Drive Axles

BMW INTEGRAL CARRIER

320i, 528e, 733i

DESCRIPTION

Final drive assembly has hypoid type ring and pinion gear. Assembly may have a multi-disc, self-locking differential (ZF DL-175). Housing has a removable rear cover. Differential carrier is retained in the sides of the housing by bearing caps and is supported by tapered roller bearings.

Shims under the bearing caps maintain proper carrier bearing preload. Drive pinion gear is supported by roller bearings and preload is maintained by a collapsible spacer between the bearings.

AXLE RATIO & IDENTIFICATION

The ring and pinion gear set with Klingelnberg tooth design can be identified by the letter "K" stamped on the drive pinion gear; Gleason teeth are noted by an "H" stamping. Letter "S" indicates a self-locking differential.

To determine axle ratio, divide number of ring gear teeth by number of drive pinion gear teeth. The number of teeth on ring and drive pinion gears is stamped on forward left side of differential housing.

REMOVAL & INSTALLATION

DRIVE SHAFT

Removal

Rear drive shaft flange access is through a hole in the rear axle support. Detach from final drive and axle shaft drive flange by removing flange bolts.

Installation

To install, reverse removal procedure using sealer on boot-to-joint surfaces. Install seal cover after packing joint with lubricant.

CONSTANT VELOCITY JOINT

Removal

Remove cover from joint housing. Remove snap ring from end of drive shaft. Remove clamps from boot. Press drive shaft from joint and note position of thrust washer, if equipped. Remove dust boot.

Installation

To install, reverse removal procedure. Convex side of thrust washer faces joint, if equipped.

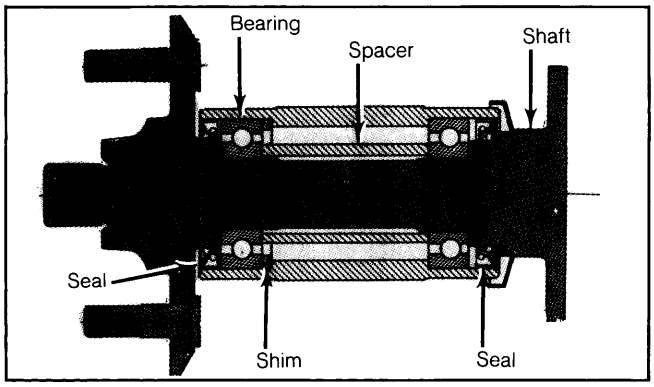
AXLE SHAFTS & BEARINGS

Removal

1) Raise and support vehicle. Remove wheel and brake drum assembly. Remove drive shaft. Loosen castellated nut (528e and 733i models) securing flange to axle shaft. Using a puller on 528e and 733i models, remove flange.

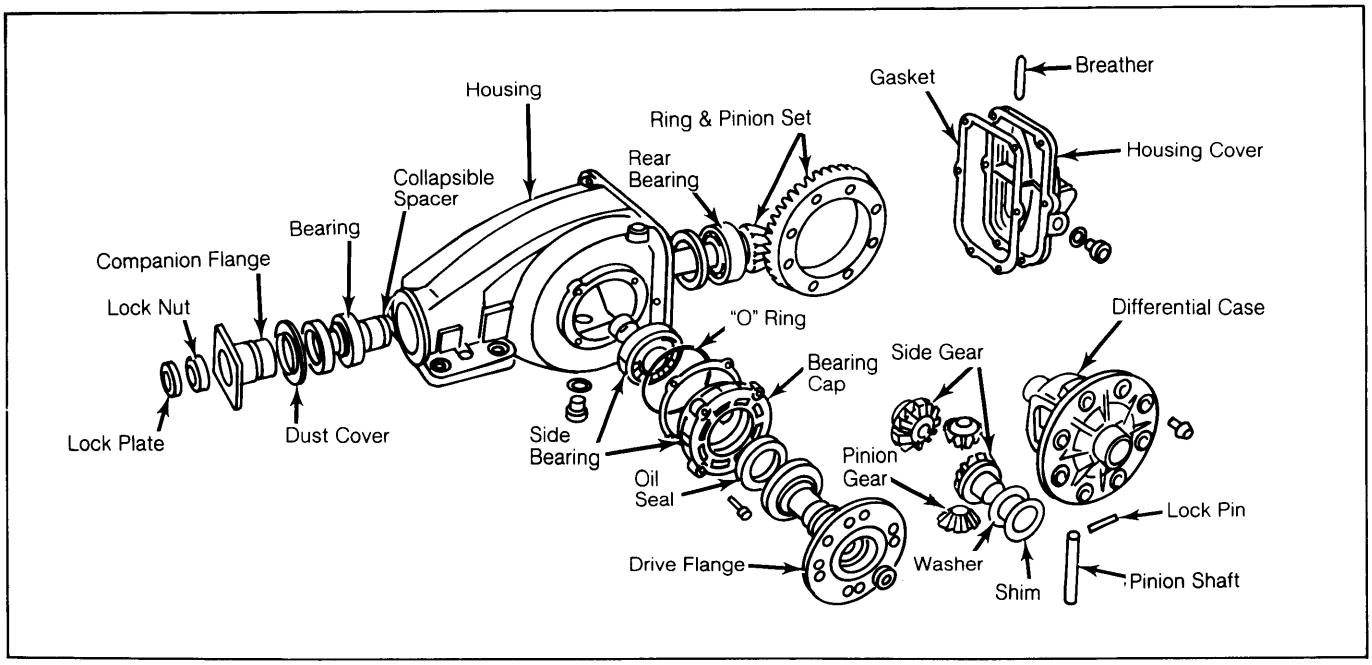
2) On all models, install castellated nut on axle shaft and drive out axle shaft using a soft-headed mallet. Remove bearings and seals. Remove spacer sleeve and shim, if equipped.

Fig. 2: Sectional View of Axle Shaft Assembly



Spacer length and shim adjust wheel bearing play.

Fig. 1: Exploded View of BMW Integral Carrier Assembly



Drive Axles

BMW INTEGRAL CARRIER (Cont.)

Installation

1) To install, reverse removal procedure noting the following: Install inner bearing. Determine distance between outer races of inner and outer bearings.

2) Measure spacer and shim. Install a spacer and shim that will obtain specified axle shaft end play. Pack bearings and hub with grease. Using new seals, complete installation procedure.

DRIVE PINION COMPANION FLANGE OIL SEAL

Removal

1) Remove final drive assembly and mount on holding fixture. Remove lock washer. Using a prick punch, mark installed position of companion flange. Using an INCH lb. torque wrench, measure and record pinion gear preload.

2) Hold flange stationary and remove lock nut. Pull off companion flange. Check bearing surface of flange. Replace flange if deeply scored. Pull out seal and discard.

Installation

1) Dip seal in gear oil. Drive seal into case until flush. Press companion flange onto pinion gear, aligning punch marks made during removal.

2) Loosely install lock nut. Using INCH lb. torque wrench, tighten lock nut. Tighten lock nut to preload value measured during removal PLUS 2 INCH lbs. (.23 N.m) for new seal.

3) If lock nut can not be tightened to specified torque value or if preload value (measured during removal) is exceeded, removal and installation of drive pinion and collapsible spacer is required. If preload value is obtained, install lock washer.

AXLE FLANGE & OIL SEAL

Removal

With final drive assembly mounted in holding fixture, pry off drive flanges with tire irons. Mark flanges for installation in original positions. Check flanges. Flanges with scored bearing or seal surfaces must be replaced. Remove and discard flange snap ring. Remove seal with puller.

Installation

Dip seal in gear oil. Drive seal into case until it rests against stop. Insert new snap ring into recessed groove in case. Replace drive flange and ensure snap ring engages groove in flange.

DIFFERENTIAL ASSEMBLY

Removal

Detach propeller shaft and drive shafts from final drive. Suspend shafts out of way. Detach self-aligning support at final drive, if equipped. Remove electrical connectors, if equipped. Support final drive on jack and remove final drive mounting bolts. Lower jack and remove final drive assembly.

Installation

To install, reverse removal procedure ensuring that assembly is stress-free when tightened to specified torque.

OVERHAUL

DISASSEMBLY

Differential Housing

1) Remove final drive assembly and mount in holding fixture. Using an INCH lb. torque wrench, measure and record preload of pinion gear and differential gears.

2) Drain oil and remove rear cover plate. Discard gasket. Remove drive flanges as previously described. Remove both bearing caps, keeping right and left parts separated. Record number and location of shims under bearing caps. Remove differential assembly from case.

3) Remove multi-tab pulse ring, if equipped. Remove side bearings with puller. Remove bolts securing ring gear to carrier. Remove ring gear. Drive out pinion shaft lock pin. Remove pinion shaft and gears. Remove side gears with shims and thrust washers.

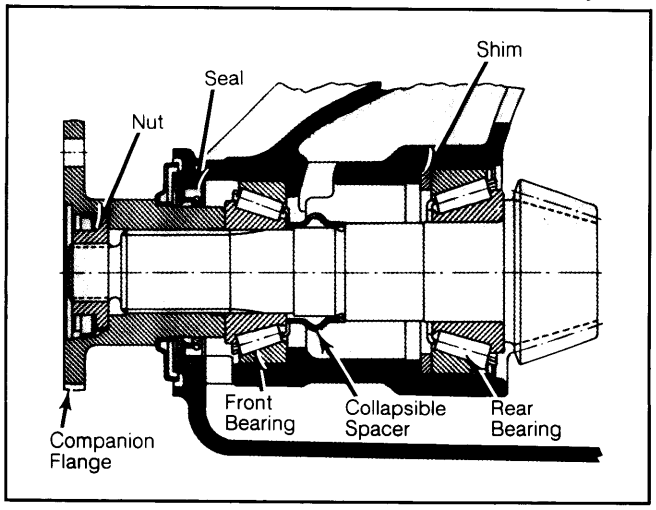
Drive Pinion Gear

1) Remove lock washer. Using a prick punch, mark installed position of companion flange. Using an INCH lb. torque wrench, measure and record pinion gear preload.

2) Hold flange stationary and remove lock nut. Pull off companion flange. Check bearing surface of flange. Replace flange if deeply scored. Pull out seal and discard. Press drive pinion from housing. Remove collapsible spacer and drive pinion rear bearing.

3) Remove drive pinion shaft oil seal. Remove pinion inner bearing race from case with puller. Note shim thickness under bearing race. Pull out front bearing race.

Fig. 3: Sectional View of Drive Pinion Gear Assembly



Note position of collapsible spacer and shim.

REASSEMBLY & ADJUSTMENT

Drive Pinion Gear

1) Install front and rear bearing races in housing. Press rear bearing onto drive pinion. Note any deviations ("+" or "-") stamped on drive pinion. This amount must be added (if "+") or subtracted (if "-") from measurement "C". *See Fig. 4.*

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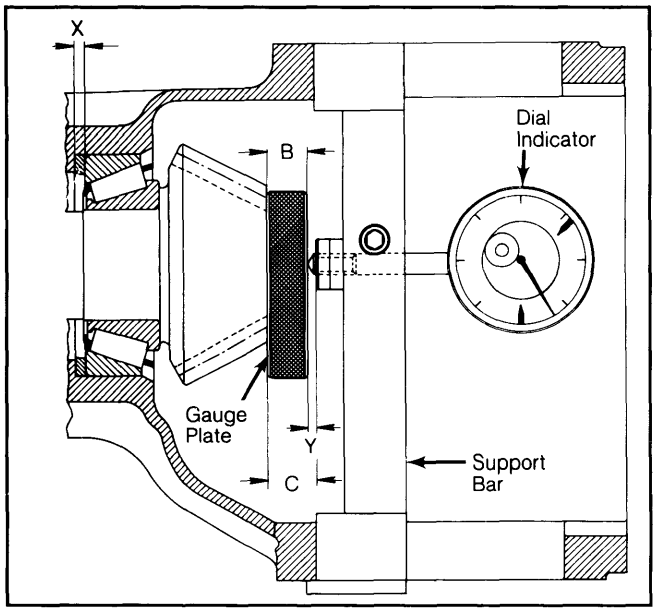
2) If original ring and pinion gear set is being installed, install drive pinion gear using original shim and new collapsible spacer. If new ring and pinion gear set is being installed, install new shim that is same thickness as original shim.

Fig. 4: Pinion Shim Measuring Points



These measurements are critical for correct differential operation.

Drive Pinion Bearing Preload

1) Install shim and drive pinion gear. Install front drive pinion gear bearing. Do not install collapsible spacer or seal. Install companion flange. Loosely install lock nut.

2) Using an INCH lb. torque wrench, tighten lock nut to obtain preload of 13 INCH lbs. (1.5 N.m) on 320i models or 22 INCH lbs. (2.5 N.m) on all other models.

3) Mount dial indicator in support bar. Place support bar and dial indicator over gauge plate. Zero dial indicator with .157" (4 mm) preload. Place gauge plate on drive pinion in housing. Place support bar with dial indicator in housing. Measure distance between support bar and gauge plate (dimension "Y").

4) Basic setting adjustments are: 320i models is .434" (11.02 mm), 528e models is .453" (11.50 mm) and 733i models is .728" (18.50 mm). Using dimensions in *Fig. 4.*, determine required shim thickness "x" by using the sample calculation chart.

5) Remove tools, companion flange and drive pinion gear. Install shims of calculated thickness. Shims are available in .0004-.0012" (.01-.03 mm) thicknesses.

6) Install shims, drive pinion gear, collapsible spacer and seal. Install companion flange and tighten lock nut to obtain specified pinion gear bearing preload. If preload is exceeded, new collapsible spacer must be installed and procedure repeated.

SAMPLE PINION BEARING PRELOAD CALCULATION

Dimension	Measurement
"C" (Basic setting)	[1] .453" (11.50 mm)
PLUS or MINUS Deviation	- .012" (.30 mm)
"C" Target	.441" (11.20 mm)
Measured value "Y"	.063" (1.60 mm)
Sum "B" (Gauge plate)	.374" (9.50 mm)
PLUS measured value "Y"	+ 1.063" (1.60 mm)
"C" actual	.437" (11.10 mm)
"C" target	.441" (11.20 mm)
"C" actual	- [2] .437" (11.10 mm)
Difference =	.004" (.10 mm)
Installed shim thickness	.163" (4.14 mm)
PLUS or MINUS difference	- .004" (.10 mm)
Shim "X" thickness =	.159" (4.04 mm)

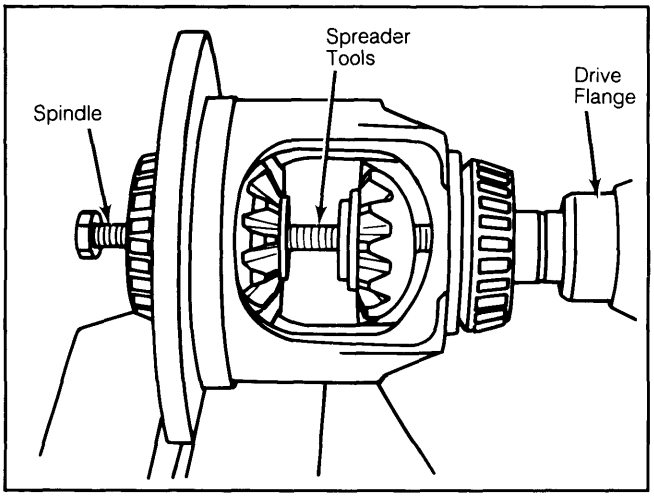
[1] — Calculations for 528e.
[2] — If "C" target is greater than "C" actual, difference is subtracted from shim thickness. If "C" target is smaller than "C" actual, difference is added to shim thickness.

Differential Housing

1) Press on side bearings. Install both differential side gears with thrust washers and shims. Ensure concave side of thrust washers face gears. Using drive flanges, center side gears.

2) Mount differential assembly in vise. Install spreader tools. *See Fig. 5.* Spread side gears by tightening spindle until drive flange can just be turned. Remove drive flange and install pinion gears. Remove spreader tools. Install pinion shaft and lock pin.

Fig. 5: Spreading Differential Side Gears



Spread gears until drive flange can just be turned.

3) Install side gear gauge plate and spindle. Hand tighten spindle. Mount dial indicator on differential case. Zero dial indicator. Tighten spindle until thrust washer is pressed flat. *See Fig. 6.*

4) Loosen spindle. Turn side gear and repeat measurement at various points. Repeat procedure on opposite side gear. Adjust specified clearance by installing thicker or thinner shims.

5) Shims are available in .002" (.05 mm) increments. Remove gauge plate and spindle, pinion shaft, pinion gears and side gears. Install shims of calculated thickness and repeat procedure.

NOTE: Ring gear tooth pattern has priority over backlash and preload adjustments. After setting backlash and preload, perform tooth contact pattern and adjust shims accordingly.

Drive Axles

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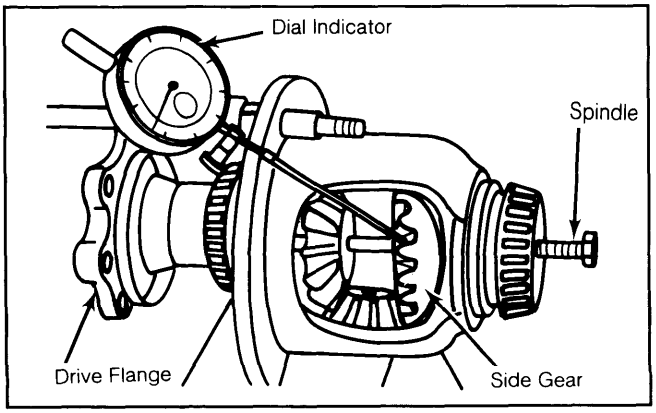
Fig. 6: Measuring Side Gear Clearance



Measure clearance at various points.

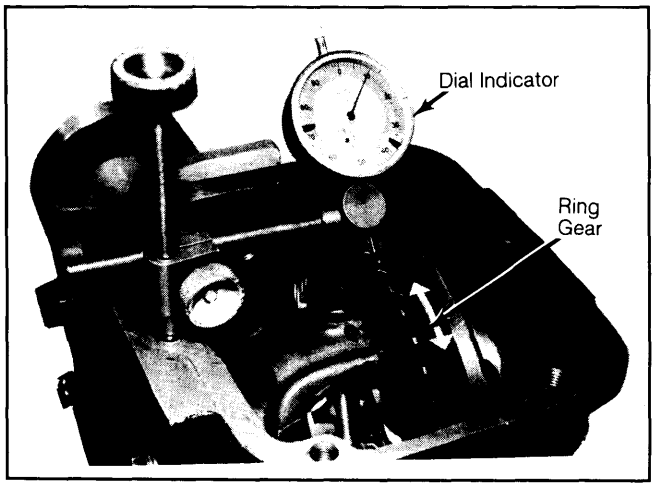
Ring Gear-to-Drive Pinion Backlash

1) Heat ring gear to 176-212°F (80-100°C) and install on differential case. Using new locking bolts, install bolts with Loctite. Tighten bolts to specification using a criss-cross pattern.

2) Install multi-tab pulse ring. Place differential assembly in housing. Install shims equally under drive flange bearing caps and install bearing caps. Tighten bearing caps to specification. Install drive flanges.

3) Mount dial indicator on housing. Zero dial indicator. Measure backlash at various points on ring gear. Move shims from side-to-side (from under bearing caps) until correct backlash is obtained. *See Fig. 7.*

Fig. 7: Checking Ring Gear-to-Drive Pinion Backlash



Measure backlash at various points on ring gear.

Differential Bearing Preload

1) Install INCH lb. torque wrench on companion flange lock nut. Measure total preload of drive pinion gear and ring gear, with seals installed. Compare preload reading with that measured during disassembly. Add 2 INCH lbs. (.23 N.m) for each new drive pinion gear seal.

2) Preload should meet specifications. If not, perform tooth contact pattern check and adjust total shim thicknesses. After final adjustments or changing shim thicknesses or positions, always verify adjustments with tooth contact pattern check. Install new rear cover gasket, cover and fill with lube oil.

AXLE ASSEMBLY SPECIFICATIONS

Application	Specification
Axle Shaft End Play	.002-.004" (.05-.10 mm)
Max. Axle Drive Flange Runout	.006" (.15 mm)
Ring Gear-to-Pinion Gear Backlash	
528e	.003-.005" (.07-.13 mm)
All Other Models	.002-.004" (.05-.10 mm)
Drive Pinion Gear Bearing Preload [1]	
With Oil Seal	
320i	15-29 INCH Lbs. (1.7-3.3 N.m)
733i	23-38 INCH Lbs. (2.6-4.3 N.m)
Without Oil Seal	
320i	13-28 INCH Lbs. (1.5-3.2 N.m)
733i	22-36 INCH Lbs. (2.5-4.1 N.m)
Total Pinion Bearing & Differential Bearing Preload	
With Oil Seal	[2] 4-6 INCH Lbs. (.45-.68 N.m)

[1] — Not available for 528e.
[2] — Greater than drive pinion gear bearing preload.

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Rear Housing Cover Bolts	31-35 (42-47)
Companion Flange Nut (Minimum)	
320i	111 (150)
528e	108 (146)
733i	224 (303)
Drive Flange Cap Bolts	16-17 (22-23)
Drive Flange Nuts	43-49 (58-66)
Axle Shaft Nut	
320i	295-346 (400-469)
528e	169-188 (229-255)
733i	289-362 (419-490)
Ring Gear Bolts	
320i	63-74 (85-100)
528e	36-40 (49-54)
733i	119-141 (161-191)
Final Drive Mounting Bolts	
320i	60-66 (81-89)
528e	89 (121)
733i	101-112 (137-152)