

Index

Index continues on next page



016 All Wheel Drive

Front final drive

Axle flange oil seal (transmission installed)

- replacing 39-10

Backlash

- adjusting 39-130

Differential

- assembly 39-50
- disassembling
/assembling 39-60

Differential bearings

- preload, adjusting 39-130
- removing/installing 39-60

Differential pinion gears

- adjusting 39-60

Driveshaft

- adjusting 39-170
- aligning 39-180
- assembly 39-140
- removing/installing 39-160
- repairing 39-150

Pinion

- adjusting 39-120

Pinion bearing preload

- checking/adjusting 39-120

Pinion gears

- installing 39-60

Ring gear

- adjusting 39-130
- installing 39-60

Ring gear/pinion

- adjusting 39-70, 39-100
- adjustment overview 39-80
- determining position 39-90

Shims

- positions 39-110
- S1, S2, S total
(1 and 2), determining 39-130
- S3, S4, S total
(3 and 4), determining 39-120

Speedometer drive gear (transmission installed)

- replacing 39-20

Index

016 All Wheel Drive

Rear final drive

Axle flange

- adjusting 39-260

Axle flange oil seal

- left/right side, replacing 39-220

Backlash

- adjusting 39-380

Clutch body

- installing 39-250
- adjustment shim thickness 39-250

Differential

- assembly 39-290
- bearing, removing/installing 39-300
- disassembling/assembling 39-300
- gears, installing 39-300

Drive flange/bearing

- bearing, removing 39-280
- cover, removing 39-280

Driveshaft flange oil seal/bearing

- replacing 39-210

Pinion

- adjusting 39-360
- assembly 39-270
- bearings, removing/installing 39-280
- determining position 39-330
- disassembling/assembling 39-280
- gears, adjusting 39-300
- nut, loosening/tightening/securing 39-280

Rear final drive

- assembly 39-200, 39-240
- housing, disassembling/assembling 39-250
- removing/installing 39-230

Ring gear

- adjusting 39-370
- removing/installing 39-300

Ring gear/pinion

- adjusting 39-310, 39-340
- adjustment overview 39-320

Shims

- positions 39-350
- S1, S2 determining 39-380
- S3 determining 39-360
- S total (S1 and S2), determining 39-370

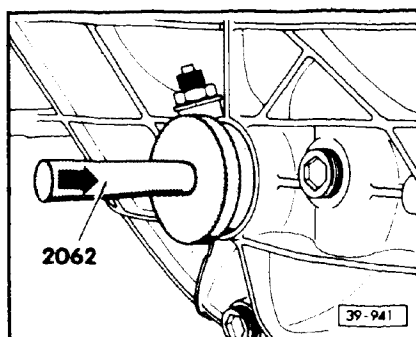
Torsen differential

- assembly 39-190

Axle flange oil seal, replacing

(transmission installed)

- remove front exhaust pipe
 - only vehicles **without** turbocharger
- remove axle shaft cover plate (right side)
- disconnect axle shaft
- remove axle flange bolt
 - hold flange stationary with drift
- place drip tray underneath and withdraw flange
- pry out oil seal with extractor lever **VW 681**
- drive in new oil seal, until seated
 - on right side, use drive sleeve **30-20** if necessary



Tightening torques

Axle flange to transmission 10 Nm
(89 in. lb or 102 cm kg),
plus an additional 90°
(1/4 turn)

Axle shaft to axle flange
M8 bolts 45 Nm (32 ft lb)
M10 bolts 80 Nm (59 ft lb)

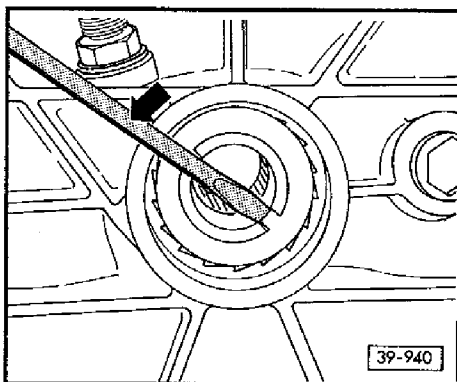
Speedometer drive gear, replacing

(transmission installed)

Note

Shown: drive gear for mechanical speedometer (vehicles built through December, 1987. For build dates from January 1988, see Repair Group 34.)

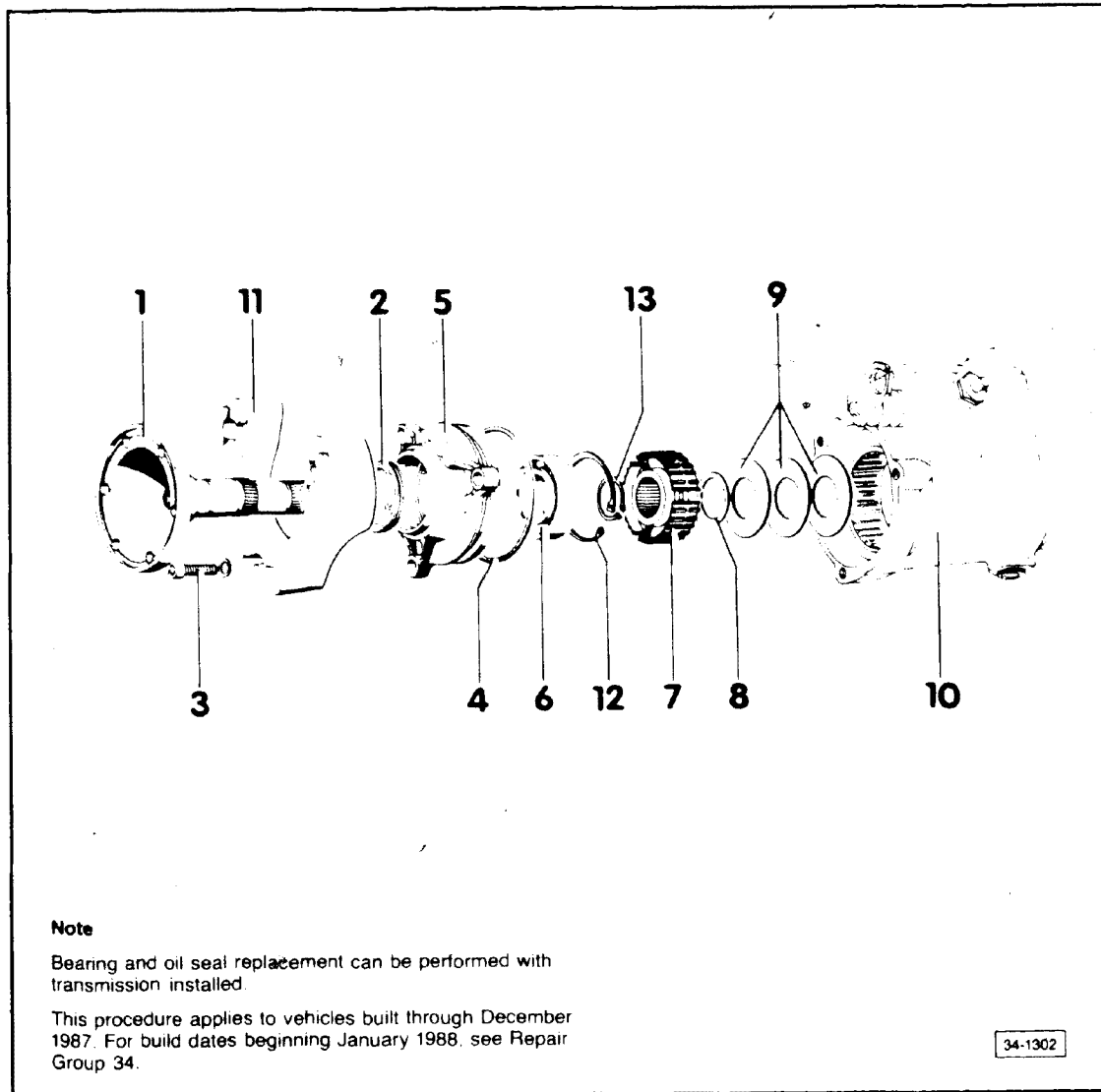
- remove axle shaft, axle flange, and oil seal (left side)



- pry out speedometer drive gear
- press in new speedometer gear
- press in new oil seal, section 39-10
- install axle flange and axle shaft

Note

See tightening torques, section 39-10



Note

Bearing and oil seal replacement can be performed with transmission installed.

This procedure applies to vehicles built through December 1987. For build dates beginning January 1988, see Repair Group 34.

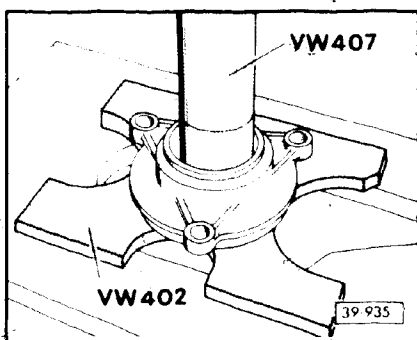
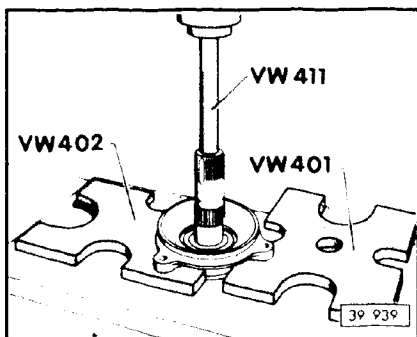
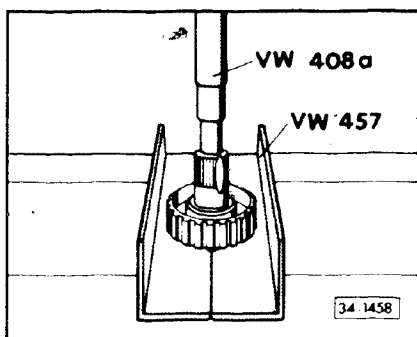
34-1302

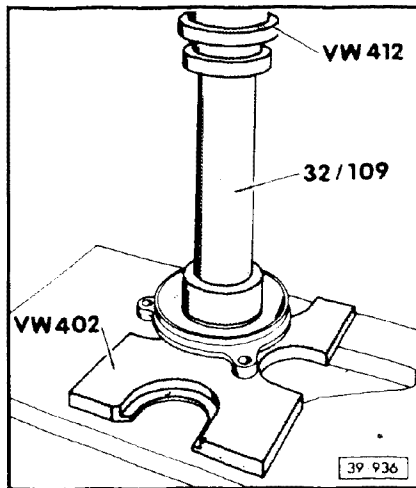
- | | |
|--|--|
| <p>1 — Driveshaft flange</p> <p>2 — Oil seal</p> <p>3 — Sockethead bolt</p> <ul style="list-style-type: none"> • clean threads • apply locking compound, Part No. D 000 600 and tighten in stages • tighten to 15 Nm (11 ft lb), then turn an additional 90° (1/4 turn) • always replace self-locking bolt <p>4 — Oil seal</p> <p>5 — Cover</p> <p>6 — Bearing</p> | <p>7 — Differential clutch gear lock
installed position, section 39-40</p> <p>8 — Washer</p> <p>9 — Spring washers
installed position, section 39-40</p> <p>10 — End cover</p> <p>11 — Damper
clean contact area for bolt head</p> <p>12 — Circlip, large</p> <p>13 — Circlip, small</p> |
|--|--|

Driveshaft flange bearing/oil seal, replacing

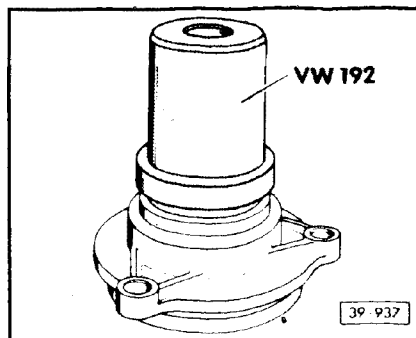
Replacing

- disconnect driveshaft at front
- remove cover
- press off clutch gear
- remove small circlip
- press out flange
- pry out oil seal
- remove large circlip (only if replacing bearing)
- press out old bearing

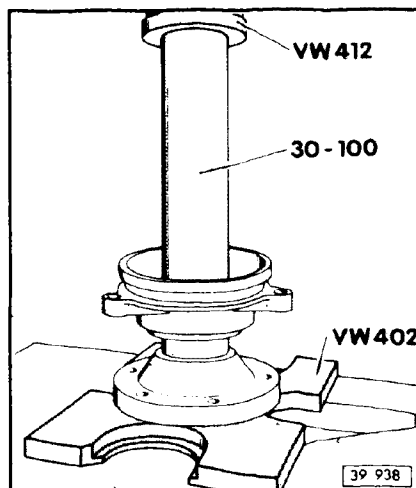




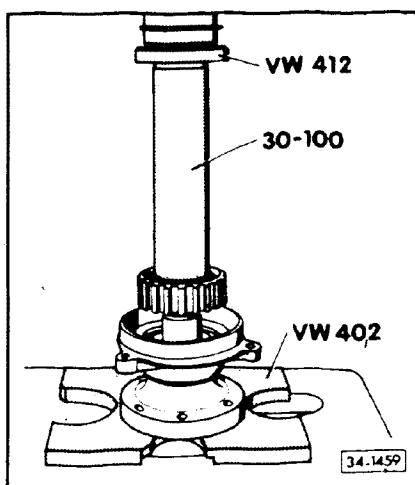
- press in new bearing
- install large circlip



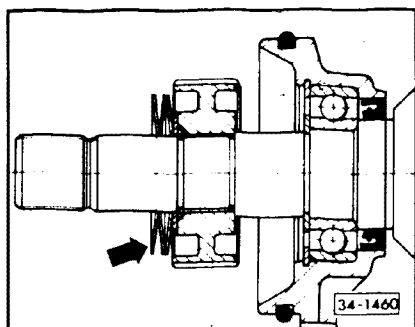
- drive in oil seal, until seated



- press flange in
- install small circlip



- press clutch gear on



- install spring washers in position (arrow)
- install cover with new oil seal
 - coat bolts with locking compound, Part No. **D 000 600**
 - tighten bolts to 30 Nm (22 ft lb)
- install driveshaft
 - tighten bolts to 55 Nm (41 ft lb)

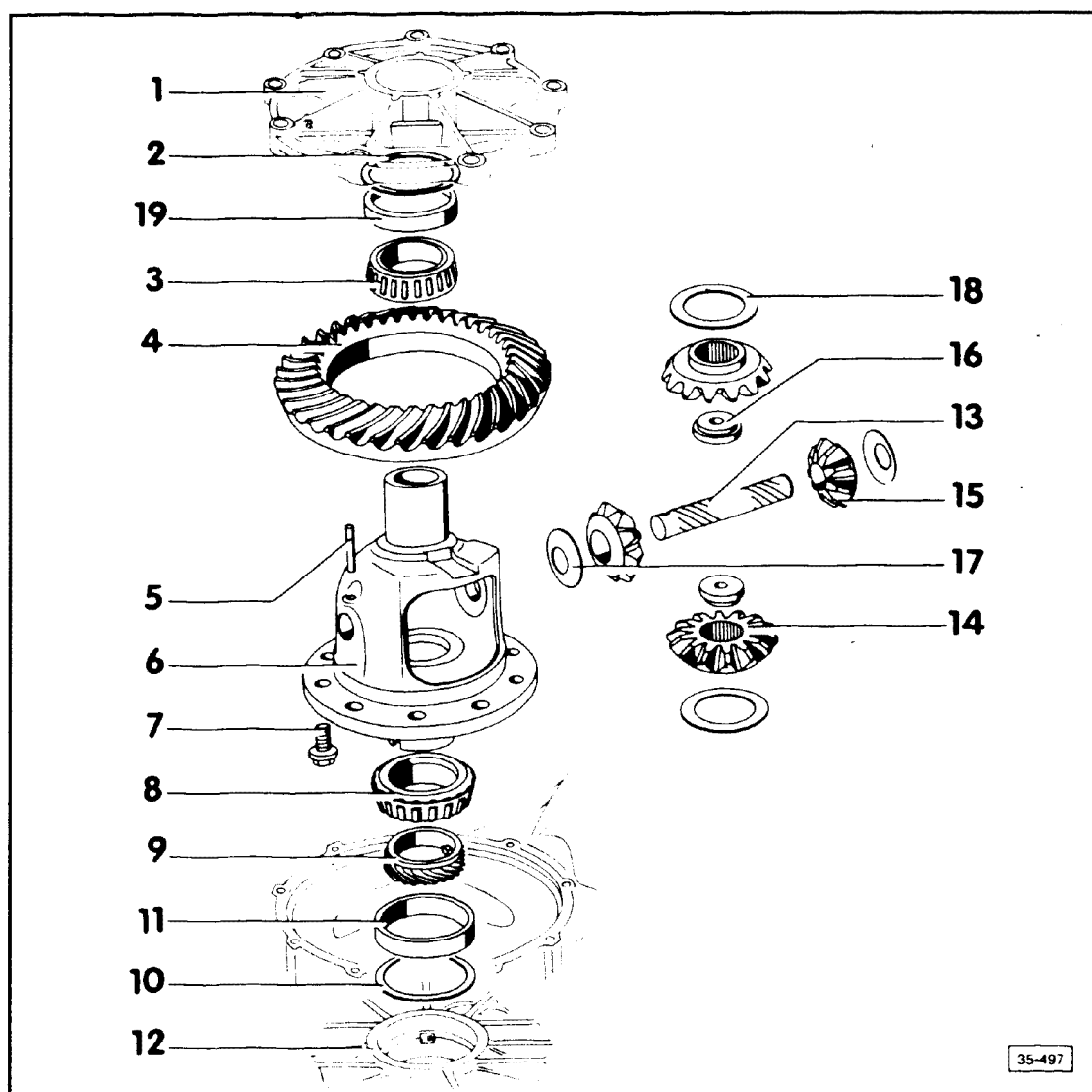
Note

Before installing the driveshaft, be sure the threads in the drive flange are totally free of locking compound. Otherwise, bolts may seize during installation, and strip during removal.

Cleaning can be done with a thread cutter.

THIS FRAME INTENTIONALLY LEFT

BLANK



CAUTION

When replacing bearings:

- adjust ring gear, section 39-130
- replace both bearings together

Note

When replacing parts marked with an asterisk (*), additional adjustments are required. See Adjustment Overview (part I), section 39-80.

- *1 — Cover (see Note)
for final drive

2 — Shim 2

- note thickness
- see Adjustment Overview (part I), section 39-80

*3 — Small bearing, inner race (see Note)

removing installing, section 39-60

*4 — Ring gear (see Note)

- drive pinion and ring gear must be replaced as matched set
- removing installing, section 39-60

5 — Roll pin

drive in flush

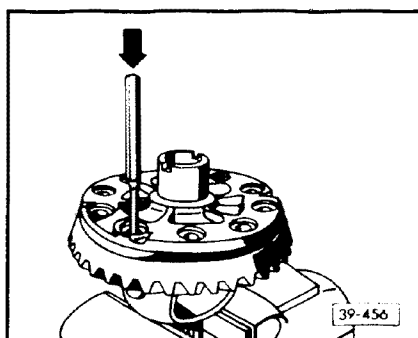
*6 — Differential housing (see Note)

Differential — Manual Transmission **39**

- 7 — **90 Nm (66 ft lb)**
 - use only specified bolts
 - tighten bolts in diagonal sequence
- * 8 — **Large bearing, inner race** (see Note)
removing/installing, section 39-60
- 9 — **Speedometer drive gear**
 - replacing with transmission installed, section 39-20
 - mechanical speedometer drive gear shown (vehicles built through December 1987)
 - electronic speedometer (build dates beginning January 1988), see Repair Group 34
- 10 — **Shim S1**
 - note thickness
 - Adjustment Overview (Part I), section 39-80
- *11 — **Large bearing, outer race** (see Note)
removing/installing, section 39-60
- *12 — **Final drive housing** (see Note)
- 13 — **Differential pinion shaft**
 - drive out using drift
 - drive in carefully to avoid damaging thrust washers
 - secure with roll pin
- 14 — **Differential side gears**
adjusting, section 39-60
- 15 — **Differential pinion gears**
- 16 — **Axle flange nut**
- 17 — **Thrust washer**
check for cracks and breaks
- 18 — **Shim(s)**
determining thickness, section 39-60
- *19 — **Small bearing outer race** (see Note)
removing/installing, section 39-60

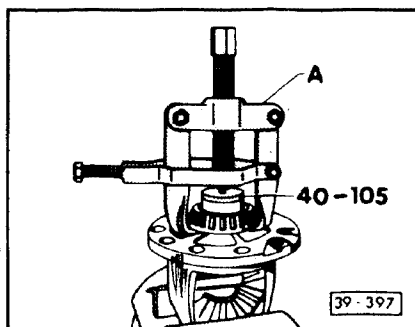
Differential, disassembling/assembling

Ring gear, removing from housing



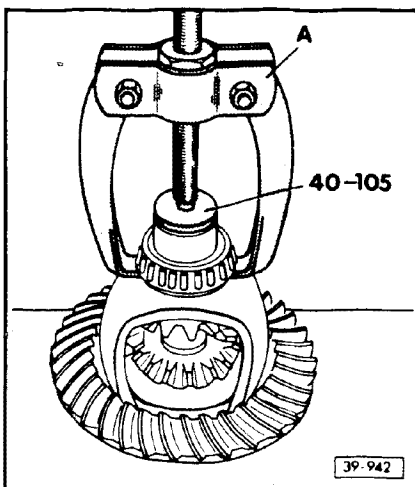
Large bearing inner race, removing from housing

A — 2-arm puller (commercial), e.g. Kukko 204/2

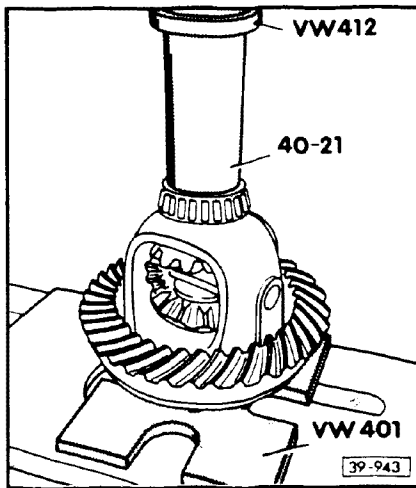


Small bearing inner race, removing from housing

A — 2-arm puller (commercial), e.g. Kukko 44/2

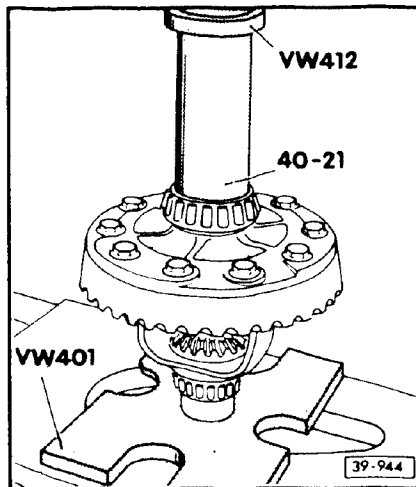


Differential – Manual Transmission 39



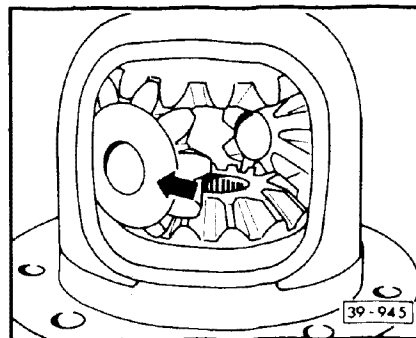
Small bearing inner race, installing

- heat inner race to approximately 100°C (212°F), and press on



Large bearing inner race, installing

- heat inner race to approximately 100°C (212°F), and press on



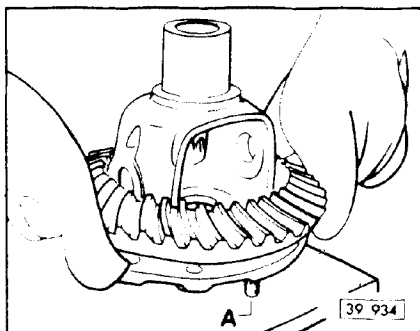
Pinion gears, installing

Note

Before assembling, lubricate parts with hypoid transmission oil.

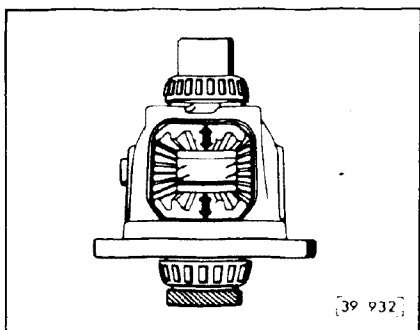
- insert differential side gears along with correct adjustment shims
 - see illustrations 39-932 and 35-395, in this section
- insert differential pinion gears approximately 180° apart
 - assemble thrust washers, using small amount of grease

- rotate gears into position (arrow)
- insert axle flange nuts
- align thrust washers
- drive in differential pinion shaft
- secure shaft with roll pin



Ring gear, installing

- heat gear to approximately 100°C (212°F), and install
- A — alignment pin, suitable size (make in-shop, if necessary)



Differential pinion gears, adjusting

- insert side gears along with thinnest shims available (i.e. 0.5 mm or 0.020 in.)
- insert pinion gears with thrust washers and drive in differential pinion shaft

CAUTION

Do not interchange differential pinion gears and thrust washers, after this point in procedure.

- hold small differential pinion gears outward and check clearance of differential side gears by hand (arrows)
- adjust clearance by changing adjustment shims so maximum clearance is 0.10 mm (0.004 in.)

Note

Clearance is correct: if you feel no play and the differential pinion gears can be turned slightly, without catching (see illustration 35-395, in this section).

The following adjustment shims are available:

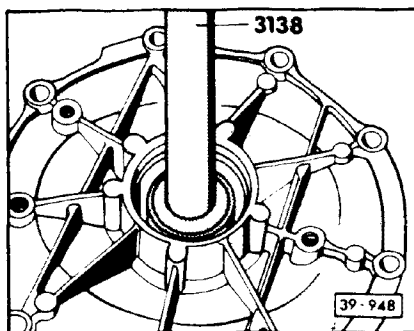
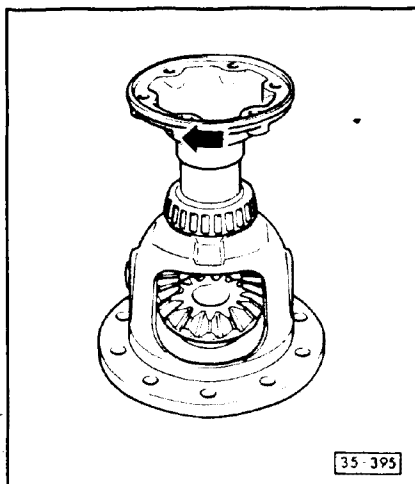
Differential — Manual Transmission 39

Thickness (mm)	Part number
0.5	011 519 215
0.6	088 409 249
0.7	088 409 249 A
0.8	088 409 249 B
0.9	088 409 249 C
1.0	088 409 249 D

CAUTION

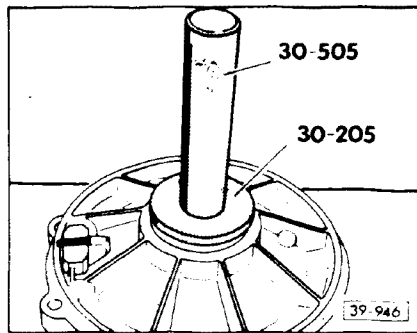
Part numbers are for reference only. Always check with your Parts Department for latest information.

Differential gears, turning



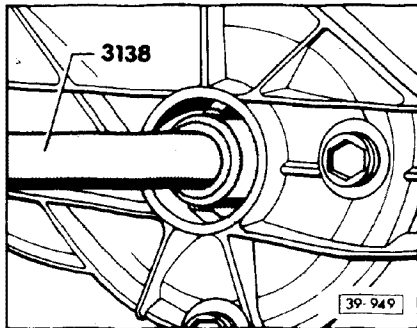
Small bearing outer race, removing

- drive race out of final drive housing cover
- use thrust ring VW 470



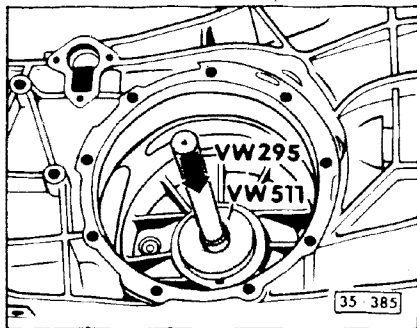
Small bearing outer race, installing

- drive race into final drive housing cover



Large bearing outer race, removing

- drive race out of final drive housing



Large bearing outer race, installing

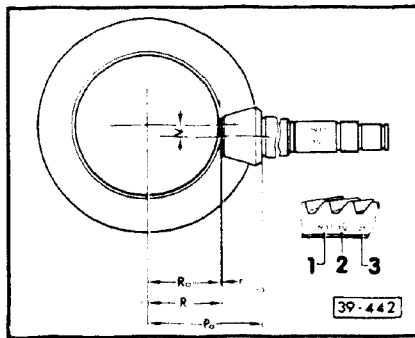
- drive race into final drive housing

Ring gear/pinion, adjusting

Note

Careful adjustment of the ring gear and pinion is important to ensure that the final drive runs quietly and has a long service life. During manufacture, the ring gear and pinion are matched as a set, and are run on special testing machines to ensure a correct mesh pattern and silent running in both directions. The quietest running position is determined by moving the pinion axially and lifting the ring gear away from the the no-play meshing position, maintaining backlash within specified tolerance.

The pinion deviation r from the master gauge R_o is measured for the ring gear/pinion sets supplied as replacement parts. A value for r is marked on the outer face of each ring gear. The ring gear and pinion must always be replaced as a matched set.



Replacement parts, identifying

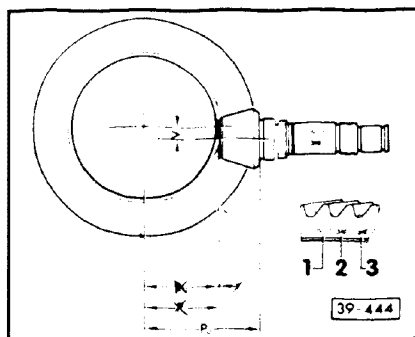
- 1— The code **0937** identifies an Oerlikon gear set with a 9:37 ratio.
- 2— A matching number (e.g. **312**) is stamped on both the ring gear and pinion, to identify a set.
- 3— Pinion deviation r is measured against the master gauge of the testing machine used in production.
 - deviation r is always given in 1/100 mm
 - example: "25" means $r = 0.25$ mm

R_o —Length of master gauge used in production

$R_o = 59.65$ mm

R — Actual dimension found between ring gear center and end face of pinion, while at quietest running position of a particular gear set.

V_o —Hypoid offset = 12 mm.



Standard-production gear sets

X— Codes shown X'd out, are not marked on production gears.

P_o— The measurement used for setting ring gears and pinions in production.

CAUTION

In production, the position of the pinion is determined by dimension **P_o** (measured from ring gear centerline to back of pinion head). The marking of deviation **r** on the ring gear, and the matching number, have been eliminated. It is therefore necessary to measure the position of the pinion before removing it, when parts that affect the position of the pinion are to be replaced. See Adjustment Overview (part I), section 39-80.

Adjustment overview (part I)

Note

When assembling the final drive, it is only necessary to adjust the ring gear or pinion, or both, if parts have been replaced which directly affect the final drive setting. The following chart should be used to avoid carrying out unnecessary adjustments:

To be adjusted	Ring Gear (S1 + S2)	Pinion (S3 + S4) using deviation r	Pinion (S3 + S4) using actual measurement	Pinion only, Shim S4
Replaced part	Section 39-120	Section 39-110	Section 39-90	Repair Group 34
Final drive housing	X		X	
Gear carrier housing				X
Differential housing	X			
Pinion bearings			X	
Differential bearings	X			
Ring gear and pinion	X	X		
Final drive cover	X			
1st/2nd gear synchronizer hub				X
1st gear needle bearing				X
Hollow shaft				X

Pinion, determining position (by actual measurement)

Note

This operation is only necessary if deviation r (section 39-70) is not marked on the ring gear, and if both pinion bearings and/or the final drive housing have to be replaced. (These parts directly affect the position of the pinion.)

- remove differential gear
- assemble measuring bar, section 39-120
- install measuring bar into final drive housing
- measure deviation from R_0 (maximum deflection in red range)
 - note this reading; it corresponds with deviation r

Note

After replacing pinion bearings and/or final drive housing:

- adjust pinion, section 39-120
 - reading obtained for r is used to determine thickness of shim **S3**

Ring gear/pinion, adjusting

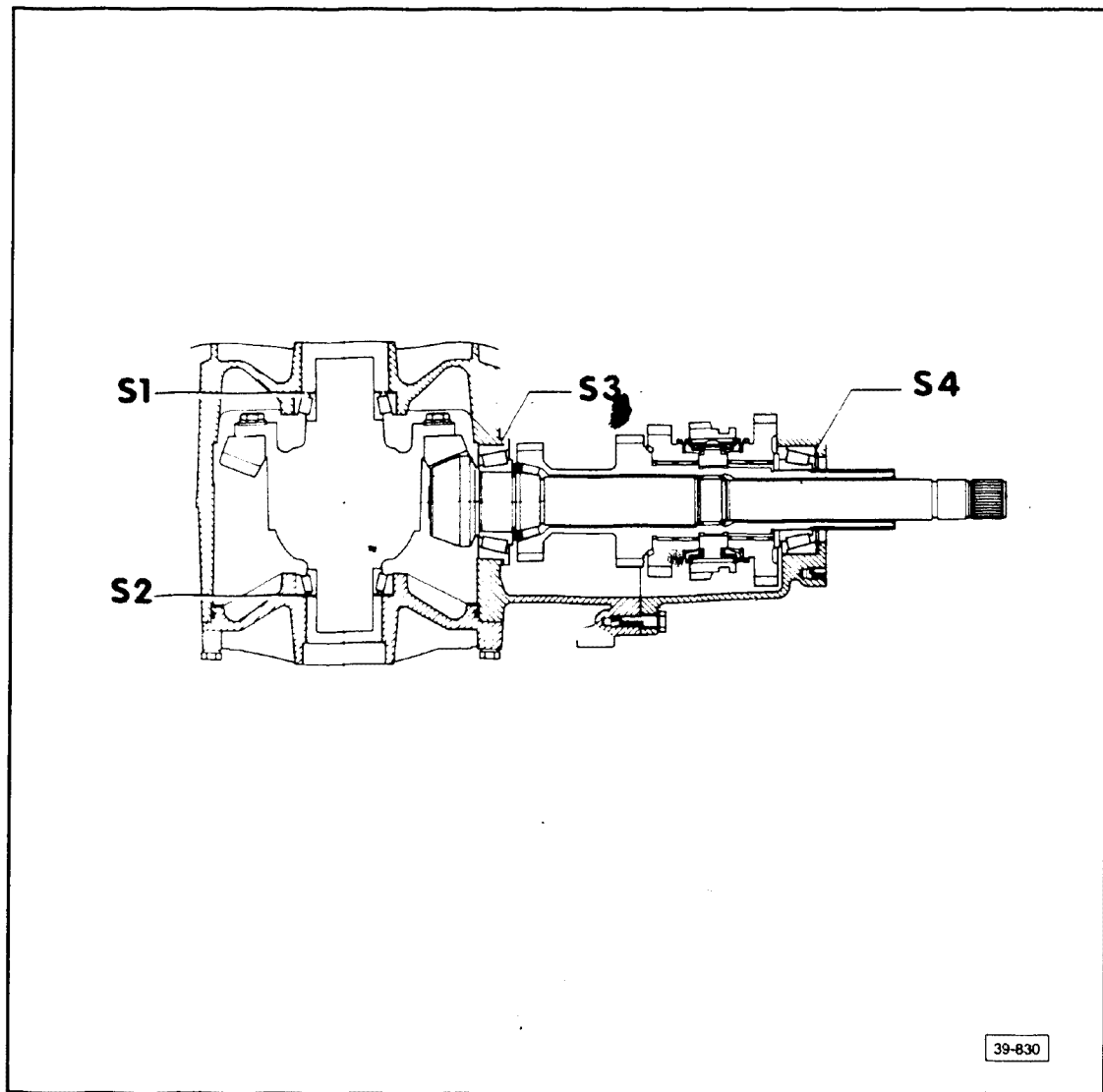
- determine total shim thickness, S_{total} (i.e. $S1 + S2$) to give specified preload of differential bearings
- determine total shim thickness, S_{total} (i.e. $S3 + S4$) to give specified preload of pinion bearings
- distribute S_{total} thickness between $S3$ and $S4$ so dimension between ring gear centerline and pinion end face corresponds to installation dimension R determined in production
- distribute S_{total} thickness between $S1$ and $S2$ to obtain specified backlash between ring gear and pinion

Note

Always try to adjust the ring gear and pinion to obtain the same quiet running position determined on the special test machine used in production.

CAUTION

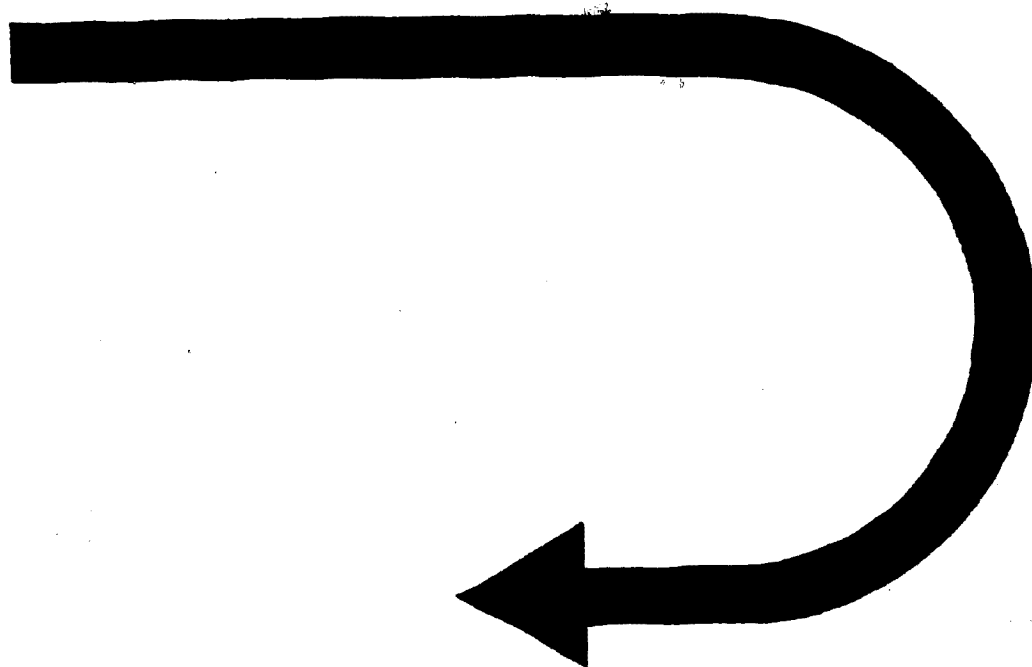
All assembly operations and measurements require great care and absolute cleanliness to produce accurate results.



- S1 = Shim behind ring gear
- S2 = Shim opposite ring gear
- S3 = Shim behind pinion head
- S4 = Shim for pinion preload

39-830

CONTINUED IN THE
BEGINNING OF NEXT ROW



Pinion, adjusting

Output shaft, adjusting

Note

It is only necessary to readjust the pinion, as shown below, when the ring gear and pinion are being replaced. If other parts which affect the position of the pinion are replaced, reset the pinion to its original position, section 39-90.

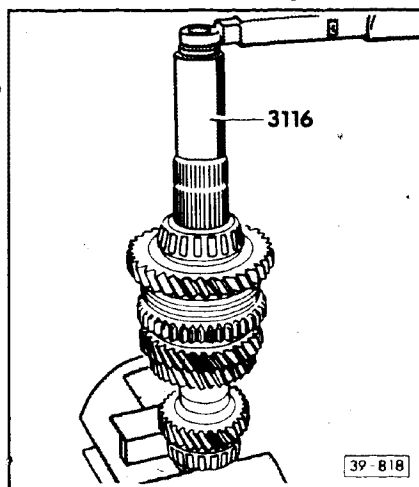
See Adjustment Overview (part I), section 39-80.

Pinion bearing preload, adjusting

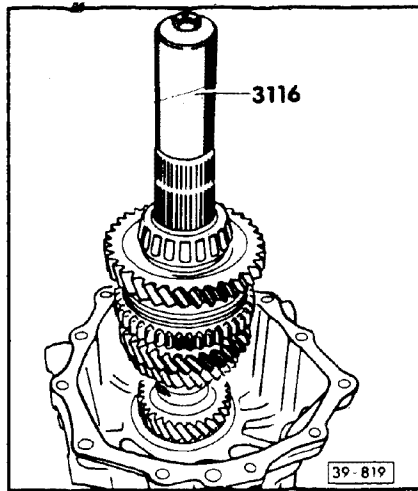
- install bearing outer races in final drive housing/bearing carrier without shims, Repair Group 35
- assemble pinion
- install sleeve **3116** and tube **VW 516**
 - tighten bolt to 10 Nm (89 in. lb or 102 cm kg)
 - use jaw covers on vise

Note

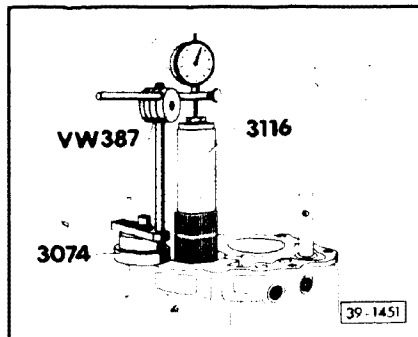
In vehicles with Torsen differential (from January 1988), the pinion was lengthened slightly. For those applications, tube **VW 516** must additionally be used, when bracing the pinion with the hollow shaft.



Differential — Manual Transmission 39

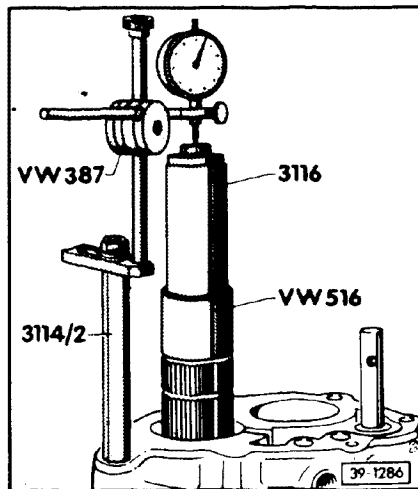


- install pinion circlip
 - **before** tensioning pinion and hollow shaft, so circlip is not damaged
- install pinion in housing without shift forks and selector rod
- remove reverse sliding gear shaft from bearing carrier
- remove reverse gear
- install bearing carrier and spacer
 - tighten bolts to 25 Nm (18 ft lb)



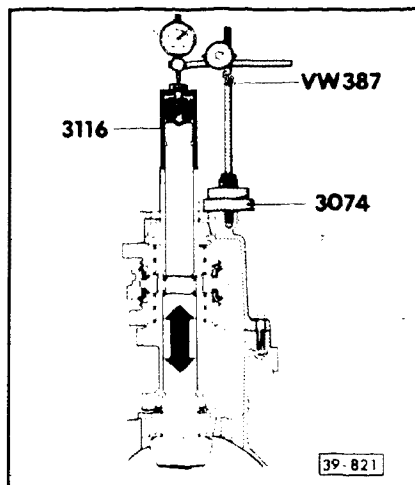
Vehicles built through December 1987

- install measuring tools
 - set dial indicator (3 mm range) to 0 with 1 mm preload



Vehicles built from January 1988 (with Torsen differential)

- install measuring tools
 - set dial indicator (3 mm range) to 0 with 1 mm preload



All vehicles

- move pinion up and down (direction of **arrow**)
 - note reading (example: 1.30 mm)

CAUTION

While taking measurements do not turn the pinion, or the bearings will settle, resulting in an incorrect reading.

- remove bearing carrier

S_{total} ($S_3 + S_4$), determining thickness

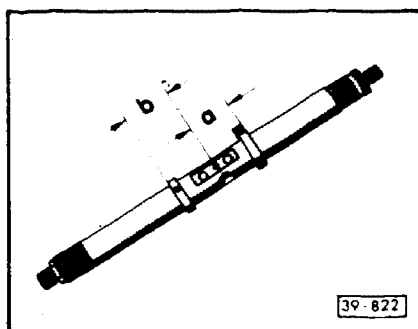
$$S_{\text{total}} = \text{measured reading} + \text{preload}$$

Example

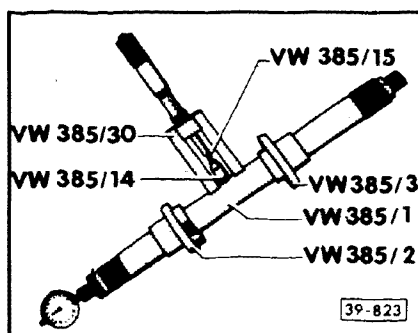
Preload (constant value)		0.30 mm
Reading (example)	+	1.30 mm
S_{total}	=	1.60 mm

Dimension e, determining

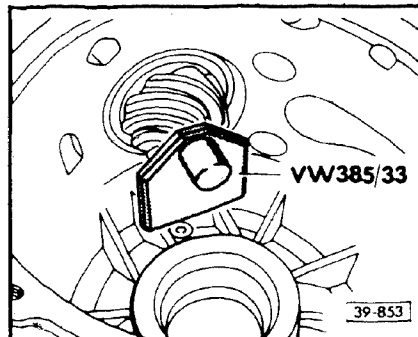
- install appropriate shim total (example 1.60 mm) behind bearing outer race in gear carrier (S_4 side)
- install end cover
- turn pinion in both directions several times to seat bearings



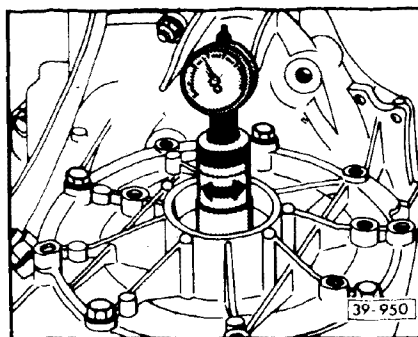
- set centering ring of universal measuring bar **VW 385/1** to:
 - $a = 35 \text{ mm}$
- set sliding ring to:
 - $b = 75 \text{ mm}$



- assemble bar as shown
 - indicator extension **VW 385/15** = 9.3 mm long
- set universal master gauge **VW 385/30** to $R_o = 59.65 \text{ mm}$
- place master gauge on measuring bar and set dial indicator (3 mm range) to 0 with 1 mm preload



- place end plate **VW 385/33** on pinion end face
- remove master gauge and install measuring bar in housing
 - centering disc **VW 385/2** faces final drive cover
- install cover for final drive housing and tighten four bolts
- pull 2nd centering ring outward over sliding ring until measuring bar can just be turned by hand

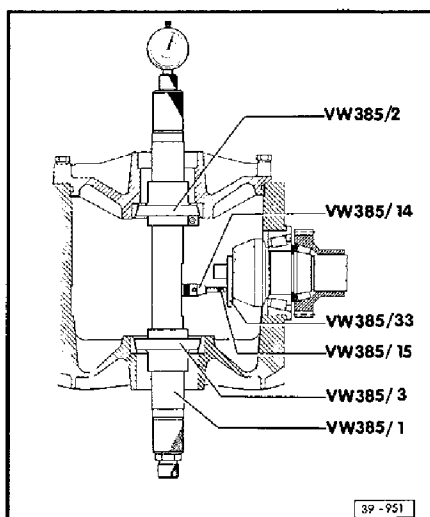


Dimension e, measuring

- turn measuring bar slightly until dial indicator contacts end face of pinion and indicates maximum deflection (return point)
 - measured reading (black number range) = dimension e

Example

$e = 0.46 \text{ mm}$

**S3 shim, determining thickness**

$$S3 = e + r$$

Note

e = dial indicator reading (maximum deflection)

r = deviation (marked on ring gear in 1/100 mm or determined by actual measurement)

Example

Dial indicator reading e		0.46 mm
Deviation r on ring gear	+	0.18 mm
S3 shim thickness	=	0.64 mm

Note

The following **S3** shims are available:

Thickness (mm)	Part number
0.20	088 311 391
0.25	088 311 391 A
0.30	088 311 391 B
0.35	088 311 391 C
0.40	088 311 391 D
0.65	088 311 391 E
0.90	088 311 391 F
1.15	088 311 391 G

Note

Due to varying tolerances, check all shims with a micrometer for correct thickness. Exact shim thickness can be attained by using shims that are thicker or thinner than specifications.

CAUTION

Part numbers are for reference only. Always check with your Parts Department for latest information.

Differential — Manual Transmission 39

S4 shim, determining thickness

$$S4 = S_{\text{total}} - S3$$

Example

Total shim thickness		1.60 mm
S3 shim thickness	—	0.64 mm
S4 shim thickness	=	0.96 mm

Note

For build dates through August 17, 1986, the following S4 shims are available:

Thickness (mm)	Part number
0.24	016 311 393
0.27	016 311 393 A
0.30	016 311 393 B
0.33	016 311 393 C
0.36	016 311 393 D
0.39	016 311 393 E
0.42	016 311 393 F
0.45	016 311 393 G
0.69	016 311 393 H
0.93	016 311 393 I
1.17	016 311 393 J
1.41	016 311 393 K

CAUTION

Part numbers are for reference only. Always check with your Parts Department for latest information.

Note

For build dates from August 18, 1986, the following S4 shims are available:

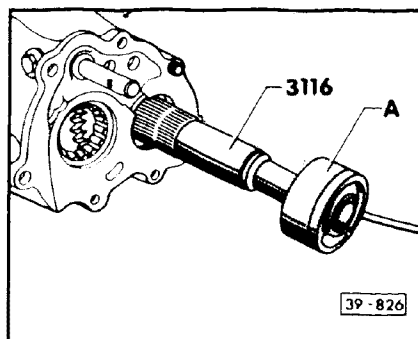
Thickness (mm)	Part number
0.24	016 311 393 AP
0.27	016 311 393 AQ
0.30	016 311 393 AR
0.33	016 311 393 AS
0.36	016 311 393 M
0.39	016 311 393 N
0.42	016 311 393 P
0.45	016 311 393 Q
0.69	016 311 393 R
0.93	016 311 393 S
1.17	016 311 393 T
1.41	016 311 393 AA

CAUTION

Part numbers are for reference only. Always check with your Parts Department for latest information.

Measurements, checking

- install pinion with correct shims S3 and S4
- turn pinion in both directions several times
- install universal measuring bar and check measurements
 - shims have been selected correctly if dial indicator shows deviation r within tolerance of ± 0.04 mm, reading counterclockwise on red scale



Pinion bearing preload, checking

(vehicles built through December 1987)

- measure turning torque
 - A – commercial torque wrench, 0-600 Ncm (0-54 in. lb)
- check turning torque and compare with specifications:

Differential – Manual Transmission 39

New bearings	Used bearings*
250-320 Ncm (25-28 in. lb)	30-60 Ncm (2.7-5.3 in. lb)

*Bearings with at least 50 km (31 miles) service

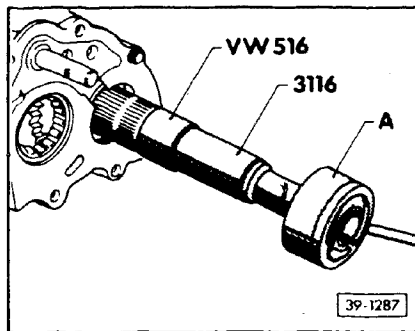
Pinion bearing preload, checking

(vehicles built from January 1988)

- measure turning torque
 - A – commercial torque wrench, 0-600 Ncm
(0-54 in. lb)
- check turning torque and compare with specifications:

New bearings	Used bearings*
250-320 Ncm (25-28 in. lb)	30-60 Ncm (2.7-5.3 in. lb)

*Bearings with at least 50 km (31 miles) service



Ring gear, adjusting

Differential, adjusting

Note

The ring gear must be adjusted if any of the following parts are replaced:

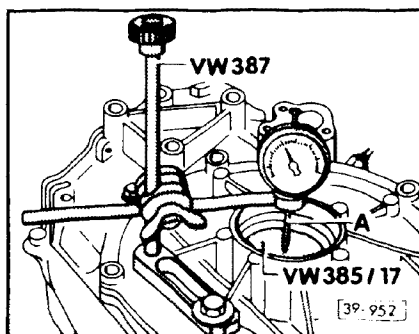
- final drive housing
- final drive cover
- differential bearings
- differential gear housing
- ring and pinion set

See Adjustment Overview (part I), section 39-80.

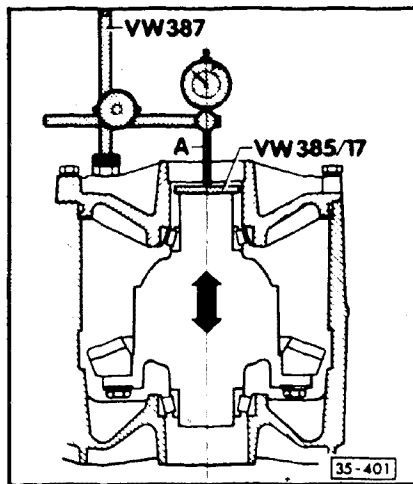
Differential bearings preload, adjusting

(pinion removed)

- remove oil seals and outer races of differential bearings
- remove shims, section 39-50
- install bearing outer races without shims and seat fully, section 39-50
- install differential gear into housing without speedometer gear
 - ring gear positioned on left side, opposite final drive cover
- install cover
 - tighten bolts to 25 Nm (18 ft lb)
- attach measuring equipment
- set dial indicator (3 mm range) to 0, with a 1 mm preload
 - A — dial indicator extension, 30 mm long



Differential — Manual Transmission 39



- move differential up and down
- read end play from dial indicator
 - A— dial indicator extension, 30 mm long
- note reading (example: 1.42 mm)

CAUTION

Do not turn differential while taking measurements, or bearings will settle, resulting in an incorrect reading.

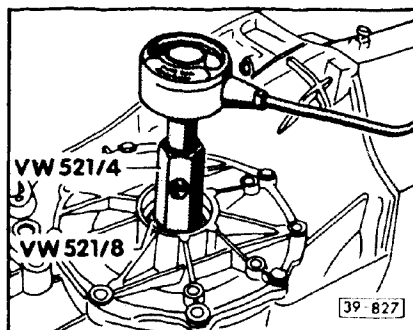
S_{total} ($S1 + S2$), determining thickness

$$S_{total} = \text{dial indicator reading} + \text{preload}$$

Example

Preload (constant value)		0.50 mm
Reading (example)	+	1.42 mm
S_{total}	=	1.92 mm

- install appropriate shim thickness (e.g. 1.92 mm) behind bearing outer race in final drive cover (S2 side)



Turning torque, measuring

- lubricate bearings with hypoid oil before installing
 - A— commercial torque wrench, 0-600 Ncm (0-54 in. lb)
- check turning torque and compare with specifications:

New bearings	Used bearings*
250-320 Ncm (25-28 in. lb)	30-60 Ncm (2.7-5.3 in. lb)

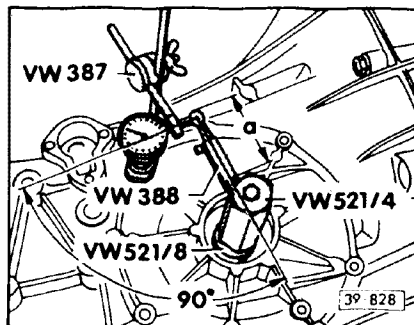
*Bearings with at least 50 km (31 miles) service

Note

If the ring gear and pinion are to be adjusted, the pinion should now be adjusted, and the setting checked, section 39-120.

Backlash, adjusting

- install pinion with shims **S3** and **S4** installed
- install **S_{total}** shim thickness on cover side of differential
- turn differential several times, in both directions, to seat bearings



- attach measuring equipment
- use dial indicator extension **VW 382/10** (6 mm flat)
- adjust measuring lever **VW 388** to:
 - **a** = 79 mm
- hold pinion to prevent it from moving, while turning ring gear up to stop, and zeroing dial indicator
- turn ring gear back and note backlash
- rotate ring gear 90°, and repeat backlash measuring procedure three more times
- add all four readings together and divide by four to determine average backlash

Average backlash, calculating

Example

1st measurement		0.84 mm
2nd measurement		0.85 mm
3rd measurement		0.84 mm
4th measurement	+	0.83 mm
		Total
	=	3.36 mm
Average backlash = 3.36 mm/4		= 0.84 mm

Note

If measurements differ by more than 0.06 mm from each other, ring gear/pinion installation is incorrect. Check ring gear and pinion; if necessary, replace them (as a matched set).

Differential – Manual Transmission 39

S2 shim, determining thickness

(opposite ring gear)

$$S2 = S_{\text{total}} - \text{average backlash} + \text{lift} \\ \text{(constant value)}$$

Note

Lift (constant value) = 0.15 mm

Example

S_{total}		1.92 mm
Average backlash	–	0.84 mm
	=	1.08 mm
Lift	+	0.15 mm
S2	=	1.23 mm

Note

The following shims are available:

Thickness (mm)	Part number
0.15	113 517 201 A
0.20	113 517 202 A
0.30	113 517 203 A
0.40	113 517 204 A
0.50	113 517 205 A
0.60	113 517 206 A
0.70	113 517 207 A
0.80	113 517 208 A
0.90	113 517 209 A
1.00	113 517 210 A
1.20	113 517 211 A

Note

Due to varying tolerances, check all shims with a micrometer for correct thickness. Exact shim thickness can be attained by using shims that are thicker or thinner than specifications.

CAUTION

Part numbers are for reference only. Always check with your Parts Department for latest information.

S1 shim, determining thickness
(ring gear side)

$$S1 = S_{total} - S2$$

Example

S_{total}		1.92 mm
S2	–	1.23 mm
S1	=	0.69 mm

Note

The following shims are available:

Thickness (mm)	Part number
0.15	005 409 385
0.20	005 409 385 A
0.25	005 409 385 B
0.50	005 409 385 C
0.80	005 409 385 D
1.00	005 409 385 E
1.50	005 409 385 F

Note

Due to varying tolerances, check all shims with a micrometer for correct thickness. Exact shim thickness can be attained by using shims that are thicker or thinner than specifications.

CAUTION

Part numbers are for reference only. Always check with your Parts Department for latest information.

- install appropriate **S1** shim on ring gear side
- install appropriate **S2** shim on side **opposite** ring gear

Differential – Manual Transmission 39

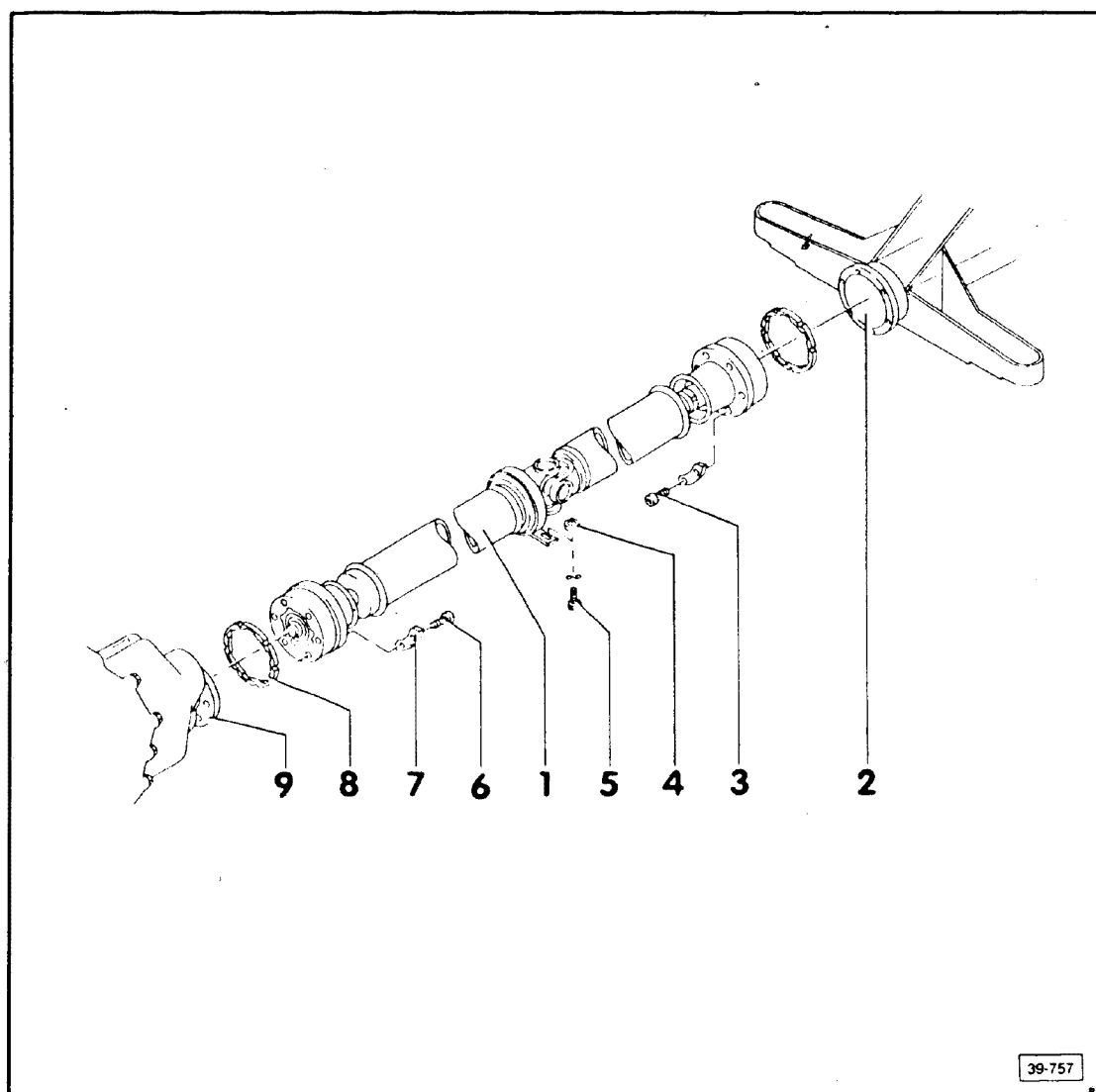
Measurement, checking

- make four backlash measurements around circumference

Note

Backlash measurements:

- must be within range = 0.12-0.22 mm
- must not deviate from each other by more than 0.05 mm



CAUTION

Do not allow driveshaft to pivot during handling. Maintain it in a linear (extended) position.

Store or transport driveshaft only in a linear (extended) position.

1 — Driveshaft

- removing/installing, section 39-160
- adjusting, section 39-170

2 — Rear final drive

3 — Self-locking bolt — 55 Nm (41 ft lb) always replace

4 — Adjustment spacers see section 39-170

5 — Hex bolts — 20 Nm (15 ft lb)

6 — Self-locking bolt — 55 Nm (41 ft lb) always replace

7 — Plate

8 — Gasket

- always replace
- peel off film protecting the adhesive, before installing

9 — Transmission

Driveshaft, repairing

Note

Driveshafts can only be removed, installed or adjusted in-shop. A damaged driveshaft **cannot** be repaired; it must be replaced. Universal joints and bearings cannot be changed. The front and rear driveshaft cannot be replaced individually.

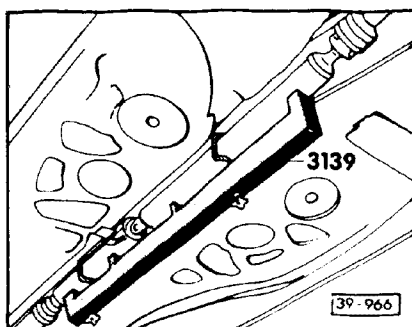
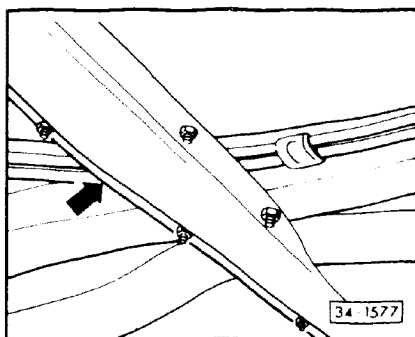
For noise and vibration complaints, check the driveshaft alignment. If careful adjustment does not eliminate the problem, the entire driveshaft must be replaced.

Use a two-pillar hoist during driveshaft removal, installation, or adjustment.

Driveshaft, removing/installing

Removing

- raise vehicle on a two-pillar hoist
- remove catalytic converter and exhaust pipe
- remove crossmember (**arrow**), if present
- loosen bolts securing driveshaft to transmission, rear final drive and body



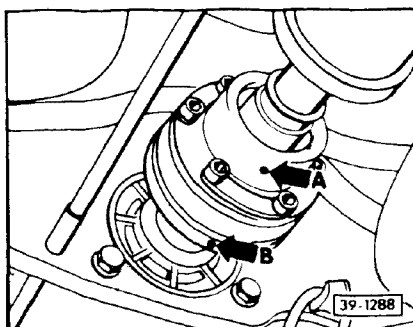
- install alignment tool **3139** and tighten plastic nuts
- mark rear driveshaft flange and final drive flange, for realignment (if not pre-marked)
- remove bolts at transmission and rear final drive
- support driveshaft and alignment tool and remove mounting bolts at body
- remove driveshaft and alignment tool

Note

After removing the driveshaft, inspect the threads on the drive flange and rear final drive for locking compound residue, which can cause bolts to seize and strip during subsequent replacement. Remove any residue with a thread cutter.

CAUTION

Do not allow driveshaft to pivot after removal. Maintain it in a linear (extended) position.



Installing

- install in reverse order of removal

CAUTION

The rear driveshaft flange may be marked with a white dot (**arrow A**) and the rear final drive flange, with a black dot (**arrow B**). During installation, align these dots, or align hand-made marks made during removal, in order to maintain driveshaft balance.

Tightening torques

Driveshaft to transmission	55 Nm (41 ft lb)
Driveshaft to rear final drive	55 Nm (41 ft lb)
Center bearing to body	20 Nm (15 ft lb)

Note

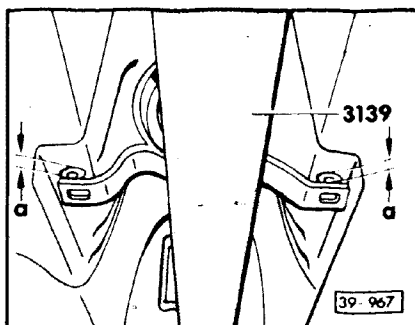
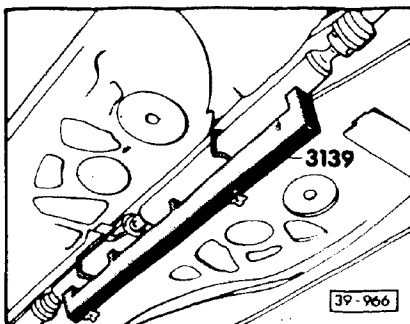
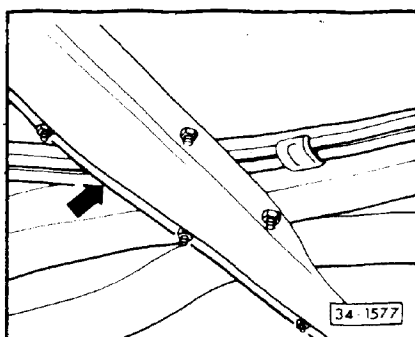
Adjust driveshaft after installing, section 39-170.

Driveshaft, adjusting

Note

Precise adjustment is mandatory for smooth, quiet operation.

- remove exhaust pipe and catalytic converter
- remove crossmember (**arrow**), if present
- loosen bolts securing driveshaft to body



- install alignment tool **3139** and tighten plastic nuts
- remove driveshaft fasteners/spacers at body

- measure gap **a** on both sides
 - dimensions on both sides must be equal
- select the appropriate spacers from the chart which follows:

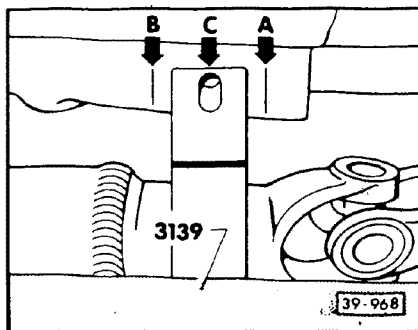
Gap a (mm)	Spacer thickness (mm)	Spacer part number
0 — 3	—	
3.1 — 5	2	857 521 143
5.1 — 7	4	857 521 143 A
7.1 — 9	6	857 521 143 B
9.1 — 11	8	857 521 143 C
11.1 — 13	10	857 521 143 D

Differential — Manual Transmission **39**

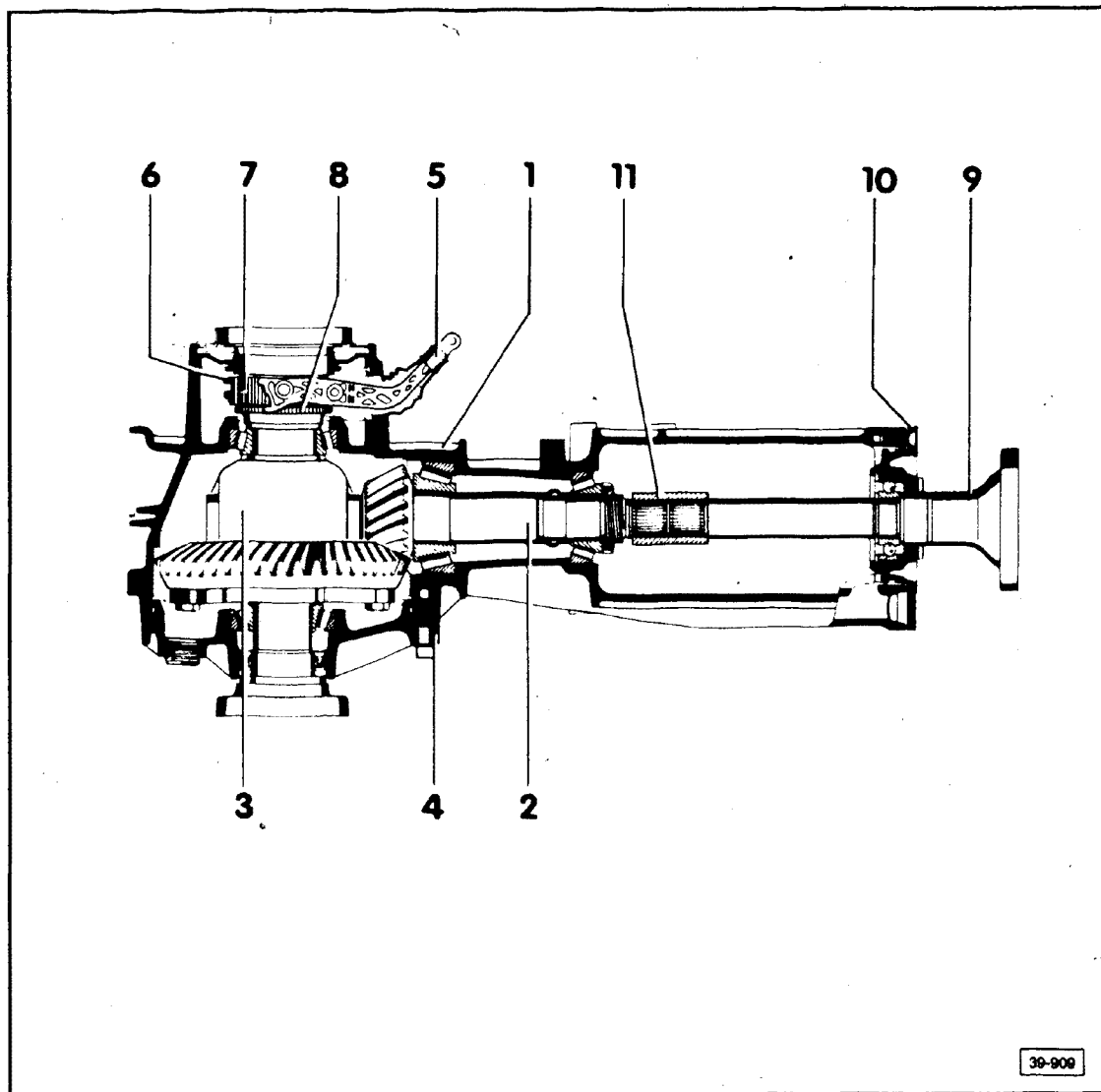
CAUTION

Part numbers are for reference only. Always check with your Parts Department for latest information.

Driveshaft, aligning longitudinally



- use installation tool to push driveshaft fully to rear
- mark position of center bearing on body (**arrow A**)
- use installation tool to push driveshaft to front
- mark position of center bearing on body (**arrow B**)
- center driveshaft
 - the center bearing must be positioned between the two marks (**arrow C**)
- insert bolts and spacers and tighten to 20 Nm (15 ft lb)
- remove installation tool



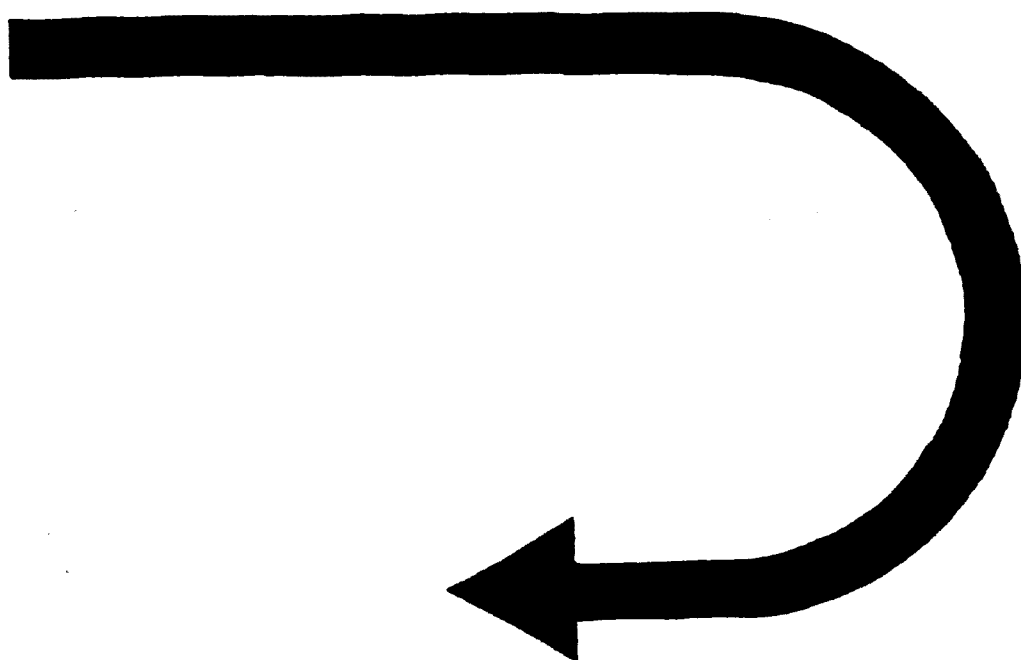
Note

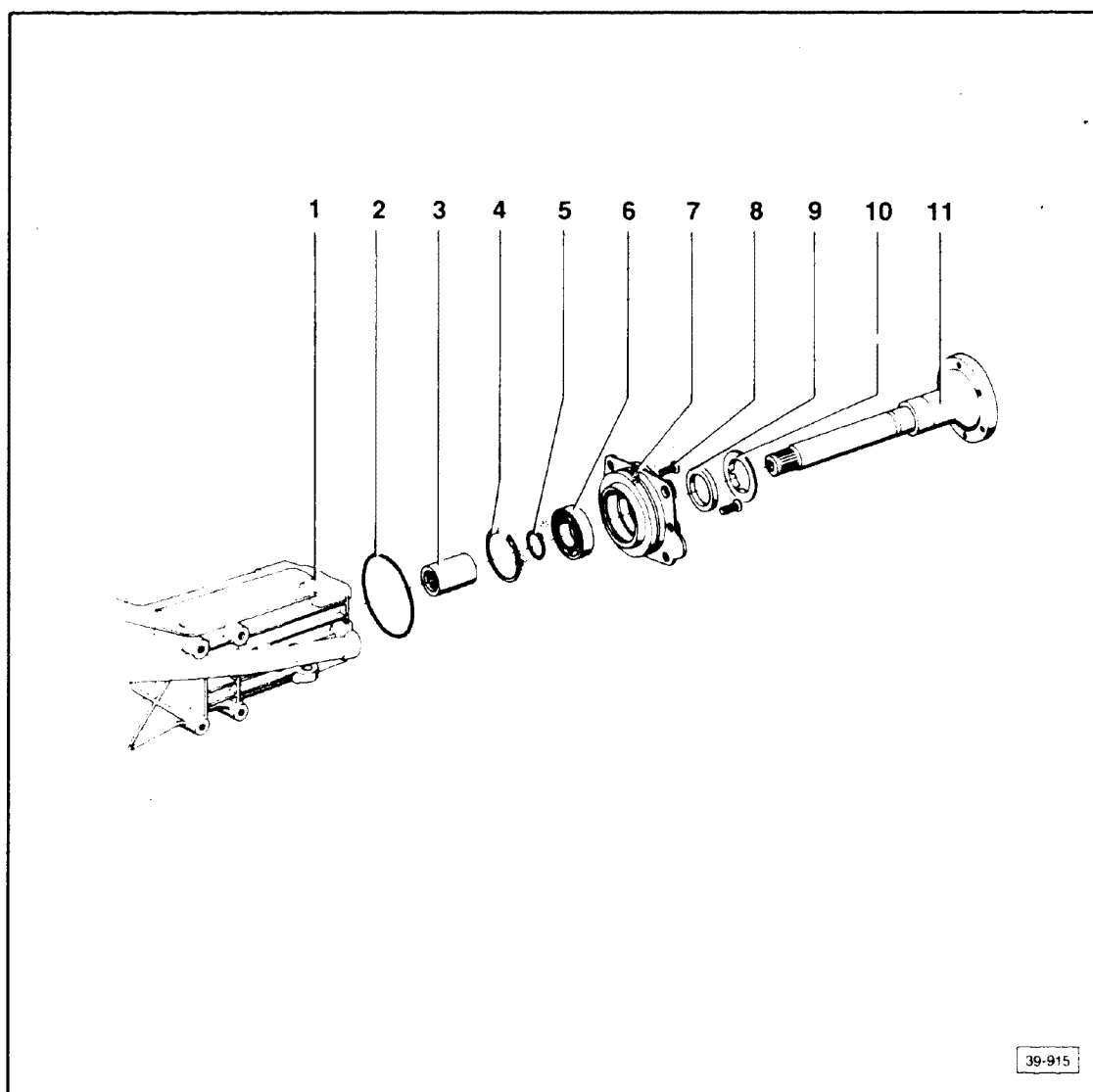
The Torsen differential should **not** be disassembled.

- 1 — Final drive housing
disassembling/assembling, section 39-250
- 2 — Pinion
disassembling/assembling, section 39-270
- 3 — Torsen differential
- 4 — Final drive cover
- 5 — Shift lock

- 6 — Operating sleeve
- 7 — Operating sleeve
- 8 — Differential lock clutch body
- 9 — Flange for driveshaft
- 10 — Final drive cover
disassembling/assembling, section 39-200
- 11 — Sleeve

CONTINUED IN THE
BEGINNING OF NEXT ROW





39-915

Note

Final drive installed

1 — **Final drive**
removing installing, section 39-230

2 — **O-ring**

3 — **Sleeve**

4 — **Large circlip**

5 — **Small circlip**

6 — **Bearing**

7 — **Cover**

* clean seat for oil seal, but do not use solvent

8 — 25 Nm (18 ft lb)

9 — **Oil seal**

- always replace
- pack area between seal lips with multi-purpose grease
- open side of oil seal faces final drive

10 — **Plastic washer**

11 — **Flange for driveshaft**

- if alignment dots are not present, mark flange in relation to driveshaft
- replace gasket between flange and driveshaft: peel off film that protects adhesive, and apply

016

Rear final drive, assembly

39-200-1

Driveshaft flange oil seal and bearing, replacing

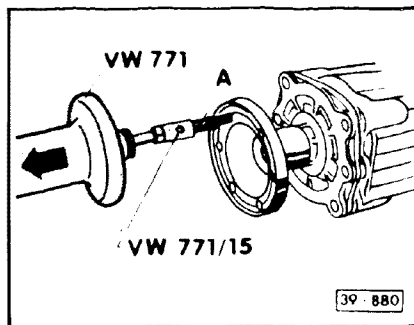
- remove exhaust system components, as necessary
- place drip tray underneath final drive, and drain oil
- mark position of drive flange at final drive, if no alignment dots are present
- remove driveshaft mounting bolts (**arrows**) at final drive
- raise driveshaft upward and tie in position

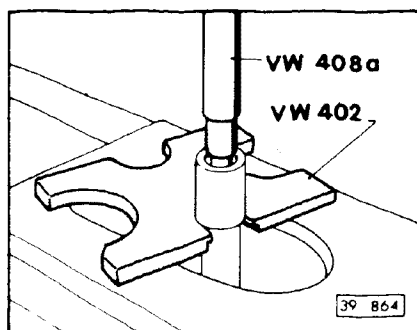
CAUTION

Position driveshaft only high enough for removing drive flange, to prevent damage to driveshaft universal joint.

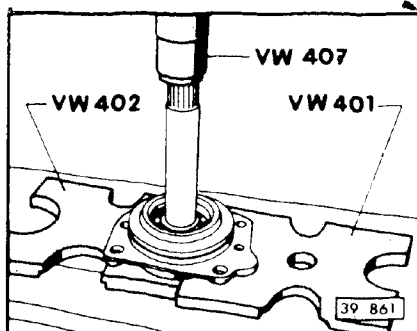
- remove cover plate
- disconnect front cable for parking brake
- disconnect final drive from crossmember, and lower carefully
- remove final drive bracket and crossmember, from final drive
- remove final drive cover bolts
- remove cover

A — M8/M10 bolt

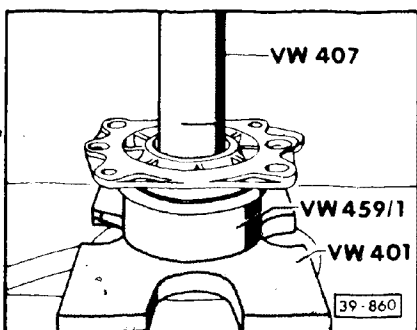




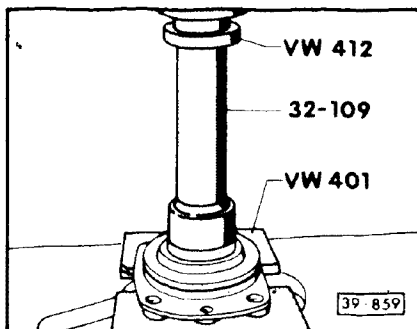
- press sleeve off
- remove small circlip



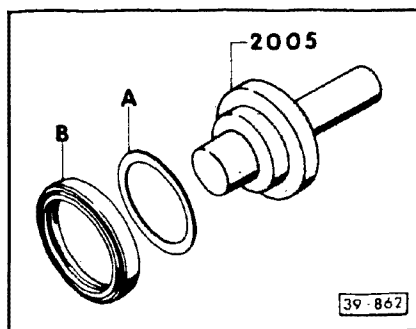
- press flange off
- pry out oil seal with extractor lever **VW 681**
- clean seat for oil seal
 - do not use solvent



- remove large circlip, only if removing bearing
- press bearing out



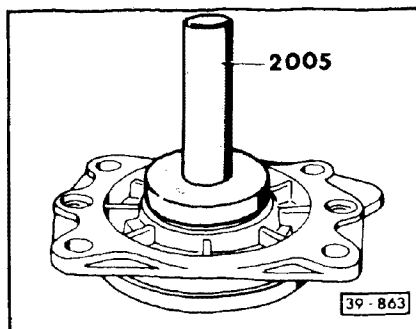
- press bearing in
- install large circlip



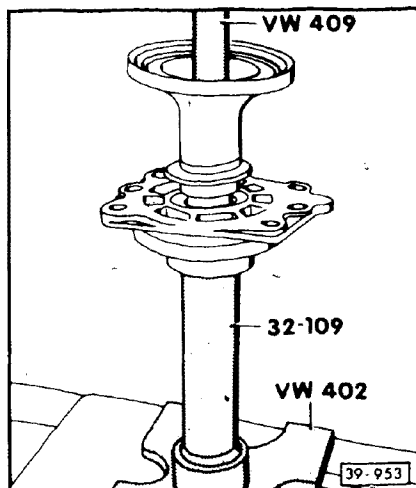
- install oil seal **B** with washer **A** onto drift **2005**
 - washer **A** part numbers:
 - 020 311 391 F**
 - 016 311 391 P** (1.05 thickness)
 - fill space between oil seal lips with multi-purpose grease
 - open-side of oil seal faces final drive

CAUTION

Part numbers are for reference only.. Always check with your Parts Department for latest information.



- drive oil seal in until seated
- remove drift and washer



- press flange in, with plastic washer
- install small circlip
- install sleeve by driving on with plastic hammer
 - if necessary, press on with punch **VW 407**
- install cover (with new O-ring) and flange; tighten
- install bracket onto final drive
- lift final drive carefully and bolt onto crossmember
- attach front parking brake cable and adjust parking brake, Repair Group 46
- add specified amount/type of oil
- install final drive cover
- bolt driveshaft on, aligning markings on driveshaft flange and rear final drive, section 39-160
- adjust driveshaft, section 39-170
- install exhaust system components, Repair Group 26

Note

When aligning the exhaust system, be sure that no parts are installed under tension.

Tightening torques

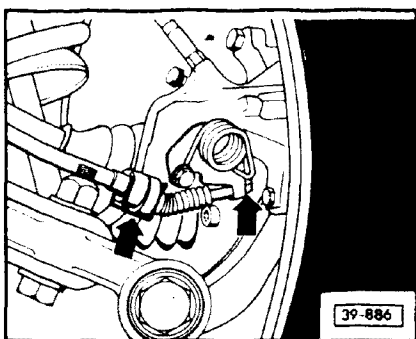
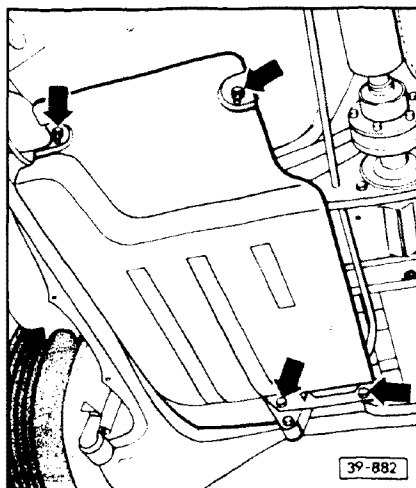
Cover to final drive	25 Nm (18 ft lb)
Crossmember to final drive	45 Nm (32 ft lb)
Driveshaft to final drive flange	55 Nm (41 ft lb)
• bolts are self-sealing • always replace bolts • clean drive flange threads with thread cutter	
Final drive bracket to final drive	25 Nm (18 ft lb)

Rear axle flange oil seals, replacing

(differential installed)

Right oil seal, replacing

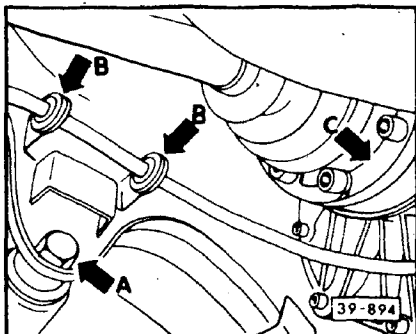
- remove cover (arrows) at fuel tank



- disconnect parking brake cable (arrows) from right caliper

CAUTION

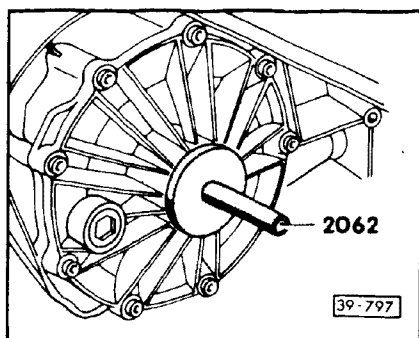
When detaching the parking brake cable, be careful not to damage the plastic cable shroud.



- disconnect trapezoidal arm from crossmember, and lower (arrow A)
- press parking brake cable out of bracket (arrow B)
- remove axle shaft, and lower (arrow C)
- remove axle flange bolt
 - while holding flange stationary with drift
- place drip tray underneath
- remove axle flange shaft by hand
 - if necessary, loosen with tire iron(s)

CAUTION

When prying out axle flange, do not damage collar on shaft housing.



- remove oil seal and discard
 - pry out with suitable-sized screwdriver
- clean seat for oil seal
 - do not use solvent
- drive in new oil seal until seated, using driver **2062**
 - pack space between oil seal lips with multi-purpose grease
 - open-side of oil seal faces final drive
- install axle flange
- replace gasket between axle shaft and axle flange
 - peel off film protecting gasket adhesive
- install axle shaft
- attach trapezoidal arm to crossmember
- connect parking brake cable at brake caliper and at fuel tank bracket
- install fuel tank cover
- add specified amount/type of oil to final drive

Tightening torques

Axle flange to final drive 10 Nm
(89 in. lb or 102 cm kg)
plus an additional 90°
(1/4 turn)

Axle shaft to axle flange

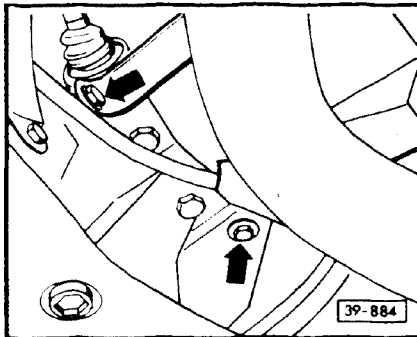
M8	45 Nm (32 ft lb)
M10	80 Nm (60 ft lb)

Trapezoidal arm to crossmember 85 Nm (63 ft lb)

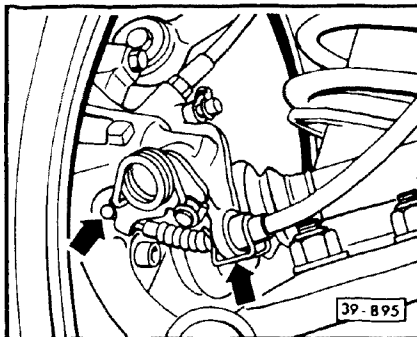
- replace self-locking nut

Left oil seal, replacing (differential installed)

- remove axle shaft cover plate (arrows)



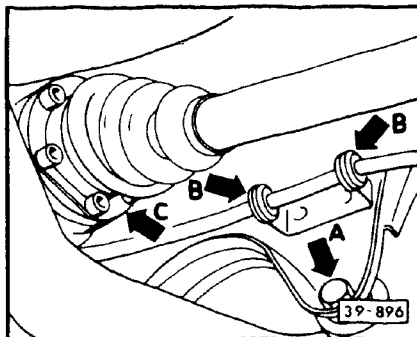
- disconnect parking brake cable (arrows) at brake caliper



CAUTION

When detaching the parking brake cable, do not damage the plastic cable shroud.

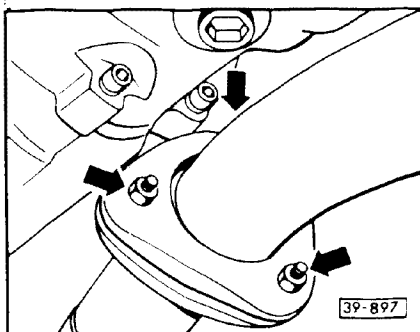
- disconnect trapezoidal arm from crossmember (arrow A), and lower
- detach parking brake cable from bracket (arrow B)
- place drip tray underneath
- unbolt axle flange (arrow C)



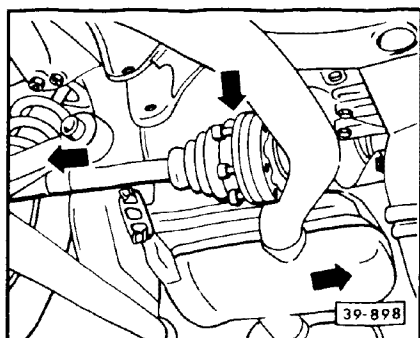
Note

Partially thread two bolts into flange, positioned opposite each other. Place suitable-sized thrust pads under bolts, between flange and housing. Turn bolts alternately and evenly, to press flange off.

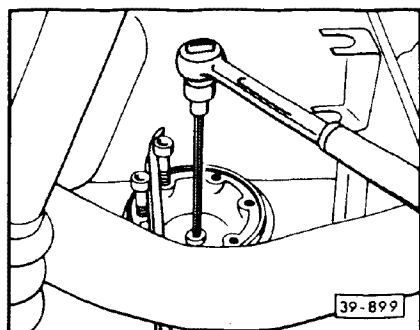
Differential — Manual Transmission 39



- loosen takedown pipe



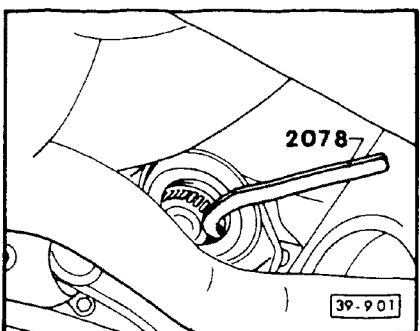
- position exhaust pipe to the right
- press trapezoidal arm to the left
- remove axle shaft from flange
- drain transmission oil



- loosen bolts on axle flange
- remove axle flange
 - pull against bolts that have been backed out

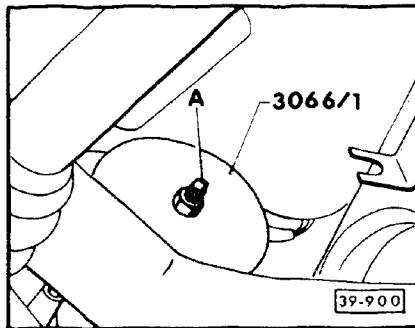
Note

Do not loosen adjustment shim between flange shaft and differential gear.



- remove oil seal and discard
 - pry out with 2078
- clean seat for oil seal
 - do not use solvent

Differential – Manual Transmission 39



- install threaded shaft **A** of seal installer **3066**, into differential gear
- place oil seal onto thrust washer **3066/1**, and tighten until seated, with hex head nut
 - pack space between seal lips with multi-purpose grease
 - open-side of oil seal faces final drive
- install flange shaft
- replace gasket between axle shaft and flange
 - peel off film that protects adhesive, and apply
- install axle shaft
- install trapezoidal arm at crossmember
- connect parking brake cable
- install axle shaft cover plate
- tighten takedown pipe

Note

When installing the exhaust system, align so that no parts are under tension.

- add specified quantity/type of oil to final drive

Tightening torques

Axle flange to final drive 10 Nm
(89 in. lb or 102 cm kg)
plus an additional 90°
(1/4 turn)

Axle shaft to axle flange

M8 45 Nm (32 ft lb)

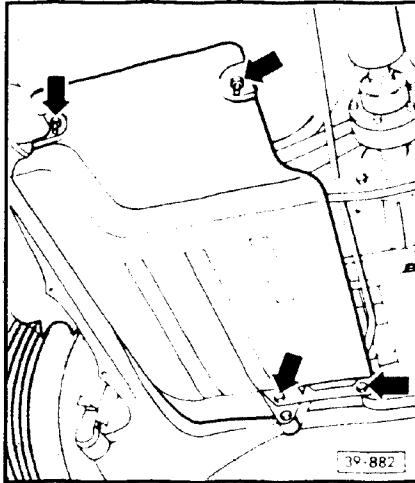
M10 80 Nm (60 ft lb)

Trapezoidal arms to crossmember 85 Nm (63 ft lb)

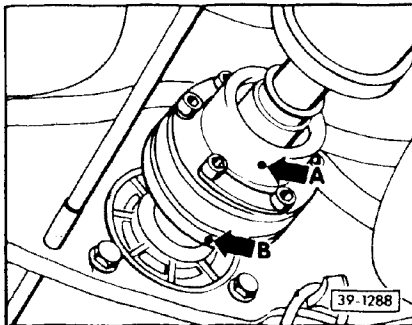
- replace self-locking nuts

Rear final drive, removing/installing

Removing



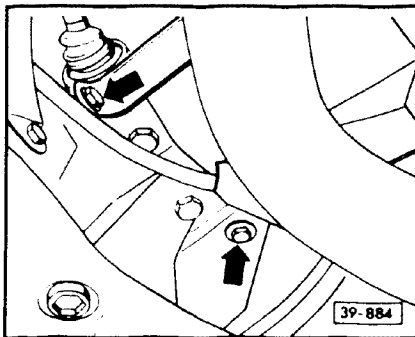
- remove cover plate (arrows)
- engage differential lock, and block wheel



- mark rear driveshaft flange **A** and final drive flange **B**, for realignment
 - if not previously marked at point of greatest imbalance (determined during Production)
- remove driveshaft mounting bolts (arrow) at final drive
 - raise driveshaft upward and tie into position

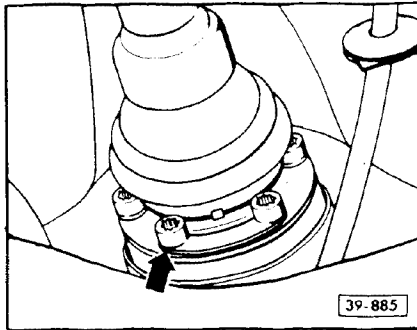
CAUTION

Position driveshaft only high enough for removing final drive, to prevent damage to driveshaft universal joint.

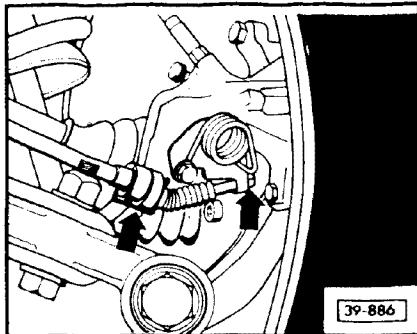


- remove left axle shaft cover plate (arrows)

Differential — Manual Transmission 39



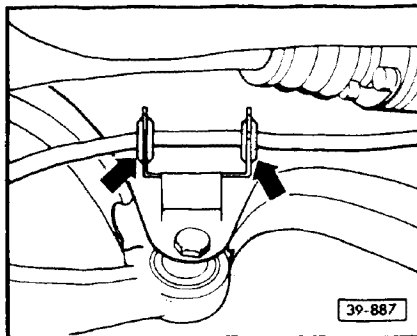
- unbolt (**arrow**) both left/right axle shafts, position aside, and tie up



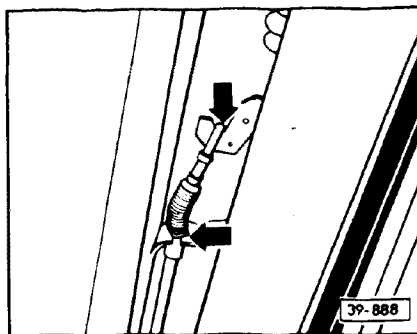
- disconnect parking brake cable from left/right brake calipers (**arrows**)

CAUTION

When disconnecting the parking brake cables, do not damage the plastic cable shrouds.

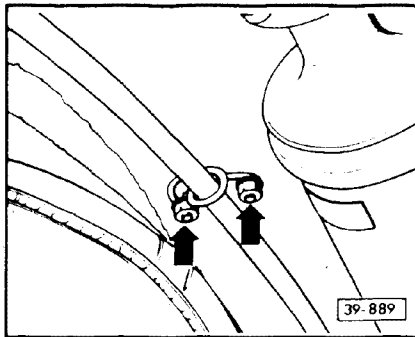


- disconnect parking brake cable from rubber grommets (**arrow**)

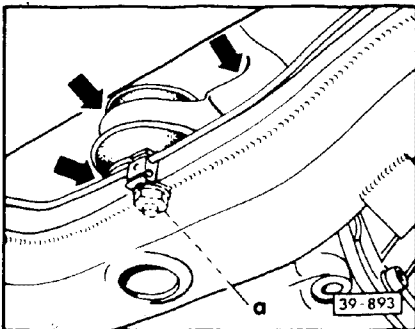


- disconnect parking brake cable at front (**arrows**)

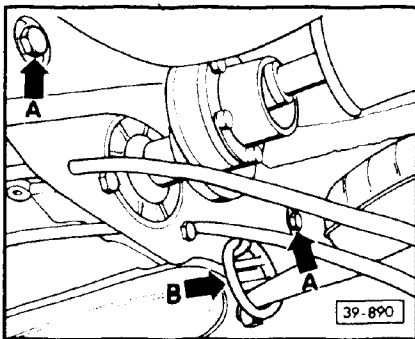
Differential — Manual Transmission 39



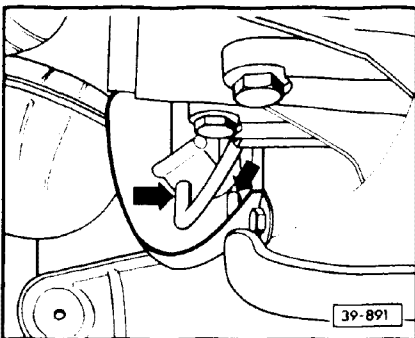
- remove parking brake cable retainer (**arrows**) on left, after loosening heat shield
- support final drive with transmission jack and **VAG 1383**
 - use small adaptor
 - strap final drive securely to jack



- detach rear mounting
 - loosen bolt **a**
 - remove three bolts (**arrows**)

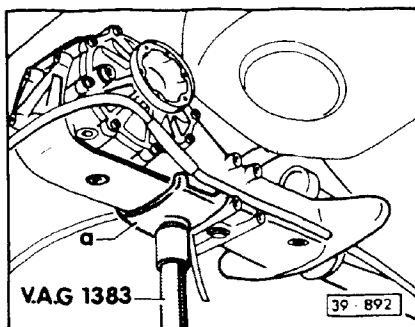


- disconnect crossmember at **arrow A**
- unhook exhaust pipe (**arrow B**)
- lower final drive slightly



- disconnect vacuum hoses (**arrows**) and remove from bracket with rubber guides
- disconnect wire connector for differential lock indicator light
- lower final drive carefully
 - **a** = adaptor

Differential — Manual Transmission 39

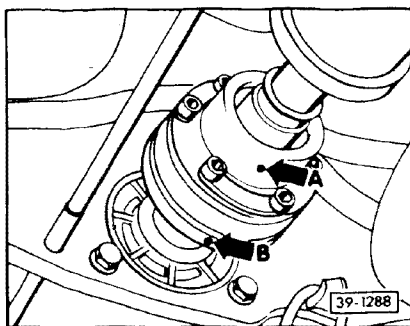


Installing

Note

Install in the reverse order of removal, noting the following:

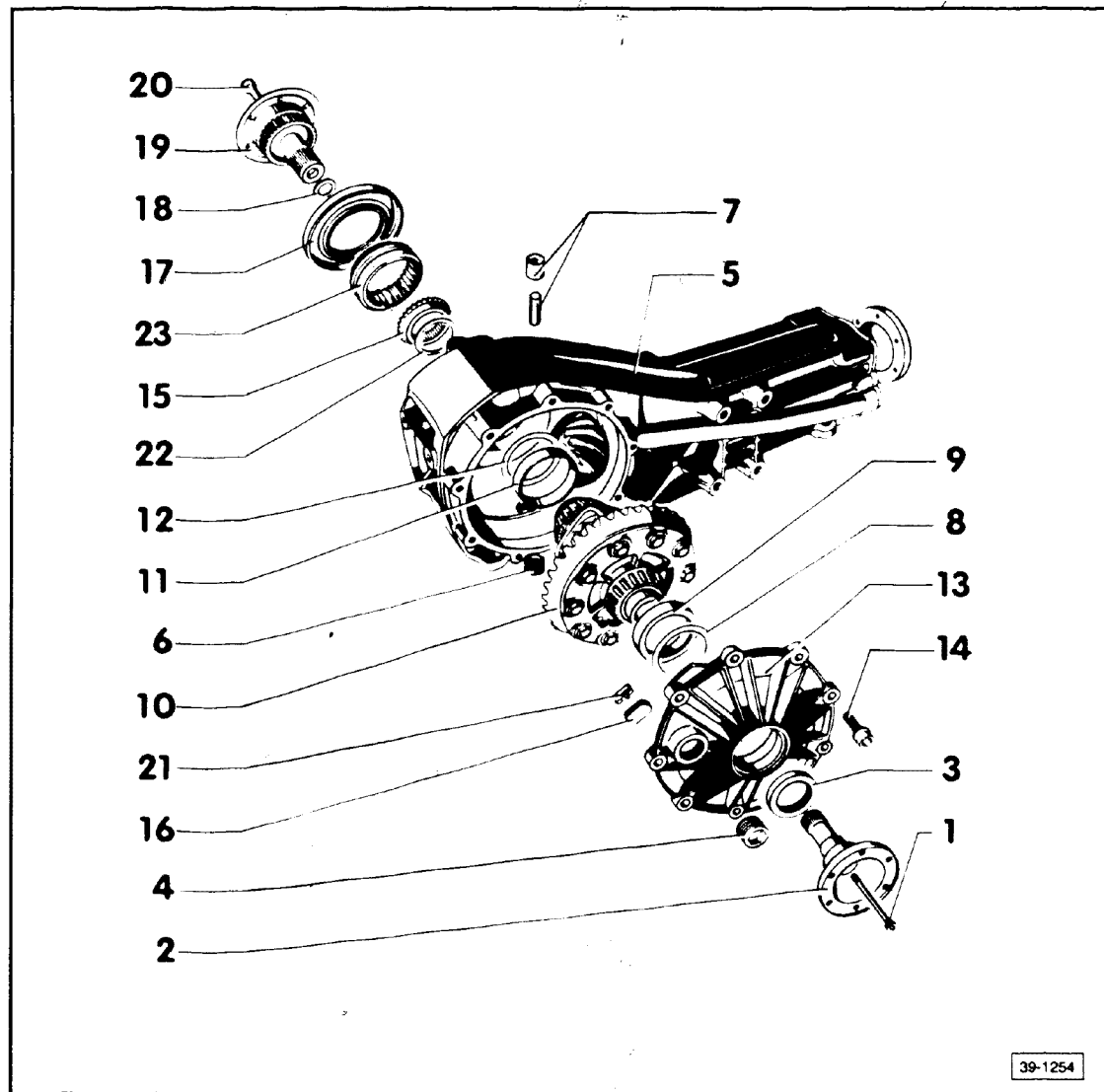
- replace self-locking nuts
- differential lock hoses are color coded. See Repair Group 34 for identification



- align markings on driveshaft (made either before disassembly or during Production), with markings on final drive
- fill transmission final drive with specified quantity/type of oil

Tightening torques

Final drive bracket to final drive	25 Nm (18 ft lb)
Crossmember to body	45 Nm (32 ft lb)
Axle shaft to final drive	
M8 bolts	45 Nm (32 ft lb)
M10 bolts	80 Nm (60 ft lb)
Driveshaft to final drive	55 Nm (40 ft lb)
• bolts are self-sealing; always replace	
• clean threads thoroughly in drive flange, using thread cutter	
Exhaust system support to crossmember	55 Nm (40 ft lb)



Note

When parts marked with an asterisk (*) are replaced, adjustment is required. See Adjustment Overview (part II), section 39-320.

Prior to disassembly, secure final drive in a repair stand, section 39-280.

1 — 10 Nm (89 in. lb or 102 cm kg)
plus an additional 1/4 turn (90°)

2 — Axle flange

3 — Oil seal
pry out with lever; drive in until seated using 2062

4 — Oil filler plug — 25 Nm (18 ft lb)

*5 — Final drive housing (see Note)
with pinion assembly, section 39-270

6 — Oil drain plug — 25 Nm (18 ft lb)

7 — Breather
installed position, section 39-250

8 — Shim S1
• note thickness
• see Adjustment Overview (part II), section 39-320

*9 — Outer race of tapered roller bearing (see Note)
removing/installing, section 39-300

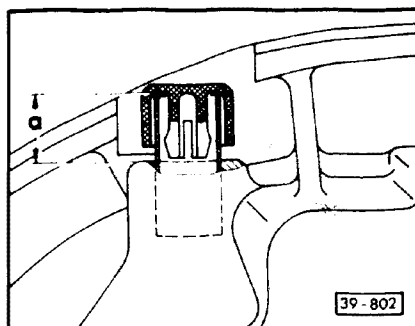
Differential — Manual Transmission **39**

- 10 — **Torsen differential**
disassembly/assembly, section 39-290
- *11 — **Outer race of tapered roller bearing** (see Note)
removing/installing, section 39-300
- 12 — **Shim S2**
 - note thickness
 - see Adjustment Overview (part II), section 39-320
- *13 — **Final drive cover** (see Note)
 - seal, with **AMV 188 000 02**
 - installed position: magnet faces downward
- 14 — **25 Nm (18 ft lb)**
- 15 — **Differential lock clutch body**
installed position, section 39-250
- 16 — **Magnet**
installed position, section 39-250
- 17 — **Seal**
removing/installing, section 39-220
- 18 — **Shim for drive flange**
 - note thickness
 - see Adjustment Overview (part II), section 39-320
- 19 — **Axle flange**
adjusting, section 39-260
- 20 — **10 Nm (89 in. lb or 102 cm kg)**
plus an additional 1/4 turn (90°)
- 21 — **Magnet clip**
 - always replace
 - installed position, section 39-250
- 22 — **Shim**
 - for adjusting clutch body
 - determining thickness, section 39-250
- 23 — **Synchronizer sleeve**

Rear final drive housing, disassembling/assembling

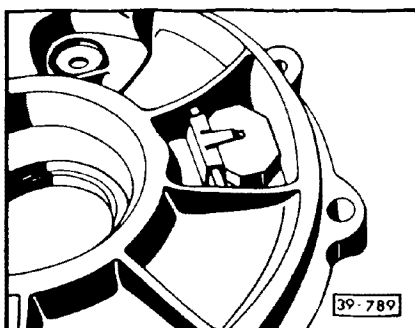
Breather sleeve, installed position

a— 13 mm (0.51 in.)



Magnet, installed position

- always replace clip when installing magnet

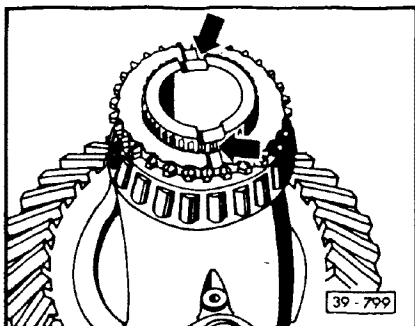


Clutch body, installing

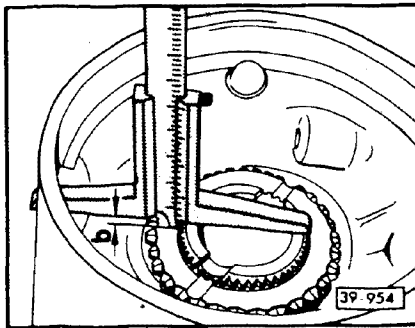
Note

Differential gear in illustration 39-799 was removed for photographic purposes.

- align oil supply grooves in clutch body and differential



Differential – Manual Transmission 39



Clutch body adjustment shim, determining thickness

- measure dimension **b** and select shim from table

Dimension b	Thickness (mm)	Part no.
-4.10	—	no washer
4.11-4.40	0.3	005 409 737
4.41-4.70	0.6	005 409 737 A
4.71-4.90	0.9	005 409 737 B

CAUTION

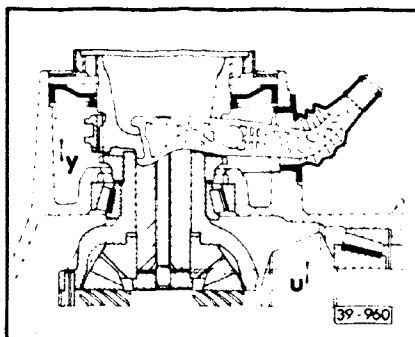
Part numbers are for reference only. Always check with your Parts Department for latest information.

Axle flange, adjusting

Note

The axle flange must be adjusted if any of the following parts are replaced:

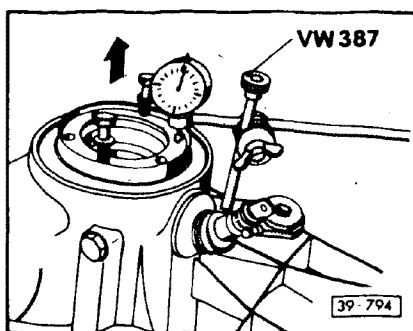
- axle flange
- differential housing
- differential pinion gears



The purpose of the adjustment is to obtain an end play of $Y = 0.2 - 0.5 \text{ mm}$ ($0.008 - 0.020 \text{ in.}$) between the flange and differential housing. This adjustment is important to ensure smooth shifting and low wear.

Shim u thickness, determining

- install flange along with original shims, and tighten bolts



- measure gap Y between flange and differential housing
- end play should be $0.2 - 0.5 \text{ mm}$ ($0.008 - 0.020 \text{ in.}$)
 - if there is too little end play, use a thicker adjustment shim
 - if there is too much end play, use a thinner adjustment shim

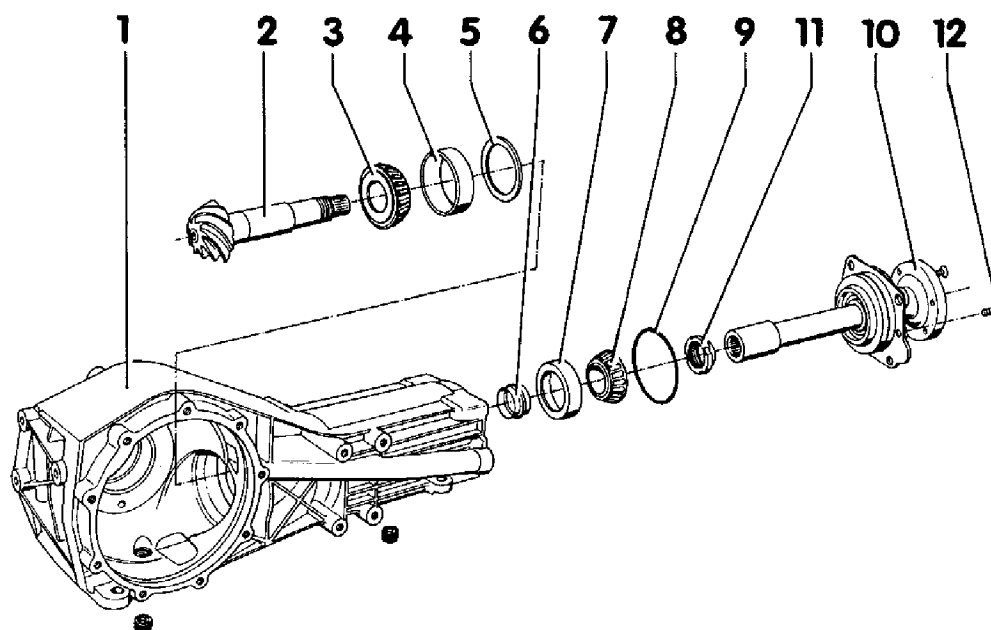
Note

The following adjustment shims are available:

Thickness (mm)	Part no.
0.3	183 525 293
0.6	183 525 293 A
0.9	183 525 293 B

CAUTION

Part numbers are for reference only. Always check with your Parts Department for latest information.



Note

When parts marked with an asterisk (*) are replaced, adjustments are required. See Adjustment Overview, section 39-320.

Replace both taper roller bearings of the pinion together. Use parts from the same manufacturer, if possible.

39-914

- | | |
|---|---|
| <p>*1 — Final drive housing (see Note)
mount housing to repair stand, section 39-280</p> <p>*2 — Pinion (see Note)
matched with ring gear, as a set</p> <p>*3 — Large taper roller bearing, inner race (see Note)
removing/installing, section 39-280</p> <p>*4 — Large taper roller bearing, outer race (see Note)
removing/installing, section 39-280</p> <p>5 — Shim S3
• note thickness
• Adjustment Overview, section 39-320</p> <p>6 — Spacer sleeve
always replace</p> | <p>*7 — Small taper roller bearing, outer race (see Note)
removing/installing, section 39-280</p> <p>*8 — Small taper roller bearing, inner race (see Note)
removing/installing, section 39-280</p> <p>9 — Seal</p> <p>10 — Drive flange shaft/cover</p> <p>11 — Pinion nut
• pry off circlip before removing
• removing/installing, section 39-280
• measuring turning torque, section 39-280
• securing, section 39-280</p> <p>12 — 25 Nm (18 ft lb)</p> |
|---|---|

All Wheel Drive 016

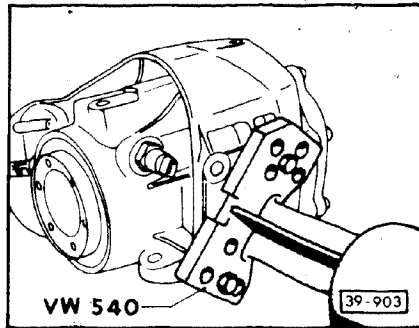
Rear final drive pinion assembly

39-270-1

Differential — Manual Transmission 39

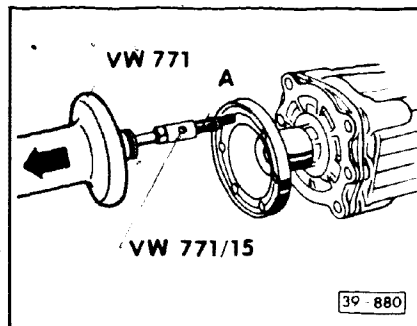
Rear final drive, disassembling/assembling pinion

Rear final drive, mounting to repair stand



Rear final drive cover, removing

A — two-size threaded pin, M8/M10,
Part No. 113 101 399 B

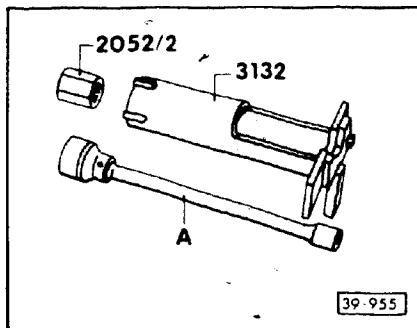


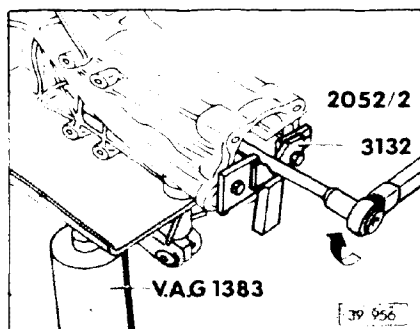
CAUTION

Part numbers are for reference only. Always check with your Parts Department for latest information.

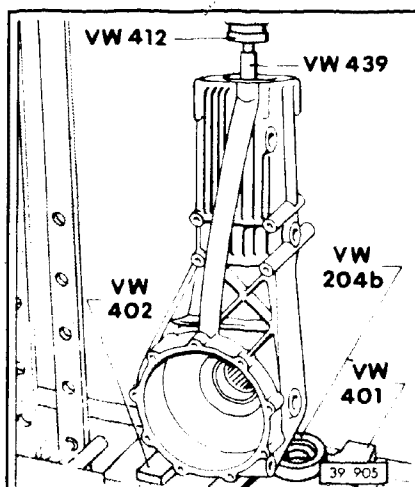
Pinion nut, loosening

A — extension and 32 mm socket



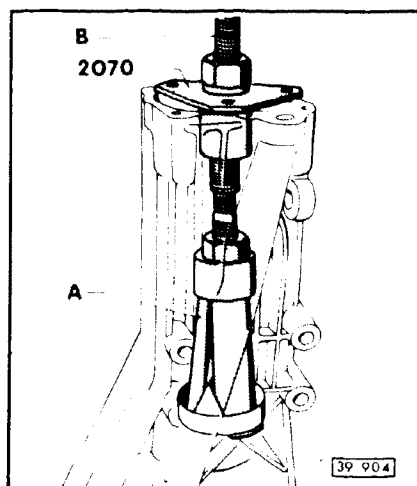


- support rear final drive as shown, to prevent damage to threads in housing



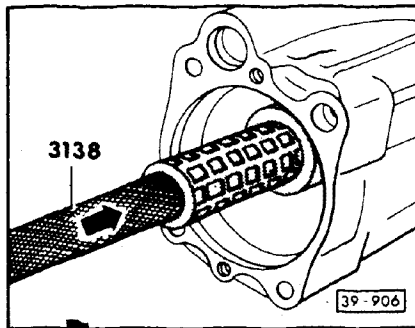
Bearing, removing

- press out of pinion

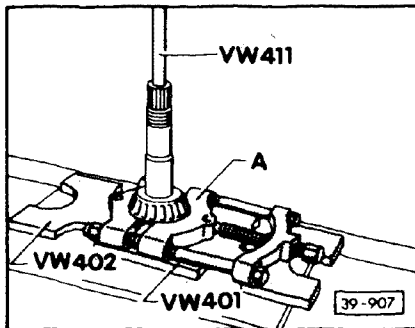


Small pinion bearing outer race, removing

- A — 46-56 mm commercial extractor, e.g. U.S. 1037 (Kukko 21/7)
- B — spindle of Kukko 22/1 puller

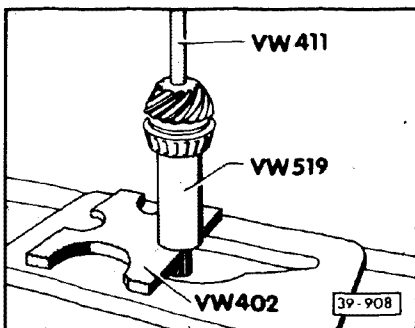


Large pinion bearing outer race, removing



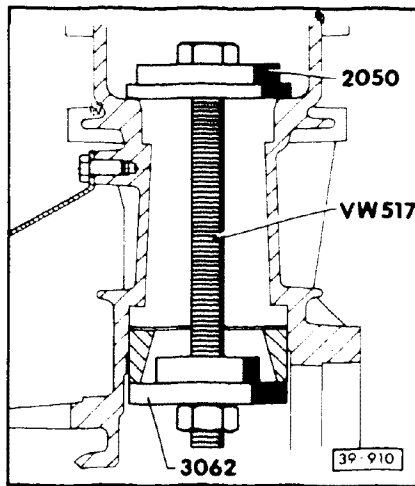
Large pinion bearing inner race, removing

A – separator, e.g. Kukko 17/2 (22-115 mm)



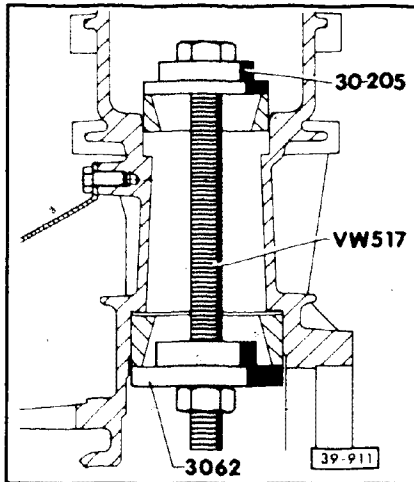
Large pinion bearing, installing

- heat bearing to approximately 120°C (248°F) before pressing on

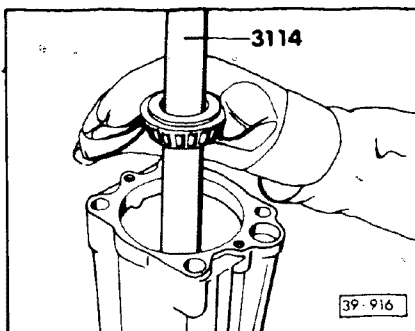


Large pinion bearing outer race, installing

- place required shim thickness behind race **before** installing



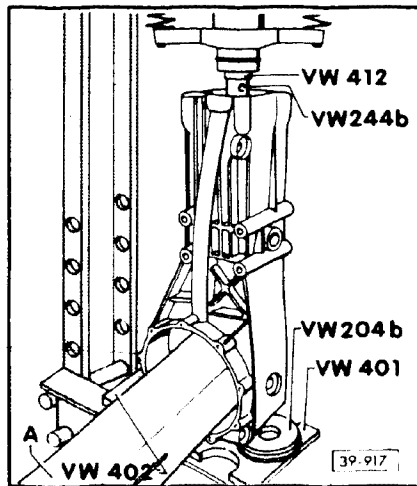
Small pinion bearing outer race, installing



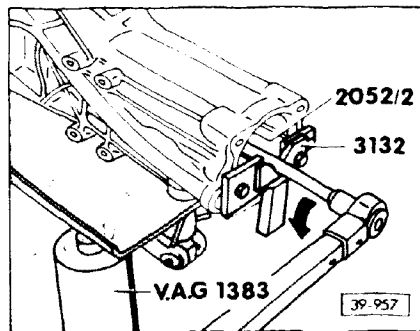
Small pinion bearing inner race, installing

- install pinion and new spacer first
- heat bearing to approximately 120°C (248°F)
- press pinion up and center rod 3114 on pinion
- install bearing

Differential — Manual Transmission 39

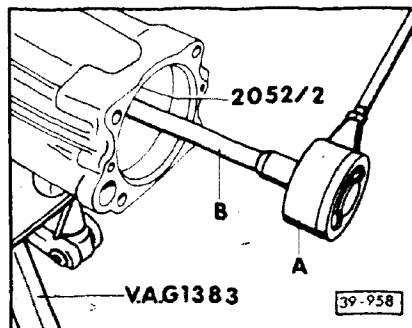


A — piece of wood to support pinion



Pinion nut, tightening

- support rear final drive as shown, to prevent damage to threads in housing



Turning torque, measuring

- A — commercial torque gauge, 0-600 Ncm (0-54 in. lb)
- B — extension with 32 mm socket

CAUTION

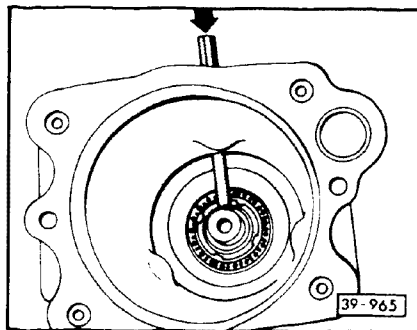
Tighten pinion nut a little at a time, and read turning torque frequently. If turning torque exceeds specifications, the spacer will have to be replaced and the adjustment repeated. Once the spacer has been compressed, it cannot be used again.

Differential – Manual Transmission 39

Turning torque specifications

New bearings	Used bearings*
250-320 Ncm (25-28 in. lb)	30-60 Ncm (2.7-5.3 in. lb)

* Bearings with at least 50 km (31 miles) service

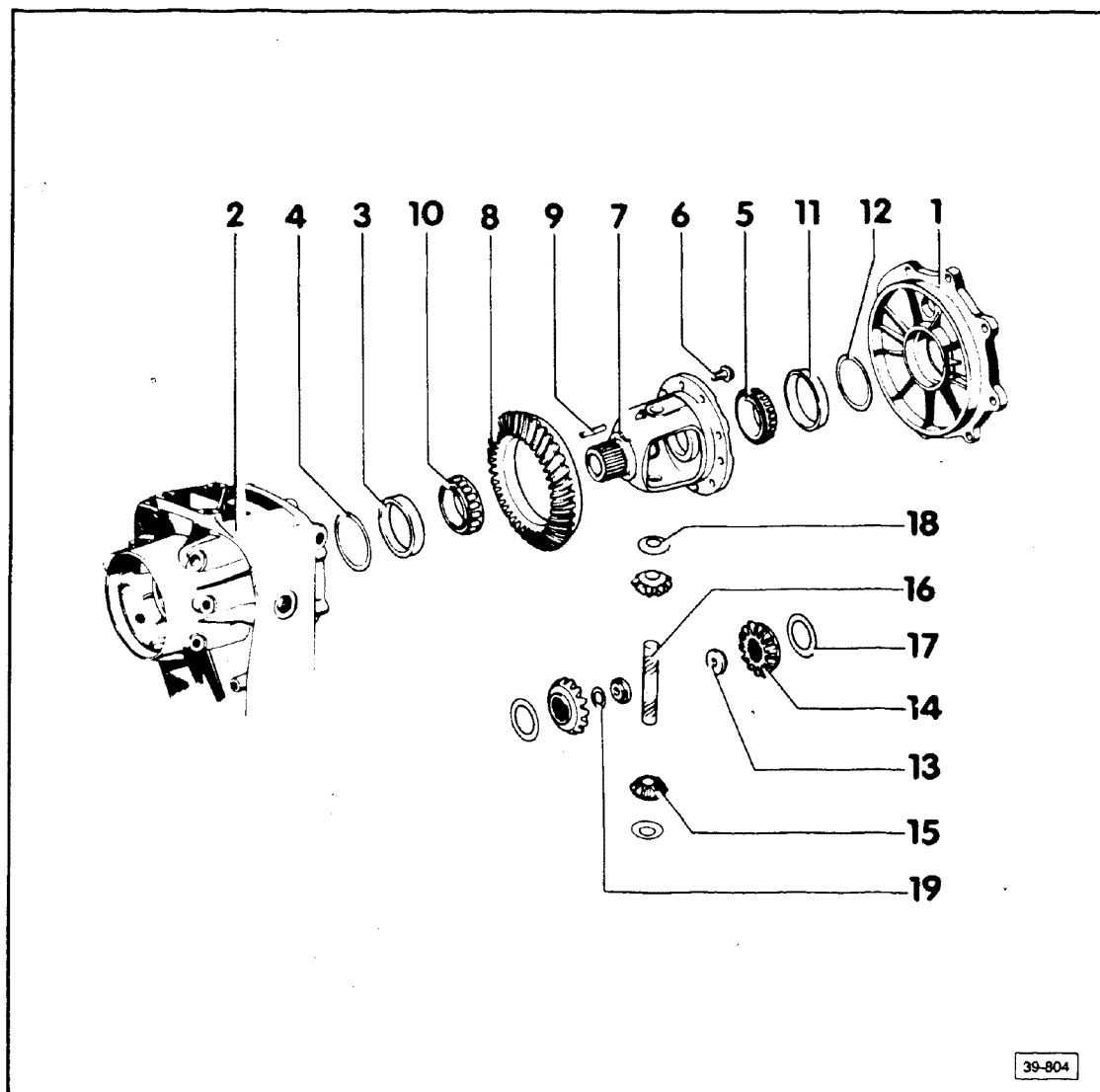


Pinion nut, securing

- insert drift through oil drain hole and crimp nut

THIS FRAME INTENTIONALLY LEFT

BLANK



Note

When parts marked with an asterisk (*) are replaced, adjustments are required. See Adjustment Overview (part II), section 39-320.

Replace both differential taper roller bearings together. Use parts from the same manufacturer, if possible.

*1 — Final drive cover (see Note)

*2 — Final drive housing (see Note)

*3 — Outer race (see Note)

- of taper roller bearing
- removing/installing, section 39-300

4 — Shim S1

- note thickness
- see Adjustment Overview (part II), section 39-320

*5 — Inner race (see Note)

- of taper roller bearing
- removing/installing, section 39-300

6 — Ring gear bolt

- only use bolts of correct specification
- tighten slightly, then continue tightening to 90 Nm (66 ft lb), in diagonal sequence

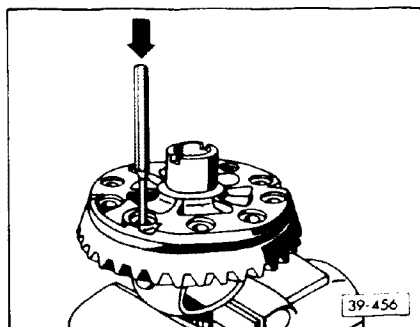
*7 — Differential housing (see Note)

Differential — Manual Transmission **39**

- *8 — **Ring gear** (see Note)
 - matched with pinion, as a set
 - removing/installing, section 39-300
- 9 — **Roll pin**
 - drive in flush
- *10 — **Inner race** (see Note)
 - of tapered roller bearing
 - removing/installing, section 39-300
- *11 — **Outer race** (see Note)
 - of tapered roller bearing
 - removing/installing, section 39-300
- 12 — **Shim S2**
 - note thickness
 - see Adjustment Overview, section 39-320
- 13 — **Axle flange nut**
- 14 — **Differential side gears**
 - adjusting, section 39-300
- 15 — **Differential pinion gears**
 - installing, section 39-300
- 16 — **Differential pinion shaft**
 - drive out using drift
 - drive in carefully, so that thrust washers are not damaged
 - drive roll pin in flush, to secure shaft
- 17 — **Shims**
 - determining thickness, section 39-300
- 18 — **Thrust washer**
 - check for cracks and nicks
- 19 — **Axle flange shaft shim**
 - determining thickness, section 39-300

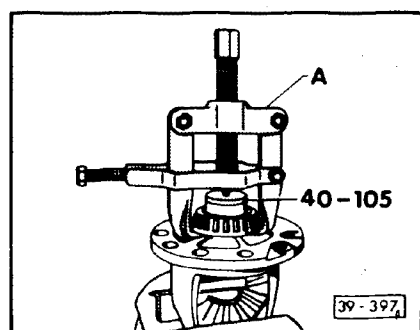
Rear final drive, disassembling/assembling differential

Ring gear, removing



Large bearing inner race, removing

A – two-arm puller (commercial),
e.g. Kukko 204/2



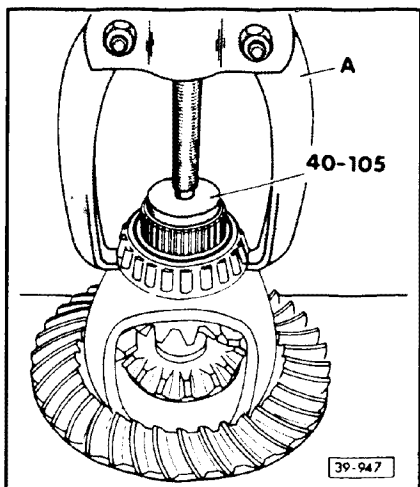
CAUTION

Always **replace** bearing if removed.

Small bearing inner race, removing

- before installing puller A, place thrust piece 40-105 on housing

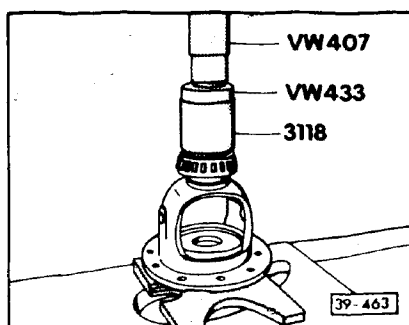
A – two-arm puller (commercial), e.g.
Kukko 44/2



CAUTION

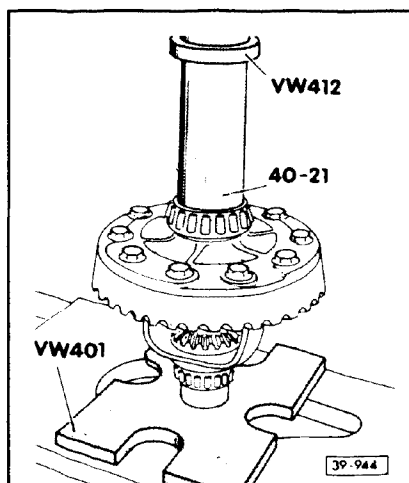
Always **replace** bearing if removed.

Differential – Manual Transmission 39



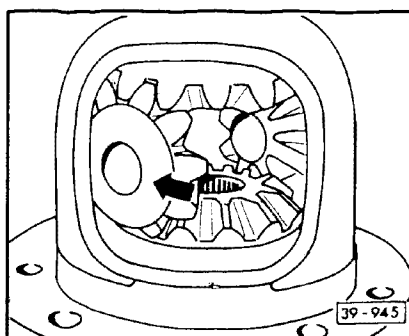
Small bearing inner race, installing

- heat bearing to approximately 100°C (212°F) and press on



Large bearing inner race, installing

- heat bearing to approximately 100°C (212°F) and press on

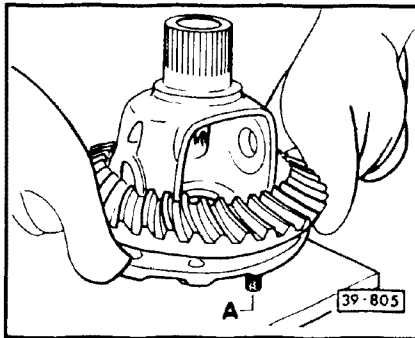


Differential gears, installing

Note

Coat parts with hypoid transmission oil before installation.

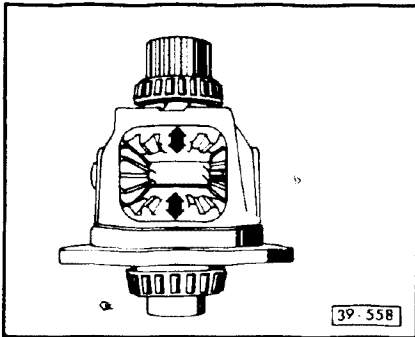
- insert differential side gears with correct adjustment shims
- insert differential pinion gears approximately 180° apart
 - coat thrust washers lightly with grease
- rotate gears into position (arrow)
- insert axle flange nuts
- align thrust washers
- drive in differential pinion shaft
- drive roll pin in flush, to secure pinion shaft



Ring gear, installing

- heat ring gear to approximately 100°C (212°F) and install

A — centering pin (make in-shop)



Differential pinion gears, adjusting

- insert side gears with thinnest shims (0.5 mm or 0.020 in.)
- insert pinion gears with thrust washers, and drive in differential pinion shaft

CAUTION

Do not interchange differential pinion gears and thrust washers after this point in the procedure.

- hold pinion gears outward and check clearance of side gears by hand (**arrows**)
- adjust clearance by changing adjustment shims so maximum clearance is 0.10 mm (0.004 in.)

Note

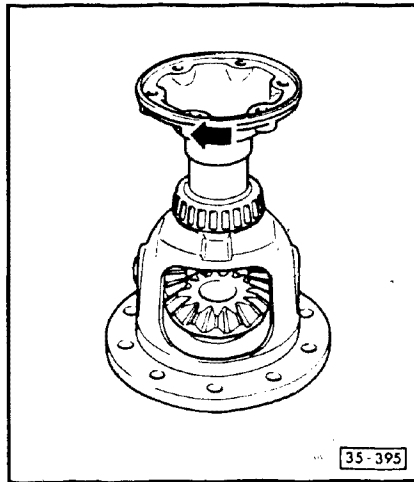
The clearance is correct if you feel no play, and the differential pinion gears can be turned slightly without catching.

The following adjustment shims are available:

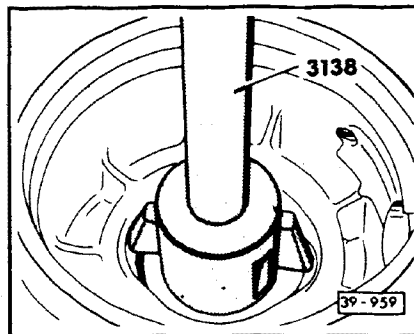
Thickness (mm)	Part no.
0.5	011 519 215
0.6	088 409 249
0.7	088 409 249 A
0.8	088 409 249 B
0.9	008 409 249 C
1.0	088 409 249 D

CAUTION

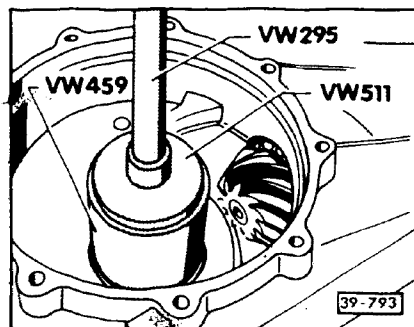
Part numbers are for reference only. Always check with your Parts Department for latest information.



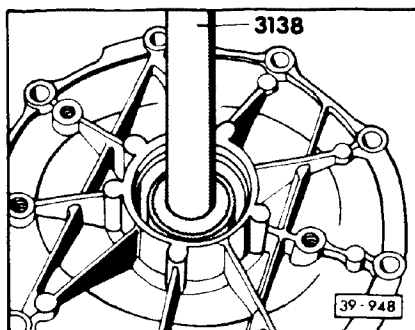
Differential pinion gears, turning



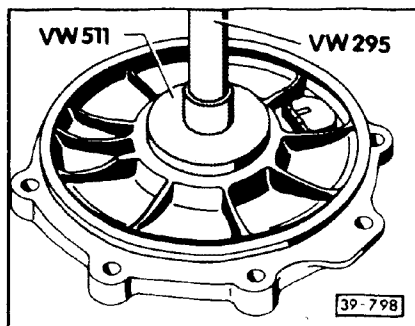
Large bearing outer race, removing from housing



Large bearing outer race, installing in housing



Small bearing outer race, removing from cover



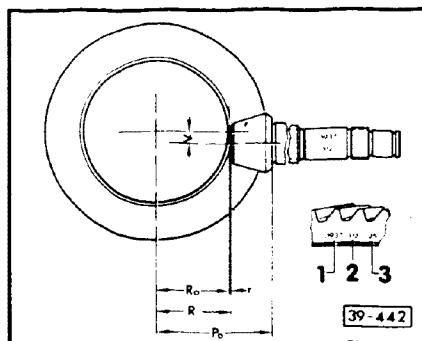
Small bearing outer race, installing in cover

Ring gear/pinion, adjusting

General notes

Careful adjustment of the ring gear and pinion is important to ensure that the final drive runs quietly and has a long service life. During manufacture, the ring gear and pinion are a matched set and are run on special testing machines to ensure a correct mesh pattern and silent running in both directions. The quietest running position is determined by moving the pinion axially and lifting the ring gear away from the no-play meshing position, maintaining the backlash within specified tolerance.

The pinion deviation r from the master gauge R_0 is measured for the ring gear/pinion sets supplied as replacement parts. A value for r is marked on the outer face of each ring gear. Ring gear and pinion must always be replaced as a matched set.



Replacement parts, identifying

- 1— The code **0937** identifies an Oerlikon gear set with a 9:37 ratio.
- 2— A matching number (e.g. **312**) is stamped on both the ring gear and pinion, to identify a set.
- 3— Pinion deviation r is measured against the master gauge of the testing machine used in Production.
 - deviation r is always given in 1/100 mm.

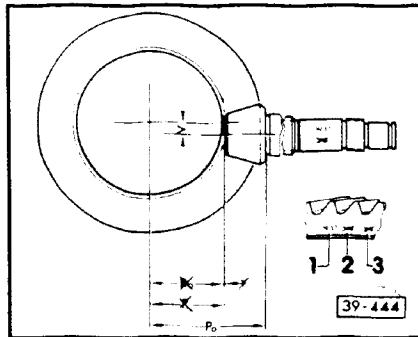
Example

"25" means $r = 0.25$ mm

R_0 —Length of master gauge used in production = 53.15 mm

R — Actual dimension found between ring gear center and end face of pinion, while at quietest running position of a particular gear set

V_0 —Hypoid offset = 35 mm



Standard-production gear sets

X— Codes shown X'd out, are not marked for production gears.

P_o—The measurement used for setting ring gears and pinions in Production.

CAUTION

The position of the pinion in production is determined by the dimension **P_o** (ring gear centerline to back of pinion head). The marking of deviation **r** on the ring gear, and the matching number, have been eliminated. It is therefore necessary to measure the position of the pinion before removing it, when parts that affect the position of the pinion are to be replaced. See Adjustment Overview (part II), section 39-320.

Adjustment overview (part II)

Note

When assembling the final drive, it is only necessary to adjust the ring gear or pinion, or both, if parts have been replaced which directly affect the final drive setting. Use the following table to avoid carrying out unnecessary adjustments:

Replaced part	To be adjusted	Ring gear (S1 + S2)	Pinion (S3) using deviation r	Pinion (S3) using actual measurement	Axle flange
		Section 39-370	Section 39-360	Section 39-330	Section 39-260
Final drive housing		X		X	
Differential gear housing		X			X
Pinion bearings				X	
Differential bearings		X			
Ring gear and pinion		X	X		
Final drive cover		X			
Flange shaft					X
Differential pinion gears					X

Pinion, determining position (by actual measurement)

Note

This operation is only necessary if deviation r (section 39-300) is not marked on the ring gear, and if both pinion bearings and/or the final drive housing have to be replaced. (These parts directly affect the position of the pinion.)

- remove differential gear
- assemble measuring bar (see section 39-360)
- install measuring bar into housing

- measure deviation from R_0 (read maximum deflection in red number range)
 - reading corresponds to deviation r
- record measurement

Note

After replacing pinion bearings or housing, or both, adjust pinion, section 39-360. The measurement recorded for deviation r is used to determine the thickness of shim **S3**.

Ring gear/pinion, adjusting

Note

When pinion and ring gear have to be adjusted, follow the sequence below:

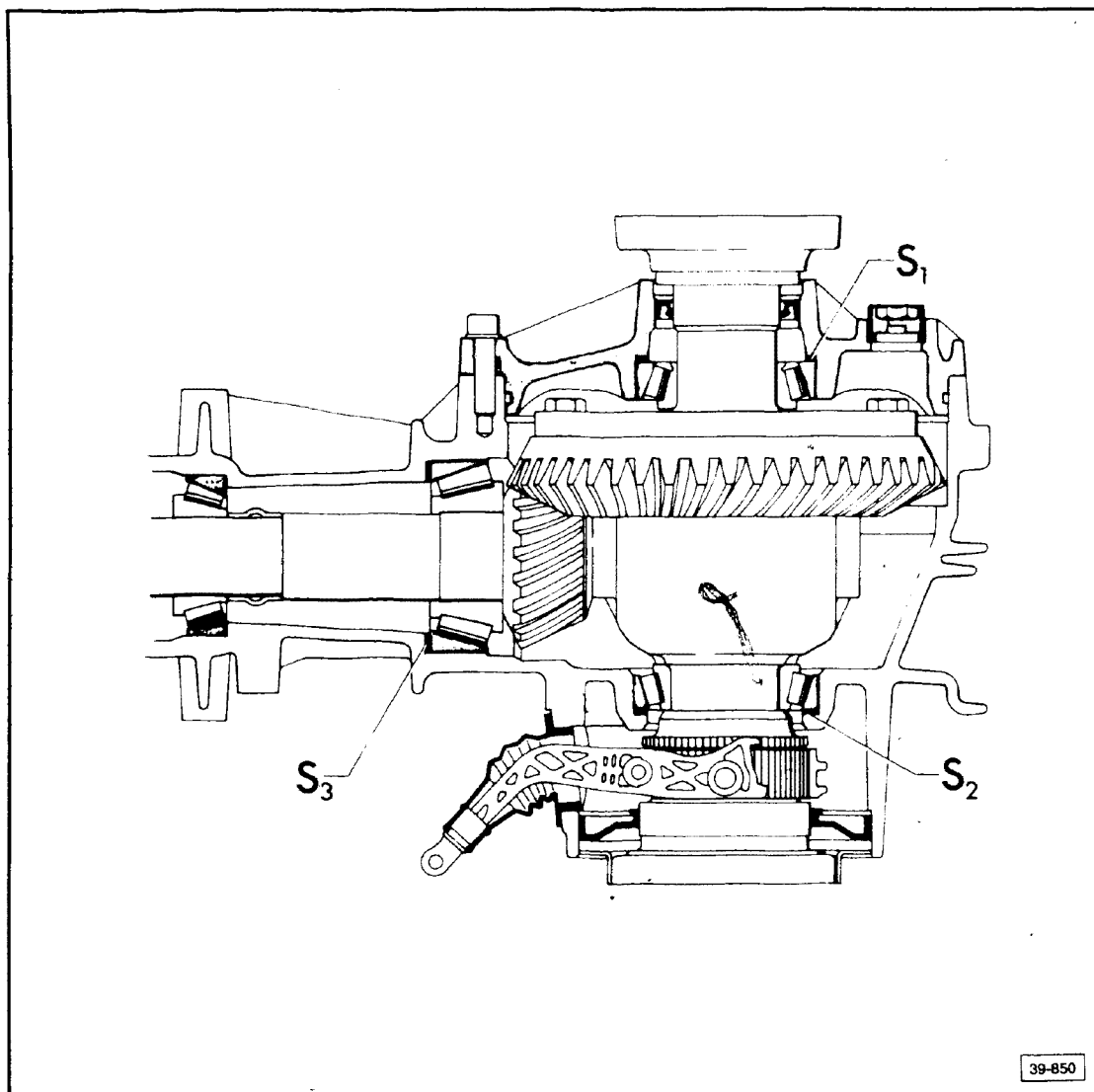
- determine total shim thickness ($S_{\text{total}} = S1 + S2$) needed to provide specified preload of differential bearings
- determine **S3** shim thickness needed to install pinion in the position determined in production
- distribute total shim thickness (S_{total}) between **S1** and **S2** to obtain specified backlash between ring gear and pinion

Note

The objective in ring gear/pinion adjustment is to attain the same quiet running position that was determined on the test machine used in production.

CAUTION

All assembly operations and measurements require great care and absolute cleanliness to produce accurate results.



- S1 = Shim behind ring gear
- S2 = Shim opposite ring gear
- S3 = Shim behind pinion head

Pinion, adjusting

(output shaft, adjusting)

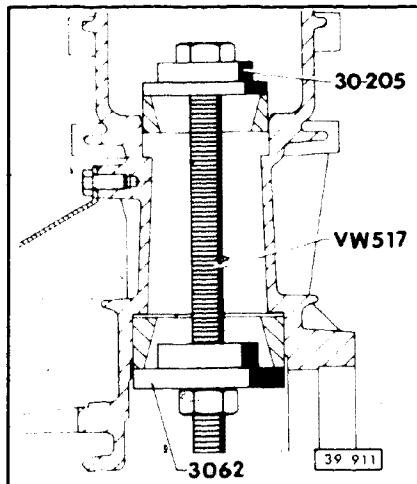
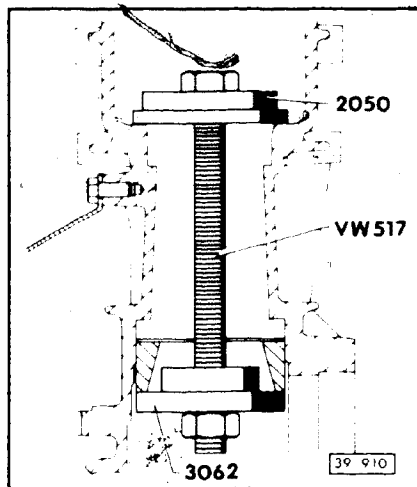
Note

It is only necessary to readjust the pinion as shown below when the ring gear/pinion set is replaced.

If other parts which affect the position of the pinion are replaced, reset the pinion to its original position, section 39-330.

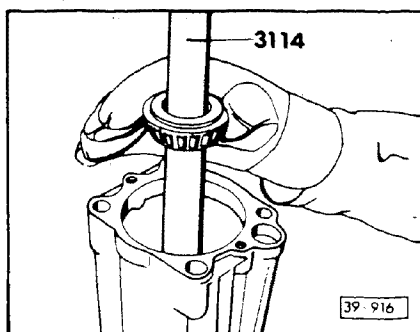
See Adjustment Overview (part II), section 39-320.

- mount final drive to holding fixture
- install large bearing outer race into housing, **without** shims

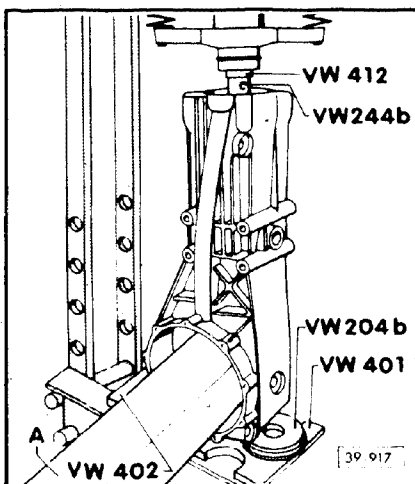


- install small bearing outer race into housing

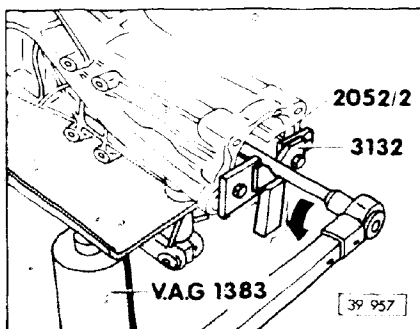
Differential – Manual Transmission 39



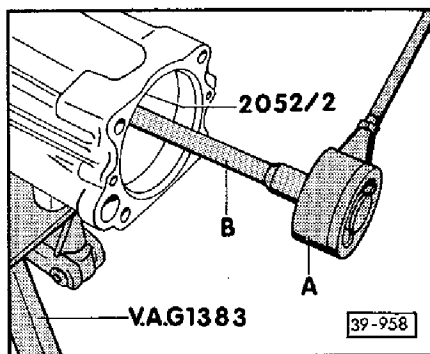
- insert pinion
- heat small bearing inner race to approximately 120°C (248°F) and slide onto pinion without spacer



- press small bearing inner race onto pinion
- A – piece of wood to support pinion

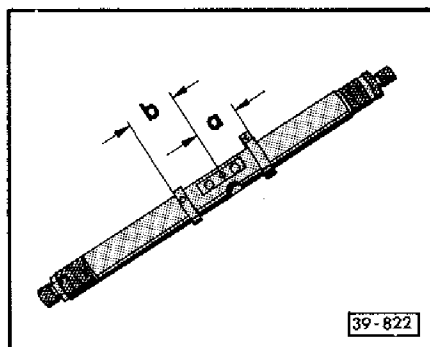


- tighten pinion nut until turning torque equals 280-320 Ncm (25-28 in. lb)



A— commercial torque gauge, 0-600 Ncm
(0-54 in. lb)

B— extension with 32 mm socket

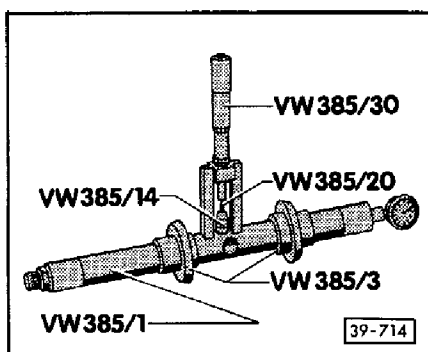


- set centering ring of universal measuring bar VW 385/1 to:

- a = 60 mm

- set sliding ring to:

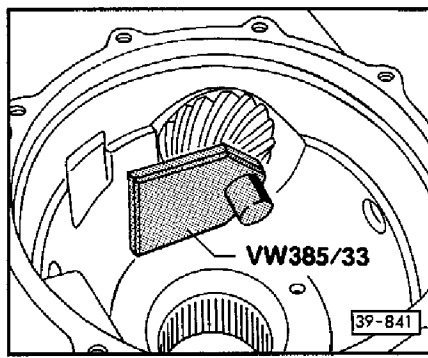
- b = 50 mm



- assemble universal measuring bar as shown
- dial indicator extension VW 385/20 = 3 mm long

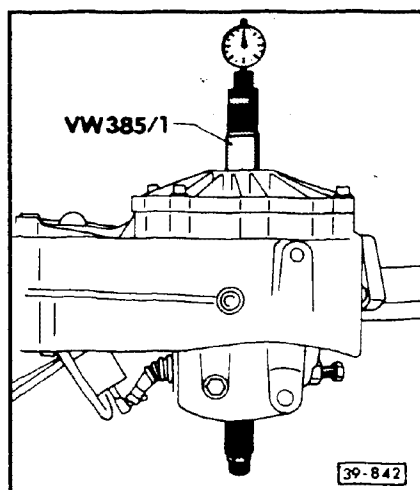
- set adjustable master gauge VW 385/30 to:
- $R_o = 53.15$ mm

- place master gauge on measuring bar and set dial indicator to 0 with 3 mm preload



- mount end plate VW 385/33 on pinion end face
- remove master gauge VW 385/30 and install measuring bar in housing
- install final drive cover and tighten four bolts
- pull 2nd centering ring outward until measuring bar can just be turned by hand

Differential — Manual Transmission 39



Dimension e, measuring

- turn measuring bar until dial indicator pin contacts end face of pinion and indicates maximum deflection (return point)
 - measured reading is dimension "e" (red number range)

Example

$$e = 1.60 \text{ mm}$$

CAUTION

When the measuring bar has been removed, check that dial indicator zeros with a 3 mm preload when master gauge **VW 385/30** is mounted. If not, repeat measurement.

S3 shim, determining thickness

$$S3 = e + r$$

- e — dial indicator reading (maximum deflection)
- r — deviation (marked on ring gear in 1/100 mm or determined by actual measurement)

Example

Dial indicator reading e	1.60 mm
Deviation r	+ 0.42 mm
Shim thickness S3	= 1.18 mm

Differential — Manual Transmission 39

The following shims are available:

Thickness (mm)	Part number
0.95	183 525 231
1.00	183 525 231 A
1.05	183 525 231 B
1.10	183 525 231 C
1.15	183 525 231 D
1.20	183 525 231 E
1.25	183 525 231 F
1.30	183 525 231 G
1.35	183 525 231 H
1.40	183 525 231 J
1.45	183 525 231 K
1.50	183 525 231 L
1.55	183 525 231 M

CAUTION

Part numbers are for reference only. Always check with your Parts Department for latest information.

Note

Shims can have varying tolerances. Check all shims for accurate thickness with a micrometer. Exact shim thickness for **S3** can be attained by using shims that are thicker or thinner than specified by part number.

- remove measuring bar
- remove pinion and reinstall with determined shim, spacer and seal
- tighten pinion nut until the specified turning torque is attained

CAUTION

Tighten pinion nut a little at a time while reading turning torque frequently. If turning torque exceeds specifications the spacer will have to be replaced before proceeding. Once the spacer has been compressed it cannot be used again.

Turning torque specifications

New bearings	Used bearings*
280-320 Ncm (25-28 in. lb)	30-60 Ncm (2.7-5.3 in. lb)

*Bearings with at least 50 km (31 miles) service

Checking measurement

- turn pinion several times in each direction
- install measuring bar and check measurement
 - shims are correct if dial indicator (red number range) shows deviation $\pm$ 0.04 mm

Ring gear, adjusting

Note

Adjust the ring gear if any of the following parts are replaced:

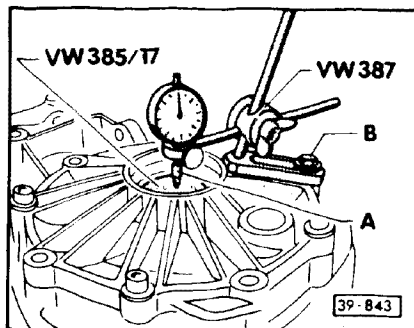
- Final drive housing
- Final drive cover
- Differential bearings
- Torsen differential
- Pinion set

See Adjustment Overview (part II), section 39-320

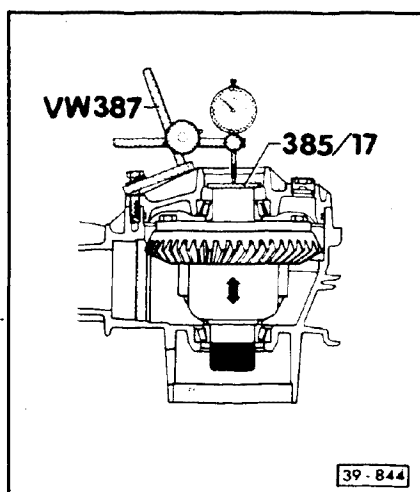
Differential bearing preload, adjusting

(pinion removed)

- remove oil seals and outer races of differential bearings
- remove shims, section 39-290
- install bearing outer races until seated, **without** shims
- install differential into housing **without** speedometer gear
 - ring gear goes on right side (cover side) in housing
- install cover and tighten bolts evenly, in a diagonal sequence
 - 25 Nm (18 ft lb)
- install measuring equipment and set dial indicator (3 mm range) to 0 with 1 mm preload
 - A— dial indicator extension, approximately 30 mm long
 - B— bolt, M8 x 45



Differential — Manual Transmission 39



- move differential up and down, read measurement on dial indicator and record

Example

Dial indicator reading = 1.60 mm

CAUTION

Do not turn differential while taking measurements, or bearings will settle, resulting in an incorrect reading.

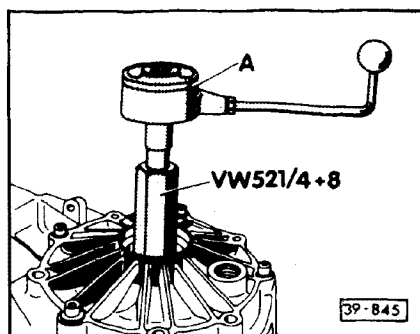
S total, (S1 + S2), determining

$S_{total} = \text{dial indicator reading} + \text{preload}$

Example

Preload (constant value)	0.40 mm
Dial indicator reading	+ 1.60 mm
S_{total}	= 2.00 mm

- install shim of appropriate thickness (2.00 mm in example) behind bearing outer race in final drive housing (S2 side)



Turning torque, measuring

A — commercial torque gauge, 0-600 Ncm

New bearings	Used bearings*
280-320 Ncm (25-28 in. lb)	30-60 Ncm (2.7-5.3 in. lb)

*Bearings with at least 50 km (31 miles) service

Note

If the ring gear and pinion are to be adjusted, the pinion should now be adjusted and the setting checked. See section 39-360.

Backlash, adjusting

Note

The backlash adjustment is conducted:

- with pinion installed
- with **S3** shim in place
- with **S total (S1 and S2)** installed in housing side of differential

- turn differential gear several times in each direction to seat bearings

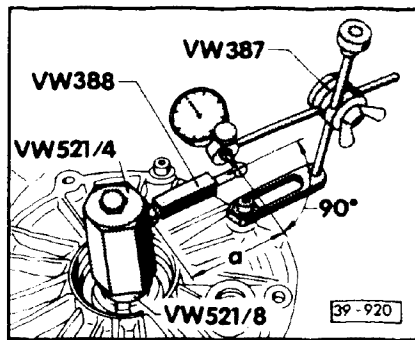
- set up measuring equipment
 - dial indicator extension = **VW 392/10** (6 mm flat)

- adjust measuring lever **VW 388** to:
 - **a** = 79 mm

- while holding pinion so it does not move, turn ring gear to stop and zero indicator
- turn ring gear back and record backlash

- loosen lock bolt on locking sleeve
- rotate ring gear 90°, tighten lock bolt and measure backlash again
- repeat above procedures two more times

- add all four readings together and divide by four to determine average backlash



CAUTION

If any of the measurements differs more than 0.06 mm from the others, the ring gear/pinion installation is incorrect. Check and replace ring gear/pinion set if necessary.

Average backlash, calculating

Example

1st measurement	0.68 mm
2nd measurement	0.70 mm
3rd measurement	0.70 mm
4th measurement	+ 0.68 mm
Total	= 2.76 mm
Average backlash = 2.76 mm/4	= 0.69 mm

S1 shim, determining thickness from table (ring-gear side)

- choose appropriate S1 shim from following table depending on average backlash calculated:

Differential – Manual Transmission **39**

Average backlash (mm)	Shim thickness S1 (mm)
0.62	0.67
0.63	0.69
0.64	0.70
0.65	0.72
0.66	0.73
0.67	0.75
0.68	0.76
0.69	0.78
0.70	0.80
0.71	0.81
0.72	0.83
0.73	0.84
0.74	0.86
0.75	0.87
0.76	0.89
0.77	0.91
0.78	0.92
0.79	0.94
0.80	0.96
0.81	0.97
0.82	0.99
0.83	1.00
0.84	1.01
0.85	1.03
0.86	1.04
0.87	1.06
0.88	1.07
0.89	1.09
0.90	1.10
0.91	1.12
0.92	1.13
0.93	1.15
0.94	1.16
0.95	1.18
0.96	1.19
0.97	1.21

Differential – Manual Transmission 39

Average backlash (mm)	Shim thickness S1 (mm)
0.98	1.23
0.99	1.24
1.00	1.25
1.01	1.27
1.02	1.28
1.03	1.30
1.04	1.32
1.05	1.33
1.06	1.35
1.07	1.36
1.08	1.38
1.09	1.39
1.10	1.41
1.11	1.42
1.12	1.43
1.13	1.45
1.14	1.46
1.15	1.48

Example

Average backlash = 0.69 mm
S1 shim from table = 0.78 mm

The following shims are available:

Thickness (mm)	Part number
0.15	005 409 385
0.20	005 409 385 A
0.25	005 409 385 B
0.50	005 409 385 C
0.80	005 409 385 D
1.00	005 409 385 E
1.50	005 409 385 F

S2 shim, determining thickness

(opposite ring-gear)

$$S2 = S_{\text{total}} - S1$$

Example

S_{total}	2.00 mm
S₁	– 0.78 mm
S₂	= 1.22 mm

Note

The following adjustment shims are available:

Thickness (mm)	Part number
0.15	005 409 381
0.20	005 409 381 A
0.25	005 409 381 B
0.55	005 409 381 C
0.60	005 409 381 D
0.65	005 409 381 E
0.80	005 409 381 F
1.35	005 409 381 G
1.50	005 409 381 H
1.65	005 409 381 J

- install **S₁** shim behind ring gear
- install **S₂** shim on side opposite ring gear

Backlash measurement, checking

- measure backlash at four locations around ring gear
 - backlash must be: 0.12 - 0.22 mm

CAUTION

Backlash must not deviate more than 0.05 mm between readings.

Repair Manual

Micro Update

Date November 15, 1991

This microfilm contains the latest technical information on the Audi 100/200 for model years 1990-92.

Some of the repair information on this microfiche also applies to the 016 All Wheel Drive transmission used in certain Audi models prior to the 1989 model year.

This microfiche has been completely revised.



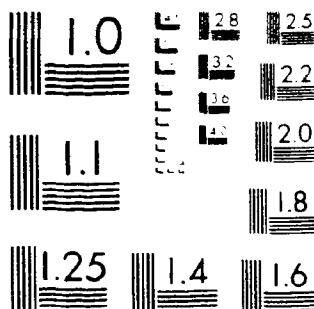
Microfilm Service Information System

Quality Control Test Pattern

ORIGINAL 9-28-81
REVISED 11-17-81

POINT SIZE

LINE WIDTH



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

14. ABCDEFGHIJKLMNOPQRSTUVWXYZ
13. ABCDEFGHIJKLMNOPQRSTUVWXYZ
12. ABCDEFGHIJKLMNOPQRSTUVWXYZ
11. ABCDEFGHIJKLMNOPQRSTUVWXYZ
10. ABCDEFGHIJKLMNOPQRSTUVWXYZ
9. ABCDEFGHIJKLMNOPQRSTUVWXYZ
8. ABCDEFGHIJKLMNOPQRSTUVWXYZ
7. ABCDEFGHIJKLMNOPQRSTUVWXYZ
6. ABCDEFGHIJKLMNOPQRSTUVWXYZ
5. ABCDEFGHIJKLMNOPQRSTUVWXYZ
12. abcdefghijklmnopqrstuvwxyz.,-:/ \$1234567890
11. abcdefghijklmnopqrstuvwxyz.,-:/ \$1234567890
10. abcdefghijklmnopqrstuvwxyz.,-:/ \$1234567890
9. abcdefghijklmnopqrstuvwxyz.,-:/ \$1234567890
8. abcdefghijklmnopqrstuvwxyz.,-:/ \$1234567890
7. abcdefghijklmnopqrstuvwxyz.,-:/ \$1234567890
6. abcdefghijklmnopqrstuvwxyz.,-:/ \$1234567890
5. abcdefghijklmnopqrstuvwxyz.,-:/ \$1234567890

5 mil.

8 mil.

10 mil.

13 mil.

15 mil.

20 mil.

30 mil.

50 mil.

Gray Scale

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

Gray Side ... 18% Reflectance

White Side ... 90% Reflectance