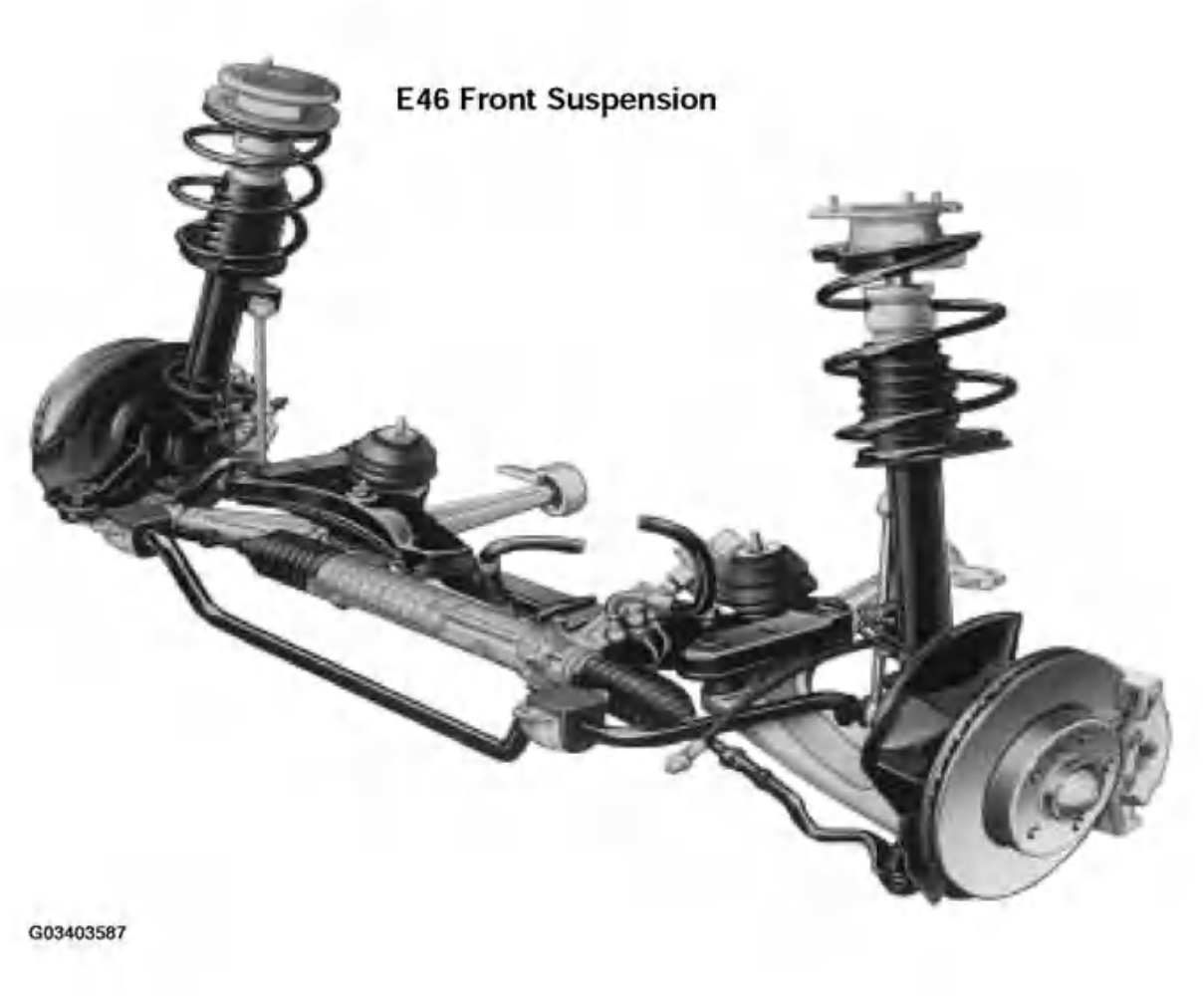


Fig. 10: Identifying Front Suspension
Courtesy of BMW OF NORTH AMERICA, INC.

Adjustments

The "Single Joint" front suspension has some adjustments available.

Front toe is adjustable on all variants. Caster is NOT adjustable, but should always be checked during the wheel alignment to insure there is no damage.

Camber is adjustable on the E46 and E85. There is a slot in the upper strut tower which will allow small Camber changes. A pin must be driven down in order to allow the Camber changes. The upper strut plate can then be moved to make a slight Camber correction of up to .5 degrees.

If the Camber adjustment cannot be achieved, check for suspension damage. Make sure the vehicle is at the proper ride height.

Use Special tool # 323 140 to make the Camber adjustment.



Fig. 11: Locating Adjustment Pin
Courtesy of BMW OF NORTH AMERICA, INC.

When using the Special tool:

- Drive out the pin in the upper strut mount.
- Loosen all 3 upper strut mounting bolts.
- Install tool and turn the adjusting nut to make camber corrections.
- Once desired value is reached, tighten upper strut mounting bolts to specification.



Fig. 12: Locating Adjustment Nut
Courtesy of BMW OF NORTH AMERICA, INC.

Double Pivot Spring Strut Axle

The "Double Pivot Spring Strut Axle" is used on the following vehicles:

- All 5 Series including E34 and E39
- E53, X5 All Models
- All 7 Series including E32, E38 and E65/E66.
- E31 8 Series

The axle beam of the double pivot is bolted to the sub-frame through three triangulated mounting bolts. The axle beam supports the steering box, engine mounting and lower control arms. The tubular cross member and compression struts complete the double pivot suspension frame work.

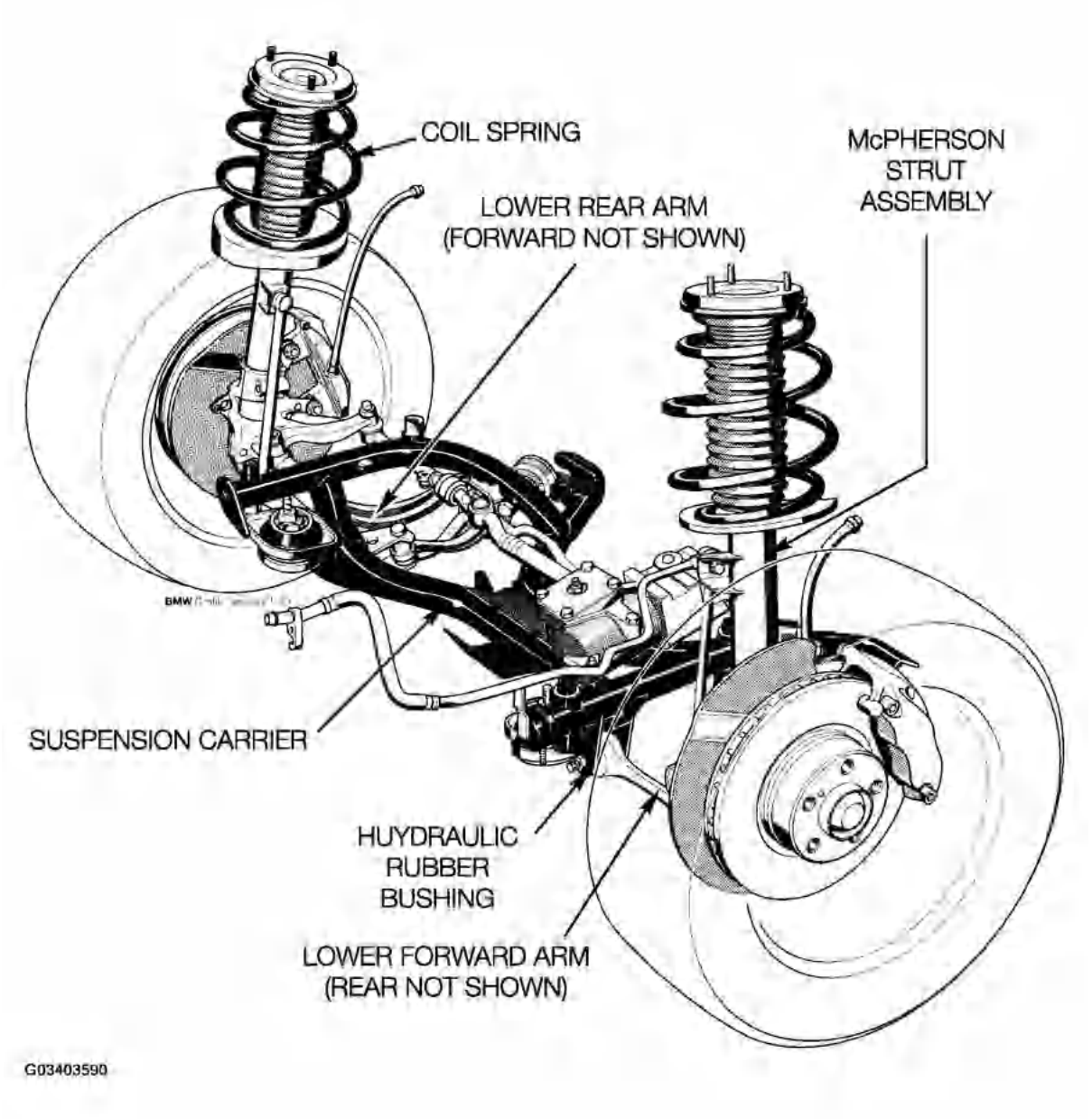


Fig. 13: Identifying Front Suspension
Courtesy of BMW OF NORTH AMERICA, INC.

The double pivot refers to the lower mounting of the strut and spindle assembly around which the wheel turns.

The lower control arm and the compression strut form the two lower pivot points.

The lower pivot point is actually an imaginary point formed by the extension of the two lower mounting arms.

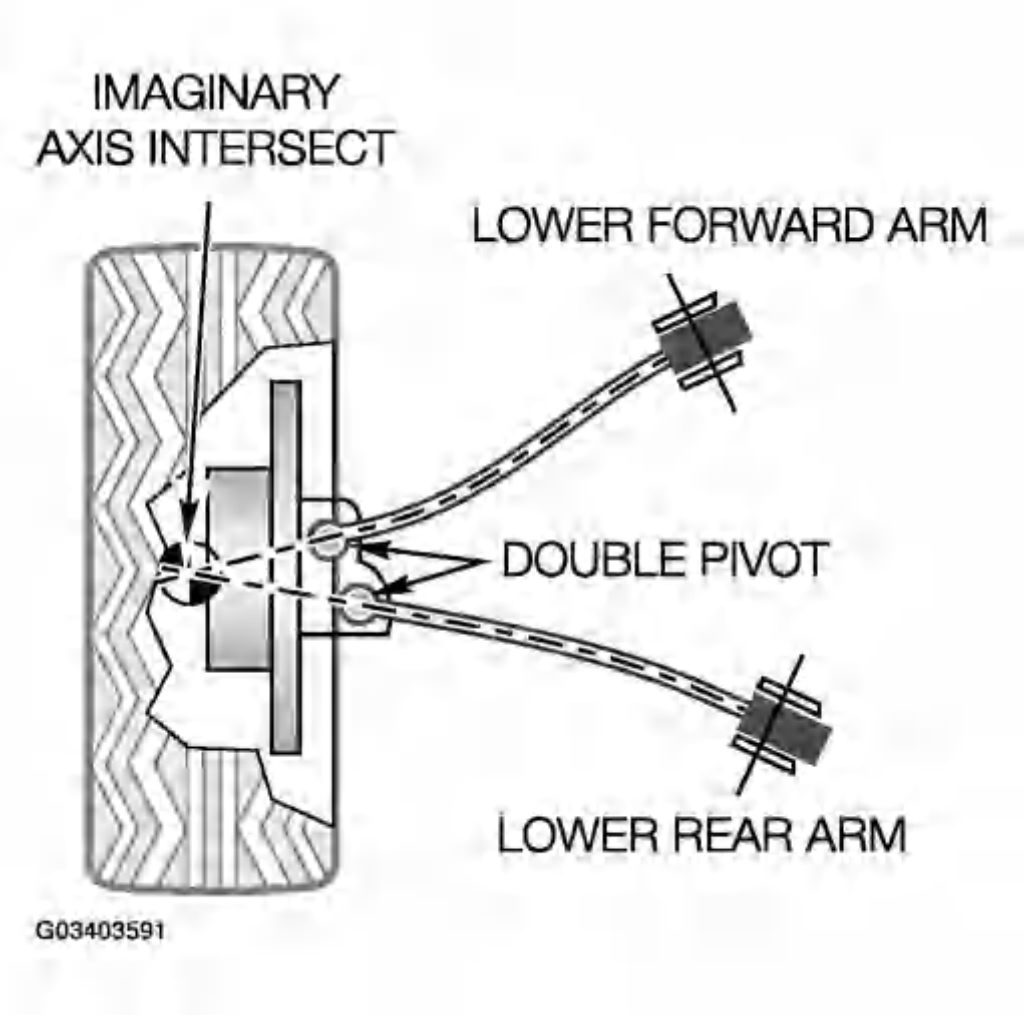


Fig. 14: Identifying Left Front Wheel
Courtesy of BMW OF NORTH AMERICA, INC.

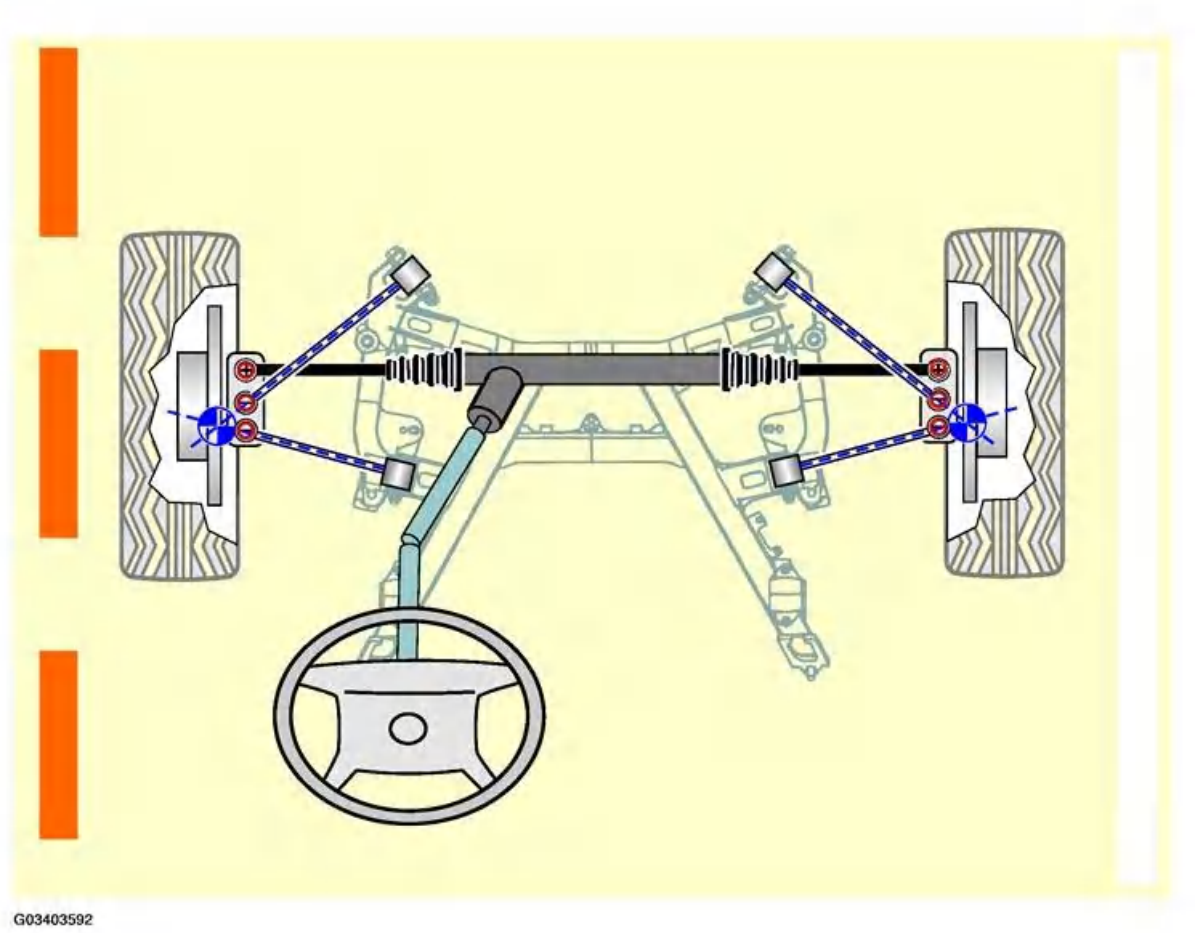


Fig. 15: Identifying Steering Assembly
Courtesy of BMW OF NORTH AMERICA, INC.

REAR SUSPENSION SYSTEMS

BMW utilizes several different configurations for the rear suspension systems depending on the model and specific needs of the vehicle in terms of handling, ride and performance. Alignment angles are not adjustable on the early rear suspension systems. The Central "C" Link rear suspension and the Integral Link rear suspension have adjustable Camber and Toe. The different rear suspension systems used include:

- Semi-Tailing Arm - E30, E36/5 318ti and E36/7 Coupe and Roadsters
- Semi-Trailing Arm with Track Link - E32, E34, E28, E24
- Central "C" Link - E36, E46 and E85
- Integral Multi-Link - E38, E39, E31, E53, E65, E66 and E52.

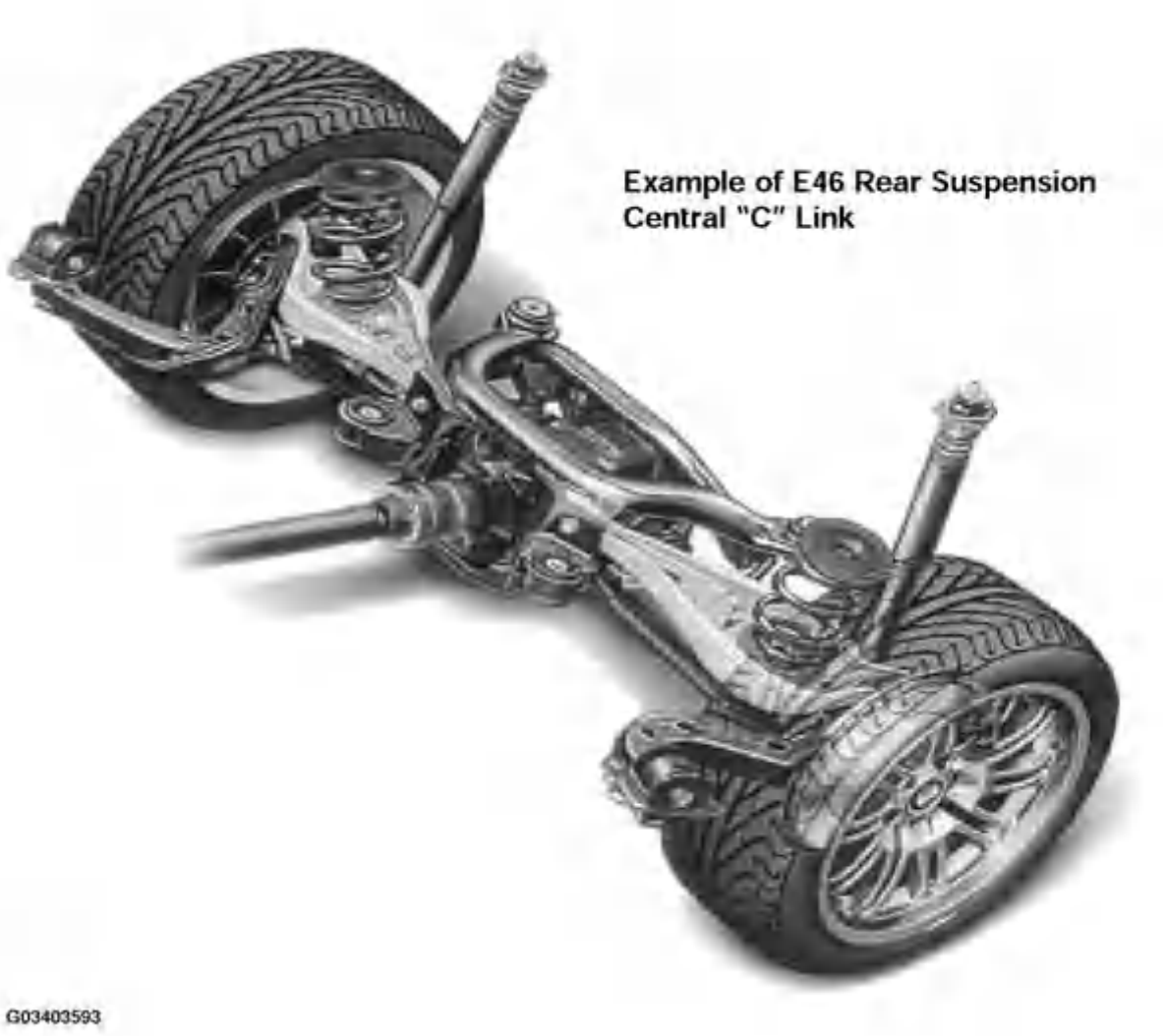


Fig. 16: Identifying Rear Suspension System
Courtesy of BMW OF NORTH AMERICA, INC.

Semi-Trailing Arm

The Semi-trailing arm rear suspension is used on the following vehicles:

- E30 All models including convertible, M3 and iX
- E36/7 Z3 Roadster and Coupe including M Roadster and Coupe
- E36/5 318ti (Compact)

The semi-trailing arm is an independent suspension system. The axle geometry is such that all points on the hub carrier move in a circular path, on a single plane during bounce and rebound. As a result of this, the rear camber and track will vary with the up and down movement of the wheel. The are no adjustable angles on this suspension system. Rear Camber is influenced by ride height. In the event of an incorrect rear toe situation, offset bushings can be installed on the trailing arms to make slight corrections.

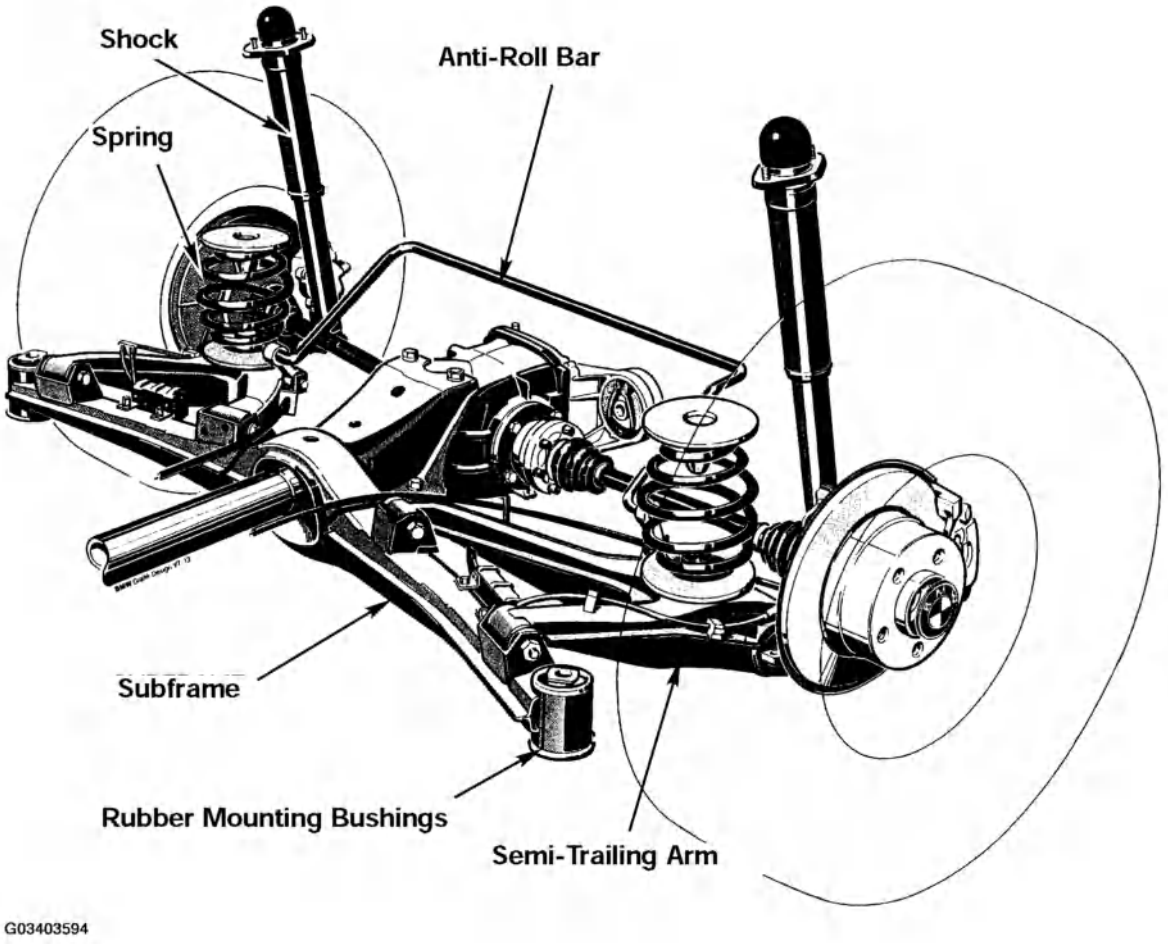


Fig. 17: Identifying Semi Trailing Arm
Courtesy of BMW OF NORTH AMERICA, INC.

Semi-Trailing Arm With "Track Link"

The "Track Link" rear suspension is used on the following vehicles:

- E24 All models including M6 and L6
- E28 All models including M5
- E32 All models
- E34 All models

The Track Link is a modified semi-trailing arm rear suspension. It incorporates an additional link that is mounted between the trailing arm and the rear axle carrier beam. The track link is mounted through rubber bushings that allow it to flex during bounce and rebound. The track link reduces the pivot axis from 20 degrees to 13 degrees which reduces the amount of camber and track change during bounce and rebound.

It provides better handling, reduces "squat" and "dive" tendencies and allows less camber change due to heavy loading.

There are no rear suspension adjustments, small corrections can be made with offset bushings.

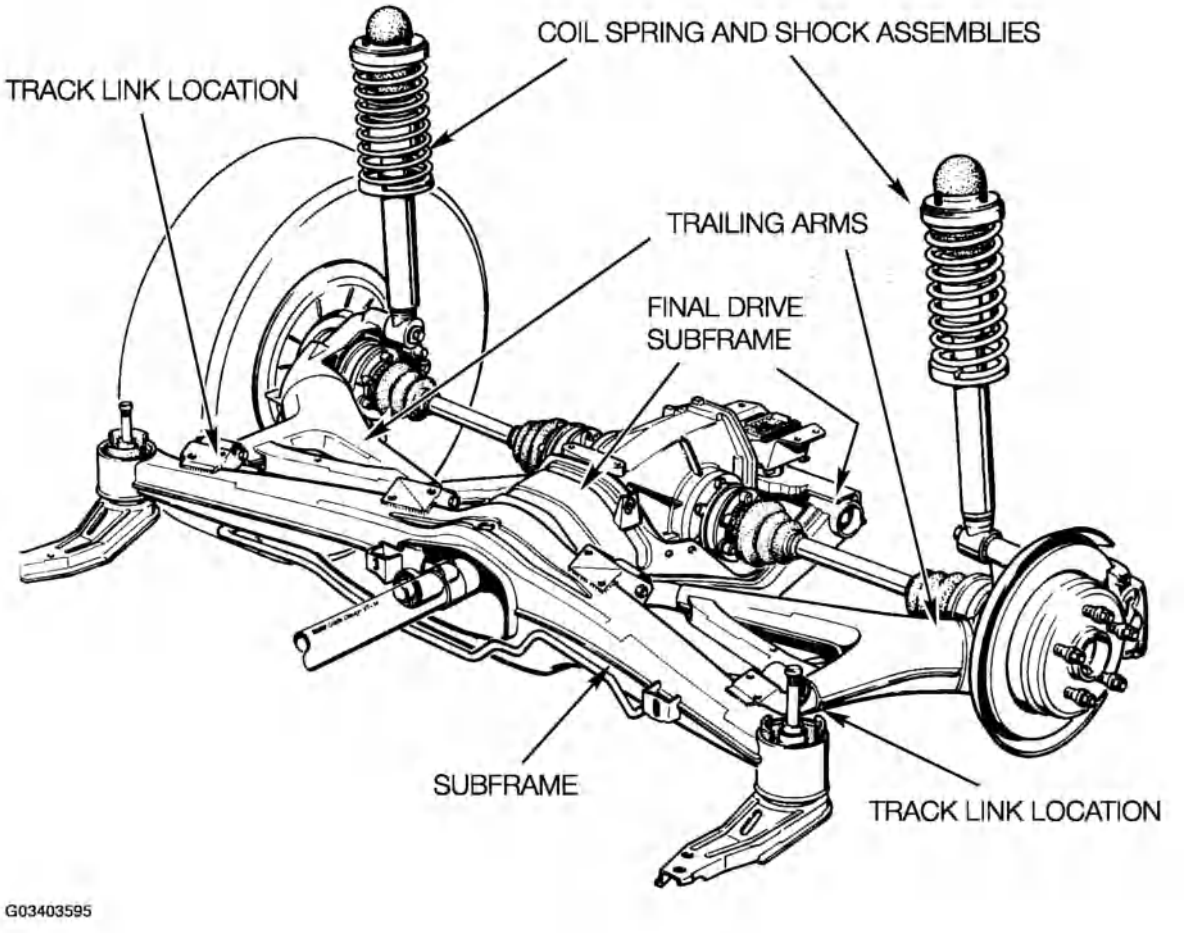


Fig. 18: Identifying Semi-Trailing Arm With Track Link
Courtesy of BMW OF NORTH AMERICA, INC.

Central "C" Link Rear Suspension

The Central "C" Link rear suspension is used on the following:

- E36 All Models except E36/7 and E36/5.
- E46 All Models
- E85 Z4 Roadster

The Central Link rear suspension consists of a cast iron longitudinal are that is bolted to the body through a rubber bushing. The wheels are additionally supported by two transverse arms that are connected to the rear axle sub-frame.

The design of this suspension allows for individual tuning of longitudinal and lateral forces acting on the vehicle. Longitudinal forces, such as starting and stopping are absorbed by the central arm. Lateral forces, such as cornering, are absorbed by the transverse links. The complete suspension exhibits little or no change in toe-in while driving.

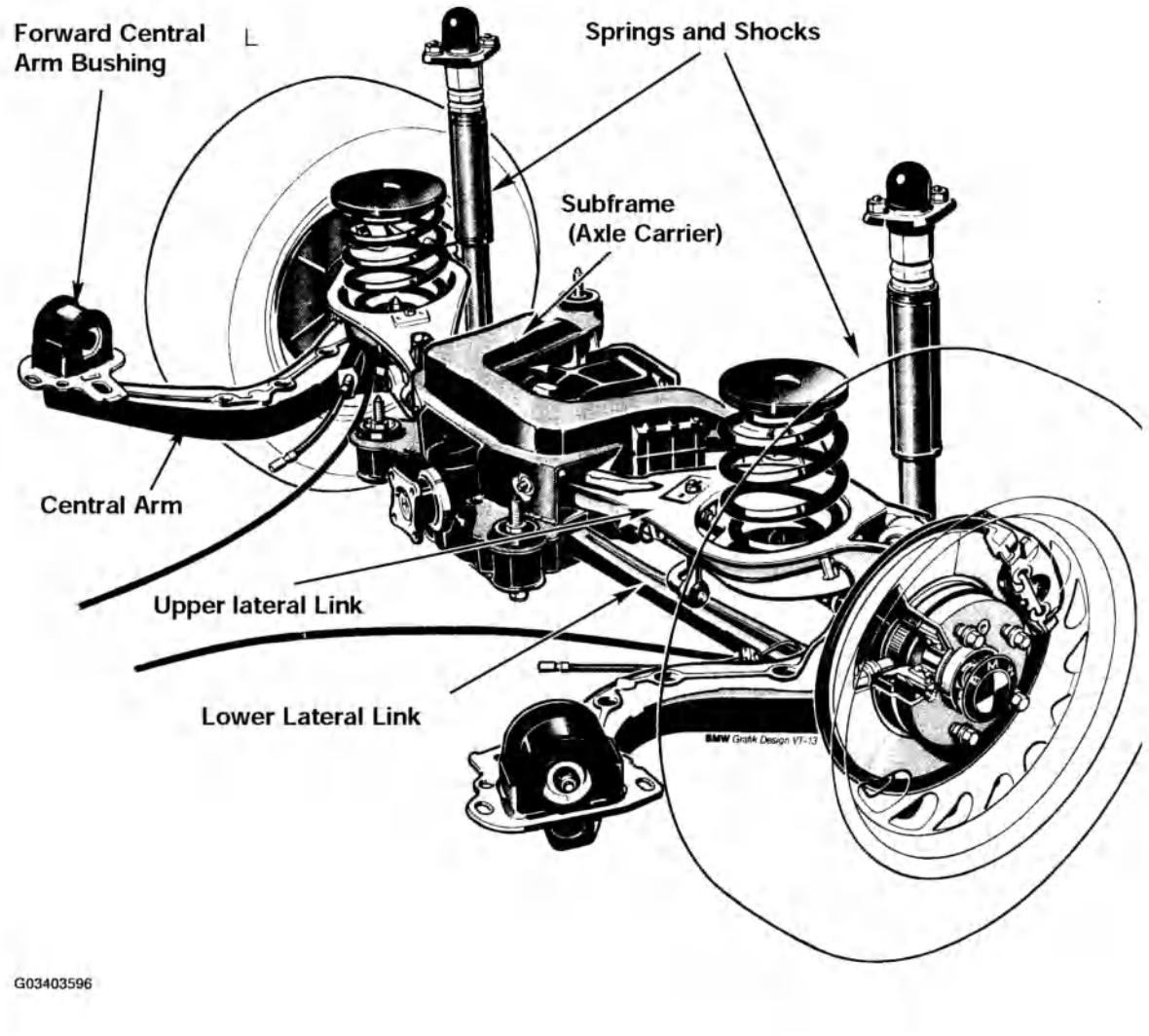


Fig. 19: Identifying Central C Link Rear Suspension
Courtesy of BMW OF NORTH AMERICA, INC.

E46 Rear Suspension

The Central "C" Link rear suspension on the E46 is almost identical to the E36 with some minor modifications:

- Upper Transverse Control Arms (Lateral Links) are made from aluminum.
- The Subframe (rear axle carrier) is of tubular steel construction.
- The differential is mounted to the subframe with a hydraulic mount.

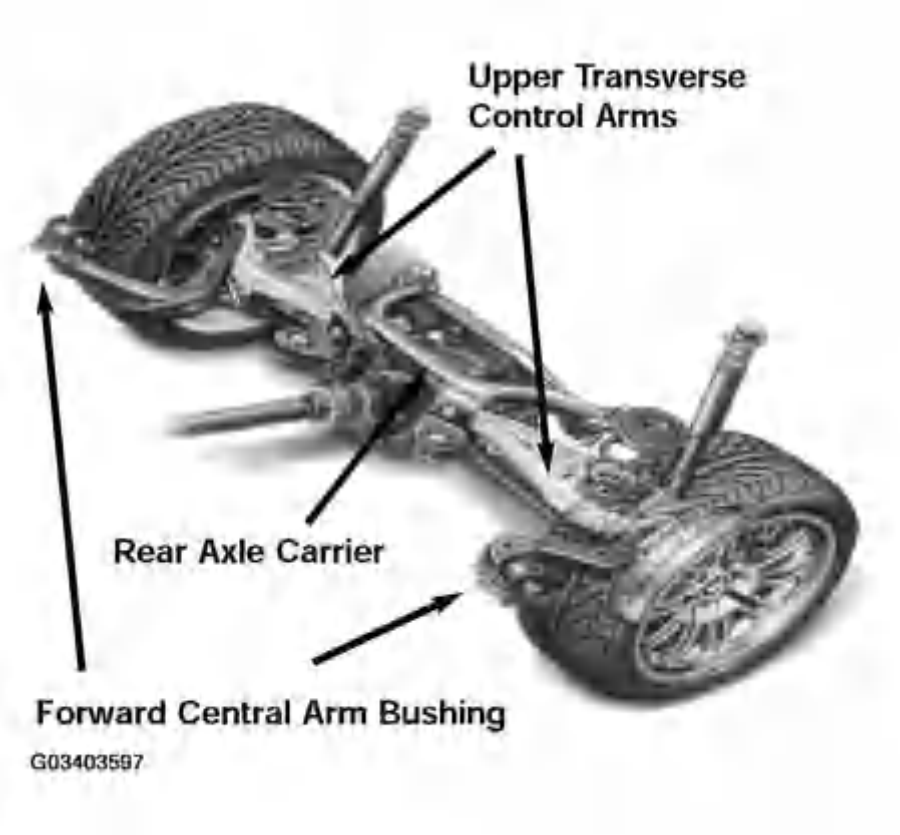


Fig. 20: Identifying E46 Rear Suspension
Courtesy of BMW OF NORTH AMERICA, INC.

E85 Rear Suspension

The E85 rear suspension is taken from the E46 design with some minor changes for the roadster. The track width has been increased by 30 mm. A reinforcement plate has been added to increase rigidity. Due to underbody aerodynamics, a duct has been added to direct airflow to the differential. The differential cover has cooling fins which will help keep the differential within it's operating temperature range.

E85 Rear Suspension

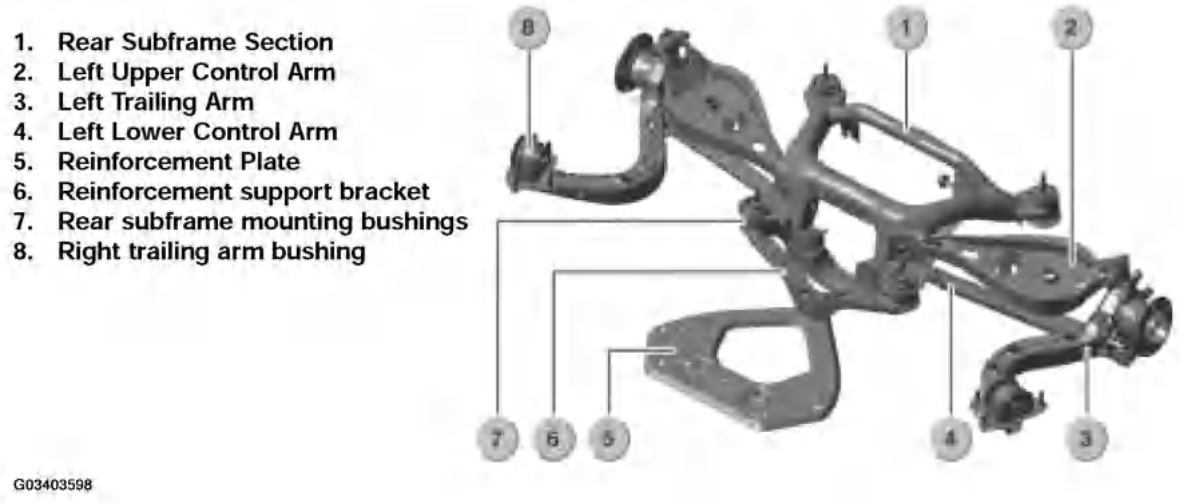


Fig. 21: Identifying E85 Rear Suspension
Courtesy of BMW OF NORTH AMERICA, INC.

Rear Suspension Adjustments (Central "C" Link)

Rear Toe

Toe is adjusted by moving the forward central arm bushing mount with a special tool. The tool part number varies between models.

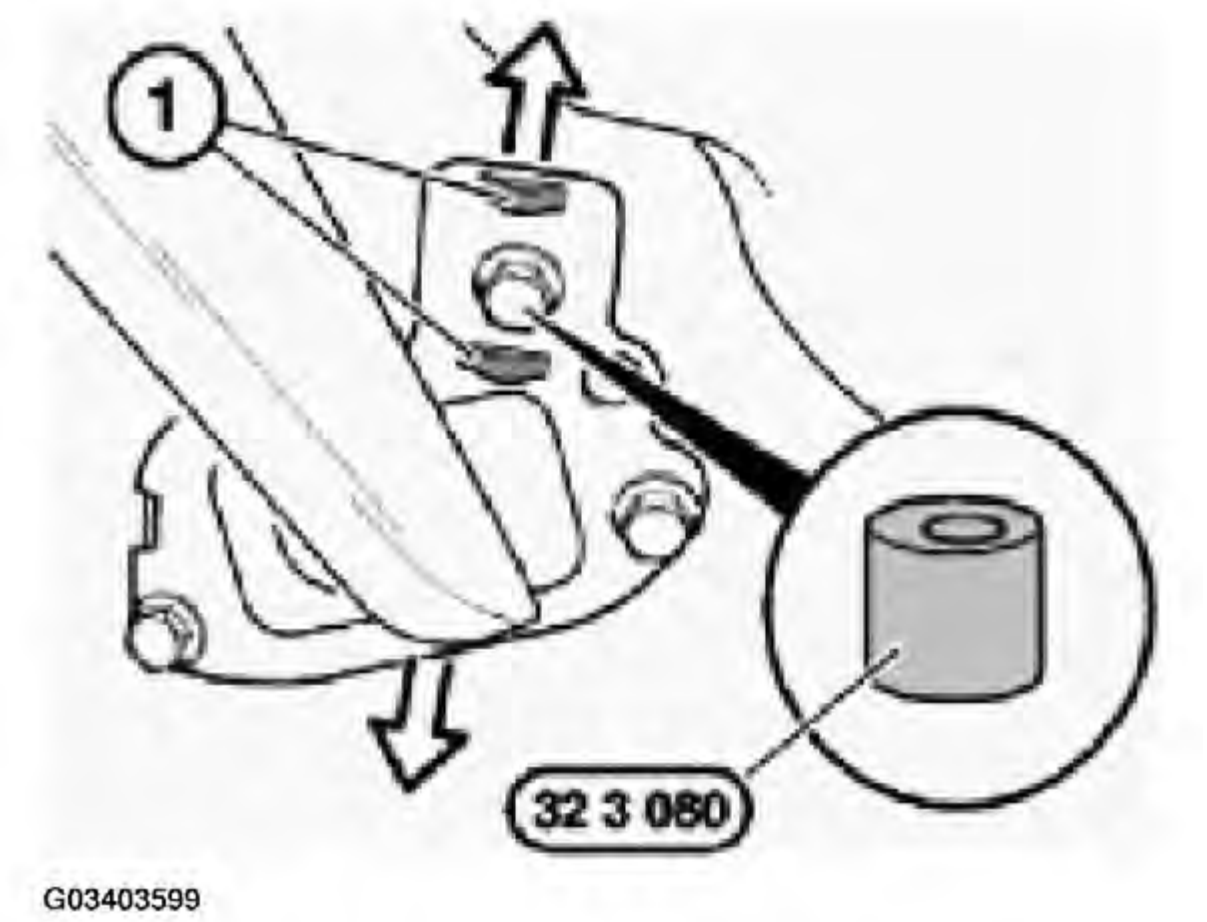


Fig. 22: Identifying Rear Toe Adjustment Bolt Tool # 90 88 6 323 080 For E36
Courtesy of BMW OF NORTH AMERICA, INC.

Tool # 90 88 6 323 080 for E36

Not Used for Z3 and 318ti

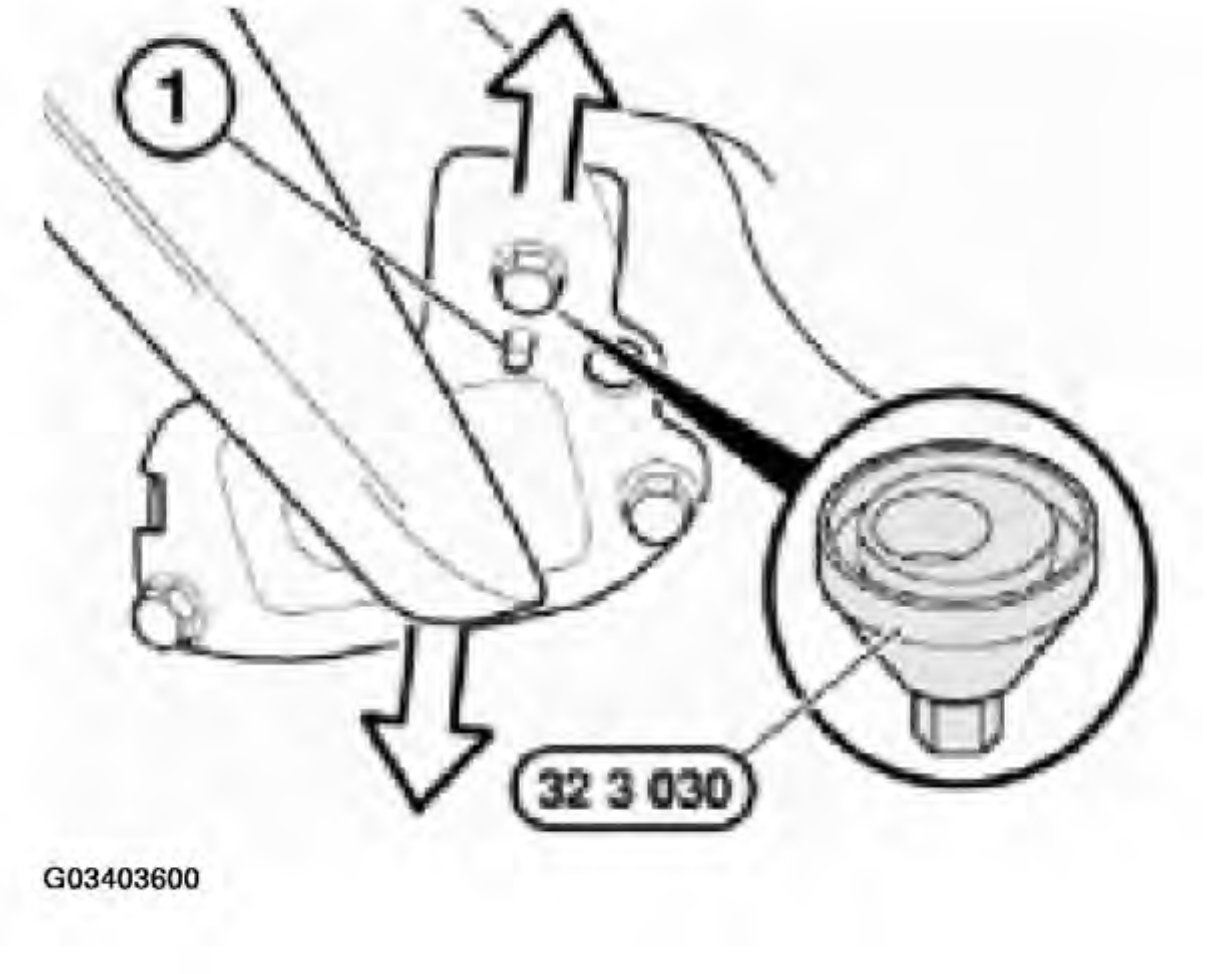


Fig. 23: Identifying Rear Toe Adjustment Bolt Tool # 90 88 323 030 For E46 And E85
Courtesy of BMW OF NORTH AMERICA, INC.

Tool # 90 88 6 323 030 for E46 and E85

Rear Camber

Rear Camber is adjusted by rotating an eccentric bolt located at the outer end of the rear lower lateral link. No Special tools are required to make the Camber adjustment.

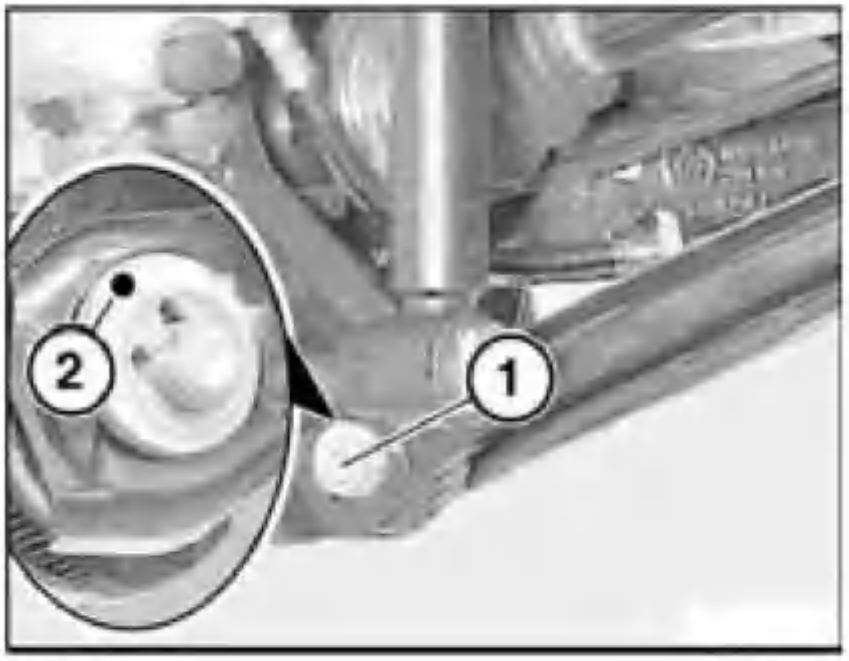


Fig. 24: Identifying Rear Camber Bolt (1 Of 2)
Courtesy of BMW OF NORTH AMERICA, INC.

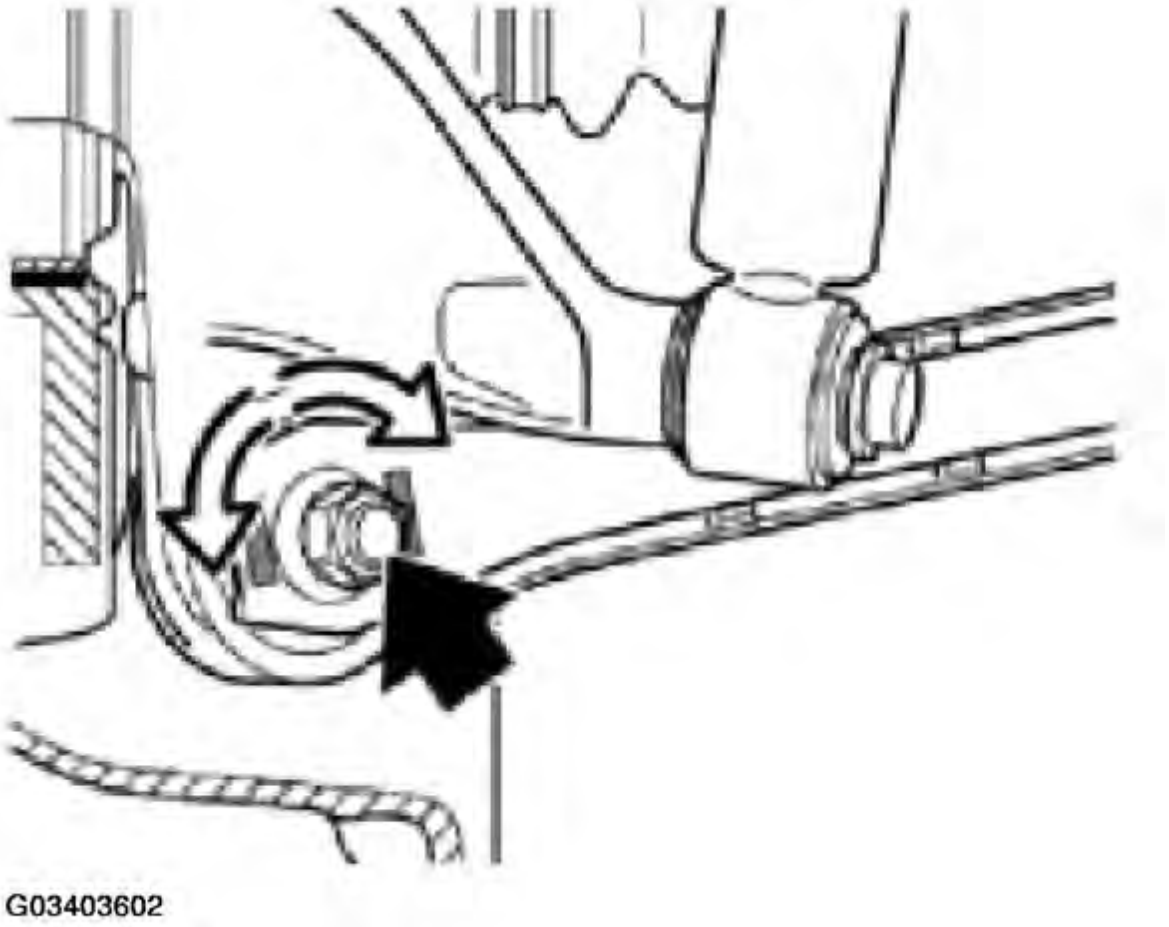


Fig. 25: Identifying Rear Camber Bolt (2 Of 2)
Courtesy of BMW OF NORTH AMERICA, INC.

Multi-Link Rear Suspensions

Multi-Link Rear suspension systems are used on the following vehicles:

- E31 8 Series including 850i, 850Ci, 850CSi and 840Ci
- E38 7 Series - All models
- E39 5 Series - All models including M5 (Touring version is slightly modified)
- E53 X5 3.0i, 4.4i and X5 4.6is
- E52 Z8
- E65 and E66

The "integral" multi-link suspension was introduced on the E31 and variations of it are used on the 5 and 7 series vehicles. Slightly modified versions are also used in the X5 and E39 Sportwagon with EHC. The multi-link suspensions incorporate what is called "elastokinematics" that allow each wheel to move and flex individually without transmitting loads and forces through the sub-frame to the other wheel.

These suspension systems incorporate anti-dive, anti-squat geometry which serves to keep the vehicle level during hard acceleration and braking.

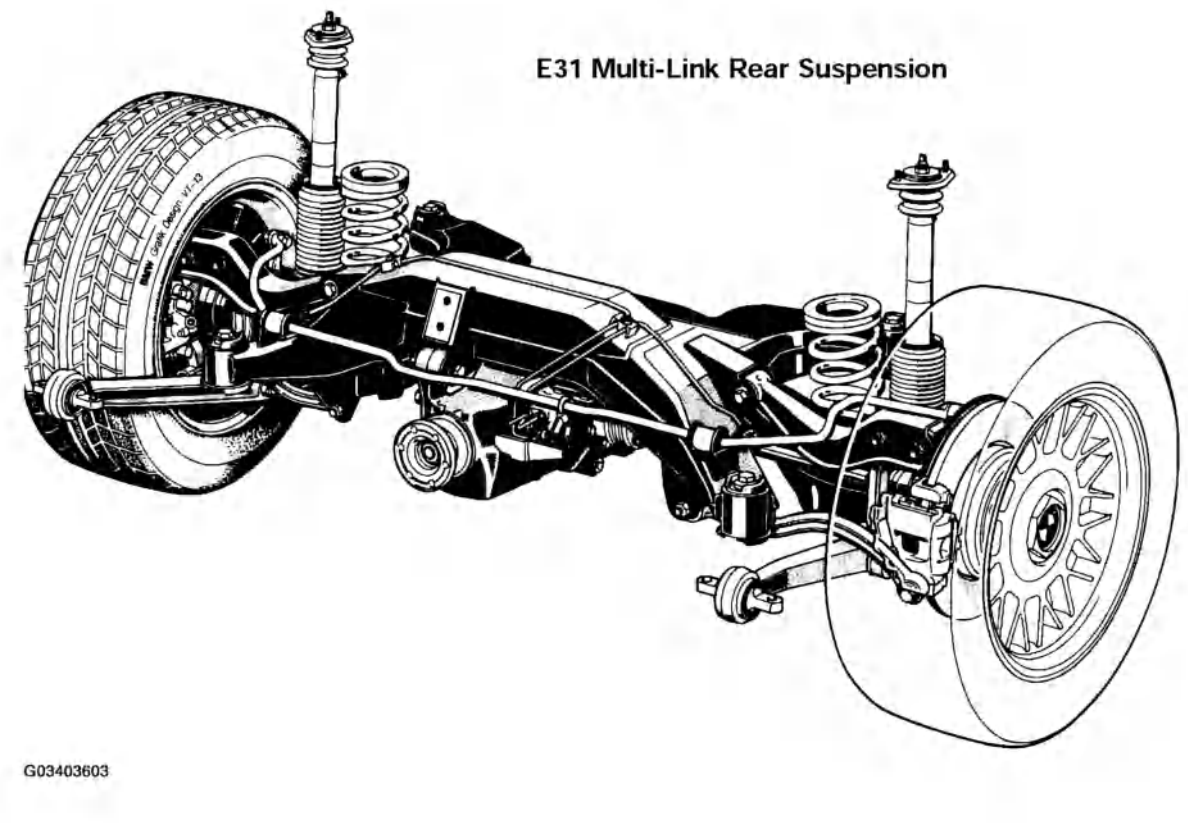


Fig. 26: Identifying E31 Multi-Link Rear Suspension
Courtesy of BMW OF NORTH AMERICA, INC.

Elasto-Kinematics

Elasto-kinematics relates to the suspension system design type. The term "elasto" implies stretching, which in fact the system does. Under extreme load (acceleration, turning, braking) the suspension changes its geometry to counteract inherent changes induced by the increased loads.

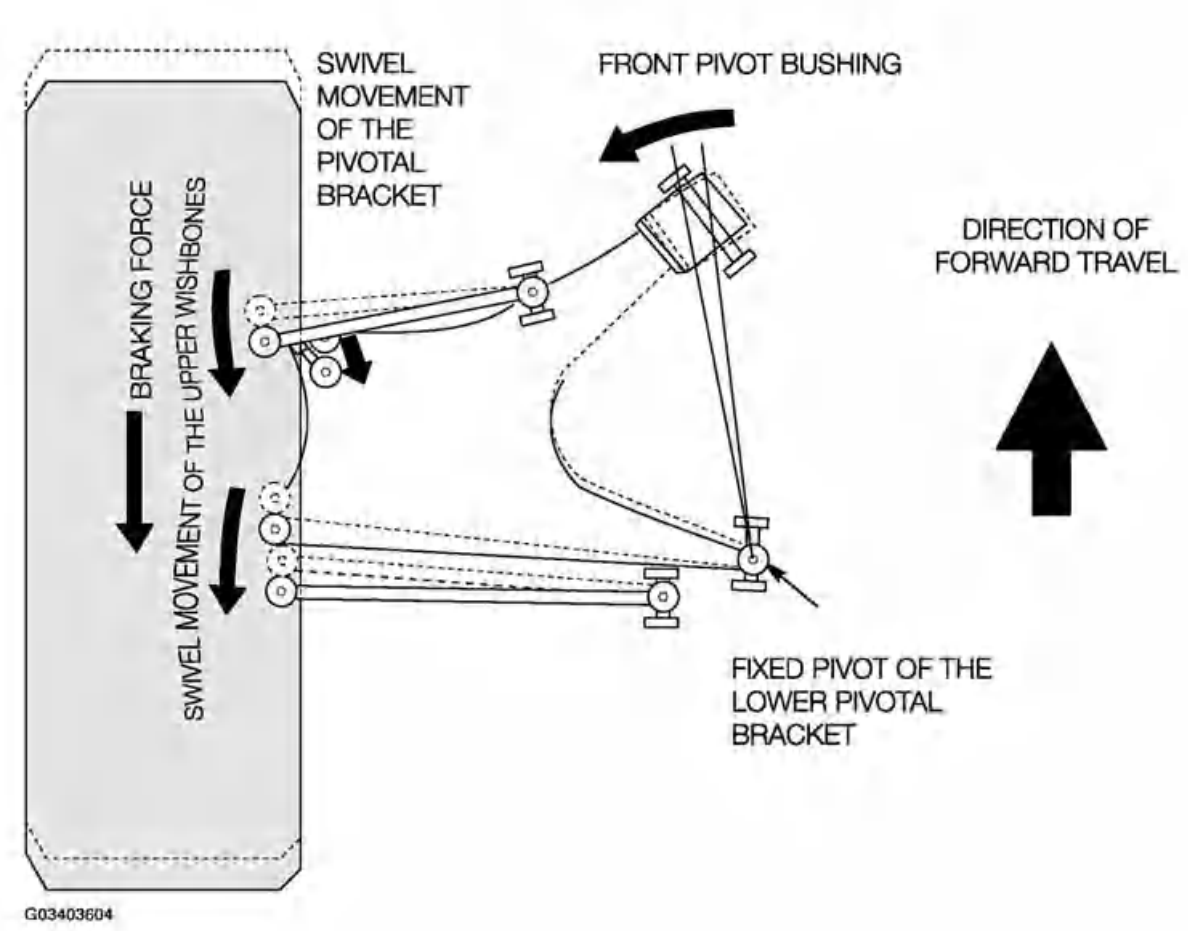


Fig. 27: Identifying Elasto-Kinematics
Courtesy of BMW OF NORTH AMERICA, INC.

The system changes are pre-determined and built into the system. The geometry changes provided by this system correct for unwanted changes that occur under load in non-elastokinematic systems.

E38/E39 Multi-Link Suspension

The E38 and E39s use a modified version of the E31 multi-link rear suspension system. The system was modified to be more compact yet provide the same handling and ride characteristics as the E31 system.

The trailing arm was eliminated and all suspension mounting is to the sub-frame of the vehicle. The E38/E39 Multi-Link Rear Suspension is made up of the following:

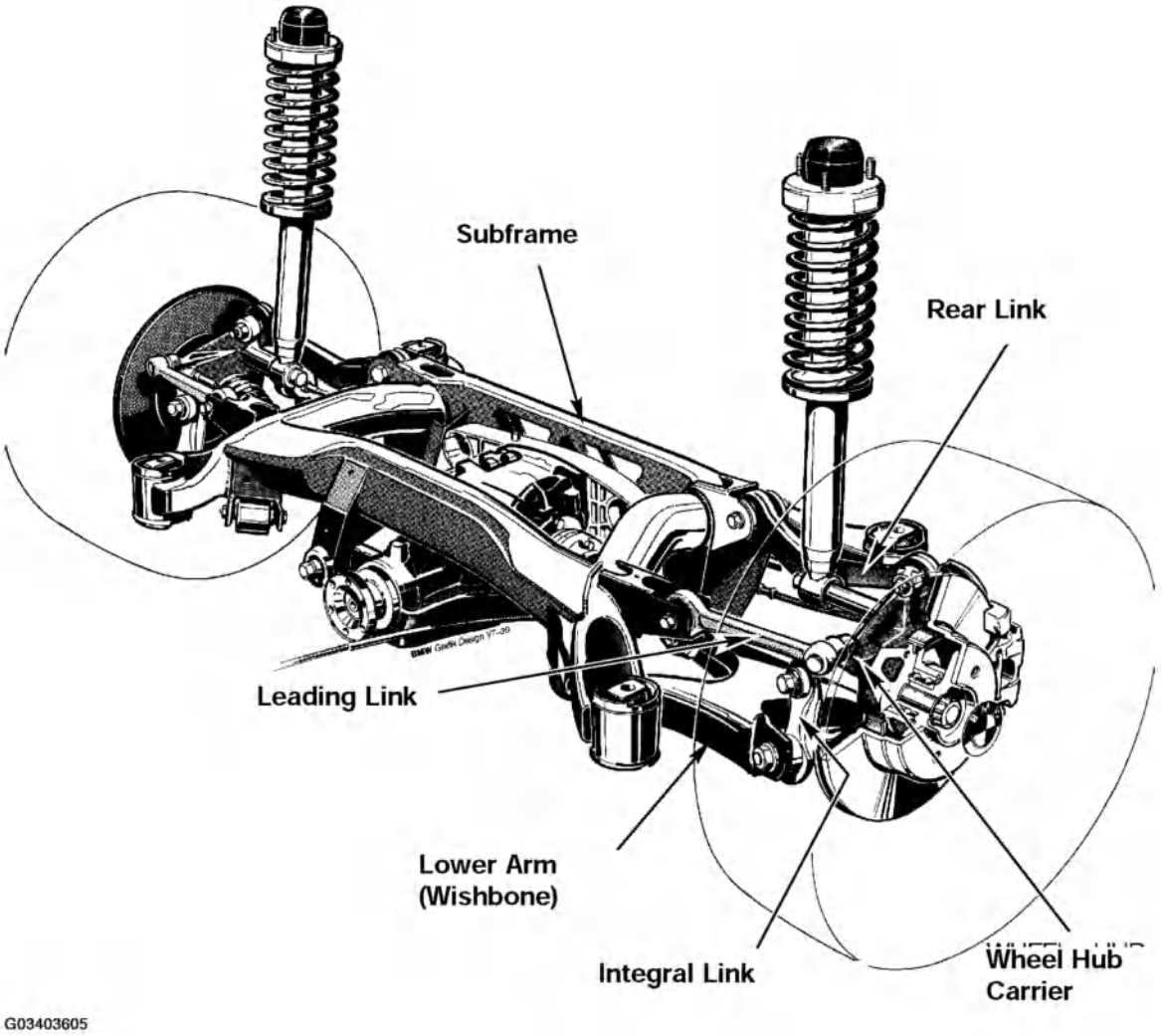


Fig. 28: Identifying E38/E39 Multi-Link Suspension
Courtesy of BMW OF NORTH AMERICA, INC.

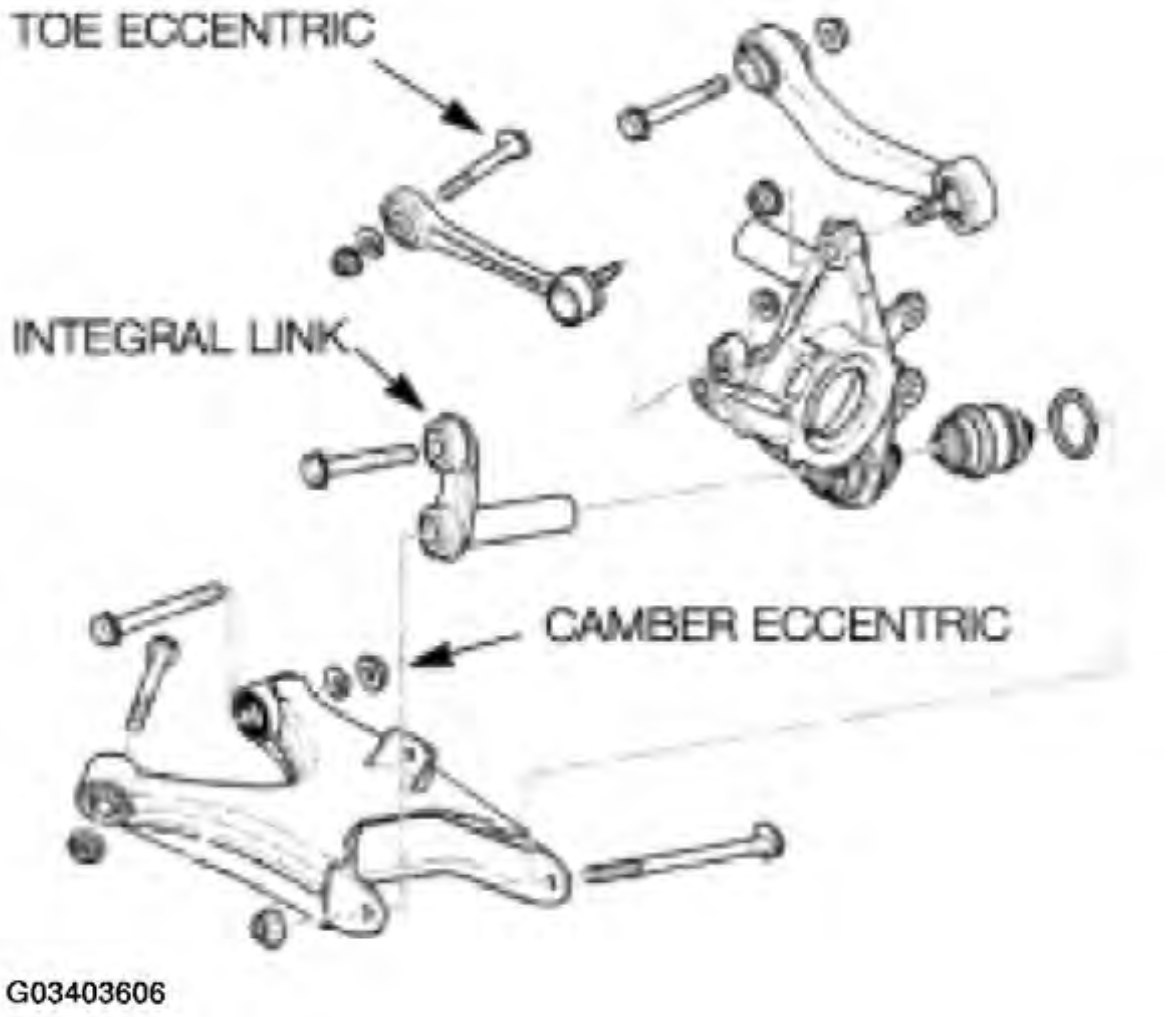


Fig. 29: Identifying Links
Courtesy of BMW OF NORTH AMERICA, INC.

Rear Suspension Adjustments

Camber and toe angles are adjustable on the E38/39 rear suspension through two eccentric bushings. There are no special tools required to perform these adjustments.

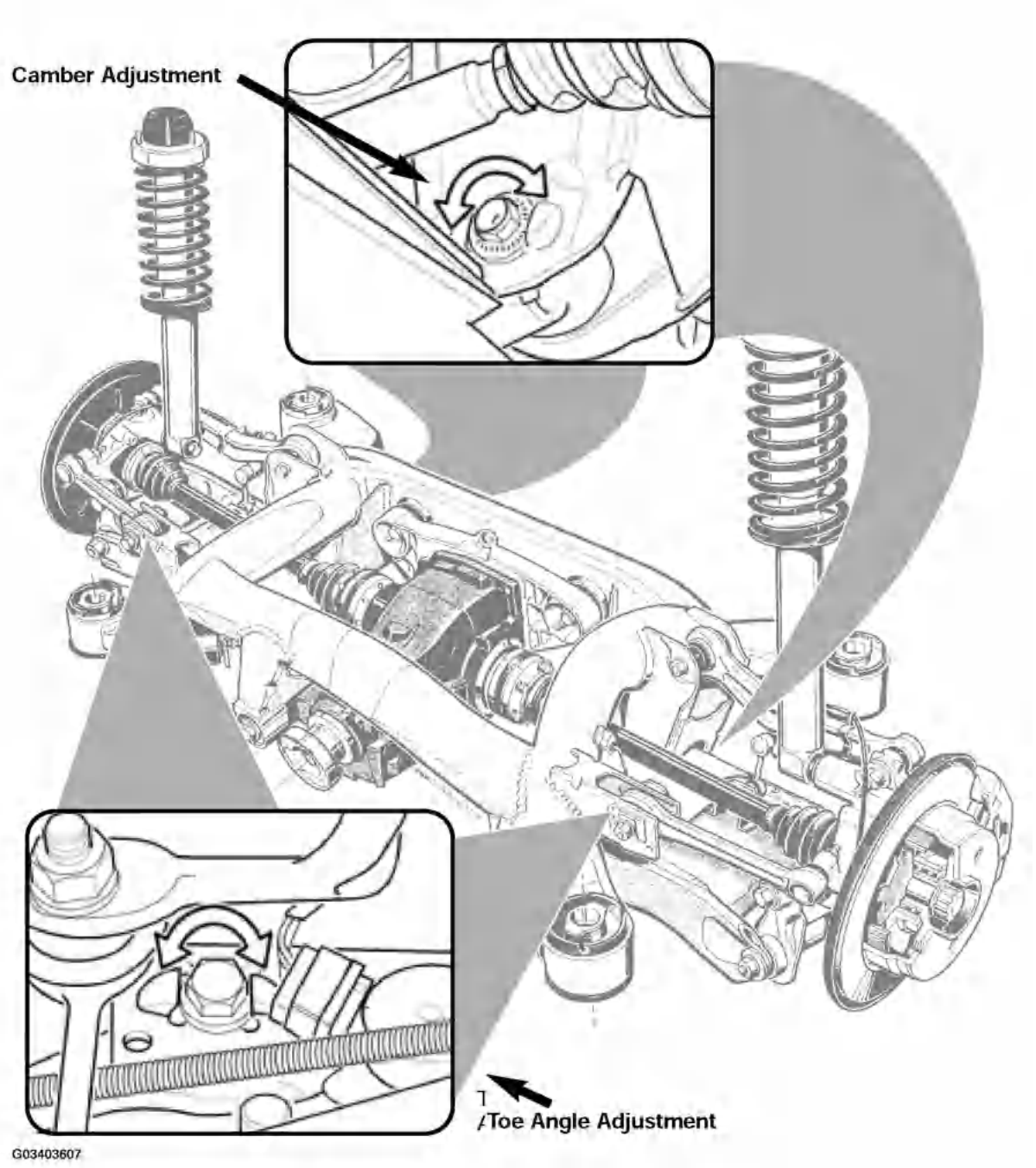


Fig. 30: Identifying Camber Adjustment Bolt
Courtesy of BMW OF NORTH AMERICA, INC.

E39 Sportwagon And X5 Rear Suspension

With the introduction of the E39 Sportwagon and the E53 X5, the rear suspension system has been modified to accommodate the increased cargo capacity. The rear suspension is also modified to allow for the optional EHC system. The X5 and Sportwagon rear suspensions differ from the standard E38 and E39. The springs are now located on the perches that are part of the wheel carrier assembly. The E39 and E53 rear suspensions are also slightly different from one another, the E39 upper shock mounts are part of the subframe assembly. The E53 upper shock mounts are still located in the body.

Both the E39 and E53 are available with optional EHC, this means that the rear springs will either be coils springs or "air springs".

The E39 rear suspension also uses special "hydro mounts". This modification is necessary due to the fact that the upper shock mounts are on the subframe. The "hydro mounts" are used to isolate the subframe to suppress road noise and vibrations from being transmitted to the body.

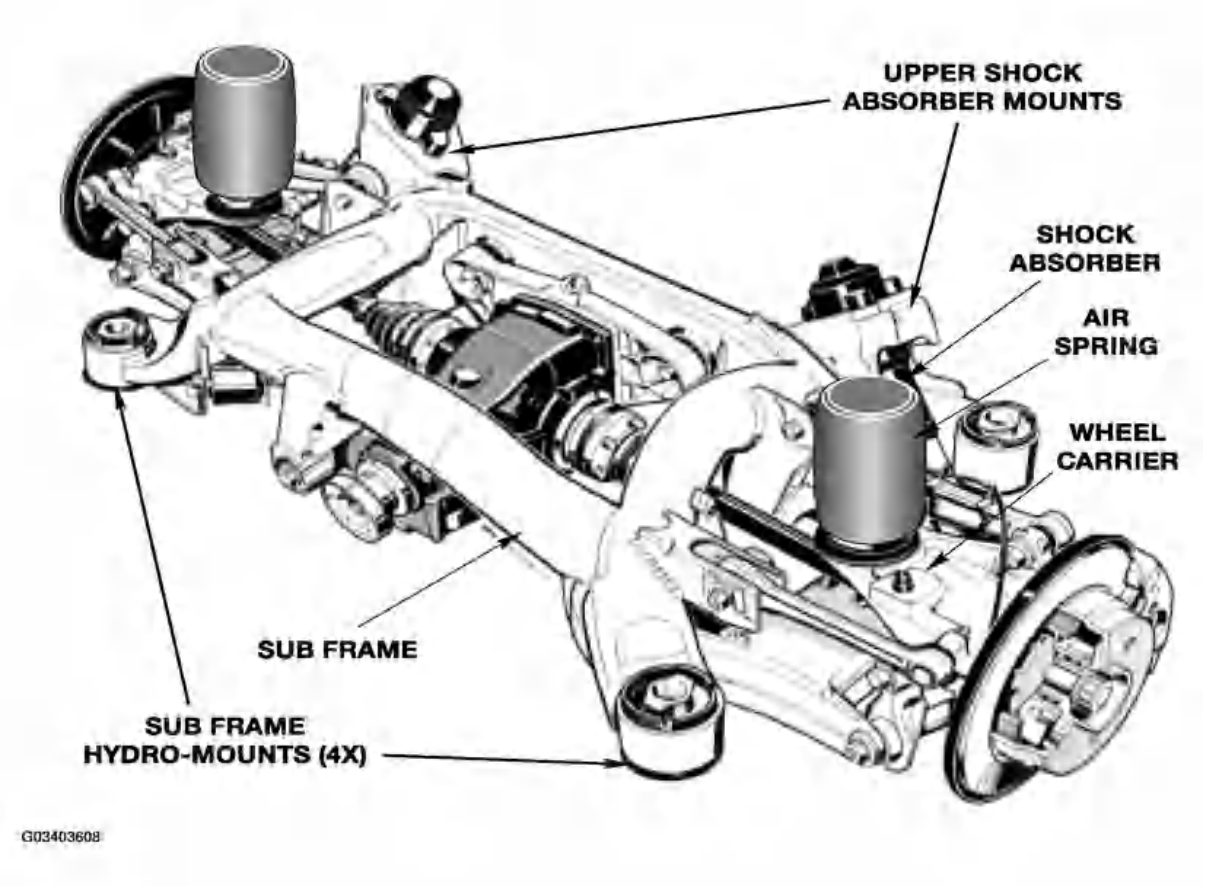


Fig. 31: Identifying E39 Sportwagon Rear Suspension With EHC.
Courtesy of BMW OF NORTH AMERICA, INC.

E65/E66 Rear Suspension

The rear axle on the E65/E66 is also the integral type. It is very similar to the E38/E39 rear suspension. The rear axle carrier (subframe) is made from tubular aluminum. The E65/E66 is also available with optional systems such as:

- EDC-K Electronic Damping Control (Continuous)
- ARS Active Roll Stabilization
- Air Suspension System

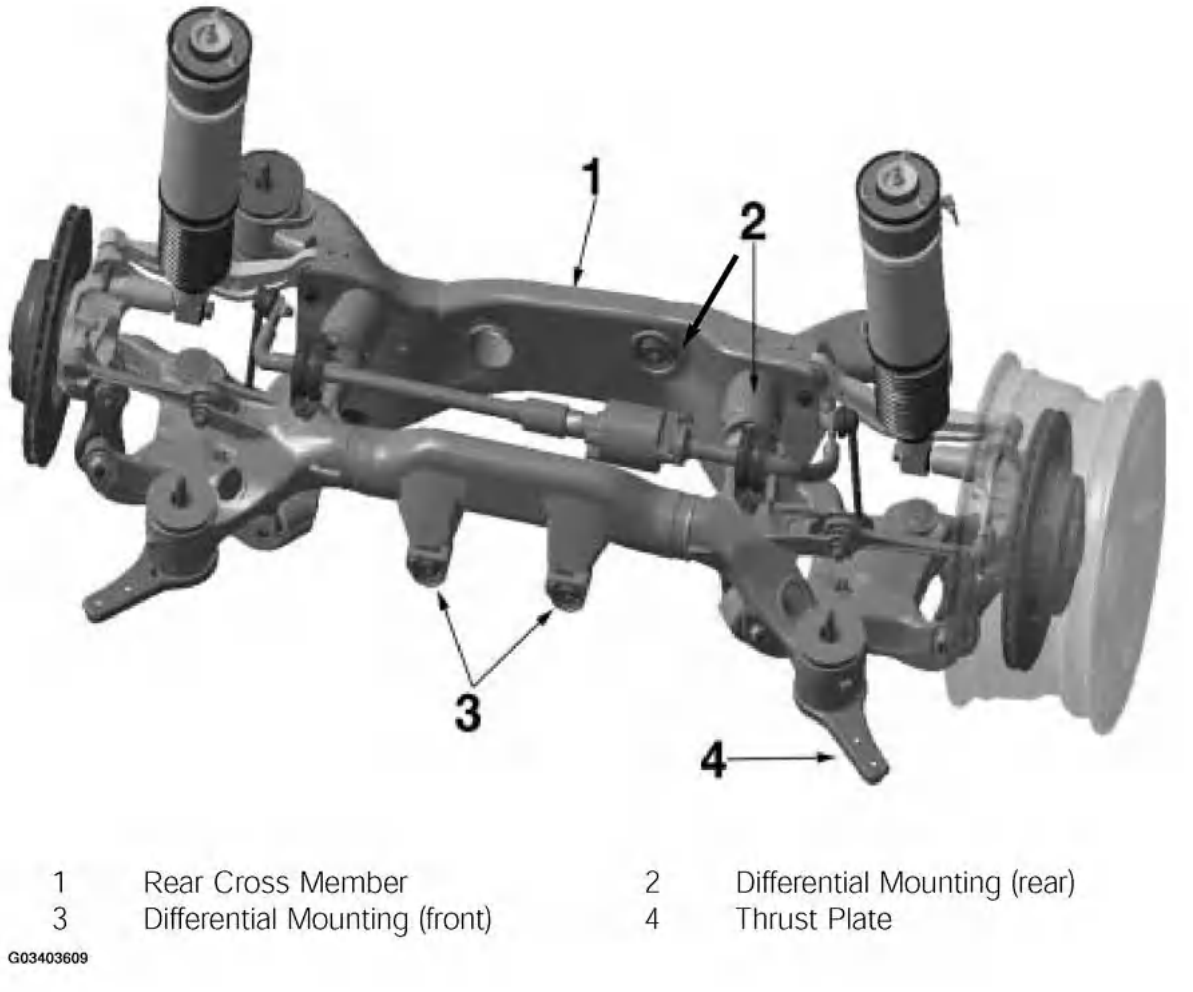


Fig. 32: Identifying E65/E66 Rear Suspension
Courtesy of BMW OF NORTH AMERICA, INC.

The Rear Toe and Rear Camber are adjusted by means of eccentric bolts. No special tools are needed to make these adjustments.

ALIGNMENT PROCEDURES

The following procedure is an outline to follow based on BMW procedures. The actual alignment procedures will vary depending upon the alignment equipment being used. Refer to the alignment equipment manufacturers procedures for specific information. The steps listed below should be followed as closely as possible to perform a quality alignment.

- Vehicle Inspection - The vehicle inspection should include a road test before and after the alignment. Note any concerns during the pre-alignment road test and verify that the concern has been rectified during the post-alignment road test.
- Install Specified Weight - Install Specified weight in vehicle and compensate for fuel by adding extra weight if needed.
- Install Alignment Sensors - Install alignment sensors as per the alignment equipment manufacturers recommended procedures.
- Compensate Sensors - Depending upon the alignment sensors being used, compensation may not be necessary. Compensation may require the vehicle to be lifted from the alignment rack. If so, be sure to remove the pins from the front and rear slip plates. If the sensors do not need to be compensated, the next step can be ignored.
- Lower Vehicle and Jounce - Make sure the pins are removed from the slip plates. Lower the vehicle back onto the alignment rack and jounce the vehicle. This will insure that the suspension has settled.
- Check Ride Height - Check ride height using metric tape measure. Always check ride height after

compensating the sensors. This will avoid having to check the ride height twice.

- Perform Alignment - Refer to the equipment manufacturers instructions for the next steps of the alignment.

When performing an alignment of a vehicle equipped with air suspension (EHC), disable the system by removing the fuse for the air supply system. This will insure that the ride height will stay consistent.

Vehicle Inspection

Before attempting to align any vehicle, it is important to inspect the vehicle completely to insure there are no damaged or loose suspension components. Regardless of the age or mileage of the vehicle, a complete inspection should be performed. The following items should be checked thoroughly:

- Tires and Wheels - Check tires for wear patterns that could indicate suspension problems. Make sure the tires are the correct size and type. Check for the correct inflation pressures. Look for wheel/rim damage which could indicate impact damage.
- Wheel bearings - Check to make sure there is no excessive wheel bearing play. This needs to be addressed for safety reasons, but loose wheel bearings will affect the quality of the alignment as well.
- Steering Linkage - Check the tie rods, center link, idler arm and pitman arm. On vehicles with rack and pinion steering, check for loose inner/outer tie rods etc.

  On vehicles with a center link, make sure the center link is level. Check flexible coupling between steering shaft and rack and pinion assembly (or steering box).

- Suspension Components - Check Struts/Shocks for leakage or damage. Check springs and perform ride height measurements.
- Subframe - Check the front and rear axle carriers. Look for bent/twisted sub frames. Check the crossmembers for evidence of shifting or displacement. Check the mounting bolts for "clean spots" which could indicate shifting or movement.
- Brakes - Check braking system by road testing the vehicle. A road test could help to identify brake related issues such as pulling or brake induced vibrations.
- Drivetrain - While road testing the vehicle, observe and vibrations and/or noises and try to isolate the cause. Noises and vibrations under acceleration (rather than coasting) may be an indication of drivetrain issues.

Road Testing

Whenever possible, a vehicle should be road tested before and after an alignment. If time allows, drive on various road surfaces and note the vehicle behavior. Check for brake pull when stopping. And most importantly, note the position of the steering wheel before and after the alignment. These are important steps to avoid comebacks and unnecessary return visits.

Ride Height Measurement

When performing alignments on BMW vehicle, the ride height must be set and checked before proceeding with any measurement or adjustments. Ride height is measured from the lower edge of the wheel rim to the lower edge of the wheel housing. Ride height specifications are in millimeters. In order to obtain the correct specification, the vehicle and suspension type must be identified. Ride height specifications depend upon rim size (15", 16", 17" etc.), engine size and the type of suspension. There are 4 different types of suspension packages:

- Series - Standard production vehicle
- Low Slung Sports Suspension - This is used on vehicle with Sports Package Option.
- Rough Road Package - For Eastern European Rough roads. Not used in US.
- M Sports Package - Used on Motorsport vehicles or those with M Package Option.

The example shown below is the ride height specifications for an E39 540i (Front Axle).

HEIGHT SPECIFICATION

Series	Â	Â
15" Rim	mm +/- 10	579
16" Rim	mm +/- 10	592
17" Rim	mm +/- 10	607
18" Rim	mm +/- 10	620
Low Slung Sports Suspension	Â	Â
15" Rim	mm	559
16" Rim	mm	572
17" Rim	mm	587
18" Rim	mm	600
Rough Road Package	Â	Â
15" Rim	mm +/- 10	599
16" Rim	mm +/- 10	612
17" Rim	mm +/- 10	627
18" Rim	mm +/- 10	640
M Sports Package	Â	Â
15" Rim	mm +/- 10	562
16" Rim	mm +/- 10	575
17" Rim	mm +/- 10	590
18" Rim	mm +/- 10	603

Ride Height

When measuring ride height, measure from the lower edge of the wheel rim to the lower edge of the wheel opening. Use a metric tape measure with divisions of 1 mm.



Fig. 33: Measuring Tire Height

Courtesy of BMW OF NORTH AMERICA, INC.

Z3 Ride Height Tool

When measuring ride height on the E36/7 (Z3). Use special tool # 313 010. Due to the design of the hood on the Z3, this tool is used to simulate the lower edge of the wheel opening.

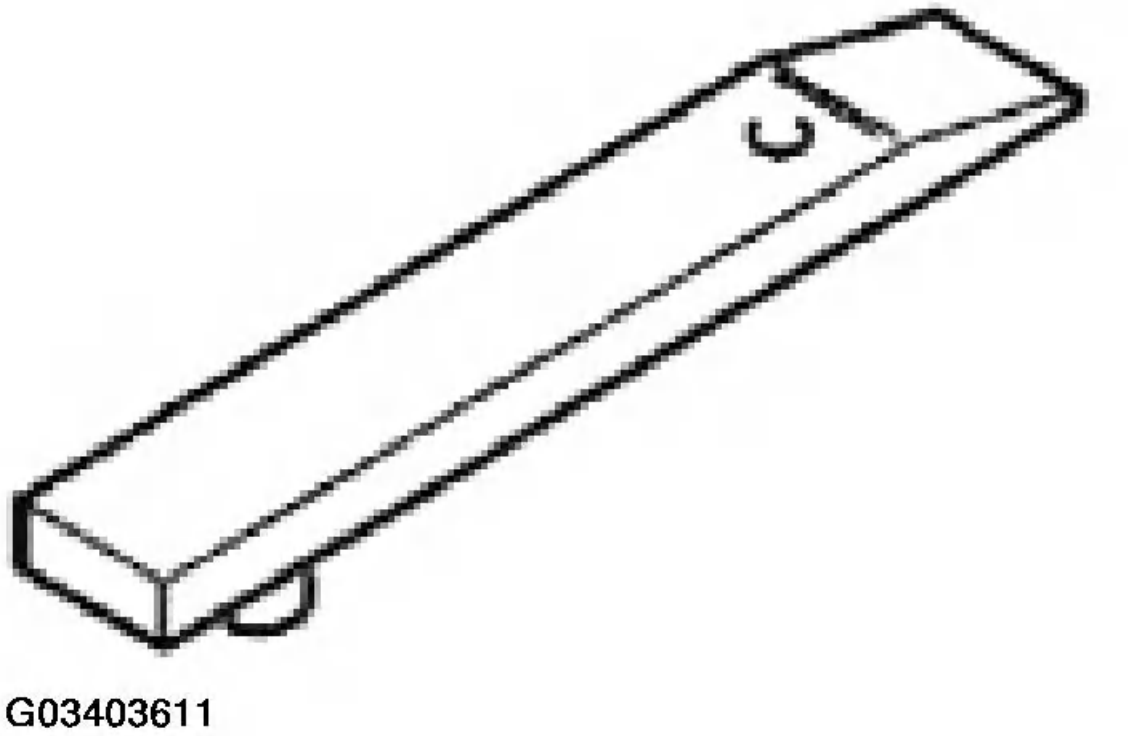


Fig. 34: Identifying Special Tool # 313 010
Courtesy of BMW OF NORTH AMERICA, INC.

Identification Of Suspension

When performing an alignment, the suspension variant must be identified. This insures that the correct alignment specifications are used and the ride height is correct. There are numerous suspension variants, there is the standard "series" production suspension, the "low slung" sports suspension, "M Sport Package" and the "Poor Road Surface" package. The latter term is for Eastern Europe, this is not used in the US.

There are various methods for determining the suspension variant used. The following is a summary of some common models:

- E38 - The "Sports" suspension variant is identified by paint markings on the front springs or by a front sway bar diameter of greater than 21.5 mm.
- E65/E66 - There is no additional identification needed to determine suspension variant (at this time).
- E39 - There is a symbol (or code) located on the front strut assembly. There is a chart in repair instructions to match to the symbol found.
- E36 - There is an auxiliary spring located on the front strut assembly. There is a measurement that needs to be made to determine suspension variant.
- E46 - There is a symbol (or code) located on the front strut assembly. There is a chart in repair instructions to match to the symbol found.

The following page shows the E39 suspension identification chart. Note the markings on the front strut housing below.

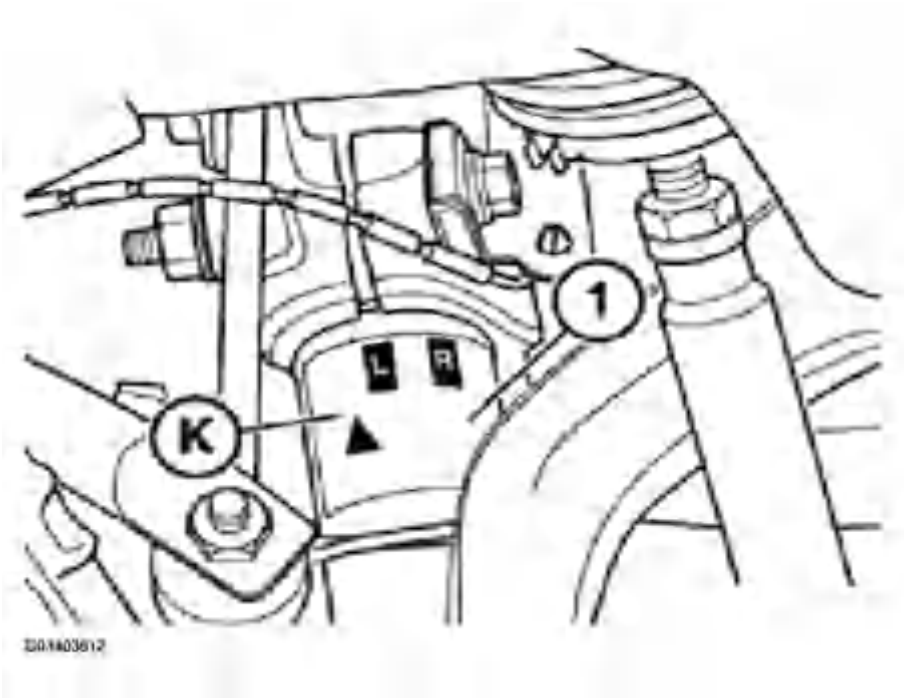


Fig. 35: Identifying Suspension
Courtesy of BMW OF NORTH AMERICA, INC.

VERSION MODEL CHART

Identifying Symbol	Version	Model
Without	Volume production	Sedan
Solid Circle	Low slung sports Suspension	4 and 6 cylinder Sedan
Solid Triangle	Low slung sports Suspension	8 cylinder sedan
Solid Square	Poor road surface (Eastern Europe)	Sedan
M5	Volume production	M5 Sedan
M5	M sports package	8 cylinder Sedan
E39BAS.SP	M sports package	4 and 6 cylinder Sedan
Circle	Volume production	Touring
Triangle	Low slung sports Suspension	Touring
Square	Poor road surface (Eastern Europe)	Touring

Vehicle Loading

In order to obtain the correct ride height, the vehicle must be loaded with the specified weight. The normal specified weight for most vehicles is as follows:

- 68 kg. in each front passenger seat
- 68 kg in the rear seat
- 21 kg in the trunk
- Fuel tank full.

Not all vehicle need to be weighed down. Usually E39 M5 and E36/E46 M3 are measured without any weight. The proper test conditions can be found under "Normal Position/Inspection Conditions".

If the vehicle fuel tank is not full, compensate by adding weight in the trunk. Fuel is approximately 7 pounds

(about 3.2kg) per gallon. For example: If the vehicle has an 18 gallon tank and it is 1/2 full, add about 63 lbs. (about 28kg.)

Alignment Sensor Mounting

There are two types of alignment sensor mounting, this depends upon equipment used. The first type is the "Rim Clamp" Method which "clamps" on the edge of the wheel rim. This method of mounting requires that the sensor be "compensated" electronically to allow for wheel runout and mounting irregularities. The second type is the "Beissbarth" type clamp, this method allows the clamp to be indexed to the rotor hub through holes in the wheel rim. The clamp hold on to the tire tread with a spring loaded clamp. The "Beissbarth" clamping method does not have to be compensated due to the fact that the clamp is actually mounted to the rotor hub, theoretically this method eliminates the need for compensation. Always remember that the holes in the rim should be clean and free of excessive rust, this could cause irregular mounting and inaccurate alignment results.



Fig. 36: Identifying Rim Clamp Mounting
Courtesy of BMW OF NORTH AMERICA, INC.



Fig. 37: Identifying Beissbarth Type Mounting
Courtesy of BMW OF NORTH AMERICA, INC.

Alignment Adjustment Summary

ALIGNMENT ADJUSTMENT SUMMARY

Â	Front Caster	Front Camber	Front Toe	Rear Camber	Rear Toe
E30	No Adjustment	No Adjustment	Yes	No Adjustment	No Adjustment (Offset Bushing)
E36	No Adjustment	No Adjustment	Yes	Yes (Eccentric)	Yes Tool # 323 080
E36/7 Z3 E36/5 318ti	No Adjustment	No Adjustment	Yes	No Adjustment	No Adjustment (Offset Bushing)
E46	No Adjustment	Yes Tool # 323 140	Yes	Yes (Eccentric)	Yes Tool # 323 030
E34	No Adjustment	No Adjustment	Yes	No Adjustment	No Adjustment (Offset Bushing)
E39	No Adjustment	No Adjustment	Yes	Yes (Eccentric)	Yes (Eccentric)
E53	No Adjustment	Yes Tool # 323 145	Yes	Yes (Eccentric)	Yes (Eccentric)
E32	No Adjustment	No Adjustment	Yes	No Adjustment	No Adjustment (Offset Bushing)
E38	No Adjustment	No Adjustment	Yes	Yes (Eccentric)	Yes (Eccentric)
E65/E66	No Adjustment	Yes Tool # 323 145	Yes	Yes (Eccentric)	Yes (Eccentric)
E85	No Adjustment	Yes Tool # 323 145	Yes	Yes (Eccentric)	Yes Tool # 323 030
E31	No Adjustment	No Adjustment	Yes	Yes (Eccentric)	Yes (Eccentric)

Alignment Specifications

There is a slight difference in terminology between this information and the information found on most alignment equipment. The following text should be helpful in understanding the different terms used. The alignment specifications are shown on the opposing page:

- Front Toe - The Total Toe specification represents the left and right toe specs added together. Toe is measured in degrees and minutes.
- Front Camber - Camber is also measured in degrees and minutes. Camber is adjustable only a some vehicles. The maximum amount of Camber adjustment is approximately .5 +/- degrees.
- Track Differential Angle with 20Â° lock on inside wheel - This angle is also known as "Toe Out on Turns". With the inside wheel turned to 20 degrees on the front turn plates, the difference in the toe angle should be as specified.
- Caster - Caster must be measured by sweeping the wheel through an arc of 10-20 degrees. (Most alignment equipment requires at least 20 degrees). Ride height is crucial to this specification. If the vehicle is too high or low in the rear, the Caster measurement will be affected. Caster is NOT a "live angle", the wheels must be re-sweeped to check the measurement again. Although Caster is NOT adjustable, it should always be checked to insure there is no "hidden damage".
- Front Wheel Displacement - More commonly known as "Setback", this is a measurement of the angle formed between the front axle to the Geometric Axis. The front axle centerline should be at 90 degrees to the Geometric Axis. A quick check of setback is to look to see if the wheel is centered in the wheel opening. Setback is a good diagnostic angle, if the Caster is off, the Setback measurement could indicate the cause. Look for bent suspension components or damaged suspension carrier/subframe.
- Maximum Wheel Lock - Also known as "Maximum Steering Angle". This is the maximum angle of the wheels when turned to the inward and outward lock position. When this measurement is out of specification, check to see if the steering rack or steering box is centered. This can cause a hazardous condition and premature tire wear.
- Rear Toe - Just as with front toe, this is the combined measurement of the rear left and right toe. Rear Toe is also measured in Degrees and Minutes.
- Rear Camber - Rear Camber is always negative on BMW vehicles. Rear Camber adjustable on some models.
- Geometrical Axis Deviation - The Geometrical Axis Deviation is also known as the "Thrust Angle". The optimum angle is zero degrees. The Thrust Angle is the angle formed between the Geometric Centerline and the Thrust Line which is the imaginary line which bisects the rear toe angle. A Thrust Angle of Zero Degrees is Optimal.

Depending upon the type of alignment equipment used, the specifications can be expressed a number of ways. Whenever possible, set the alignment equipment to read in degrees and minutes. Some alignment equipment has this option, this is more desirable than trying to convert from inches to degrees etc.

The alignment angles are expressed in degrees and minutes. For example:

6Â° 30' is expressed as 6 degrees, 30 minutes.

There are 360 degrees in a circle and 60 minutes to each degree. The are also 60 seconds to each minute, but adjustments this fine are rarely used.

32 M Wheel alignment E39 / US

32 00 WHEEL ALIGNMENT E39/M5

Observe test conditions	Â	Â
Front axle:	Â	Â
Total toe	Â	0Â° 10' +/- 10'
Camber (difference between left/right max. 40/M5, M sports package max. 30)	Â	-30' +/- 30'

Track differential angle with 20 lock on inside wheel	Â	-1Â° 43' +/- 30'
Caster (difference between left/right max. 30')	Â	Â
With Â° 10+/- wheel rock	Â	6Â° 27' +/- 30'
With Â° 20+/- wheel rock	Â	6Â° 49' +/- 30'
Front wheel displacement	Â	0' +/- 10'
Maximum wheel lock	Â	Â
Inside wheel	approx.Â°	41.5
Outside wheel	approx.Â°	32
Turning circle	approx. m	Â
Rear axle:	Â	Â
Total toe	Â	Â
Alignment check	Â	0Â° 10' +/- 10'
Adjustment	Â	0Â° 10' +/- 8'
Camber (difference between left/right max. 15')	Â	Â
Alignment check	Â	-1Â° 50' +/- 15'
Adjustment	Â	-1Â° 49' +/- 5'
Geometrical axis deviation	Â	0Â° +/- 12'

Article GUID: A00212592

1995-2002 SUSPENSION

Rear - E36

IDENTIFICATION

1995-2002 CHASSIS & ENGINE IDENTIFICATION

Model (Chassis Code)	Engine Size (Code)
1995	
318ti (E36)	1.8L (M42)
1996-98	
Z3 (E36)	1.9L (M44)
1996-1999	
318ti (E36)	1.9L (M44)
1997-1998	
Z3 (E36)	2.8L (M52)
1998-1999	
M Roadster (E36)	3.2L (S52)
1999	
M Coupe (E36)	3.2L (S52)
Z3 (E36)	2.8L (M52TU)
1999-2000	
Z3 (E36)	2.5L (M52TU)
2000-2002	
M Roadster (E36)	3.2L (S54)
M Coupe (E36)	3.2L (S54)
2001-2002	
Z3 (E36)	2.5L (M54)
Z3 (E36)	3.0L (M54)

DESCRIPTION

The E36 uses independent rear suspension. Trailing arms locate the rear wheels and anchor the coil springs, shock absorbers and stabilizer bar. The differential is mounted to the rear axle carrier with rubber mounts. See Fig. 1 .

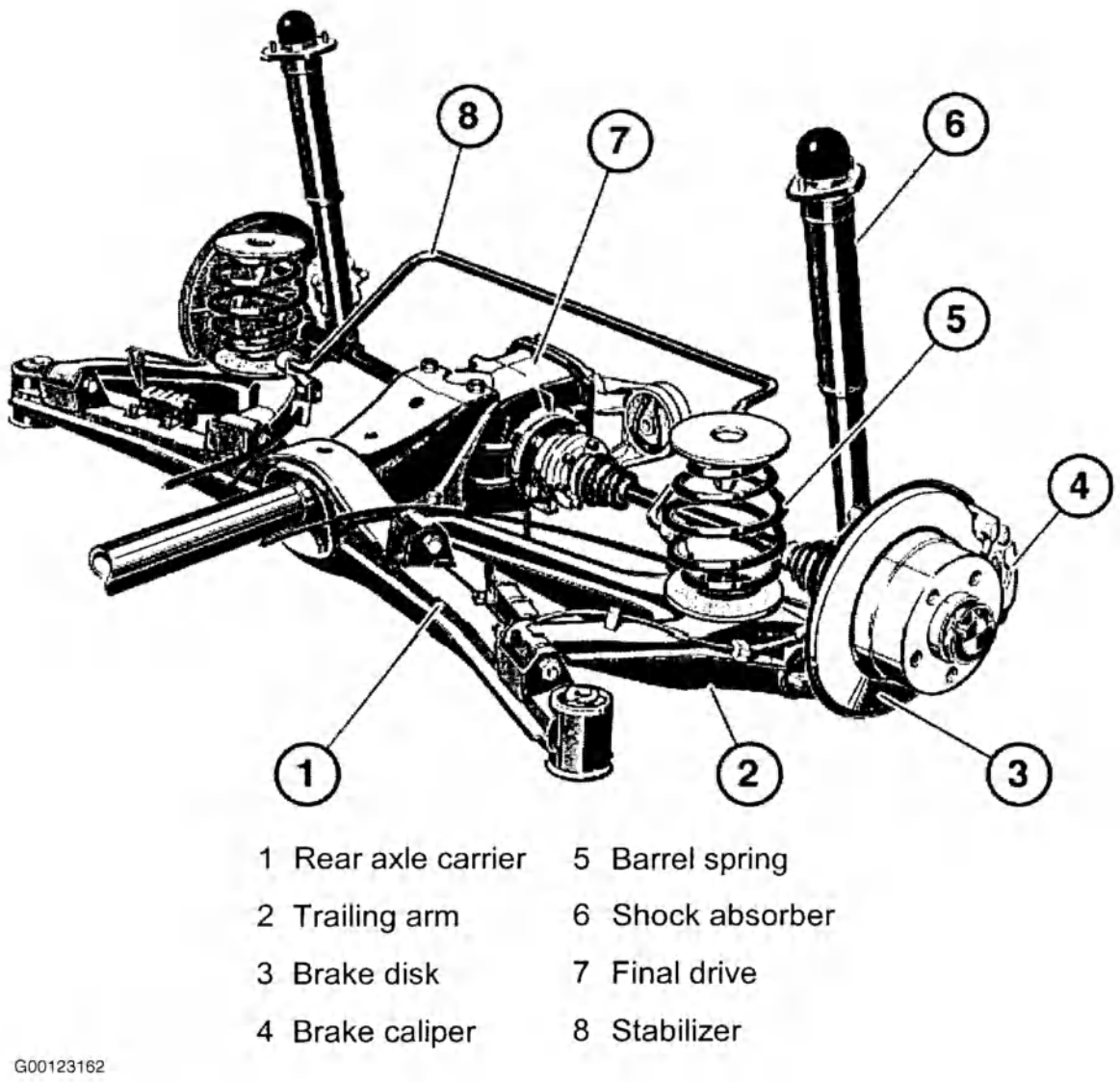


Fig. 1: Identifying Rear Suspension Components
Courtesy of BMW OF NORTH AMERICA, INC.

ADJUSTMENTS

RIDE HEIGHT

Load each front seat with 150 lbs. Place 46 lbs. in trunk and ensure gas tank is full. To measure front ride height, see FRONT - E36 article. Measure rear ride height from lower edge of wheel arch to bottom edge of wheel rim. Determine average value of each wheel after lifting and lowering vehicle body and then average each axle. For correct ride height, see REAR RIDE HEIGHT SPECIFICATIONS table. If ride height is not within specification or deviates more than 0.4" (10 mm) between wheels, coil springs must be replaced. Replacement spring can be determined from parts microfiche, parts supplier, or on old spring at one end.

REAR RIDE HEIGHT SPECIFICATIONS

Application	In. (mm)
318ti	
Standard Suspension	
15" Rim	20.1 (524)
16" Rim	21.1 (537)
17" Rim	21.7 (552)
Low-Slung Sports Suspension	

15" Rim	20.0 (509)
16" Rim	20.6 (522)
17" Rim	21.1 (537)
Rough Road Package	
15" Rim	21.4 (544)
16" Rim	21.9 (557)
17" Rim	22.5 (572)
Z3	
Standard Suspension	
15" Rim	22.2 (565)
16" Rim	22.8 (578)
17" Rim	23.3 (593)
Low-Slung Sports Suspension	
15" Rim	21.7 (550)
16" Rim	22.2 (563)
17" Rim	22.8 (578)
M Roadster	
Standard Suspension	
15" Rim	22.2 (565)
16" Rim	22.8 (578)
17" Rim	23.1 (588)
Low-Slung Sports Suspension	
15" Rim	21.7 (550)
16" Rim	22.2 (563)
17" Rim	22.8 (578)
Z3 Roadster	
Standard Suspension	
15" Rim	25.5 (647)
16" Rim	26.0 (660)
17" Rim	26.6 (675)
Low-Slung Sports Suspension	
15" Rim	24.9 (632)
16" Rim	25.4 (645)
17" Rim	26.0 (660)
M Roadster	
Standard Suspension	
15" Rim	25.5 (647)
16" Rim	26.0 (660)
17" Rim	26.1 (664)
Low-Slung Sports Suspension	
15" Rim	24.9 (632)
16" Rim	25.4 (645)
17" Rim	26.0 (660)
M Coupe	
15" Rim	25.3 (642)
16" Rim	25.8 (655)
17" Rim	26.1 (664)
Z3 Coupe	
15" Rim	25.3 (642)

16" Rim	25.8 (655)
17" Rim	26.4 (670)

WHEEL ALIGNMENT SPECIFICATIONS & PROCEDURES

NOTE: See appropriate SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

TROUBLE SHOOTING

To trouble shoot most symptoms, see TROUBLE SHOOTING table.

Whether a spring strut shock absorber has to be replaced can only be ascertained by checking while it is installed with a shock absorber tester or while it is removed with a shock absorber test machine.

TROUBLE SHOOTING

Fault	Cause	Remedy
Shock Absorbers Bottoming	Rubber Damper Faulty	Check/Replace Rubber Damper
Shock Absorbers Bottoming	Shock Absorber Faulty	Replace Shock Absorber
Drumming Noise	Rubber Mount Of Rear Axle Carrier Faulty	Replace Rubber Mount
Drumming Noise	Rubber Mount Of Final Drive Suspension Faulty	Replace Rubber Mount
Drumming Noise	Rubber Mount Of Control Arm Faulty	Replace Rubber Mount
Drumming Noise	Rubber Mount Of Trailing Arm Faulty	Replace Rubber Mount
Grinding Noise Only When Driving In Curves	Wheel Bearing Faulty	Replace Wheel Bearing
Poor Handling Characteristics Or Low Directional Stability	Rubber Mount Of Control Arm Faulty	Replace Rubber Mount
Poor Handling Characteristics Or Low Directional Stability	Rubber Mount Of Rear Axle Carrier Faulty	Replace Rubber Mount
Poor Handling Characteristics Or Low Directional Stability	Rear Axle Geometry Not OK	Perform Chassis Alignment
Shock Absorber noise	Shock Absorber Loose	Tighten Shock Absorber
Shock Absorber noise	Installed New Shock Absorber Was Stored Horizontally With Retracted Piston Rod	Store Shock Absorbers Standing Upright With Piston Rods Run Out At Room Temperature For 24 Hours
Shock Absorber noise	Shock Absorber Faulty	Shock Absorber Faulty
Rattling Noise	Shock Absorber Loose	Tighten Shock Absorber
Rattling Noise	Upper Shock Absorber Bushing Faulty	Replace Bushing
Rattling Noise	Lower Shock Absorber Bushing Faulty	Replace Shock Absorber
Rattling Noise	Stabilizer Bracket Loose	Tighten Bracket
Rattling Noise	Stabilizer Rubber Mount Faulty	Replace Rubber Mount
Rattling Noise	Stabilizer Broken	Replace Stabilizer
Rattling Noise	Rubber Mount On Rear Axle Carrier Faulty	Replace Rubber Mount
Worn Down Areas On Tire	Shock Absorber Faulty	Replace Shock Absorber
Excessive Tire Wear	Rear Axle Geometry Not OK	Perform Chassis Alignment

Long After Swinging Of Body After Driving Over Rough Road	Shock Absorber Effect Insufficient	Replace Shock Absorber
Body Dipping While Accelerating	Shock Absorber Effect Insufficient	Replace Shock Absorber
Wheels Jumping Even On Normal Road Surfaces	Shock Absorber Effect Insufficient	Replace Shock Absorber
Rear Of Car Out Of Control While Braking	Shock Absorber Effect Insufficient	Replace Shock Absorber
Rear End Skid When Braking With Each Side On Different Road Surface	Rubber Mount Of Trailing Arm Faulty	Replace Rubber Mount
Hesitation Of Rear Wheels With Hard Braking	Rubber Mount Of Trailing Arm Faulty	Replace Rubber Mount
Unsteady Taking Of Curves Due To Self-Steering Or Poor Rear End Track Stability	Rubber Mount On Rear Axle Carrier Faulty	Replace Rubber Mount
Unsteady Taking Of Curves Due To Self-Steering Or Poor Rear End Track Stability	Rubber Mount Of Final Drive Suspension Faulty	Replace Rubber Mount

REMOVAL & INSTALLATION

AXLE CARRIER ASSEMBLY

Removal

1. Raise and support vehicle. Remove rear wheels.
2. Disconnect handbrake cables from handbrake lever and pull cables out of guide tubes. See appropriate DISC article in BRAKES.
3. On Z3, remove console tray and handbrake lever if necessary.
4. Disconnect drive shaft. See appropriate DRIVE SHAFTS & UNIVERSAL JOINTS article in DRIVE AXLES.
5. Disconnect speedometer signal plug on differential.
6. Remove ABS speed sensors.
7. Disconnect brake pad wear sensor, if necessary.
8. Unfasten stabilizer on semi-trailing arms.
9. Disconnect line from carbon canister.
10. On M Roadster and M Coupe, remove brake calipers. On all other vehicles, install pedal support and actuate brake pedal. This prevents brake fluid from escaping from the brake system when the brake line is disconnected.
11. Disconnect left and right brake lines. See Fig. 2 .
12. Support axle carrier assembly with special tool (00 2 030/041/042 and 33 3 271/272/273/274/275/303). See Fig. 3 .
13. Unscrew nut (1) and bolts (2) on axle carrier assembly. See Fig. 4 .
14. Slightly raise semi-trailing arm, unfasten screw, remove shock absorber and lower semi-trailing arm slightly. See Fig. 5 .
15. Unscrew screw on differential cover to body. See Fig. 6 .
16. Lower rear axle until coil springs are exposed. Remove coil springs. See Fig. 7 .
17. Remove axle carrier.

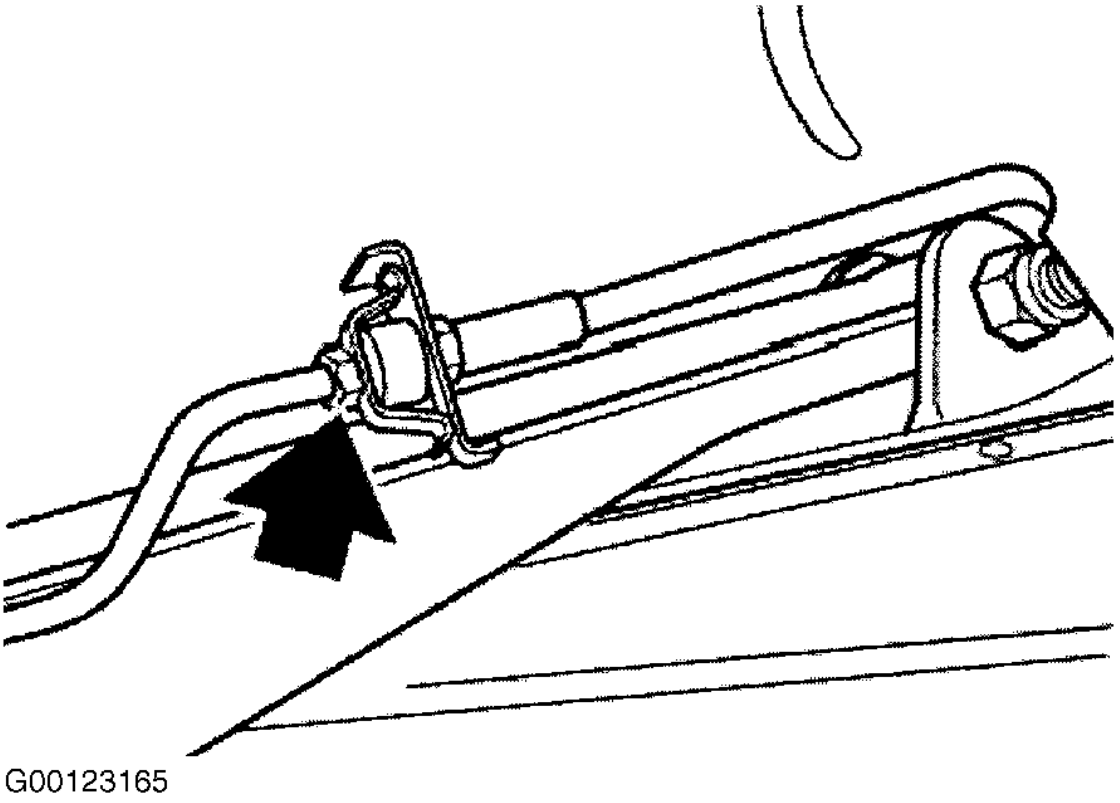


Fig. 2: Removing Brake Line
Courtesy of BMW OF NORTH AMERICA, INC.

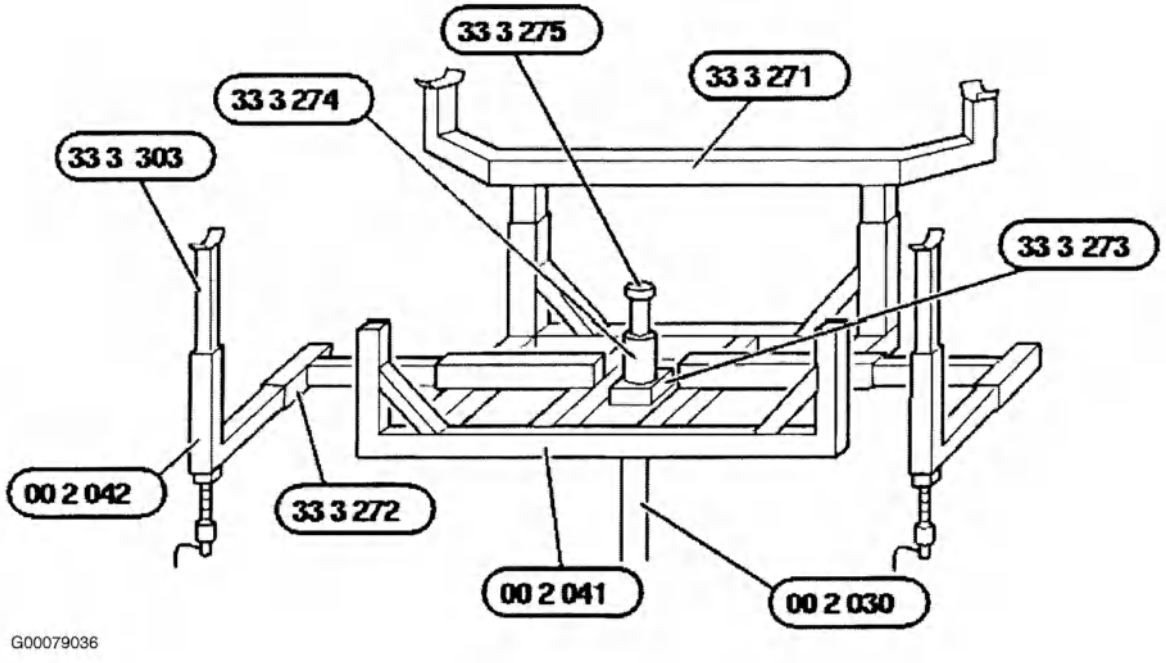


Fig. 3: Exploded View Of Axle Carrier Support Tool
Courtesy of BMW OF NORTH AMERICA, INC.

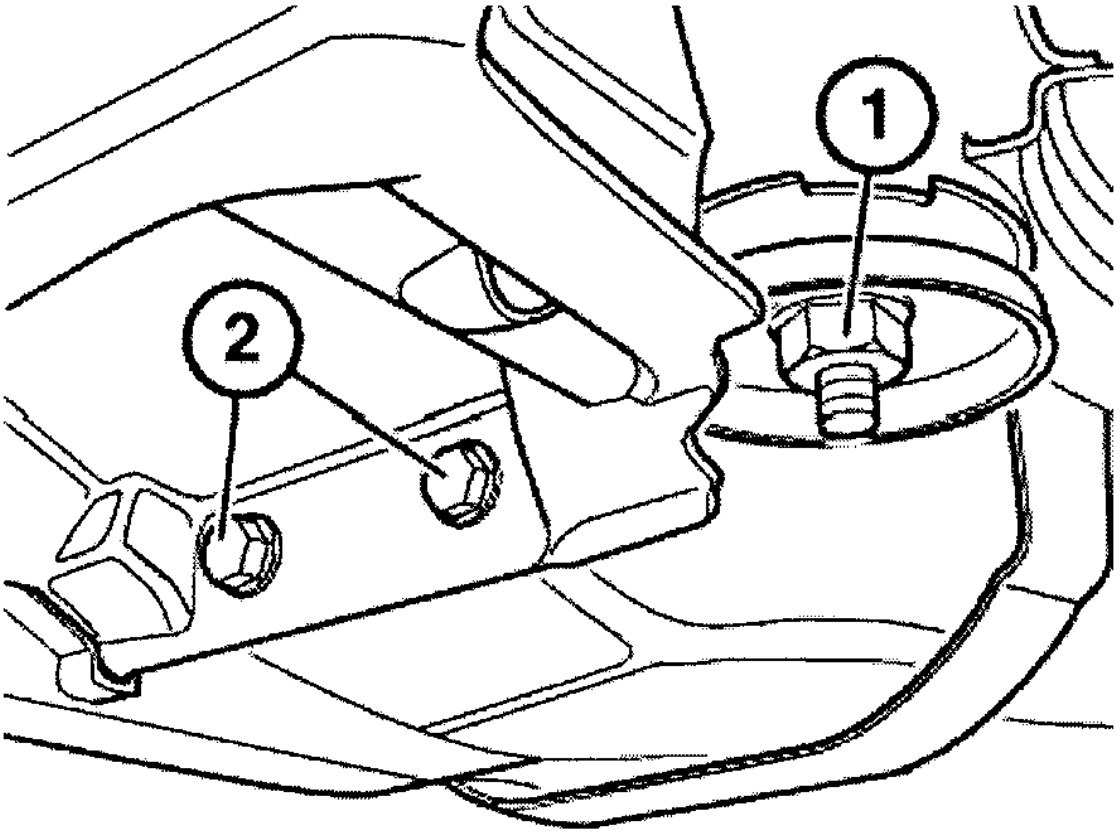


Fig. 4: Identifying Axle Carrier Bolts & Nuts
Courtesy of BMW OF NORTH AMERICA, INC.

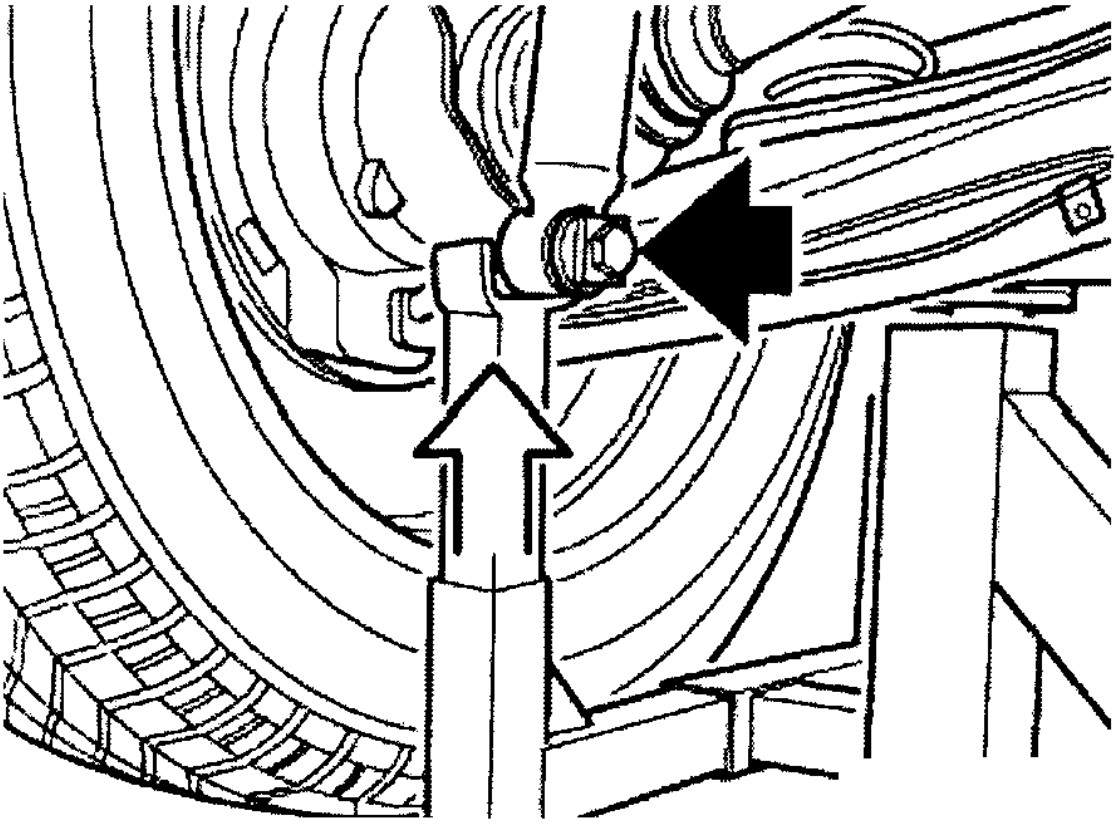


Fig. 5: Supporting Semi-Trailing Arm
Courtesy of BMW OF NORTH AMERICA, INC.

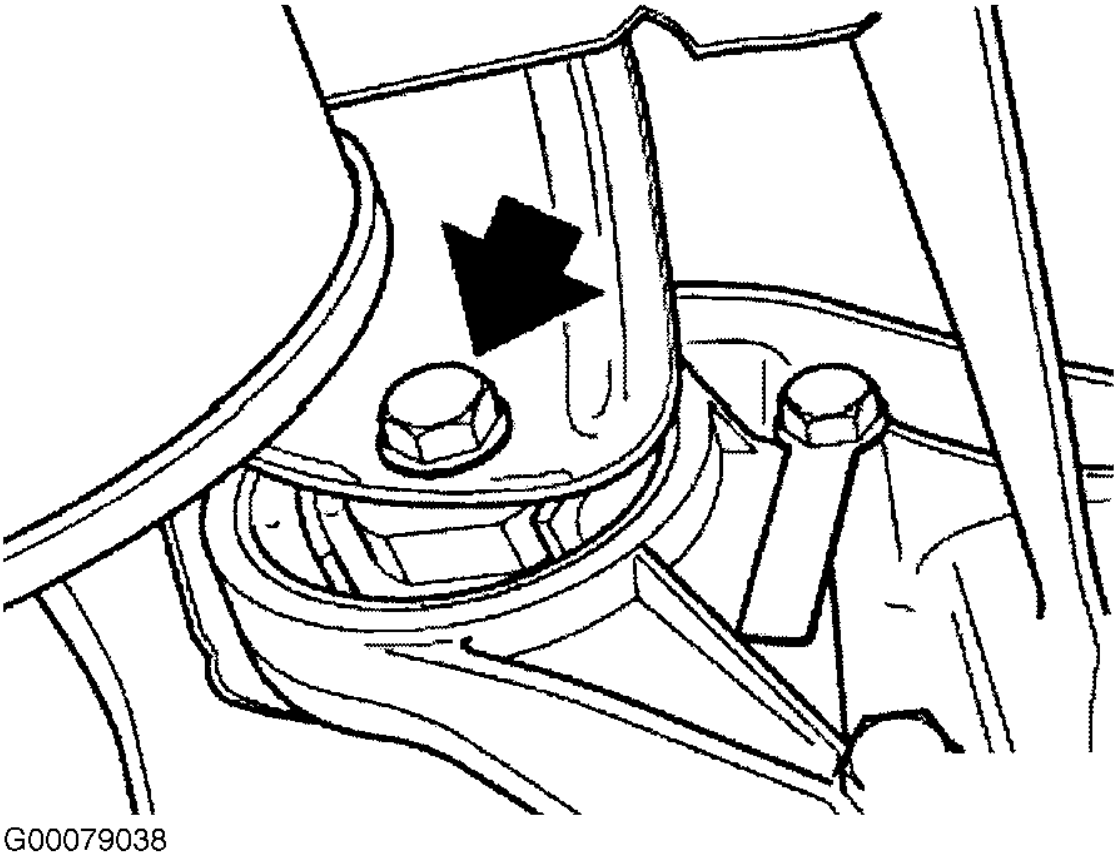


Fig. 6: Identifying Axle Carrier Rear Mounting Bolt
Courtesy of BMW OF NORTH AMERICA, INC.

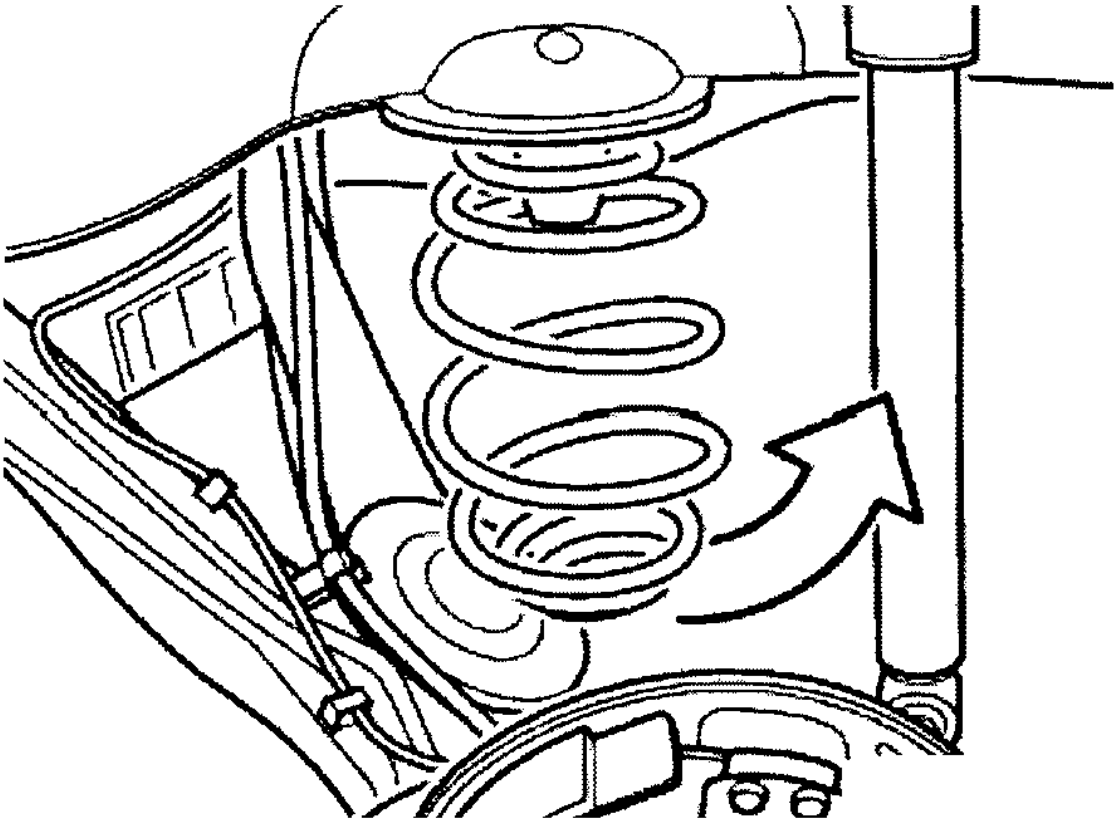


Fig. 7: Removing Rear Coil Spring
Courtesy of BMW OF NORTH AMERICA, INC.

Installation

1. To install, reverse removal procedure. Replace self-locking nuts. Tighten fasteners to specification. See TORQUE SPECIFICATIONS .
2. Bleed brake system and adjust handbrake. See appropriate DISC article in BRAKES.

AXLE CARRIER RUBBER MOUNT

Removal & Installation

NOTE: Observe installation position of rubber mount in axle carrier. See Fig. 8 .

1. Remove axle carrier assembly. See AXLE CARRIER ASSEMBLY .
2. Pull out rubber mount using special tool (00 8 550 and 33 3 107/111). See Fig. 9 . If necessary, heat axle carrier with an industrial hot air blower.

NOTE: Only use rubber mounts of one single manufacturer.

3. Coat NEW rubber mount with Circolight. Pull in with special tool (33 3 103/104/112/115). See Fig. 10 .
4. Install axle carrier assembly. See AXLE CARRIER ASSEMBLY .

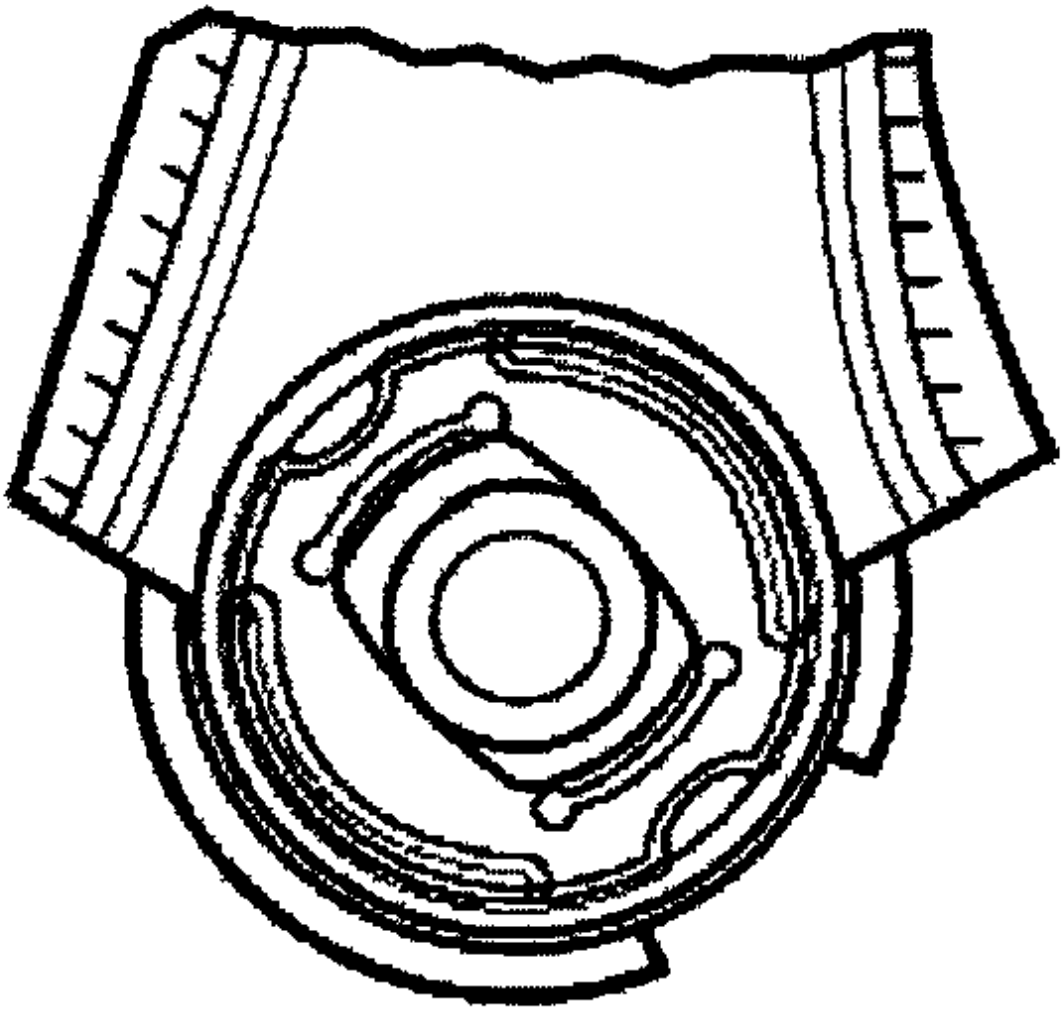


Fig. 8: Observing Installation Position Of Rubber Mount
Courtesy of BMW OF NORTH AMERICA, INC.

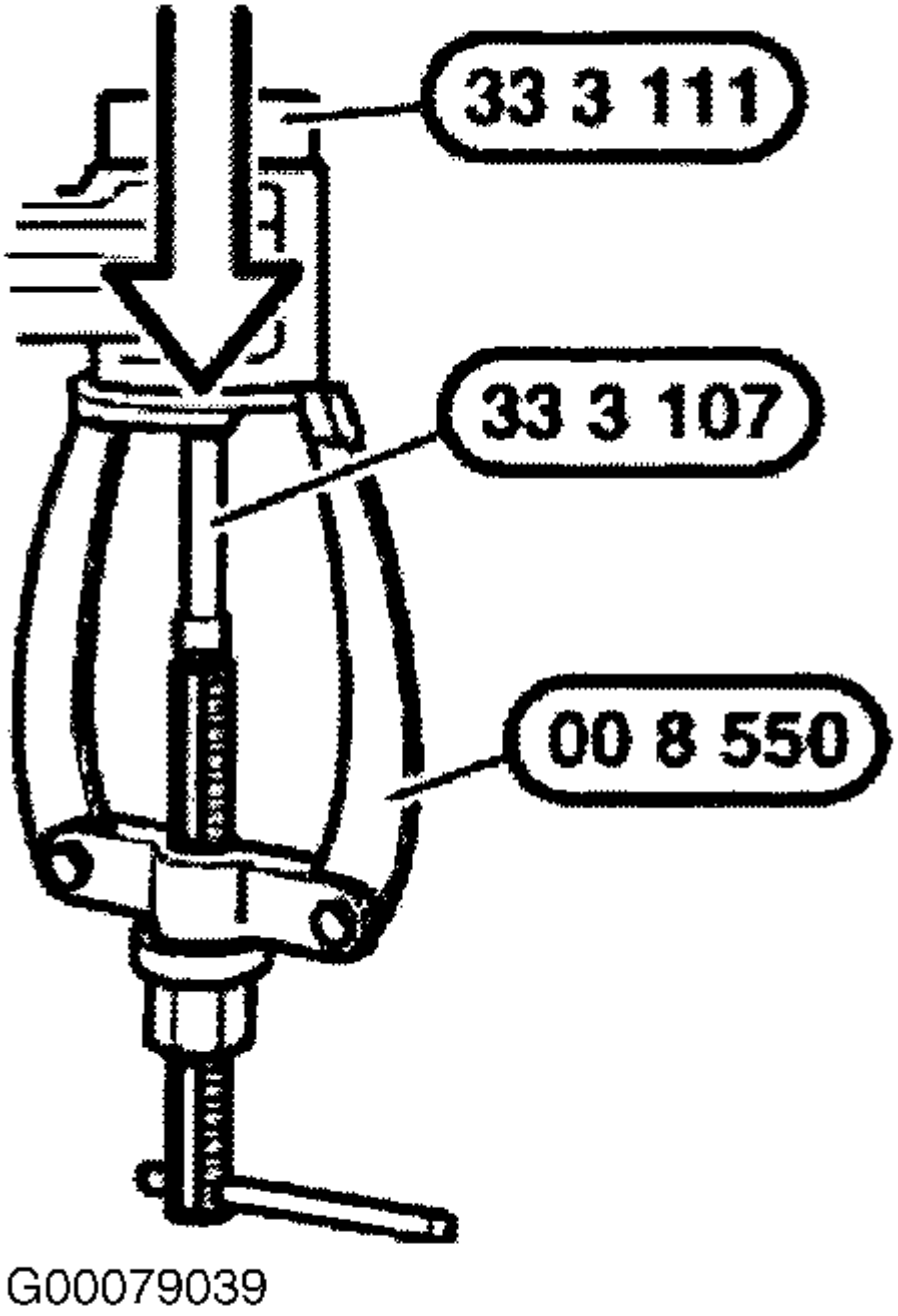


Fig. 9: Removing Subframe Rubber Mount
Courtesy of BMW OF NORTH AMERICA, INC.

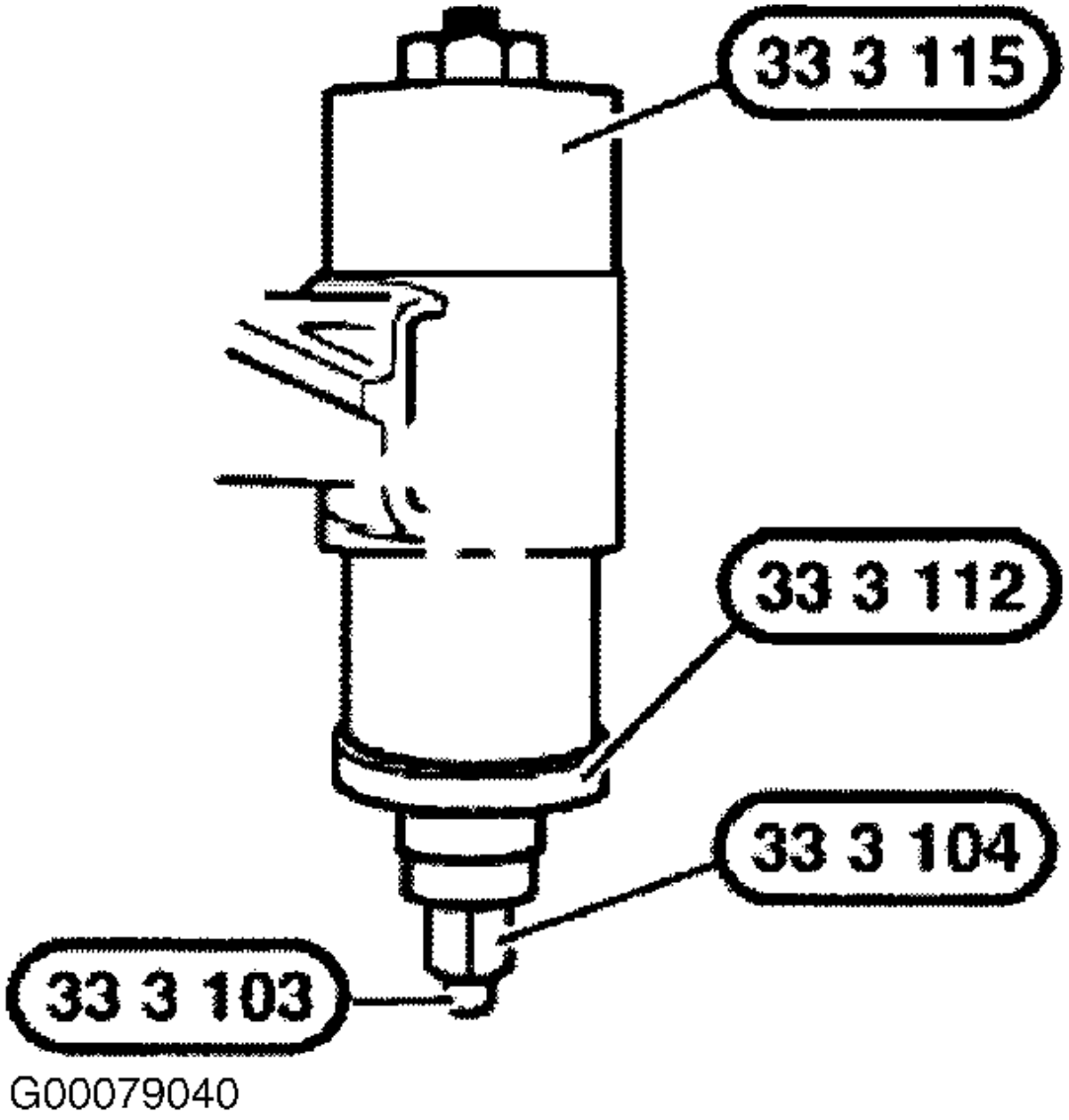


Fig. 10: Installing Subframe rubber mount
Courtesy of BMW OF NORTH AMERICA, INC.

COIL SPRING

Removal

1. Raise and support vehicle. Remove rear wheel assembly.
2. Remove drive axle from differential output flange and suspend aside. See AXLE SHAFT article.
3. Unscrew stabilizer on trailing arm, if necessary.
4. Using a jack, support trailing arm and disconnect shock absorber. See Fig. 5 .
5. Lower trailing arm, and remove coil spring. See Fig. 7 .

Installation

NOTE: Only refit coil springs with identical BMW number. On the rough road package version, the spring pad top is .8" (22 mm) thick.

1. Check coil spring for surface damage and check spring mounts. Replace if necessary.
2. To install, reverse removal procedure. Use washer (1). See Fig. 11 . Tighten screw to specification. See TORQUE SPECIFICATIONS .

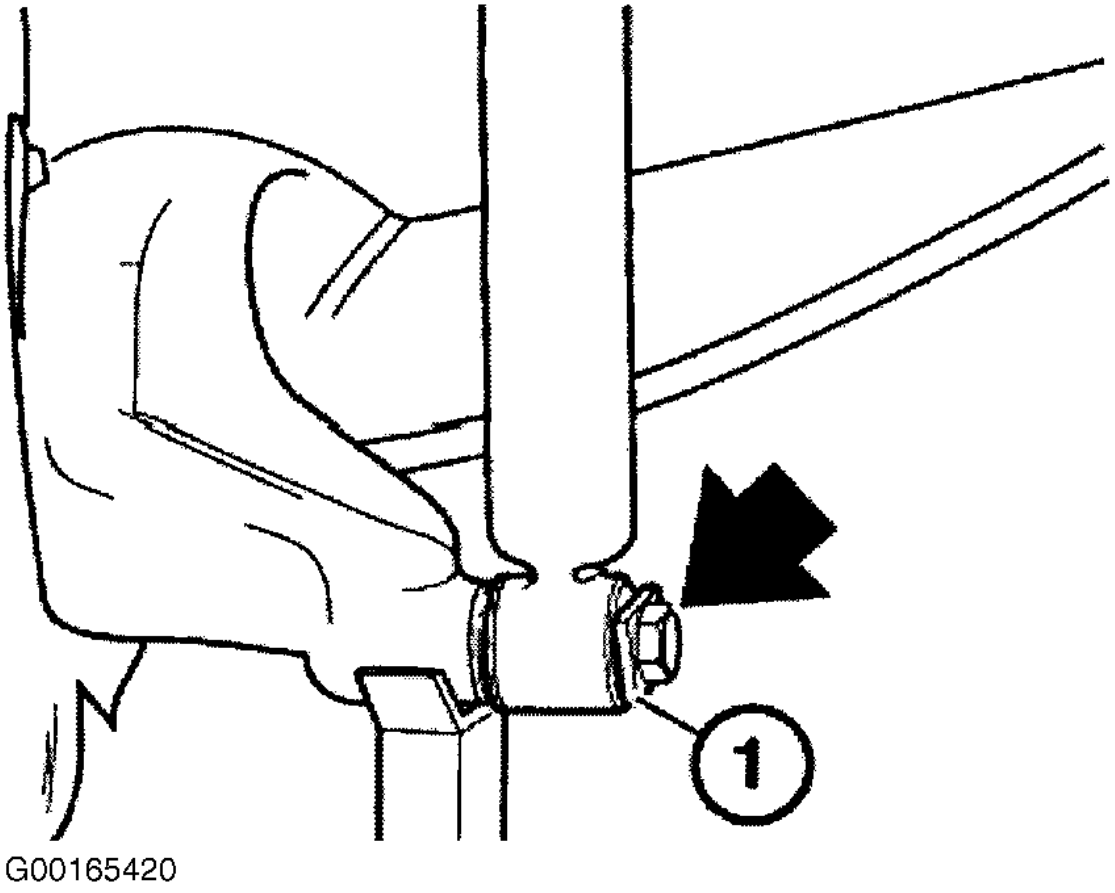


Fig. 11: Locating Trailing Arm Washer
Courtesy of BMW OF NORTH AMERICA, INC.

SHOCK ABSORBER

WARNING: Shock absorber prevents trailing arm and drive axle from dropping too far. Support trailing arm during disassembly to avoid CV joint damage.

CAUTION: The shock absorber has the function of an arrester band. To prevent damage to the axle shaft, do not remove the support or raise the vehicle.

Removal

1. On convertible models, remove shock absorber nuts located under plastic caps in the convertible top compartment. On Z3 Roadster, remove panel from convertible top compartment. On all other vehicles, remove trunk trim.
2. Raise and support vehicle. Using a jack, support trailing arm and unfasten screw (1). See Fig. 12 .
3. If necessary, remove reinforcement plate. Pull off cap. Unscrew nuts and remove shock absorber. See Fig. 13 .

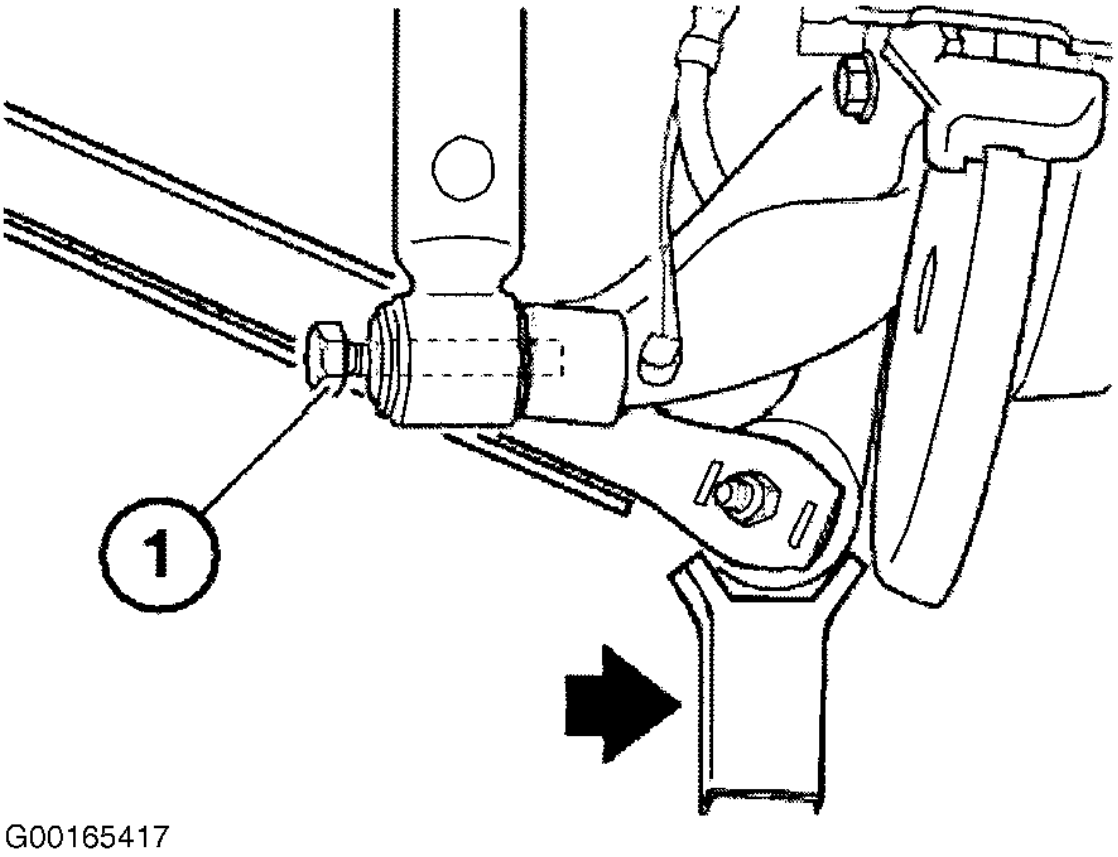


Fig. 12: Locating Trailing Arm Screw
Courtesy of BMW OF NORTH AMERICA, INC.

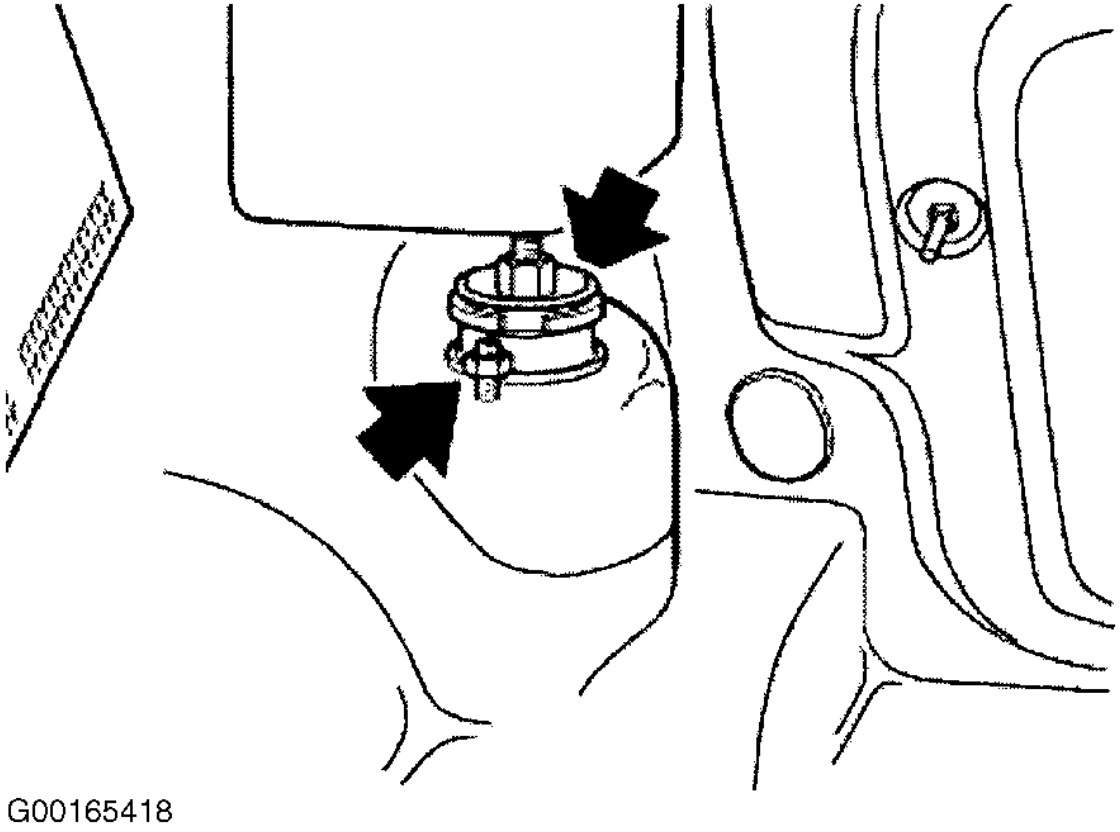


Fig. 13: Locating Shock Absorber Nuts
Courtesy of BMW OF NORTH AMERICA, INC.

Installation

1. To install, reverse removal procedure. Replace all self-locking nuts and tighten to specification. See TORQUE SPECIFICATIONS .
2. When replacing the shock absorber, always ensure that the replacement unit is marked with the same code (K) as the old shock absorber. See Fig. 14 .
3. Install NEW seal between body and shock absorber.
4. On Z3 Roadster and coupe, if the support bearing is replaced, stick a rubber ring in middle of underside of joint seal (2) and in middle on upper side of support element (5). It is essential to ensure that rubber ring is stuck on exactly in middle so that when screwed on ring is not jammed between inner sleeve of support bearing (3) and joint seal (2) or support element (5). See Fig. 15 .

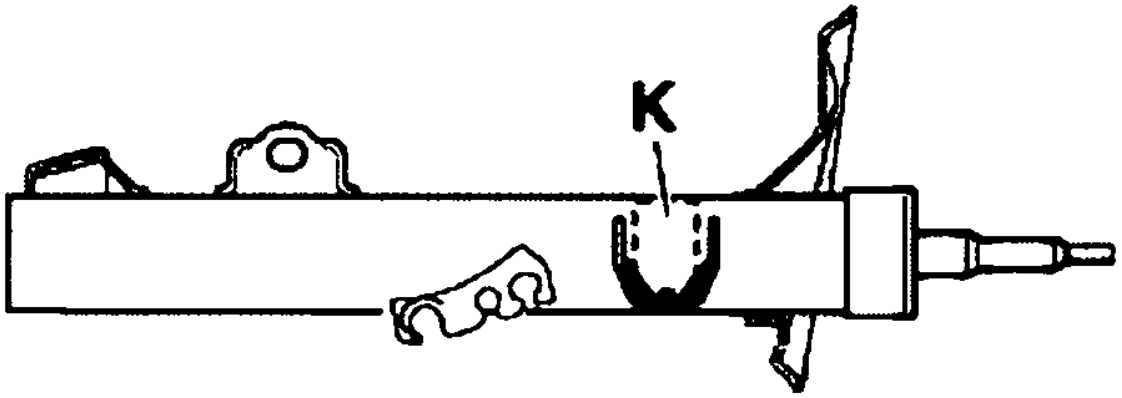
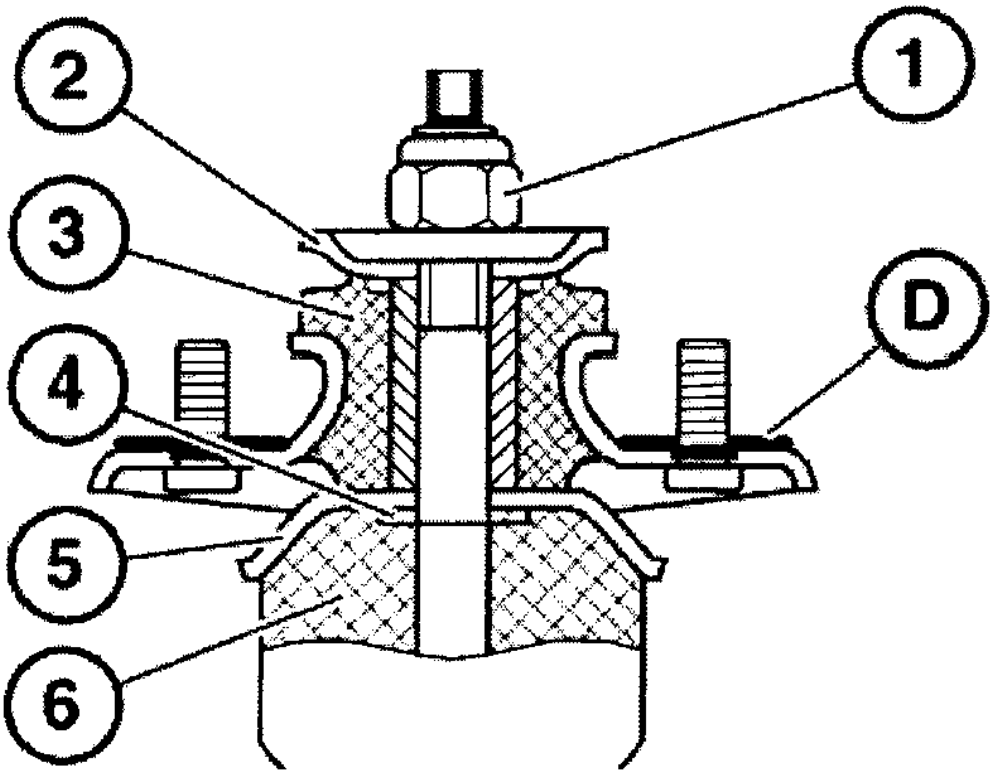


Fig. 14: Identifying Shock Absorber
Courtesy of BMW OF NORTH AMERICA, INC.



1 = Nut
2 = Joint seat
3 = Support bearing
4 = Supporting ring
5 = Support element
6 = Auxiliary spring
D = Seal

G00165419

Fig. 15: Identifying Support Bearing Components
Courtesy of BMW OF NORTH AMERICA, INC.

STABILIZER BAR LINK

Removal & Installation

1. Raise and support rear of vehicle. Remove stabilizer bar with links.
2. Clamp stabilizer bar link in a soft jaw vise. Rotate stabilizer bar and pull out of link. See Fig. 16 .
3. If rubber mount remains on stabilizer bar, cut through rubber with a knife and remove.
4. Clamp NEW stabilizer link in soft jaw vise. Coat end of stabilizer bar and inside rubber mount with Circolight. Press stabilizer bar as far as possible into stabilizer link with rotary motions.

5. Immediately rotate stabilizer link into position. Once mounting agent (Circolight) has evaporated, stabilizer link can no longer be rotated. See Fig. 17 .
6. To complete installation, reverse removal procedure.



Fig. 16: Removing Stabilizer Bar From Link
Courtesy of BMW OF NORTH AMERICA, INC.

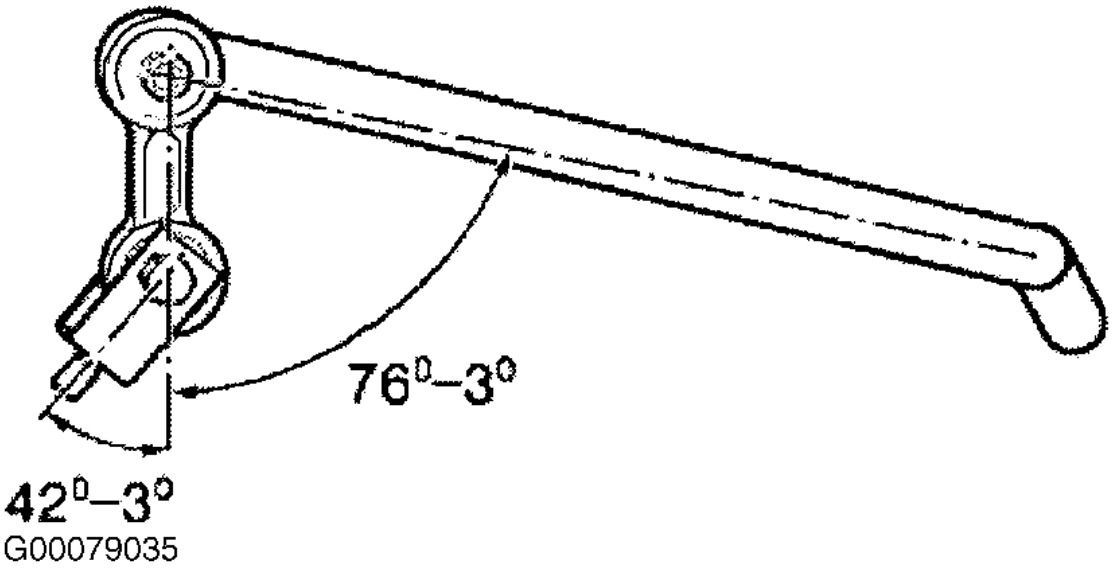


Fig. 17: Positioning Stabilizer Bar-To-Link
Courtesy of BMW OF NORTH AMERICA, INC.

TRAILING ARM

Removal

1. Raise and support rear of vehicle. Remove rear wheel.
2. Remove parking brake cable from parking brake lever. See appropriate DISC article in BRAKES.

3. Remove coil spring. See COIL SPRING .
4. Disconnect ABS speed sensor.
5. Disconnect brake pad wear indicator, if necessary.
6. Unscrew stabilizer on trailing arm, if necessary.
7. Install brake pedal support and actuate brake pedal. This prevents brake fluid from escaping from the brake system when the brake line is disconnected. Disconnect brake line at union on trailing arm. See Fig. 2 .
8. Using a jack, support trailing arm from underneath. Remove 2 trailing arm-to-rear subframe bolts. Remove trailing arm. See Fig. 18 .

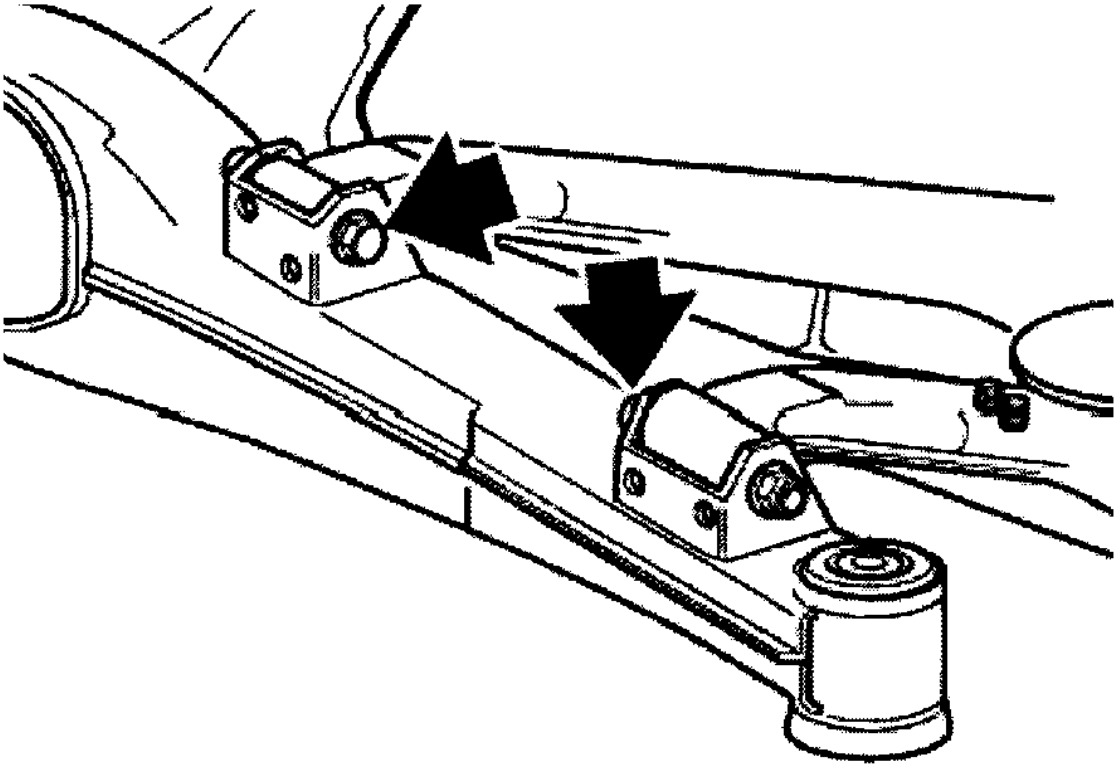


Fig. 18: Removing Trailing Arm
Courtesy of BMW OF NORTH AMERICA, INC.

Installation

1. To install, reverse removal procedure. Replace self-locking nuts and tighten to specification. See TORQUE SPECIFICATIONS .
2. Bleed brake system. See appropriate DISC article in BRAKES.

TRAILING ARM RUBBER MOUNT

Removal & Installation

1. Remove trailing arm. See TRAILING ARM .
2. Coat bulge on rubber mount with Circolight.
3. Pull out rubber mount with special tool (33 3 051/052/053/054). See Fig. 19 .
4. Coat new rubber mounts with Circolight. Pull in using special tool (33 3 051/052/054/055). See Fig. 20 .
5. Install trailing arm. See TRAILING ARM .

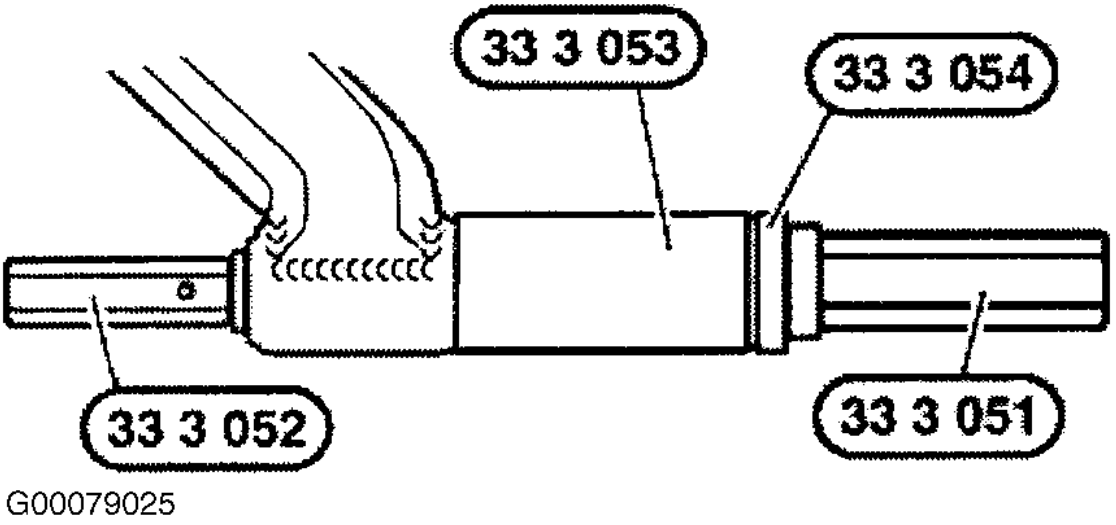


Fig. 19: Removing Trailing Arm Rubber Mounts
Courtesy of BMW OF NORTH AMERICA, INC.

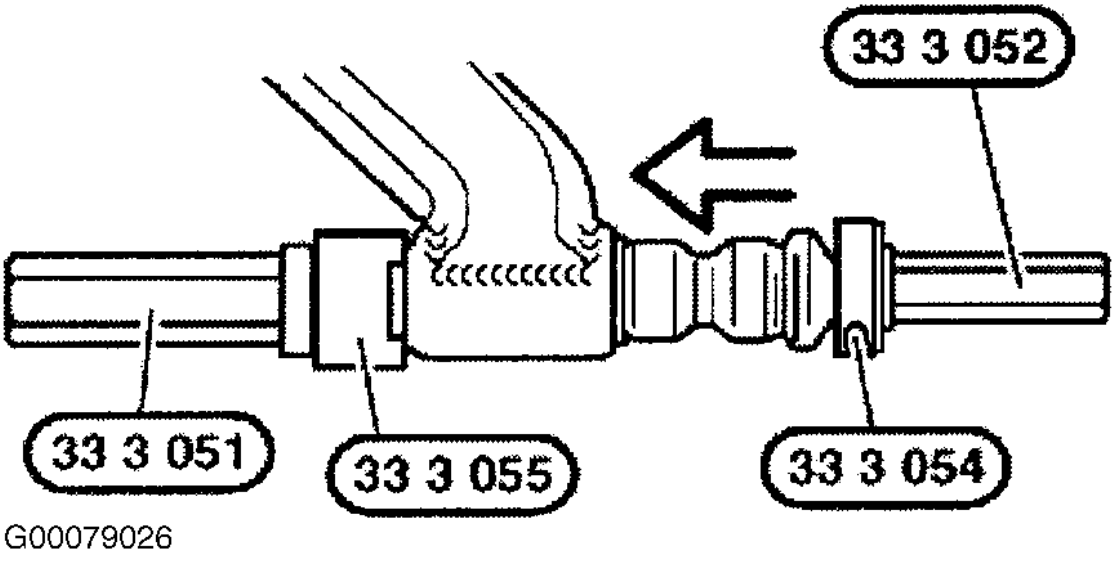


Fig. 20: Installing Trailing Arm Rubber Mounts
Courtesy of BMW OF NORTH AMERICA, INC.

WHEEL BEARINGS

For removal and installation of wheel bearings, see appropriate DISC article in BRAKES.

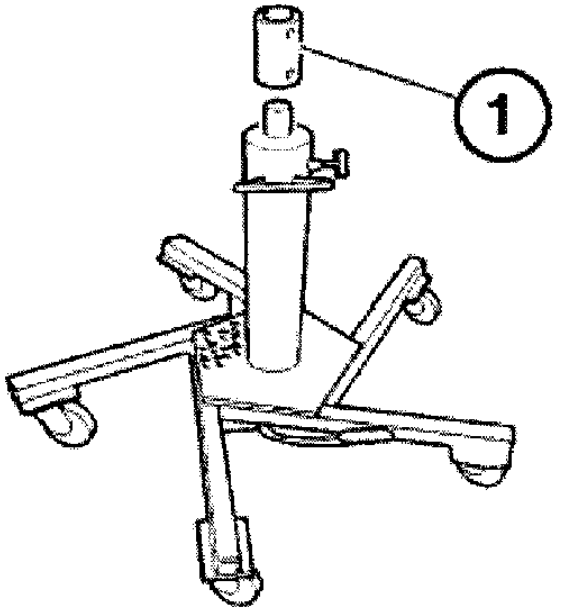
TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Axle Carrier To Body	57 (77)

Brake Hose Couplings	13-14 (17-19)
Compression Strut On Body	
8.8 Thread	15 (21)
10.9 Thread	22 (30)
Differential Cover To Body	57 (77)
Trailing Arm To Rear Axle Carrier	
10.9 Thread	57 (77)
All Others	49 (67)
Shock Absorber Piston Rod On Thrust Bearing	10 (14)
Shock Absorber Support On Rear Axle Carrier	10 (14)
Shock Absorber To Trailing Arm	57 (77)
Wheel Lug Bolt	81-96 (110-130)

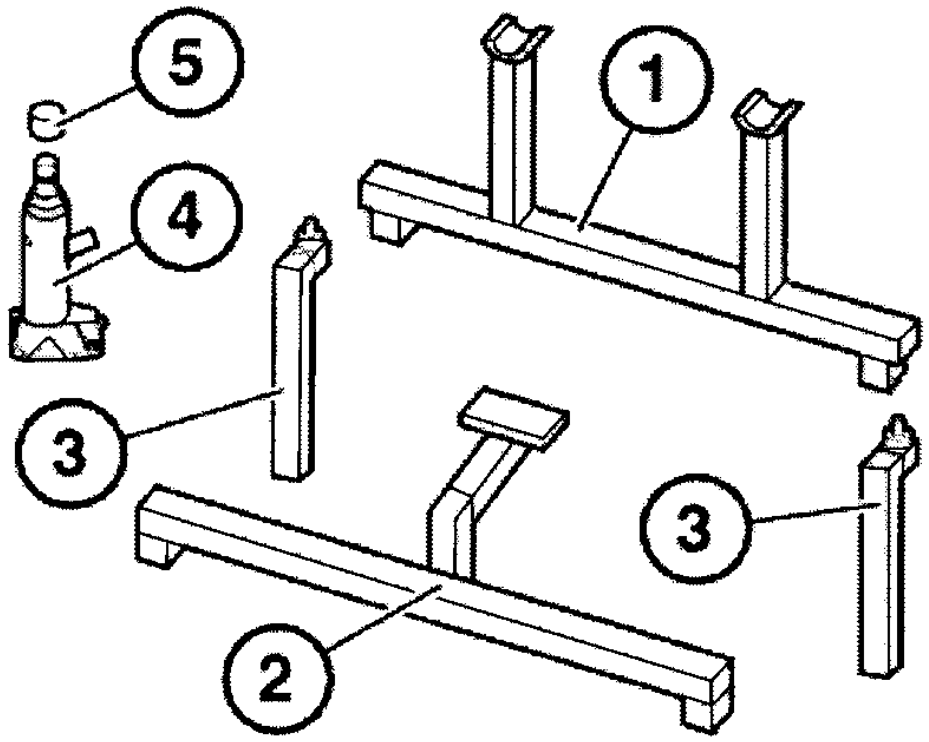
SPECIAL TOOLS



1 = 00 2 031 Adapter for transmission brackets
Note: Model series: E30, E31, E32, E34, E36
In conjunction with: 23 0 000, 24 0 130

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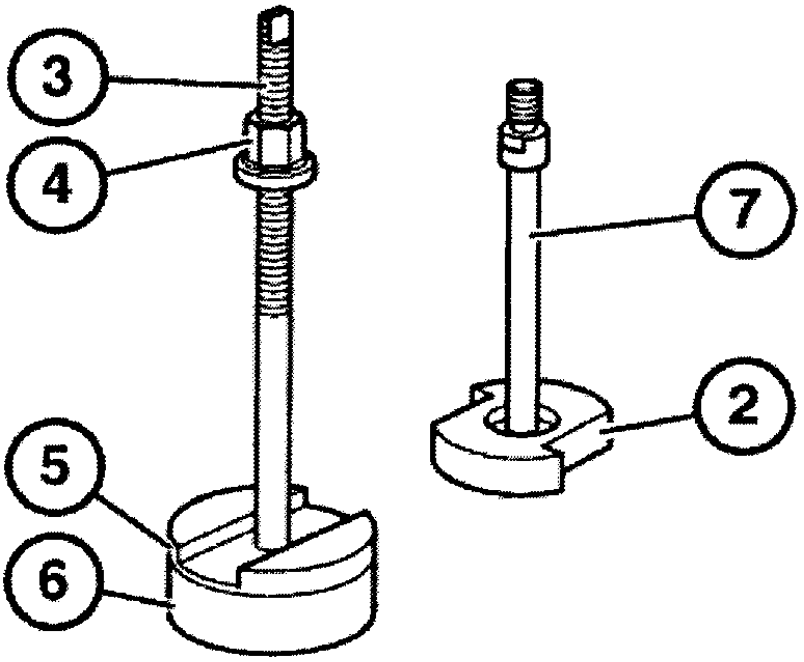
Fig. 21: Identifying Hydro-Lifter Basic Unit (00 2 030)
Courtesy of BMW OF NORTH AMERICA, INC.



1 = 33 3 271 Support
Note: For cross member
2 = 33 3 272 T-piece (2)
3 = 33 3 273 Base plate
Note: For hydraulic jack
4 = 33 3 274 Hydraulic jack
Note: Hydraulic jack
5 = 33 3 275 Thrust piece (rubber)
Note: For hydraulic jack

G00165422

Fig. 22: Identifying Set Of Supports (33 3 270)
Courtesy of BMW OF NORTH AMERICA, INC.



2 = 33 3 102 Formed disc
Note: For removal operations - Series: E28

3 = 33 3 103 Spindle for fitting
Note: Model series: E28, E30, E31, E36

4 = 33 3 104 Nut with bearing
Note: Model series: E28, E30, E31, E34, E36

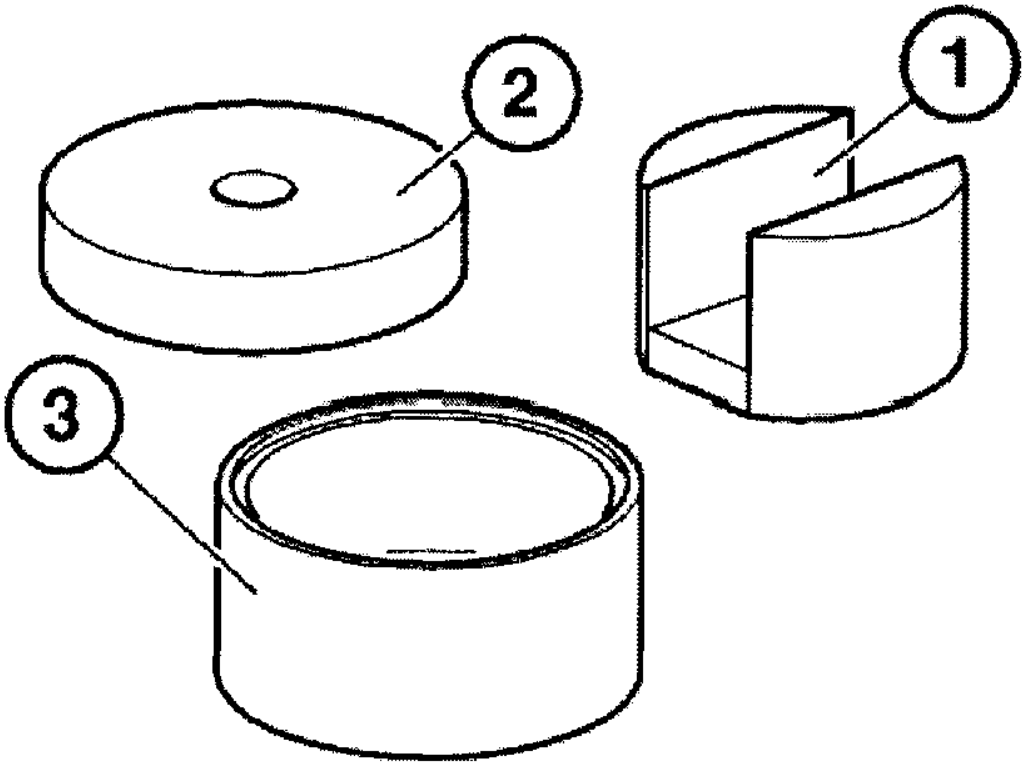
5 = 33 3 105 Formed disc
Note: For press-fitting operations - Series: E28

6 = 33 3 106 Formed disc
Note: For holding during installation - Series: E28

7 = 33 3 107 Spindle
Note: For removal operations - Series: E28, E30, E31, E36

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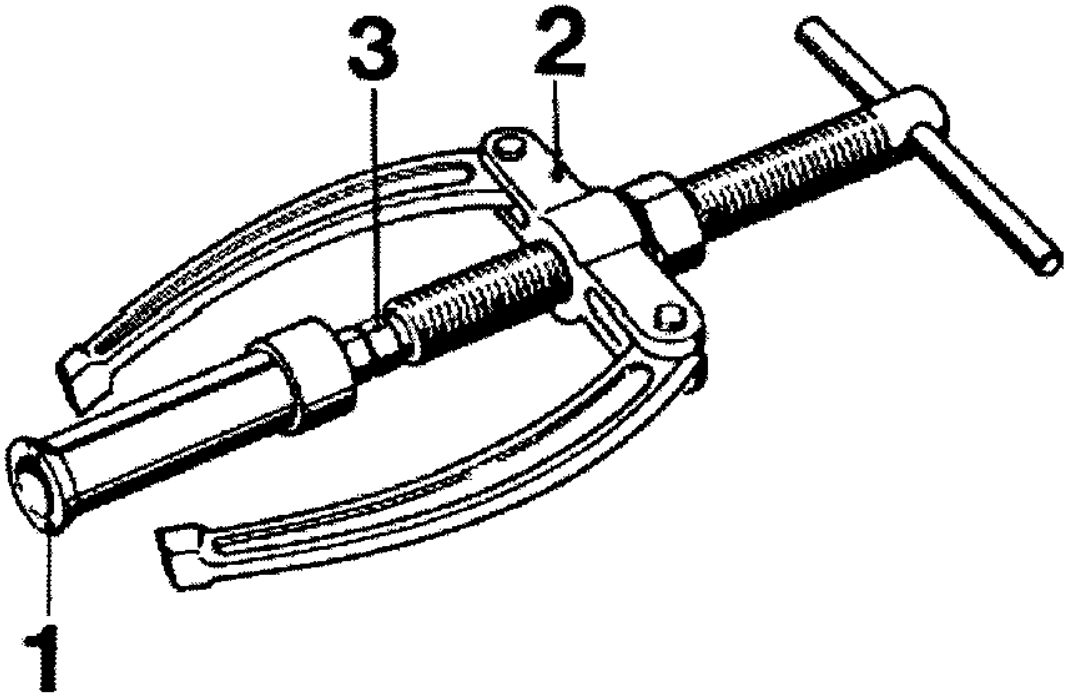
Fig. 23: Identifying Set Of Tools (33 3 100)
Courtesy of BMW OF NORTH AMERICA, INC.



1 = 33 3 111 Formed disc
Note: For removing top rubber mount
In conjunction with: 33 3 107
2 = 33 3 112 Formed disc
Note: For installing bottom rubber mount
4 = 33 3 114 Nut
5 = 33 3 115 Formed disc
Note: For holding during installation

G00165424

Fig. 24: Identifying Tool (33 3 110)
Courtesy of BMW OF NORTH AMERICA, INC.



1 = 00 8 551 Internal puller Kukko 21/5
2 = 00 8 552 Counter-support Kukko 22-2
3 = 00 8 553 Reducer ring
4 = 00 8 554 Spindle without nut
G00165421

Fig. 25: Identifying Universal Puller Kukko 21/5, 22-2 (00 8 550)
Courtesy of BMW OF NORTH AMERICA, INC.

Article GUID: A00136274

WHEELS AND TIRES

36 1 010 SPRING LIFTER

SPRING LIFTER GENERAL SPECIFICATION

Note:	For lifting retaining spring when removing and installing balance weight
Series:	E12, E21, E23, E24, E28, E30, E31, E32, E34, E36, E38, E39, E46, E52, E53, E60, E61, E63, E64, E65, E66, E83, E85, E87, E90
Storage location:	28
SI number:	1 01 96(034)
Order number:	36 1 010
Â	Spring lifter

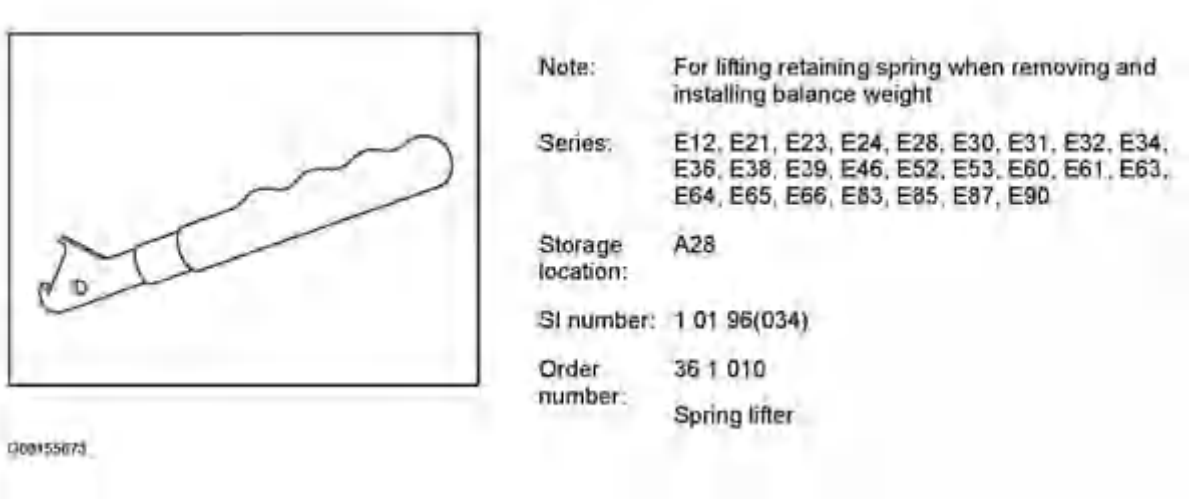


Fig. 1: Identifying Spring Lifter
Courtesy of BMW OF NORTH AMERICA, INC.

36 1 020 TIRE PLIERS

TIRE PLIERS GENERAL SPECIFICATION

Note:	For compressing sides of tires when removing and installing retaining spring
Series:	E12, E21, E23, E24, E28, E30, E31, E32, E34, E36, E38, E39, E46, E52, E53, E60, E61, E63, E64, E65, E66, E83, E85, E87, E90
SI number:	1 01 96(034)
Order number:	36 1 020
Â	Tire pliers

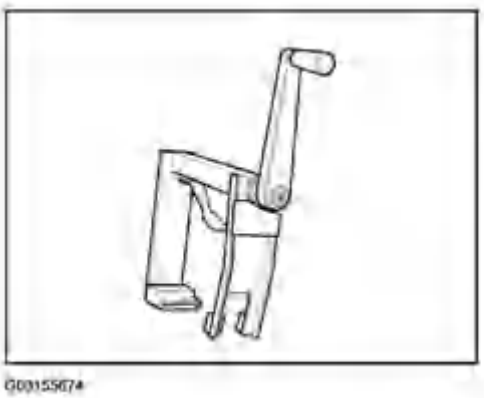
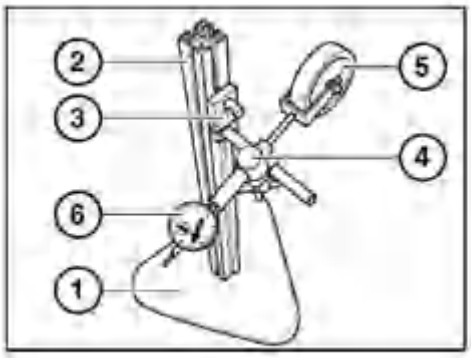


Fig. 2: Identifying Tire Pliers
Courtesy of BMW OF NORTH AMERICA, INC.

36 1 030 TESTER

36 1 030 TESTER GENERAL SPECIFICATION

Note:	For measuring vertical and lateral runout of wheels
Series:	E12, E21, E23, E24, E28, E30, E30/C, E30tou, E31, E32, E32/3, E34, E34tou, E36, E36/2, E36/3, E36/5, E36/7, E36/C, E36tou, E38, E38/3, E39, E39PL, E39tou, E46, E46/16, E46/2, E46/3, E46/5, E46/C, E52, E53, E60, E61, E63, E64, E65, E66, E67, E83, E85, E87, E90, R50, R52, R53, RR1
SI number:	1 11 00(594)
Order number:	36 1 030
Â	Tester
Consisting of:	Â
1 = 36 1 031	Pedestal
2 = 36 1 032	Post with clamp
3 = 36 1 033	Holder with clamp
4 = 36 1 034	Clamp
5 = 36 1 035	Measuring roller
6 = 36 1 036	Dial gauge



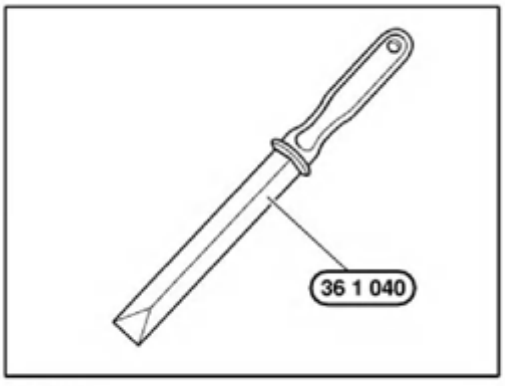
Note:	For measuring vertical and lateral runout of wheels
Series:	E12, E21, E23, E24, E28, E30, E30/C, E30tou, E31, E32, E32/3, E34, E34tou, E36, E36/2, E36/3, E36/5, E36/7, E36/C, E36tou, E38, E38/3, E39, E39PL, E39tou, E46, E46/16, E46/2, E46/3, E46/5, E46/C, E52, E53, E60, E61, E63, E64, E65, E66, E67, E83, E85, E87, E90, R50, R52, R53, RR1
SI number:	1 11 00(594)
Order number:	36 1 030
	Tester
Consisting of:	
1 = 36 1 031	Pedestal
2 = 36 1 032	Post with clamp
3 = 36 1 033	Holder with clamp
4 = 36 1 034	Clamp
5 = 36 1 035	Measuring roller
6 = 36 1 036	Dial gauge

Fig. 3: Identifying 36 1 030 Tester
Courtesy of BMW OF NORTH AMERICA, INC.

36 1 040 SCRAPER

SCRAPER GENERAL SPECIFICATION

Note:	For removing stick-on weights from aluminum rims
Series:	All models
Storage location:	Single
SI number:	1 13 00(596)
Order number:	36 1 040
Â	Scraper



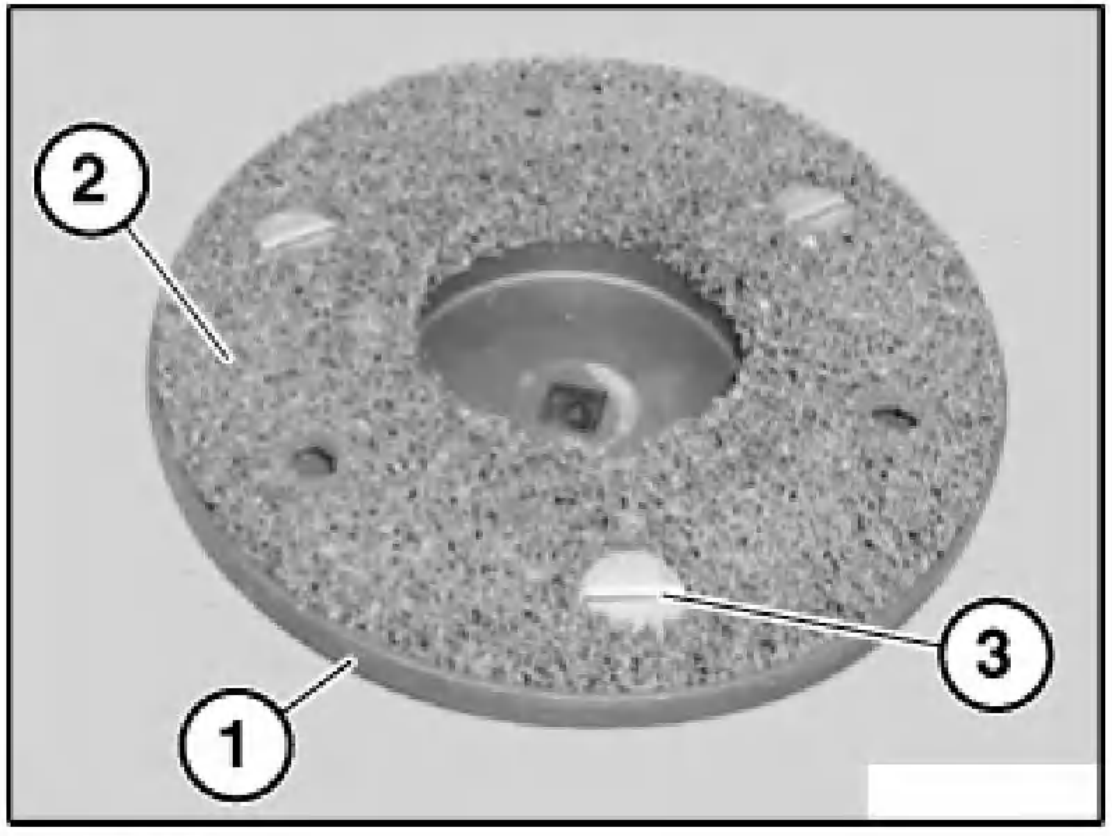
Note:	For removing stick-on weights from aluminum rims
Series:	All models
Storage location:	Single
SI number:	1 13 00(596)
Order number:	36 1 040
	Scraper

Fig. 4: Identifying Scraper
Courtesy of BMW OF NORTH AMERICA, INC.

36 1 250 WHEEL HUB GRINDER

WHEEL HUB GRINDER GENERAL SPECIFICATION

Note:	For cleaning wheel hubs
Series:	E12, E21, E23, E24, E28, E30, E30/C, E30tou, E31, E32, E32/3, E34, E34tou, E36, E36/2, E36/3, E36/5, E36/7, E36/C, E36tou, E38, E38/3, E39, E39PL, E39tou, E46, E46/16, E46/2, E46/3, E46/5, E46/C, E52, E53, E60, E61, E63, E64, E65, E66, E67, E83, E85, E87, E90, R50, R52, R53
SI number:	1 15 03(005)
Order number:	36 1 250
Â	Wheel hub grinder
Consisting of:	Â
1 = 36 1 251	Basic body
Â	NOTE: Basic body with mounting screws (slotted pan-head screw)
2 = 36 1 252	Grinding wheel
3 = 36 1 253	Slotted pan-head screw (3 x)
Â	NOTE: For securing grinding wheel on basic body



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Fig. 5: Identifying Wheel Hub Grinder

Courtesy of BMW OF NORTH AMERICA, INC.

36 1 300 SET OF WHEEL STUD ADAPTERS

Minimum set: Mechanical tools

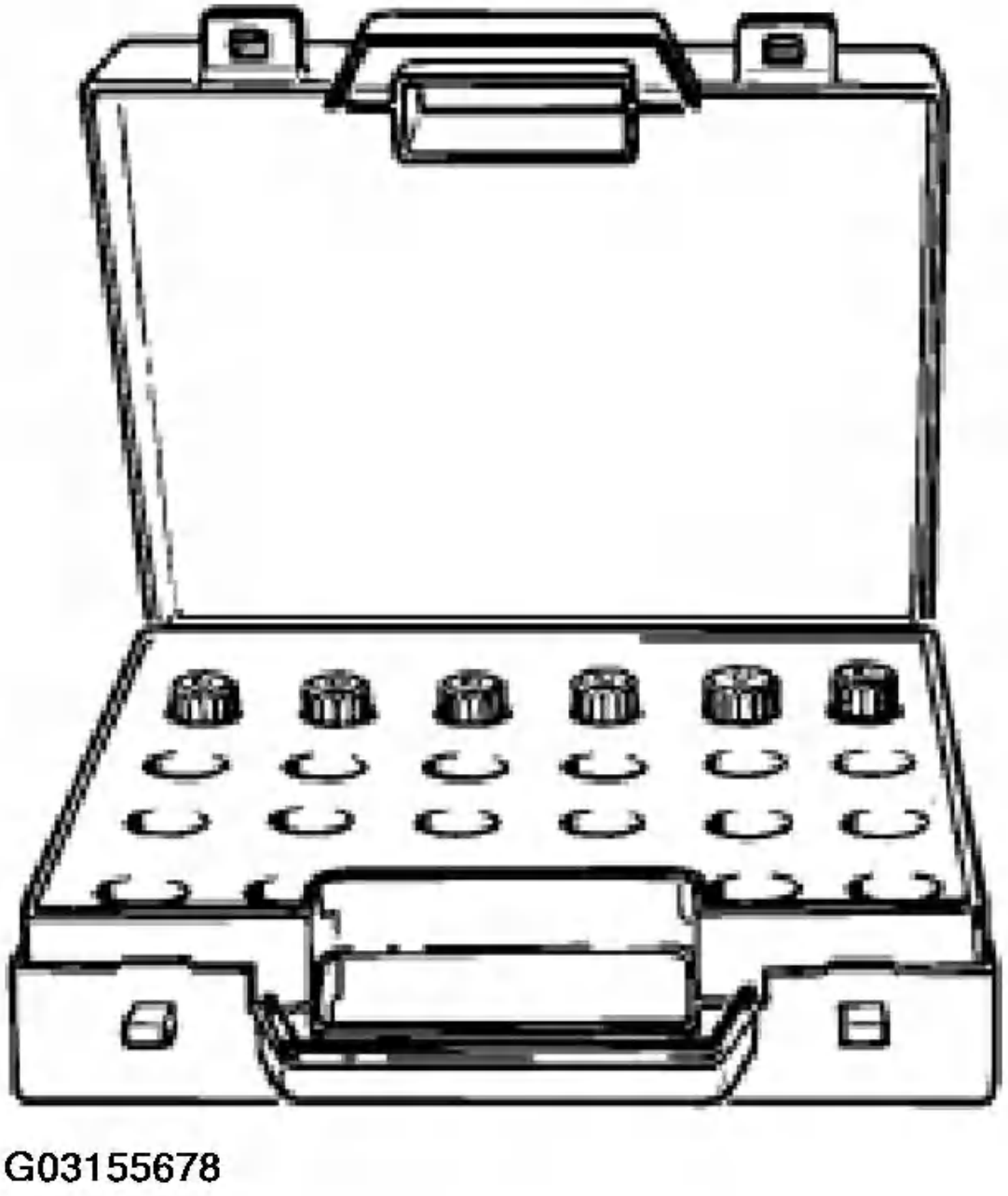


Fig. 6: Identifying 36 1 300 Set Of Wheel Stud Adapters - Mechanical Tool
Courtesy of BMW OF NORTH AMERICA, INC.

WHEEL STUD ADAPTERS GENERAL SPECIFICATION

Note:	For loosening and tightening wheel studs (antitheft)
Series:	E12, E21, E23, E24, E28, E30, E31, E32, E34, E36, E38, E39, E46, E46/16, E46/2, E46/3, E46/5, E46/C, E52, E53, E60, E61, E63, E64, E65, E66,

	E67, E83, E85, E87, E90, E91, R50, R52, R53
SI number:	1 27 04 (167)
Order number:	36 1 300
Â	Set of wheel stud adapters
Consisting of:	Â
36 1 301	Code 11
36 1 302	Code 12
36 1 303	Code 13
36 1 304	Code 14
36 1 306	Code 16
36 1 307	Code 17
36 1 308	Code 18
36 1 309	Code 19
36 1 311	Code 20
36 1 312	Code 31
Note:	Replaced by 36 1 324, 12/2004
36 1 313	Code 32
Note:	Replaced by 36 1 325, 12/2004
36 1 314	Code 33
Â	NOTE: Replaced by 36 1 326, 12/2004
36 1 315	Code 34
Â	NOTE: Replaced by 36 1 327, 12/2004
36 1 316	Code 35
Â	NOTE: Replaced by 36 1 328, 12/2004
36 1 317	Code 36
Â	NOTE: Replaced by 36 1 329, 12/2004
36 1 318	Code 37
Â	NOTE: Replaced by 36 1 331, 12/2004
36 1 319	Code 38
Â	NOTE: Replaced by 36 1 332, 12/2004
36 1 321	Code 39
Â	NOTE: Replaced by 36 1 323 Code 30, 12/2004
36 1 322	Code 40
Â	NOTE: Replaced by 36 1 333, 12/2004

36 1 305	Code 15

Article GUID: A00202808

WHEELS

36 10 WHEELS

WHEELS - TIGHTENING TORQUE SPECIFICATIONS

Application	Type	Thread	Measure
1AZ Wheel bolt	All	M12	120 +/- 10 Nm
Â	E53, E65, E66, E67, E83	M14	140 +/- 10 Nm

DISC WHEELS (RIMS)

36 12 TIRES

TIRES - TIGHTENING TORQUE SPECIFICATIONS

Application	Type	Measure
1AZ Cover on M-Mobility system	M-roadster / M-coupe	2 Nm
2AZ Hose, sealant bottle on cover	M-roadster / M-coupe	2 Nm
3AZ Control head to M-Mobility system	M3 / M5 / M-roadster / M-coupe	15 Nm
4AZ Control head to sealant bottle	M3 / M5 / M-roadster / M-coupe	2.4 Nm

36 11 WHEEL RIMS

WHEEL RIMS - TIGHTENING TORQUE SPECIFICATIONS

Application	Type	Measure
1AZ Wheel cover on disc wheel Bolts coated with blue Loctite No. 243	All	9 Nm
2AZ Valve on disc wheel (RDC)	E38 / E39 / E46 / E53 / E65 / E66	3.5 Nm
3AZ Wheel electronics (RDC) on valve	E38 / E39 / E46 / E53 / E65 / E66	3.5 Nm

TYRES

36 12 TIRES

TIRES - TIGHTENING TORQUE SPECIFICATIONS

Application	Type	Measure
1AZ Cover on M-Mobility system	M-roadster / M-coupe	2 Nm
2AZ Hose, sealant bottle on cover	M-roadster / M-coupe	2 Nm
3AZ Control head to M-Mobility system	M3 / M5 / M-roadster / M-coupe	15 Nm
4AZ Control head to sealant bottle	M3 / M5 / M-roadster / M-coupe	2.4 Nm

Article GUID: A00202658

GENERAL

31 32 SHOCK ABSORBERS E36

SHOCK ABSORBERS E36 TECHNICAL SPECIFICATIONS

Shock absorber, limit value for Boge shock tester Front/rear axle (If the value for the rear axle is not specified, no wear can be ascertained with commercially available measuring equipment.)	mm	4-cylinder series: 59/45 4-cylinder sport suspension: 47/35 6-cylinder series: 52/45 6-cylinder sport suspension: 45/35 M3: 33/24 Rough road package: see Series Z3: 50/32

Article GUID: A00202379

WHEELS

36 10 WHEELS ONE-PART ALLOY WHEELS

WHEELS ONE-PART ALLOY WHEELS TECHNICAL SPECIFICATION

Max. radial runout of tire Rim with tire	max. mm	1.1
Max. axial runout or tire Rim with tire	max. mm	1.3
Max. radial runout out rim	max. mm	0.3
Max. axial runout of rim	max. mm	0.3
Max. imbalance for each side (before balancing)	max. g	90 for clamp weights 120 for stick-on weights
Permissible residual imbalance for each side (after balancing)	max. g	4
Elimination of imbalance: Up to 60 g with one weight or more than 60 g with two weights	.....	.....

36 10 WHEELS STEEL AND ALUMINUM STRIP WHEELS

WHEELS STEEL AND ALUMINUM STRIP WHEELS TECHNICAL SPECIFICATION

Max. radial runout of tire Rim with tire	max. mm	1.6
Max. axial runout or tire Rim with tire	max. mm	1.8
Max. radial runout out rim	max. mm	0.8
Max. axial runout of rim	max. mm	0.8
Max. imbalance for each side (before balancing)	max. g	90 for clamp weights 120 for stick -on weights
Permissible residual imbalance for each side (after balancing)	max. g	4
Elimination of imbalance: Up to 60 g with one weight or more than 60 g with two weights	.....	.....

36 10 WHEELS TWO-PART ALLOY WHEELS

WHEELS TWO-PART ALLOY WHEELS TECHNICAL SPECIFICATION

Max. radial runout of tire Rim with tire	max. mm	1.3
Max. axial runout or tire Rim with tire	max. mm	1.5
Max. radial runout out rim	max. mm	0.5
Max. axial runout of rim	max. mm	0.5
Max. imbalance for each side (before balancing)	max. g	90 for clamp weights 120 for stick -on weights
Permissible residual imbalance for each side (after balancing)	max. g	4
Elimination of imbalance:		

Up to 60 g with one weight or more than 60 g with two weights	.....	.....

Article GUID: A00202378

WHEELS

36 10 008 ELECTRONIC BALANCING OF LEFT OR RIGHT FRONT WHEEL (FINISH BALANCER)

Always balance wheels in a stationary state prior to electronic balancing,

refer to 36 10 508 STATIONARY WHEEL BALANCING (WHEEL REMOVED) .

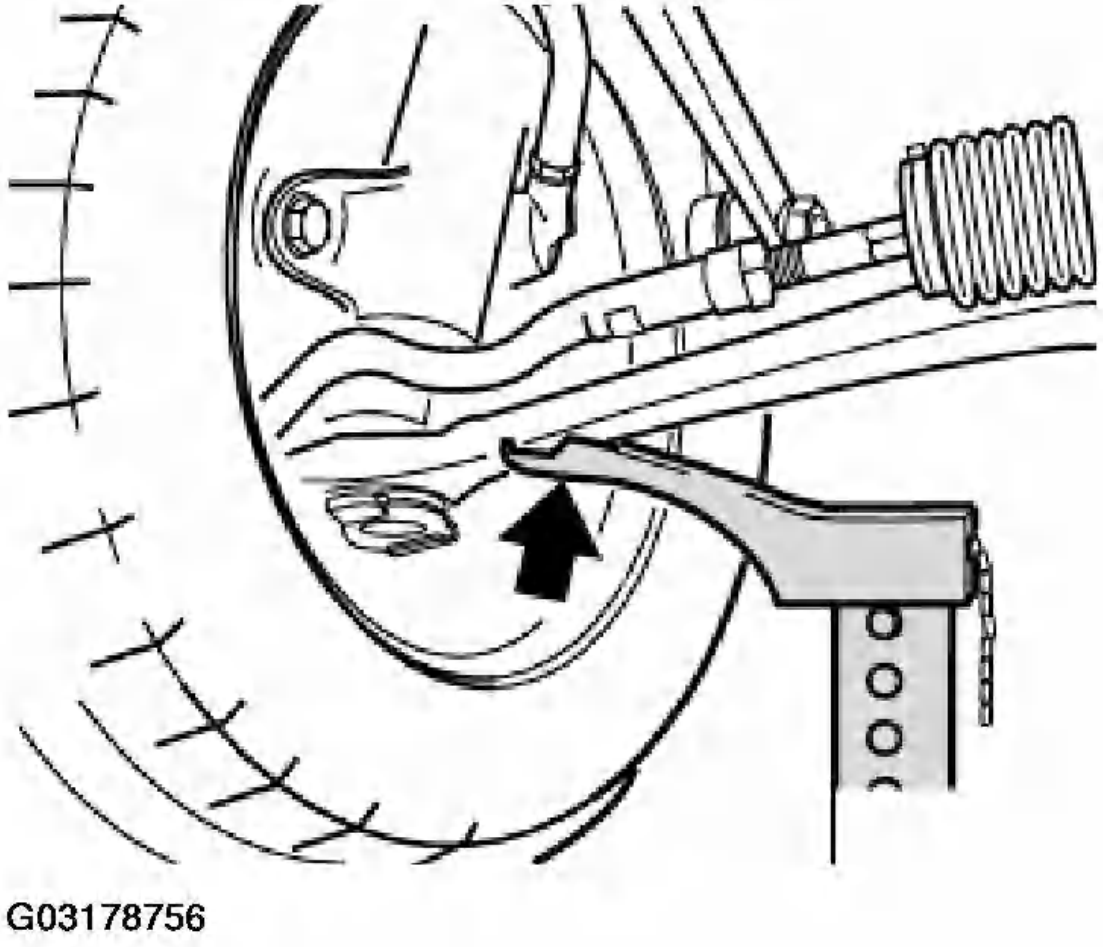
CAUTION: Balancing should always be carried out on a solid surface (concrete floor without basement).

If the displayed value for finish-balancing is more than 15 grams on one wheel, the possible causes (e.g. inaccurate stationary balancing, wheel centering, etc.) must be eliminated before finish-balancing is completed and the previously finish-balanced wheel must be rechecked.

Apply balancing gauge on control arm.

Position of application:

Outside of control arm on narrow cross section, approx. 50 mm away from ball joint.



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Fig. 1: Identifying Take-Up Pivot
Courtesy of BMW OF NORTH AMERICA, INC.

Use a suitable take-up pivot or additional pivot.

CAUTION: Vehicle must not be loaded!

Lower car slowly.

Do not let it fall on control arm.

Otherwise wheel suspension could be damaged.

Make a chalk mark on side of tire opposite valve.

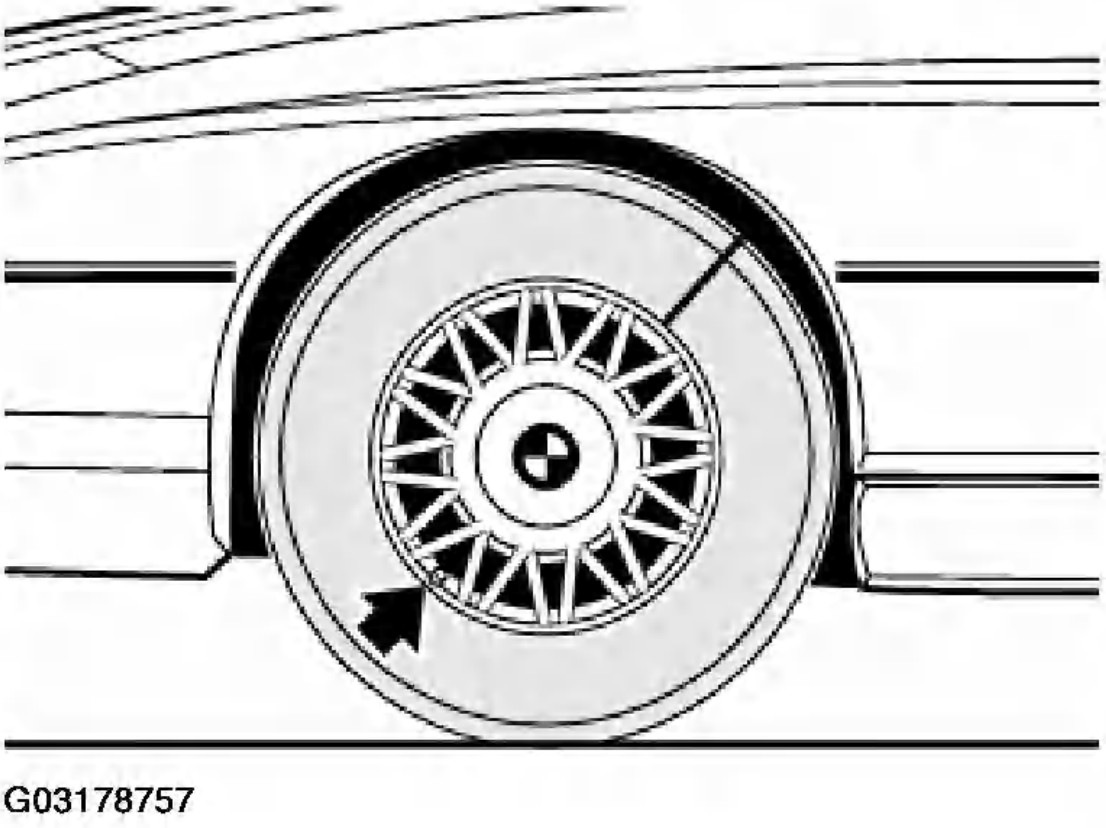


Fig. 2: Placing Chalk Mark On Side Of Tire Opposite Valve
Courtesy of BMW OF NORTH AMERICA, INC.

Connect wires for test sensor.

Balance wheel according to instructions supplied with balancing machine.

36 10 058 ELECTRONIC BALANCING OF LEFT OR RIGHT REAR WHEEL (FINISH BALANCER)

NOTE: Always balance wheels in a stationary state prior to electronic balancing, refer to 36 10 508 STATIONARY WHEEL BALANCING (WHEEL REMOVED) .

CAUTION: Balancing should always be carried out on a solid surface (concrete floor without basement).

If during finishing one wheel a display value in excess of 15 g appears, possible causes (e.g. imprecise stationary balancing, centering etc.) must be traced and remedied before finishing and the finished wheels must then be checked again.

Apply balancing gauge on trailing arm as close as possible to wheel.

Use a suitable take-up pivot or additional pivot.

Apply a trolley jack underneath final drive with light pressure to decouple oscillation from final drive.

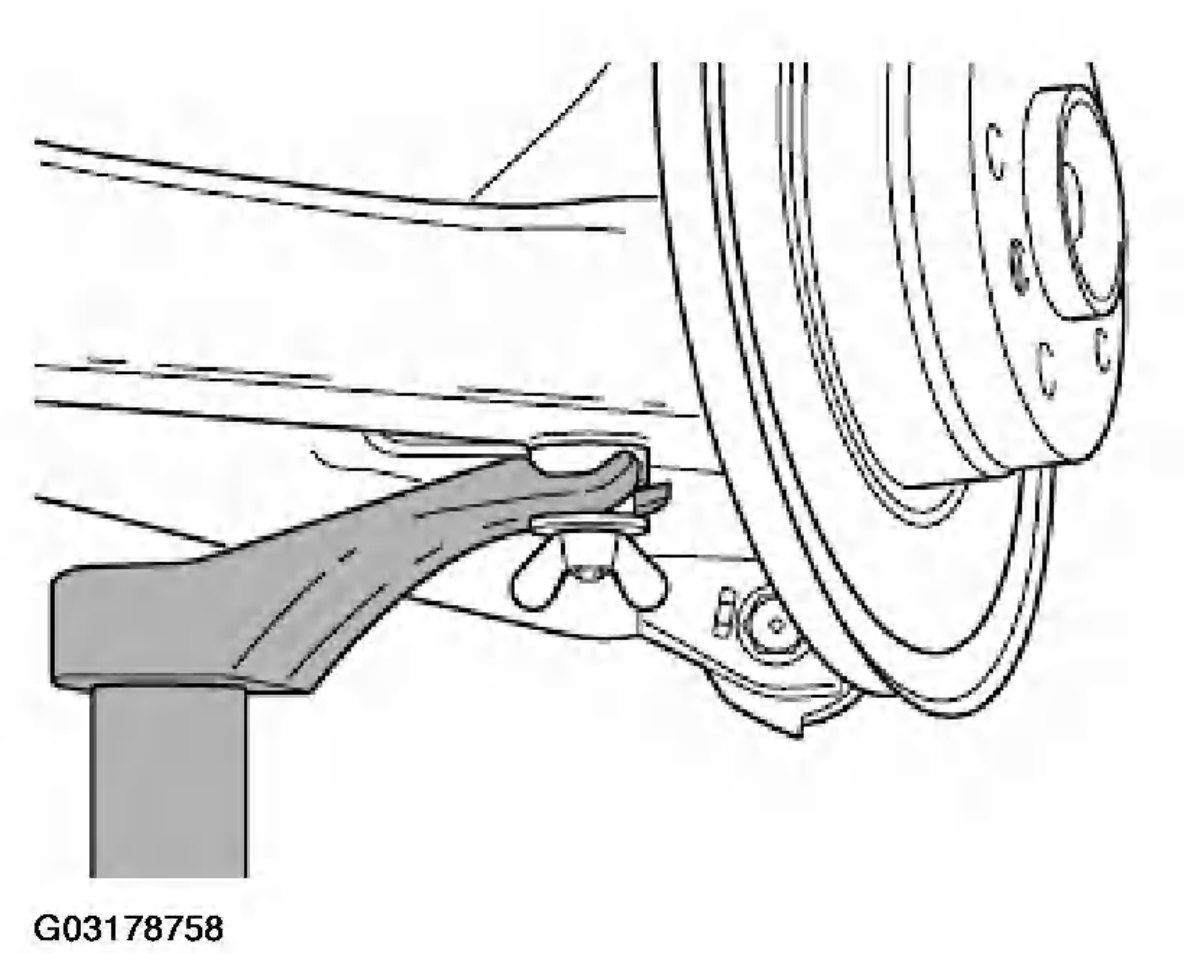


Fig. 3: Identifying Take-Up Pivot
Courtesy of BMW OF NORTH AMERICA, INC.

Make a chalk mark on side of tire opposite valve.

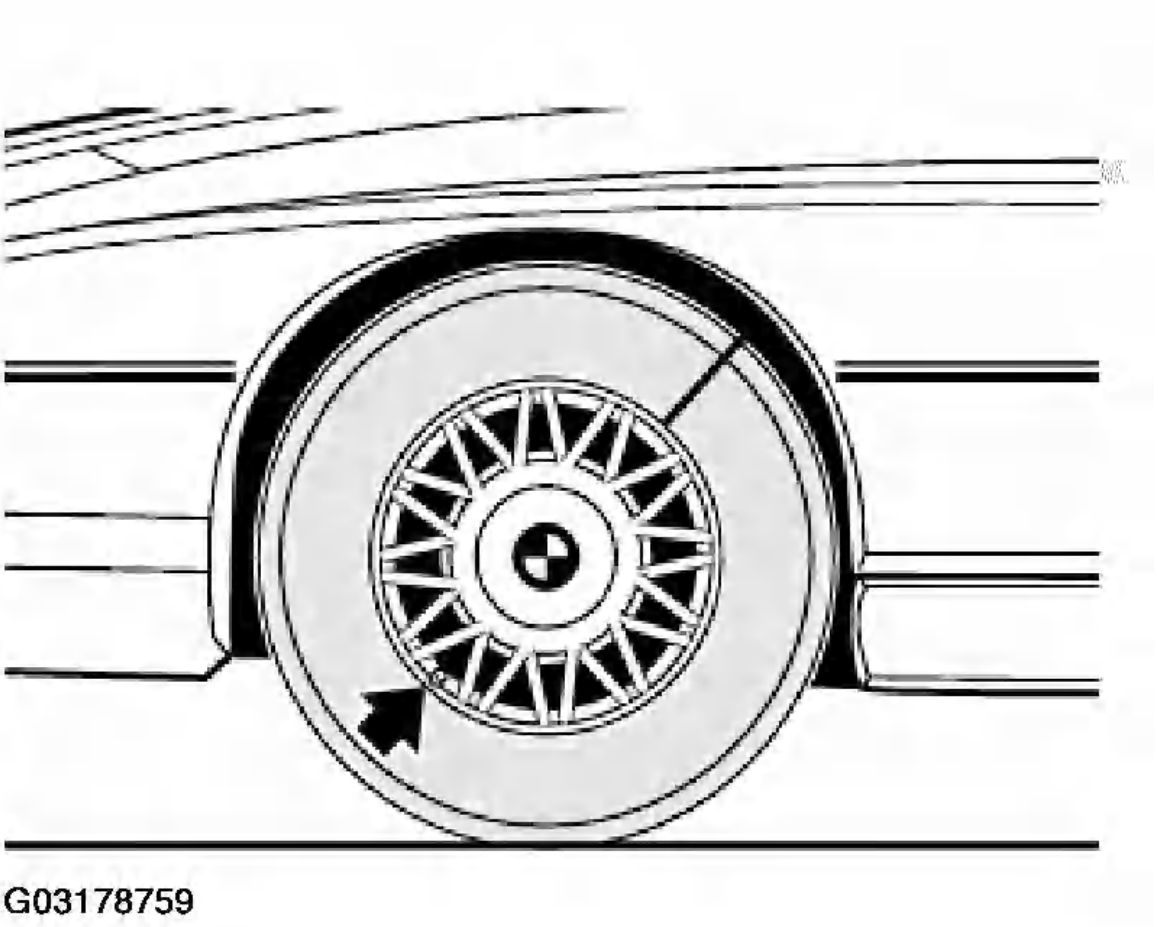


Fig. 4: Placing Chalk Mark On Side Of Tire Opposite Valve
Courtesy of BMW OF NORTH AMERICA, INC.

Check whether rear wheels can be turned easily.

Connect wires for test sensor.

CAUTION: Balance wheel according to instructions supplied with balancing machine.

Balancing is carried out with engine power at approx. 100 km/h.

This requires a smooth-running engine without misfiring, closed doors, engine bonnet and luggage-compartment lid as well as a driver sitting quietly in car.

Exhaust-gas extraction hoses must not touch tail panel.

36 10 209 CHECKING FRONT AND REAR WHEEL FOR FACE AND RADIAL RUNOUT

NOTE: For Special Tool identification, see SPECIAL TOOLS - Z3 .

Special Tools Required:

- 36 1 030

Important!

Wheel bearing must be OK!

Lift vehicle.

Check wheel with special tool 36 1 030 (measuring fixture) for lateral runout. Refer to 36 10 WHEELS ONE-PART ALLOY WHEELS , 36 10 WHEELS STEEL AND ALUMINUM STRIP WHEELS or 36 10 WHEELS TWO-PART ALLOY WHEELS .

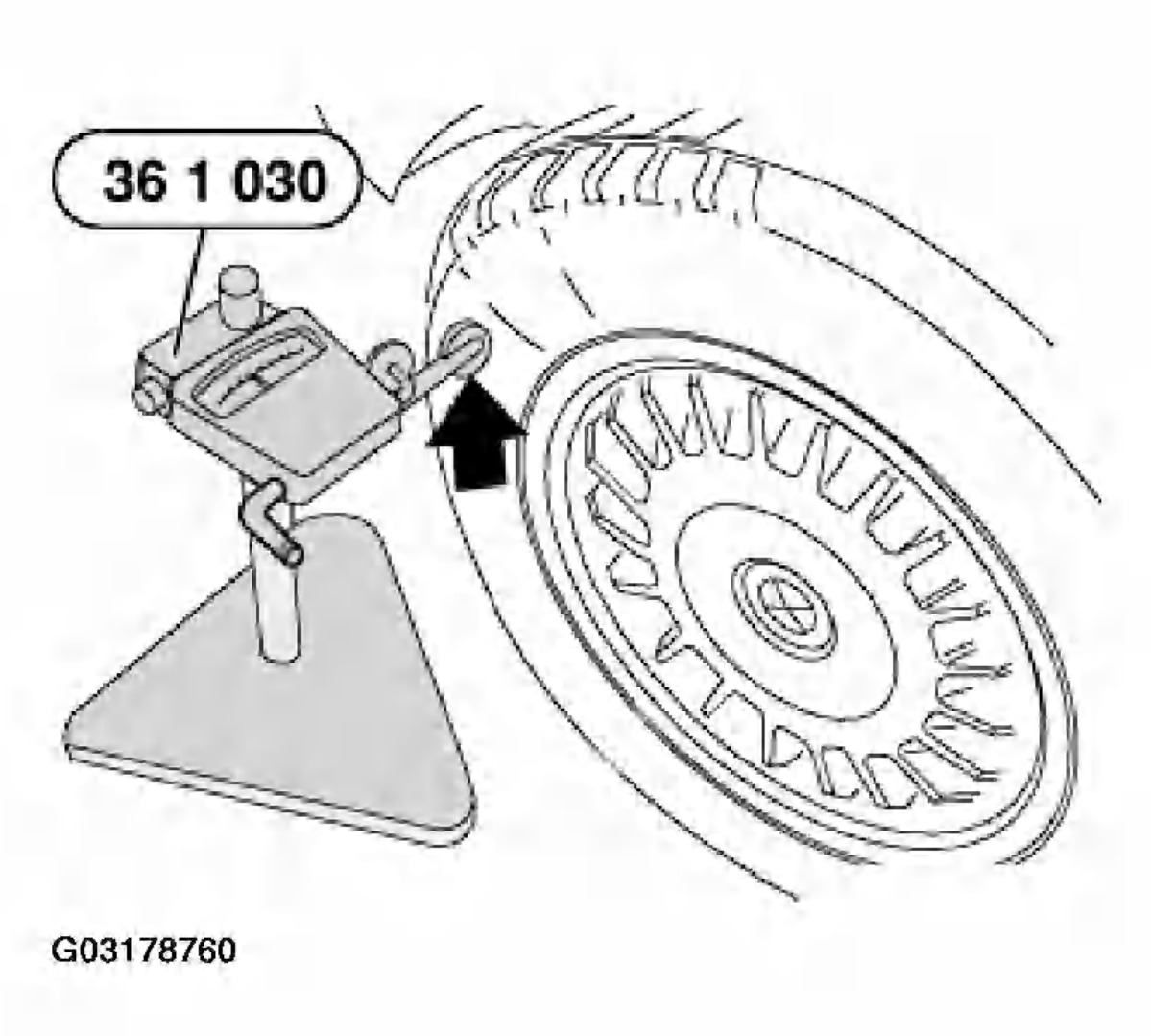


Fig. 5: Checking Wheel Lateral Runout With Special Tool
Courtesy of BMW OF NORTH AMERICA, INC.

Check wheel with special tool 36 1 030 (measuring fixture) for radial runout. Refer to 36 10 WHEELS ONE-PART ALLOY WHEELS , 36 10 WHEELS STEEL AND ALUMINUM STRIP WHEELS or 36 10 WHEELS TWO-PART ALLOY WHEELS .

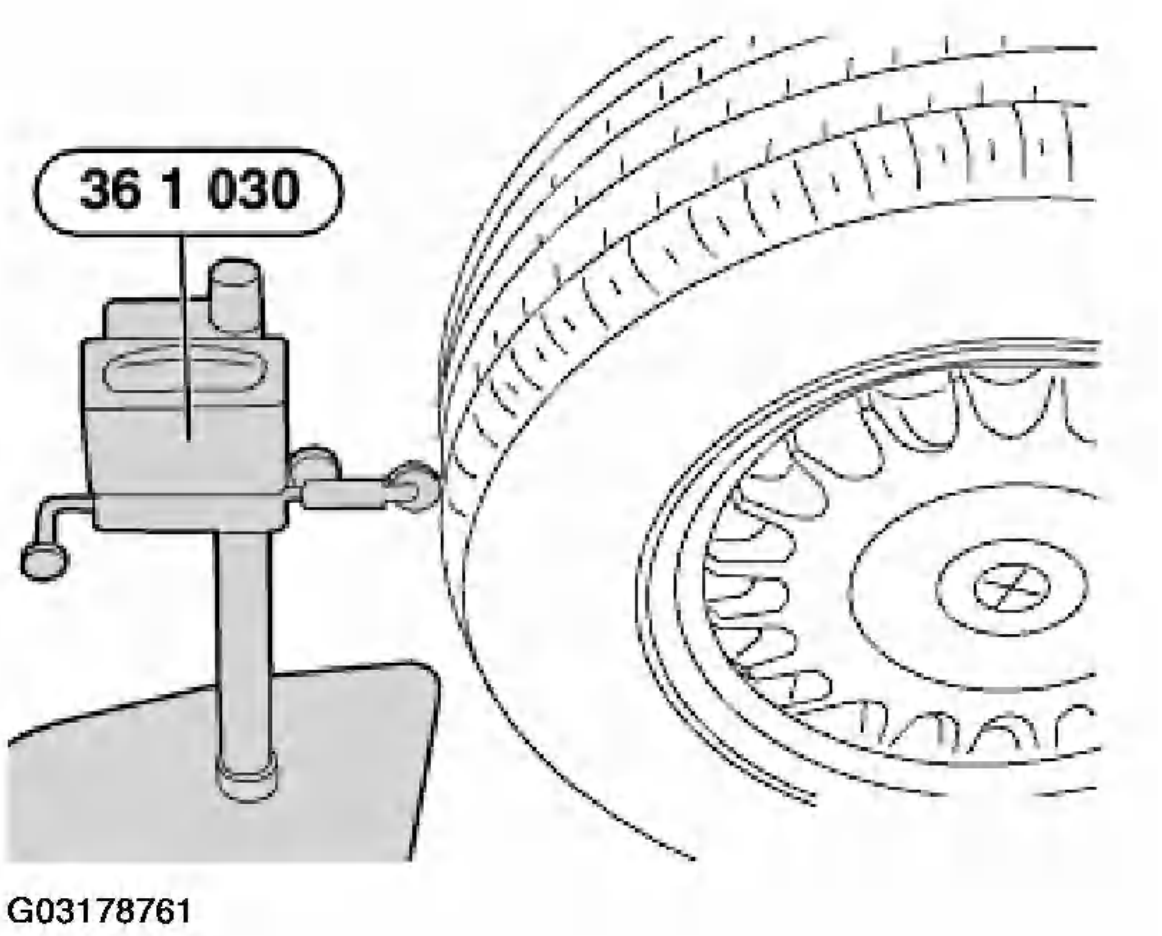


Fig. 6: Checking Wheel Radial Runout With Special Tool
Courtesy of BMW OF NORTH AMERICA, INC.

If applicable, remove balance weights.

Check lateral runout of rim with special tool 36 1 030 (measuring fixture). Refer to 36 10 WHEELS ONE-PART ALLOY WHEELS , 36 10 WHEELS STEEL AND ALUMINUM STRIP WHEELS or 36 10 WHEELS TWO-PART ALLOY WHEELS .

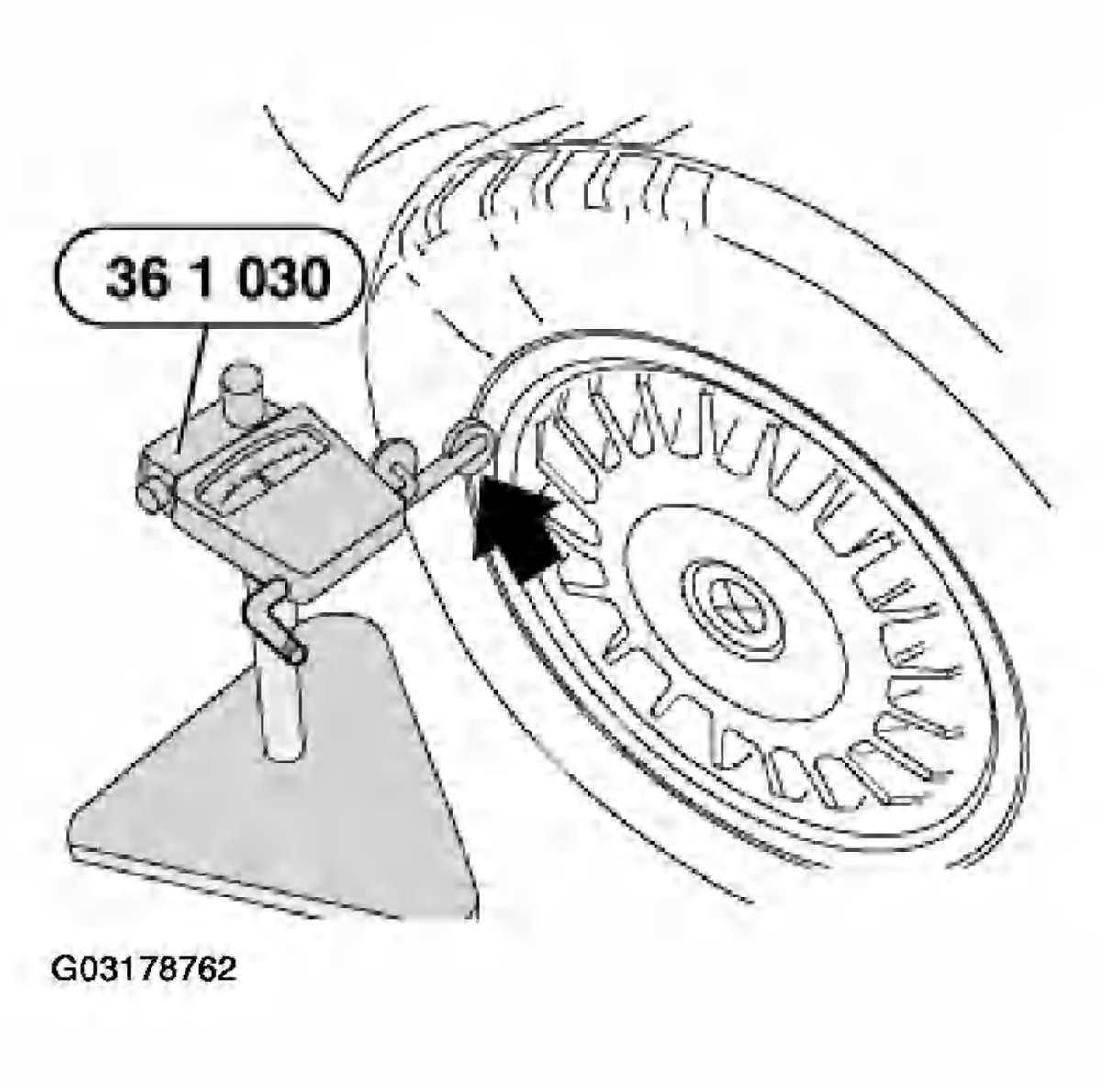


Fig. 7: Checking Lateral Runout Of Rim With Special Tool
Courtesy of BMW OF NORTH AMERICA, INC.

Check radial runout of rim with special tool 36 1 030 (measuring fixture). Refer to 36 10 WHEELS ONE-PART ALLOY WHEELS , 36 10 WHEELS STEEL AND ALUMINUM STRIP WHEELS or 36 10 WHEELS TWO-PART ALLOY WHEELS .

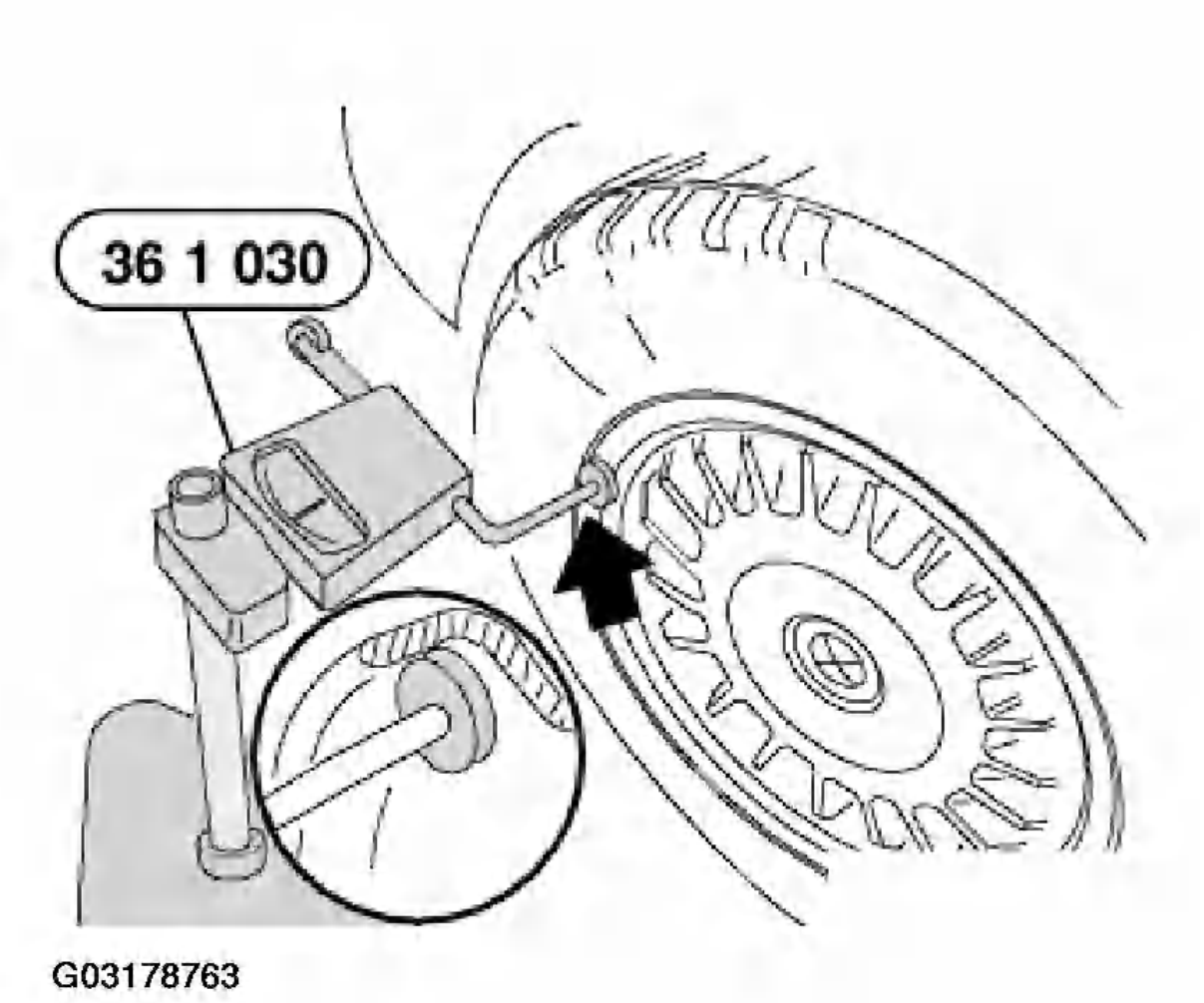


Fig. 8: Checking Radial Runout Of Rim With Special Tool
Courtesy of BMW OF NORTH AMERICA, INC.

36 10 300 REMOVING OR INSTALLING FRONT OR REAR WHEEL

NOTE: For Special Tool identification, see SPECIAL TOOLS - Z3 .

Special Tools Required:

- 36 1 250

Important!

Wheel was balanced electronically.

Observe the following in order to avoid positioning errors and imbalance:

- Loosen wheel bolts.
- Wheel positioned with valve facing down.
- If several wheels are removed at the same time, mark the installation location of the wheels on the tires (e.g. with chalk).
- Mark out wheel to wheel hub.
- Mark out lockable wheel bolt in relation to wheel.
- Release wheel bolts and remove wheel.

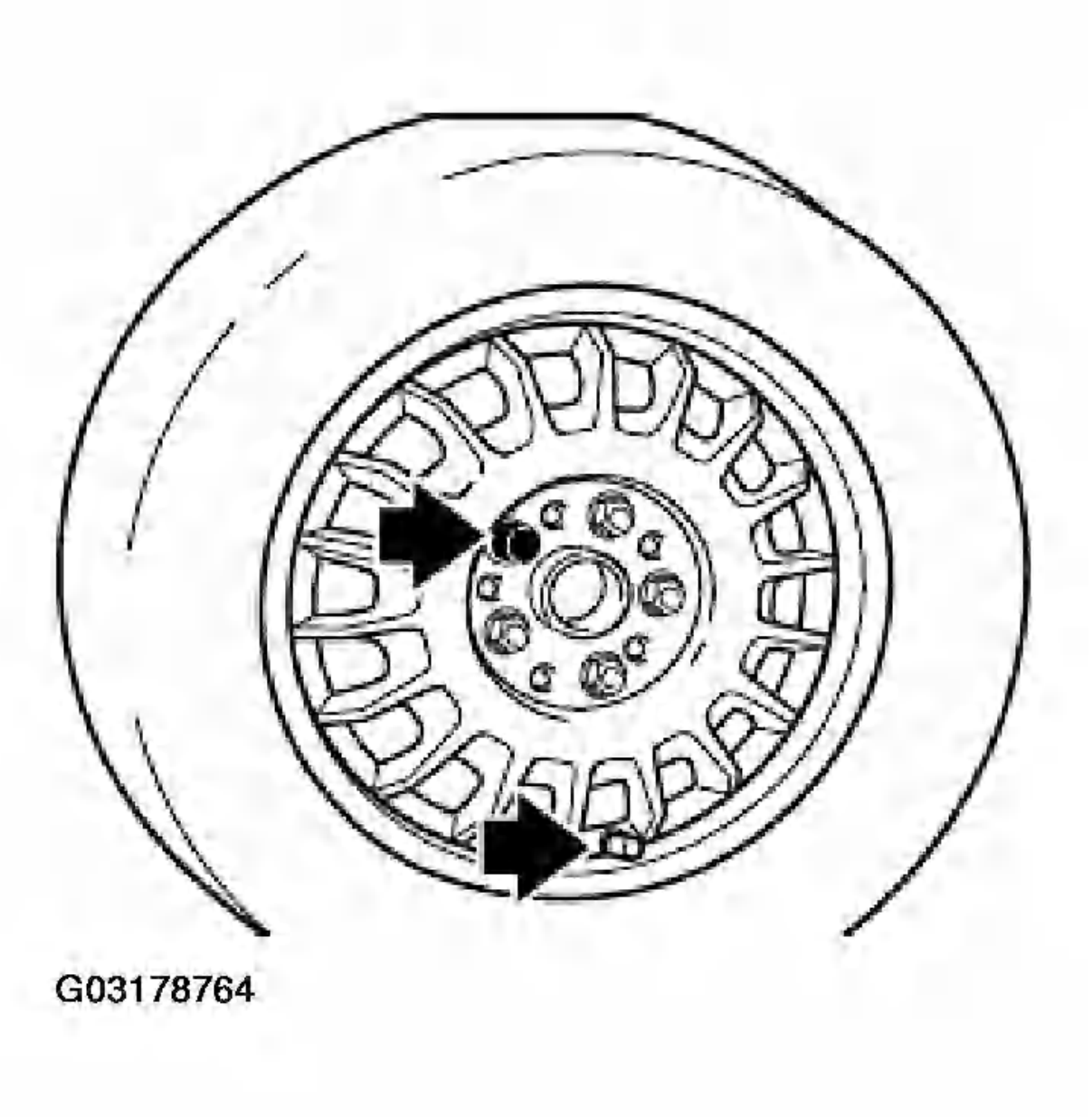


Fig. 9: Wheel Positioned With Valve Facing Down
Courtesy of BMW OF NORTH AMERICA, INC.

Important!

Contact faces between brake disc and disc wheel and between brake disc and wheel hub must be free of grease.

Remove dirt, grease residues and corrosion from contact face (1) with a drill and special tool 36 1 250.

Important!

Do not operate special tool 36 1 250 with an impact screwdriver!

NOTE: Degrease contact face with universal cleaner.

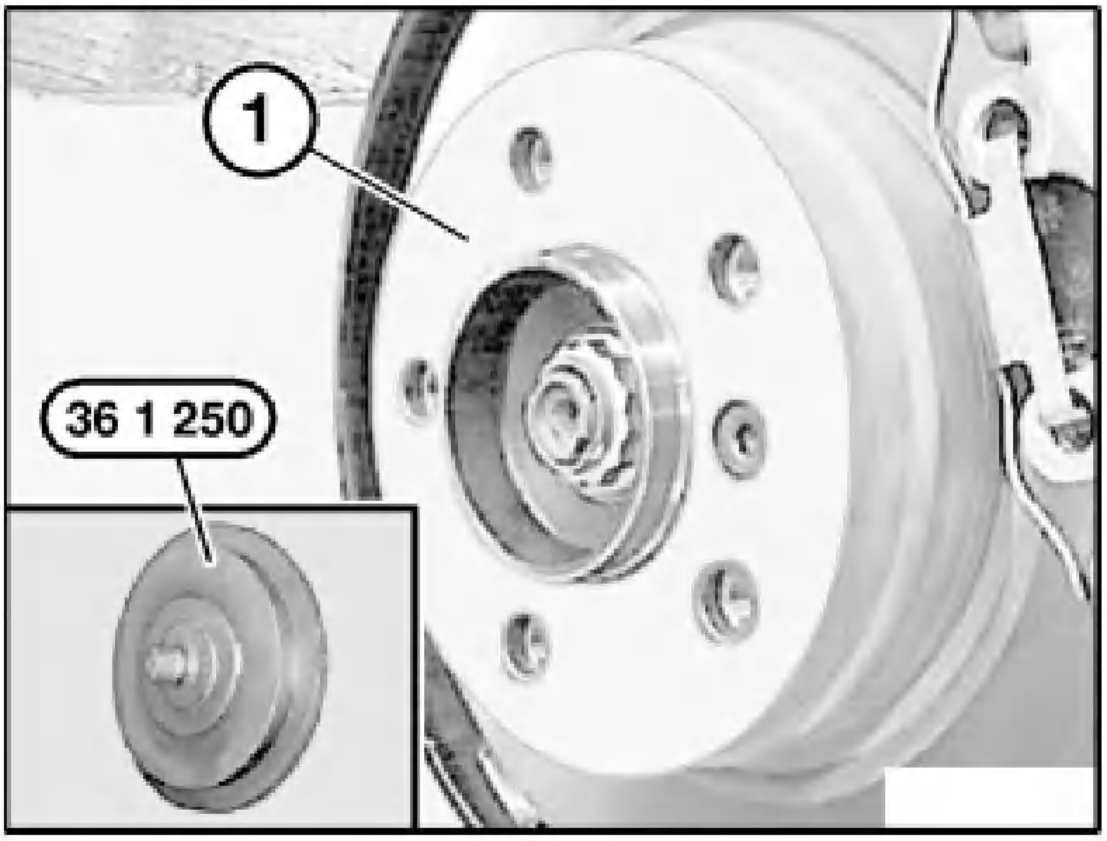


Fig. 10: Identifying Contact Face
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: If there are grease residues in the area of the wheel stud bore, the brake disc must be removed and cleaned. Refer to BRAKE DISC .

Remove dirt, grease residues and corrosion from contact face (1) with a drill and special tool 36 1 250.

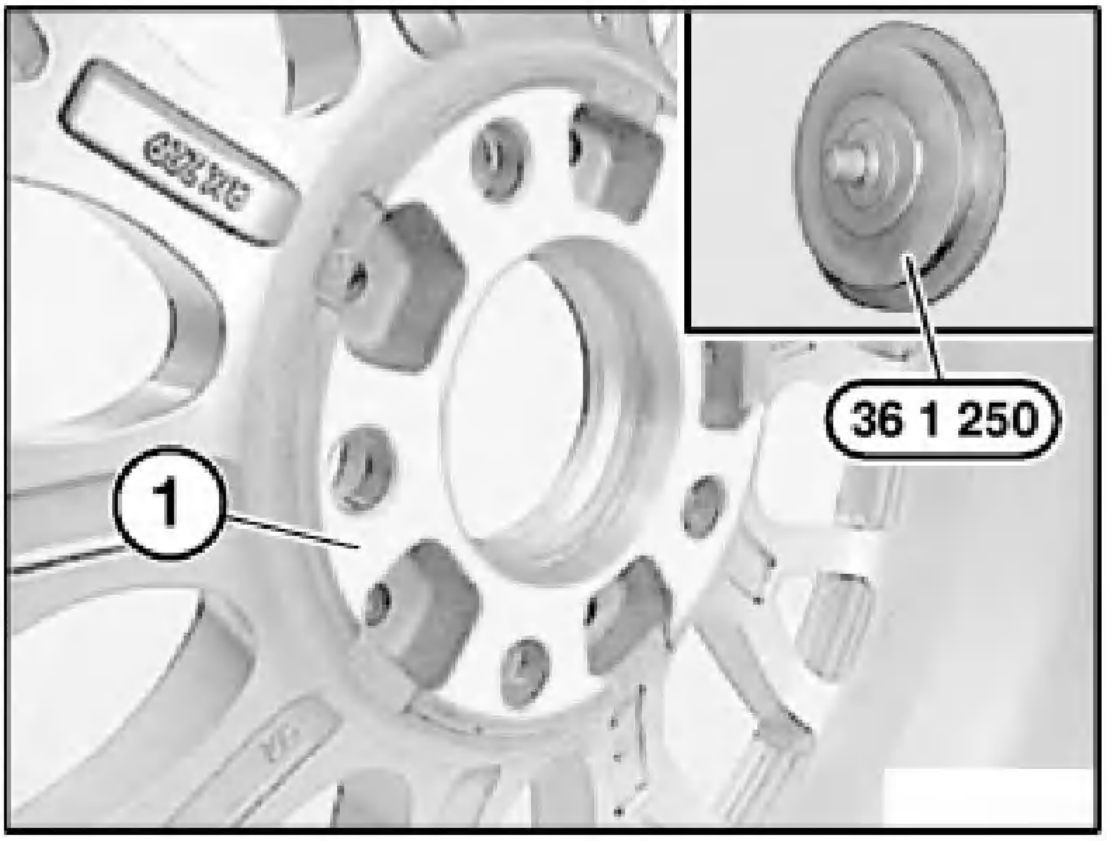


Fig. 11: Removing Dirt, Grease And Corrosion From Contact Face With Drill And Special Tool
Courtesy of BMW OF NORTH AMERICA, INC.

Important!

Do not operate special tool 36 1 250 with an impact screwdriver!

NOTE: Degrease contact face with universal cleaner.

Check brake disc retaining bolt (1) for secure seating.

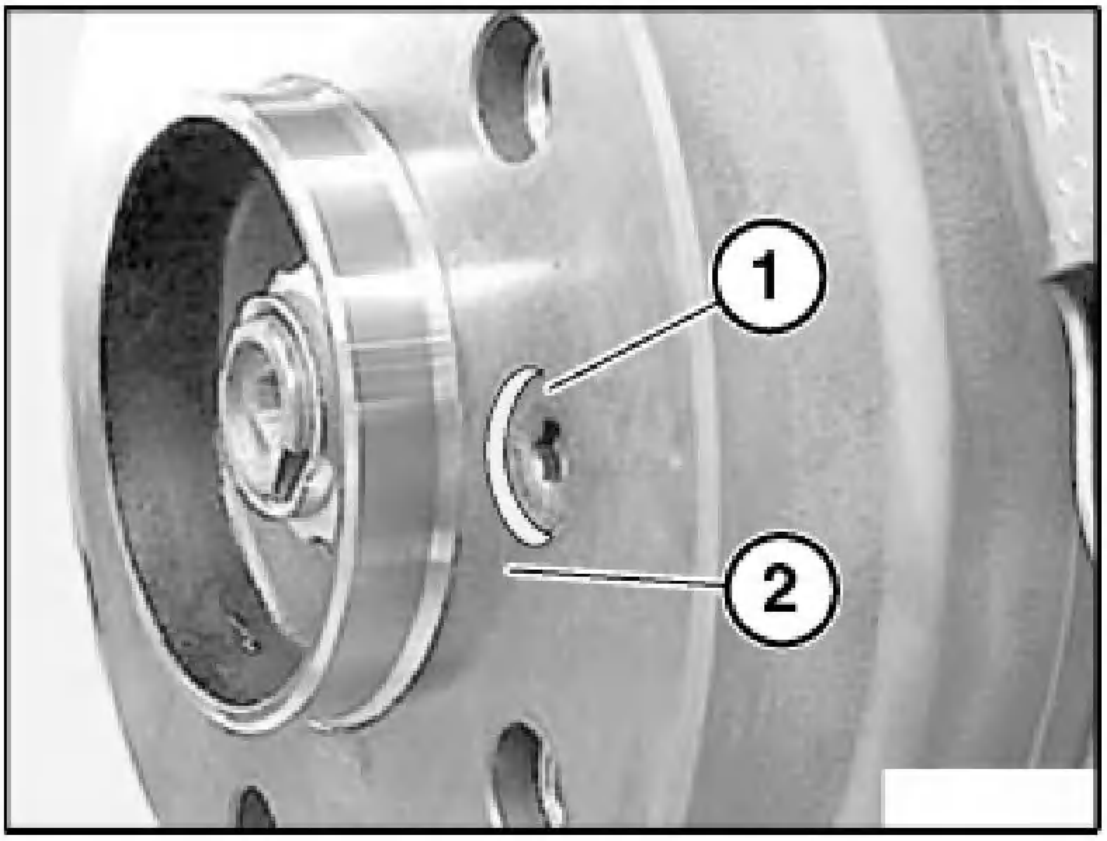


Fig. 12: Checking Brake Disc Retaining Bolt For Secure Seating
Courtesy of BMW OF NORTH AMERICA, INC.

Important!

Brake disc retaining bolt must under no circumstances protrude over contact face (2) between brake disc and disc wheel.

Tightening torque for brake disc retaining screw, front axle and rear axle, refer to TORQUE SPECIFICATIONS .

Apply a thin coat of grease to wheel centering (1) in disc wheel.

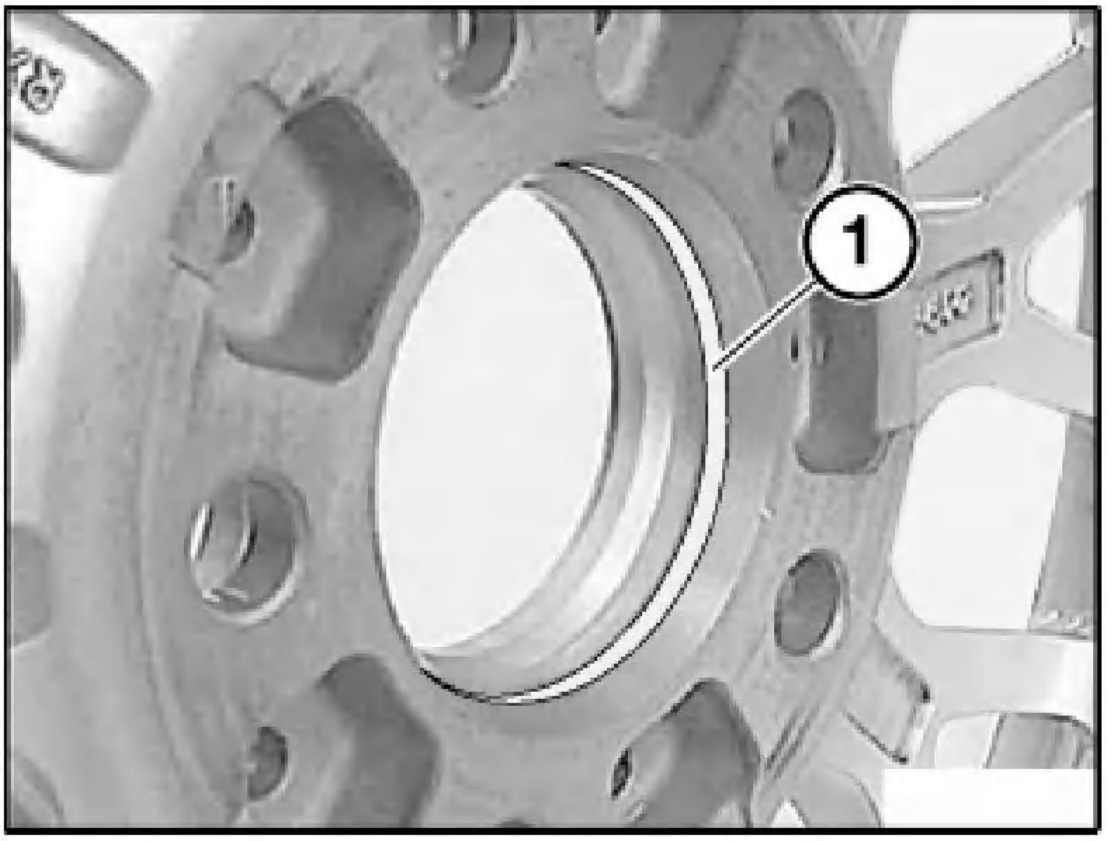


Fig. 13: Identifying Wheel Centering In Disc Wheel
Courtesy of BMW OF NORTH AMERICA, INC.

Wheel studs with taper:

a. Wheel bolt - galvanized.
b. Wheel bolt - black chrome plated.
c. Wheel bolt - black chrome plated and lockable.
d. Lockable wheel stud with adapter, black chrome-plated.

NOTE: To release and tighten down lockable wheel stud, use a matching adapter from special tool 36 1 300 (wheel stud adapter set).

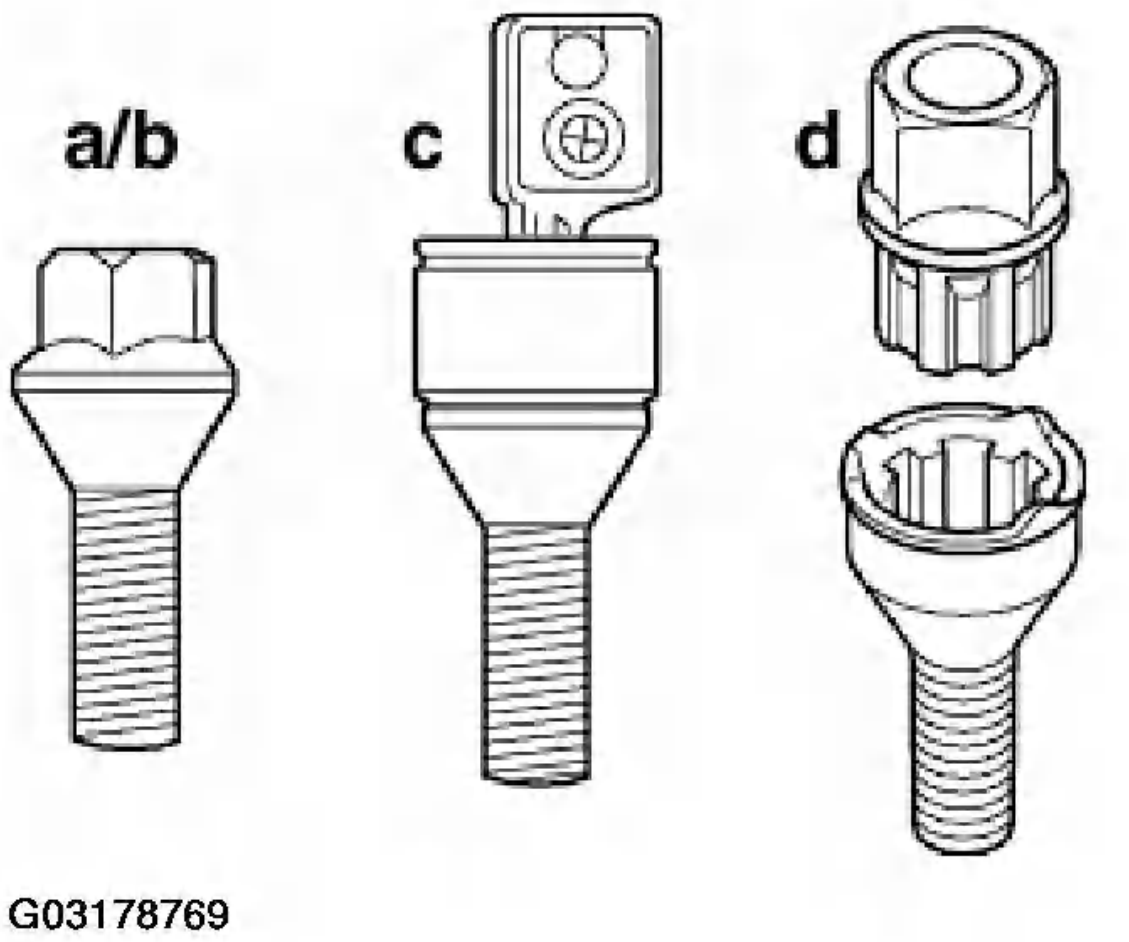


Fig. 14: Identifying Types Of Wheel Studs With Taper
Courtesy of BMW OF NORTH AMERICA, INC.

Clean wheel bolts and check threads for damage, replace, if necessary.

Replace rusty wheel bolts.

Important!

Do not apply oil to new wheel bolts.

In the case of used wheel bolts, apply an extremely thin coating of engine oil to the threads and tapers before reinstalling them.

Important!

Under no circumstances use pneumatic or power screwdrivers to install and tighten the wheel bolts.

Important!

Disc wheel must rest uniformly against brake disc.

Screw in wheel studs and, to center disc wheel, tighten down by hand diagonally and evenly.

Using torque wrench, firmly tighten wheel studs in diagonal and even sequence.

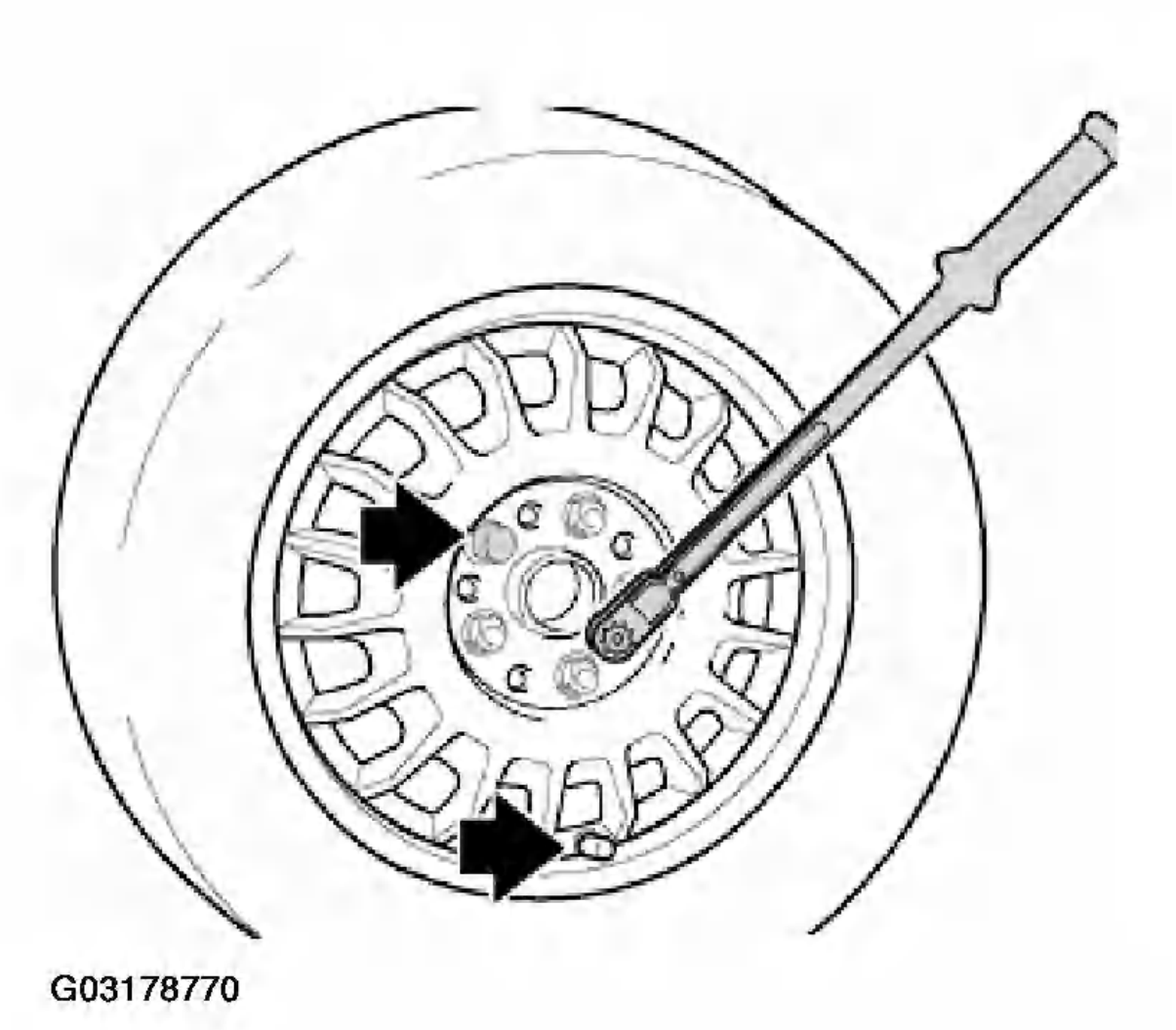


Fig. 15: Installing Wheel Studs Using Torque Wrench
Courtesy of BMW OF NORTH AMERICA, INC.

Tightening torque, refer to TORQUE SPECIFICATIONS .

36 10 508 STATIONARY WHEEL BALANCING (WHEEL REMOVED)

NOTE: For Special Tool identification, see SPECIAL TOOLS - Z3 .

Special Tools Required:

- 36 1 010
- 36 1 020

IMPORTANT: Use only BMW-approved balance weights.

Remove old balance weights, stones in treads and larger pieces of dirt.

Check pressure and condition of tires, check for damage and flat spots (caused by long standing time of car on tires which have been run hot) and, if necessary, check wheel and tire for radial and lateral runout, refer to 36 10 209 CHECKING FRONT AND REAR WHEEL FOR FACE AND RADIAL RUNOUT .

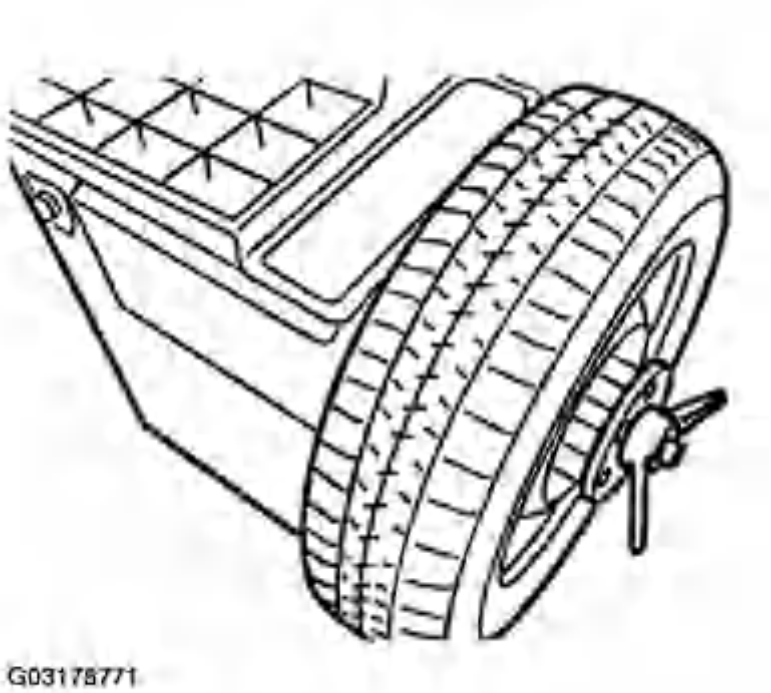


Fig. 16: Tire On Balancing Machine
Courtesy of BMW OF NORTH AMERICA, INC.

Use BMW-approved centering elements of relevant balancing machine manufacturers.

1. Basic flange.
2. Center.
3. Type flange.
4. Clamping nut.

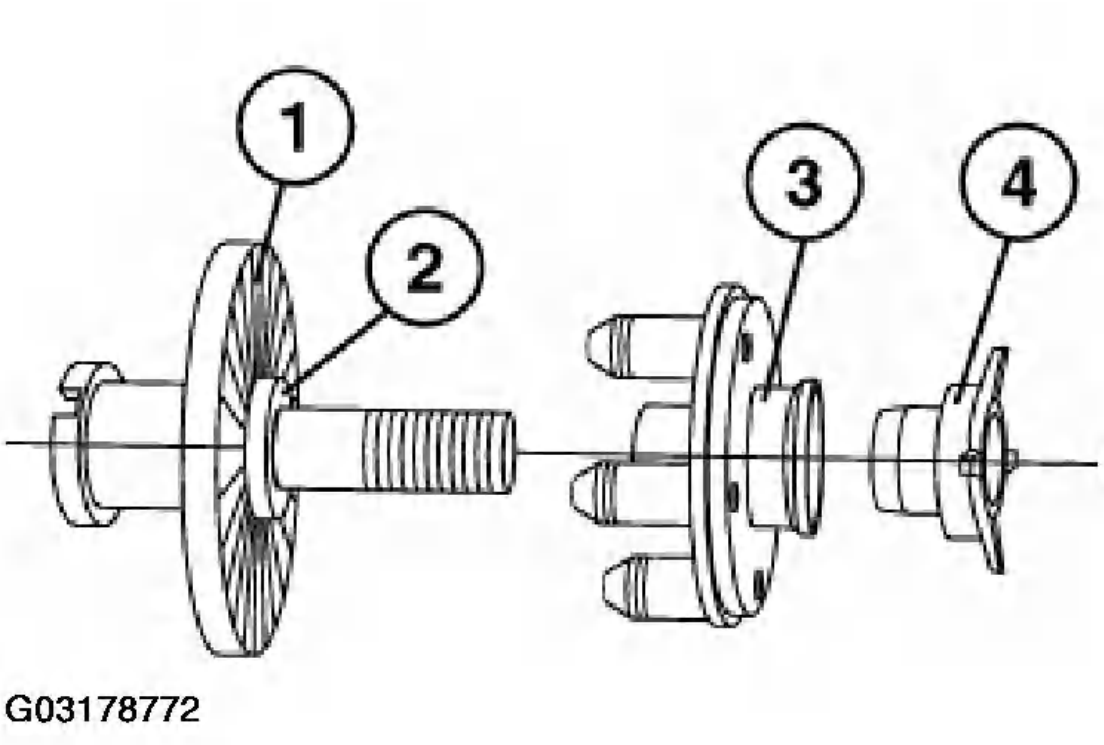


Fig. 17: Identifying Centering Elements Of Balancing Machine
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: To avoid retooling errors, it is essential to fit the wheel on the balancing machine (e.g. valve pointing downwards) in the same way as it is subsequently fitted on the vehicle. Balance wheel in accordance with operating instructions of relevant balancing machine.

On light-alloy rims with distinctive J-shape rim flange, proceed as follows:

1. Gently force off tire sidewall with special tool 36 1 020 at appropriate point from rim flange.
2. Install retaining clip (1).
3. Remove special tool 36 1 020.

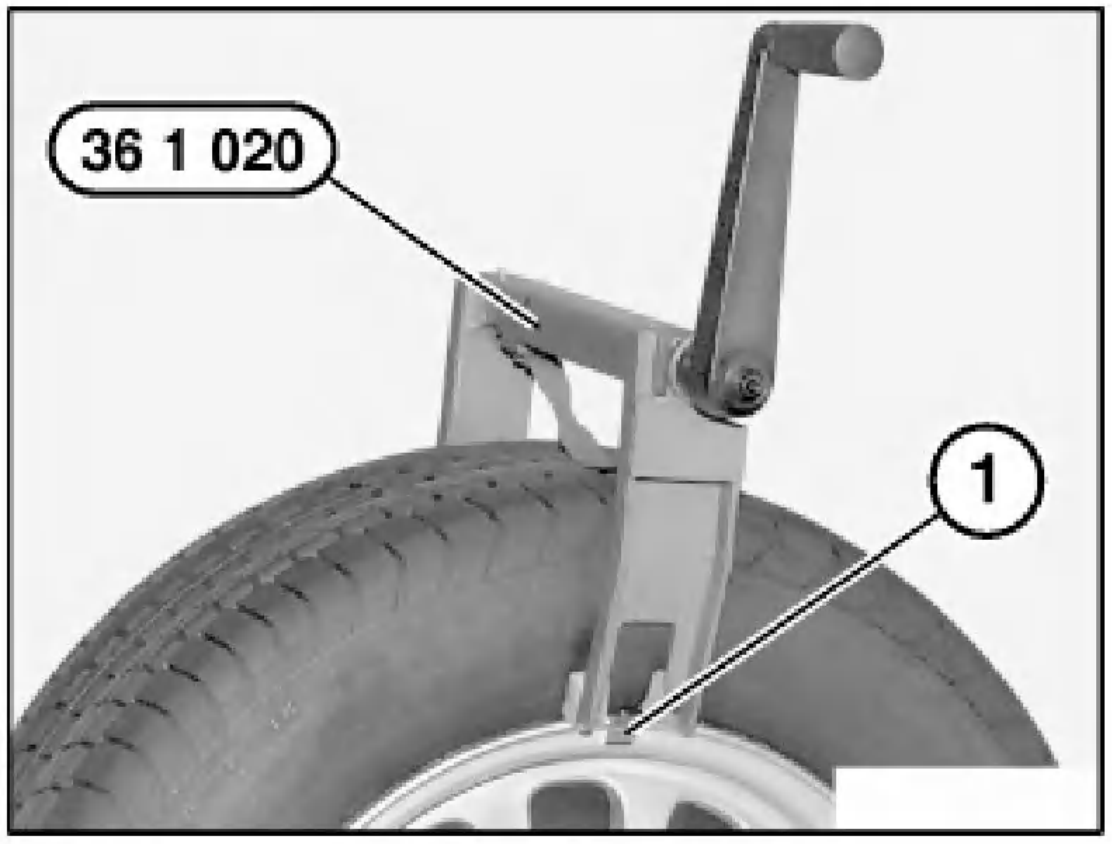


Fig. 18: Installing Retaining Clip Using Tire Pliers
Courtesy of BMW OF NORTH AMERICA, INC.

Raise retaining clip with special tool 36 1 010. Slide balance weight underneath and allow it to snap into place.

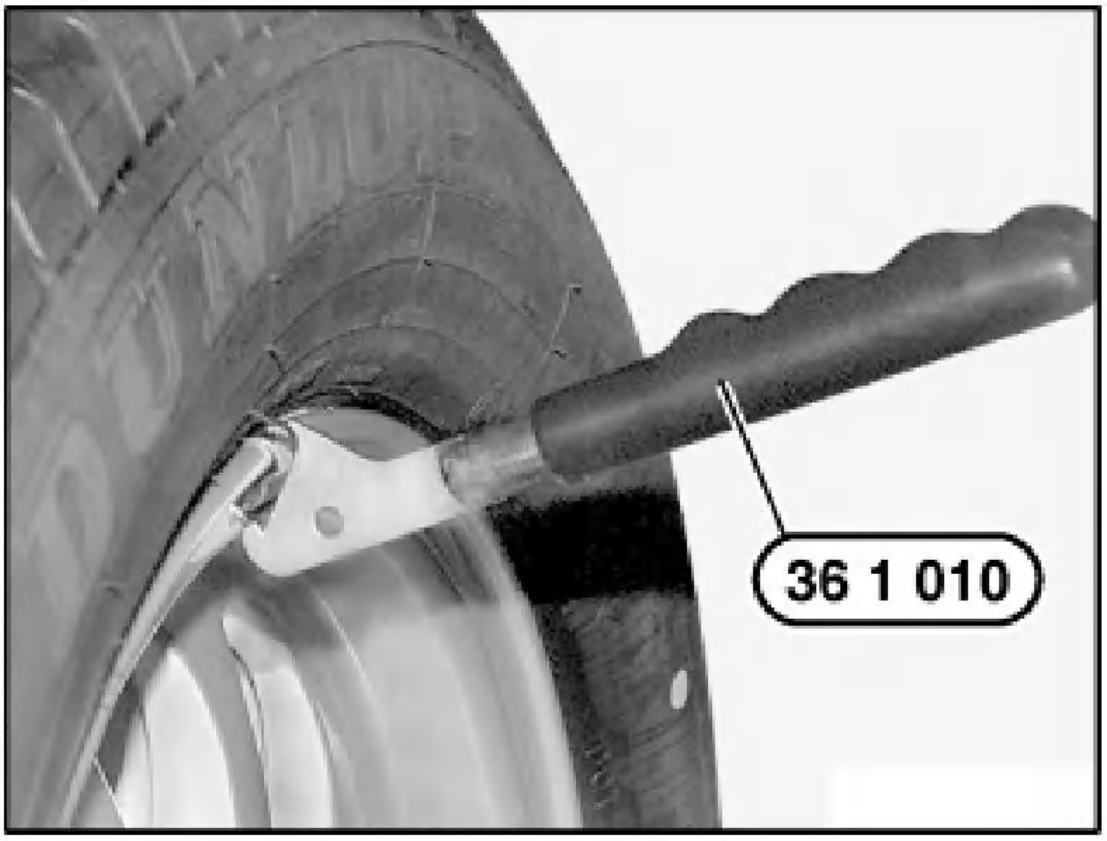


Fig. 19: Raising Retaining Clip With Spring Lifter
Courtesy of BMW OF NORTH AMERICA, INC.

Arrangement of balance weights for light-alloy rims with distinctive J-shape rim flanges.

1. Spring retainer.
2. Balance weight.

Adhesive weights must be used on all other light-alloy rims.

Max, out-of-balance per wheel, refer to 36 10 WHEELS ONE-PART ALLOY WHEELS , 36 10 WHEELS STEEL AND ALUMINUM STRIP WHEELS or 36 10 WHEELS TWO-PART ALLOY WHEELS .

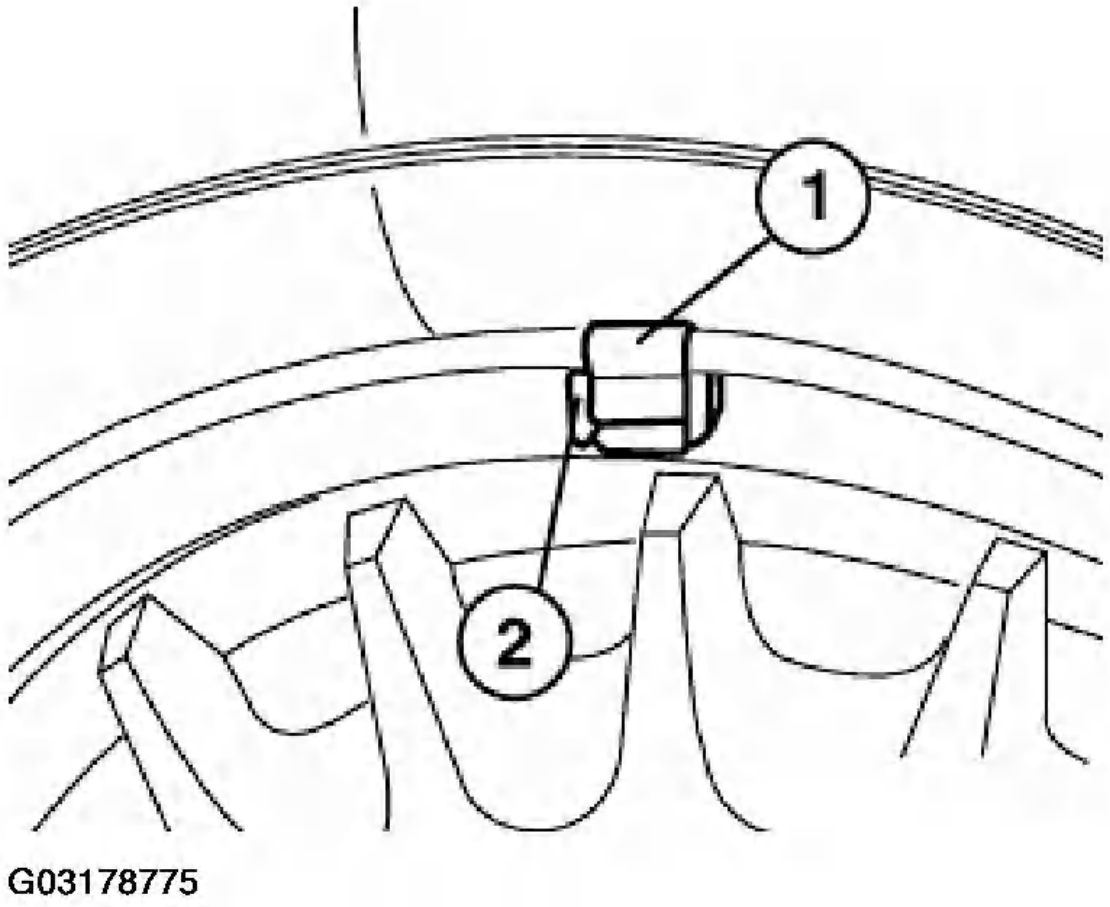


Fig. 20: Identifying Balance Weights Components
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: When using adhesive weights, proceed as follows:

1. Carefully remove old adhesive weights. Do not damage rim when doing so.
2. Select suitable location for fitting.
3. Clean adhesive area thoroughly.

36 10 713 CHECKING ONE ROAD WHEEL ON BALANCING MACHINE FOR FACE AND RADIAL RUNOUT (WHEEL REMOVED)

NOTE: For Special Tool identification, see SPECIAL TOOLS - Z3 .

Special Tools Required:

- 36 1 030
- 36 1 031
- 36 1 032
- 36 1 033
- 36 1 034
- 36 1 035
- 36 1 036

Remove wheel. Refer to 36 10 300 REMOVING OR INSTALLING FRONT OR REAR WHEEL .

Mount wheel in balancing machine.

In order to avoid transformation errors, the wheel must be mounted on the balancing machine in the same manner as subsequently mounted on the car (e.g. valve facing down).

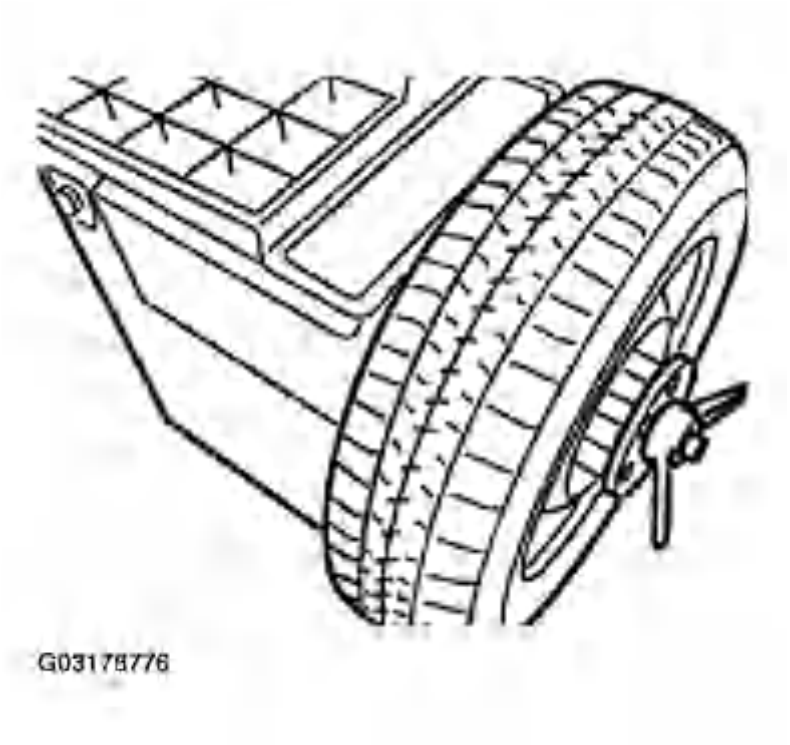


Fig. 21: Mounting Wheel In Balancing Machine
Courtesy of BMW OF NORTH AMERICA, INC.

Use suitable wheel center supplied with corresponding balancing machine.

1. Basic flange.
2. Center.
3. Type flange.
4. Clamping nut.

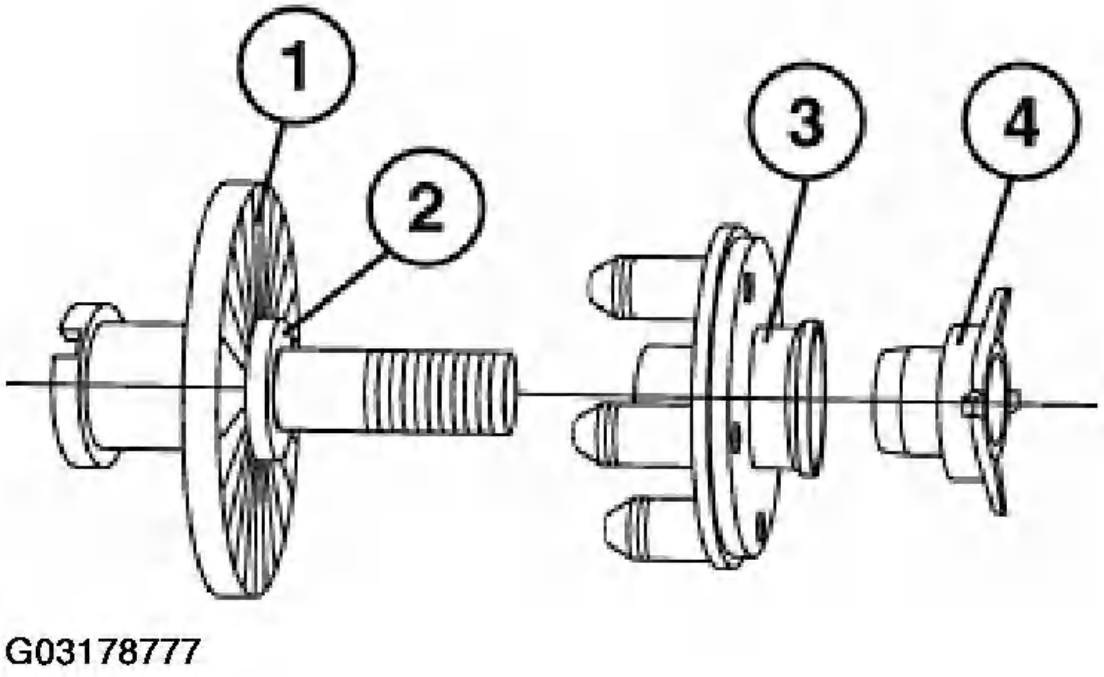


Fig. 22: Identifying Centering Elements Of Balancing Machine
Courtesy of BMW OF NORTH AMERICA, INC.

Use special tool 36 1 030 for testing.

Special tool 36 1 030 consists of:

1. Stand 36 1 031.
2. Post with clamp 36 1 032.
3. Holder with clamp 36 1 033.
4. Clamp 36 1 034.
5. Measuring roller 36 1 035.
6. Dial gauge 36 1 036.

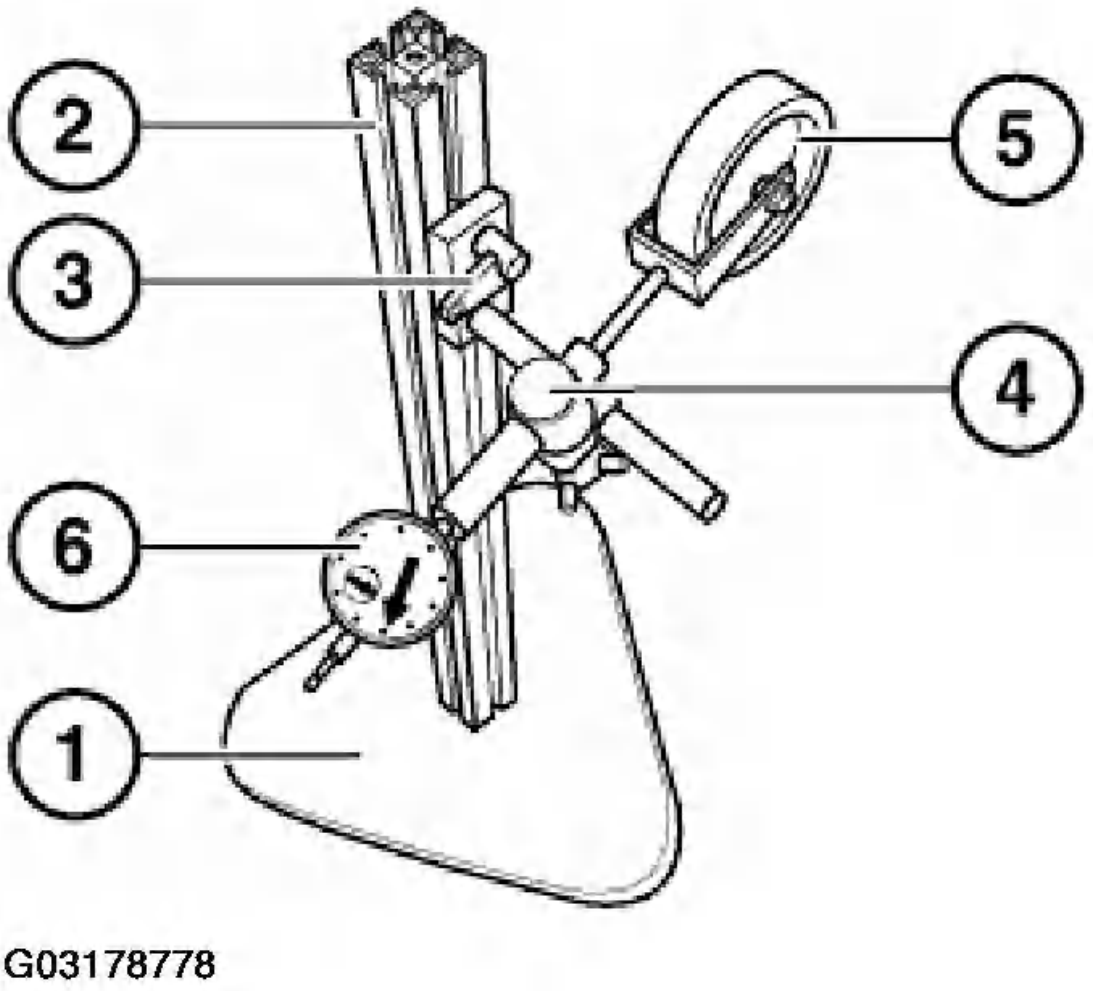


Fig. 23: Identifying Tester For Measuring Vertical And Lateral Runout
Courtesy of BMW OF NORTH AMERICA, INC.

Position special tool 36 1 030 on tire tread.

Turn wheel by hand and measure max. tire radial runout, refer to 36 10 WHEELS ONE-PART ALLOY WHEELS , 36 10 WHEELS STEEL AND ALUMINUM STRIP WHEELS or 36 10 WHEELS TWO-PART ALLOY WHEELS .

NOTE: Measuring device must be vertical to tire tread.

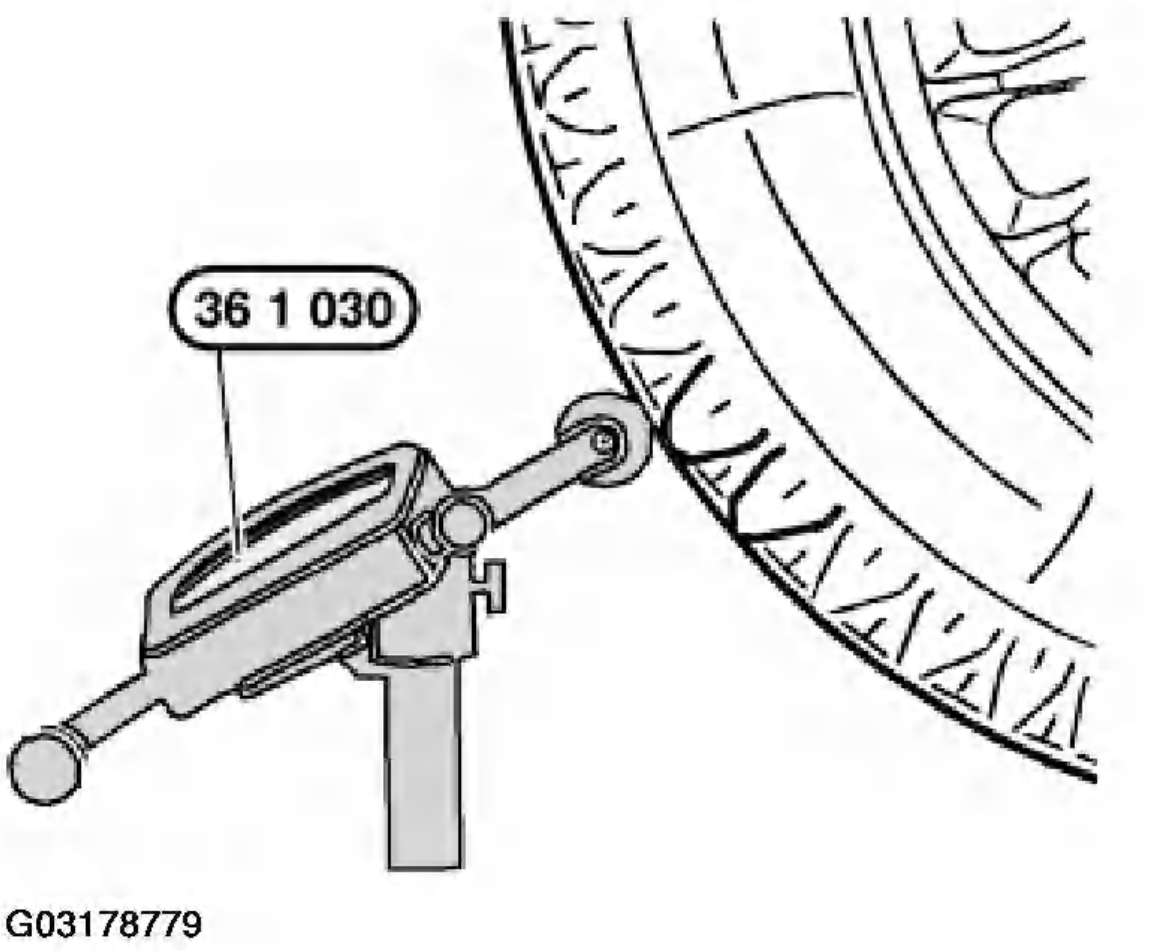


Fig. 24: Positioning Special Tool On Tire Tread
Courtesy of BMW OF NORTH AMERICA, INC.

Position special tool 36 1 030 on tire sidewall.

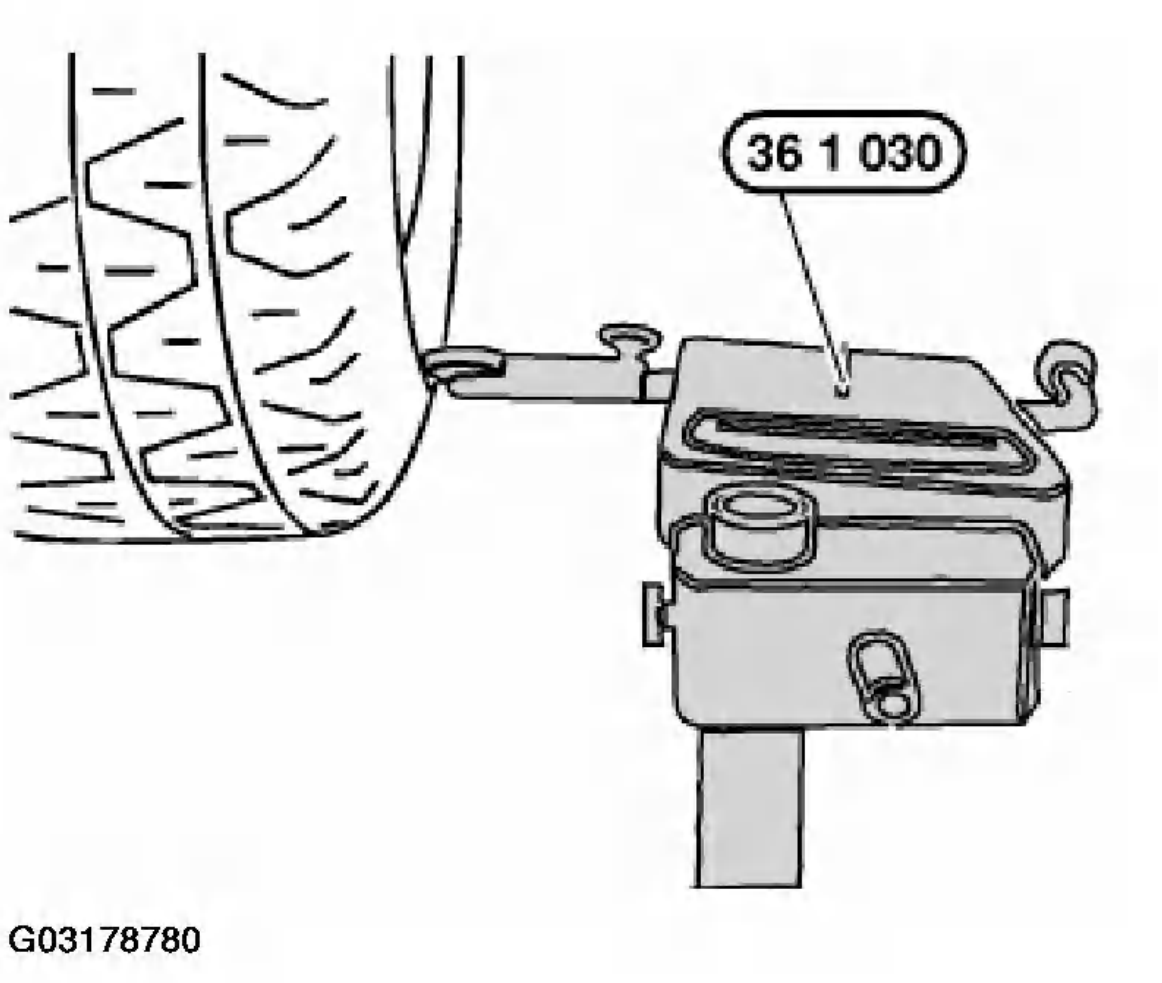


Fig. 25: Aligning Tire Runout Tester Against Sidewall
Courtesy of BMW OF NORTH AMERICA, INC.

Turn wheel by hand and measure max. tire face runout, refer to 36 10 WHEELS ONE-PART ALLOY WHEELS , 36 10 WHEELS STEEL AND ALUMINUM STRIP WHEELS or 36 10 WHEELS TWO-PART ALLOY WHEELS .

NOTE: Measuring device must be vertical to tire sidewall.

Never measure on printed text on tire!

If necessary, check disc wheel (rim) for radial and face runout. Refer to 36 10 715 CHECKING RIM FOR FACE AND RADIAL RUNOUT .

36 10 715 CHECKING RIM FOR FACE AND RADIAL RUNOUT

Remove wheel. Refer to 36 10 300 REMOVING OR INSTALLING FRONT OR REAR WHEEL .

Check front or back wheel for face and radial runout. Refer to 36 10 209 CHECKING FRONT AND REAR WHEEL FOR FACE AND RADIAL RUNOUT .

Pull tire off rim.

Remove fitted balancing weights.

Remove dirt from rim well and rim flange.

Mount disc wheel in balancing machine.

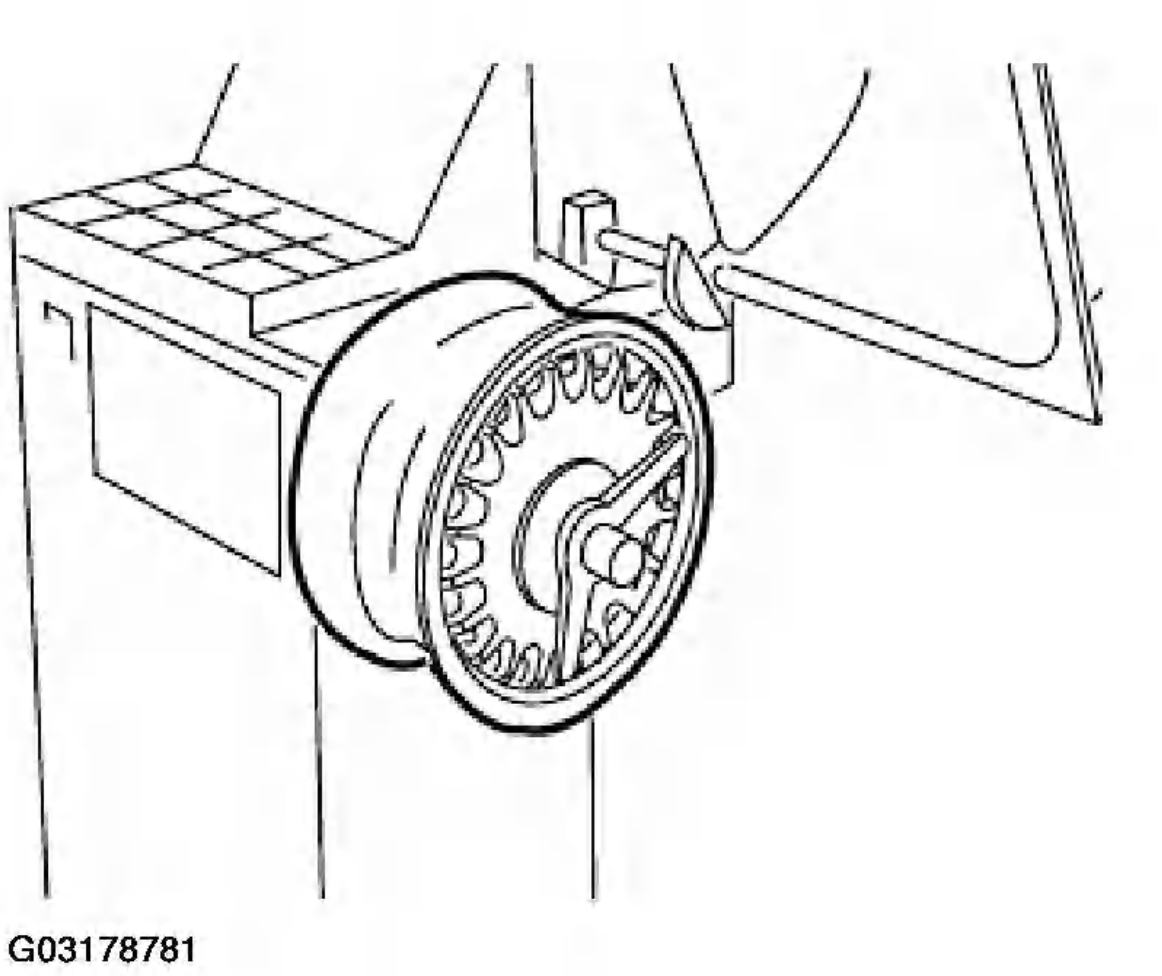


Fig. 26: Mounting Disc Wheel In Balancing Machine
Courtesy of BMW OF NORTH AMERICA, INC.

Use suitable wheel center supplied with corresponding balancing machine.

1. Basic flange.
2. Center.
3. Type flange.
4. Clamping nut.

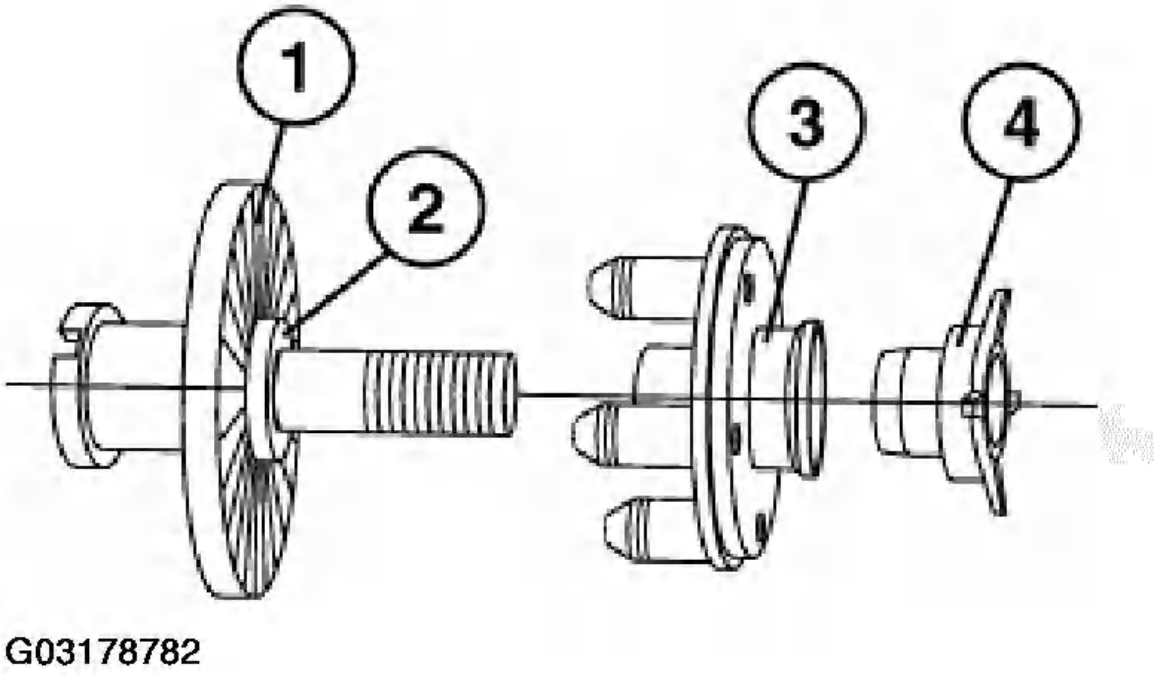


Fig. 27: Identifying Centering Elements Of Balancing Machine
Courtesy of BMW OF NORTH AMERICA, INC.

Place dial gauge sensor on rim shoulder.

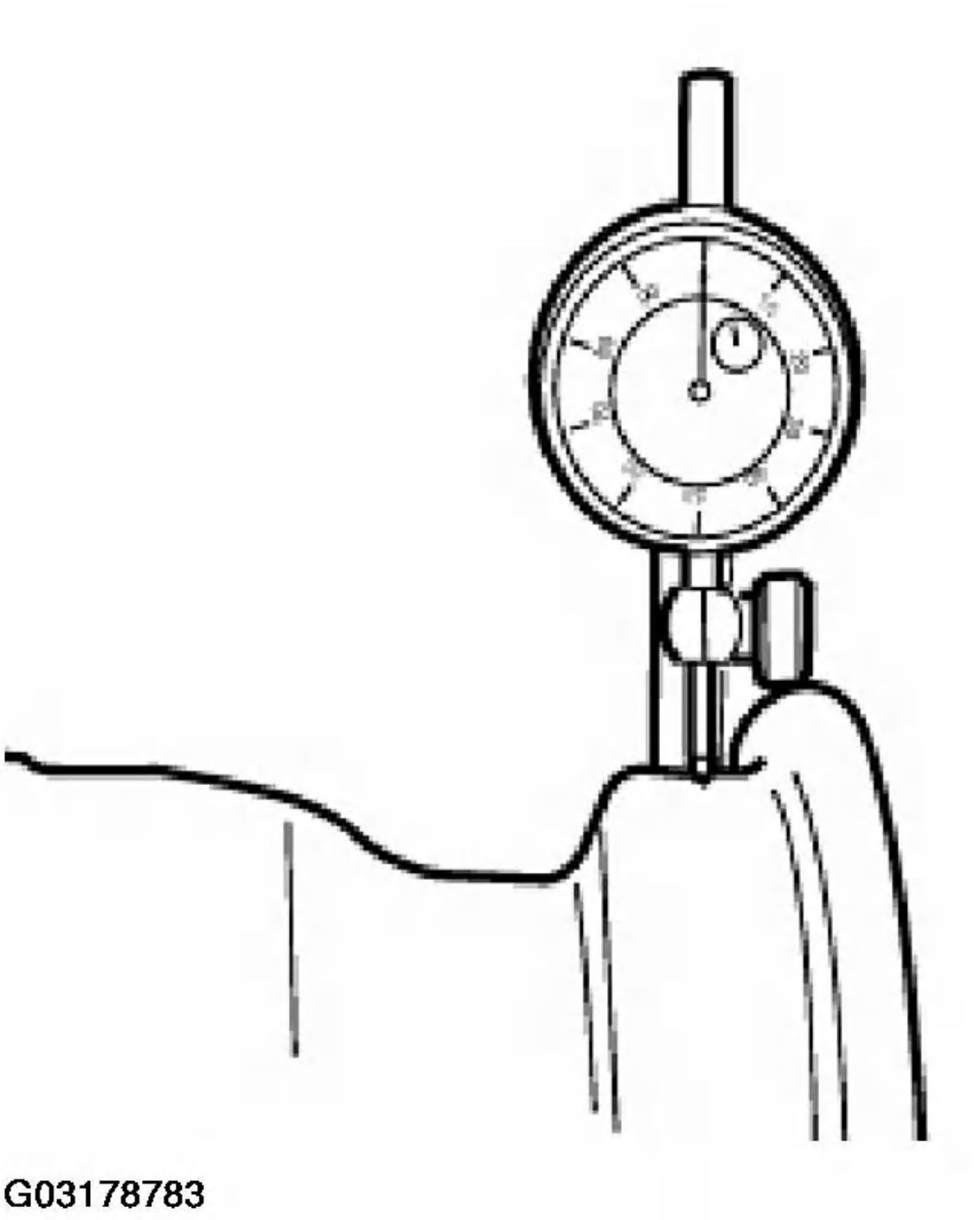


Fig. 28: Placing Dial Gauge Sensor On Rim Shoulder
Courtesy of BMW OF NORTH AMERICA, INC.

Turn wheel by hand and measure maximum radial runout, refer to 36 10 WHEELS ONE-PART ALLOY WHEELS , 36 10 WHEELS STEEL AND ALUMINUM STRIP WHEELS or 36 10 WHEELS TWO-PART ALLOY WHEELS .

Carry out measurement on both rim shoulder sides.

NOTE: Dial gauge must be vertical to rim shoulder.

Position sensor on rim flange.

Turn wheel by hand and measure maximum lateral runout, refer to 36 10 WHEELS ONE-PART ALLOY WHEELS , 36 10 WHEELS STEEL AND ALUMINUM STRIP WHEELS or 36 10 WHEELS TWO-PART ALLOY WHEELS .

Carry out measurement on both rim flanges.

NOTE: Dial gauge must be vertical to rim flange.

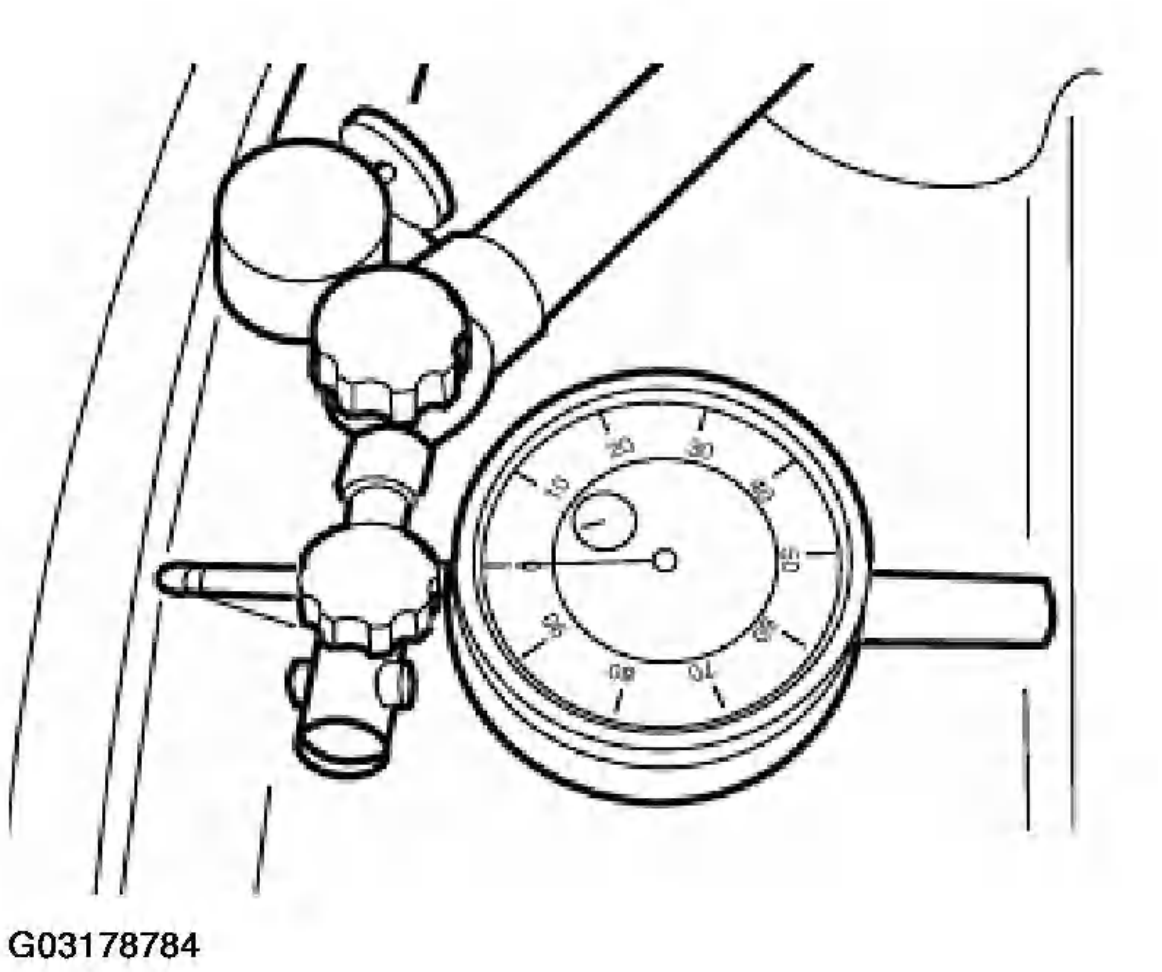


Fig. 29: View Of Dial Gauge Vertical To Rim Flange
Courtesy of BMW OF NORTH AMERICA, INC.

Important!

Avoid transformation errors during subsequent installation tasks. Refer to 36 10 508 STATIONARY WHEEL BALANCING (WHEEL REMOVED) .

TIRES

36 12 001 CHANGING A TIRE (ON FRONT, REAR OR SPARE WHEEL)

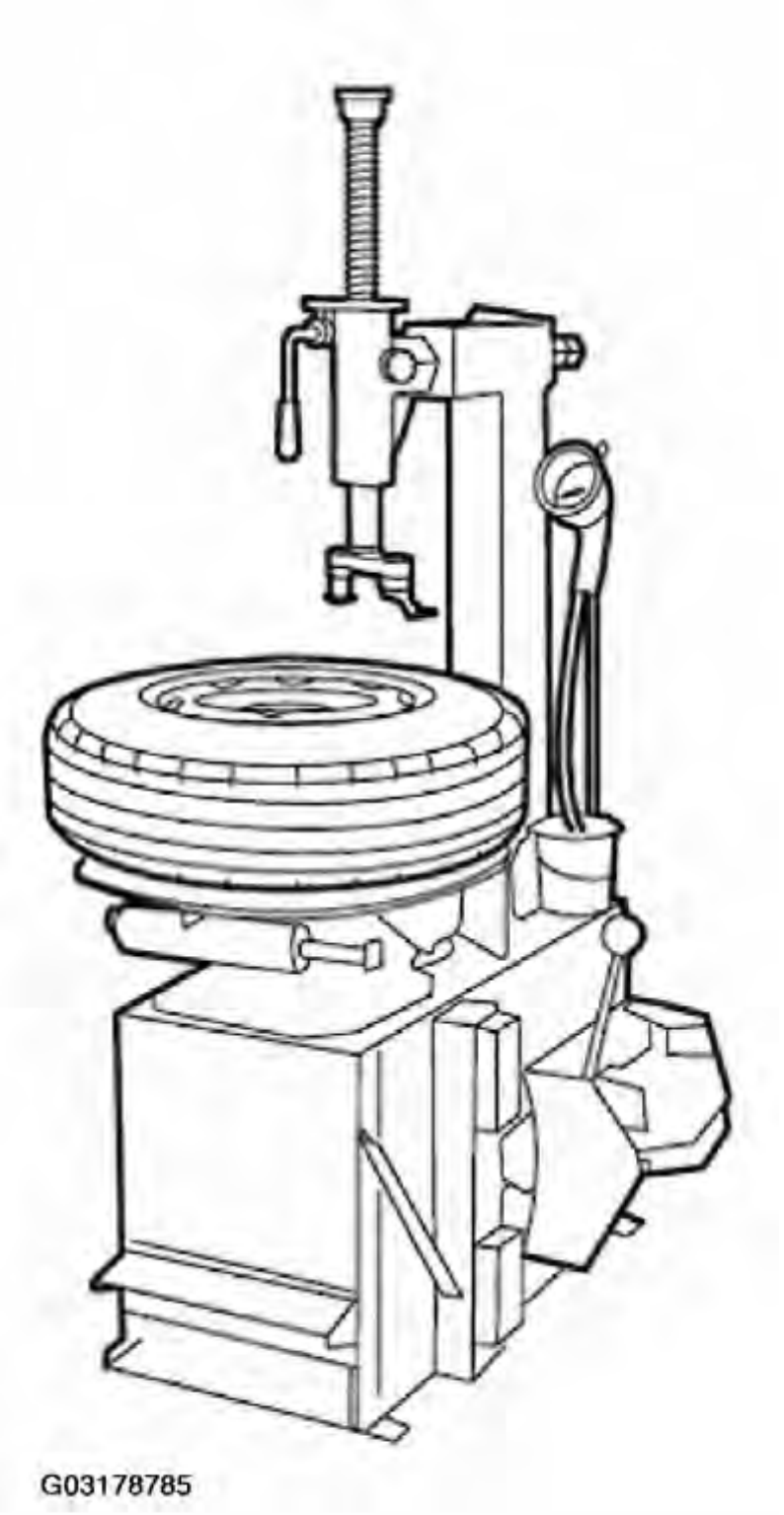


Fig. 30: Identifying Tire Changing Machine
Courtesy of BMW OF NORTH AMERICA, INC.

Refer to the operating manual of the relevant fitting equipment manufacturer for details on how to fit the tire correctly. The equipment must be in perfect condition to exclude the risk of damaging the disc wheel and the tire.

NOTE: Comply with approved tires, tire sizes and optional extra.

Models With M-Mobility System

If the tire was filled with the M-Mobility system after a puncture, it will be necessary before removal to drill an

approx. 25 mm dia. hole in the sidewall of the tire. Drain sealing fluid from this hole and dispose of this fluid in an environmentally responsible manner. Clean the disc wheel after removing the tire.

Tire Removal With A Fitting Machine:

Unscrew valve insert, discharge air, force off tire bead from rim flange with pressing-off horn of device on outside and inside.

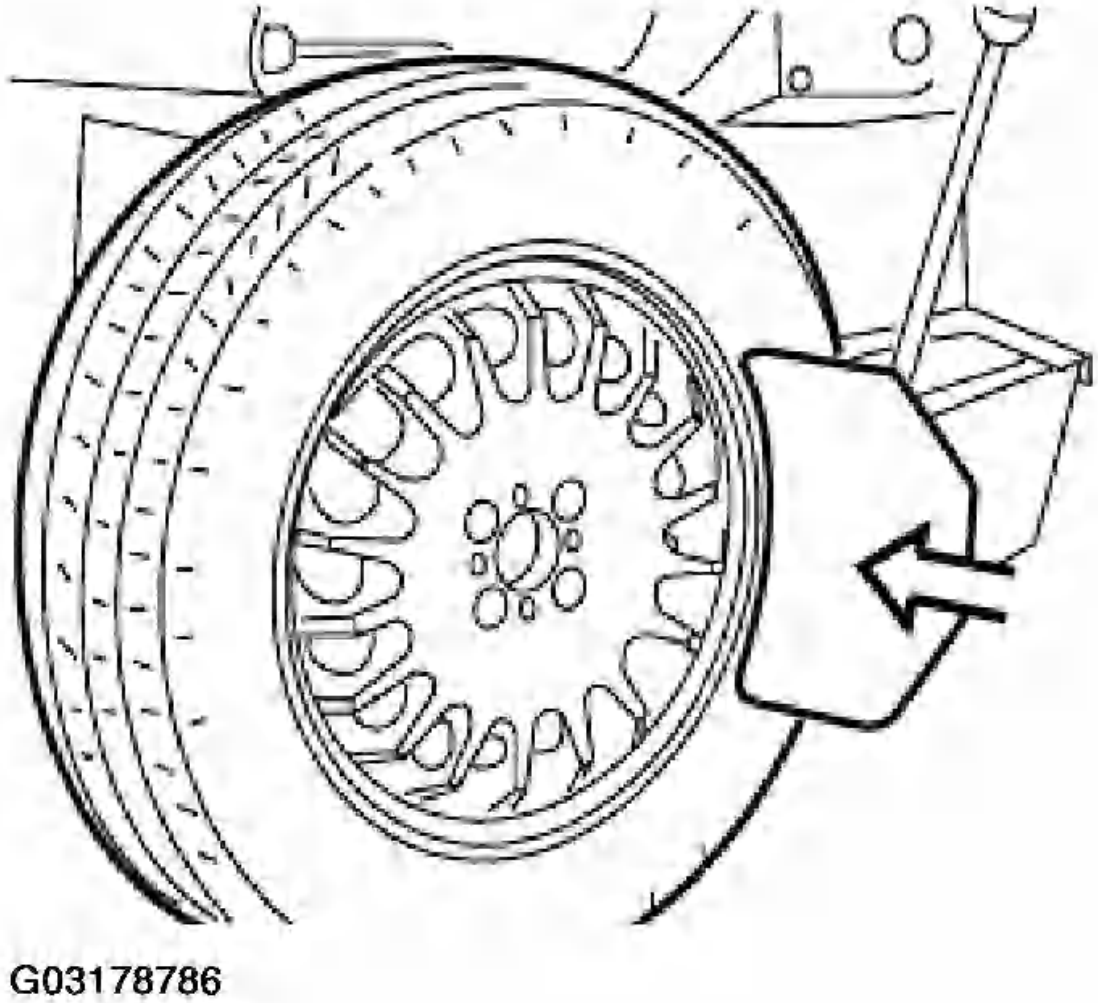


Fig. 31: Pressing Tire Bead Off Rim Flange
Courtesy of BMW OF NORTH AMERICA, INC.

If tire beads are stuck, first release the tire with the pressing-off horn at several points of the wheel before actually pressing off, apply tire mounting paste between tire and rim flange and press off the tires completely.

Pull off balance weights on rim and clean rim to remove large pieces of dirt.

Clamp wheel on mounting machine.

Narrow rim shoulder always faces upwards.

Important!

Vehicles With RDC:

To prevent the pressing-off horn from damaging the RDC wheel electronics, do not rest the pressing-off horn on both rim sides in the area of the valve.

Swing or fold mounting pillar into position and let it engage.

Adjust mounting head, pressing it on the rim edge fully, and turn down the lever for the clamp; normally the distance of the mounting head will set in automatically.

The valve must be approx. 15 cm to the right of the assembly head so as to prevent the tire iron from damaging the RDC wheel electronics.

Raise tire bead with tire iron over mounting finger.

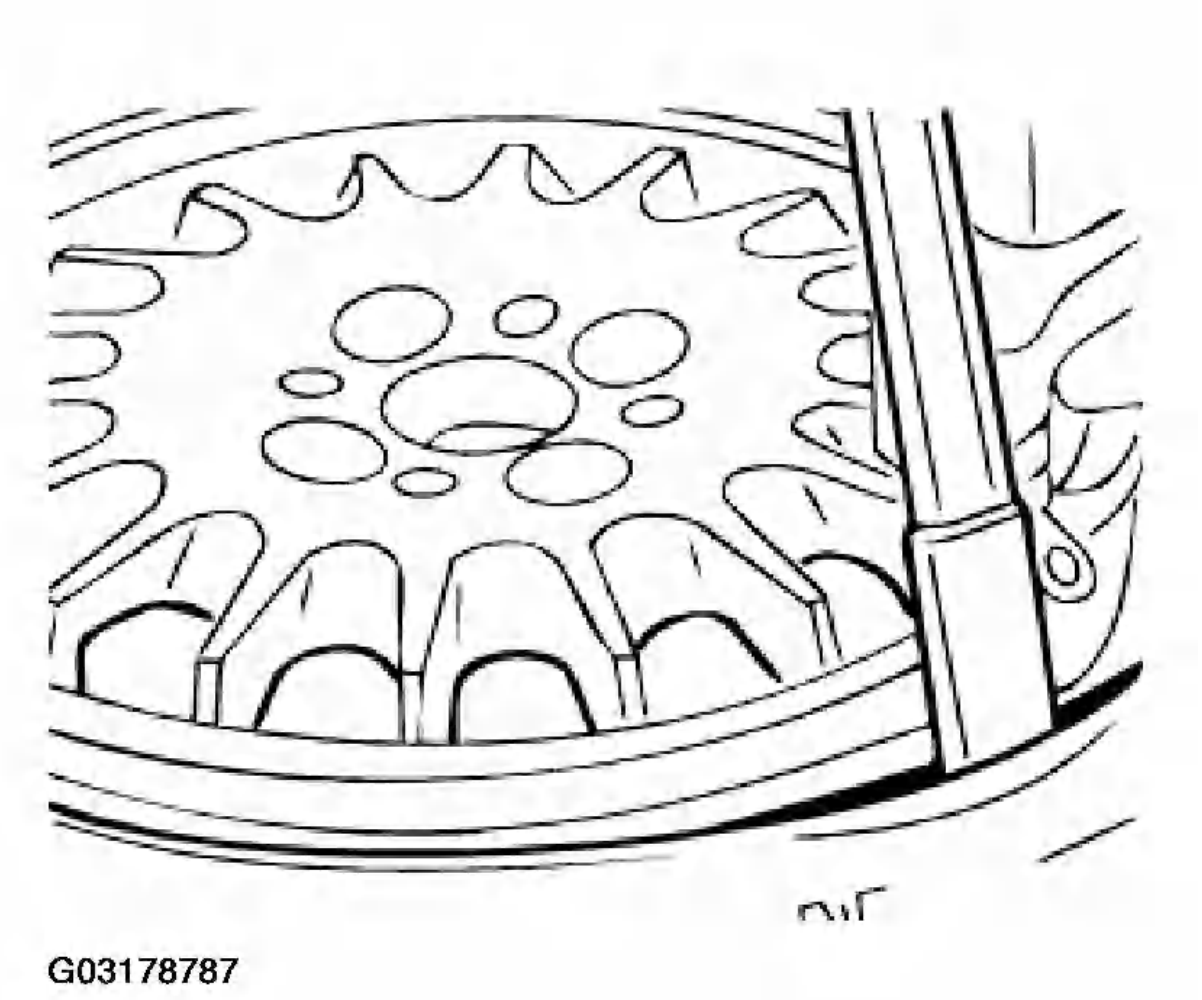


Fig. 32: Raising Tire Bead With Tire Iron
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: On aluminum rims, it is best to use a tire iron coated (either fully or partially) with shrink-on plastic tubing to prevent damage.

Let fitting machine run back a short distance (counterclockwise) so that tire bead can slide fully onto mounting finger.

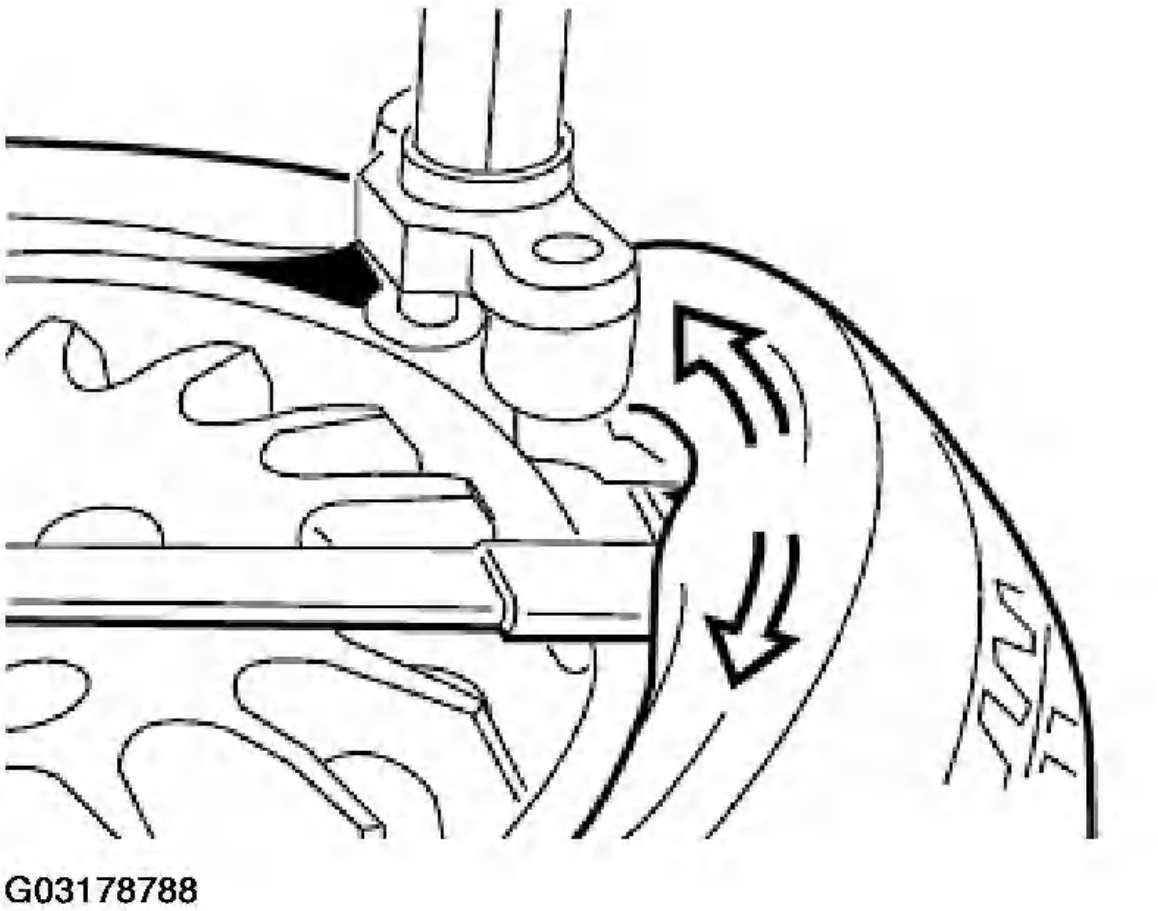


Fig. 33: Inserting Mounting Finger Under Upper Tire Bead
Courtesy of BMW OF NORTH AMERICA, INC.

Then let fitting machine run forward in stages (clockwise).

In so doing, always check whether the lower bead is fully resting in the well and allow the tire time to move.

If the bead clamps, stop the machine and let it run back slightly.

If the upper bead is pulled off the rim, also lift the bottom bead over the mounting finger with the tire iron.

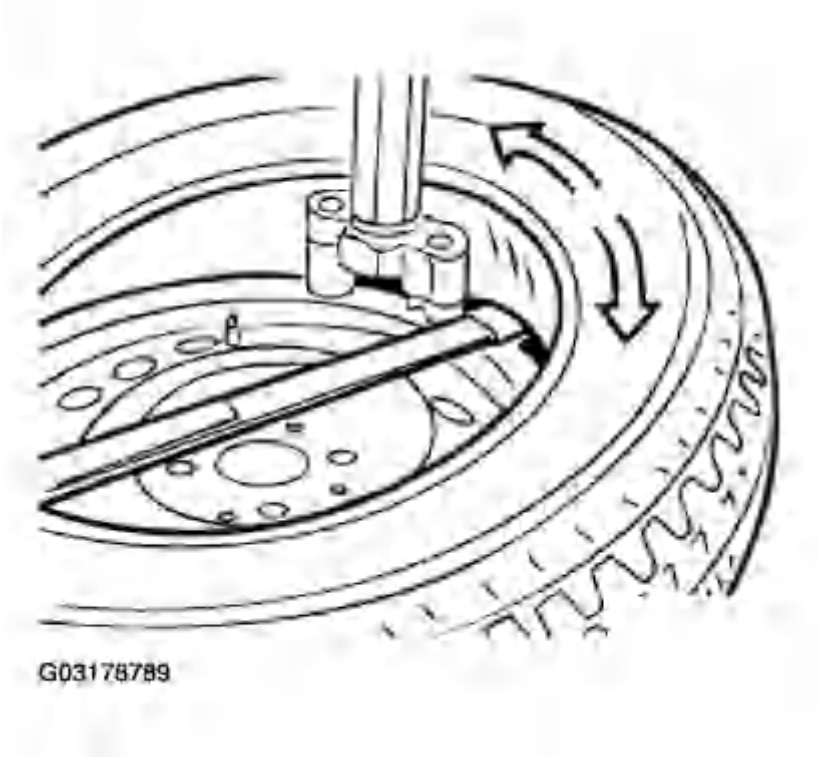


Fig. 34: Inserting Mounting Finger Under Lower Tire Bead
Courtesy of BMW OF NORTH AMERICA, INC.

Let machine run back a short distance again and then forward (clockwise) briefly until there is complete separation of the tire from the rim.

Important!

Vehicles With RDC:

Tire bead must not press onto RDC wheel electronics.

Release lock and tilt back or swing away mounting pillar.

Unclamp and clean rim.

Replace valve.

Coat rim flange and tire beads with mounting paste.

Important!

Vehicles with RDC:

When the wheel electronics are installed, the rim must not be cleaned with high-pressure cleaning equipment.

Visually inspect wheel electronics for external damage and check for tight fit; do not retighten screw and union nut. If valve parts are loose, the complete valve must be replaced.

Keep wheel electronics free of tire mounting paste.

Clamp rim on fitting machine, valve must be located at 180Â° to mounting head.

Slide on tire with lower bead partially over rim flange.

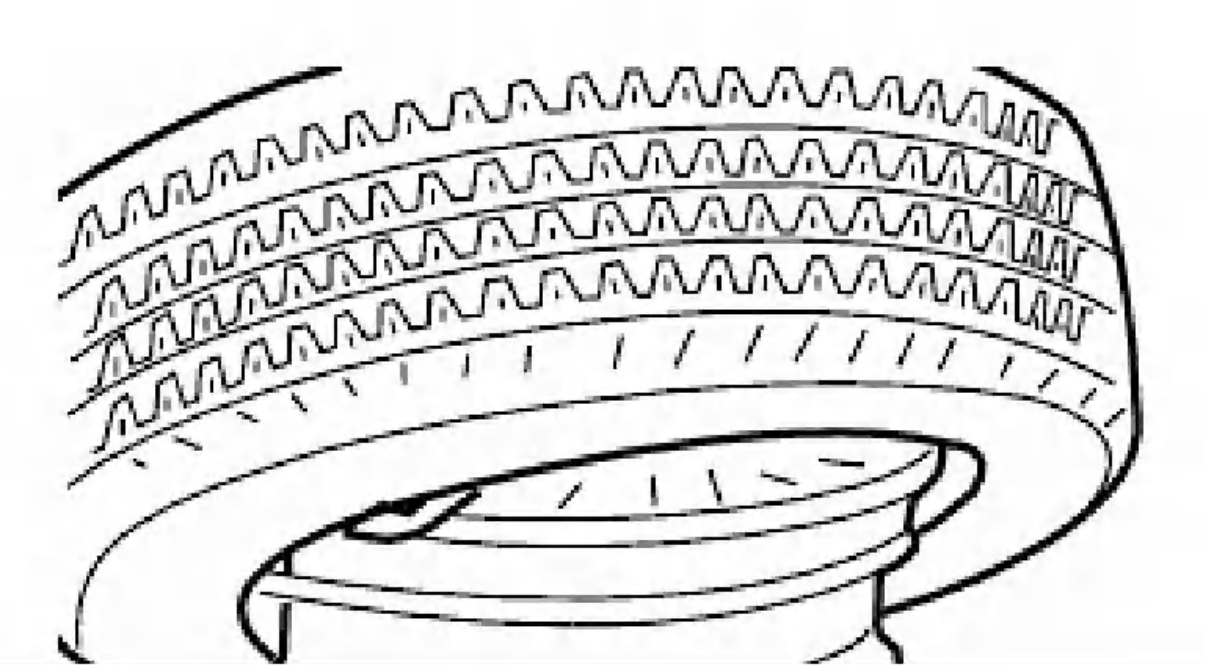


Fig. 35: Sliding Lower Bead Over Rim Flange
Courtesy of BMW OF NORTH AMERICA, INC.

Swing or tilt mounting pillar into position and lock.

Check adjustment of mounting finger, readjusting if necessary, and clamp.

Press tire under mounting finger by hand.

Tire bead must seat in rollers next to mounting finger.

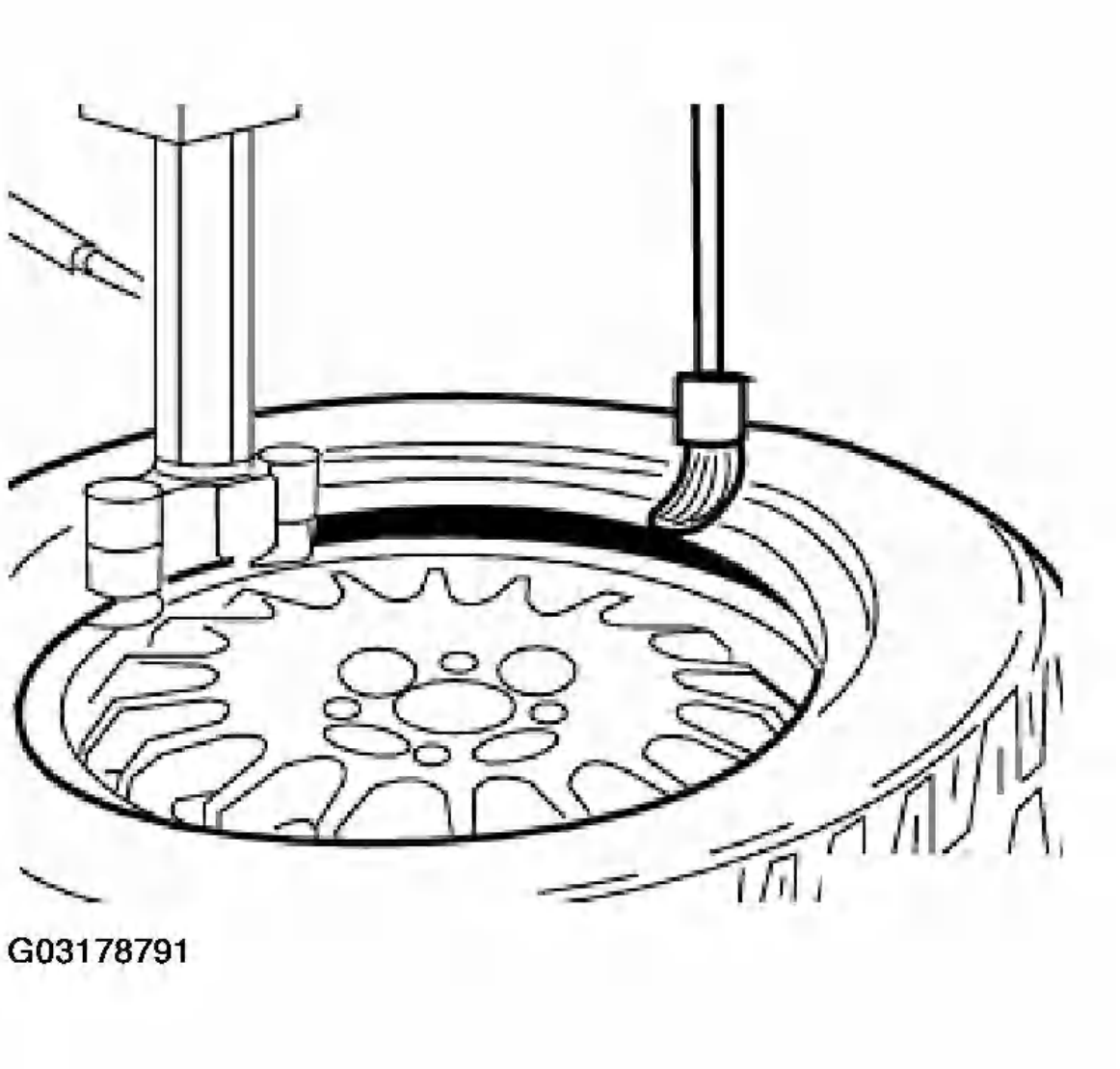


Fig. 36: Tire Bead Seated In Rollers Next To Mounting Finger
Courtesy of BMW OF NORTH AMERICA, INC.

Let fitting machine run forward (clockwise) a short distance.

Lower tire bead will drop into well.

Important!

Vehicles With RDC:

Fit lower tire bead so that no pressure forces are exerted on RDC wheel electronics.

Turn wheel again into fitting position so that valve is at 180Â° to mounting head.

Press upper tire bead under mounting finger. Bead must seat in rollers next to mounting finger.

Important!

Do not pinch or damage bead.

Operate fitting machine forwards (clockwise) little by little; while doing so, make sure the lower tire bead remains in the well.

Fig. 37: Pressing Upper Tire Bead Under Mounting Finger
Courtesy of BMW OF NORTH AMERICA, INC.

Important!

Vehicles With RDC:

Fit upper tire bead so that no pressure forces are exerted on RDC wheel electronics.

After mounting, first release clamps and then inflate tire (without valve).

Fig. 38: Identifying Uninflated Tire On Rim
Courtesy of BMW OF NORTH AMERICA, INC.

Increase pressure up to 3.3 bar (330 kPa) in steps (jumping pressure).

If the tire bead does not slip on all round at the rim edge, do not increase pressure further but rather drain off air.

Press off tire bead again, coat rim flange again with tire mounting paste, and pump up again to 3.3 bar. When the beads are resting properly on the rim shoulders, increase inflation pressure to max. 4.0 bar to "settle" the tire.

Screw in valve and correct tire pressure.

MOUNTING

36 13 SUBSEQUENT INSTALLATION OF WHEEL-BOLT LOCK

Loosen wheel bolts.

Lift car until wheel can be turned.

Loosen wheel bolts enough for it to be easy to move wheel on wheel hub.

Turn wheel so that valve is face down.

Fig. 39: Aligning Wheel With Valve Facing Downwards
Courtesy of BMW OF NORTH AMERICA, INC.

Remove upper wheel bolt and insert wheel-bolt lock.

Possible play in wheel center and wheel weight could cause imbalance.

This imbalance is reduced to a minimum by installing the somewhat heavier wheel-bolt lock in the top wheel-bolt position.

Fig. 40: Identifying Top Wheel-Bolt Position
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten wheel bolts crosswise and by hand in this position (wheel-bolt lock at top, valve at bottom).

Lower car and tighten wheel bolts crosswise.

For tightening torque, refer to WHEELS .

Should a customer complain about wheel imbalance after installation of wheel-bolt lock, wheels will have to be finish-balanced.

OPERATING FLUIDS

Operating Fluids - Front Axle - All Models

1.0 GENERAL INFORMATION ON HIGH TEMPERATURE MULTI-PURPOSE GREASE

High temperature multi-purpose grease consists of a lithium complex soap in a mineral oil product with a selected combination of additives. Extremely fine soap is contained in the oil, and serves as the basic ingredient.

This lubricating grease possesses the following properties:

- Very good thermal resistance and penetration stability

  The structure and consistency must be maintained over long service life with temperatures from -22Â°F to +302Â°F (-30Â°C to +150Â°C) in continuous operation and very high loads.

- Oxidation stability

  A lubricating grease contains effective inhibitors (which limit or prevent chemical reactions) in order to stop oxidation at very high operating temperatures.

- Water resistance and corrosion inhibition

  A high temperature multi-purpose grease is water resistant. At the same time lubricated parts are given maximum protection against rust by the corrosion inhibitors.

2.0 APPROVED HIGH TEMPERATURE MULTI-PURPOSE GREASE

High temperature multi-purpose grease is used for the lubrication of wheel bearings.

BALL BEARINGS (E24 FROM MID 1982, E28, E30, E31, E32 AND ALL FOLLOWING)

Provided with lifetime lubrication.

No subsequent lubrication approved!

TAPERED ROLLER BEARINGS (E23, E21)

50 grams grease packing in wheel hub and 20 grams in wheel hub grease cap per wheel.

Grease type: Retinax A

CRC Part No. SL 3131 (former BMW Part No. 81 22 9 407 710)

3.0 APPROVED FRONT AXLE FINAL DRIVE OILS

Approvals are the same as for rear axle final drive oils. Refer to REAR AXLE .

Article GUID: A00217933

APPROVED HYDRAULIC FLUIDS

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 Â°C to +75 Â°C.

E24, E28, E32, E34, AND E38

E24, E28 produced prior to 9/87

Pentosin CHF 4548 was used for initial factory filling.

For filling up and replacement the following oil is to be used:

Pentosin CHF 7.1 BMW Part No. 81 22 1 468 879

Pentosin CHF 4548 and CHF 7.1 can be mixed in these cars.

For complete system oil replacement:

Reputable brand name LHM oils (green color) can also be used (Shell, Castrol, Exxon, etc.)

NOTE: Mixing of CHF and LHM oils is not permitted.

E24, E28 produced since 9/87

Pentosin CHF 7.1 is used for initial factory filling.

For filling up and replacement use only Pentosin CHF 7.1

BMW Part No. 81 22 1 468 879

For complete oil replacement:

Reputable brand name LHM oils (green color) can also be used.

NOTE: Mixing of CHF 7.1 and LHM oils is not permitted.

E32 produced prior to 9/91

Use only Pentosin CHF 7.1.

Mixing with other oils is not permitted.

E32, E34 produced since 9/91

Use only Pentosin CHF 11S

NOTE: All cars have a label indicating the respective type on the hydraulic fluid reservoir. Since both Pentosin CHF 11S and CHF 7.1 are green in color, the reservoir label must be carefully checked prior to adding fluid.

Mixing CHF 11S and CHF 7.1 is not permitted.

Pentosin CHF 11S BMW Part No. 82 11 1 468 041

E38 produced since 1/94

Use only Pentosin CHF 11S

NOTE: All cars have a label indicating the respective type on the hydraulic fluid reservoir. Since both Pentosin CHF 11S and CHF 7.1 are green in color, the reservoir label must be carefully checked prior to adding fluid.

Mixing CHF 11S and CHF 7.1 is not permitted.

Pentosin CHF 11S BMW Part No. 82 11 1 468 041

LHM HYDRAULIC FLUID

LHM hydraulic fluid has a favorable viscosity range and permits problem-free operation of the self-leveling rear suspension at very low and very high temperatures. The solidification point is -78Â°F/-61Â°C.

CHECKING HYDRAULIC FLUID LEVELS

The hydraulic fluid level must be checked on an unloaded car and at every Inspection I or, for cars without a Service Indicator, at 10, 000 mi/15, 000 km intervals.

NOTE: Not required as of 1993 model year vehicles.

Special checking instructions apply to the E32 - always refer to the latest edition of the Repair Instructions.

NOTE: Never fill above the " max" mark. There are no replacement intervals for hydraulic fluid.

Article GUID: A00217941

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 Â°C to +75 Â°C.

BALL AND NUT OR RACK AND PINION POWER STEERING

Only reputable brand Automatic Transmission Fluid (ATF) of DexronÂ® 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

KINEMATIC DIAGNOSIS SYSTEM AND ENVIRONMENT

BMW KDS (Beissbarth)



Fig. 1: Identifying Kinematic Diagnosis System And Environment
Courtesy of BMW OF NORTH AMERICA, INC.

1. FOREWORD

1.1 Objectives

Wheel alignment has become an increasingly complex subject. The aim of this BMW Service Technology bulletin, therefore, is to achieve several objectives:

- Creation of guidelines for working with the BMW Kinematic Diagnosis System (KDS).
- Familiarization with wheel alignment technology for current vehicles and clarifying any questions which arise in this connection.
- Transparency and clarification of different terms.
- Clarification of the causes of errors in the past, such that they can be avoided after reading this document.
- Creation of conditions for dealing safely with the BMW KDS.

1.2 Further development of the BMW Kinematic Diagnosis System

- The BMW Kinematic Diagnosis System is an integrated part of automotive system concepts. It ensures

that work is carried out in a particularly rational manner which is appropriate for BMW requirements, such that you can also be certain of being prepared for future technological developments. As far as precision and performance in wheel alignment and tuning is concerned, BMW, together with leading manufacturers, has made the best of what is technically feasible: the BMW Kinematic Diagnosis System.

- The BMW Kinematic Diagnosis System manufactured by Beissbarth is more than just the further development of conventional wheel alignment equipment. It sets new standards in precision, performance, speed and handling. It is a guarantor for the perfection which BMW service customers rely on.
- Ride comfort, road safety and tire wear depend to a large extent on the perfect interplay of the vehicle's kinematic functions. BMW is constantly launching new generations of chassis which are even better than their predecessors. This is why there are fewer kinematics system adjusting points and narrower tolerances when measuring and tuning the chassis.
- With the use of the multi-link rear suspension and the E36, the electronic wheel alignment devices are no longer suitable for BMW wheel alignment purposes. This applies to both the measuring procedure and measuring precision. The generation of equipment which was approved with the E36 series still fulfils all the requirements placed on a modern wheel alignment device, including the use of the latest computer technology.
- Only BMW Kinematic Diagnosis Systems manufactured by Beissarth and Bosch may be used for wheel alignment.

1.3 Technical Data



Fig. 2: Technical Data Display
Courtesy of BMW OF NORTH AMERICA, INC.

BMW KINEMATIC DIAGNOSIS SYSTEM - TECHNICAL DATA SPECIFICATIONS

1)	Display	- 17" graphic screen with high-resolution graphics (640x480 pixels with 256 colors)
2)	On-screen text	- In the appropriate national language
3)	Wheel dimensions	- 12"...20"
4)	Vehicle memory locations	- Unlimited
5)	Rotating plates	- Load bearing capacity 1000 kg, angle of rotation +/- 360Â°, 450 x 450 x 50 mm (L x W x H), sliding range +/- 50 mm, weight 18 kg
6)	Sliding plates	- Loadbearing capacity 1000 kg, angle of rotation +/- 10Â°, 450x450 x 50mm (L x W x H)
7)	Electrical connection	- 100...115 V/220...240V 50/60 Hz, 0.5 kW (other connections on request)

1.4 Scope Of Delivery

1 - PC display device with graphic screen, graphical tablet, small or large equipment cabinet including automatic charging station, DIN A4 dot matrix printer

4 - Measuring sensors with CCD camera technology and infrared data transmission with built-in power supply

1 - Cable set (comprising 4 cables)

1 - Brake clamping device

1 - Steering lock device

2 - Electronic precision rotating plates with integrated sensor without access ramps

2 - Sliding plates without access ramps

4 - BMW quick-clamping units, comprising a P8-68 locating bell and P267 01 quick-acting clamp including coated holding claws

1 - Operating instructions for BMW KDS (8 languages)

1 BMW software and the BMW vehicle set-point data with setting screens as well as text for the measurement preparations

1.5 Accessories Required

2 Locating rods for positioning the vehicle

1 Set of sand bags for the prescribed loading

1.6 Accessories recommended

4 - Quick-clamping units

2 - Sets of access ramps

1 - Remote control display

1 - Trolley (for ballast bags, rotating and sliding plates and 4 quick-acting clamps)

2. MEASURING OPTIONS USING THE BMW KINEMATIC DIAGNOSIS SYSTEM

2.1 Front Axle

- Toe-in (single and total toe-in in relation to the geometrical drive axis)

- Camber (with steering wheel pointing straight ahead)
- Wheel displacement (in relation to the left-hand front wheel)
- Castor, kingpin inclination and toe-differential angle

2.2 Rear Axle

- Toe-in (single and total toe-in in relation to the longitudinal center plane of the vehicle -> previously called symmetrical axis)
- Geometrical drive axis
- Camber

2.3 Other Measuring Options

- Rear Wheel Displacement
- Wheelbase Difference
- Lateral Displacement On Right
- Lateral Displacement On Left
- Track Difference
- Axial Displacement

3. SYSTEM DESCRIPTION

3.1 BMW Kinematic Diagnosis System 1, Based On The Beissbarth ML4000

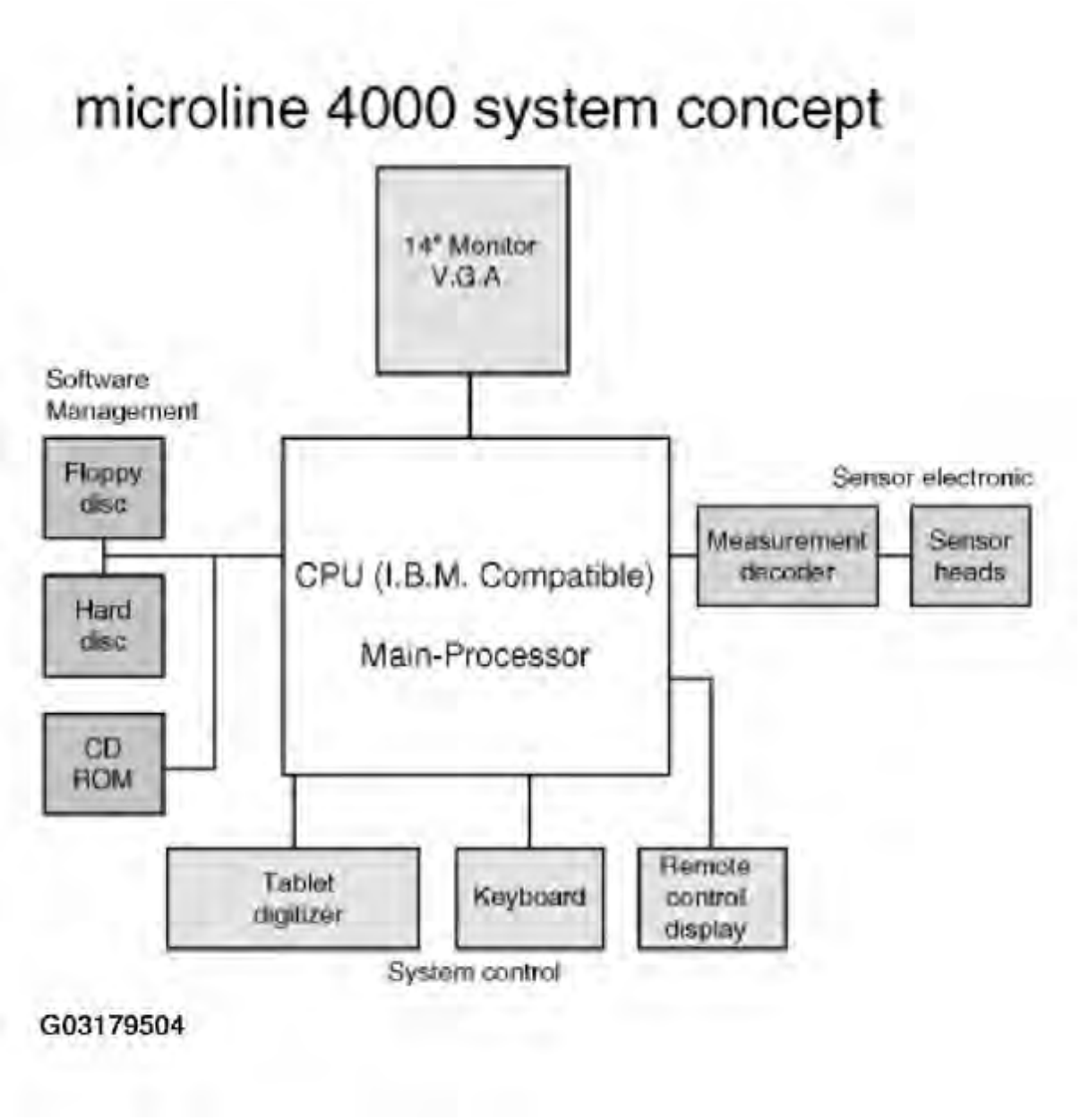


Fig. 3: BMW Kinematic Diagnosis System Concept Chart
Courtesy of BMW OF NORTH AMERICA, INC.

The KDS 1 is available in two different designs at no extra charge:

1. Mobile Workstation



Fig. 4: Identifying Mobile Workstation
Courtesy of BMW OF NORTH AMERICA, INC.

2. Mobile Compact Cabinet



Fig. 5: Identifying Mobile Compact Cabinet
Courtesy of BMW OF NORTH AMERICA, INC.

The larger workstation offers a small storage area for accessories, whilst the compact cabinet is mobile and ideal for restricted working areas. Both variants can be supplied as a cableless measuring system (infrared). From the point of view of measuring technology, there is only a difference in the handling and equipping of the system. For both designs, the four measuring sensors are stored in integrated inserts with rechargeable battery charging points. When automatically charged over night, the measuring sensor batteries provide enough power for 10 hours of continuous use.

3.2 Computer

The KDS 1 system comprises tested and reliable industrial components. The computer is an IBM-compatible, 32-bit Intel processor with CD ROM drive to the industry standard.



Fig. 6: Identifying System Comprises Tested And Reliable Industrial Components
Courtesy of BMW OF NORTH AMERICA, INC.

3.3 Graphical Tablet

All functions are shown in graphical form on a "pictogram" panel. The panel is protected by a plexiglass cover. It can easily be replaced if more extensive design modifications are necessary. The operator interface has no membrane and is thus protected against damage. The main functions are activated by clicking the icon with the digital pen.

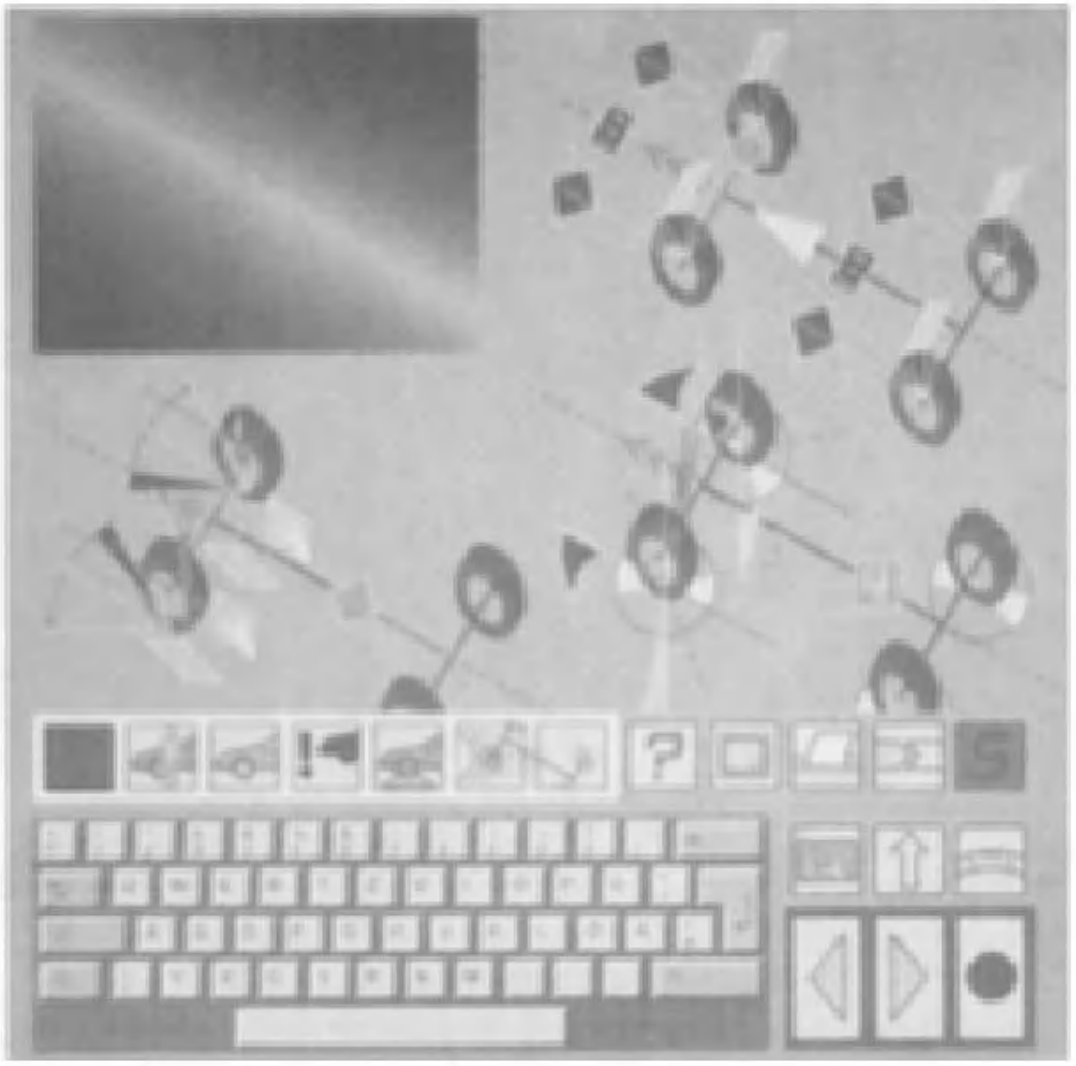


Fig. 7: Identifying Graphical Tablet
Courtesy of BMW OF NORTH AMERICA, INC.

3.4 Equipment Cabinet

The PC with graphic monitor and removable operating panel, supports for the measuring sensors, the remote control and the A4 printer are integrated into the workstation. The charging station is located in the cabinet and can also be connected to the measuring sensors and the remote control using the plug-in cables (operating while simultaneously charging the batteries).

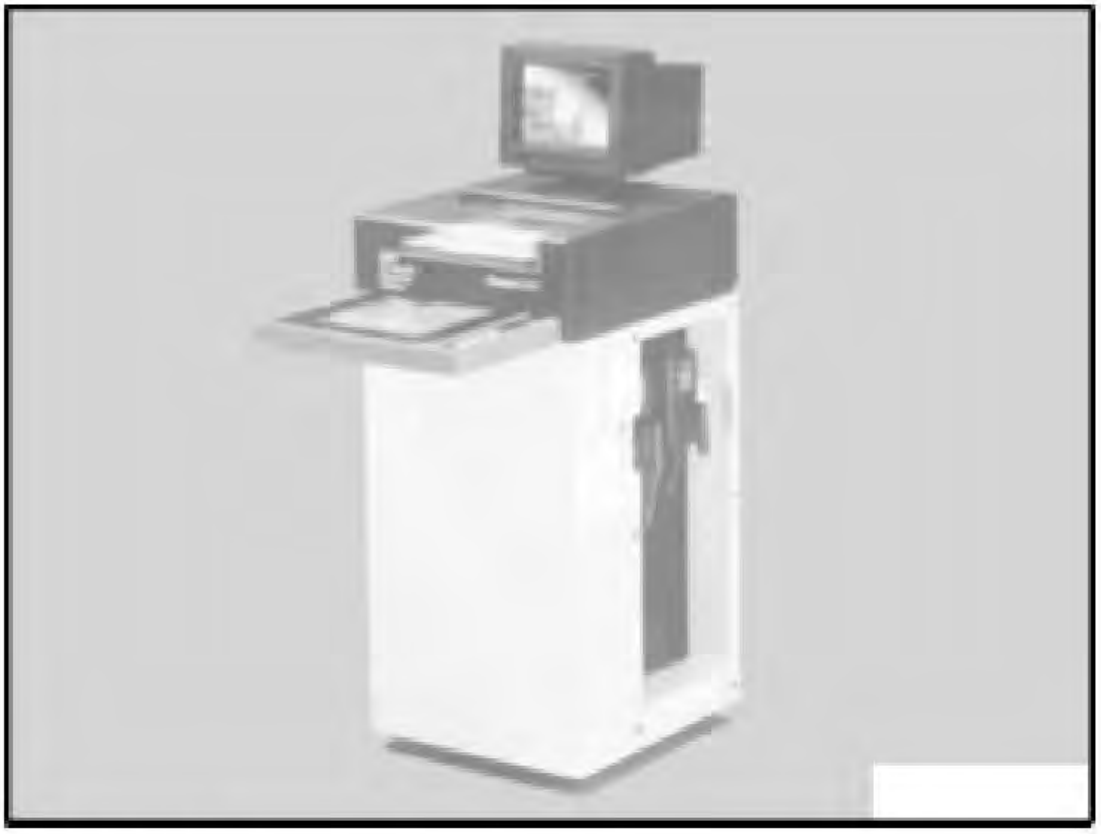


Fig. 8: Identifying Equipment Cabinet
Courtesy of BMW OF NORTH AMERICA, INC.

3.5 Remote Display

A cableless remote display can be supplied on request. The remote control keys are only active during measuring and adjustment (not for customer data input, or if selecting a vehicle or editing the setpoint data etc.). The following displays are supported by the remote control:

- Measured value with setpoint/actual comparison and tolerance bar
- Steering graphics for steering routines
- Live overview of the track/camber values with a setpoint/actual comparison
- Rim run-out compensation



Fig. 9: Identifying Remote Display
Courtesy of BMW OF NORTH AMERICA, INC.

3.6 Measuring Sensors With CCD Camera

The measuring sensors are each equipped for automatic measurement with two CCD cameras and their own processor for the cableless infrared transmission of data with integrated batteries. Benefits:

- No temperature deviation
- Very high measuring resolution (the track
- Single track range of more than +/- 9 degrees for the constant display of toe-in when changing the tie-rod ends
- Exact system accuracy, i.e. when carrying out measurements at the vehicle following rim run-out compensation, the toe-in and camber measurements are accurate to 2 angular minutes



Fig. 10: Measuring Sensors With CCD Camera
Courtesy of BMW OF NORTH AMERICA, INC.

3.7 BMW Quick-Acting Clamp

BMW quick-acting clamp for holding the measuring sensors precisely in position and measuring without rim run-out compensation.

NOTE: Any existing quick-acting clamps, e.g. from older F1600s or ML-3000s, must not be used on the BMW KDS.

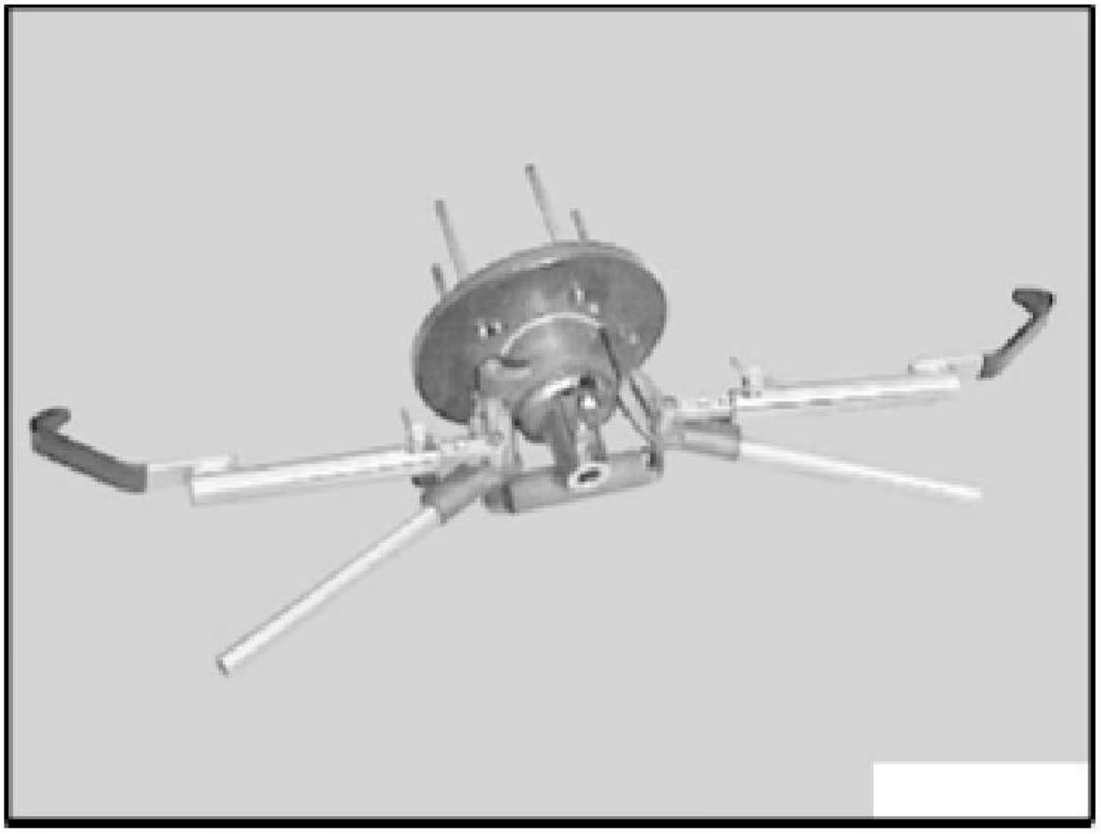


Fig. 11: Measuring BMW Quick-Acting Clamp For Holding
Courtesy of BMW OF NORTH AMERICA, INC.

3.8 Rotating/Sliding Plates

- Electronic precision rotating plates for the front wheels with integrated sensor (360 degree measuring range)
- Stable sliding plates for the rear wheels with a swivelling/rotating top plate
- Accessories: Cover hood for aluminum rotating plates

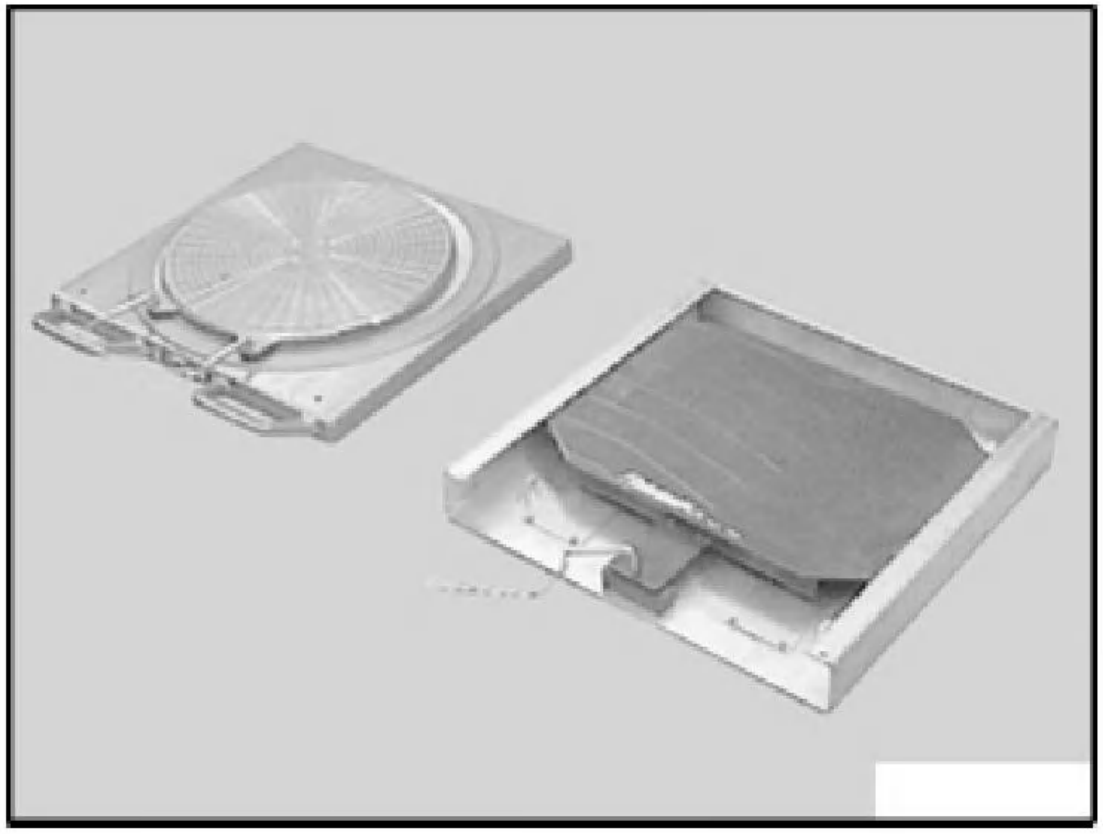


Fig. 12: Identifying Rotating/Sliding Plates
Courtesy of BMW OF NORTH AMERICA, INC.

3.9 Sensor Pins

- A new BMW light alloy wheel (styling no. 18) has been available as optional equipment from April 1993. When measurements are being made on vehicles with these wheels, new sensor pins are required for the quick-acting clamps of the recommended wheel alignment equipment.
- The new sensor pins are included in the scope of supply for new deliveries of KDS 1 (order number: BS 90 19 11).

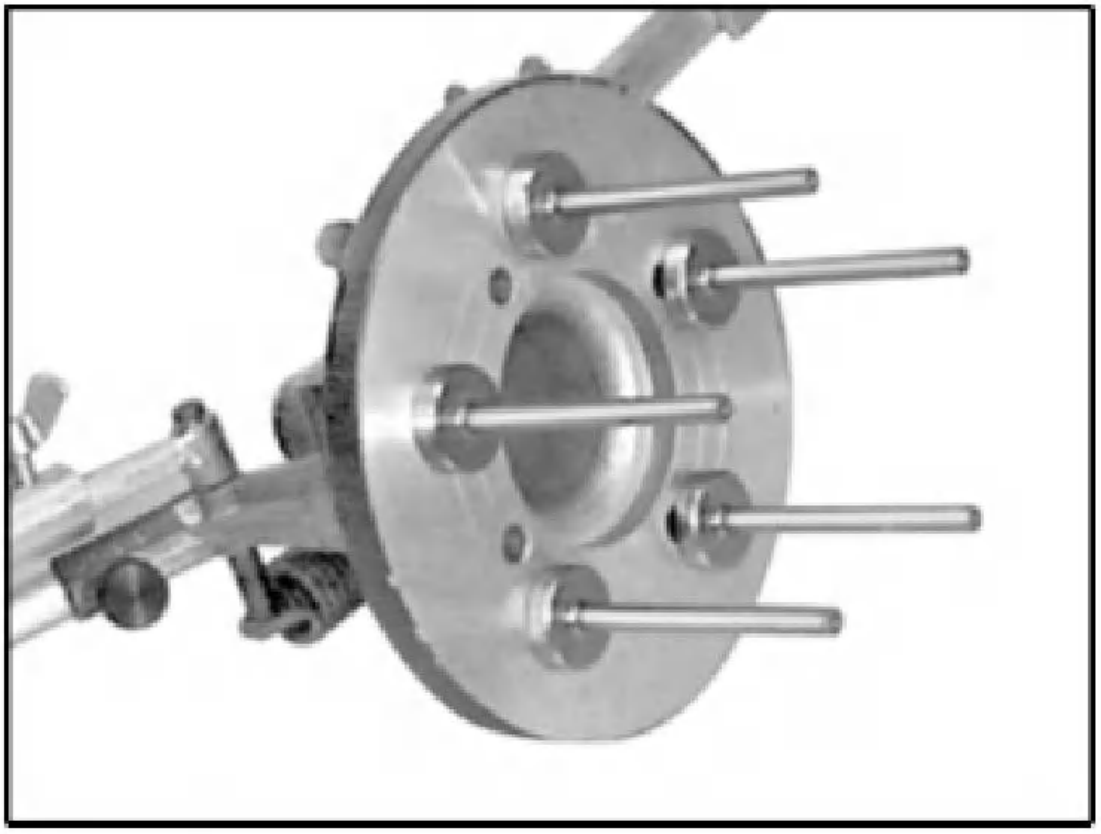


Fig. 13: Identifying Sensor Pins
Courtesy of BMW OF NORTH AMERICA, INC.

3.10 Spoiler Adapter

- In the case of vehicles with very low spoilers, the sensor beam may be broken by the spoiler between the measuring sensors. This primarily occurs in front of the front axle.
- The spoiler adapter is used here as a connecting element between the measuring equipment clamp and the measuring sensor. Thanks to the adapter, the sensors are placed 50 mm lower, thus allowing the sensor beam to move freely below the spoiler.



Fig. 14: Identifying Spoiler Adapter
Courtesy of BMW OF NORTH AMERICA, INC.

3.11 Quick-Clamping Units

- Quick-clamping units for wheel alignment on non-BMW vehicles with rim run-out compensation.
- Rims without sensors boreholes (rims for BMW vehicles from other manufacturers)

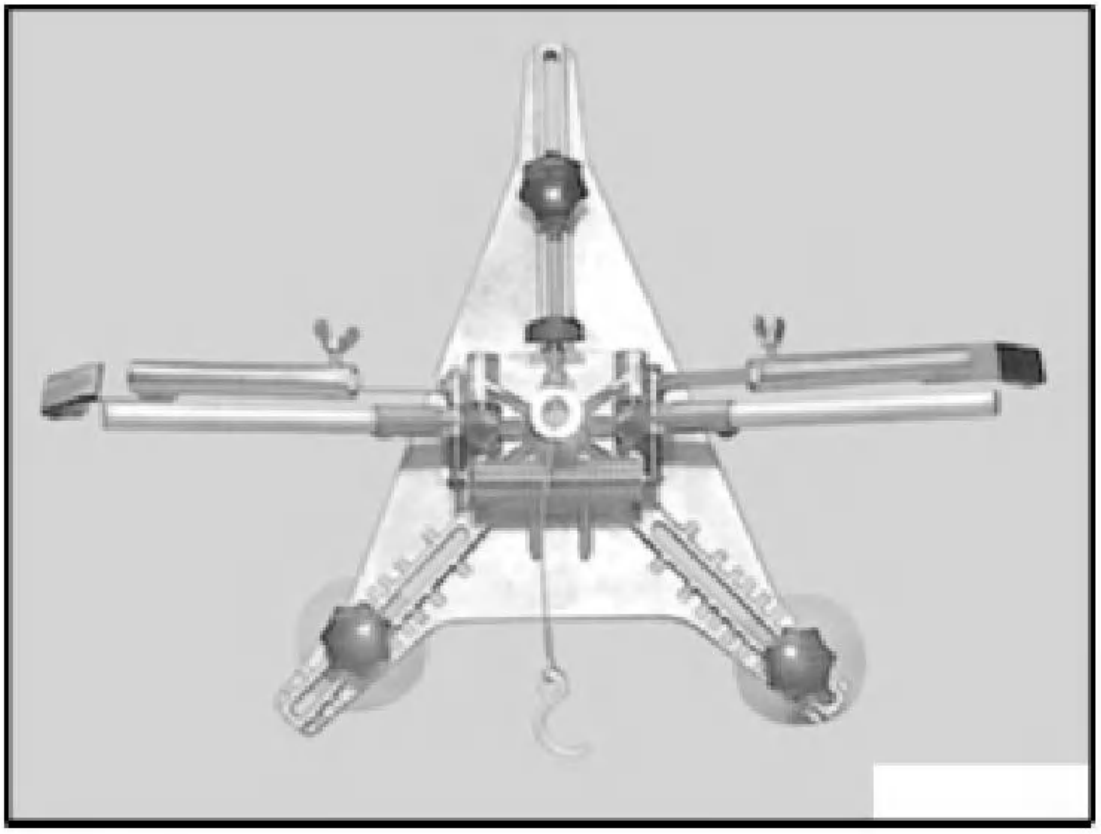


Fig. 15: Identifying Quick-Clamping Units For Wheel Alignment Non-BMW
Courtesy of BMW OF NORTH AMERICA, INC.

3.12 Retainers

- The most varied clamping options for the measuring equipment are possible thanks to the versatile retainers and the rubber-coated thrust pieces, even on exotic light-alloy rims.



Fig. 16: Identifying Retainers
Courtesy of BMW OF NORTH AMERICA, INC.

4. WORKSTATION

4.1 Environment

All lifting platforms currently recommended by BMW (see Workshop Equipment Planning documentation, Issue 11) for wheel alignment meet the requirements for the BMW KDS.

No particular requirements have to be met in respect of the location at which the BMW KDS is used. The measuring device can be installed over working pits or on lifting platforms.

Requirements:

- Wheel alignment pits
- Pillar-type lifts with set-down device
- 2 plunger-type lifting platforms with set-down device
- Repair stands with set-down device
- One measuring area (approx. 4.5 m x 7.0 m).
- The rotating plates must be pinned to the platform

The support surfaces for the rotating and sliding plates may only display the following maximum height difference:

- from left to right +/- 0.5 mm
- from front to back +/- 1.0 mm
- diagonally +/- 1.0 mm.

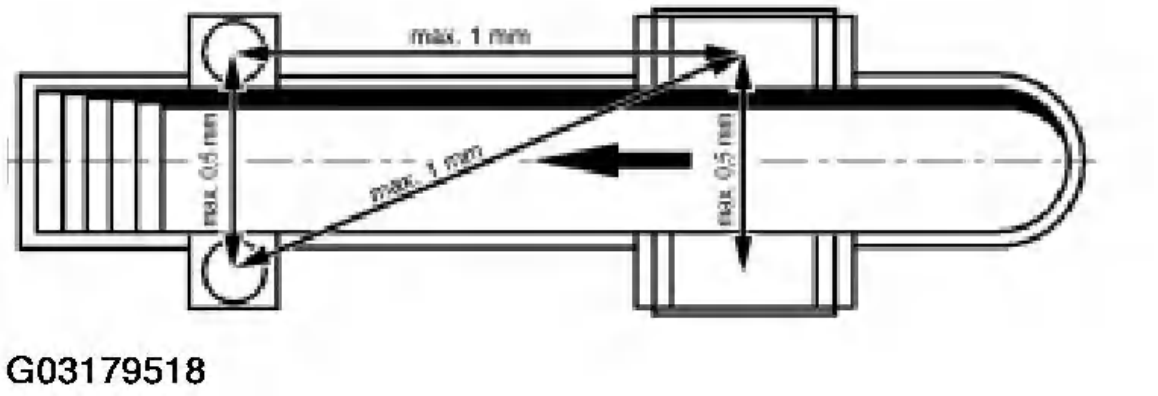


Fig. 17: Cutaway View Of For Rotating And Sliding Plates
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: A difference in the height of the rotary plates of +/- 2 mm from left to right results in a measuring error of 4.8Â° in the camber.
As a comparison: The camber tolerance on the E36 is +/- 10'. The tire tread difference or varying tire pressure cause measuring errors of the same magnitude.

4.2 Preconditions For Alignment

When carrying out the wheel alignment, the front and rear wheels must be centered on the rotating and sliding plates in order that all wheel suspensions remain free of tension during the steering routine and adjustment work. As a result, the rotating and sliding plates for the relevant wheel bases and track widths of the vehicle to be aligned must be moved.

4.3 Measuring Tolerance

All measuring tolerances are system tolerances. This means that the sum of all individual tolerances gives the value shown in the example. Example of camber: Quick-acting clamp + measuring sensor + computer = 1' at a measuring range of +/- 3Â° (all BMW vehicles are within this measuring range).

4.4 Levelling The Measuring Station

The manufacturers of the BMW KDS (Beissbarth/Bosch) are able to measure the measuring area to the required accuracy using levelling devices. Any "normal" water level is not suitable for this. Lifting platforms must be levelled under load so that the uneven deflection in the travel rails is taken into account.

IMPORTANT: Adjustment work for the lifting platform concerned must be executed by a specialist (manufacturer's after-sales service).

5. CHASSIS-RELATED TERMS

5.1 Toe-Differential Angle

Description:

- The toe-differential angle (a) is the angular position of the internal wheel on the curve in relation to the external wheel on the curve when driving round bends. The steering is designed such that the angular position of the wheels in relation to each other changes as the steering angle increases.
- In ideal cases, the wheel axes meet at point D in any steering position (except for straight ahead).

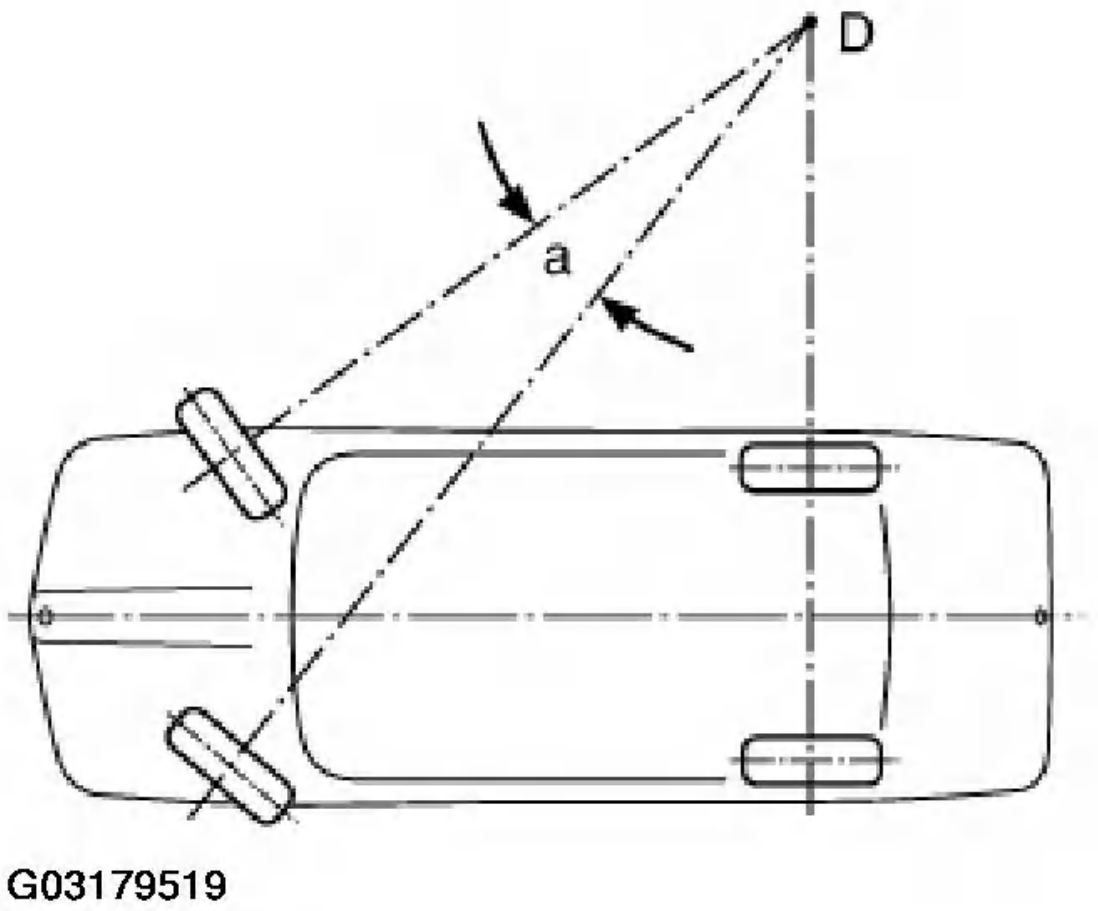


Fig. 18: Identifying Toe-Differential Angle
Courtesy of BMW OF NORTH AMERICA, INC.

5.2 Camber

- The camber is the angle of inclination of the wheel in relation to the vertical.

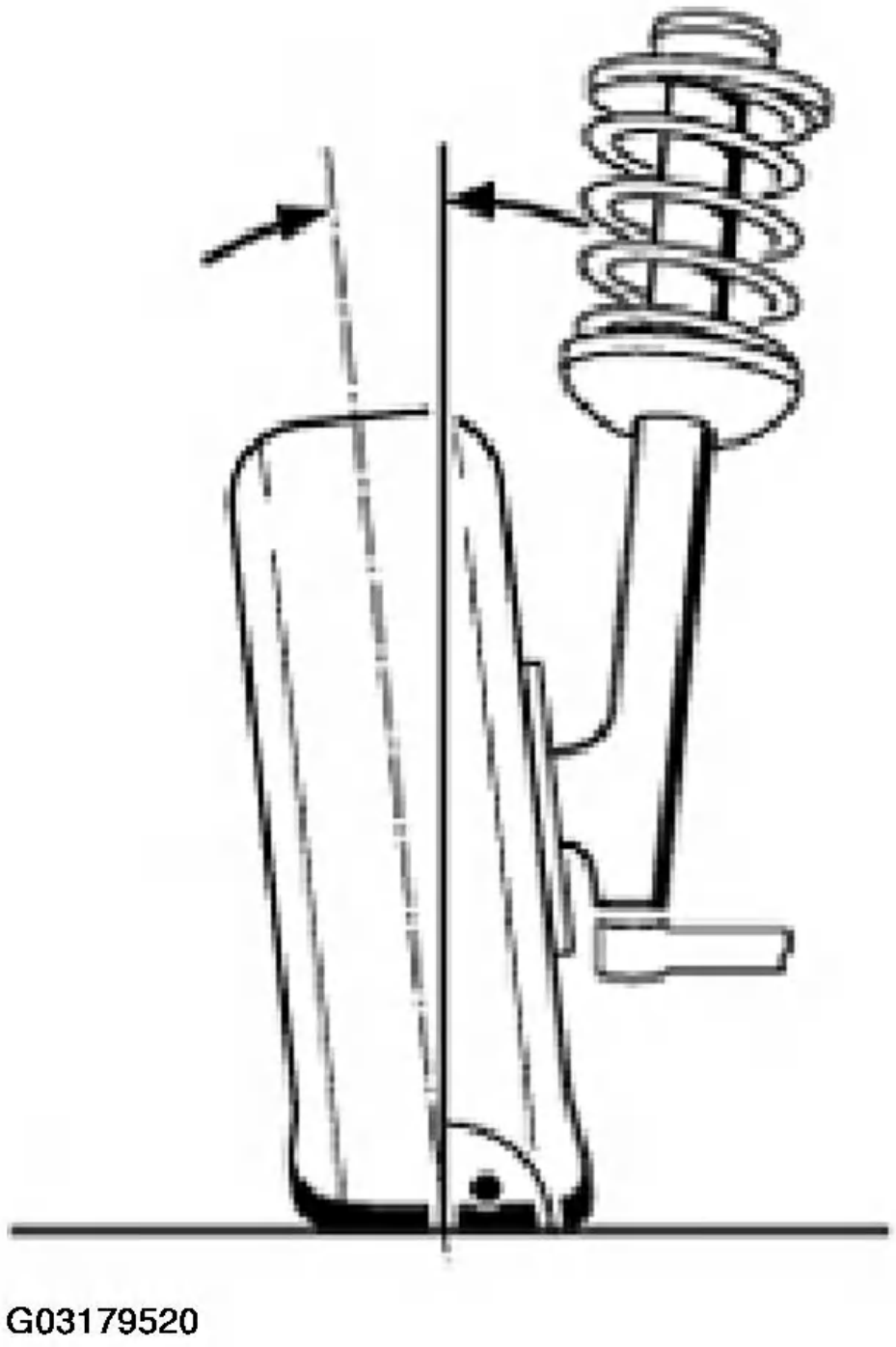


Fig. 19: Identifying Camber Angle
Courtesy of BMW OF NORTH AMERICA, INC.

5.3 Toe-In

- The toe-in is the reduction in the distance between the front of the wheels and the rear. The toe-in prevents the wheels from moving apart whilst driving (wobbling and grinding).

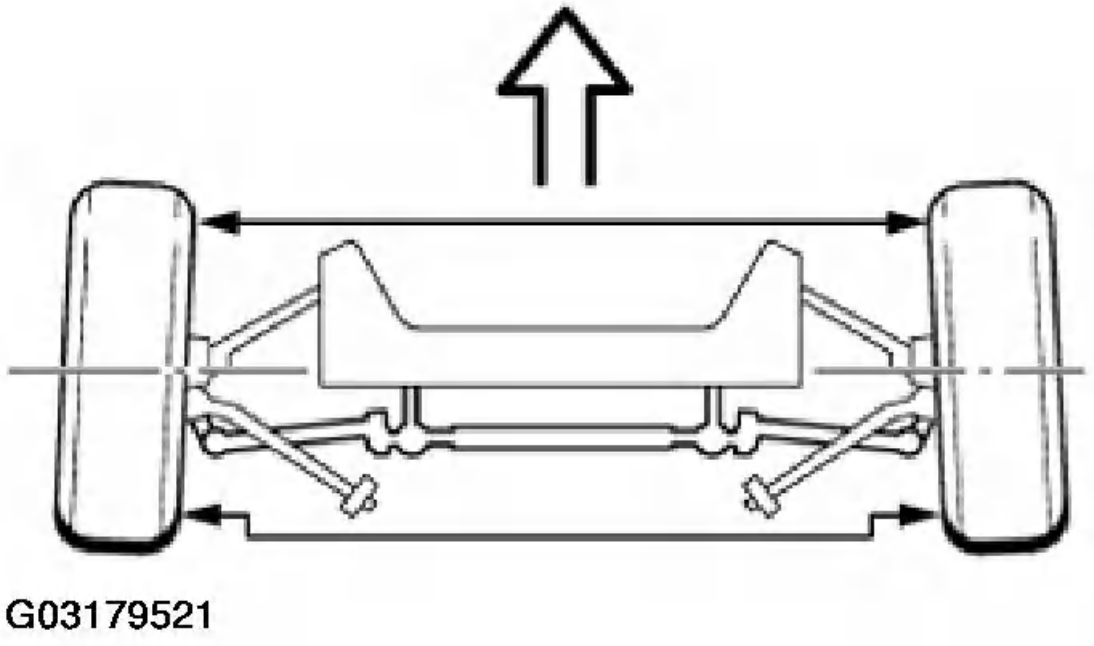


Fig. 20: Identifying Toe-In Angle
Courtesy of BMW OF NORTH AMERICA, INC.

5.4 Caster

- The castor is the kingpin angle seen from the side in the opposite direction of travel. The line through the center of the spring strut mount and control arm ball joint corresponds to the kingpin.

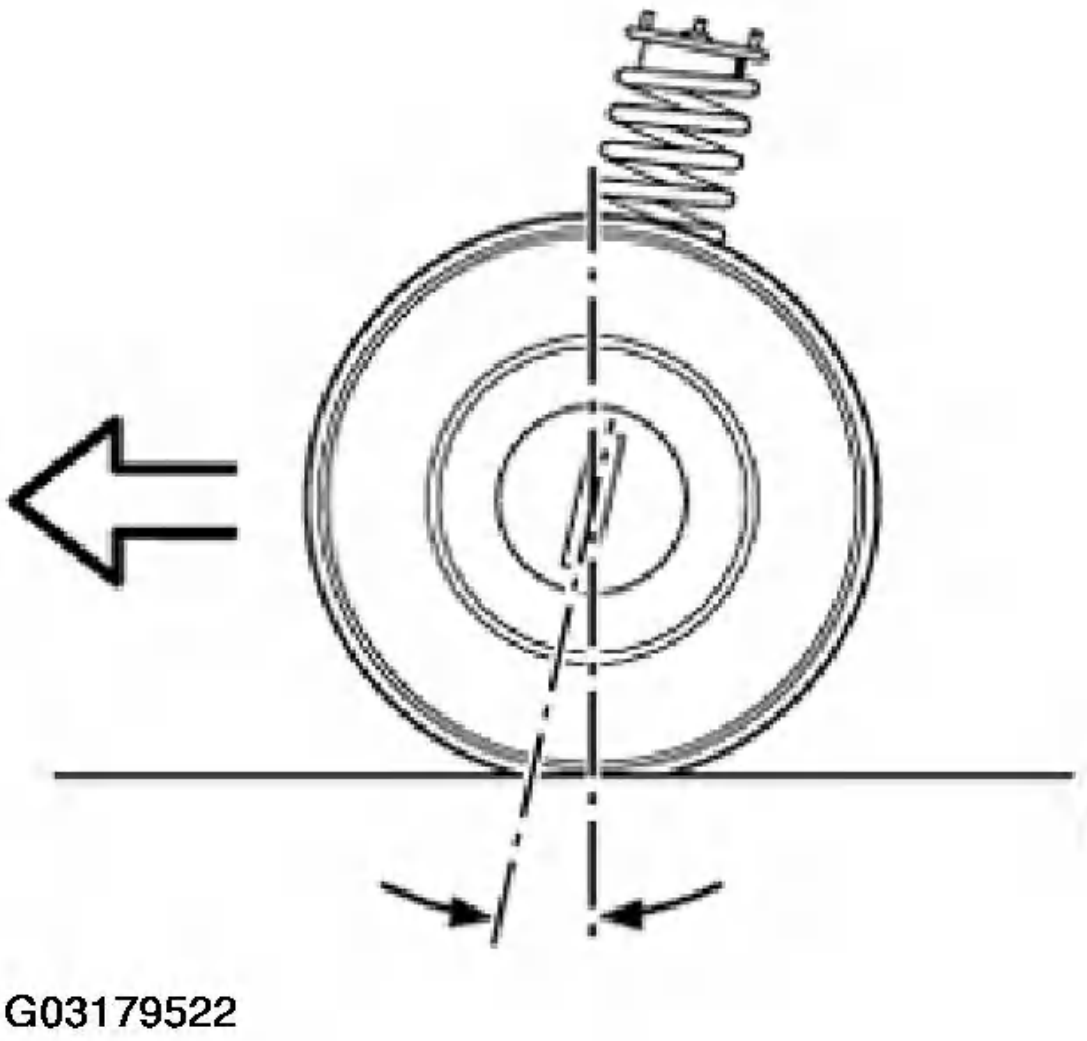


Fig. 21: Identifying Castor Angle
Courtesy of BMW OF NORTH AMERICA, INC.

5.5 Geometrical Drive Axis/Symmetrical Axis

- (1) The geometrical drive axis is the line bisecting the angle of the overall rear wheel toe. The measurements of the front wheels relate to this axis.
- (2) The symmetrical axis represents the center line through the front and rear axes.

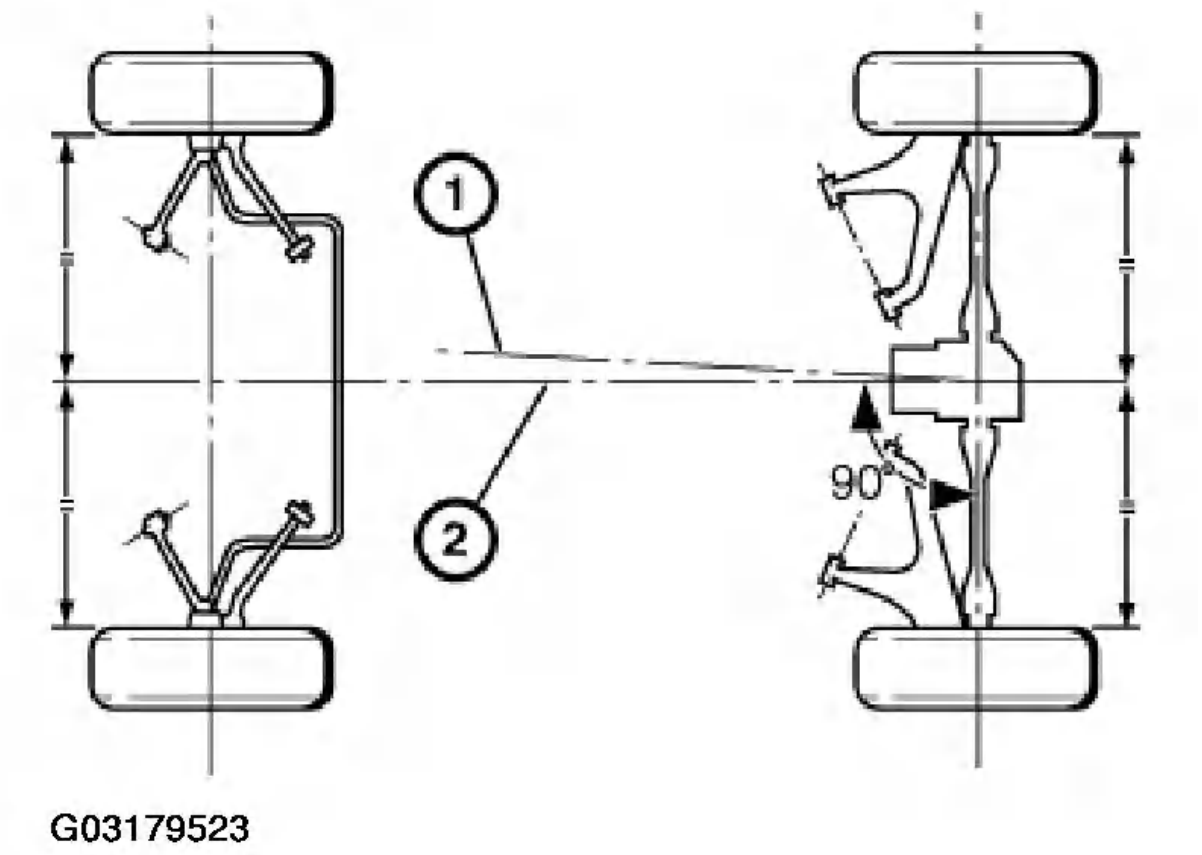


Fig. 22: Identifying Geometrical Drive Axis Angle
Courtesy of BMW OF NORTH AMERICA, INC.

5.6 Wheel Displacement Angle

- The wheel displacement angle is the angular deviation of the connecting line of the wheel contact points in relation to a line running at 90Â° to the geometrical drive axis. The wheel displacement angle is positive if the right-hand wheel is displaced to the front, and is negative if it is displaced to the rear.

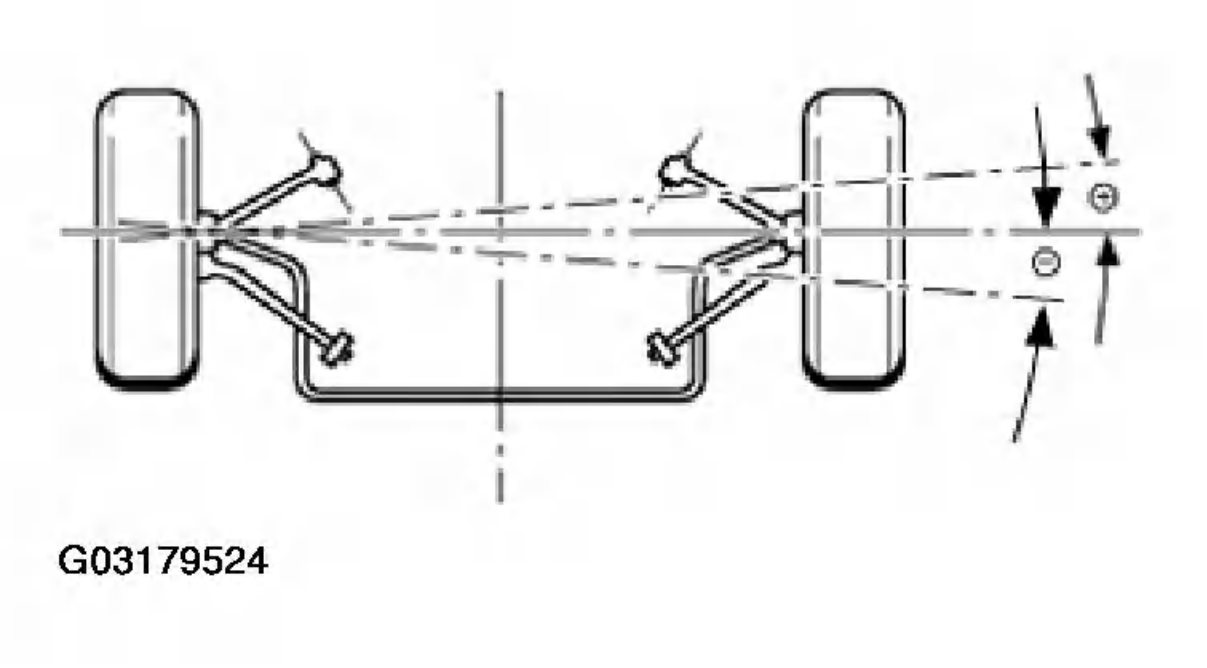


Fig. 23: Identifying Wheel Displacement Angle
Courtesy of BMW OF NORTH AMERICA, INC.

5.7 Kingpin Offset

- The kingpin offset is the distance from the center of the wheel contact point to the contact point of the kingpin extrapolation.

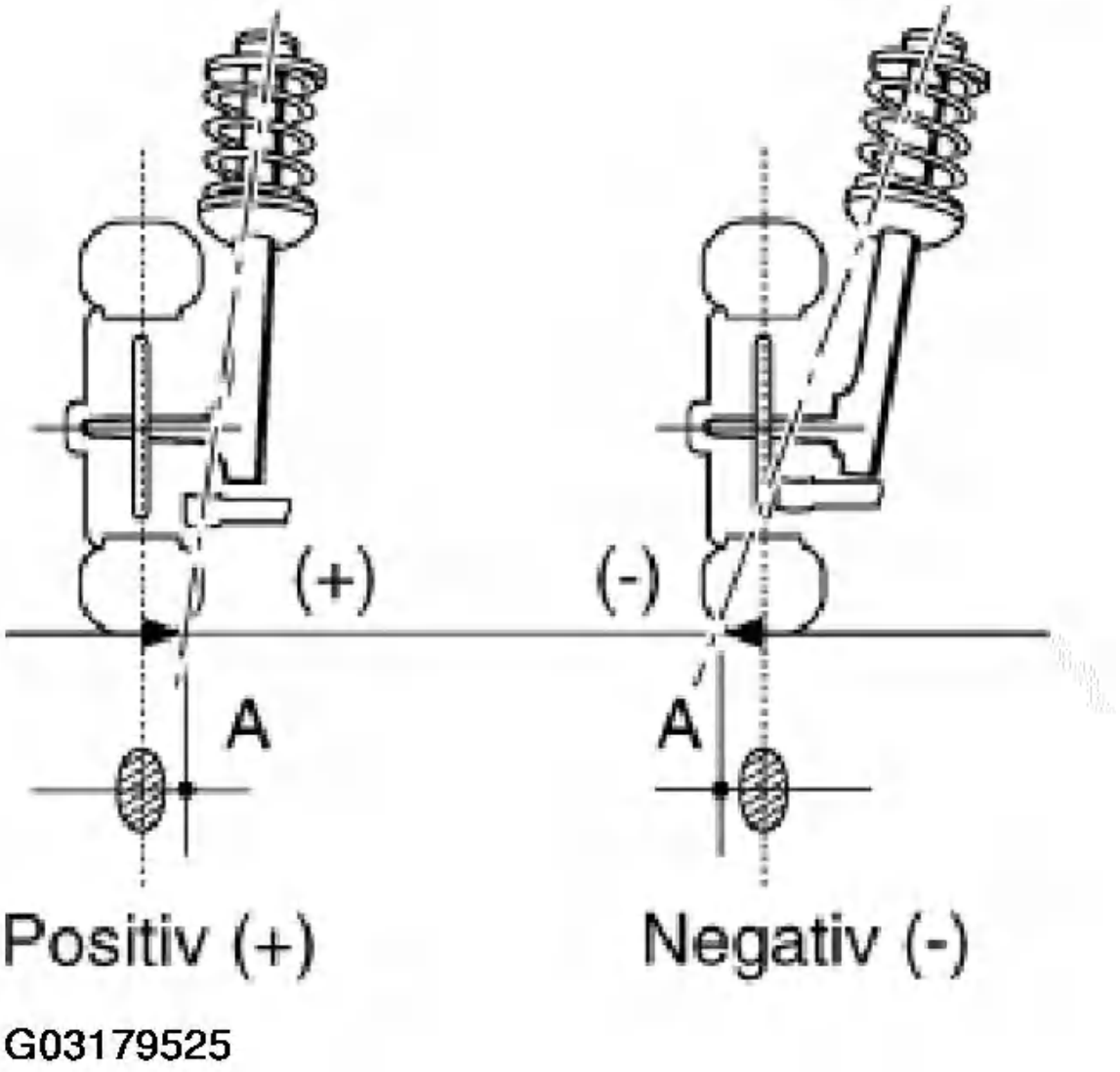


Fig. 24: Identifying Kingpin Offset Angle
Courtesy of BMW OF NORTH AMERICA, INC.

6. WHEEL SUSPENSION

Those parts which connect the wheel to the mostly load-bearing floor elements of the bodywork and guide it in the required direction belong to the wheel suspension. They are connected by axles or other comparable structures and guided by the arms. The wheel suspension plays a decisive role in the handling characteristics of a vehicle. Two main groups have to be distinguished: 1. Rigid axle suspension and 2. Independent wheel suspension.

6.1 Rigid Axle Suspension

RIGID AXLE SUSPENSION SPECIFICATIONS

Description	Advantages	Disadvantages
The rigid axle suspension has a rigid connection between both wheels or wheel pairs. Any change in one wheel is more or less transferred to the other. It is	In the event of deflection taking place, there are no changes to the camber or wheel toe. This means: less tire wear and good track stability.	Non-driven rear axles may also acquire negative camber as well as increasing tire lateral guidance, thus increasing tire wear.

now only fitted as a rear axle, if at all. However it is frequently used for lorries or busses.		

6.2 Independent Wheel Suspension

INDEPENDENT WHEEL SUSPENSION DESCRIPTION

Description	Advantages	Disadvantages
State-of-the-art individual wheel suspension is available on BMW vehicles on the front and rear axles. This development has its cause in mass inertia, as a reduction in the non-suspended mass improves wheel and ground contact, and the wheel stays better on the road. Control arms and trailing arms, which have to absorb high longitudinal and lateral forces to some extent, are required for guiding independently suspended wheels.	Wheels suspended independently from each other have no mutual influence on each other.	Depending on the type, changes may occur in the camber, wheel toe, track width, castor and wheelbase.

7. WHEEL ALIGNMENT PROCEDURE

7.1 Measuring Options

An overview of all measuring options and values (VA = front axle, HA = rear axle) is shown below.

MEASURING OPTIONS SPECIFICATIONS

Measuring options	Measuring accuracy	In measuring range	Total measuring range
Total wheel toe (VA + HA)	+/- 2'	+/-2Â°	+/-18Â°
Single wheel toe (VA + HA)	+/-2'	+/-2Â°	+/-9Â°
Camber (VA + HA)	+/-1'	+/-3Â°	+/-10Â°
Wheel displacement (VA)	+/-2'	+/-2Â°	+/-9Â°
Geometrical drive axis	+/-2'	+/-2Â°	+/-9Â°
Castor	+/-4'	+/-18Â°	+/-22Â°
Kingpin inclination	+/-4'	+/-18Â°	+/-22Â°
Toe-differential angle	+/-4'	+/-20Â°	+/-20Â°
Maximum steering angle (VA)	+/-4'	+/-60Â°	+/-300Â°
Maximum steering angle (HA)	+/-4'	+/-9Â°	+/-9Â°
Castor correction range	+/-4'	+/-7Â°	+/-10Â°

NOTE: The measuring accuracy details only apply when using the precision rotating and sliding plates as well as the BMW quick-acting clamps.

7.2 Preparatory Work

Before commencing the measurement, preparatory work must be carried out at the measuring area and on the vehicle (see BMW KDS operating instructions). Preparatory work includes:

- Easy-running rotating and sliding plates

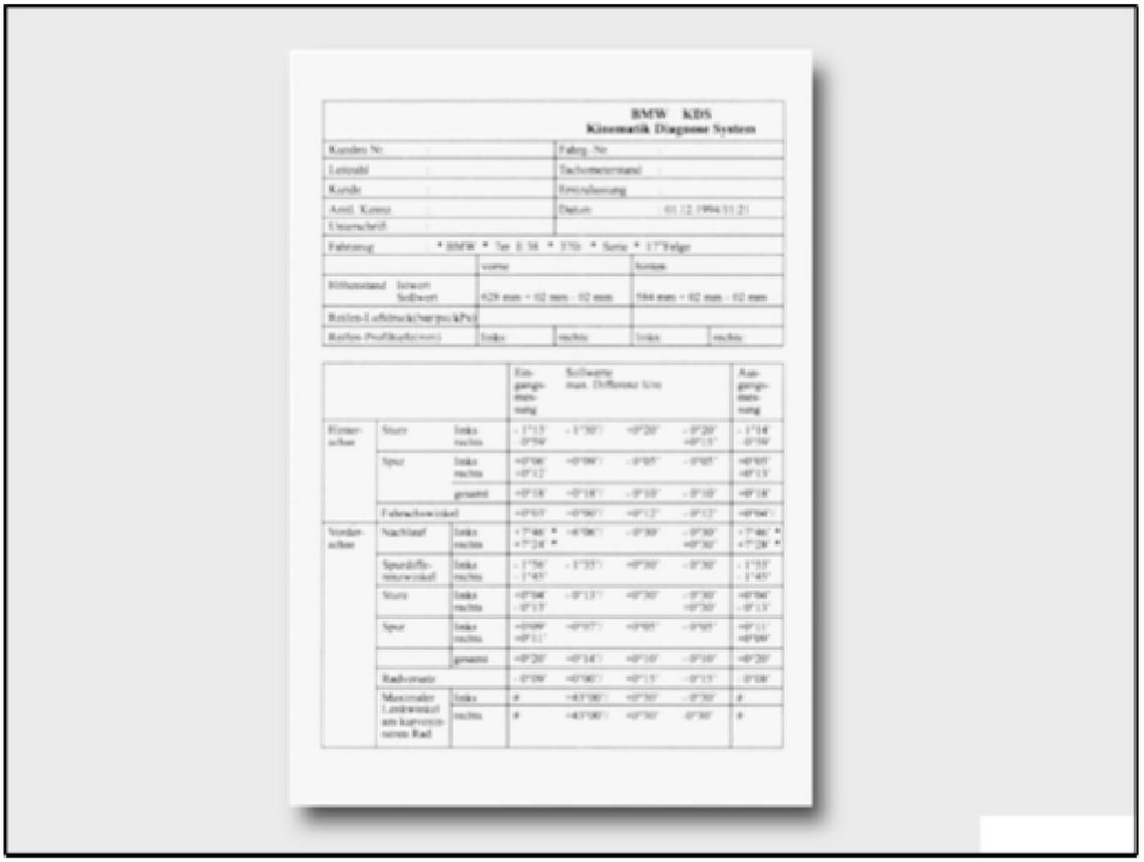
- Aligning the rotating and sliding plates in relation to the track width and wheelbase
- Centering the vehicle on the plates
- Applying the parking brake
- Removing the lock pins on the plates to prevent tension in the chassis under loading
- Checking the rim and tire size, tread depth, tire pressure, steering wheel play, wheel bearings and condition of suspension and shock absorbers
- Fastening the measuring equipment to the wheels
- Loading the vehicle according to BMW KDS specifications
- Rock the vehicle firmly with the brakes released to ensure a stable center position
- Lock the service brake using the brake clamping device

7.3 Initial/Final Measurement

This measurement can be carried out as a program-guided measurement in the same way as any subsequent adjusting work and the final measurement. The sequence of the chassis measuring points to be called up is specified and controlled by the system software. The individual steps comprise:

- Driving straight ahead to correctly record the wheel toe and camber values for the rear axle
- Steering routine for recording the castor, kingpin inclination and toe-differential angle
- Recording the wheel toe and camber of the front axle (adjust the steering center point in advance)
- Steering routine for measuring the maximum steering angle on the left/right
- Checking the overview of measured values with the setpoint and actual comparison of all measured values

7.4 Printing Out The Data



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Fig. 25: Specification Data
Courtesy of BMW OF NORTH AMERICA, INC.

The report printout from the integrated DIN A4 printer is subdivided into three sections:

- Header lines with customer and vehicle identification data --> the customer data entered before beginning the measurement as well as vehicle data are printed out here.
- Centre section with vehicle data -> this includes the make, type, model and vehicle model year defined when the setpoint data record was selected. The values previously measured for height level, tire pressure and tread depth are also printed in this section.
- The end section with all vehicle alignment values comprises the 3 columns initial measurement, setpoint values and output measurement. The measured values are recorded separately in these three columns.

8. SPECIAL FEATURES

8.1 Free Wheel Alignment

With free wheel alignment the selection and sequence of the measuring points is freely selectable. The following points must be observed for attaining the correct measurement results:

- Carry out all work in the same way as with the program-guided measurement.
- Before measuring the wheel toe and camber values for the rear axle, the steering must be in the "straight ahead" position to ensure that it is perfectly aligned in relation to the longitudinal center plane of the vehicle.
- Before measuring the single wheel toe values on the front axle, the center of steering must be established to ensure the correct position of the steering wheel.

8.2 System Settings

The following settings must only be entered or set once: language, display format, date/time, advertising text, remote control with display, rotating plate selection and printer settings. They remain stored.

9. BMW KINEMATIC DIAGNOSIS SYSTEM COMPARISON (BOSCH - BEISSBARTH)

BMW KINEMATIC DIAGNOSIS SYSTEM SPECIFICATIONS

Bosch		Beissbarth
Measured value recording	Infrared	CCD camera
Data transmission	Cable	Infrared / cable
Measuring sensor power supply	Cable	Battery/ cable
Remote control	Infrared	Infrared
Remote control with measured value display	Cable	Infrared
Setpoint data memory	Floppy disk	Hard disk
Measured value memory	Always the last vehicle measured	Unlimited vehicle memory
Operating system	--	MS-DOS
Languages	English and one language on request	EN, DE, NI, SV, IT, FR, SP (further languages can be called up)
Update	3.5" floppy disk	3.5" floppy disk using TIS/DIS
Monitor	20"	17"
Computer	--	Pentium
Disk drives	2 x floppy disk	1 x floppy, 1 x CD ROM

10. CONTROL MODIFICATION (MENU)

10.1 Remote Control With Display

The following steps show how the remote control with display is activated:

1. Call up the "Service" menu in special functions ("S" key)
2. Call up the "Remote control" sub-menu in the "Service" menu.
3. Select the "Remote control with display" item in the "Remote control" sub-menu - this configuration is retained.

IMPORTANT: In the case of equipment without remote control, this must be configured to "No remote control".

10.2 Brief Operating Instructions

1. Activate the remote control with the "ON" button (it may also be switched on during alignment). The title page will appear on the LCD.
2. Select "Straight ahead" of the "Initial measurement", "Adjustment work" or "Final measurement" at the measuring equipment cabinet. The steering graphics for "Straight ahead" will appear on the LCD.
3. Use the "Forward arrow" to change to the next measurement image. Display blocks will appear on the LCD with the designation of the measured value and tolerance bar with the measured value. If the measured value is within the tolerance range, it is shown in dark figures against a light background. If the measured value is outside the tolerance range, it will be shown in inverse video (light figures against a dark background).
4. By pressing the "F" key shortly, you can move alternately between the designation of the measured value and the setpoint value with the tolerance inside the display blocks.
5. You can scroll through the measured values using the "Forward arrow", "Backward arrow" and "Cancel" (red dot) keys. The function of these keys is identical to that of the keys on the graphics panel.
6. Even with "Free alignment", it is possible to scroll through the measured values in the same way as with "Program-guided alignment".
7. During measurement, the report print-out can be initiated using the "Printer" key. The remote control keys are only active during measurement and adjustment (not during customer data input, vehicle selection etc.).

10.3 Display Support

- Measured values with a setpoint/actual comparison and tolerance bar (setpoint figures can be displayed with the "F" key).
- Steering graphics for steering routines.
- Overview of measured values with current setpoint/actual comparison
- Rim run-out compensation.
- With all other functions (e.g. customer input), the title illustration appears on the LCD display.

If the data transmission from the remote control to the computer is interrupted, the remote control icon in the bottom right-hand corner of the screen changes color from green to red and the illustration on the LCD display is shown inversely - black turns to white, white to black. This change does not take place in the title illustration. Once the line-of-sight connection has been re-established, the remote control continues to operate from the point of interruption in the program. A continuous visual connection during alignment is therefore not necessary.

- The "Hour glass" icon in the LCD display means: "Please wait".
- The "Battery" icon in the top right-hand corner of the LCD display means that the battery reserve has been reached.
- To switch off the remote control: press the "F" key for 5 seconds, then return it to its charging unit or connect it to a charge cable. The title illustration will again appear as a charging check.
- If, during the measurement, the remote control has been placed back in the charging unit, it must be switched on again using the "ON" button.

11. UPDATING THE SOFTWARE/SETPOINT DATA

Floppy disks will no longer be sent to BMW partners who have acquired a "BMW KDS (Beissbarth/Bosch)". For cost-related reasons, you can create these disks yourself on the "DIS-tester" or on the "TIS/EPC server". The data for this is regularly updated on the TIS CD.

11.1 Requirements

- BMW KDS (Beissbarth/Bosch)
- TIS CD program status (Beissbarth): from CD 12/95
- EPC program status: from 12/95
- TIS CD program status (Bosch): from CD 08/97
- DIS program status: from V6.0
- 3.5" diskettes, 1.44 MB (Beissbarth 5 diskettes/Bosch 1 diskette)

11.2 Procedure (Beissbarth)

1. Go to the "Administration" screen
2. Select the KDS button
3. Select Beissbarth
4. Insert "Diskette 1" on request and confirm with "OK" (program diskette 1 of 2 is created, label it)
5. Insert "Diskette 2" on request and confirm with "OK" (program diskette 2 of 2 is created, label it)
6. Insert "Diskette 3" on request and confirm with "OK" (setpoint data diskette 1 of 3 is created, label it)
7. Insert "Diskette 4" on request and confirm with "OK" (setpoint data diskette 2 of 3 is created, label it)
8. Insert "Diskette 5" on request and confirm with "OK" (setpoint data diskette 3 of 3 is created, label it)
9. Perform update and/or setpoint data on the KDS in the usual manner with the diskettes which have just been created.

11.3 Procedure (Bosch)

1. Go to the "Administration" screen
2. Select the KDS button
3. Select Bosch
4. Label "Diskette 3.1", insert it into the drive on request and confirm with "OK" (2x) --> Setpoint data is copied to the diskettes.
5. Insert setpoint data diskette 3.1 into the 3.1 floppy disk drive, insert operating system diskette 3.0 into the 3.0 drive.
6. Switch on the machine in the usual manner.

IMPORTANT: When creating the KDS diskettes, all data on the diskettes used is overwritten.

NOTE: In the event of an error, a corresponding message is shown and the program is cancelled completely. The procedure must be run from the beginning again and all data on the diskette will be deleted. A new diskette may have to be used.

12. CREATING, COPYING AND EDITING SETPOINT DATA

12.1 Copying

- Press the "C" button and select the vehicle to be copied.
- Select the "Edit setpoint data" menu item from the special functions. Create a new vehicle in the usual manner. The setpoint values for the last vehicle selected will appear in the data input screen. Enter the data and save the data record.

12.2 Creating

- Press the "C" button and select the "Edit setpoint data" menu item from the special functions. Create a new vehicle in the usual manner. An empty data input screen will appear. Enter the data and save the data record.

12.3 Editing

- Factory-programmed setpoint data can neither be deleted nor modified. If this data does need to be modified, a new vehicle with modified setpoint data must be created. New vehicles created by the user are identified by a "+" in the selection menu. These vehicles can be deleted by the user using the "-" key or modified using the "< >" key. These keys only appear if vehicles have been entered by the user.

13. SPECIAL FUNCTIONS

13.1 Customer-Specific Printer Report Header

The sub-item "Customer-specific text" must be called up in the "Special functions" menu. An input screen will appear on the monitor. This input screen must be filled out with the name and address and stored with the "S" screen key. The text entered is inserted into the report header.

13.2 Adjusting Options

- Call up the "Service" menu in the special functions ("S" key).
- Select the "Wheel toe adjustment" item or the "Camber adjustment" item from the "Adjustment" sub-menu. The toe and camber adjustment program will guide the user step by step through the adjustment using text and images. The measuring deviation for each measuring sensor will be shown on the screen when the adjustment has been completed.
- You can store the adjustment values in the measuring sensor using the "Store" key or you can quit the program with the "Red dot key" without saving them (check). The adjustment values can be printed out.

13.3 Rotating Plate Test

- Call up the "Service" menu in the special functions ("S" key).
- Call up the "Rotating plate" item in the "Service" menu. Turn the left-hand and right-hand rotating plate and check the display on the screen. Important: The measuring range is +/- 306 degrees.

13.4 Viewing And Deleting Customer Entries From Database

- Call up the menu item "Delete" in the "Database" menu in the special functions. The data input screen will appear. Fill in the search fields with the data to be deleted.
- Use the "-" button to delete this data record. A new data record can then be highlighted and deleted with the digital pen.
- You can scroll through the entire database with the "Arrow up" and "Arrow down" keys.

14. MODIFICATIONS WITHIN PROGRAM

Further modifications were carried out within the program which only slightly change the program sequence but which optimize the alignment in respect of comfort and speed. This is described below:

- Optimization of the rim run-out compensation in respect of speed.
- Optimization of the steering routines: Highlighted values within the gate can still be corrected. The message "Rotating plates not connected" no longer causes the steering routine to be cancelled. Further measurements can be carried out after the rotating plates have been connected.
- Standardization of screen colors with the colors on the tablet.
- Addition of texts in several foreign languages.
- Elimination of program-related and cosmetic faults.

- Electronic water level.
- Omission of kingpin inclination measurement.

15. FAULTS

15.1 Tyre Faults

TYRE FAULTS SPECIFICATIONS

Fault	Effect
1) Wheel toe, camber, toe-differential angle and castor not correct	1) Severe tire squeaking even at relatively low speeds
2) Excessive toe-in and excessive positive camber	2) Tires are worn down on one outside edge in the longitudinal direction
3) Excessive negative camber	3) Tyre wear on inside edge
4) Worn front-axle suspension on front-wheel-drive vehicles	4) Increased noise / Vehicle pulls on one side when accelerating
5) Incorrect wheel alignment	5) Wheels scrubbing / Tyre surface shows feathering in the tread
6) Play in the suspension due to mechanical parts (suspension, steering)	6) Washout / Wobbling of front wheels
7) Tyre pressure too low	7) Outside tire surface wear

15.2 Front Axle Faults

FRONT AXLE FAULTS SPECIFICATIONS

Fault	Cause	Remedy
1. Toe deviation	a. Vehicle not in normal position b. Tie rod(s) bent c. Tie rod ball joints worn d. Rubber mount in control arm defective	a. Correct height level b. Replace tie rod(s) c. Replace tie rod(s) d. Replace control arm
2. Camber deviation: The camber is fixed during the design stage and cannot be adjusted.	a. Rubber mount in control arm defective b. Control arm deformed c. Spring strut deformed d. Traction strut worn e. Spring deflection too great f. Front axle carrier deformed	a. Replace control arm b. Replace control arm c. Replace spring strut d. Replace control arm e. Replace coil spring, height level f. Replace front axle carrier

	g. Spring strut mount deformed h. Distortion in the floor assembly (engine bracket)	g. Repair forward structure h. Repair body
3. Castor deviation: The castor is fixed during the design stage and cannot be adjusted.	a. Rubber mount for tension / traction strut defective b. Tension / traction strut deformed c. Control arm deformed d. Spring strut deformed e. Wheelhouse deformed (spring strut mount) f. Distortion in the floor assembly (engine bracket)	a. Replace rubber mount b. Replace tension / traction strut c. Replace control arm d. Replace spring strut e. Repair forward structure f. Repair body
4. Toe-differential angle deviation	Requirement: camber and castor are correct a. Tie rods unevenly adjusted	a. Set wheel toe on left and right to identical values
5. Wheel displacement deviation	Requirement: Front wheels have same single toe in relation to the geometrical axis a. Front axle carrier deformed b. Engine bracket deformed c. Control arm deformed d. Tension / traction strut deformed	a. Replace front axle carrier b. Repair body c. Replace control arm d. Replace tension / traction strut

15.3 Rear Axle Faults

REAR AXLE FAULTS SPECIFICATIONS

Fault	Cause	Remedy
1. Camber deviation	a. Vehicle not in normal position: spring deflection too great b. Rubber mount on rear axle c. Rear axle carrier deformed d. Control arm deformed e. Traction strut deformed f. Distortion in the floor assembly g. Swinging arm deformed	a. Correct height level b. Replace rubber mount c. Check rear axle carrier and replace, if necessary d. Check control arm and replace, if necessary e. Check traction strut and replace, if necessary f. Repair body g. Replace swinging arm
2. Rear wheel position is not correct	a. Rear axle carrier has been shifted laterally b. Distortion in the floor	a. Check the rubber mounts on the rear axle carrier and replace, if necessary

	assembly	b. Repair body
3. Toe deviation	a. Vehicle not in normal position, i.e. spring deflection too great b. Rubber mount in rear axle carrier defective c. Control arm deformed d. Rubber mount and swinging arm defective e. Rear axle carrier deformed f. Traction strut deformed	a. Correct height level b. Replace rubber mount c. Replace control arm d. Replace swinging arm e. Check rear axle carrier and replace, if necessary f. Check traction strut and replace, if necessary
4. Deviation from the geometrical drive axis	Requirement: Total wheel toe is correct a. Distortion in the floor assembly	a. Repair body

Further details on the "Kinematic Diagnosis System" can be found in the operating instructions for the BMW KDS (Beissbarth/Bosch).

Functional and system descriptions are not subject to change. Parts availability and immediate ordering availability cannot be derived from this information. The specialist departments will be providing further details at the relevant time.

RUNFLAT INDICATOR

All models



Fig. 26: Identifying Runflat Indicator
Courtesy of BMW OF NORTH AMERICA, INC.

INTRODUCTION

The Run Flat Indicator (RPA) monitors the tire pressure throughout the journey.

The entire vehicle weight is carried by the air pressure in the tires. If the pressure in one of the tires should drop, the tire will gradually "cave in". The resulting flexing means that the defective tire will quickly receive additional damage. The tire could burst.

Some 80 % of all flat tires are caused by small holes (e.g. caused by nails). The holes result in a gradual loss of pressure in the affected tire. Many "tire blowouts" can be traced back to preliminary damage caused by a gradual loss of pressure.

A gradual loss of pressure in one tire may remain unnoticed for a long time. The lack of pressure only makes itself clearly felt when driving when the tire is almost completely empty.

As tire pressure drops, the radius of the wheel and with it the tires rolling circumference will also decrease. The upshot is that the wheel speed of the affected tire is increased.

The RPA records the wheel speeds using the wheel-speed sensors of the Dynamic Stability Control (DSC). The RPA compares the speeds of the individual wheels and computes an average speed. In this way the RPA is able to detect a loss of tire pressure.

The RPA detects a drop in pressure below about 30 % +/- 10 % of the initial value. The RPA indicator and warning light indicates a drop in tire pressure. The RPA will indicate this after just a short distance, as a rule after a few minutes, from a certain minimum speed (e.g. 25 km/h) up to the permissible top speed.

IMPORTANT: Responsibility resides with the driver at all times.

Check tire pressures regularly, at least twice a month and before embarking on lengthy journeys.

During initialization, the set tire pressure is taken as the initial value for the current set of tires.

If all 4 tires lose pressure at the same rate, the wheel speeds will also change at the same rate. The RPA is unable to detect a uniform drop in pressure in all tires (e.g. due to diffusion = natural loss of air from all 4 tires)

IMPORTANT: Correct function of the Run Flat Indicator is not guaranteed when the emergency wheel is fitted.

As the emergency wheel has a much smaller diameter, the correct operation of the RPA can no longer be guaranteed.

BRIEF DESCRIPTION OF COMPONENTS

The SMG system comprises the following key components:

4 Wheel Speed Sensors The wheel-speed sensors of the Dynamic Stability Control (DSC) measure the wheel speeds of the individual wheels.

RPA button (E46, E53, E83, E85) The RPA button is only needed for initializing the PRA.

(RPA initialization means "teaching the system the tire pressures".

CID: Central Information Display Vehicles that are equipped with CID are initialized using the CID.

On-board computer button and rocker switch on turn-signal/main-beam switch (E87, E90, E91) Initialization is performed on the LCD display, using the BC button and the rocker switch on the turn-signal/main-beam switch. The on-board computer functions are selected with the rocker switch.

The RPA software is in the following control units, depending on model series:

- RPA Control Unit (E46 all-wheel drive)

  The E46 All-wheel drive has a separate RPA control unit.

  The 4 wheel-speed sensors measure the wheel speeds. The DSC control unit sends the signals through 4 direct wires to the RPA control unit.

Alternatively

- DSC control unit with additional software for Run Flat Indicator (E46, E53, E60, E61, E63, E64, E83, E85, E87, E90, E91)

  With DSC Mk60 and DSC 8, the RPA is integrated into the DSC control unit through additional software.

Alternatively

- CIM: Chassis integration module (E65, E66)

  The CIM controls:

  - Servotronic
  - Steering column adjustment
  - Run Flat Indicator (RPA)

The following control units are involved in the functions of the Run Flat Indicator:

- CAS: Car Access System E60, E61, E63, E64, E65, E66, E87, E90, E91

  The CAS control unit provides input signals relating to terminal status (e.g. terminal 15 ON).

- GM: Basic Module E46, E53, E83, E85

  The general module provides input signals relating to terminal status (e.g. terminal 15 ON).

- JBE: Junction Box Electronics E87, E90, E91

  The JBE is the data interface (= gateway) between the K-CAN and the PT-CAN. (K-CAN stands for "Body Controller Area Network"; PT-CAN stands for "Powertrain Controller Area Network") The junction box consists of the junction-box electronics and the electrical distribution center.

- KGM: Body-Gateway Module E60, E61, E63, E64 from 09/2005

  The body-gateway module replaces the safety and gateway module (SGM). The KGM forms the data interface (= gateway) between the K-CAN and the PT-CAN.

- M-ASK/CCC: Multi-Audio System Controller/Car Communication Computer The M-ASK/CCC will emits an acoustic warning through the loudspeakers if tire pressure drops. (On vehicles without M-ASK or CCC, the instrument cluster will emit the warning.)

- SGM: Safety and gateway module E60, E61, E63, E64 up to 09/2005 E65, E66 from 03/2004

  The SGM is the data interface (= gateway) between the K-CAN, byteflight and the PT-CAN.

- SZL: Steering Column Switch Cluster E87, E90, E91

  The signals from the on-board computer button and from the rocker switch are recorded and processed in the SZL. The data are transmitted to the instrument cluster through a direct wire (on-board computer).

- ZGM: Central Gateway Module E65, E66 until 03/2004

The ZGM forms the data interface (= gateway) between the K-CAN and the PT-CAN.

- KOMBI and CID:Instrument Cluster and Central Information Display A fault in the RPA or drop in tire pressure will be indicated by the RPA indicator and warning light in instrument cluster. At the same time, the symbol will light up in the LC display.

  Faults registered by the RPA are indicated as follows by the RPA indicator and warning light (for variations, please refer to national version):

  - The RPA indicator and warning light lights up:
    - Red (with acoustic signal): Drop in tire pressure more than approx. 30 % +/- 10 %. Driving safety is no longer guaranteed.
    - Yellow: RPA failed

Information about the Check-Control message can be called up in the CID (CID is fitted depending on the vehicle's equipment).

RPA Indicator And Warning Lights And Central Information Display

Installation Location

The Run Flat Indicator (RPA) has the following displays in the instrument cluster:

- RPA Indicator And Warning Light
- Symbol In LC Display



Fig. 27: Identifying Runflat Indicator (E83 Shown)
Courtesy of BMW OF NORTH AMERICA, INC.



Item	Description	Item	Description
1	Symbol for check control message (yellow or red) on E60	2	"BMW Service" menu in the Central Information Display (CID)
3	Check control message in the Central Information Display (CID)		

Fig. 28: Identifying RPA Warning In Central Information Display
Courtesy of BMW OF NORTH AMERICA, INC.

How It Works RPA fault is displayed as follows:

- Via the RPA indicator and warning light The RPA indicator and warning light lights up:
  - Red (with acoustic signal): Drop in tire pressure more than approx. 30 % +/- 10 %. Driving safety is no longer guaranteed.
  - Yellow: The RPA has developed a fault.
- Indicator or symbol in LC display (yellow or red).
- Check control message in Central Information Display (CID) with additional information text.

If the RPA should fail, the following Check-Control messages are possible (for example):

RPA FAILURE MESSAGES & EXPLANATIONS

Check Control Message In CID Status Bar	Further Information
Flat tire!	Flat tire Stop the vehicle carefully. Please refer to the Owner's Handbook for how to change a wheel. Tires with emergency-running characteristics (RSC): The journey can be continued for a limited distance at speeds up to max. 80 km/h, please refer to the Owner's Handbook. Have the tires checked by the nearest BMW Service

Run Flat Indicator failure!	Run Flat Indicator Run Flat Indicator failed Flat tires cannot be detected. Have the problem checked by BMW Service as soon as possible.

SYSTEM FUNCTIONS

The Run Flat Indicator (RPA) comprises the following functions:

- Self-test
- Initialization
- Detects drop in tire pressure
- Visual and acoustic warning

Self-Test

The RPA performs a self-test when terminal 15 is switched ON. A fault in the RPA is indicated by the RPA indicator and warning light and by a symbol in the LCD display.

Initialization

Initialization is started manually (e.g. by pressing the RPA button). Then (after the journey has started), initialization will run as a fully automatic calibration sequence. In other words, the circumference of individual tires are recorded and evaluated.

To allow a drop in tire pressure to be detected, the system considers different speed ranges and driving situations. Taking account of the driving situation means that the system has to be primed for each speed range individually.

From 09/2004 (starting with E87), these speed ranges and driving situations have been combined into 3 calibration ranges. This means greater clarity for output via the BMW diagnosis systems Group Tester One (GT1) and DISplus.

The initialization phase lasts approx. 5 to 15 minutes for the individual speed ranges. The end of the initialization phase is not indicated.

Detects Drop In Tyre Pressure

The RPA records the wheel speeds using the wheel-speed sensors from the DSC. The RPA compares the speeds of the individual wheels and computes an average speed. In this way the RPA is able to detect a loss of tire pressure. (In the event of a tire losing pressure, the tire rolling circumference of the affected tire is also reduced.)

Visual And Acoustic Warning

A drop in pressure in one tire of approx. 30 % +/- 10 % from the initial value is indicated by the RPA indicator and warning light. In addition, an acoustic signal sounds.

Signal output: Depending on the model concerned, either via the instrument cluster or the multi-audio system controller (M-ASK)/Car Communication Computer (CCC).

NOTE: DSC malfunction
The sensors used by the RPA are all monitored by the DSC. If DSC detect a fault, the RPA will also register a malfunction.

SPECIAL CONDITIONS FOR SYSTEM FUNCTION

The following operating conditions may cause a delay in the warning being given in the event of a drop in tire pressure:

- Heavy braking
- Rapid acceleration
- High rate of lateral acceleration
- Cornering (in a tight corner)
- Vehicle speed dropping below a minimum speed (the RPA only responds when a certain minimum speed has been reached)
- Large difference in slip (between axles or between wheel on one side of vehicle)
- Initialization not being completed in current speed range (see "Controls")
- Winter conditions

The following operating conditions may cause a delay in the warning being given in the event of a drop in tire pressure:

- Driving with snow chains fitted

  Driving with snow chains may impair the correct function of the RPA.

  The system will work as normal again after the snow chains have been removed and the vehicle is driven for a few minutes. (Repeat initialization not necessary.)

  NOTE: Do not perform initialization when snow chains are fitted.

  Initialization and snow chains will cause incorrect adaptation values.

- Trailer towing

  Initialization should be performed when a trailer with a weight greater than approx. 300 kg is being towed.

  Repeat the initialization process after detaching or unloading the trailer.

- Old/new tires

  NOTE: Only fit tires with the same tread depth!

  Avoid fitting tires with greatly different tread depth (from approx. 2 millimetres) on one axle. The different diameters mean that the correct operation of the RPA is no longer guaranteed.

In the following cases, the system will not emit a warning despite a drop in tire pressure being detected :

- The same amount of pressure is lost in 2 or more tires.
- Drops in tire pressures caused by diffusion and affecting all 4 tires equally
- If a tire is damaged with a sudden loss of all pressure (tire blowout, warning is given too late)

OPERATION

The Run Flat Indicator (RPA) is initialized using the following control elements:

- RPA button
- On-board computer button on turn-signal/main-beam switch
- With iDrive in the Central Information Display (CID) with the controller

Always perform initialization immediately after correcting the tire pressure, especially if a tire is changed or the wheels are interchanged. Only check tire pressures when the tires are cold.

IMPORTANT: Set the tires to the correct pressure before performing initialization. During initialization, the set tire pressure is taken as the initial value for the current set of wheels.

Correct the tire pressures when the tires are cold to prevent the data recorded from being affected by temperature.

Responsibility resides with the driver at all times.

IMPORTANT: Check tire pressures regularly, at least twice a month and before embarking on lengthy journeys. During initialization, the set tire pressure is taken as the initial value for the current set of tires.

Initialize the RPA in the following situations:

- If tire pressure is changed

  (tire pressure is corrected or reset)

- If the position of the tires is changed (change of axles, wheels), even if the tire pressure is not changed
- If a tire is changed or the wheels are interchanged

  (e.g. old tires for new tires, summer tires for winter tires, etc.)

Start initialization as follows:

- Terminal 15 ON

  (engine OFF or ON, do not pull away)

- Vehicles with RPA button
  - Press and hold the RPA button until the RPA indicator and warning light lights up yellow for a few seconds
- Vehicles with BC button (on-board computer function)
  - In the on-board computer function select "RPA" and "INIT" (LCD display) with the rocker switch on the turn-signal/main-beam switch. Press the BC button to confirm.
  - Press and hold the BC button for approx. 5 seconds, until a box with a tick appears behind the "INIT" display.
- Vehicles with Central Information Display

  Initialization is performed via the Central Information Display (CID) and controller.

  - Select "RPA" in the "Settings" menu and confirm.
  - Select "Set" and confirm.
- Drive off

  The end of the initialization phase is not indicated.

Preconditions For Activation

The Run Flat Indicator (RPA) is automatically activated when terminal 15 is switched ON. The RPA cannot be switched off manually.

NOTES FOR SERVICE STAFF

Service staff should note the following points:

General information:

General information for Service staff on the Run Flat Indicator The following general information on the Run Flat Indicator (RPA) is given for Service staff:

- Wheel-Speed Sensor Failure
- Read Off Status Of Initialization Phase

Wheel-Speed Sensor Failure If no signal is received from one of the wheel-speed sensors, the RPA will switch to "inactive" mode after approx. 2 minutes. The RPA indicator and warning light lights up yellow. The fault is indicated with a check control message. A fault is recorded in the fault memory of the RPA control unit.

If the RPA is integrated into the DSC, a fault will be recorded in the DSC control unit. If the signal returns after a signal failure, the RPA will be active again after driving for approx. 30 minutes. The fault will remain stored in the fault memory.

Read off status of initialization phase The status of the initialization phase can be displayed in the service functions for the control unit concerned (e.g. DSC control unit).

Diagnosis:

Encoding/Programming The Run Flat Indicator

- Encoding At the factory, the Run Flat Indicator (RPA) software is adapted to the model series concerned (encoding data). The RPA is encoded with the encoding data. Here, different parameters specific to the various vehicle models are written into the control unit.
- Programming The RPA is automatically programmed with the software for the Dynamic Stability Control (DSC).

US NATIONAL VERSION

A flat tire is indicated as follows:

- E53, E83, E85

  Yellow RPA indicator and warning light without acoustic signal

- E60, E61, E63, E64, E65, E66, E90, E91

  Yellow RPA indicator and warning light with acoustic signal

An RPA failure is indicated as follows:

- Yellow RPA indicator and warning light without acoustic signal

Subject to alteration due to misprints, errors and technical modifications.

TIRES WITH EMERGENCY RUNNING CHARACTERISTICS AND TYRE PRESSURE WARNING SYSTEMS

All models

GENERAL INFORMATION

Warning Systems

BMW AG offers two different systems to warn the driver of a drop in tire pressure.

WARNING SYSTEMS SPECIFICATIONS

System	Description	Measuring principle
RDC	Tyre pressure control	Tyre pressure/temperature
RDW	Tyre pressure warning	Comparison of wheel speeds

Emergency Running Systems

In addition to the warning systems, two emergency running systems are also employed to prevent a depressurized tire from caving in:

Components of emergency running system with self-supporting tires:

EMERGENCY RUNNING SYSTEM COMPONENTS (WITH SELF-SUPPORTING TIRES)

RDW (standard equipment)	Tyre pressure warning
RDC (available as option from 03/2000)	Tyre pressure control
SST	Self Supporting Tyre
EH2 disc wheel	Disc wheel with Extended Hump 2

Components of emergency running system with integrated support ring:

EMERGENCY RUNNING SYSTEM COMPONENTS (WITH INTEGRATED SUPPORT RING)

Support ring	NOTE: In the future, only for heavy safety vehicles (E38/3)
RDC (optional)	Tyre pressure control
H2 disc wheel	Standard disc wheel with Hump 2

TYRE PRESSURE CONTROL (RDC)

RDC System Description

RDC permanently monitors the tire pressure and the temperature in the tires, both while the vehicle is being driven and when it is stationary. Data is transmitted via data telegram by the wheel electronic units to the antennas installed in the wheel housing and on to the RDC control unit. There, the data received is compared with the stored limit values.

After correcting the air pressure with the engine off and the ignition on, press the Set button and hold (approx. 6 seconds) until the words "Set tire pressure" appear in the instrument cluster (instrument cluster high) or the yellow LED lights up (basic instrument cluster).

If the limit values are exceeded, the driver will be warned via the instrument cluster in two stages, as follows:

RDC WARNING SYSTEM (LOSS OF TIRE PRESSURE)

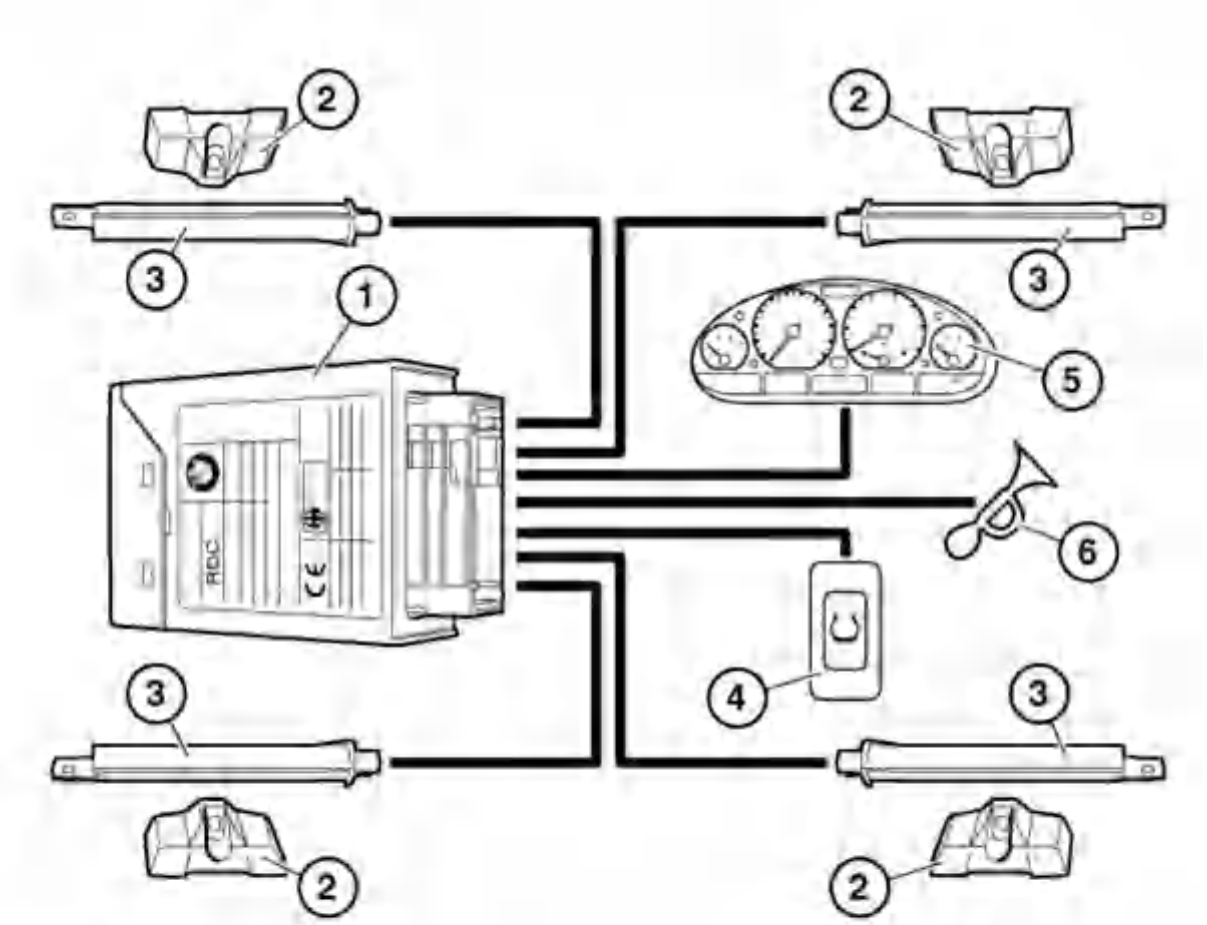
Loss of tire pressure	Warning
Drop in tire pressure of 0.2 to 0.4 bar	Yellow LED on basic instrument cluster, or Text: "Check tire pressure" on instrument cluster high Gong: no
Drop in tire pressure of more than 0.4 bar	Red LED on basic instrument cluster, or Text: "Tyre failure" on instrument cluster high Gong: yes

Advantages of RDC

ADVANTAGES OF RDC

1) Safety	• early warning in the event of rapid loss of pressure • warning of loss of tire pressure through normal diffusion
2) Comfort	• unchanging ride comfort • instruction to check tire pressure as necessary
3) Service life, economy	• minimization of tire wear • minimization of fuel consumption
4) New developments	• allow tires with emergency running characteristics to be fitted • no spare wheel if tires with emergency running characteristics are fitted (saves weight)

RDC System Layout



(1) RDC control unit
(2) Wheel electronic units (4 off)
Wheel electronic unit for spare wheel (optional)
(4) Set button
(5) Display element
(6) Anti-theft warning system

G03179528

Fig. 29: RDC System Layout
Courtesy of BMW OF NORTH AMERICA, INC.

Component Description

RDC Control Unit

Fully diagnosis-compatible

Task:

Evaluates the following telegrams from the wheel electronic units:

- Tyre Pressure
- Tyre Air Temperature
- Identification Number Of Wheel Electronic Unit
- Remaining Service Life Of Wheel Electronic Unit Battery

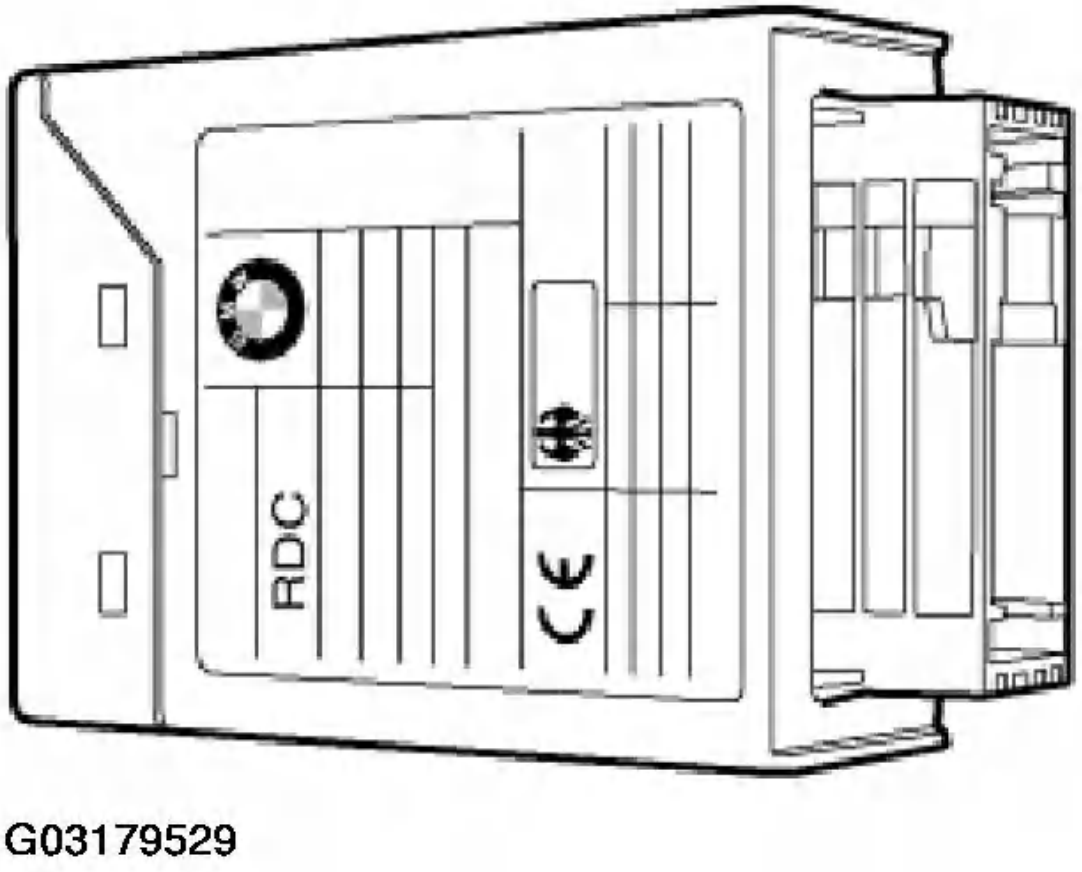


Fig. 30: Identifying RDC Control Unit
Courtesy of BMW OF NORTH AMERICA, INC.

If required, information or a warning is transmitted.

Wheel Electronic Unit With Valve

Components:

- Pressure Sensor
- Temperature Sensor
- Transmitter
  - Frequencies According To Country
- Power Supply
  - Service Life: Approx. 7 Years
  - Not Exchangeable

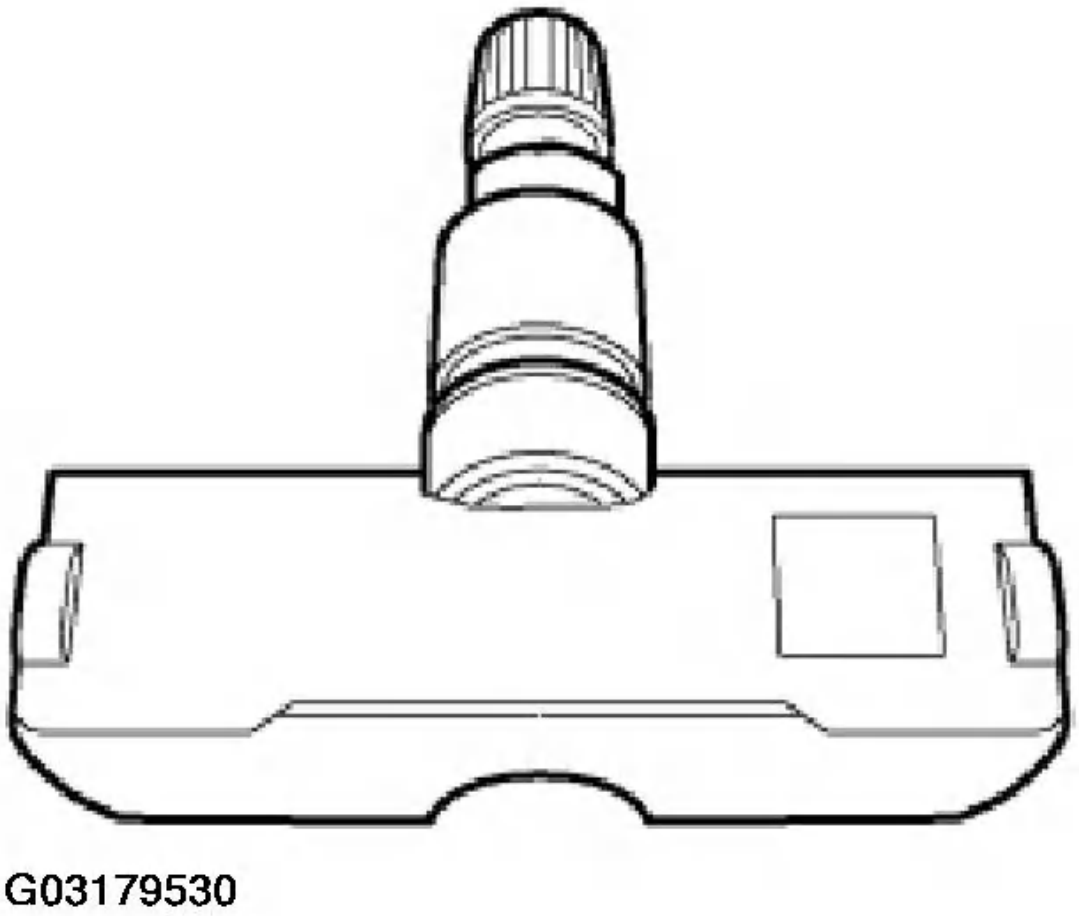


Fig. 31: Identifying Wheel Electronic Unit With Valve
Courtesy of BMW OF NORTH AMERICA, INC.

Installation Location Of Wheel Electronic Unit In Disc Wheel

The wheel electronic unit (1) is screwed to the valve (2) on the disc wheel (3)

Identifying feature: Metal Tyre Valves

NOTE: Different valves have to be used to allow for the different disc wheel sizes. The valves are colour-coded. The correct coding can be taken from the spare parts catalogue.

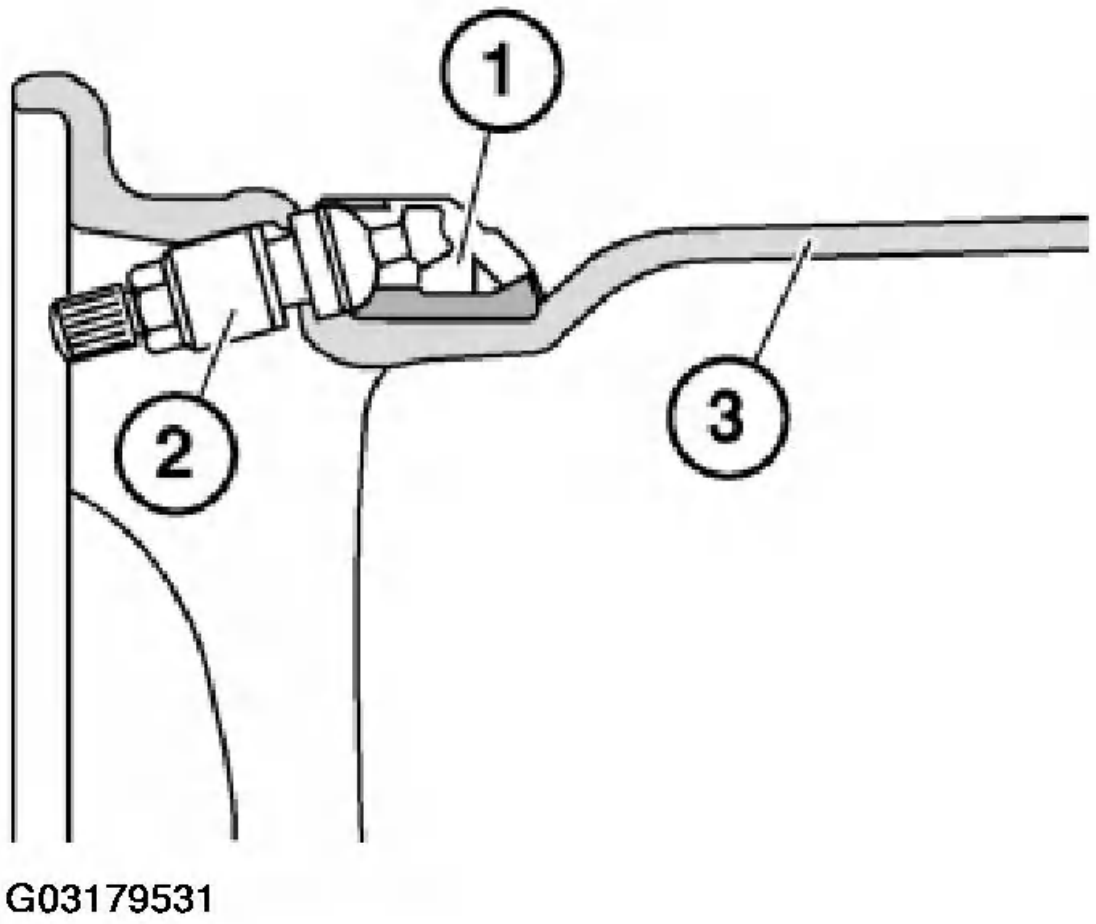


Fig. 32: Identifying Installed Position Of Wheel Electronic Unit In Disc Wheel
Courtesy of BMW OF NORTH AMERICA, INC.

Antenna

There is an antenna in each wheel housing.

Task: Receives telegrams and forwards these to the RDC control unit.

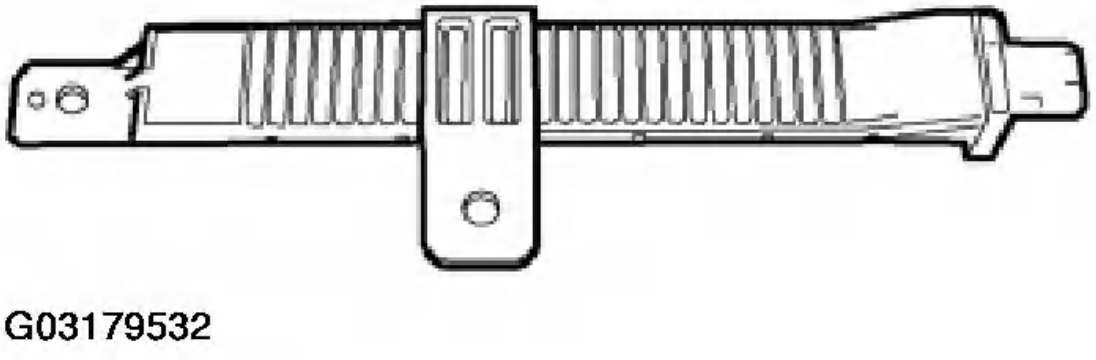


Fig. 33: Identifying RDC Antenna
Courtesy of BMW OF NORTH AMERICA, INC.

Component Description

Set Button

Installed in the instrument panel to the right of the steering wheel. (E46: in the center console)

Symbol: tire cross-section

Task: initialization after resetting cold tire pressure or after changing tire or wheel location.

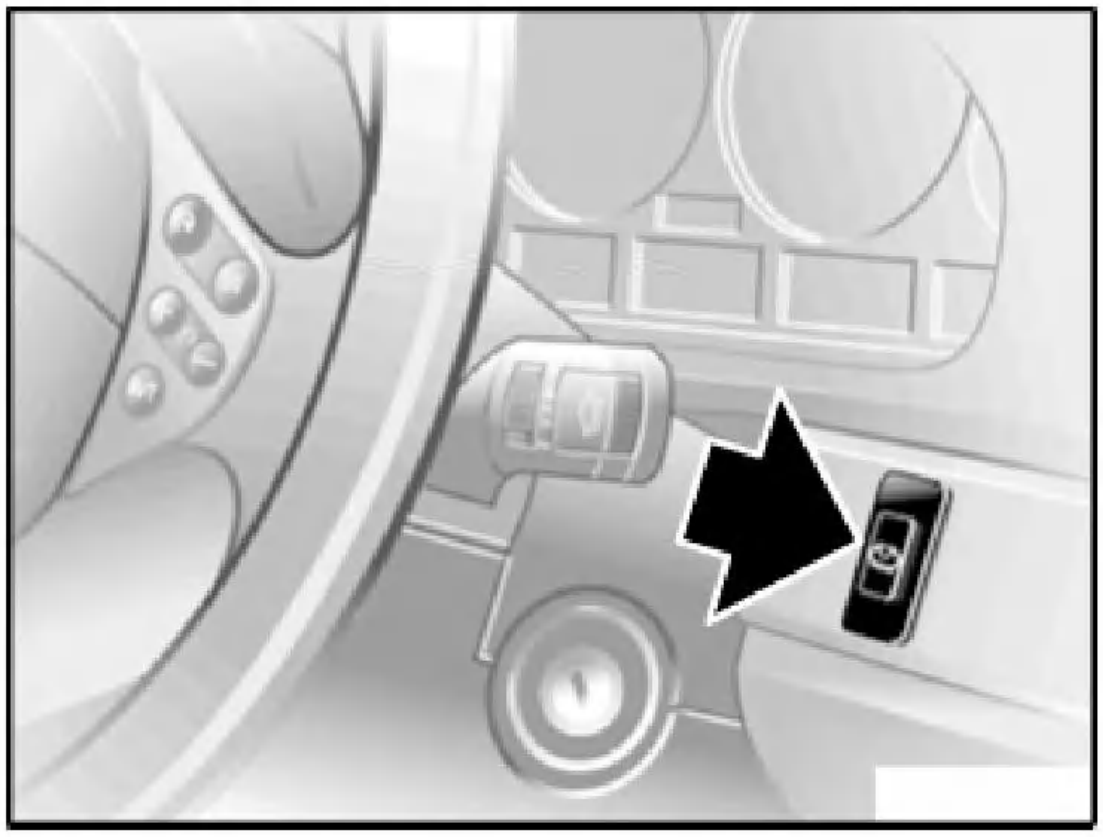


Fig. 34: Identifying RDC Set Button
Courtesy of BMW OF NORTH AMERICA, INC.

Display Element In Instrument Cluster

Indicator lamp lights up yellow:

- drop in tire pressure of 0.2 to 0.4 bar

Indicator lamp lights up red:

- drop in tire pressure of greater than 0.4 bar

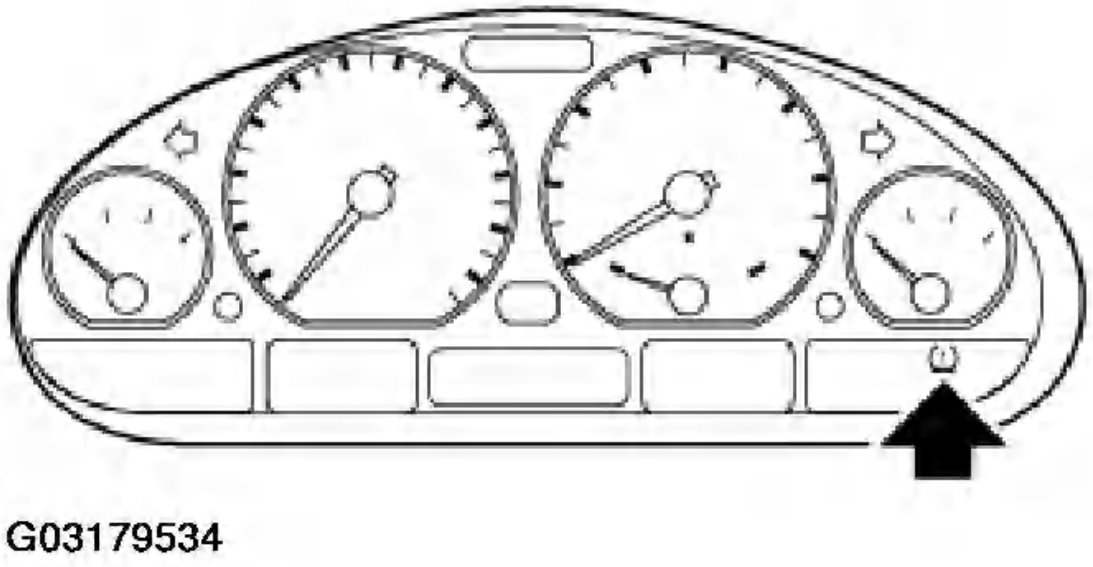


Fig. 35: Identifying RDC Indicator In Instrument Cluster Display
Courtesy of BMW OF NORTH AMERICA, INC.

TYRE PRESSURE WARNING RDW

RDW System Description

RDW measures the wheel speeds on all four wheels, using the wheel speed sensors of the ABS/ASC or ABS/DSC system. It compares the wheel speeds of the diagonally opposite wheels and of the average speed.

In the event of a drop in tire pressure, the dynamic diameter of a wheel will change, leading to a changed wheel speed.

A drop in tire pressure of 30 +/- 10 % can be detected on all wheels from about 15 km/h (10 mph) up to the vehicle's top speed.

If this value is exceeded, the driver will be warned via the instrument cluster as follows:

RDW SYSTEM DESCRIPTION

Loss of tire pressure	Warning
Loss of tire pressure of 30 +/- 10 %	Red LED Text: "Tyre failure" Gong: yes The vehicle is not to be driven faster than 80 km/h (50 mph).

NOTE: A cautious driving style with moderate forward and transverse acceleration will help to prolong the service life of the defective tire.

Advantages of RDW

With two exceptions, the advantages of RDC also apply to RDW.

Exceptions:

- no warning of loss of tire pressure through normal diffusion

- tire pressure still have to be checked regularly, every 14 days

RDW System Layout

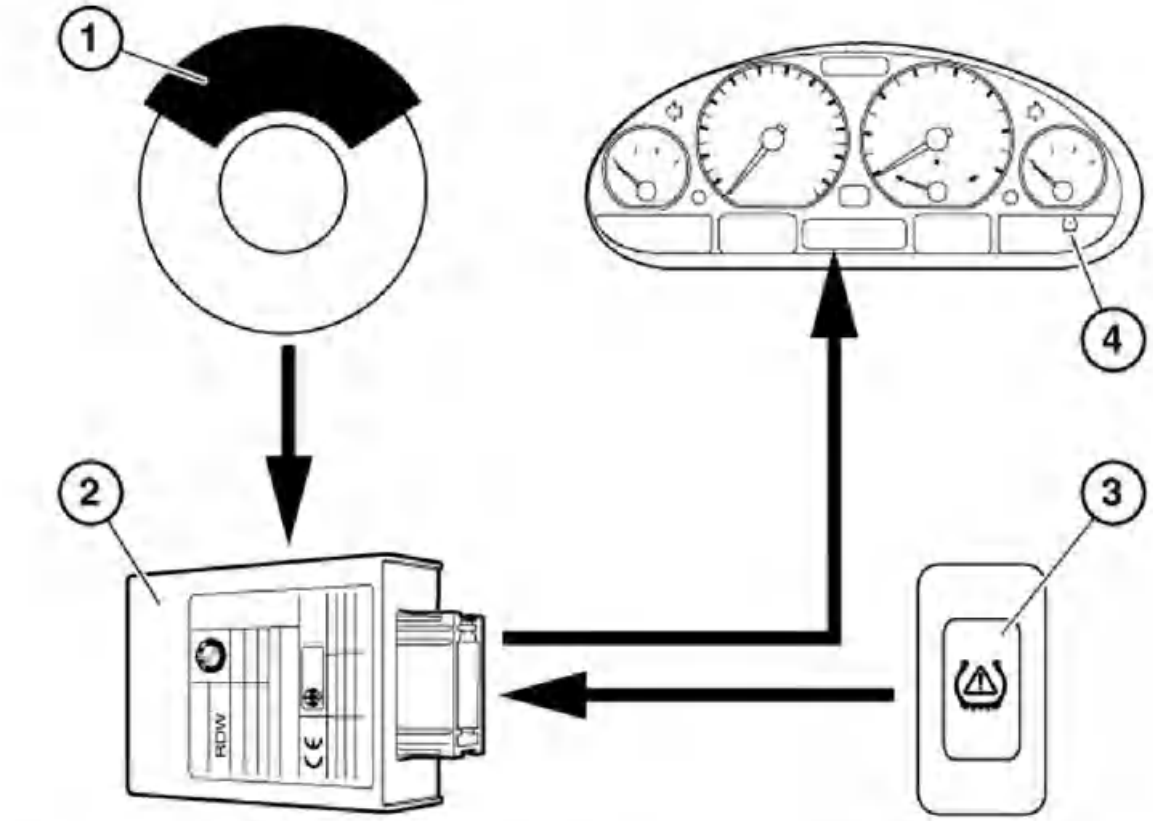


Fig. 36: RDW System Layout
Courtesy of BMW OF NORTH AMERICA, INC.

Component Description

RDW Control Unit

Fully diagnosis-compatible

Task:

- evaluates wheel speeds.
- a warning is transmitted as required.

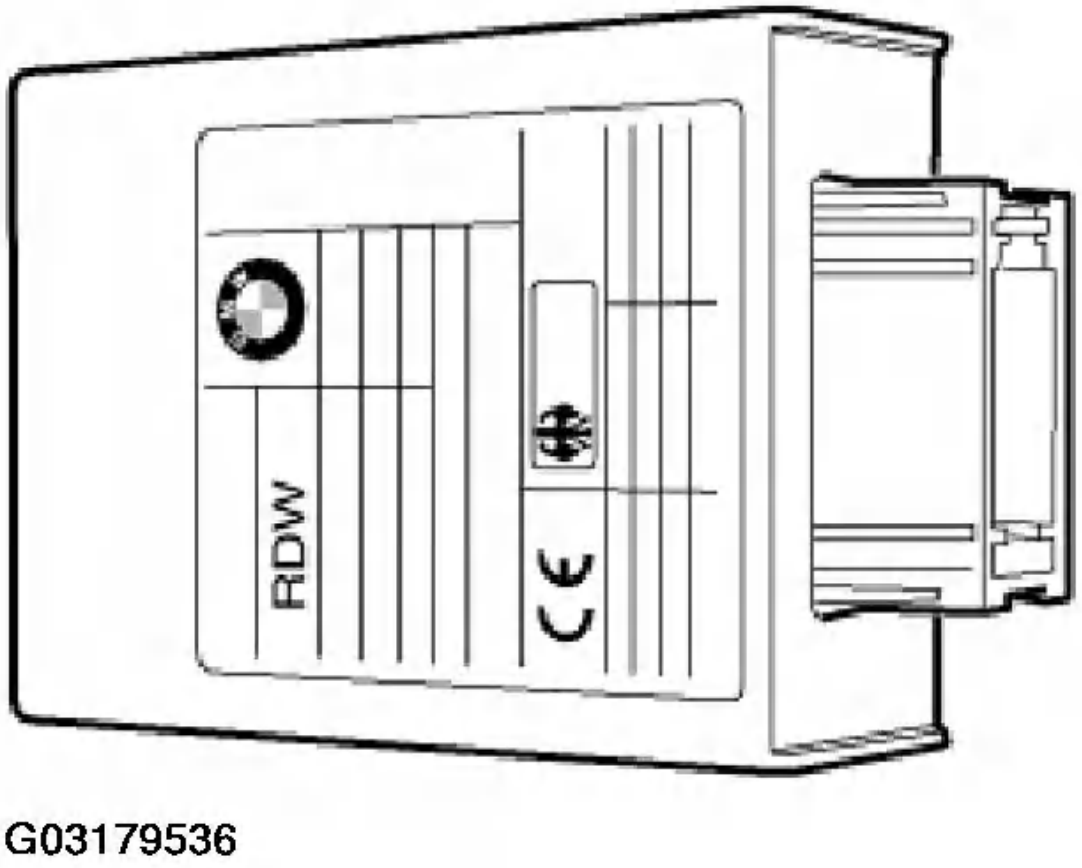


Fig. 37: Identifying RDW Control Unit
Courtesy of BMW OF NORTH AMERICA, INC.

Set Button

Installed in the dashboard to the right of the steering wheel. Symbol: tire cross-section with warning triangle.

Task: initialization after resetting cold tire pressure or after changing tire or wheel location.

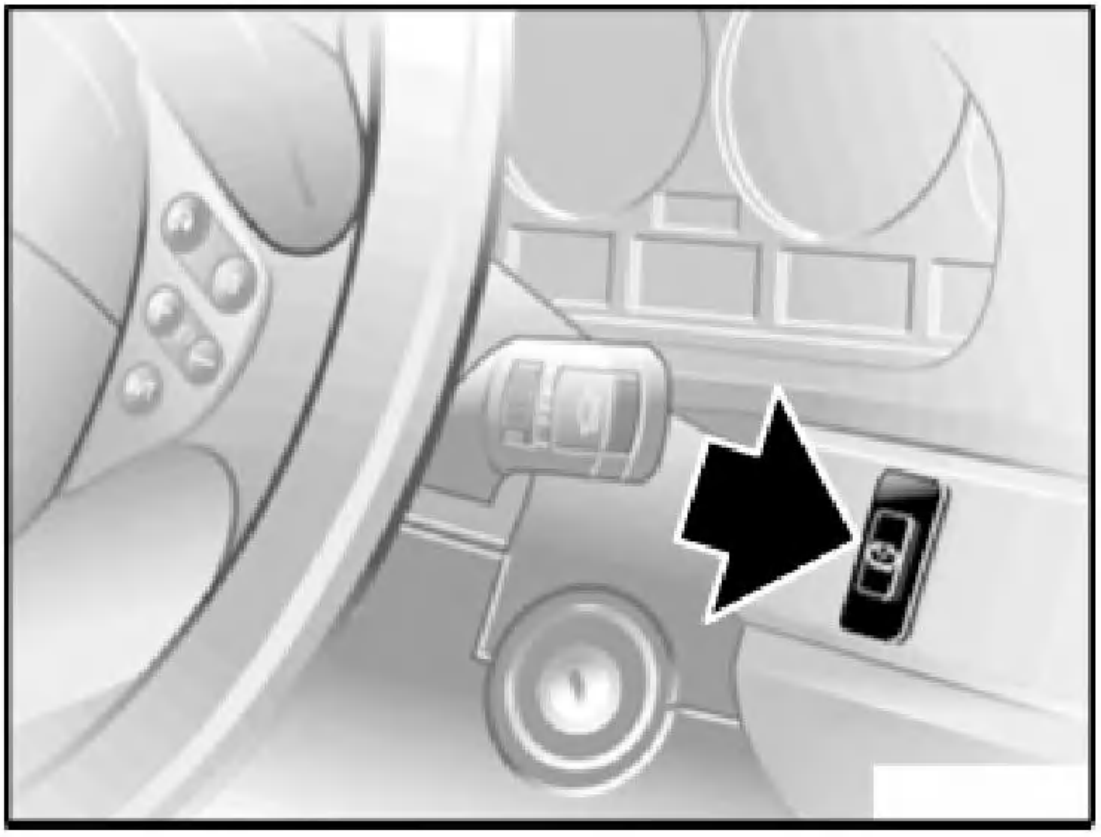


Fig. 38: Identifying Set Button
Courtesy of BMW OF NORTH AMERICA, INC.

Display Element In Instrument Cluster

Indicator lamp lights up red:

- drop in tire pressure 30 +/- 10 %

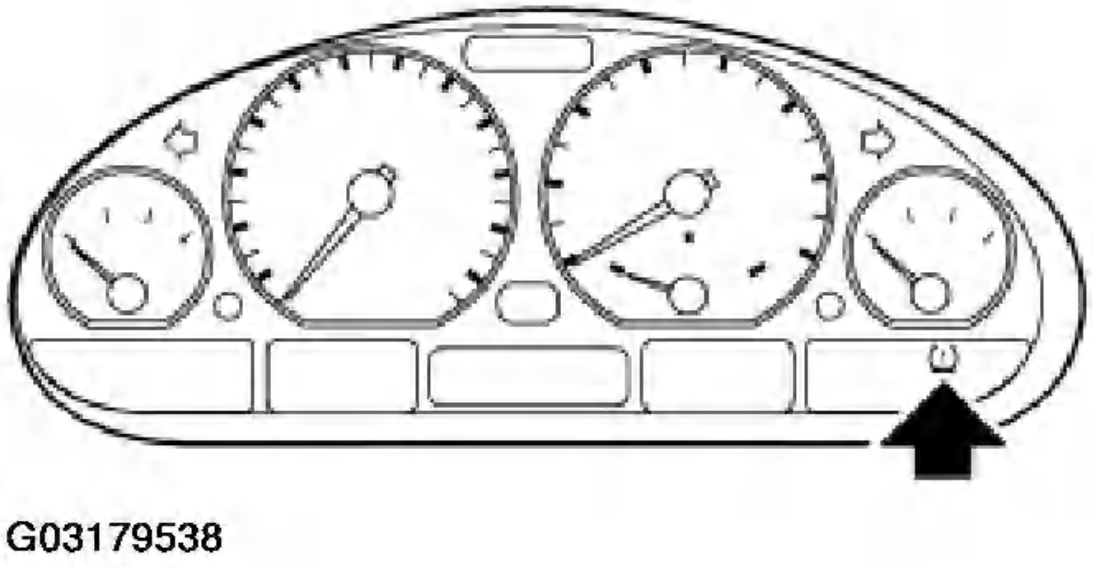


Fig. 39: Identifying RDW Indicator Lamp
Courtesy of BMW OF NORTH AMERICA, INC.

EMERGENCY RUNNING SYSTEMS

Introduction

Tires with emergency running characteristics can still be used for a certain distance even if they suffer a complete loss of pressure. There are two different systems which meet these requirements:

- emergency running system with self-supporting tires
- emergency running system with integrated support ring

Emergency Running Systems Setup

Emergency Running System With Self-Supporting Tires

The side walls of the self-supporting tire are reinforced. In conjunction with a special disc wheel, the tire can still be used for a certain distance even if it suffers a complete loss of pressure.

Mobility is retained for the following distances up to a speed of 80 km/h (50 mph) and with a cautious, suitably adapted driving style:

EMERGENCY RUNNING SYSTEM DESCRIPTION

Unloaded vehicle	max. 500 km (300 miles)
Unloaded roadster	less than 250 km (150 miles)
Fully loaded vehicle	max. 50 km (30 miles)

Self-supporting tires demand permanent monitoring of the tire pressure to ensure that the driver is given adequate warning if pressure is lost during a journey. For this reason, these tires are only available in conjunction with the warning system RDW and from 03/2000 also with RDC.

To prevent the self-supporting tires from becoming detached from the disc wheel in the event of a complete loss of tire pressure, they must be fitted to newly developed wheels with modified disc wheel humps, but with unchanged tire seating (= standard disc wheel).

However, the new wheels can also be used for standard tires of the same size.

Comparison Standard Tyres/Self-Supporting Tires

Standard Tires, Unpressurised

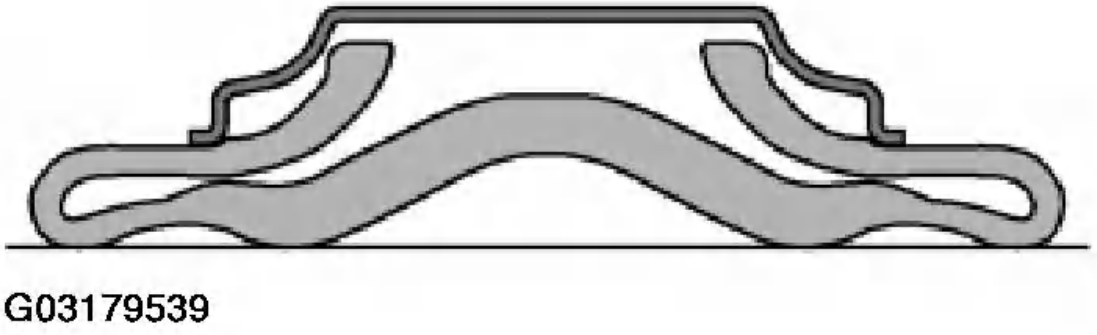


Fig. 40: Identifying Unpressurised, Standard Tires
Courtesy of BMW OF NORTH AMERICA, INC.

Self-supporting tires, unpressurised

Envulcanised reinforcement (1) made of a temperature-resistant rubber compound.

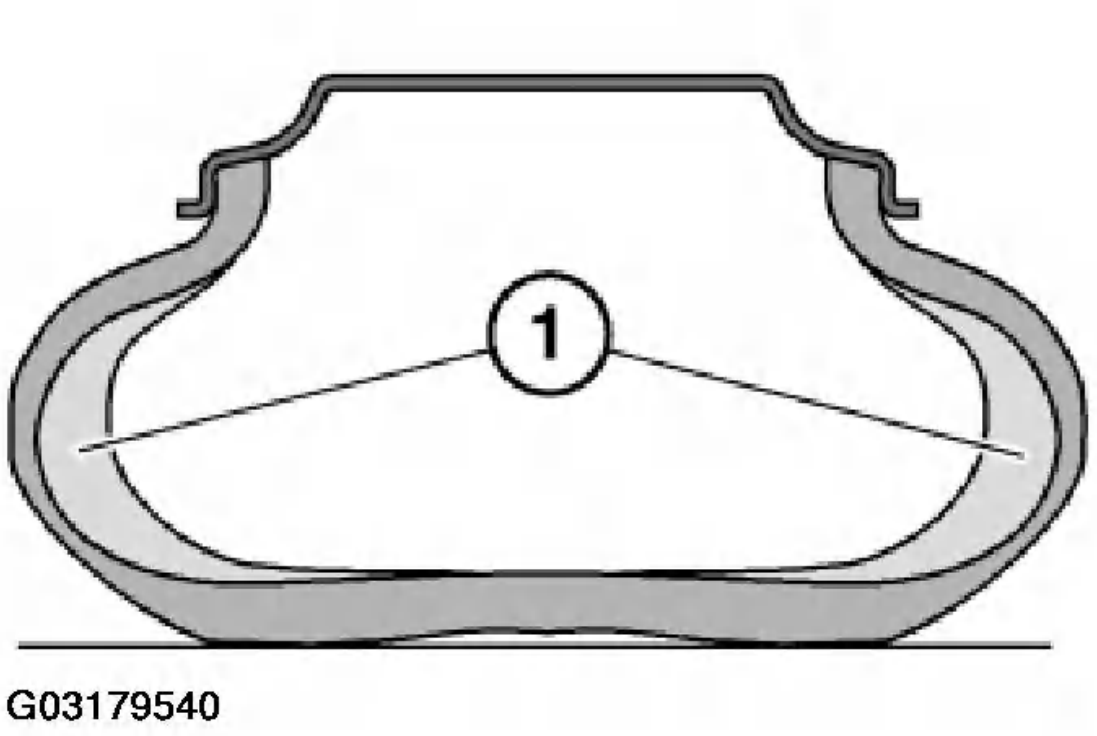


Fig. 41: Identifying Unpressurised, Self-Supporting Tires
Courtesy of BMW OF NORTH AMERICA, INC.

Disc Wheels

H2 Disc Wheel (Standard Disc Wheel) For Emergency Running System With Integrated Support Ring

(1) Hump 2 of standard disc wheel

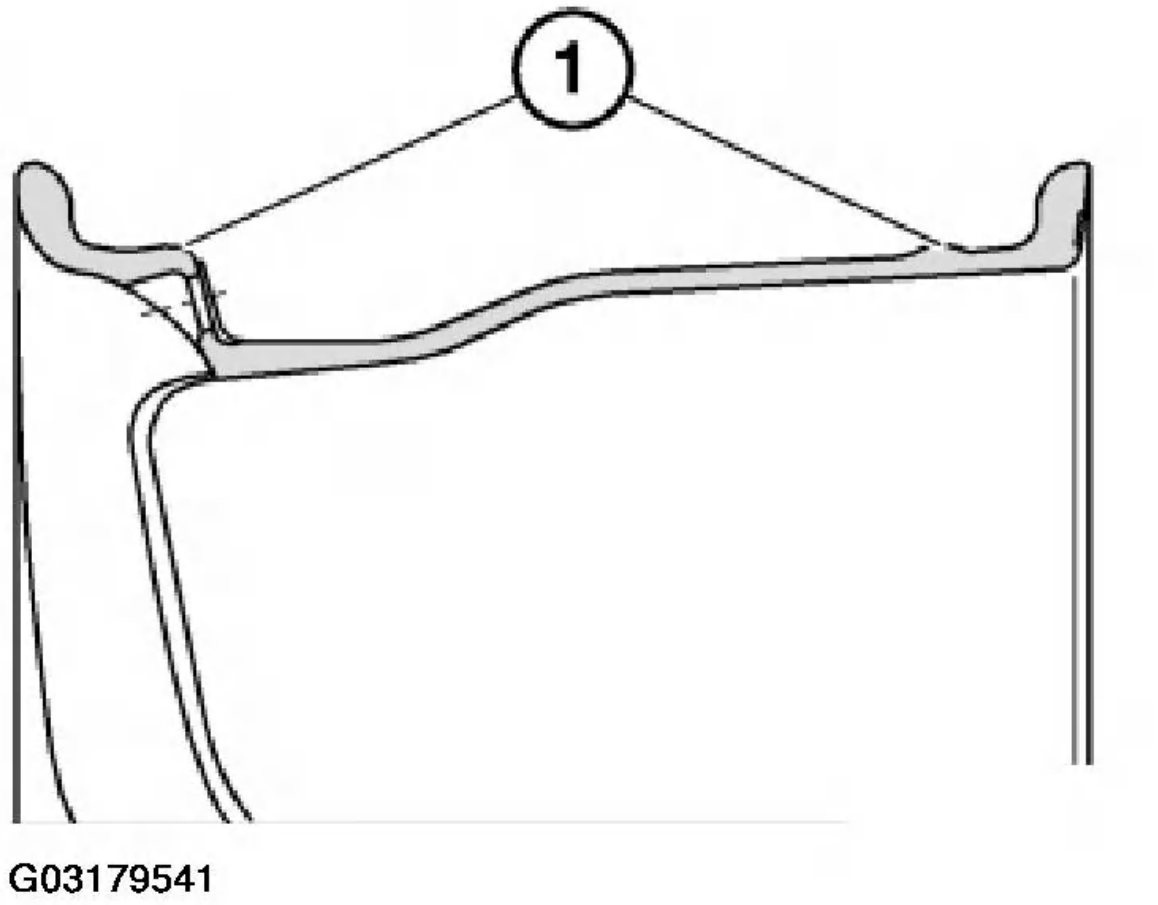


Fig. 42: Identifying H2 Disc Wheel
Courtesy of BMW OF NORTH AMERICA, INC.

EH2 Disc Wheel For Emergency Running System With Self-Supporting Tyre

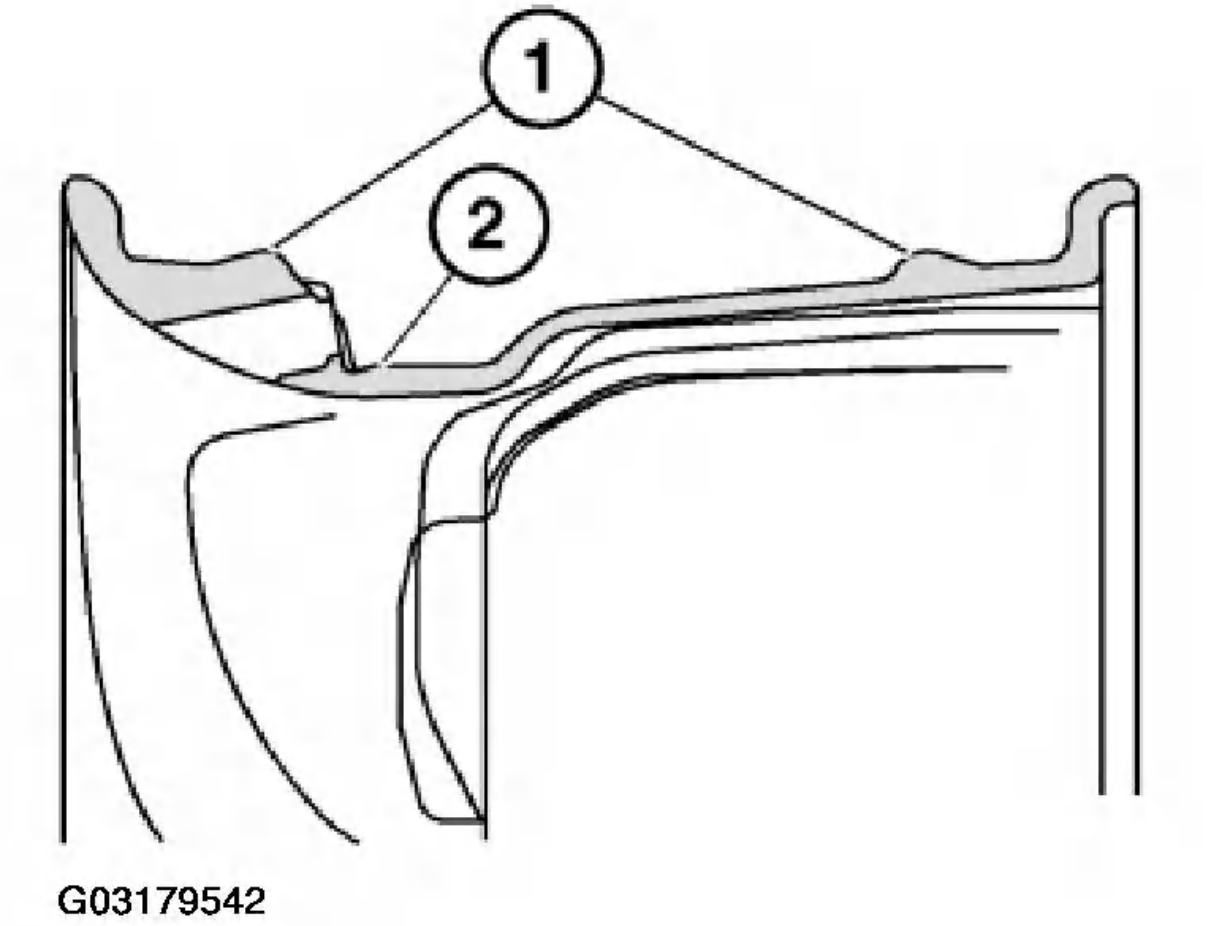


Fig. 43: Identifying EH2 Disc Wheel
Courtesy of BMW OF NORTH AMERICA, INC.

1. Extended Hump 2 of disc wheel
2. Drop center relocated a few millimetres to the center (precentring on outside)

NOTE: The new EH2 disc wheels (extended Hump 2 inner and outer) will be used more frequently on BMW vehicles in the future as they can also help to delay standard tires from being lost in the event of a drop in tire pressure. Example: from current 1.1 bar to 0.6 bar (X5 or Landrover disc wheel)

Emergency Running System With Integrated Support Ring

(In the future, primarily on heavy safety vehicles)

The support ring is made of a high-strength resilient plastic and is fitted on the disc wheel inside the tire. The support ring can only be removed using special tools which have been specially approved by BMW. It can only be removed after destroying the tire.

Emergency running systems with integrated support ring are used in particular on heavy safety vehicles. They allow the vehicle to be driven away from a potential danger without dropping speed even if the tires have suffered a complete loss of pressure (flight situation).

It is possible as an option to have the tire pressure monitored by an RDC system. The RDC is installed by pressing the components into the support ring before it is fitted.

Emergency Running System With Integrated Support Ring

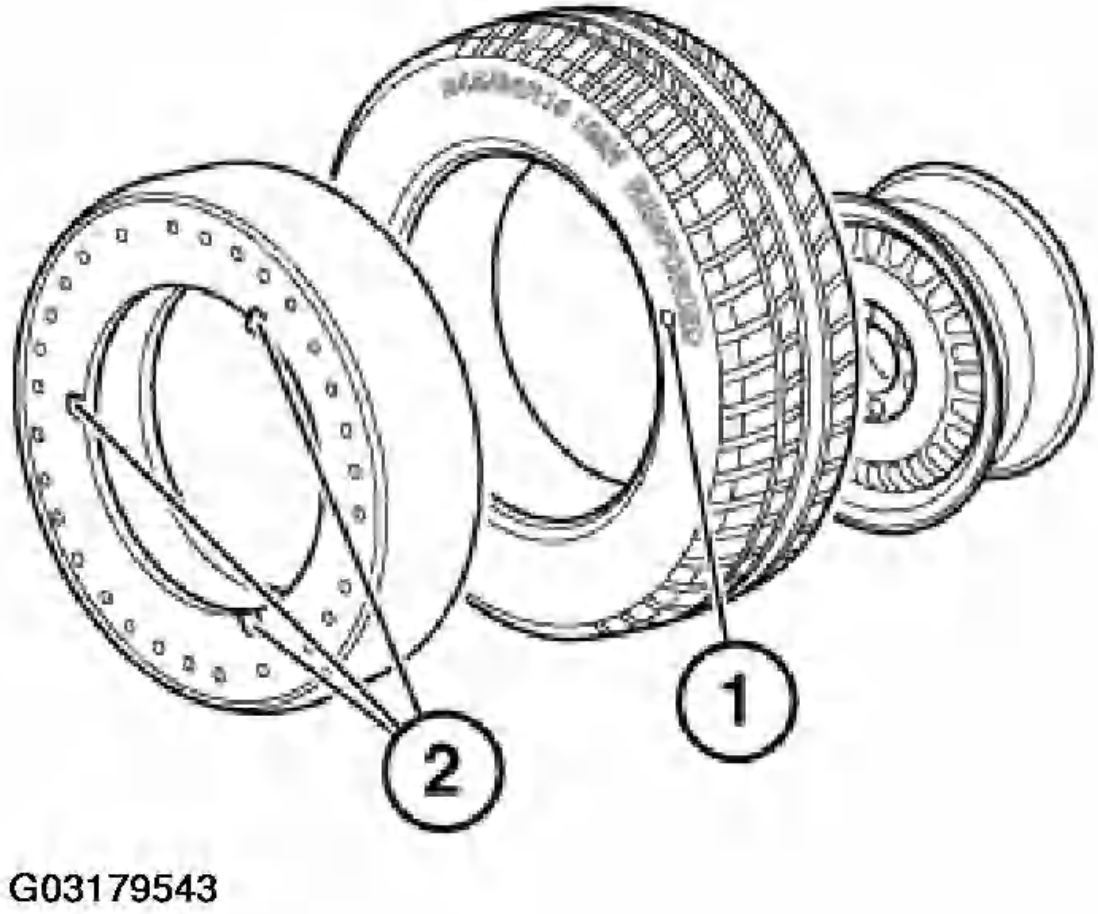


Fig. 44: Identifying Support Ring And Tyre
Courtesy of BMW OF NORTH AMERICA, INC.

1. Tyre
2. Support ring

Installation Location Of RDC Wheel Electronic Unit

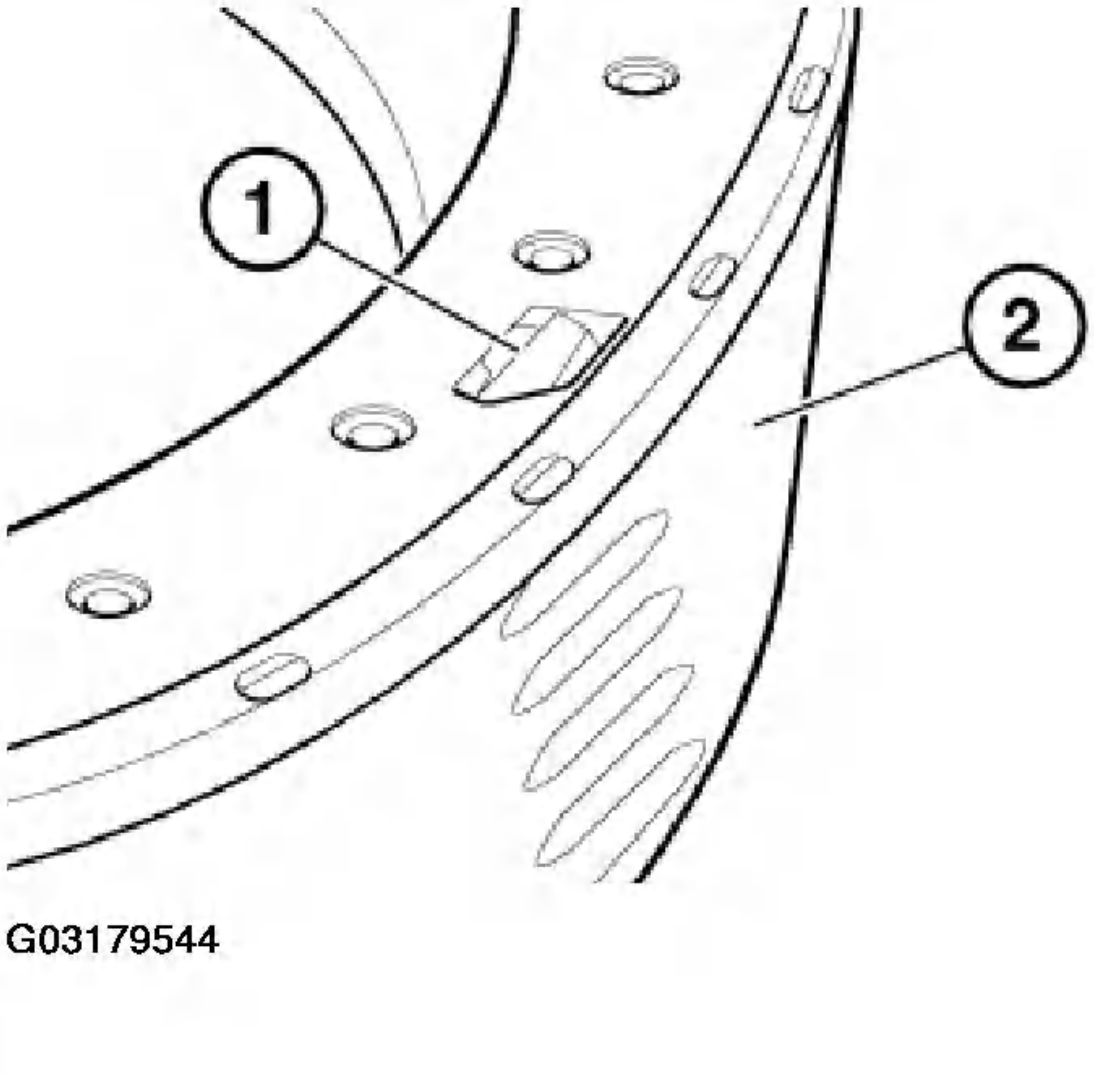


Fig. 45: Identifying Wheel Electronic Unit And Support Ring
Courtesy of BMW OF NORTH AMERICA, INC.

1. Wheel electronic unit
2. Support ring

For further information on the subject of "Tyre pressure warning systems and tires with emergency running characteristics", please refer to the vehicle Owner's Handbook.

A Parts Information bulletin will be published with information on how to order parts.

Functional and system descriptions are not subject to change. Parts availability and immediate ordering availability cannot be derived from this information. The specialized departments will inform the markets with further details at the appropriate time.

STORING WHEELS AND TIRES

All Models

WHEELS/TIRES - GENERAL NOTES

The service of storing a customer's wheels is one which is now almost taken for granted. For this reason, we have published this BMW Technical Service bulletin to provide a uniform storage concept, which will prevent damage being caused due to incorrect storage.

The tires rubber will age under the influence of sunlight, heat, humidity, movements in the air and ozone, and will thus lose some of its stability and elasticity. For this reason, tires should never be stored in the open-air. If open-air storage cannot be avoided, the wheels/tires must be stored in a clean and dry condition and covered with waterproof material. It is essential that wheels/tires are protected against rain, snow and sunlight, but due to the risk of corrosion they must not be stored in tire sacks. For more information on protective covers for wheels and tires, see SI 36 01 88 (864).

Wheels/tires with tire pressure control (RDC) must not be cleaned with high-pressure cleaning equipment. For general information on RDC, TIRES WITH EMERGENCY RUNNING CHARACTERISTICS AND TYRE PRESSURE WARNING SYSTEMS.

Storage Requirements

The following requirements apply in general to storage in enclosed rooms:

STORING WHEELS AND TIRES SPECIFICATIONS

cool	15...25 Â°C / sources of heat screened, or 1 m minimum distance from source of heat
dry	Prevent water and condensation Avoid contact with mineral lubrication products
dark	Protect from direct sunlight and high-UV artificial light
moderate ventilation	Avoid a supply of oxygen and ozone

In short, the storage room should be cool and dry. It is not necessary to heat the room during the winter. In the summer, the doors and windows should be kept closed to ensure that no air can circulate. In addition, the windows can also be coated with sun protection paint.

The storage room should not contain any working electric machinery, welding equipment, distribution boxes etc. as electrical sparks generate ozone which can have a serious impact on the surface of the tire (ozone cracks).

Tires should not be allowed to come into contact with oil, petrol, or other mineral lubricants as these dissolve rubber, making the tire porous.

Preparing Wheels/Tires

1. Before removing a wheel, mark its position on the vehicle.
2. Whenever possible, keep the tire on its wheel (complete wheels).
3. Correct the inflation pressure and recheck every 2 months.
4. Ensure that tires are stored at a sufficient distance above the ground. Wheels/tires should never be stored on the ground.
5. Complete the storage forms. These should contain the following data:
   - Type and size of tire
   - Condition and tread depth
   - Customer's address
   - Date and signature of customer

Wheel/Tyre Storage Requirements

A. Tyre fitted to wheel

Do not store upright...

NOTE: If storing the wheels upright cannot be avoided, the inflation pressure must be increased to 3.5 bar.



Fig. 46: Use Care When Storing Wheel/Tyre Storage In Upright Position (Tyre Fitted To Wheel)
Courtesy of BMW OF NORTH AMERICA, INC.

... but rather hang...

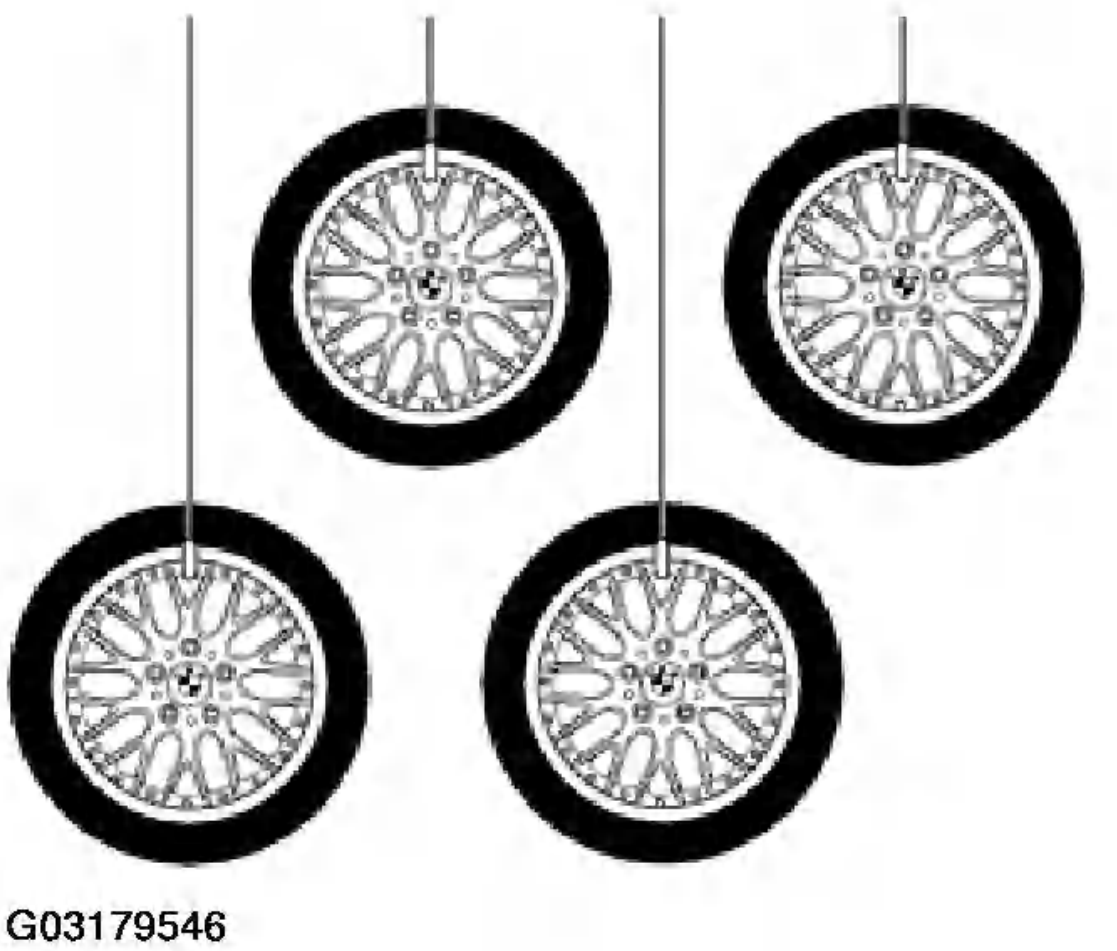


Fig. 47: Preferred: Store Tires In Hanging Position (Tyre Fitted To Wheel)
Courtesy of BMW OF NORTH AMERICA, INC.

... or stack.

NOTE: Never store tires on the ground.
Use a wooden palette or similar.

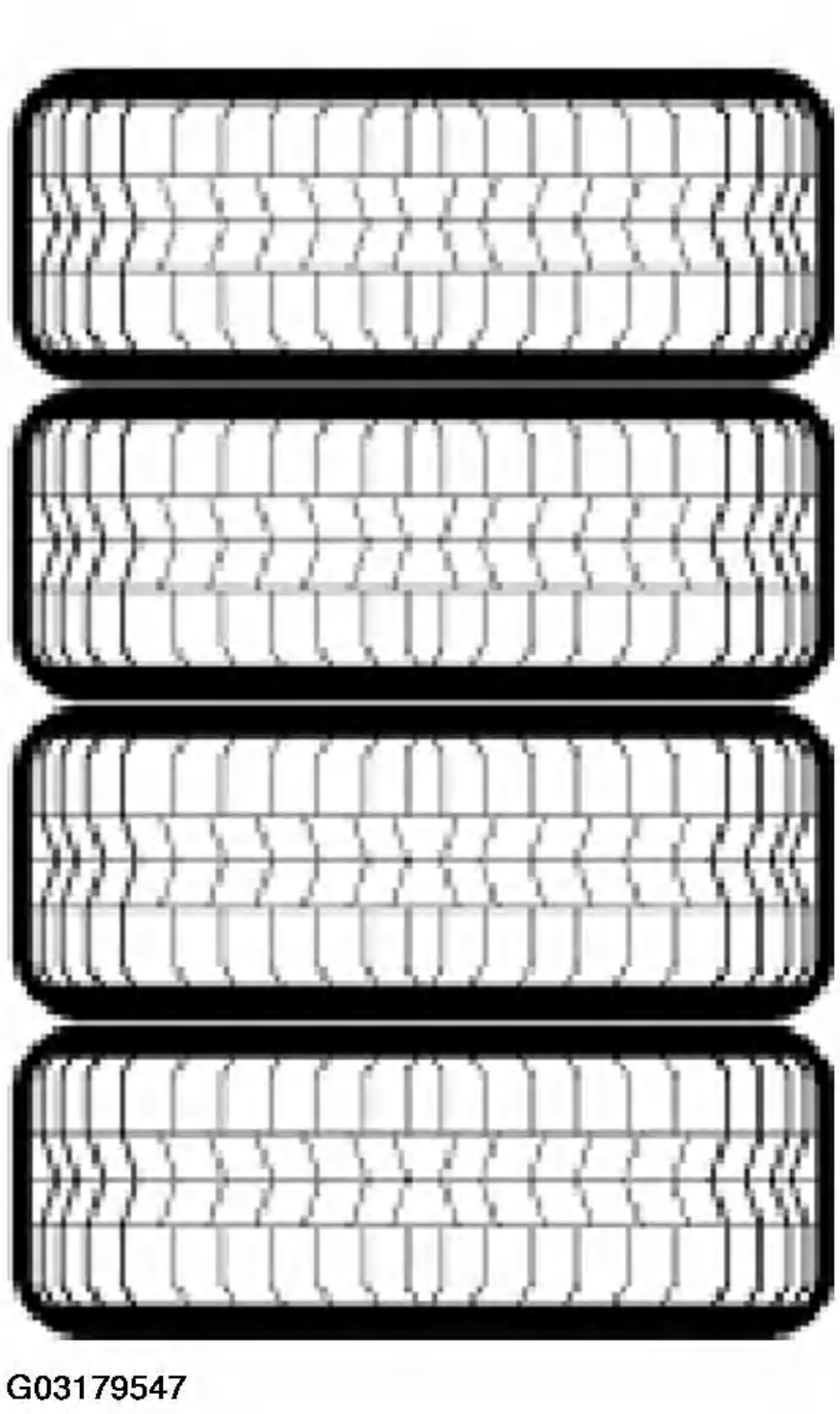


Fig. 48: Storing Tires In Stacked Position (Tyre Fitted To Wheel)
Courtesy of BMW OF NORTH AMERICA, INC.

B. Tires Not Fitted

Do not stack...

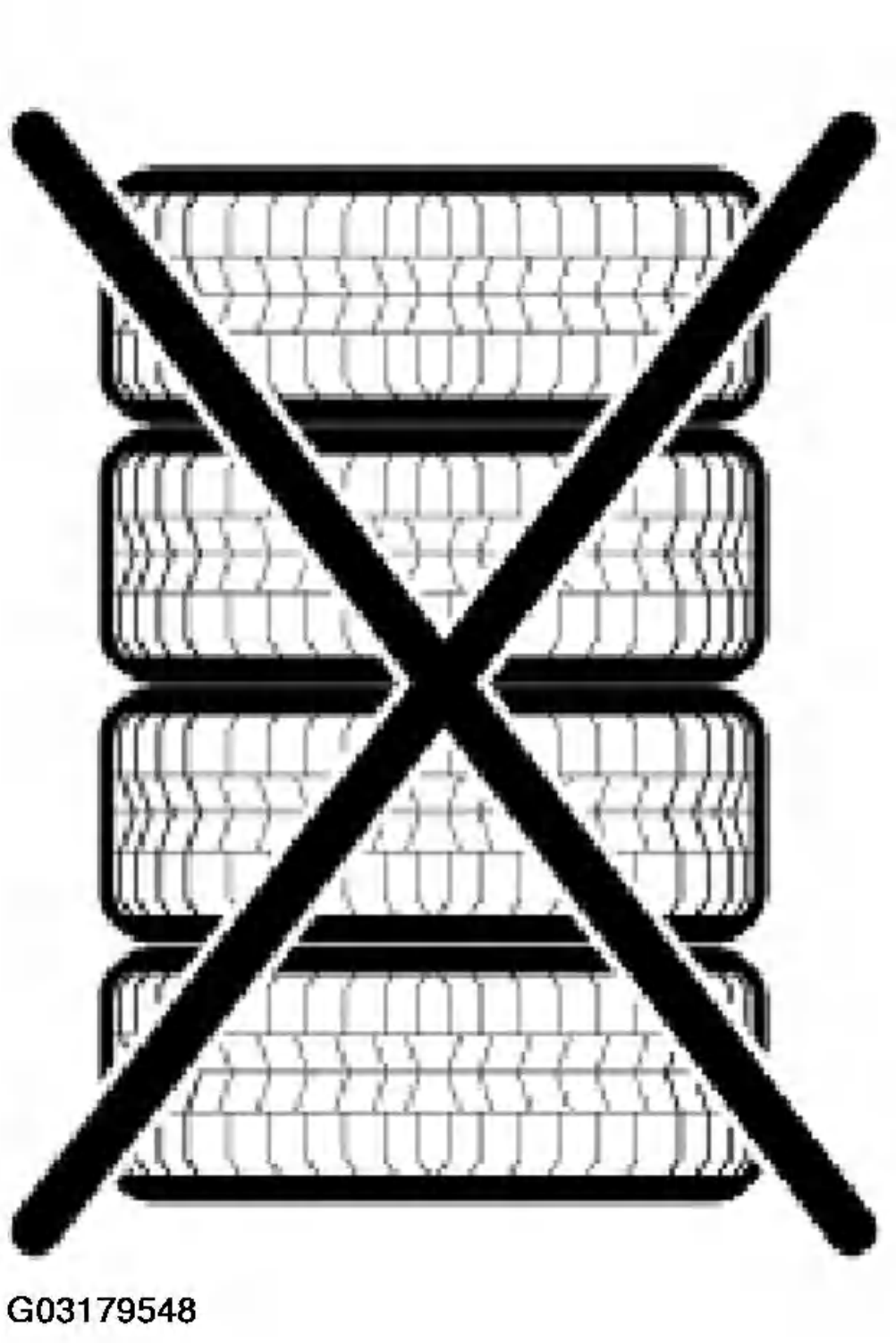


Fig. 49: DO NOT Store Wheel/Tyre In Staked Position (Tires Not Fitted)
Courtesy of BMW OF NORTH AMERICA, INC.

... do not hang...

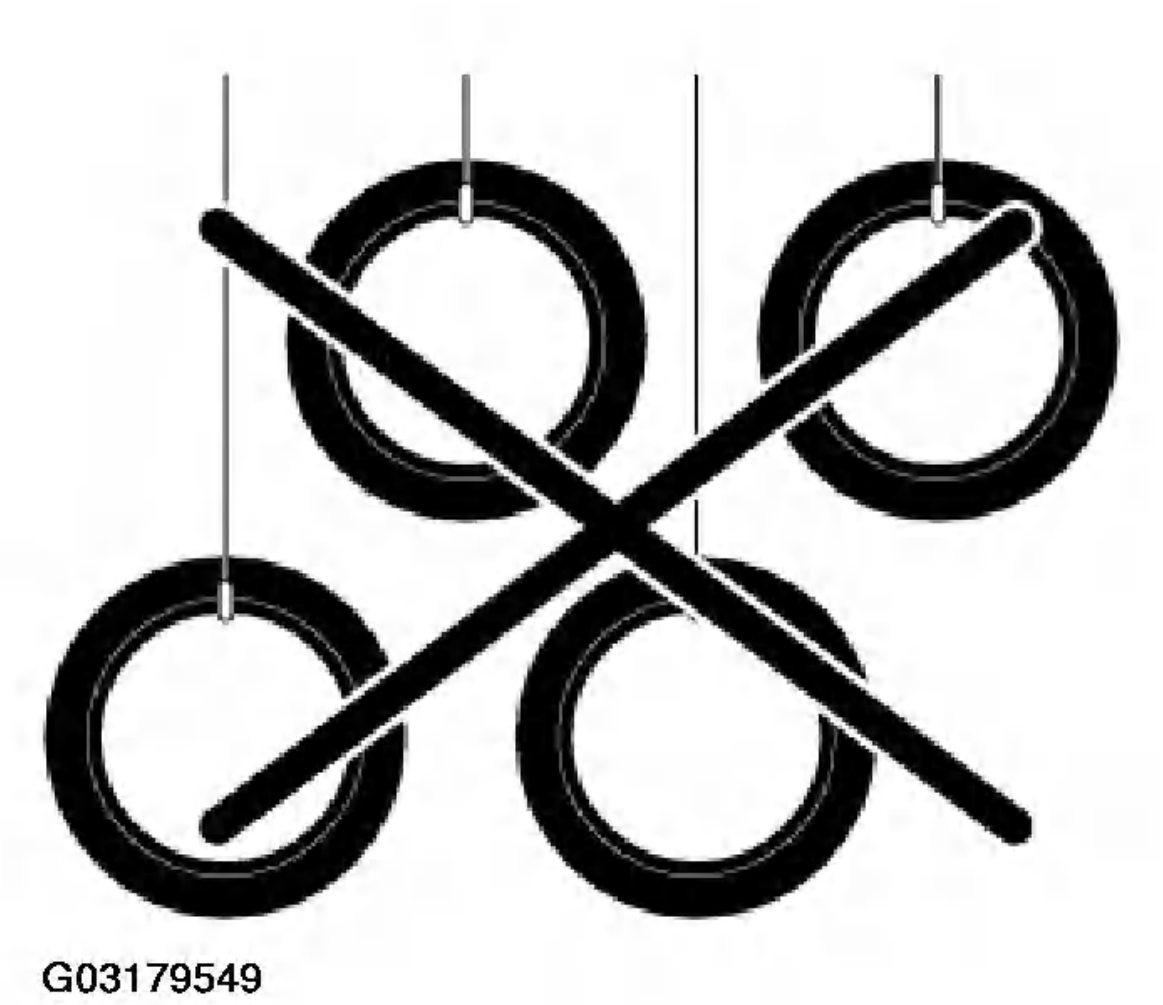


Fig. 50: DO NOT Store Wheel/Tyre In Hanging Position (Tires Not Fitted)
Courtesy of BMW OF NORTH AMERICA, INC.

... but rather store them upright and turn them every 4 weeks.

NOTE: Never store tires on the ground.
Use commercially available shelves.

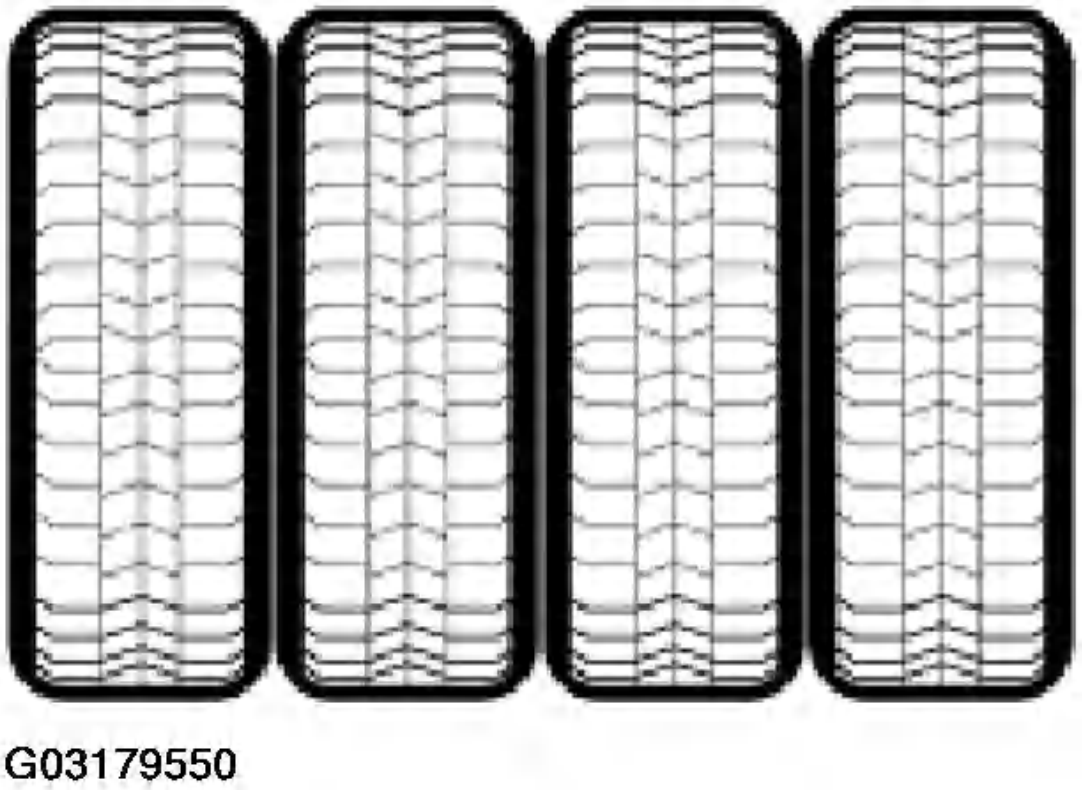


Fig. 51: Preferred: Store Tires In Staked Position (Tires Not Fitted)
Courtesy of BMW OF NORTH AMERICA, INC.

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