

MANUAL TRANS OVERHAUL - TYPE 012

Article Text

1998 Volkswagen Passat

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ARTICLE BEGINNING

1997-98 MANUAL TRANSMISSIONS

Volkswagen/Audi V.A.G. Type 012 5-Speed

1997-98; A4

1998 Volkswagen; Passat

APPLICATION

TRANSAXLE APPLICATIONS

AA

Vehicle Model	Transaxle Model
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Audi

A4 1.8L	012.CTE, DHW
A4 2.8L (172 HP)	012.CTJ, CWY, CWJ, DHX
A4 2.8L (191 HP)	012.DDK, DHY

Volkswagen

Passat 1.8L	012, DHW
Passat 1.9L	012.DHL
Passat 2.8L	012.DHY

AA

IDENTIFICATION

Transaxle identification code is located on top of transaxle case flange near transaxle-to-engine mounting surface. First 3 letters of transaxle code identify transaxle for vehicle application. Remaining identification code numbers identify build day, month, and year.

Transaxle identification model number is located on side of transaxle case flange near transaxle-to-engine mounting surface. First 3 numbers of identification model number will be 012, identifying transaxle as a 5-speed manual gearbox used on front wheel drive vehicles.

ADJUSTMENTS

See appropriate MANUAL TRANSMISSION SERVICING article in TRANSMISSION section.

LUBRICATION

Check fluid level with vehicle on level surface. Fluid level should be to bottom of fluid filler opening. Add fluid as needed. Use SAE 75W/90 synthetic gear oil. Capacity is 2.4 qts. (2.25L).

ON-VEHICLE SERVICE

AXLE SHAFTS

See appropriate AXLE SHAFTS article in AXLE SHAFTS & TRANSFER CASES.

TROUBLE SHOOTING

See GENERAL TROUBLE SHOOTING article.

REMOVAL & INSTALLATION

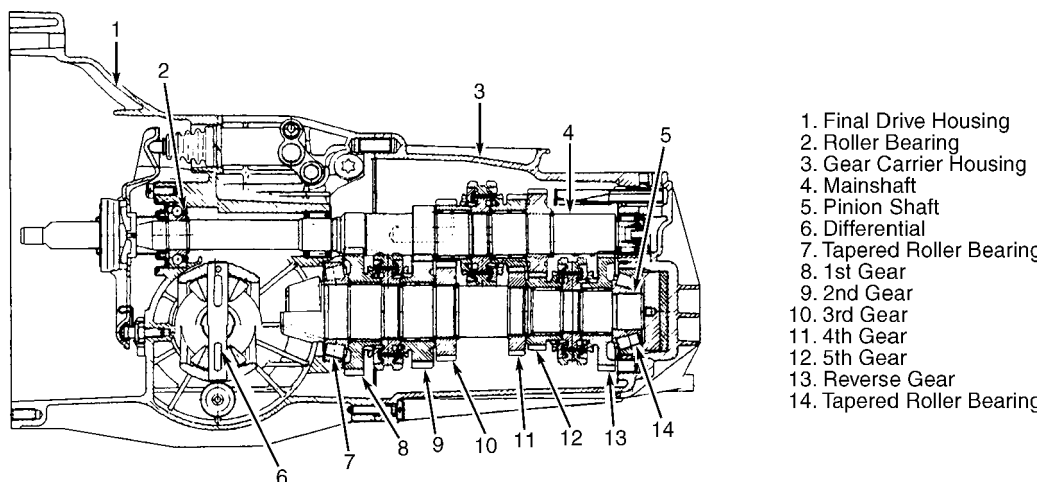
NOTE: For transaxle removal, see appropriate MANUAL TRANSMISSION REMOVAL article in TRANSMISSION section.

TRANSAXLE DISASSEMBLY

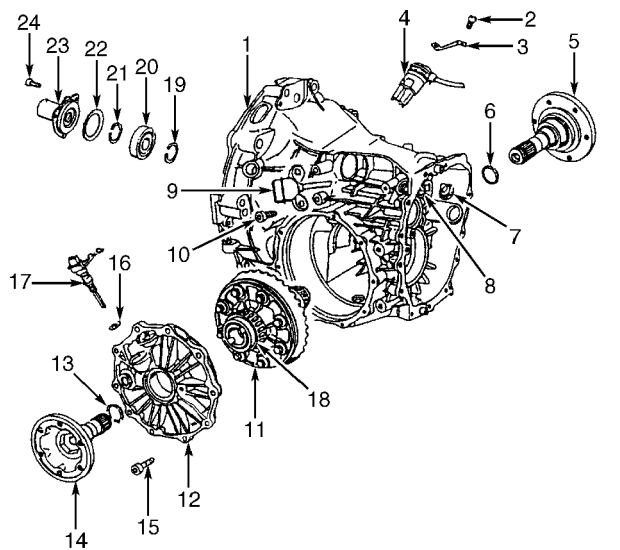
1) Drain fluid and remove clutch release lever, clutch release bearing and guide sleeve. Remove snap ring in front of ball bearing, and measure and record snap ring thickness. Remove roller bearing from final drive using Puller (VAG 1582) and Gripper (VAG 1582/2). DO NOT damage roller bearing cage with puller.

2) Remove snap ring behind bearing, and measure and record snap ring thickness. Remove gear carrier housing bolts. Remove gear carrier housing. See Fig. 2.

3) Remove multifunction switch. Remove relay shaft bolts. Remove bolt and shift detent. Remove input shaft, pinion shaft, relay shaft, selector rods with shift rod and shift forks as an assembly.



93G24782
Fig. 1: Cut-Away View Of 012 Transaxle
Courtesy of Audi of America, Inc.



- | | |
|-----------------------------------|------------------------------|
| 1. Transmission Housing | 13. Snap Ring |
| 2. Screw | 14. Left Drive Flange |
| 3. Locking Plate | 15. Torx Bolt |
| 4. Multifunction Switch | 16. Vehicle Speed Sensor Sea |
| 5. Right Drive Flange Shaft | 17. Vehicle Speed Sensor |
| 6. Snap Ring | 18. Speedometer Drive Gear |
| 7. 5th/Reverse Gear Lock | 19. Snap Ring |
| 8. Shift Shaft Cover | 20. Input Shaft Bearing |
| 9. Multifunction Switch Connector | 21. Snap Ring |
| 10. Torx Bolt | 22. Belleville Spring Washer |
| 11. Differential | 23. Guide Sleeve With Seal |
| 12. Final Drive Cover | 24. Torx Bolt |

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Fig. 2: Exploded View Of Transaxle Assembly
 Courtesy of Audi of America, Inc.

COMPONENT DISASSEMBLY & REASSEMBLY

GEAR CARRIER

Disassembly

Remove gear carrier from final drive housing. Remove pinion shaft gear assembly, input shaft gear assembly and shift selector assembly together, as an assembly. Pry out oil retainer using screwdriver. Remove inner shift rod sealing ring.

Cleaning & Inspection

Clean gear carrier housing with solvent. Dry with compressed air. Inspect for cracks and distortion, and replace as necessary.

Reassembly

Push oil retainer into gear carrier housing until oil retainer detent engages into housing. Retainer faces upward in gear carrier housing. Install inner shift rod sealing ring .04" (1.0 mm) below housing lip. Install assembled input shaft, pinion shaft and shift selector assemblies into gear carrier housing. Install gear carrier on final drive housing. Tighten Torx bolts to 18 ft. lbs. (25 N.m).

INPUT SHAFT

NOTE: Snap rings are of different thicknesses and should be measured as they are removed. If a gear or shaft is replaced, snap ring must be measured and replacement snap rings must be same size.

Disassembly

1) Remove snap ring, roller bearing and snap ring from input shaft. Remove input shaft from final drive housing and gear carrier housing. Remove 5th gear snap ring and press off 5th gear.

2) Remove 4th gear, 4th synchro ring and operating sleeve. Press off 3rd/4th synchro hub then remove 3rd gear and 3rd gear synchro ring.

Cleaning & Inspection

Clean all parts with cleaning solvent and dry with compressed air. Inspect for chipped gears, galling and scoring on gears and shaft. Replace any damaged or broken parts. See Fig. 3.

Reassembly

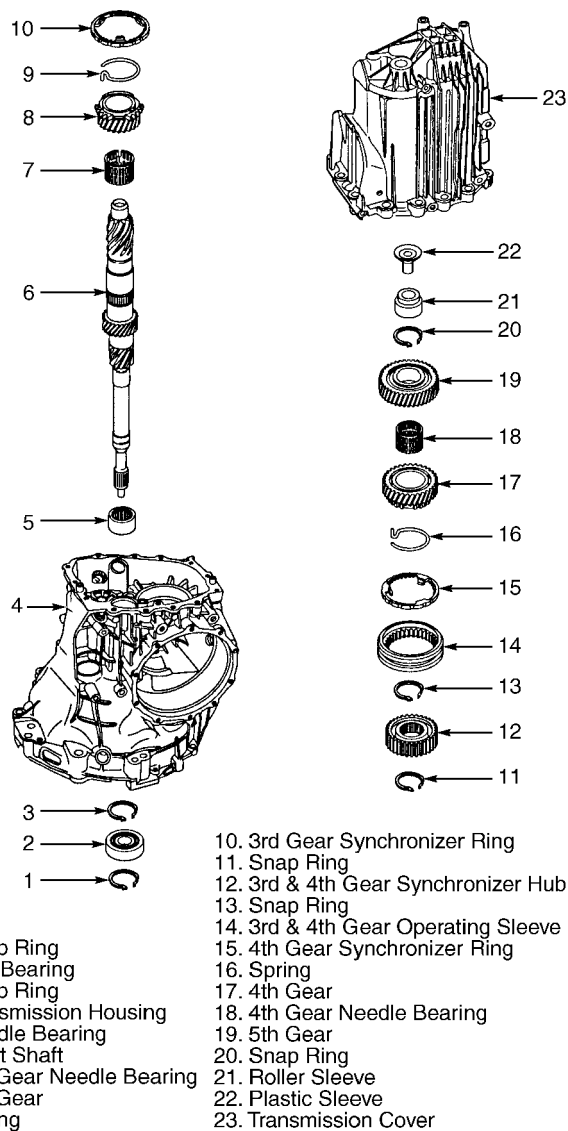
1) Install needle bearing in final drive housing. Needle bearing installed depth "A" should be 1.56" (39.5 mm) from lower edge of straightedge to upper edge of bearing. See Fig. 4.

2) Install snap ring on input shaft. Slide roller bearing on input shaft up to stop. Install shaft on roller bearing, and insert it into final drive housing opening. Install snap ring on input shaft and press in bearing using Special Tool (3235 A-B). Evenly press in bearing as far as possible. Ensure open side of plastic cage faces guide sleeve. See Fig. 5.

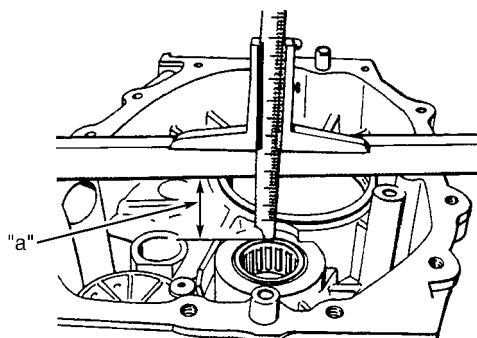
3) Install spring in 4th gear with angled end of spring into hole. Press synchronizer ring in operating sleeve and measure gap "a" using with a feeler gauge in positions "A", "B" and "C". See Fig. 6. Add measured values and divide by 3. Value obtained must not be less than .02" (.5 mm). Install 3rd/4th gear, ensuring recessed side of operating sleeve faces 3rd gear. When pressing on 5th gear assembly, ensure higher collar faces reverse gear and oil pocket faces 4th gear.

NOTE: Thickness of snap rings No. 1, 2, 4 and 5 must always be measured. Snap ring No. 3 size is always same. Snap rings No. 1 and 2 size is determined during input shaft adjustment. See Fig. 7.

4) Replace input shaft needle bearing using a slide hammer and puller. Install bearing to a depth of 8.5" (216.0 mm) as measured from housing face. Install 4th gear snap ring ensuring thickest snap ring possible is installed (position 4). See Fig. 7. Select 5th gear snap ring in same manner (position 5). See INPUT SHAFT SNAP RINGS table.



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Fig. 3: Exploded View Of Input Shaft
Courtesy of Audi of America, Inc.

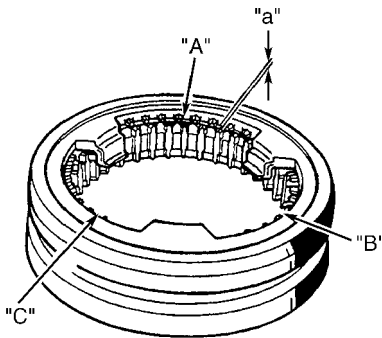


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Fig. 4: Measuring Needle Bearing Installation Depth
Courtesy of Audi of America, Inc.

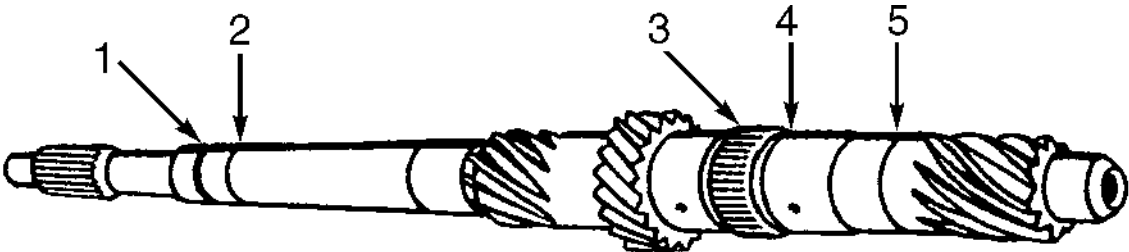
Fig. 9. Use formula to find roller bearing snap ring thickness. $X = a - b$. Example: 28.5 mm - 26.8 mm = 1.70 mm. See INPUT SHAFT ROLLER BEARING SNAP RING table.

INPUT SHAFT ROLLER BEARING SNAP RING

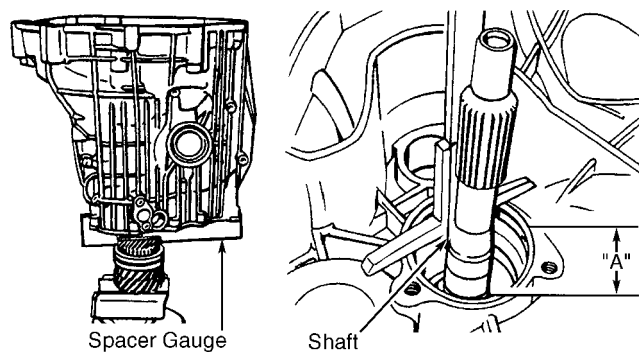
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Part No.		Measurement In. (mm)		Thickness - In. (mm)
N 902-941-14		.058-.061 (1.48-1.56)		.061 (1.54)
N 902-941-15		.062-.064 (1.57-1.65)		.064 (1.63)
N 902-941-16		.065-.068 (1.66-1.74)		.067 (1.72)
N 902-941-17		.069-.072 (1.75-1.83)		.071 (1.81)
N 902-941-18		.073-.075 (1.84-1.92)		.074 (1.90)
N 902-941-19		.076-.079 (1.93-2.01)		.078 (1.99)
N 902-941-20		.080-.082 (2.02-2.10)		.081 (2.08)
N 902-941-11		.083-.086 (2.12-2.19)		.085 (2.17)
AA				



93A24786
 Fig. 6: Identifying Synchro Ring Measuring Points
 Courtesy of Audi of America, Inc.

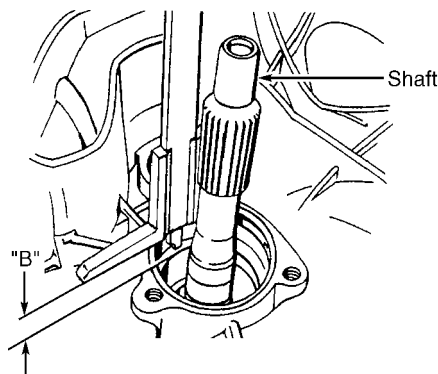


93B24787
 Fig. 7: Identifying Snap Ring Locations
 Courtesy of Audi of America, Inc.



93C24788

Fig. 8: Measuring To Lower Groove On Input Shaft
Courtesy of Audi of America, Inc.



93D24789

Fig. 9: Measuring To Ball Bearing Seat
Courtesy of Audi of America, Inc.

PINION SHAFT

NOTE: DO NOT damage seal lips between taper roller bearings. If pinion bearings are to be replaced, record and measure clearances. Snap rings are different in thickness and diameter and should be measured as removed. If gear or shaft is replaced, measure snap rings for correct size and fit.

NOTE: See Fig. 10 for disassembly and reassembly reference.

Disassembly

1) Remove pinion shaft from final drive housing and transaxle housing. Pull out bushing for small tapered roller bearing outer race using Internal Extractor (Kukko 21/1). Pull out small tapered roller bearing outer race, using Special Tool (VW 771 and VW 771/40). Press out small tapered roller bearing inner race with reverse gar, using Separating Tool (Kukko 17/2). Press off 5th and reverse gear synchronizer hub with same tool.

2) With Press Tools (VW 408a and VW 402), press off 4th gear. Use Separating Tool (Kukko 17/2), press off 3rd gear. Press off 1st and 2nd gear synchronizer hub. See Fig. 11. Use the same setup to press off large tapered roller bearing inner race. With Bushing Puller (3128) under outer race, operate tool to remove race.

Cleaning & Inspection

Clean all parts in cleaning solvent and dry with compressed air. Inspect for chipped gear teeth, galling, scoring and excessive wear. Replace parts (as necessary). Ensure all parts are dry and free of any lubricants. All snap rings must be replaced during reassembly. See PINION SHAFT SNAP RING table.

Reassembly

1) Press roller bearing onto pinion shaft and secure using snap ring. See Fig. 12. Install needle bearing and 1st gear, ensuring spring angled end is in gear bore. See Fig. 13. Install synchronizer ring onto 1st/2nd gear synchronizer hub, ensuring higher shoulder faces 1st gear.

2) Install snap ring and 2nd gear needle bearing. See Fig. 12. Install 1st/2nd gear synchronizer hub, synchronizer ring, 2nd gear and snap ring. Install 3rd gear with groove facing 4th gear. Install 4th gear with shoulder facing 3rd gear and snap ring.

3) Install needle bearing and 5th gear, ensuring angled end of spring is in bore. See Fig. 13. Install 5th gear synchro ring and snap ring. See Fig. 12. Press on 5th/reverse synchronizer hub, ensuring inner shoulder faces 5th gear. Install snap ring and reverse gear needle bearing.

4) Install 5th/reverse synchronizer hub onto synchronizer ring. Install reverse gear, ensuring angled end of spring is in bore. See Fig. 13. Install taper roller bearing inner race on pinion shaft.

5) Install washer, pressure plate, shim and taper roller bearing outer race into gear carrier housing.

PINION SHAFT SNAP RING

AA
Part No. Thickness In. (mm)

Snap Ring No. 1

N 902 950.01		.079 (2.00)
N 902 950.08		.080 (2.03)
N 902 950.04		.081 (2.06)
N 902 950.09		.082 (2.09)
N 902 950.10		.083 (2.12)
N 902 950.11		.084 (2.15)

Snap Ring No. 2 (Blue)

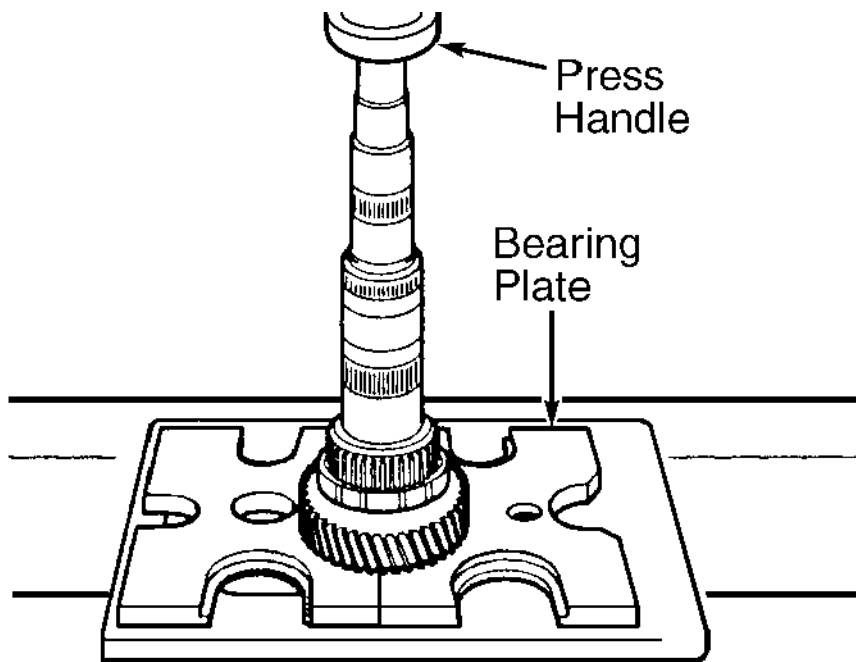
N 902 947.01		.075 (1.90)
N 902 947.02		.076 (1.93)
N 902 947.03		.077 (1.95)
N 902 947.04		.078 (1.98)
N 902 947.05		.079 (2.00)

Snap Ring No. 3 (Blue)

N 902 947.06		.098 (2.50)
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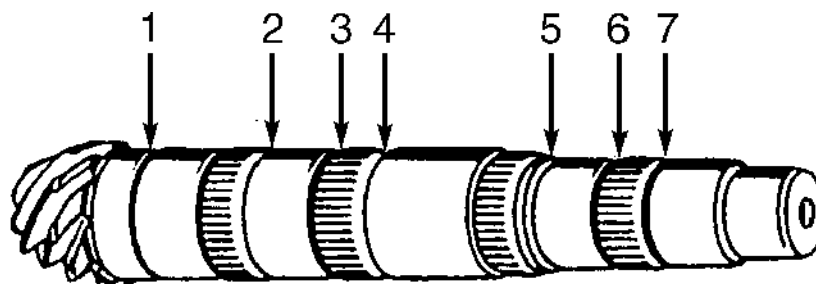
Snap Ring No. 4

N 902 946.02		.075 (1.90)
N 902 946.09		.076 (1.93)
N 902 946.10		.078 (1.98)
N 902 946.06		.079 (2.00)



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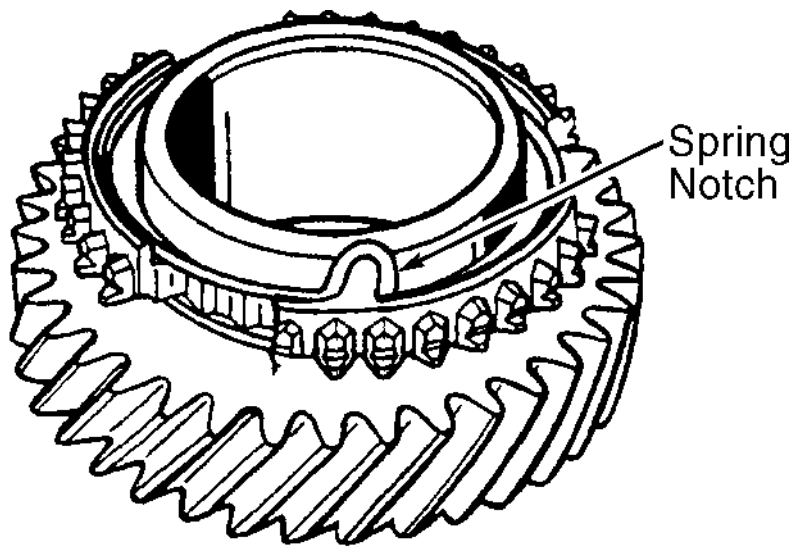
Fig. 11: Pressing Off 1st/2nd Synchronizer Hub
 Courtesy of Audi of America, Inc.



- | | |
|---------------------------|----------------------------|
| 1. Snap Ring No. 1 | 5. Snap Ring No. 5 |
| 2. Snap Ring No. 2 (Blue) | 6. Snap Ring No. 6 (Brown) |
| 3. Snap Ring No. 3 (Blue) | 7. Snap Ring No. 7 (Blue) |
| 4. Snap Ring No. 4 | |

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Fig. 12: Identifying Snap Rings On Pinion Shaft
 Courtesy of Audi of America, Inc.



93124792
Fig. 13: Identifying Spring & Notch In Gear
 Courtesy of Audi of America, Inc.

SHIFT SELECTOR ASSEMBLY

Disassembly

For disassembly, refer to appropriate figures and note the following procedures. See Figs. 14 and 15. To remove ball sleeve, use Press Tools (VW 401, 423 and 472/2). Remove 3rd and 4th gear shift rod with Internal Puller (Kukko 21/4) and slide hammer. Remove gear lock for 5th and reverse gears, located above position for drive axle heat shield.

Cleaning & Inspection

Clean all parts in cleaning solvent and dry with compressed air. Inspect for damaged or excessively worn parts. All components can be replaced individually except 5th/reverse gear shift fork which must be replaced together with selector ring and selector shaft.

Reassembly

1) For reassembly, see exploded views of components for guidance. See Figs. 14 and 15. Install 5th and reverse gear shift fork and coupling plate for shift rod so Dimension "A" is 2.165" (55 mm) and Dimension "B" is 2.362" (60 mm). See Fig. 16.

2) Press ball sleeve into place, using Press Plates (VW 401, 423 and 472/2). Drive 3rd and 4th gear shift rod bushing into stop, using Driver and Drift (VW 295 and 295a). Install sealing washer into position so dimension shown is .04" (1 mm). See Fig. 17. Install complete selector mechanism assembly. See Fig. 18. Install heat shield over drive axle.

REVERSE IDLER GEAR

Disassembly & Reassembly

1) Remove snap ring, washer and reverse idler gear from reverse idler gear shaft. Remove reverse idler gear needle bearings

and thrust washer. Remove reverse idler gear shaft Torx bolt and remove shaft.

2) Clean all parts in cleaning solvent and dry with compressed air. Inspect for damaged or excessively worn parts. Replace as necessary.

3) Install Reverse idler gear shaft to gear carrier housing. Tighten Torx bolt to 26 ft. lbs. (35 N.m). Install thrust washer and needle bearings. Install reverse idler gear, washer and snap ring. See Fig. 19.

5TH/REVERSE GEAR LOCK

NOTE: If 5th gear or reverse gear hangs up or catches, remove, check and reassemble 5th reverse gear assembly as necessary.

Disassembly & Reassembly

1) Remove 2 heat shield bolts and pivot and remove heat shield from above drive axle. See Fig. 19. Remove 2 bolts and remove 5th/reverse gear lock.

2) Place spring in housing. Turn counterclockwise using light pressure until spring snaps in place in base of housing. Place 5th/reverse gear bushing on spring so bent end of spring lies in groove. See Fig. 20.

3) Press spring together using 5th/reverse gear bushing. Twist 5th/reverse gear bushing about one turn counterclockwise until tab on 5th/reverse gear bushing lines up on groove in housing. Press 5th/reverse gear bushing tab into groove in housing to stop surface.

4) Turn 5th/reverse gear bushing clockwise and release 5th/reverse gear bushing into assembly end position. To ensure installation is correct, 5th/reverse gear bushing tab "A" must always face away from groove "B" on plastic housing.

FINAL DRIVE HOUSING

Disassembly

Refer to illustration during disassembly. See Fig. 22. Remove final drive flange seal and transaxle breather. Remove tapered roller bearing outer race and 3rd/4th gear shift rod bushing. Remove pinion shaft needle bearing. Remove speedometer drive and multifunction switch and connector.

Cleaning & Inspection

Clean all parts with cleaning solvent and dry with compressed air. Inspect housing for cracks and damage, and replace as necessary.

Reassembly

Install seal for drive flange .02" (.5 mm) below housing edge. Install multifunction switch with locking plate. Tighten retaining plate to 18 ft. lbs. (25 N.m). Install 5th/reverse gear lock with beveled side of plastic bushing facing relay shaft bore. Tighten retaining bolt to 89 INCH lbs. (10 N.m).

GEAR CARRIER HOUSING

Disassembly

Remove input shaft needle bearing and plastic sleeves. Remove Torx bolt for reverse axle. Pry out oil retainer using screwdriver and remove inner shift rod seal.

Cleaning & Inspection

Clean all parts with cleaning solvent and dry with compressed air. Inspect housing for cracks or damage. Replace as necessary.

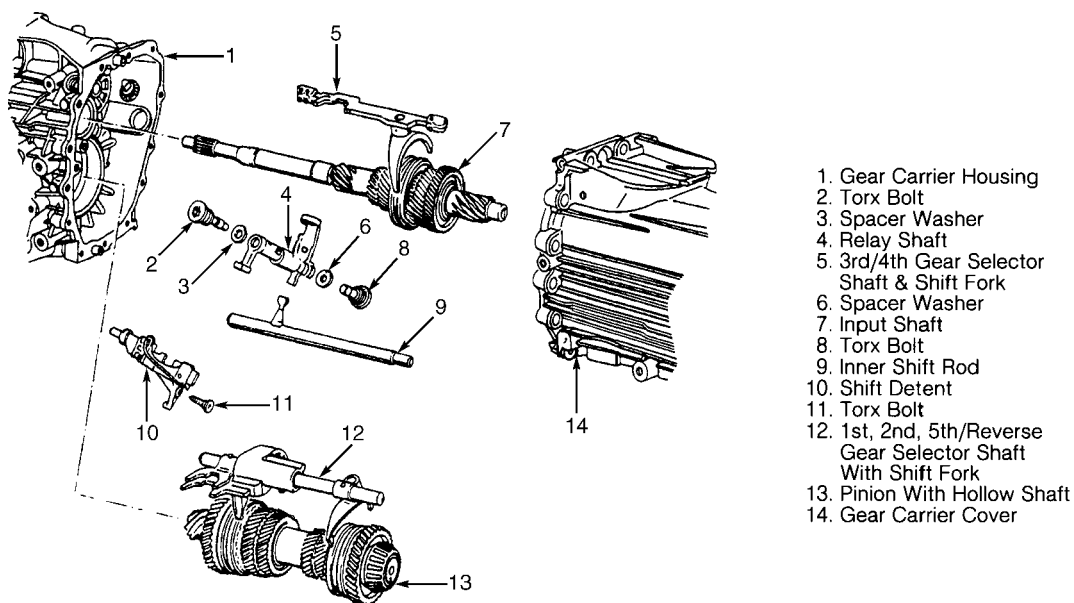
Reassembly

1) Install inner shaft rod seal .04" (1.0 mm) below housing lip. Push oil retainer into gear carrier housing until oil retainer detent engages into carrier housing. Ensure retainer cup points upward in gear carrier housing. Install reverse gear shaft.

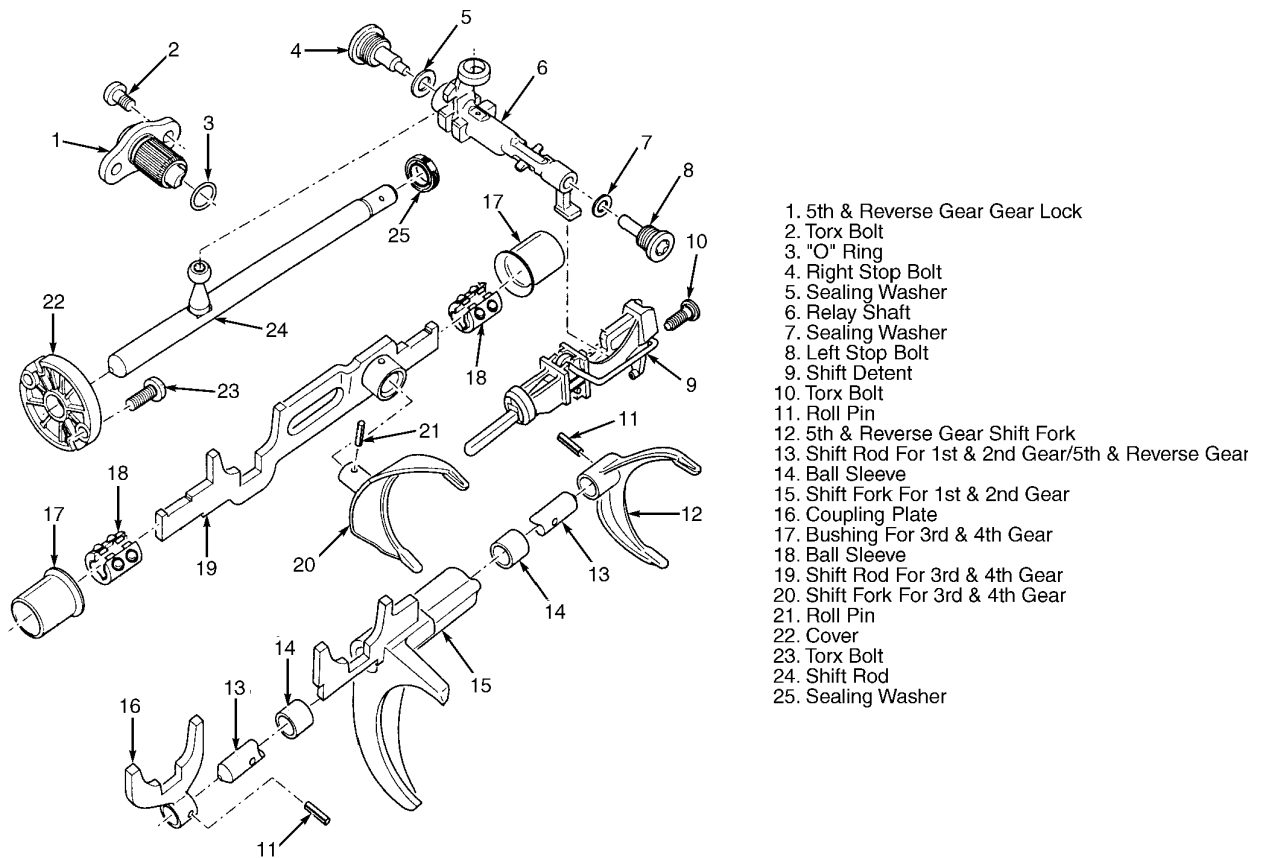
2) Install input shaft needle bearing into gear carrier 8.50" (216 mm) measured from gear housing face. On input shaft with oil holes, insert plastic sleeve into end of input shaft.

DRIVE FLANGE SEAL

1) If transaxle is in vehicle, remove heat shield from drive axle. Remove drive axle from transaxle drive flange, then turn steering to left as far as possible. Tie up drive axle as high as possible without damaging paint on drive axle. Position drip pan under transaxle. Have assistant hold 2 iron bars under drive flange, as shown. Install 2 bolts in opposite holes in drive flange and evenly tighten bolts to remove flange. See Fig. 21.

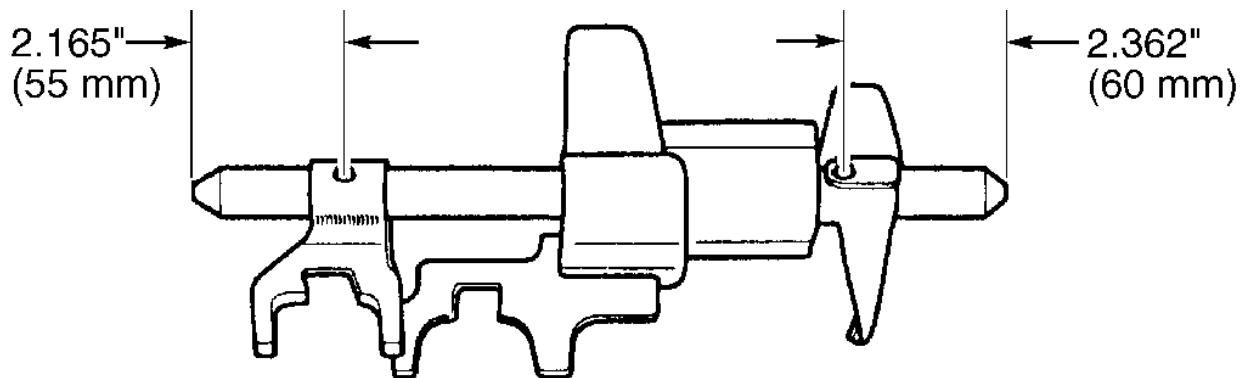


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Fig. 14: Exploded View Of Shift Selector Assembly
Courtesy of Audi of America, Inc.

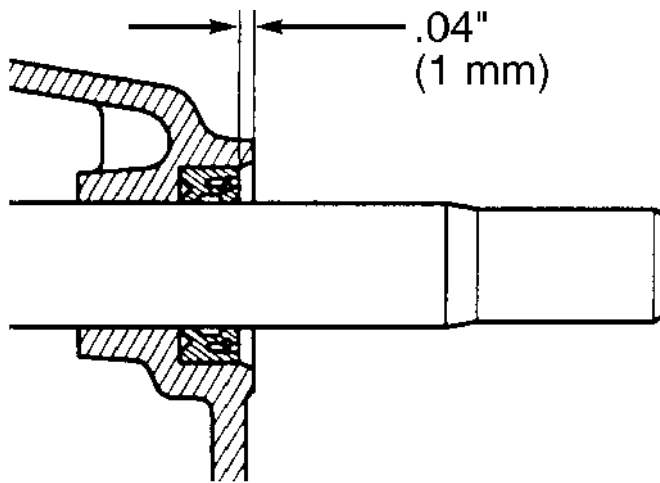


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Fig. 15: Exploded View Of Selector Mechanism

Courtesy of Audi Of America, Inc.

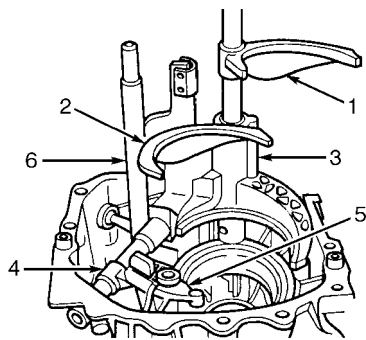


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Fig. 16: Installing 5th/Reverse Shift Fork & Coupling Plate
 Courtesy of Audi of America, Inc.



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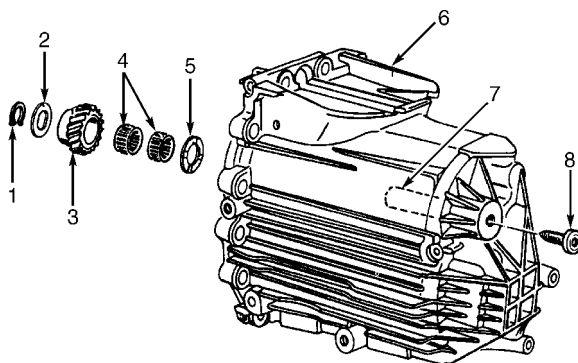
Fig. 17: Installed Position Of Sealing Washer
Courtesy of Audi of America, Inc.



- | | |
|----------------------------------|-----------------|
| 1. 5th & Reverse Gear Shift Fork | 4. Relay Shaft |
| 2. 3rd & 4th Gear Shift Fork | 5. Shift Detent |
| 3. 1st & 2nd Gear Shift Fork | 6. Shift Rod |

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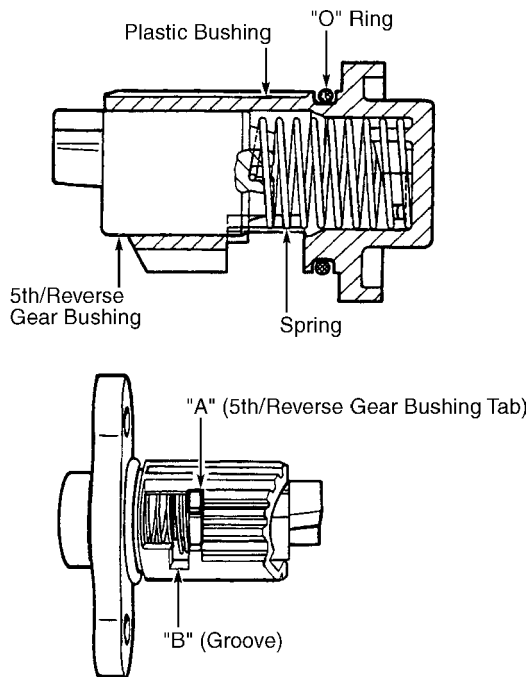
Fig. 18: Installing Shift Selector Mechanism Assembly
Courtesy of Audi of America, Inc.



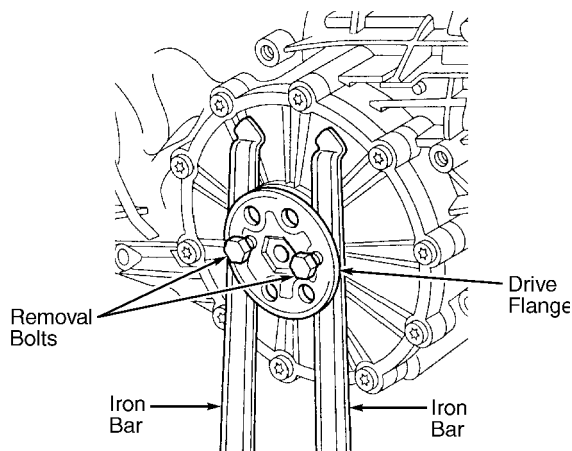
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|-----------------------|-------------------------|
| 1. Snap Ring | 5. Thrust Washer |
| 2. Washer | 6. Gear Carrier Housing |
| 3. Reverse Idler Gear | 7. Reverse Idler Shaft |
| 4. Needle Bearing | 8. Torx Bolt |

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Fig. 19: Exploded View Of Reverse Idler Gear Components
Courtesy of Audi of America, Inc.



93B24795
Fig. 20: Identifying Correct Procedure To Assemble 5th/Reverse Gear
 Courtesy of Audi of America, Inc.



99C04339
Fig. 21: Removing Drive Flange From Final Drive
 Courtesy of Audi of America, Inc.

2) Clamp flange in soft-jawed vise. Press new snap ring into groove while pushing old snap ring out at same time. Remove drive flange seal with Extractor Lever (VW 681). Lubricate seal lip-to-dust lip area with thin layer of multipurpose grease. Lightly oil outer edge of new flange seal. With suitable arbor, drive in new right-hand seal .22" (5.5 mm) below transaxle housing surface. Repeat for left-hand seal to same dimension.

NOTE: If installing old drive flange, seal must be pressed in about .26" (6.5 mm) so new seal does not set on running surface of old seal.

3) Install drive flange by driving it into position with Needle Bearing Drift (VW 295). Bolt drive axle to drive flange.

Tighten bolts to 30 ft. lbs. (40 N.m) if M8 bolts, or to 57 ft. lbs. (77 N.m) if M10 bolts. Install heat shield. Check transaxle oil level.

DIFFERENTIAL

NOTE: Differential can be removed with transaxle installed.
Differential can be removed without disassembling shift mechanism, input shaft, pinion shaft or transaxle cover.

Disassembly

1) Remove differential bearing inner and outer race using puller. Remove all bolts, and use punch to remove ring gear from differential. Use puller to remove large differential inner race. Use puller to remove large differential bearing outer race from flange cover.

2) Rotate side gears to bring pinion gears to an opening in case. Remove pinion gears, thrust washers and side gears.

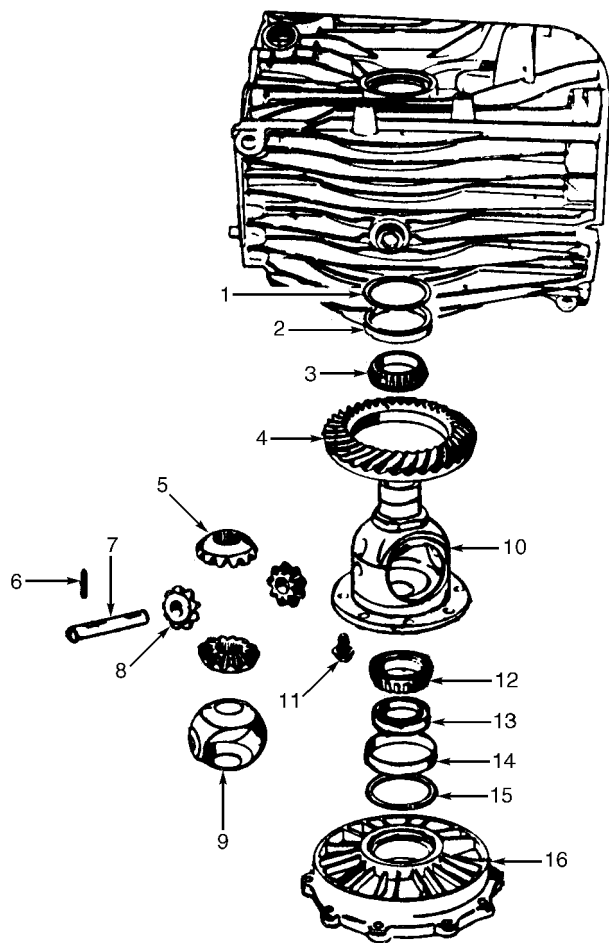
Cleaning & Inspection

Clean all parts with cleaning solvent and dry with compressed air. Inspect all parts for chipped gears, scoring and damage. Replace as necessary. Lubricate parts with transaxle fluid prior to reassembly.

Reassembly

1) Install right tapered roller bearing outer race by inserting race into position and using a Driver (VW 472/1). To install right tapered roller bearing inner race, heat it to about 212°F (100°C) and press it into position. Install left tapered roller bearing inner race after heating to about 212°F (100°C) and pressing it into position. Install the left tapered roller bearing outer race, using Driver (VW 472/1).

2) Install ring gear using centering pins on flange. Heat ring gear to about 212°F (100°C) and press it into position. Lubricate a one-piece thrust washer with transaxle oil and install it. Position large differential bevel gears, then install small differential bevel gears 180 degrees from their final position, then rotate into place. Drive in differential bevel gear shaft to final position and secure it in place.



- | | |
|--|---|
| 1. Shim "S ₂ " | 9. Thrust Washer |
| 2. Differential Bearing Small Outer Race | 10. Differential Housing |
| 3. Differential Bearing Small Inner Race | 11. Ring Gear Bolt |
| 4. Ring Gear | 12. Differential Bearing Large Inner Race |
| 5. Differential Side Gears | 13. Speedometer Gear |
| 6. Roll Pin | 14. Differential Bearing Large Outer Race |
| 7. Differential Pinion Shaft | 15. Shim "S ₁ " |
| 8. Differential Pinion Gears | 16. Cover |

93C24796
Fig. 22: Exploded View Of Differential Assembly
 Courtesy of Audi of America, Inc.

ADJUSTMENTS

NOTE: When assembling final drive, it is necessary to adjust ring gear, pinion or both. See ADJUSTMENT TABLE. See Fig. 23.

ADJUSTMENT TABLE

Component replaced: ▼	Component to be adjusted:			
	Ring gear "S1" + "S2"	Pinion shaft "S3" + "S4" via deviation "r"	Pinion shaft "S4"	Backlash measurement
Transmission housing ¹	X	X		X
Transmission cover			X	
Differential housing	X			X
Tapered roller bearing for pinion shaft		X		X
Tapered roller bearing for differential	X			X
Gear set ²	X	X		X
Cover for final drive	X			X

1 - If the transmission housing is replaced, adjust input shaft.

2 - Replace pinion shaft and ring gear together as a set only.

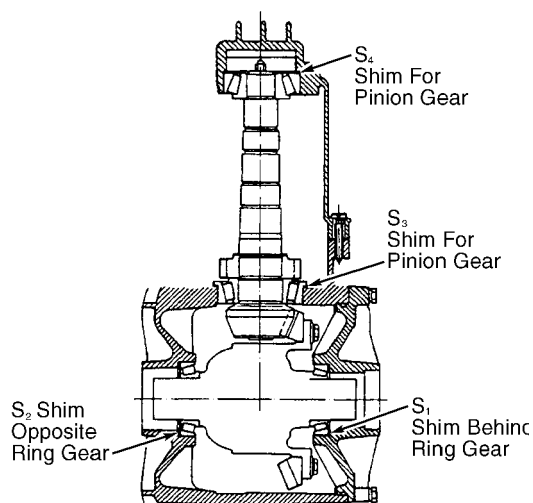
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Fig. 23: Adjustment Table
Courtesy of Audi of America, Inc.

PINION SHAFT & RING GEAR

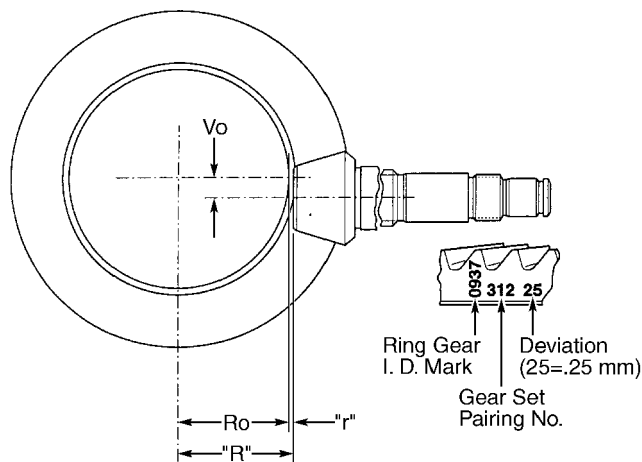
NOTE: If pinion shaft and gear ring have to be adjusted, use the following sequence for maximum efficiency. See Fig. 24.

Determine total shim thickness "STOTAL" for "S1" + "S2". This is the adjusting preload for tapered roller bearing for differential. Determine total shim thickness "STOTAL" for "S3" + "S4". This is the adjusting preload for tapered roller bearing for pinion shaft. Distribute total shim thickness "STOTAL" for "S3" + "S4" so dimension between center of gear ring and face of pinion shaft equals dimension "r" (factory set dimension). See Fig. 25. Distribute total shim thickness "STOTAL" for "S1" + "S2" so specified backlash between ring gear and pinion shaft is maintained.



93I24800

Fig. 24: Identifying Shim Adjustment Points
Courtesy of Audi of America, Inc.



99G04341
Fig. 25: Factory Dimensions Used In Adjustment Procedures
 Courtesy of Audi of America, Inc.

PINION SHAFT ADJUSTING

1) Determine total shim thickness "STOTAL" for "S3" + "S4" by adjusting preload of tapered roller bearing for pinion shaft. Press on double tapered roller bearing inner race (toward gear end) and secure bearing in this position. Install tapered roller bearing outer race without shims into transaxle housing, using Driver (VW519 and VW 204b).

2) Install tapered roller bearing outer race for pinion shaft with shim "S4", .39" (1.0 mm), into transaxle cover. This is for initial measurement. Install fully assembled pinion shaft into transaxle housing. Install cover and tighten bolts to 16 ft. lbs. (22 N.m).

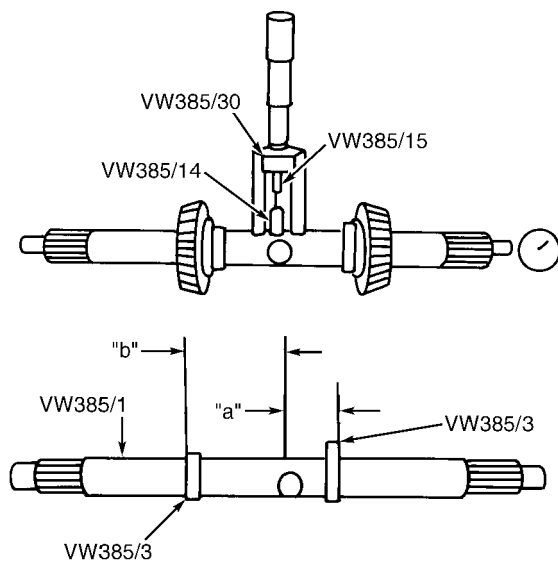
3) Turn transaxle so cover points downward. Press down on face of pinion shaft using a Removal Tool (VW 296) until tapered roller bearing outer race contacts transaxle cover. Holding this pressure, turn pinion shaft by hand to seat tapered roller bearing.

4) Assemble and install Measuring Equipment (VW387), using a 1.2" (30 mm) dial indicator extension. Set dial indicator to "0" with .039" (1.0 mm) preload. Ensure dial indicator extension contacts machined surface on face of drive shaft. Turn transaxle 180 degrees so cover faces upward. Read and record end play on dial indicator.

NOTE: If measurement has to be repeated, turn pinion shaft 5 rotations in both directions to seat tapered roller bearing. Then, set dial indicator to "0" with .08" (2.0 mm) preload.

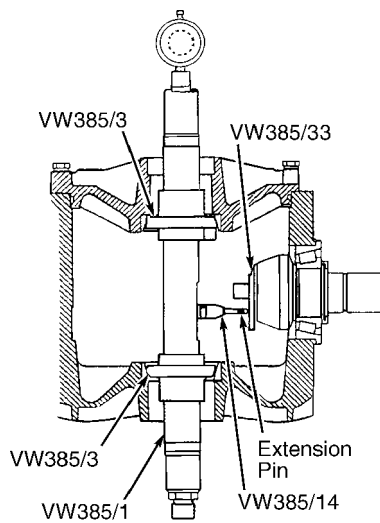
5) Using the formula "STOTAL" = "s4" + measured value + bearing preload and .018" (.45 mm) as an example of recorded end play, see the following example: Installed shim "S4" = .039" (1.00 mm), + recorded end play (.018" (0.45 mm), + Bearing Preload Constant .006" (0.15 mm) = "STOTAL" for "S3" + "S4" = .063" (1.60 mm).

6) To determine thickness of shim "S3", use the following formula: Example: "STOTAL" for "S3" + "S4" = .063" (1.60 mm), - Installed Shim "S4" .039" (1.00 mm) = Thickness of Shim "S3" = .026" (0.60 mm).



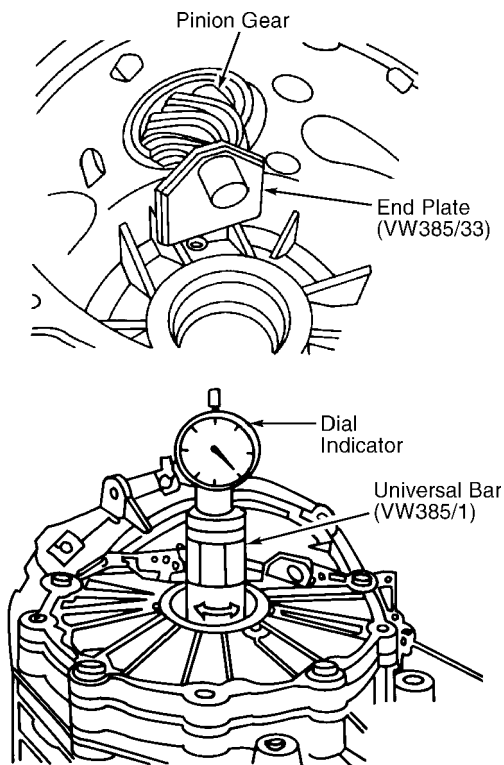
93D24797

Fig. 26: Identifying Universal Measuring Bar
Courtesy of Audi of America, Inc.



93F24799

Fig. 27: Measuring Pinion Depth
Courtesy of Audi of America, Inc.



93E24798

Fig. 28: Identifying Dimension "E" Measuring Points
 Courtesy of Audi of America, Inc.

CHECKING PRELOAD FOR TAPERED ROLLER BEARING FOR PINION SHAFT

1) Turn pinion shaft 5 rotations in each direction to seat tapered roller bearing. If pinion shaft cannot be turned by hand, install M10x20 bolt into face of pinion shaft for assistance. Remove bolt after shaft has been turned.

2) Install dial indicator measuring device (VW387 and VW 792/1) and secure to transaxle housing with bolt. Set dial indicator to "0" with .079" (2 mm) preload. Loosen transaxle cover bolts and turn pinion shaft. If correct shims were selected, dial indicator should read .002-.006" (.05-.15 mm). Tighten cover bolts to 16 ft. lbs. (22 N.m). Remove measuring tools. Turn pinion shaft 5 rotations in each direction to seat tapered roller bearing.

NOTE: Dimension "E" is required to determine final shim thickness of "S3" + "S4".

3) Set adjustment rings of Universal Mandrel (VW385/1) measuring bar to the following dimensions: "A" = 1.38" (35 mm), "B" = 2.95" (75 mm). Assemble Measuring Attachments (VW385/15 and 385/30) as shown. See Fig. 26. For measurements, see DIAL INDICATOR MEASUREMENTS table.

DIAL INDICATOR MEASUREMENTS

AA		
Dial Indicator	Measurement	Ring Gear
Extension	"Ro"	Diameter

"A"	In. (mm)	In. (mm)
.26" (6.5 mm) For VW385/30 master Gauge	2.16 (54.95)	6.7 (170)
.37" (9.3 mm) For VW385/15 Extension Pin	2.35 (59.65)	7.1 (180)
AA		

NOTE: If drive flange does not have polygon bearing, use Centering Disc VW385/2 instead of VW385/3 opposite dial indicator.

4) Set dial indicator to "0" with .079" (2 mm) preload. Place End Gauge (VW385/33) on face of pinion shaft. Ensure contact is precisely installed and oil-free. Remove master gauge and install Measuring Mandrel (VW385/1) onto transaxle housing. A dial indicator extension of .26" (6.5 mm) must be installed.

5) Be sure Centering Disc (VW385/33) faces cover for final drive. Install differential cover and tighten 4 bolts to 16 ft. lbs. (22 N.m). Using adjustable ring, pull second Centering Disc out as far as possible so mandrel can be turned by hand. Turn mandrel until dial indicator plunger tip touches end gauge on pinion shaft head. Measure maximum runout (return point).

NOTE: In the following example, runout is .01" (.26 mm).

6) After removing universal mandrel, and with Master Gauge (VW385/30) in place, check dial indicator again to see if it is set to "0" with .079" (2 mm) preload. Correct adjustments as needed. To determine thickness of shim "S3", use the following formula: "S3" = .024" (.60 mm) + Deviation "r" = .015" (.38 mm) - Value measured for "e" = .010" (.26 mm) = Thickness of Shim "S3", .025" (.72 mm). Shims for "S3" are available in various thicknesses from .02" (.40 mm) to .03" (.75 mm) in .002" (.05 mm) increments. Use 2 shims if needed to reach maximum thickness.

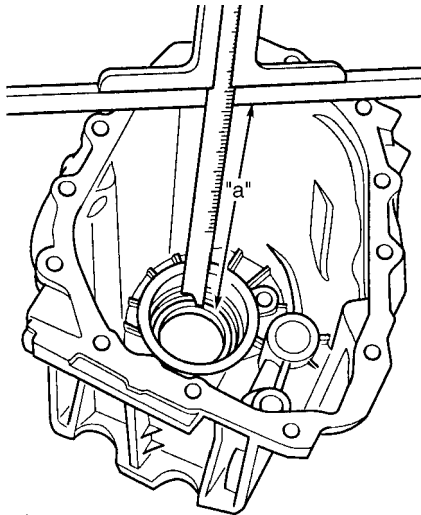
7) To determine thickness of shim "S4", use the following formula: "S4" = "STOTAL" - "S3". Total Shim Thickness ("STOTAL") for "S3" + "S4" = .063" (1.60 mm) - Thickness of Shim "S3" = .025" (.72 mm) = Thickness of Shim "S3" .038" (.88 mm). Shims for "S4" are available in various thicknesses from .019" (.49 mm) to .035" (.89 mm) in .002" (.04 mm) increments. Use 2 shims if needed to reach maximum thickness.

8) To check dimension "r", install pinion shaft with measured shims "S3" and "S4". Turn shaft 5 rotations in each direction. Install Universal Mandrel. See Fig. 26. Read dial indicator counterclockwise (Red scale). If shims are correct, deviation "r" (as marked on outer circumference of ring gear) should be indicated on dial within +/- .002" (.04 mm). After removing universal mandrel, and with Master Gauge (VW385/30) in place, check dial indicator again to see if it is set to "0" with .079" (2 mm) preload. Correct adjustments as needed.

TRANSAXLE HOUSING COVER

1) If transaxle housing cover is replaced, "S4" shim must be

redetermined. Clean housing mating surfaces. With a depth gauge, measure difference between depth "a" on old and new transaxle cover. See Fig. 29. Use the following example: Old Transaxle Cover = 10.13" (257.40 mm). New Transaxle Cover = 10.14" (257.55 mm). Difference: = 0.006" (.15 mm)



99104342
Fig. 29: Measuring Transaxle Housing Depth
Courtesy of Audi of America, Inc.

2) Install thicker shim "S4" if new transaxle cover is deeper, or thinner shim "S4" if old transaxle cover is deeper. Use the following example: Previous "S4" Shim = .037" (0.95 mm) + Difference of Housing = .006" (0.15 mm) = New "S4" Shim = .043" (1.10 mm) Install tapered roller bearing outer race with new "S4" shim into transaxle cover. Install fully assembled pinion shaft into transaxle housing. Install cover and tighten bolts to 16 ft. lbs. (22 N.m).

CHECKING PRELOAD FOR PINION SHAFT TAPERED ROLLER BEARING

1) Turn pinion shaft 5 rotations in each direction to seat tapered roller bearing. If necessary, simultaneously turn both drive flanges to rotate pinion shaft. Install Measuring Tools (VW387 and VW 792/1) and secure to transaxle housing. Attach dial indicator to center of transaxle cover and set to "0" with .079" (2 mm) preload.

2) Loosen transaxle cover bolts and turn pinion shaft. If correct shims are installed, dial indicator will read .002-.006" (.05-.15 mm). Remove measuring tools. Coat sealing surfaces with thin layer of Sealant (AMV 188 001 02). Install and tighten cover bolts to 16 ft. lbs. (22 N.m).

RING GEAR ADJUSTING

1) Ring gear must be adjusted if any of following parts were replaced:

- * Final Drive Housing
- * Gear Carrier Housing
- * Differential Bearings

- * Differential Gear Housing
- * Ring And Pinion Set

2) To adjust differential bearing preload (pinion removed) remove oil seals and outer races of differential tapered roller bearings. Remove shims. Install tapered bearing outer race into transaxle housing with "S2" shim. Press in tapered roller bearing outer race into differential cover without shim "S1". Install differential into transaxle housing without VSS drive gear. Ring gear should be located on left side in front of final drive cover. Install differential cover and tighten 4 bolts to 18 ft. lbs. (25 N.m). Position transaxle with differential cover upward.

3) Turn differential 5 rotations in both directions to seat tapered roller bearing. Assemble and install Measuring Device (VW387 and 385/17). Set dial indicator to "0" with .079" (2 mm) preload. Ensure tip of dial indicator is centered on differential. Lift differential using Locking Sleeve and Bushing (VW521/4 and 521/8), without turning it, and read play on dial indicator. Record play.

4) Use the following formula and example to determine final "S2" shim requirement: $"STOTAL" = "S2" + \text{measured value} + \text{bearing preload}$. Installed Preliminary Shim $"S2" = .047"$ (1.20 mm) + Dimension = .024" (0.62 mm) + Bearing Preload (Constant) = .012" (0.30 mm) = "STOTAL" For $"S1" + "S2" = .083"$ (2.12 mm).

5) To determining thickness of shim "S1", use the following formula: $"S1" = "STOTAL" - "S2"$. Total Shim Thickness "STOTAL" For $"S1" + "S2" = .083"$ (2.12 mm) - Installed Shim $"S2" = .047"$ (1.20 mm) = Thickness of Shim $"S1" = .036"$ (0.92 mm).

RING GEAR BACKLASH

1) With ring gear in transaxle and pinion shaft installed with "S3" and "S4" shims, install differential with cutout for bevel gears facing pinion shaft. Turn differential 5 rotations in each direction. Attach dial gauge with Holder (VW387) to housing. Install Locking Sleeve (VW521/4) and Bushing (VW521/8 or 521/12). Use .24" (6.0 mm) Extension Pin (VW382/10). Set Measuring Lever (VW388) to Dimension "a". If dimension "a" is 2.64" (67.0 mm), ring gear diameter is 6.7" (170 mm). If dimension "a" is 2.84" (72 mm), ring gear diameter is 7.1" (180 mm).

2) Ensure pinion shaft is held so it will not turn. Install Clamp (3177), if necessary. Turn ring gear until it contacts a tooth flank (end of backlash travel). Set dial indicator to "0" with a .079" (2.0 mm) preload. Turn ring gear until it contacts opposite tooth flank (backlash). Read and record measurement on dial indicator. Turn ring gear another 90 degrees and repeat measurement process 3 times.

NOTE: If clamp was installed on pinion shaft, it will have to be loosened before ring gear can be rotated between measurements. If clamp is used, re-install differential 180 degrees to final position and repeat measurements.

3) Determine backlash by adding 4 measurements together and divide total by 4 to reach average backlash. Example: 1st Measurement

= .011" (.28 mm) + 2nd Measurement = .012" (.30 mm) + 3rd Measurement = .012" (.30 mm) + 4th Measurement = .011" (.28 mm) = Total of Measurements is .046" (1.16 mm) divided by 4 = .0114" (.29 mm) average backlash.

NOTE: If measurements vary more than .0024" (.06 mm) from each other, ring gear installation or set may not be correct. Check and adjust as needed, then repeat measurements.

4) Shim thickness "S1" is equal to total ("STOTAL") minus thickness of "S2". Example: "S1" + "S2" Thickness = .0835" (2.12 mm) - Thickness of "S2" = .0417" (1.06 mm) = Thickness of Shim "S1" = .0417" (1.06 mm). "S1" shims are available in sizes from .018" (.45 mm) to .035" (.90 mm) in .002" (.05 mm) increments. 2 shims may be used together if needed.

5) Shim thickness "S2" is equal to original thickness of "S2" shim minus average backlash plus amount of lift. Example: Original "S2" Shim = .0472" (1.20 mm) - Average Backlash = .0114" (.29 mm) + Lift (Constant) = .0059" (0.15 mm) = Thickness of Shim "S2" is .0417" (1.06 mm). "S2" shims are available in sizes from .018" (.45 mm) to .035" (.90 mm) in .002" (.05 mm) increments. 2 shims may be used together if needed.

6) After installing "S2" and "S1" shims, turn differential 5 rotations in each direction, then measure backlash 4 times on circumference, following procedure given previously. Backlash should be within .005-.009" (.12-.22 mm). If not, repeat adjustments, but do not change total shim thickness ("STOTAL"). Be sure individual measurements do not vary by more than .002" (.06 mm).

TRANSAXLE REASSEMBLY

1) Lightly coat sealing face on final drive housing with sealing compound. Install new gasket and dowel pins. Attach gear carrier housing to final drive housing. Tighten Torx bolt to 18 ft. lbs. (25 N.m).

2) Assemble input shaft, pinion with hollow shaft, relay shaft, selector rods and shift forks. All must be installed together as one unit into gear carrier housing. Install relay shaft and locking segment. Tighten relay shaft bolts to 30 ft. lbs. (40 N.m). Tighten locking segment bolt to 18 ft. lbs. (25 N.m).

3) Install multifunction switch, and tighten retaining plate bolt to 18 ft. lbs. (25 N.m). Install 5th/reverse lock bolt and tighten to 89 INCH lbs. (10 N.m). Install roller bearing on input shaft and use selected snap rings that are installed before and after roller bearing.

4) Install guide sleeve with sealing ring, and tighten bolts to 26 ft. lbs. (35 N.m). Install assembled differential gear and final drive cover. Tighten final drive cover bolts in crisscross pattern to 18 ft. lbs. (25 N.m). Install drive flanges with proper snap rings. Install speedometer drive.

5) Install transaxle breather sleeve so sleeve extends .8" (21 mm) above vent lip. Install clutch return lever and clutch release

bearing. Install multifunction connector, and tighten bolt to 89 INCH lbs. (10 N.m).

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

[illegible]

Application	Ft.	Lbs.	(N.m)
Catalytic Converter Bolts	18	(25)	
Clutch Slave Cylinder-To-Transmission Bolt	18	(25)	
Drive Axle-To-Flange Shaft Bolts			
M8	30	(40)	
M10	57	(77)	
Final Drive Cover Bolts	18	(25)	
Exhaust Pipe Clamp Nuts	30	(40)	
Heat Shield Bolts	17	(23)	
Input Shaft Needle Bearing Bolt	18	(25)	
Multifunction Switch Torx Bolt	26	(35)	
Pivot Rod Shaft Bolt	30	(40)	
Reverse Idler Gear Torx Bolt	26	(35)	
Selector Mechanism Stop Bolt	30	(40)	
Shift Rod Bolt	17	(23)	
Shift Detent Torx Bolt	18	(25)	
Transmission Cover Bolts	16	(22)	
Transmission-To-Engine Bolts			
M10	33	(45)	
M12	48	(65)	
Transmission Mount Bolts			
4-Cylinder			
M8X20	17	(23)	
M10X30	30	(40)	
M10X35	37	(50)	
V-6			
M8X20	17	(23)	
M10X35	30	(40)	

INCH Lbs. (N.m)

5th/Reverse Gear Lock Bolt **89 (10)**

[illegible]

END OF ARTICLE