Drive pinion and ring gear, adjusting

General notes:

- *Drive pinion and ring gear must be very carefully adjusted to ensure long service life and smooth running. At the factory, drive pinion and ring gear are adjusted relative to each other to ensure smooth running and low noise in both directions. The location for the smoothest running is determined by moving drive pinion axially whereby ring gear is moved far enough out of the backlash-free position so that the backlash is within specified tolerances.*

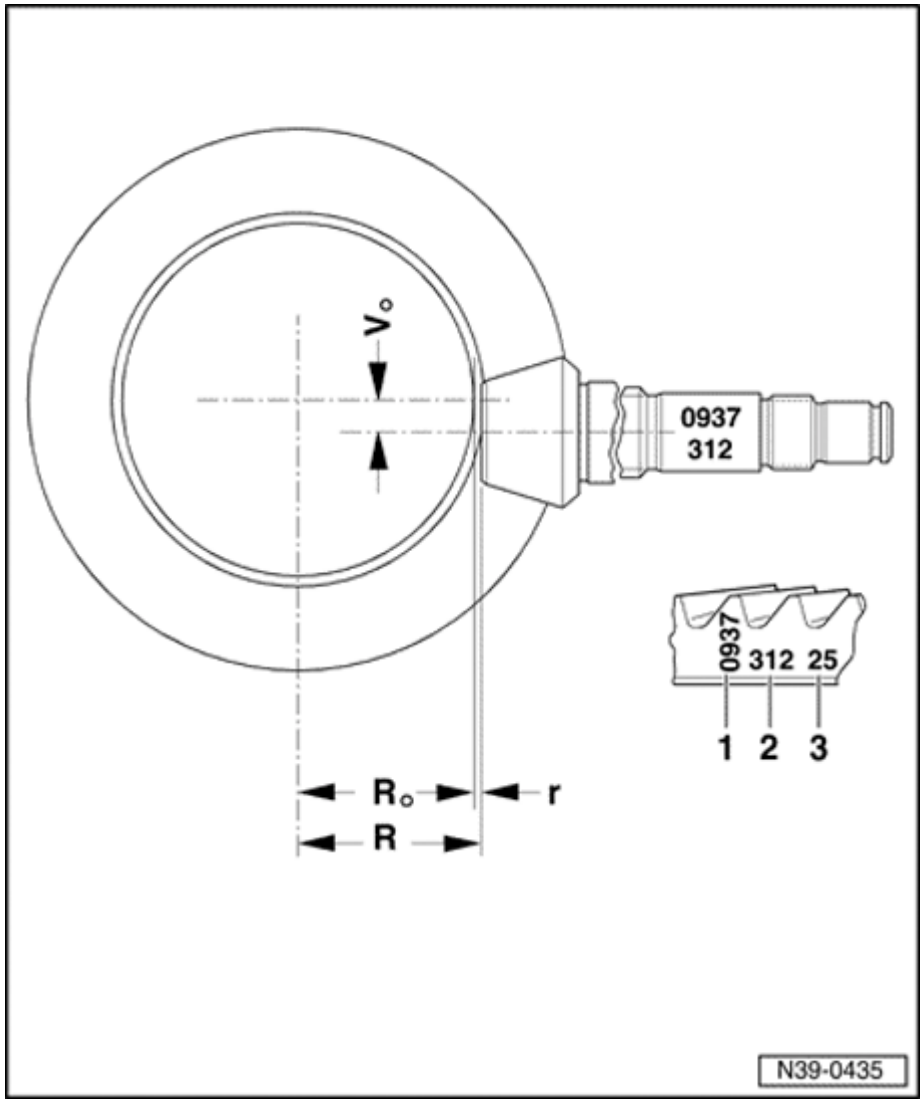
- *The goal of the adjustment is to reproduce the setting for the quietest possible running, as obtained on the test machine during production.*

- *The deviation, or tolerance "r" which is based on the master gauge "R0" is measured for the final drive sets supplied as replacement parts and marked on the outer circumference of the ring gear. Every drive pinion set - drive pinion and ring gear - may only be replaced together.*

- *Follow general repair notes for tapered roller bearings and shims.*

- *Make sure that all installation and measurement procedures are performed with the utmost care and cleanliness to ensure a successful result.*

39-167



Gear set, adjusting and marking

1 - Identification "0937" means the Oerlikon gear set with a ratio of 37: 9.

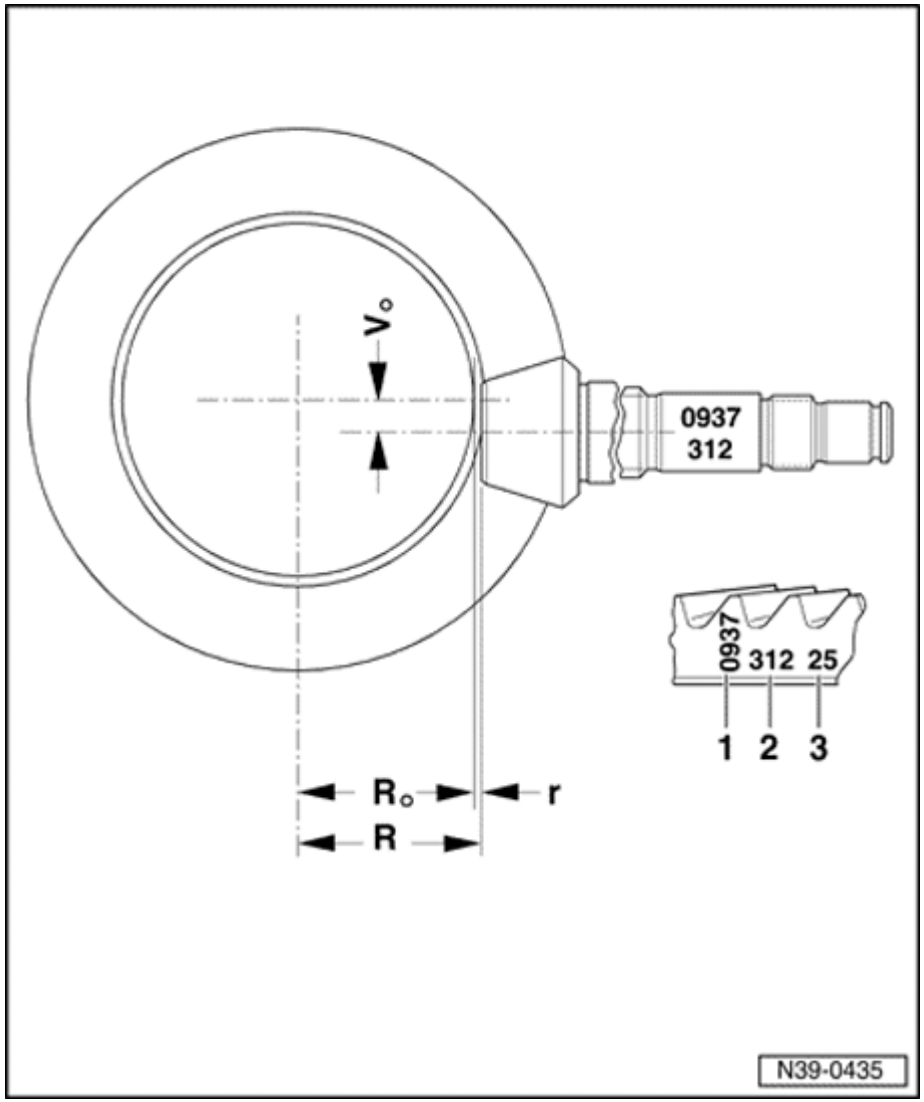
2 - Pairing number (312) of gear set.

3 - Dimension "r" is based on the master gauge used on the test bench during production. Dimension "r" is always given in 1/100 mm. Example: "25" means r = 0.25 mm

Ro - Length of test machine master gauge used "Ro".

Ro - ring gear = 57.50 mm

39-168



R - Actual dimension between ring gear axis and face of drive pinion in position of quietest running for this gear set R = Ro + r

Vo - Hypoid offset

Gear set, adjustment sequence

If drive pinion and gear ring have to be adjusted, the following sequence is recommended for maximum efficiency:

1.) Determine total shim thickness "Stot"for S1 + S2 for the specified pre-tension of tapered roller bearings for differential.

2.) Determine total shim thickness "S3" so that the drive pinion is installed in the same location as on the test machine during production.

3.) Distribute total shim thickness Stotal S1 + S2, so that the specified backlash between ring gear and drive pinion is maintained.

Note:

Overview of components and adjustment shims
⇒ *page 39-171* .

39-170

Adjustment overview

Note:

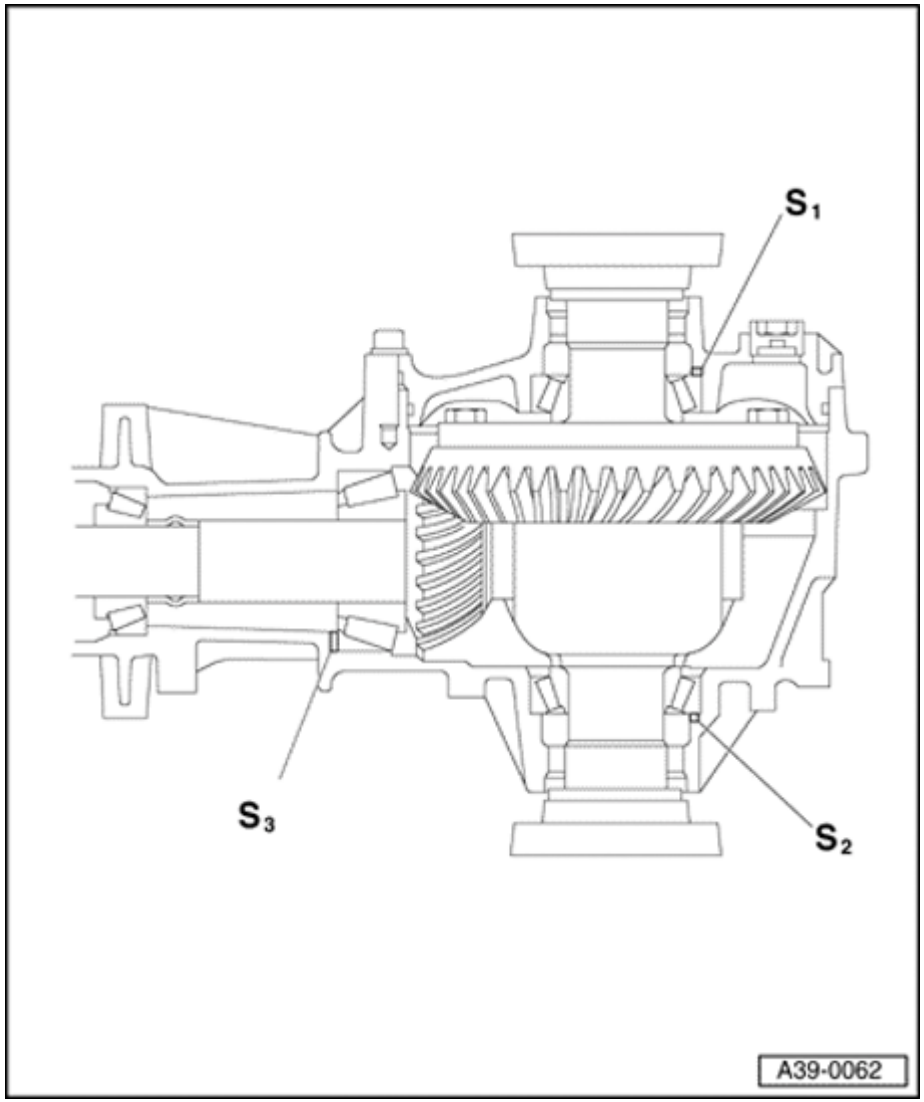
When working on transmission, drive pinion or gear set only need to be adjusted if components were replaced which directly influence the final drive. Note the follow table to prevent unnecessary adjustments:

	Component to be adjusted:		
Component replaced: ▼	Ring gear "S1"+"S2" 1) ⇒ page 39-186	Drive pinion "S3" 1) via deviation "r" ⇒ page 39-177	Backlash Checking ⇒ page 39-192
Final drive housing	X	X	X
Differential housing	X		X
Tapered roller bearing for drive pinion		X	X
Tapered roller bearing for differential	X		X
Gear set 2)	X	X	X
Cover for final drive	X		X

1) Adjustment shims; Installed position ⇒ page 39-171

2) Drive pinion and ring gear; only replace together as a set

39-171



Shim location

Note:

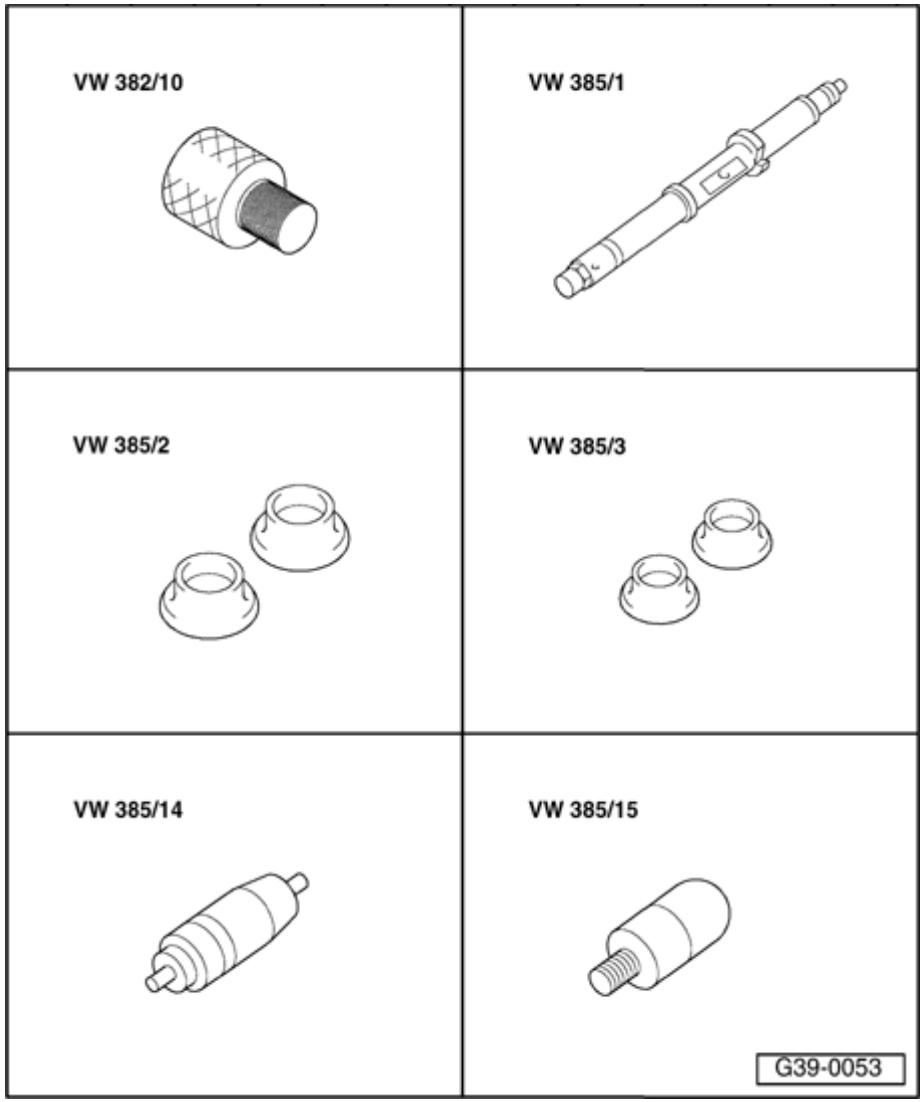
Adjustment overview when replacing individual components of differential ⇒ page 39-170 .

S1 - Adjustment shim for ring gear in final drive cover

S2 - Adjustment shim for ring gear in final drive housing

S3 - Adjustment shim for ring gear in final drive housing

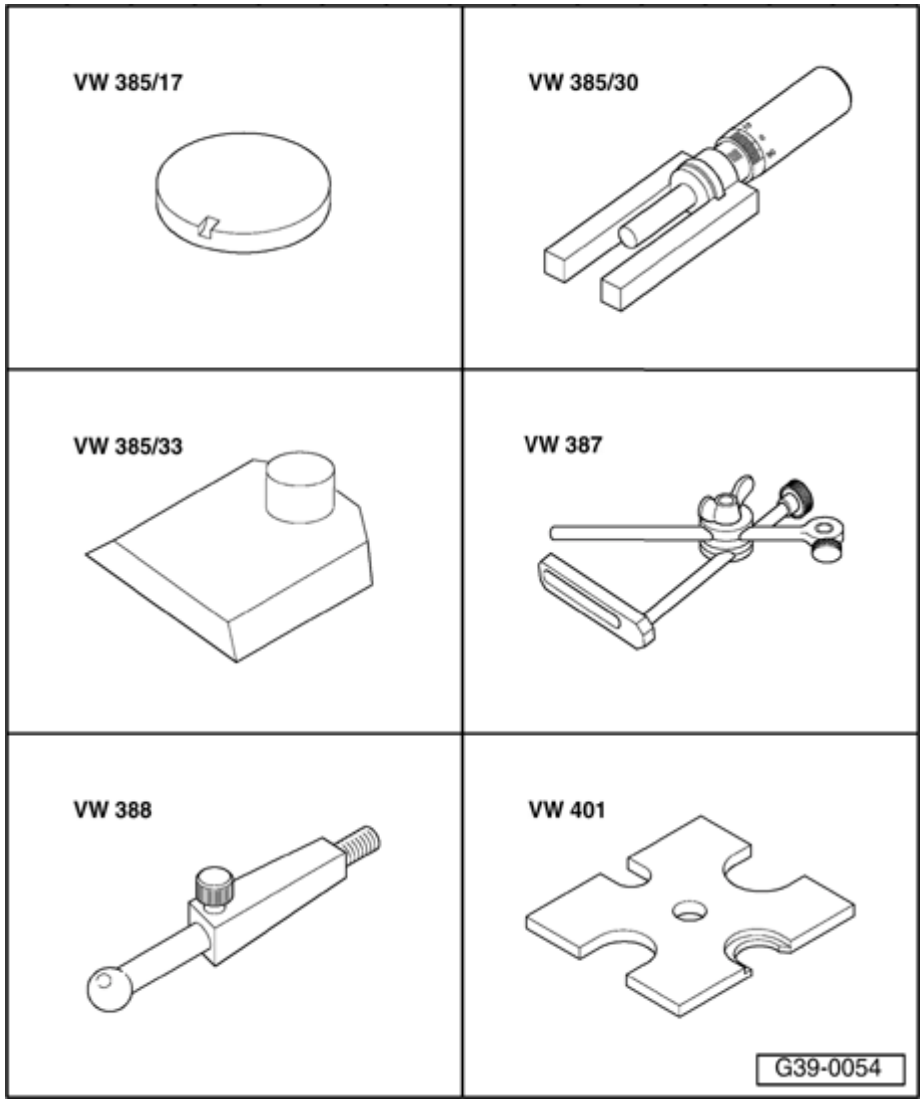
39-172



Special tools and equipment

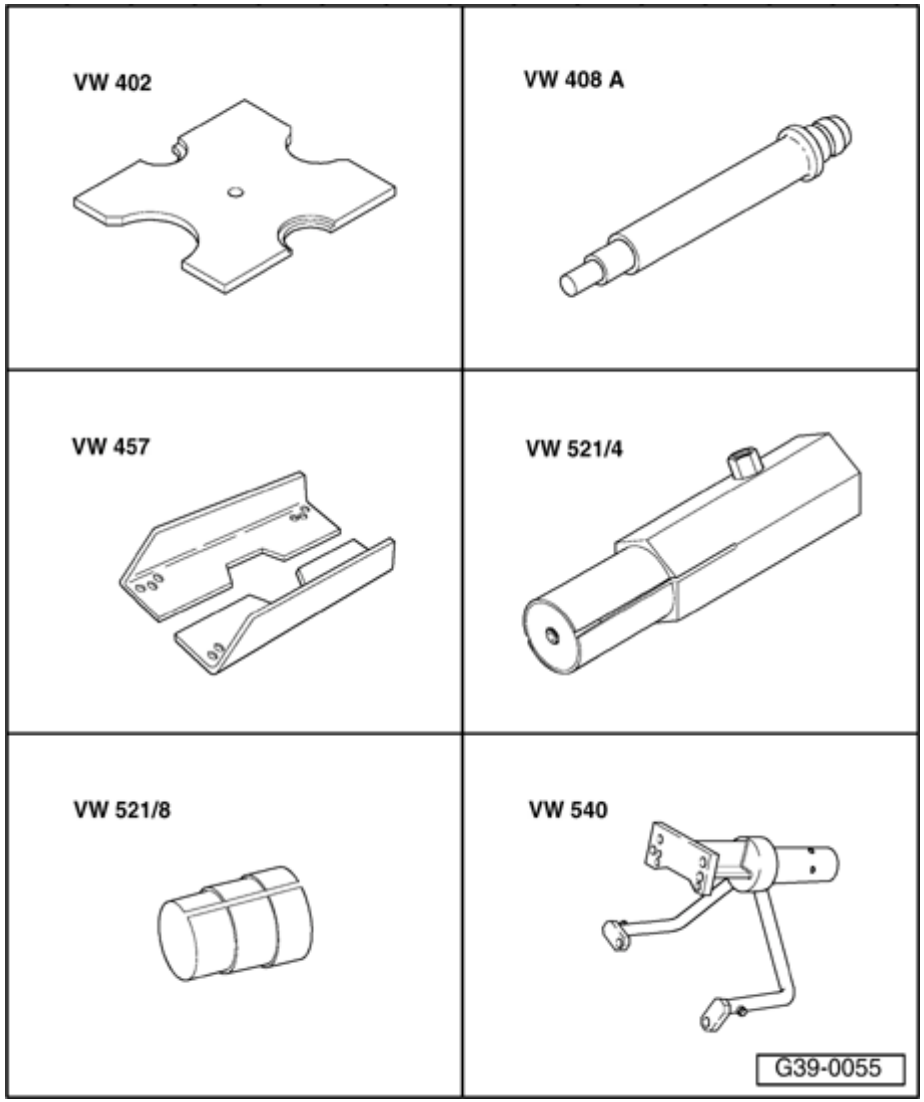
- VW382/10 extension pin
- VW385/1 measuring bar
- VW385/2 centering disc
- VW385/3 plastic piece
- VW385/14 measuring rod
- VW385/15 extension pin

39-173



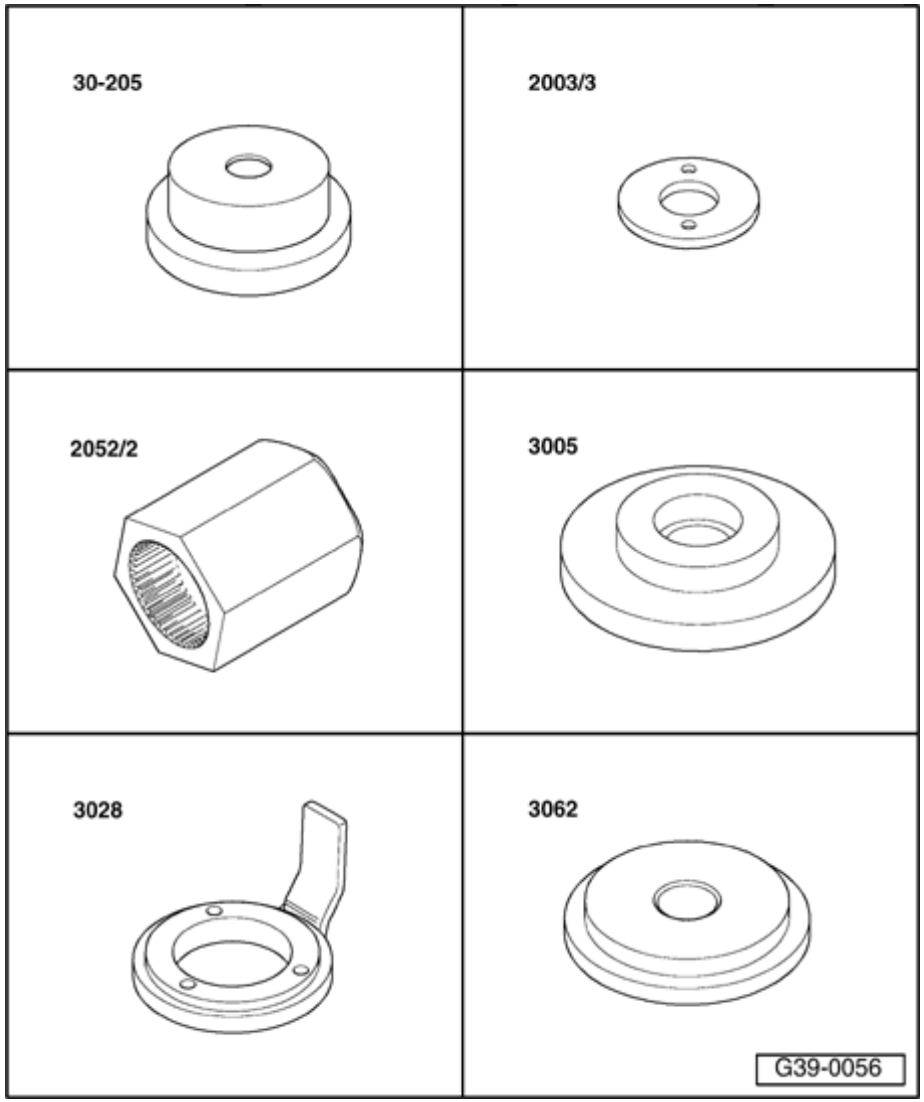
- VW385/17 magnetic plate
- VW385/30 master gauge-adjustable
- VW385/33 end gauge
- VW387 dial gauge holder
- VW388 measuring lever
- VW401 thrust plate

39-174



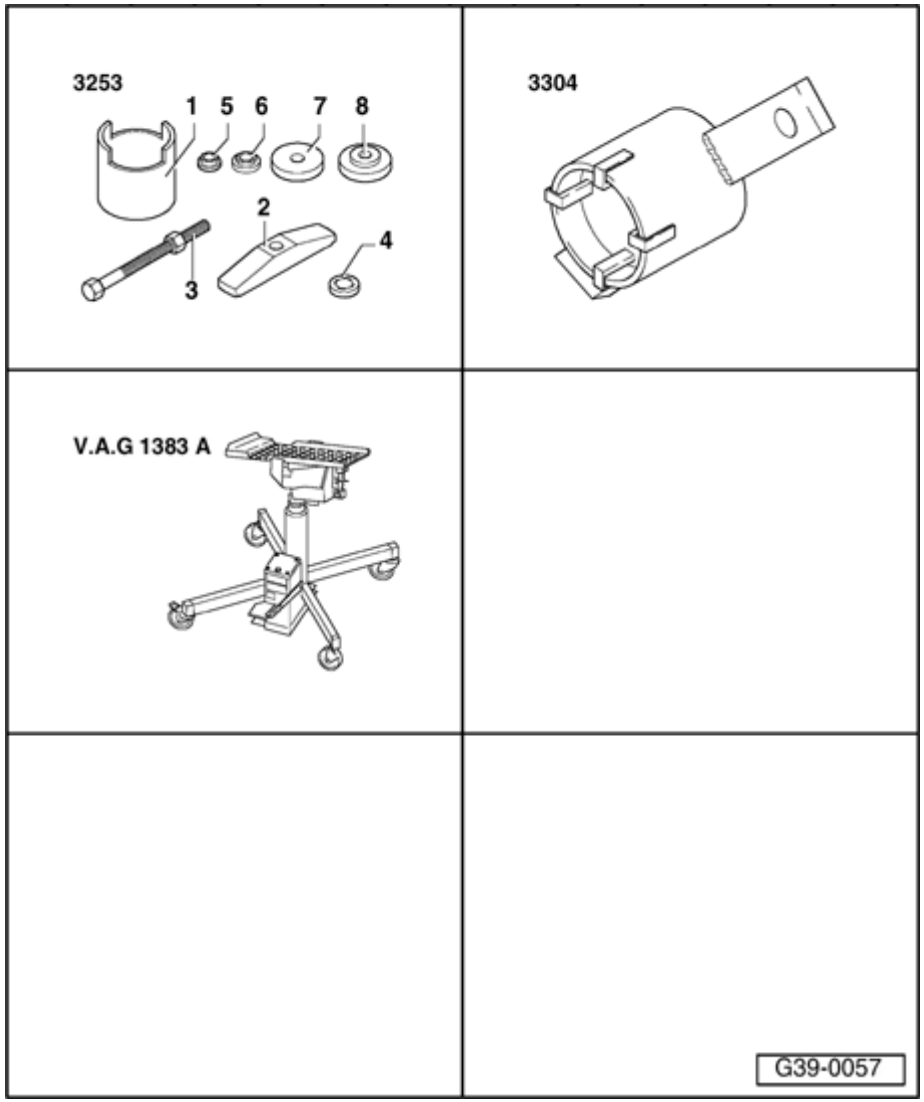
- VW402 thrust plate
- VW408A punch
- VW457 support channels
- VW521/4 locking sleeve for ring gear
- VW521/8 bushing for ring gear
- VW540 holding fixture

39-175



- 30-205 thrust pad
- 2003/3 seal installer
- 2052/2 assembly tool for drive pinion
- 3005 thrust pad
- 3028 retainer
- 3062 thrust pad

39-176



- 3253 wheel bearing assembly set with 3253/3 and 3253/4
- 3304 retainer
- Engine/transmission jack VAG1383A engine/gearbox jack
- Dial gauge extension 30 mm
- Dial gage
- Torque gauge 0 - 600 Ncm

39-177

Drive pinion, adjusting

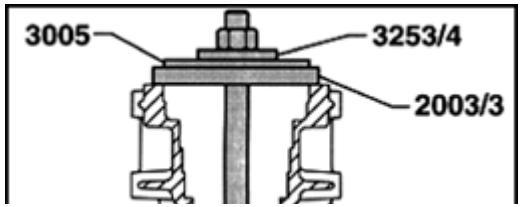
Notes:

- *Before adjusting drive pinion, adjust ring gear (determine total shim thickness "S" total" for adjustment shims "S1" + "S2")* ⇒ *page 39-186* .
- *Drive pinion only has to be adjusted again if gear set, tapered roller bearings for drive pinion or final drive housing was replaced. Adjustment overview* ⇒ *page 39-170* .
- *Do not grease new tapered roller bearings additionally for friction torque measurement. The bearings are already greased with a special oil from the factory.*

Determining Shim "S3"

(adjust preload of tapered roller bearing for drive pinion)

- Clamp final drive into engine and transmission assembly stand ⇒ page 39-123 .

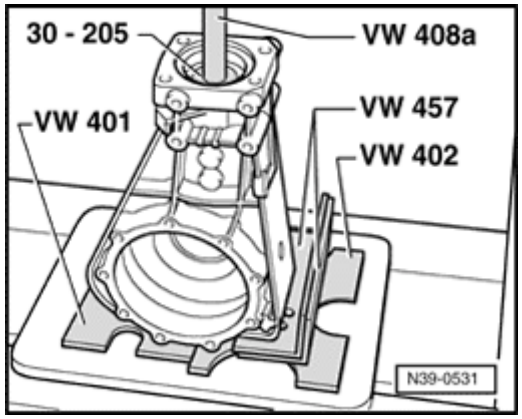


- Pull large tapered roller bearing outer race into housing.

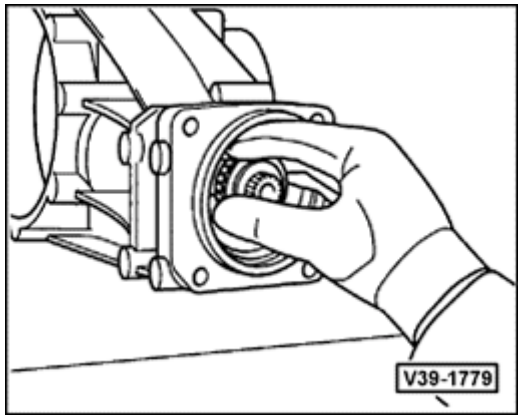
Note:

On 3253/4 pressure disc, marking "Oben" points toward nut on installation device

39-178



- Pulling small tapered roller bearing outer race into housing.
- The outer race must be oiled and installed using VW408A punch and 30-205 thrust pad.



- Install drive pinion without spacer sleeve.

WARNING!

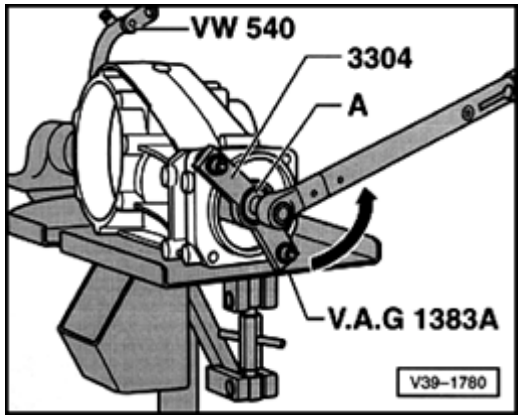
Wear protective gloves!

- Heat up small tapered roller bearing inner race to approx. 100 °C and position on drive pinion.

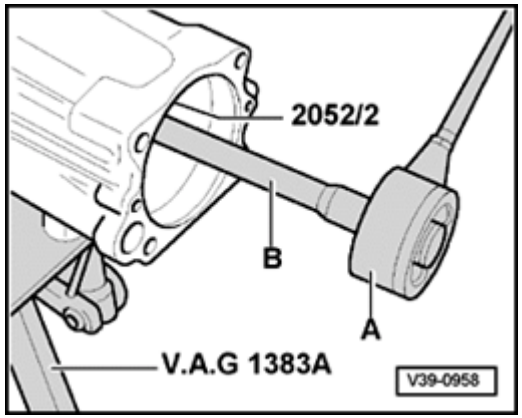
Notes:

- *Do not grease new tapered roller bearings additionally for friction torque measurement. The bearings are already greased with a special oil from the factory.*
- *Only install spacer sleeve if friction torque has been adjusted (Shim S3 already determined).*

39-179



- Install 3304 retainer using two hex bolts M8 x 30.
- When tightening nut, support final drive (e.g. using VAG1359/2 universal mount with VAG1383A transmission hoist).
- Always replace drive pinion nut.
- Tighten nut for drive pinion until no more drive pinion backlash is present.
- Increase tightening torque further until specified friction torque is attained; while tightening measure friction torque multiple times.



A - Standard torque gauge, 0 to 600 Ncm

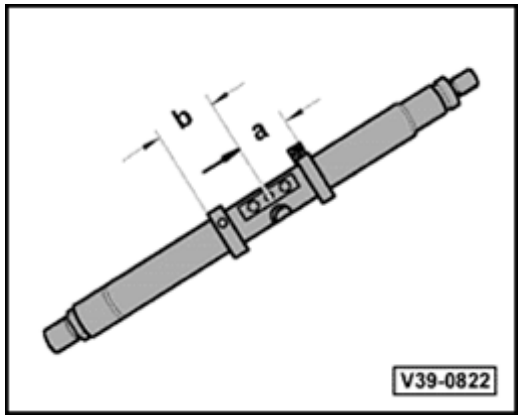
B - Extension with 32 mm wrench socket

- Adjust to following friction torque

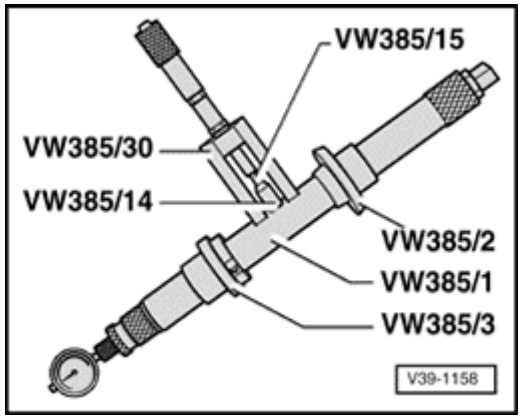
New bearings	Run-in bearings 1)
200 to 250 Ncm	30 to 60 Ncm

1) have been run in at least 50 km

39-180



- Adjust adjustment ring of VW385/1 measuring bar.
  - Dimension a = 60 mm
- Adjust sliding adjustment ring.
  - Dimension b = 55 mm

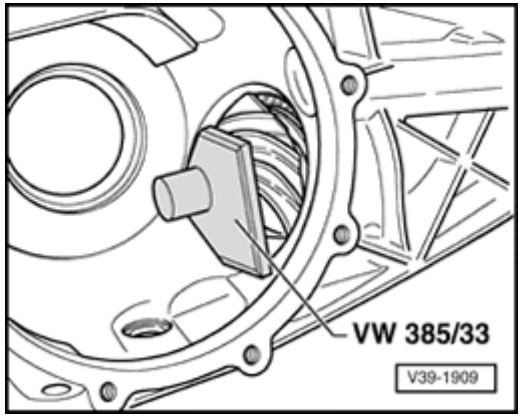


- Assemble measuring bar as shown in illustration.
  - VW385/15 extension pin 9 mm
- Adjust VW385/30 master gauge-adjustable.
  - Ro = 57.50 mm
- Set dial indicator (3 mm measuring range) to 0 with 2 mm preload.

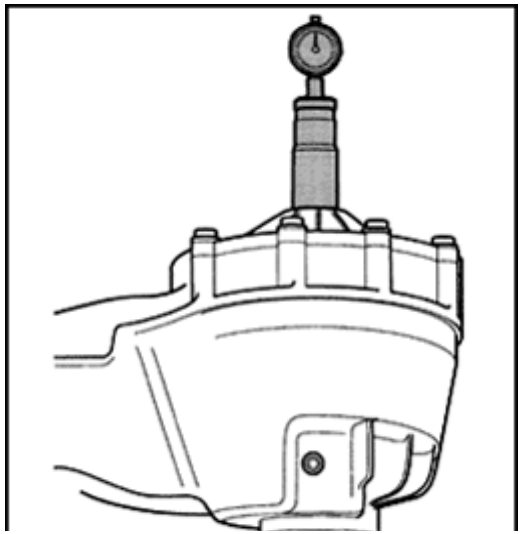
39-181

Note:

Turn differential at least 5 rotations in each direction to seat the tapered roller bearings. Otherwise, measurement will result in false readings.

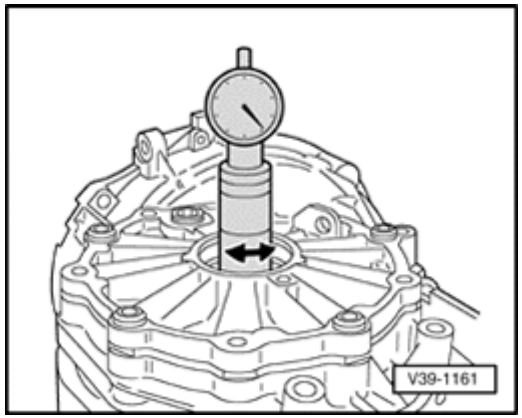


- Position VW385/33 end gauge on drive pinion head.



- Remove master gauge and insert measuring mandrel into housing.
  - VW385/3 plastic piece faces final drive cover
- Install cover for final drive and tighten four bolts.
- Using adjustable ring, pull 2nd centering disc out far enough, so that the mandrel can only just be turned by hand.

39-182



Determining dimension "e"

- Turn measuring mandrel until dial indicator plunger tip touches end gauge on pinion shaft head, and measure the maximum run-out (return point). Measured value is dimension "e" (red numbered area).
  - Measured value in the following example: "e" = 1.60 mm

Note:

Dimension "e" is required to determine thickness of S3 shim.

- After removing universal mandrel, and with VW385/30 master gauge in place, check dial indicator again to see if it indicates 0, with 2 mm preload. If not, repeat measurement.

Determining thickness of shim "S3"

Formula:

"S3" = "e" - "r"

e = determined value

r = deviation (indicated in 1/100 mm on ring gear)

Example:

	determined value "e"	1.60 mm
-	Deviation "r"	0.42 mm
=	Thickness of shim "S3"	1.18 mm

- Determine shim as closely as possible according to table. Part numbers

⇒ *Parts-catalog*

Available shims for S3

Adjustment shim thickness (mm) 1)		
0.95	1.20	1.45
1.00	1.25	1.50
1.05	1.30	1.55
1.10	1.35	
1.15	1.40	

1) By using shim tolerances, it is possible to determine the exact shim thickness required, insert two shims if necessary

- Removing universal mandrel.

- Remove drive pinion and large tapered roller bearing outer race and install together with determined adjustment shim "S3" and spacer sleeve ⇒ Page 39-159 onward.

- Insert small tapered roller bearing inner race and tighten nut for drive pinion until specified friction torque is attained ⇒ Fig. 11 , ⇒ page 39-164 .

Notes:

- *Do not grease new tapered roller bearings additionally for friction torque measurement. The bearings are already greased with a special oil from the factory.*

- *Increase torque slowly and measure friction torque multiple times. If the specified friction torque is surpassed, replace spacer sleeve and repeat adjustment! Any spacer sleeve that has been pressed together too far one time must be replaced.*

- Adjust friction torque to following values:

New bearings	Run-in bearings 1)
200 to 250 Ncm	30 to 60 Ncm

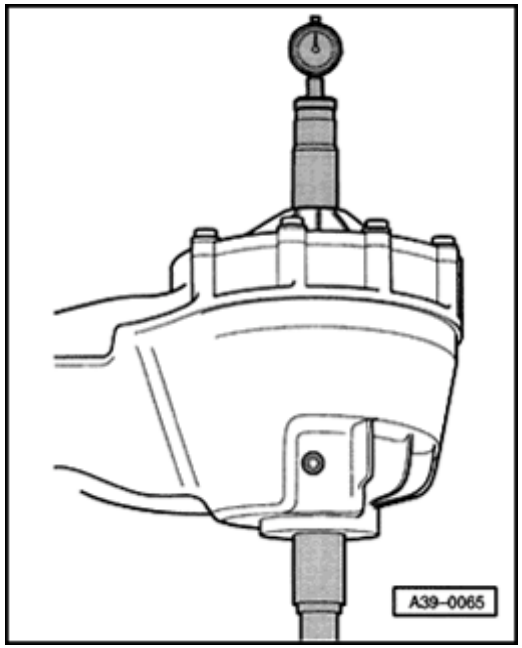
[1)] have been run in at least 50 km

39-185

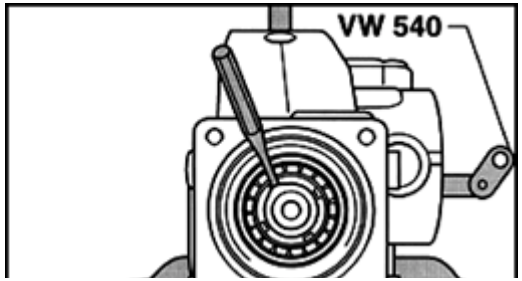
Perform check measurement

Checking dimension "r"

- Rotate drive pinion at least 5 complete revolutions in both directions.



- Insert universal mandrel and perform check measurement.
  - ♦ If adjustment shims were determined correctly, dial indicator must indicate deviation "r" with a tolerance of ± 0.04 mm (reading counterclockwise in red number display).



- Peen drive pinion nut using mandrel.

39-186

Ring gear, adjusting

(Adjusting differential)

Procedures after which the ring gear must be adjusted ⇒ Adjustment overview ⇒ page 39-170 .

Notes:

- *Tapered roller bearings for differential are low-friction bearings. Therefore friction torque can only be used for check measurement in a limited way. A correct adjustment is only possible by determining the total thickness "Sges".*

- *Do not grease new tapered roller bearings additionally for friction torque measurement. The bearings are already greased with a special oil from the factory.*

Total shim thickness "Stotal" for adjustment shims "S1" + "S2", determining

(adjust preload of tapered roller bearing for differential)

- Drive pinion removed or ring gear detached from differential housing

- Pry out drive flange seal using tire iron.

- Remove tapered roller bearings for differential and remove adjustment shims ⇒ page 39-136 .

- Press tapered roller bearing outer race for left side of differential housing (housing side) together with shim "S2" into differential housing ⇒ Page 39-144 . Use a shim "S2*" with a 1.00 mm thickness for measurement purposes (1 shims with 0.80 and 1 with 0.20 mm).

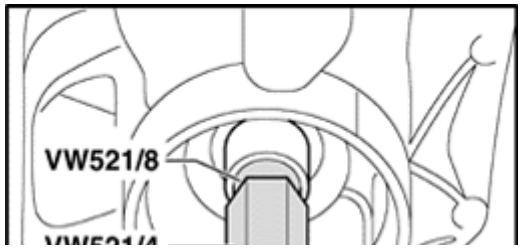
Note:

All measurements are performed with shim S2 with 1.00 mm thickness. The shim will be indicated by "S2" in the following procedures. After determining backlash, S2* is replaced by final shim S2.*

- Press in tapered roller bearing outer race for right side (cover side) of differential without adjustment shims to stop ⇒ Fig. 8 , ⇒ page 39-136 .

- Insert differential in housing. Ring gear is on the right side (cover side).

- Install cover and tighten bolts to 25 Nm.

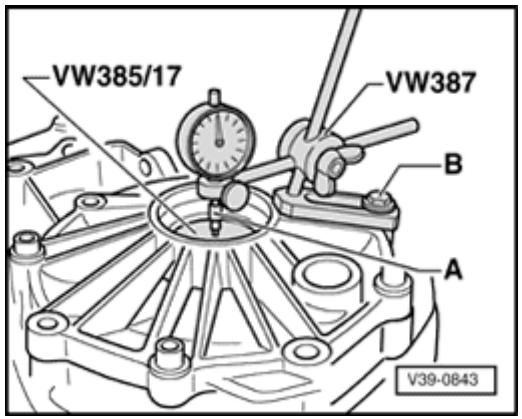


- Install VW521/4 locking sleeve and 521/8 sleeve press tool into differential housing on housing side.
- Rotate cover side of differential housing upward.

39-188

- Turn differential 5 rotations in each direction to seat the tapered roller bearing.

- Place VW385/17 magnetic plate onto differential.

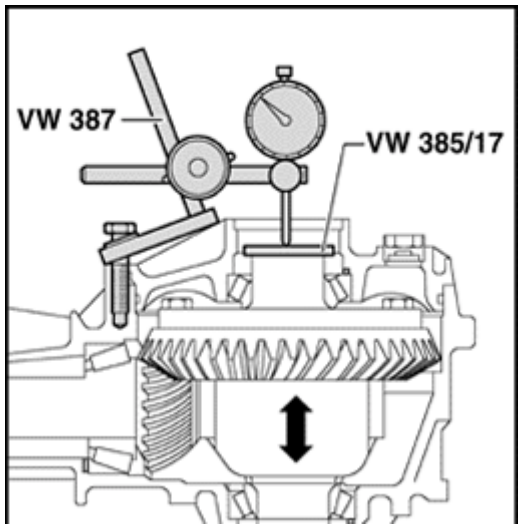


- Install measuring tools.

A - Dial gauge extension approx. 30 mm long

B - Hex bolt M8 x 45

- Set dial gauge extension onto center of VW 385/17 magnetic plate.
- Set dial indicator (3 mm measuring range) to 0 with 2 mm preload.



- Lift the differential without turning it, read play on dial indicator and note.

  ♦ Measured value in the following example: 0.50 mm

Note:

If measurement is repeated, differential must first be rotated 5 complete revolutions in both directions again to seat tapered roller bearing.

39-189

Formula:

"Stotal" = "S2*" + measured value + bearing preload

Example:

	Installed shim(s) "S2*"	1.00 mm
+	Measurement	0.50 mm
+	Bearing preload (constant)	0.30 mm
=	Total shim thickness "Stotal"for shims "S1" + "S2"	1.80 mm

Determining thickness of shim "S1*"

Notes:

- *"S1*" is used for the initial measurement. After determining backlash, "S1*" is replaced with final shim "S1".*
- *The total shim thickness "Stotal" remains unchanged.*

Formula:

"S1*" = "Stotal" - "S2*"

Example:

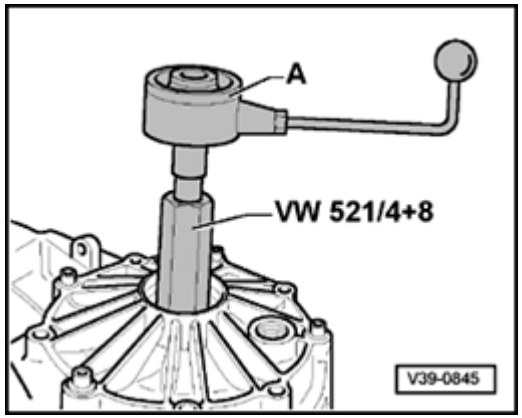
	Total shim thickness "Stotal"for shims "S1" + "S2"	1.80 mm
-	Installed shim(s) "S2*"	1.00 mm
=	Thickness of shim "S1*"	0.80 mm

- Determine adjustment shim(s) as closely as possible according to table ⇒ page 39-195 .

39-191

Measuring friction torque (check measurement)

- Drive pinion removed
- Differential installed with shims "S1*" and "S2*"



- Position torque gauge 0 to 600 Ncm -A- on differential.
- Read friction torque.

Friction torque specified values:

New bearings	Run-in bearings 1)
150 to 300 Ncm	30 to 60 Ncm

1) have been run in at least 50 km

Notes:

- *Tapered roller bearings for differential are low-friction bearings. Therefore friction torque can only be used for check measurement in a limited way. A correct adjustment is only possible by determining the total thickness "Sges".*
- *Do not grease new tapered roller bearings additionally for friction torque measurement. The bearings are already greased with a special oil from the factory.*
- *For a new adjustment of the gear set, the drive pinion adjustment*

should now be checked ⇒ page 39-177 .

39-192

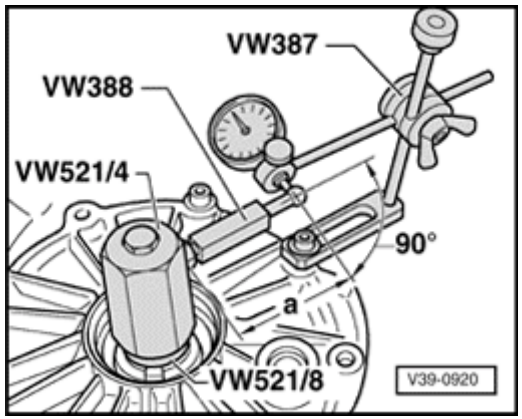
Adjusting backlash

(position of ring gear in transmission housing)

- Drive pinion installed with shim S3
- Differential installed with shims "S1*" and "S2*"

- Insert differential into final drive housing, install cover and tighten all bolts to 25 Nm.

- Turn differential 5 rotations in each direction to seat the tapered roller bearing.



- Install measuring tools.
- Use VW382/10 extension pin, 6 mm.
- Set VW388 measuring lever to dimension "a" = 60 mm.
- Determine backlash between teeth flanks as follows:
  - Turn ring gear until it contacts a tooth flank (end of backlash travel).
  - Set dial indicator to 0 with 1 mm preload.

- Turn ring gear back until it contacts opposite tooth flank (backlash).

- Read backlash and note.

- Turn ring gear an additional 90° in each case and repeat measurement 3 times.

Note:

If measurements vary more than 0.06 mm from each other, ring gear or gear set is not installed correctly. Check installation, replace gear set if necessary.

Determining average backlash

Example:

	1. Measurement	0.28 mm
+	2. Measurement	0.30 mm
+	3. Measurement	0.30 mm
+	4. Measurement	0.28 mm
=	Total of measurements	1.16 mm

- Result: The average backlash is 1.16 mm / 4 = 0.29 mm

Determining thickness of shim "S2"

Formula:

"S2" = "S2*" - backlash + lift

Example:

	Installed shim "S2*"	1.00 mm
-	Average backlash	0.29 mm
+	Lift (constant)	0.15 mm
=	Thickness of shim "S2"	0.86 mm

- Determine shim as closely as possible according to table. Part numbers

⇒ *Parts-catalog*

Available shims for S2

Adjustment shim thickness (mm) 1)		
0.15	0.50	1.50
0.20	0.80	
0.25	1.00	

1) By using shim tolerances, it is possible to

determine the exact shim thickness required, insert two shims if necessary

Determining thickness of shim "S1"

Formula:

"S1" = "Stotal" - "S2"

Example:

	Total shim thickness "Stotal" for "S1" + "S2"	1.80 mm
-	Thickness of shim "S2"	0.86 mm
=	Thickness of shim "S1"	0.94 mm

- Determine shim as closely as possible according to table. Part numbers

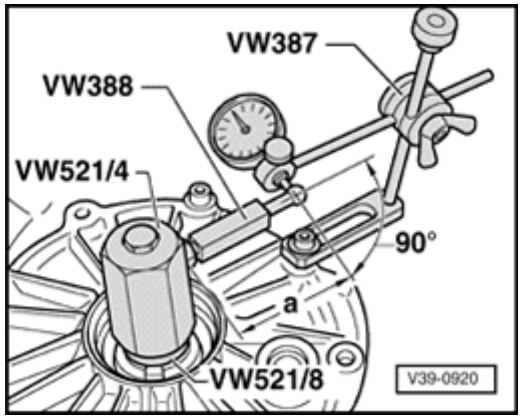
⇒ *Parts-catalog*

Available shims for S1

Thickness of adjustment shims in mm[1)]		
0.15	0.50	0.90
0.20	0.60	1.00
0.30	0.70	1.20

0.40	0.80	

1) By using shim tolerances, it is possible to determine the exact shim thickness required, insert two shims if necessary



Checking measurement

- Drive pinion installed with shim S3
- Differential installed with shims "S1" and "S2"

- Turn differential 5 rotations in each direction to seat the tapered roller bearing.
- Measure backlash 4 times on circumference.
  - Specification: 0.12 to 0.22 mm

Notes:

- *If backlash is outside tolerance, repeat adjustments. Do not change total shim thickness "Stotal" while doing so.*
- *The individual measurement values can deviate a maximum of 0.06 mm from each other*