39-146

Drive pinion and ring gear, adjusting

Note:

- *Careful adjustment of the drive pinion and ring gear is important for the service life and smooth running of the final drive. For this reason, the drive pinion and ring gear are matched together during manufacture, and checked to ensure a good mesh pattern and quiet running in both directions of rotation. The position of quietest running is found by moving the drive pinion in an axial direction and at the same time lifting the ring gear out of the zero-play mesh position by the amount necessary to maintain the backlash within the specified tolerance.*

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

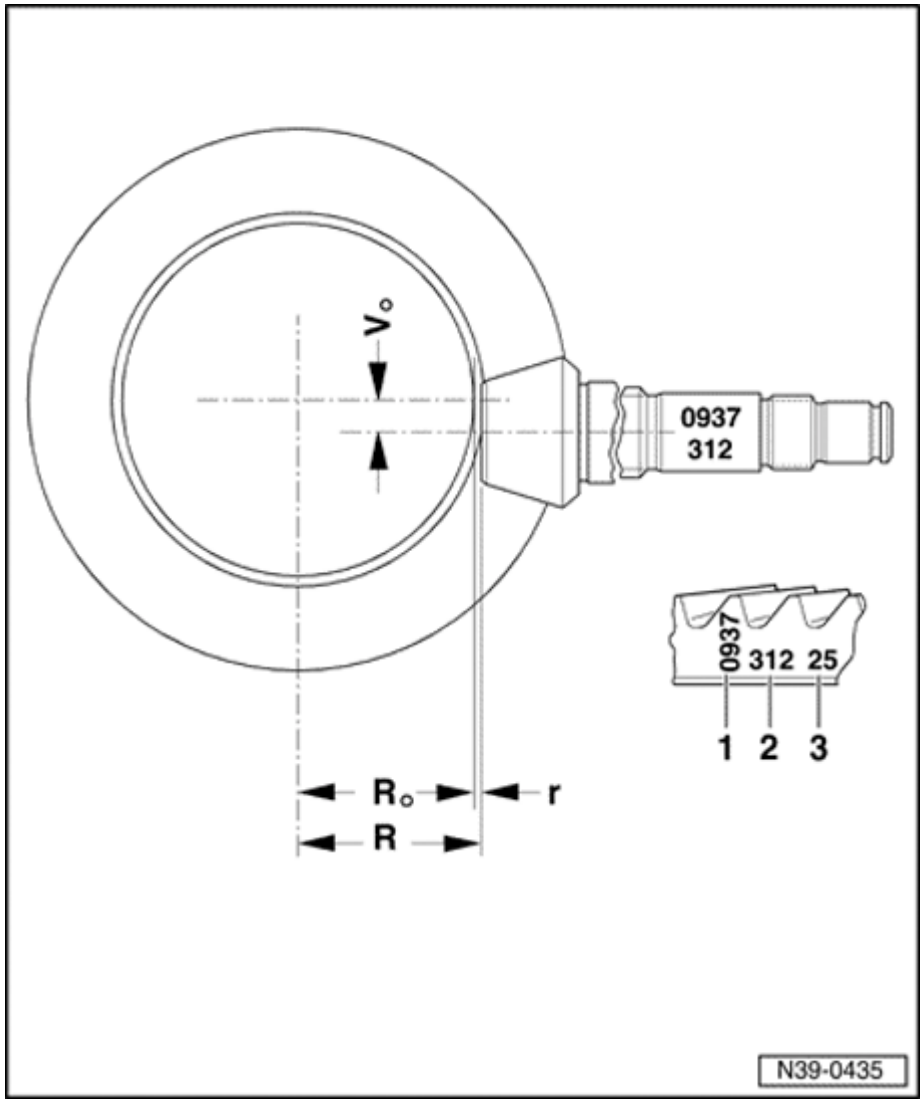
- *The deviation (tolerance) "r," which is related to the master gauge "Ro" is measured for the final drive sets supplied as replacement parts and marked on the outer circumference of the ring gear. The final drive set (drive pinion and ring gear) may only be replaced together as a matched pair.*

- *Observe the general repair instructions for*

tapered roller bearings and shims.

- *Maximum care and cleanliness are essential for achieving good results when performing repairs and taking measurements.*

39-147



Gear sets, adjusting and marking

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

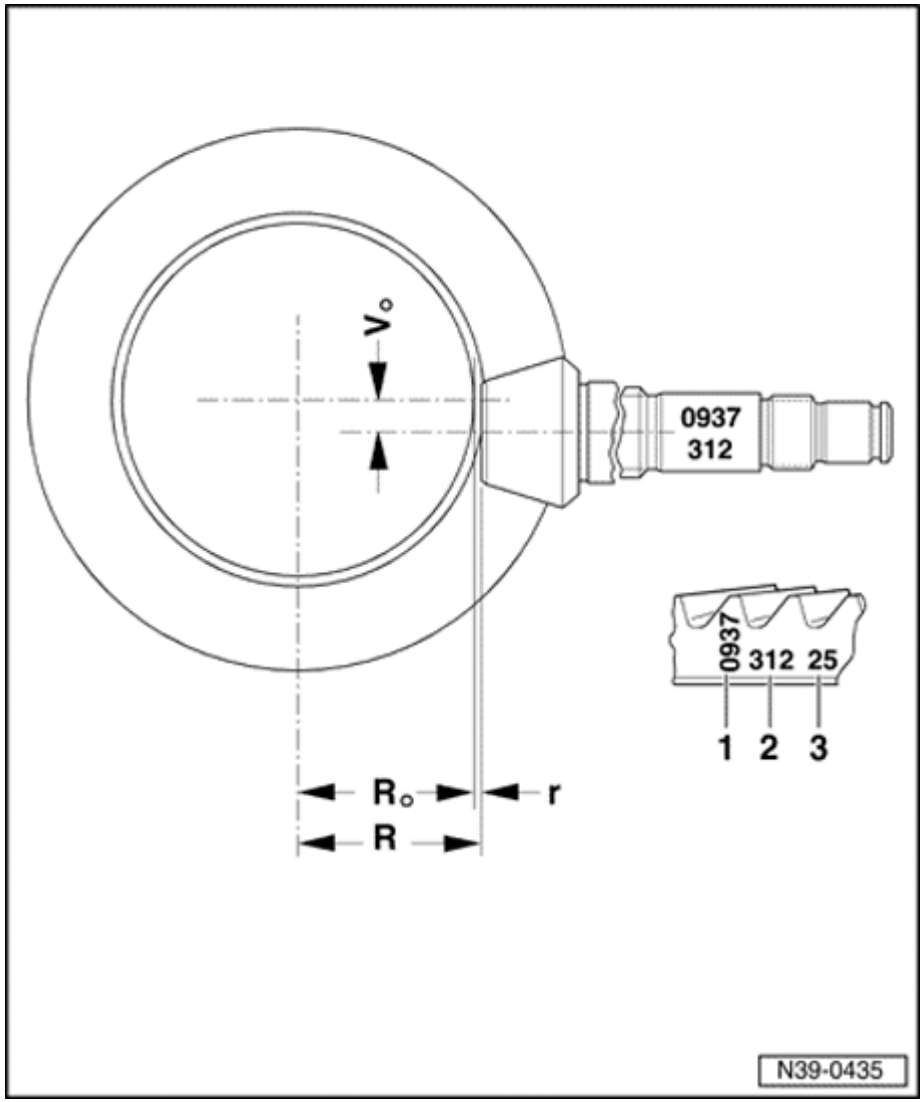
2 - Gear set pairing number (312).

3 - Deviation (tolerance) "r" is based on the test machine master gauge used in the production. The deviation "r" is always given in 1/100 mm. Example: "25" signifies r = 0.25 mm

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

Ro - Ring gear = 57.50 mm

39-148



R - Actual distance between center axis of ring gear and face of drive pinion at point with quietest running for this gear set. R = Ro + r

Vo - Hypoid offset

Readjusting final drive set, recommended sequence

The following work sequence is recommended to save time when the drive pinion and ring gear have to be adjusted:

1.) Determine total shim thickness "S_{total}" for "S1" + "S2" for the specified preload for tapered roller bearings for differential.

2.) Determine total shim thickness "S3" to reproduce the installation position for the drive pinion determined on the test machine in production.

3.) Distribute total shim thickness "S_{total}" for "S1" + "S2" so that the specified backlash exists between ring gear and drive pinion.

Note:

Overview of components and shims ⇒ *Page 39-151* .

Adjustment overview

Note:

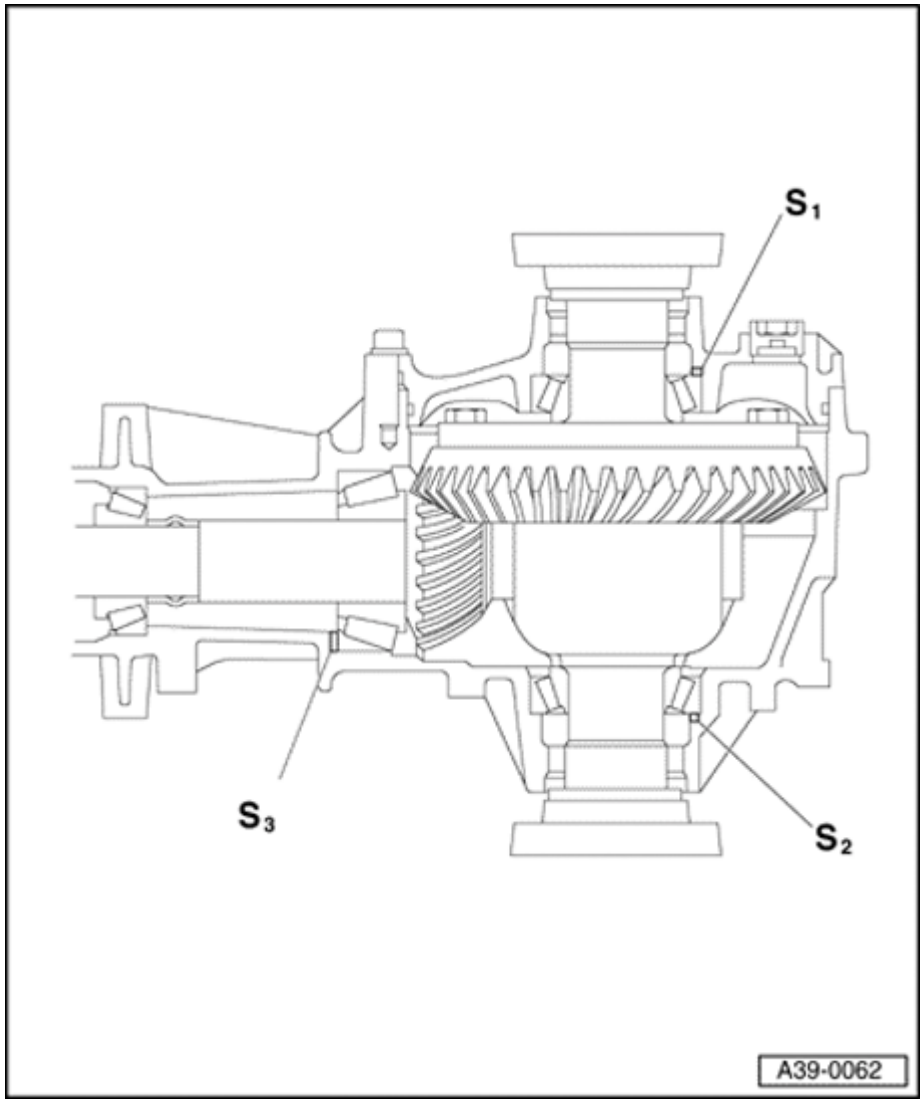
If repairs have been carried out on the final drive it is only necessary to adjust the drive pinion or final drive set if components have been replaced which have a direct effect on the adjustments of the final drive. Refer to the following table to avoid unnecessary adjustments:

	adjustment required:		
Part replaced: ▼	Ring gear "S1"+"S2" 1) ⇒ Page 39-163	Drive pinion "S3" 1) via deviation "r" ⇒ Page 39-154	Check backlash ⇒ Page 39-169
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
Final drive set 2)	X	X	X
Cover for final drive	X		X

1) Shims; installation position ⇒ Page 39-151 .

2) Drive pinion and ring gear; only replace together.

39-151



Shims, position

Note:

Adjustment overview when replacing individual components of final drive ⇒ *Page 39-150* .

S1 - Adjustment shim for ring gear in cover for final drive

S2 - Adjustment shim for ring gear in final drive housing

S3 - Adjustment shim for drive pinion in final drive housing

39-152

Special tools, testers and auxiliary items

- Dial gauge extension VW 382/10
- Universal mandrel VW 385/1
- Centralizing disc VW 385/2
- Centralizing disc VW 385/3
- Measuring plunger VW 385/14
- Dial gauge extension VW 385/15
- Measuring plate VW 385/17
- Master gauge VW 385/30
- End dimension plate VW 385/33
- Universal dial gauge bracket VW 387
- Measuring lever VW 388
- Press plate VW 401

- Press plate VW 402
- Press tool VW 408 A
- Support rails VW 457

39-153

- Ring gear adjusting appliance VW 521/4
- Ring gear adjusting appliance VW 521/8
- Engine and transmission support VW 540
- Thrust plate 30-205
- Installing ring 2003/3
- Pinion assembly appliance 2052/2
- Thrust plate 3005
- Retainer 3028
- Thrust pad 3062
- Fitting appliance 3253 with 3253/3 and 3253/4
- Retainer 3304
- Engine/transmission jack V.A.G 1383 A

- Universal support V.A.G 1359/2
- Dial gauge extension 30 mm
- Dial gauge
- Torque gauge 0-600 Ncm

39-154

Drive pinion, adjusting

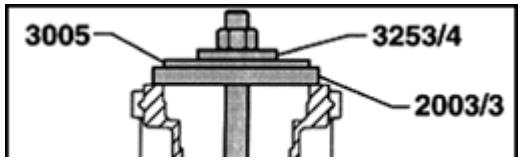
Note:

- *Before adjusting drive pinion, adjust ring gear (determine total shim thickness "S_{total}" for shims "S1" + "S2")* ⇒ *Page 39-163* .
- *The drive pinion only has to be readjusted if the final drive set (ring gear and drive pinion), the tapered roller bearings for the drive pinion or the final drive housing are replaced. Adjustment overview* ⇒ *Page 39-150* .
- *Do not additionally oil new tapered roller bearings for friction torque measurement. The bearings have already been treated with a special oil by the manufacturer.*

Determine thickness of shim "S3"

(Setting preload of tapered roller bearings for drive pinion)

- Mount final drive onto engine and transmission support ⇒ Page 39-108 .

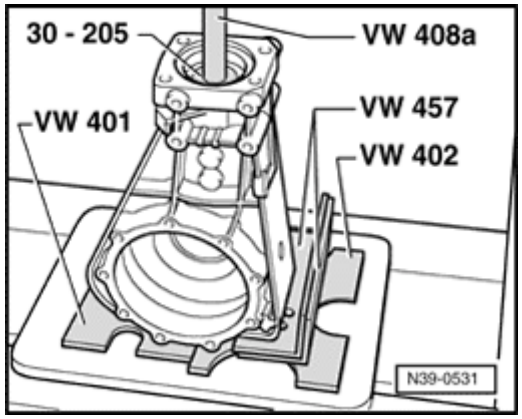


- Pull outer race of large tapered roller bearing into housing (without shim).

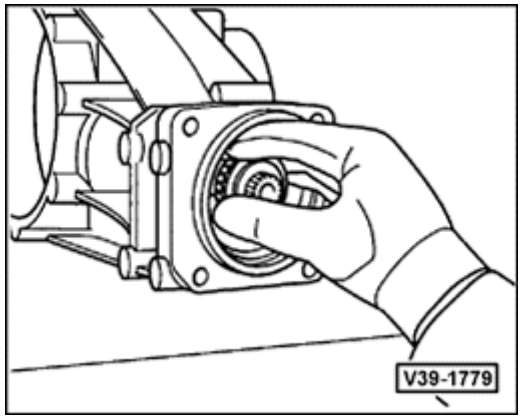
Note:

Inscription "Oben" with thrust washer 3253/4 faces the nut of the puller.

39-155



- Pull outer race for small tapered roller bearing into housing.
- Lubricate outer race with oil and fit using press tool VW 408 A and thrust plate 30-205.



- Insert drive pinion without spacer sleeve.

CAUTION!

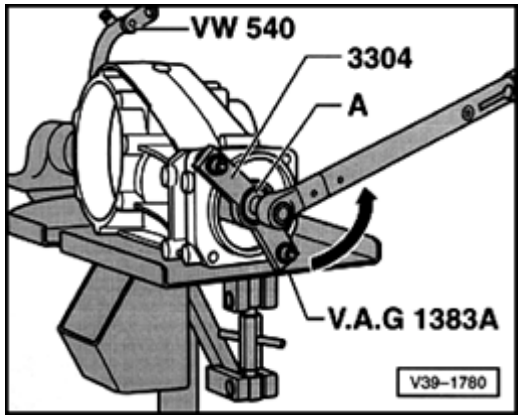
Wear protective gloves.

- Heat inner race for tapered roller bearing to approx. 100 ° C and fit onto drive pinion.

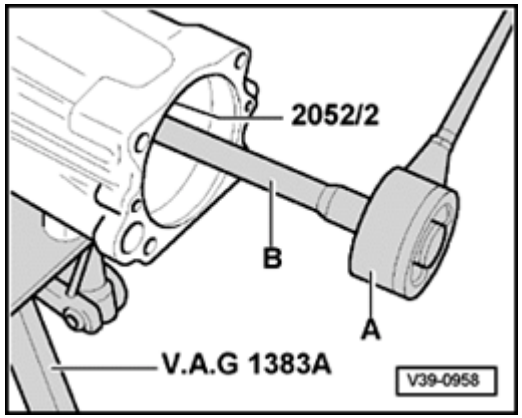
Note:

- *Do not additionally oil new tapered roller bearings for friction torque measurement. The bearings have already been treated with a special oil by the manufacturer.*
- *Only install spacer sleeve for final friction torque measurement (after determining shim "S3").*

39-156



- Secure retainer 3304 with two M8 x 30 hex bolts.
- Support final drive when tightening nut (e.g. using universal support V.A.G 1359/2 in conjunction with transmission jack V.A.G 1383 A).
- Fit a new drive pinion nut.
- Tighten drive pinion nut just far enough so that no play can be felt at drive pinion.
- Gradually increase tightening torque, checking friction torque at regular intervals, unti specified friction torque is obtained.



A - Torque gauge, commercially available, 0-600 Ncm

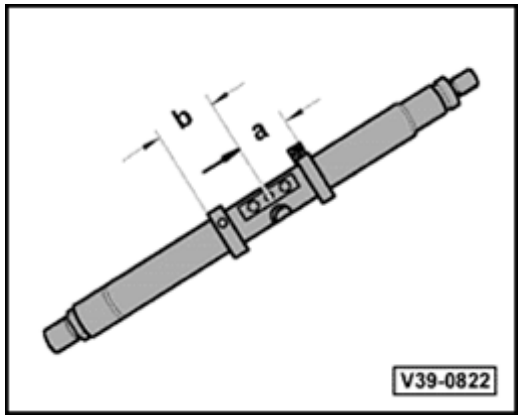
B - Extension with 32 mm socket

The following friction torques should be set:

New bearings	**Used bearings** [1)]
200-250 Ncm	30-60 Ncm

[1)] run at least 50 km (30 miles)

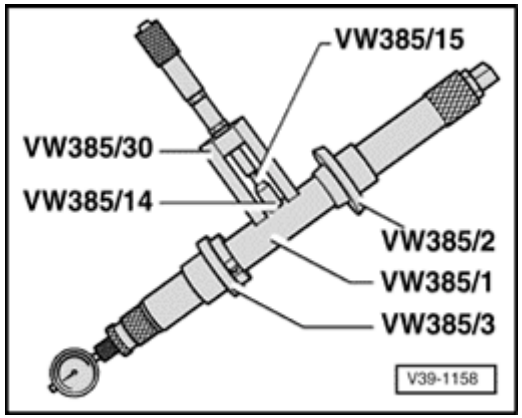
39-157



- Set adjustment ring of universal mandrel VW 385/1.

  Distance a = 60 mm
- Set sliding adjustment ring.

  Dimension b = 55 mm



- Assemble universal mandrel as illustrated:

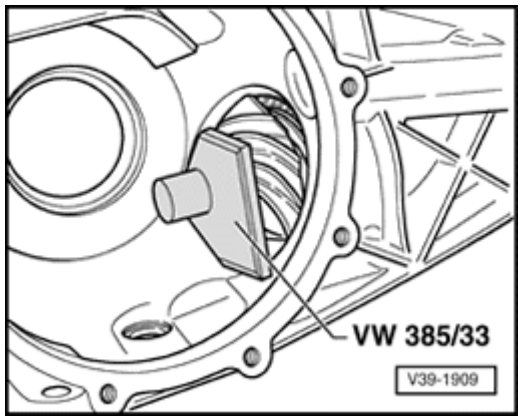
  Dial gauge extension VW 385/15 = 9 mm long
- Set universal master gauge VW 385/30.

  Ro = 57.50 mm
- Set dial gauge (3 mm measuring range) to "0" with 2 mm preload.

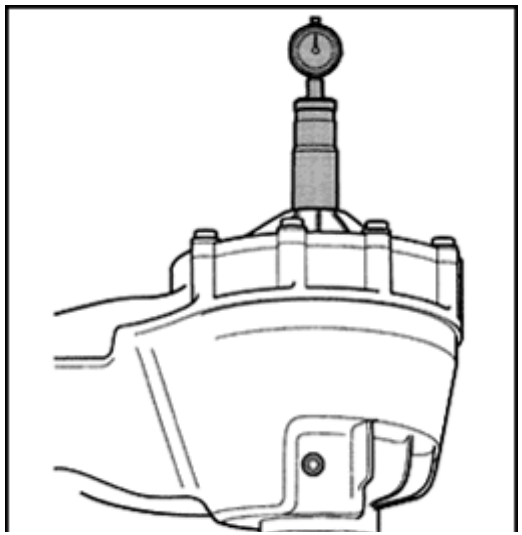
39-158

Note:

Before performing following measurements turn drive pinion at least five turns in both directions, so that the tapered roller bearings settle. Otherwise a false reading will be obtained.



- Place end measuring plate VW 385/33 onto drive pinion head.

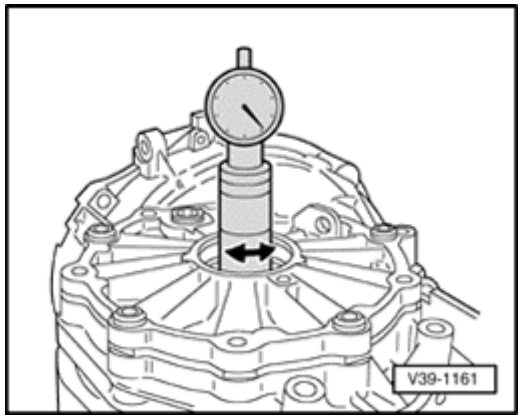


- Remove master gauge and insert measuring mandrel in the housing.

  The centering disc VW 385/3 faces toward cover for final drive

- Fit cover for final drive and tighten 4 bolts.
- Using adjustable ring, move 2nd centering disc out as far as possible so that mandrel can still just be turned by hand.

39-159



Determining measurement "e"

- Turn mandrel until dial gauge point touches end measuring plate on drive pinion head, then measure maximum deflection (return point). Measured value is dimension "e" (in red scale).
  - Measurement in following example: "e" = 1.60 mm

Note:

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

- After removing universal mandrel, check once again whether dial gauge reads "0" with 2 mm preload when master gauge VW 385/30 is in place, otherwise repeat measurement.

Determining shim thickness "S3"

Formula:

"S3" = "e" - "r"

e = Measured value

r = Deviation (tolerance): marked on ring gear in 1/100 mm

Example:

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

- Determine shim(s) as accurately as possible from table.

⇒ *Parts catalog*

The following shims are available for "S3"

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) Using the shim tolerance variations it is possible to find the exact shim thickness required, insert two shims if necessary.

- Remove universal mandrel.

- Remove drive pinion and outer race of large tapered roller bearing and install together with measured shims "S3" and spacer sleeve ⇒ from Page 39-139 .

Install inner race of small tapered roller bearing and tighten nut for drive pinion until specified friction torque is obtained

⇒ *Fig. 11* , ⇒ Page 39-144 .

Note:

- *Do not additionally oil new tapered roller bearings for friction torque measurement. The bearings have already been treated with a special oil by the manufacturer.*

- *Increase tightening torque slowly and check friction torque at regular intervals, if the specified friction torque is exceeded, the spacer sleeve must be replaced and the adjustment repeated. A spacer sleeve which has been compressed too much cannot be reused.*

- Set to following friction torques:

New bearings	Used bearings 1)
200-250 Ncm	30-60 Ncm

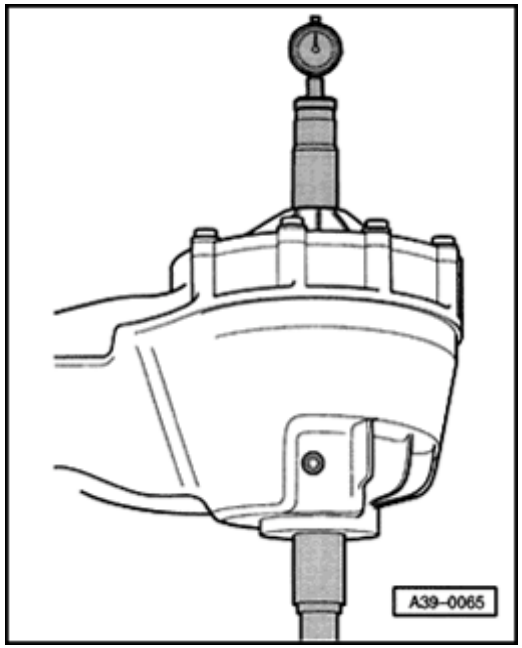
[1)] run at least 50 km (30 miles)

39-162

Performing check measurement

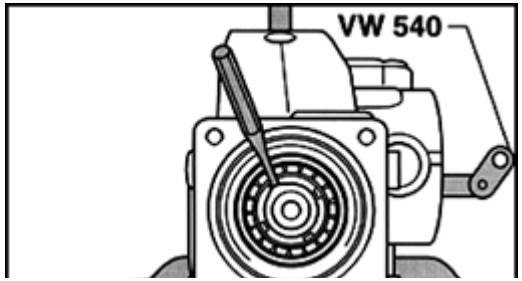
Checking dimension "r"

- Turn drive pinion at least 5 turns in both directions.



- Insert universal mandrel and perform check measurement.

  If the shims have been correctly selected, the dial gauge should now show the value of "r" as marked on the ring gear, reading anti-clockwise in the red scale, within a tolerance of ± 0.04 mm.



- Peen drive pinion nut with a punch.

39-163

Ring gear, adjusting

(Adjusting differential)

Repairs after which the ring gear has to be adjusted ⇒ Page 39-150 , Adjustment overview

Note:

- *Differential tapered roller bearings are low friction bearings. Therefore the friction torque only has a limited use as a check. Correct adjustment is only possible by determining the total shim thickness "S_{total}."*

- *Do not additionally oil new tapered roller bearings for friction torque measurement. The bearings have already been treated with a special oil by the manufacturer.*

Determining total shim thickness "S_{total}" for shims "S1" + "S2"

(Setting preload of tapered roller bearing for differential)

- Drive pinion removed or ring gear dismantled from differential housing

- Pull out drive flange oil seal with lever.

- Remove differential tapered roller bearing outer races and take out shims ⇒ Page 39-120 .

Press outer race of left tapered roller bearing for differential (housing side) with shim "S2" into housing

⇒ *Fig. 2* , ⇒ Page 39-126 . To perform measurement use a shim "S2*" with a thickness of 1.00 mm (one 0.80 mm shim and one 0.20 mm shim).

Note:

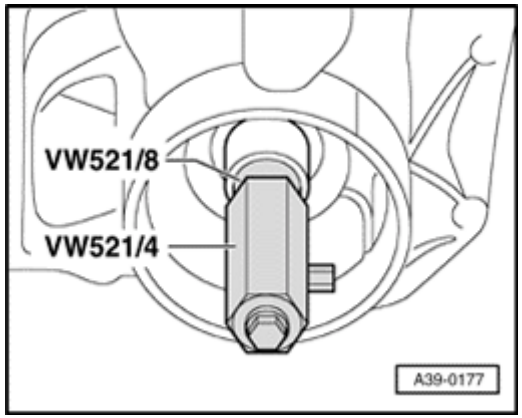
For measurement purposes a shim "S2" of 1.0 mm is initially inserted which will be designated "S2" in the following. After determining the backlash "S2*" will be replaced by the correct "S2.."*

-	Press in outer race of right tapered roller bearing for differential (final drive cover side) without shims	⇒ *Fig. 8* , ⇒ Page 39-120 (install as far as

the stop).

- Insert differential into housing. Ring gear is positioned on right side (cover side).

- Fit cover and tighten bolts to 25 Nm.

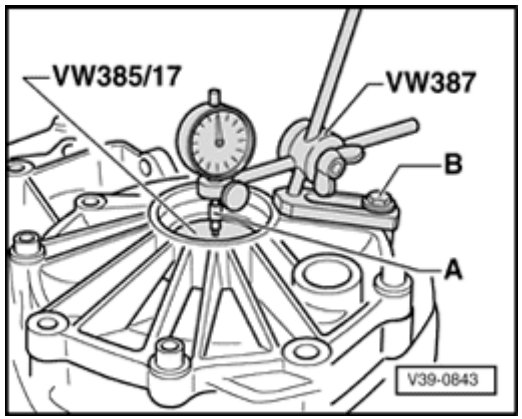


- Install special tools VW 521/4 and 521/8 onto housing side in differential housing.
- Turn cover side of differential housing upward.

39-165

- Turn differential 5 turns in both directions to settle tapered roller bearing.

- Place measuring plate VW 385/17 onto differential.



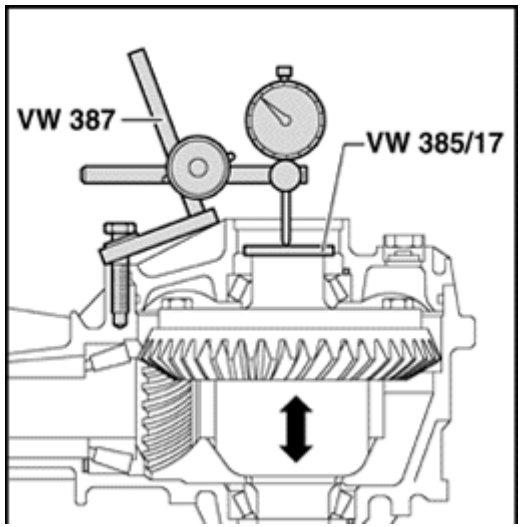
- Fit measuring tools.

A - Dial gauge extension approx. 30 mm long

B - Hex bolt M8 x 45

- Place D.T.I. extension on center of measuring plate VW 385/17.

- Set dial gauge (3 mm measuring range) to "0" with 2 mm preload.



- Lift differential without turning; read play on dial gauge and note.

  Measurement in following example: 0.50 mm

Note:

If the measurement has to be repeated, the differential must again be turned 5 turns in each direction to settle the tapered roller bearing.

39-166

Formula:

"S_{total}" = "S2*" + measurement + bearing preload

Example:

	Inserted shim(s) "S2*"	1.00 mm
+	Measured value	0.50 mm
+	Bearing preload (constant)	0.30 mm
=	Total shim thickness "S_{total}" for shims "S1" + "S2"	1.80 mm

39-167

Determining thickness of shim "S1*"

Note:

- *The preliminary adjustment shim "S1*" will be replaced with the final shim "S1" after determining the backlash.*
- *The total shim thickness "S_{total}" remains unchanged.*

Formula:

"S1*" = "S_{total}" - "S2*"

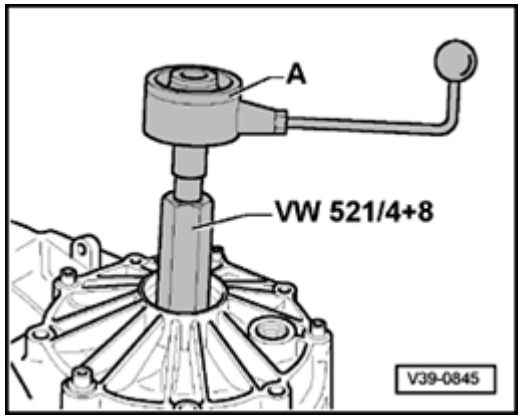
Example:

	Total shim thickness "S_{total}" for shims "S1" + "S2"	1.80 mm
-	Inserted shim(s) "S2*"	1.00 mm
=	Thickness of shim "S1*"	0.80 mm

- Determine shim(s) as accurately as possible from table ⇒ Page 39-172 .

Measuring friction torque (check)

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



- Fit torque gauge 0-600 Ncm -A- onto differential.
- Read friction torque.

Friction torque specifications:

New bearings	Used bearings 1)
150-300 Ncm	30-60 Ncm

1) run at least 50 km (30 miles)

Note:

- *Differential tapered roller bearings are low friction bearings. Therefore the friction torque only has a limited use as a check. Correct adjustment is only possible by determining the total shim thickness "S_{total}."*
- *Do not additionally oil new tapered roller bearings for friction torque measurement. The bearings have already been treated with a special oil by the manufacturer.*
- *If the final drive set (drive pinion and ring gear) is being re-adjusted, the adjustment of the drive pinion should be performed now, and the*

adjustment checked ⇒ *Page 39-154* .

39-169

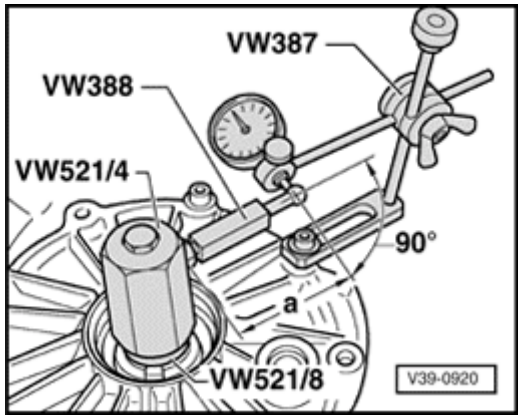
Adjusting backlash

(Positioning ring gear in final drive housing)

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

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

- Turn differential 5 turns in both directions to settle tapered roller bearings.



- Assemble measuring equipment.

  Use dial gauge extension VW 382/10 (6 mm flat).

- Set measuring lever VW 388 to dimension "a" = 60 mm.
- Determine play between teeth flanks as follows:
  - Turn ring gear until it makes contact with a tooth flank (end of backlash travel).
  - Set dial gauge to "0" with 1 mm preload.

- Turn ring gear back until lying against an opposite tooth flank (backlash).

- Read backlash and note value.

- Turn ring gear through 90° and repeat measurements a further 3 times.

Note:

If the individual measurements differ by more than 0.06 mm from each other, the installation of the ring gear or the final drive set itself is not correct. Check installation, replace final drive set if necessary.

Determining average backlash

Example:

	1st measurement	0.28 mm
+	2nd measurement	0.30 mm
+	3rd measurement	0.30 mm
+	4th measurement	0.28 mm
=	Sum of measured values	1.16 mm

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

Determining thickness of shim "S2"

Formula:

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

Example:

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

- Determine shim(s) as accurately as possible from table.

⇒ *Parts catalog*

The following shims are available for "S2"

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

1) Using the shim tolerance variations it is

possible to find the exact shim thickness required, insert two shims if necessary.

39-172

Determining thickness of shim "S1"

Formula:

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

Example:

	Total shim thickness "S_{total}" for "S1" + "S2"	1.80 mm
-	Thickness of shim "S2"	0.86 mm
=	Thickness of shim "S1"	0.94 mm

- Determine shim(s) as accurately as possible from table. Part numbers

⇒ *Parts catalog*

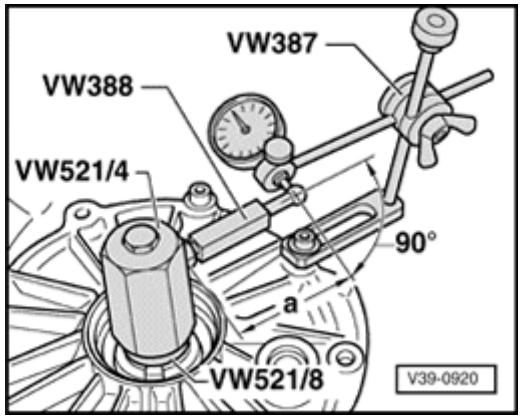
The following shims are available for "S1"

Shim thickness (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) Using the shim tolerance variations it is possible to find the exact shim thickness required, insert two shims if necessary.

39-173



Performing check measurement

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

- Turn differential 5 turns in both directions so that tapered roller bearings settle.
- Measure backlash four times on circumference.
  - Specifications: 0.12-0.22 mm

Note:

- *If the backlash lies outside the tolerances, the adjustments must be repeated, but the total shim thickness "S_{total}" must remain unchanged.*
- *The individual measurements must not differ by more than 0.06 mm from each other.*