Repair Manual

911 Carrera 4
(993)

Volume II:
Transmission
Manual

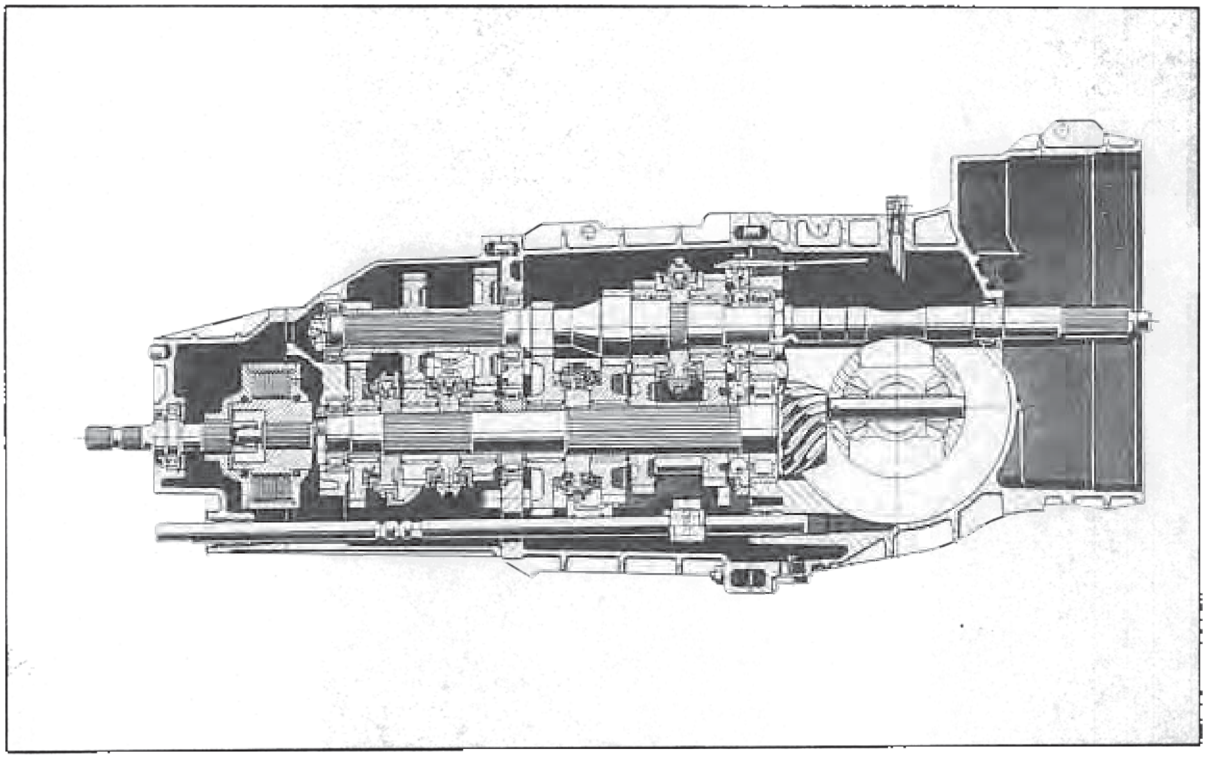
Dr. Ing. h.c. F. Porsche Aktiengesellschaft

II Manual Transmission (911 Carrera 4)

3 Transmission

3 Technical data

6 speed manual transmission G 64



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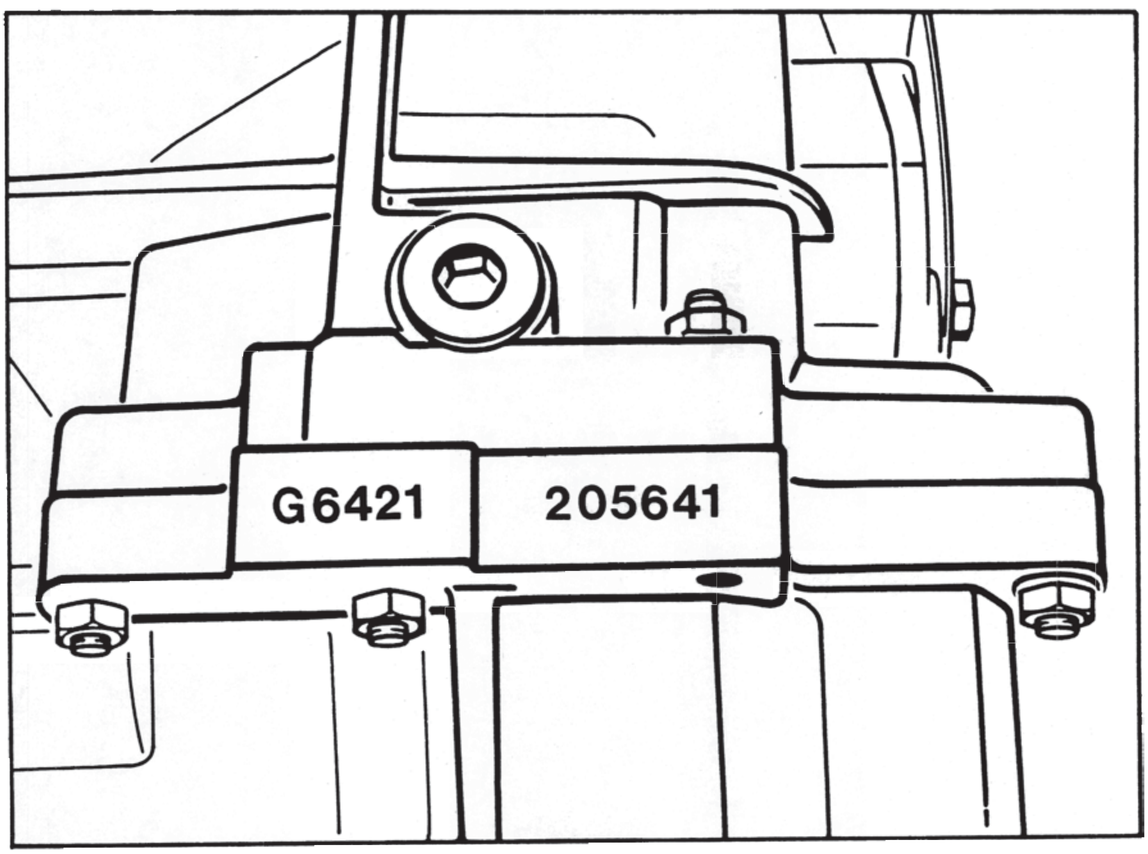
Type	Equipment	installed in:	Model year
G 64/21	6 speed	911 Carrera 4 worldwide except USA, CH, A	’95 / ’96
G 64/20	6 speed	911 Carrera 4 USA, CH, A	’95 / ’96
		911 Carrera 4 worldwide	’97

3 Technical Data

Structure of transmission numbers

G64/21	1	05641
Transmission type	**Index for variances within the engine no.** 1 = standard differential 2 = lock differential	**Number** e.g. 05641



3 Technical Data (Manual transmission)

General Data	**Manual transmission G 64 / 21 / 20**	
Transmission ratios	G64/21 Z_1 $Z_2 = Z_2 : Z_1$	G64/20 Z_1 $Z_2 = Z_2 : Z_1$
1st gear	11 : 42 = 3.818	11 : 42 = 3.818
2nd gear	20 : 43 = 2.150	21 : 43 = 2.048
3rd gear	25 : 39 = 1.560	27 : 38 = 1.407
4th gear	33 : 41 = 1.242	34 : 38 = 1.118
5th gear	41 : 42 = 1.024	42 : 39 = 0.928
6th gear	39 : 32 = 0.820	40 : 31 = 0.775
Reverse	14 : 40 = 2.857	14 : 40 = 2.857
Final drive	Hypoid bevel-gear drive with 16 mm offset	
Final drive ratio	9 : 31 = 3.444	9 : 31 = 3.444
Capacity	3.8 liters multigrade transmission oil SAE 75 W 90 of API classification GL 5 (or MIL-L 2105 B)	

3 Technical Data

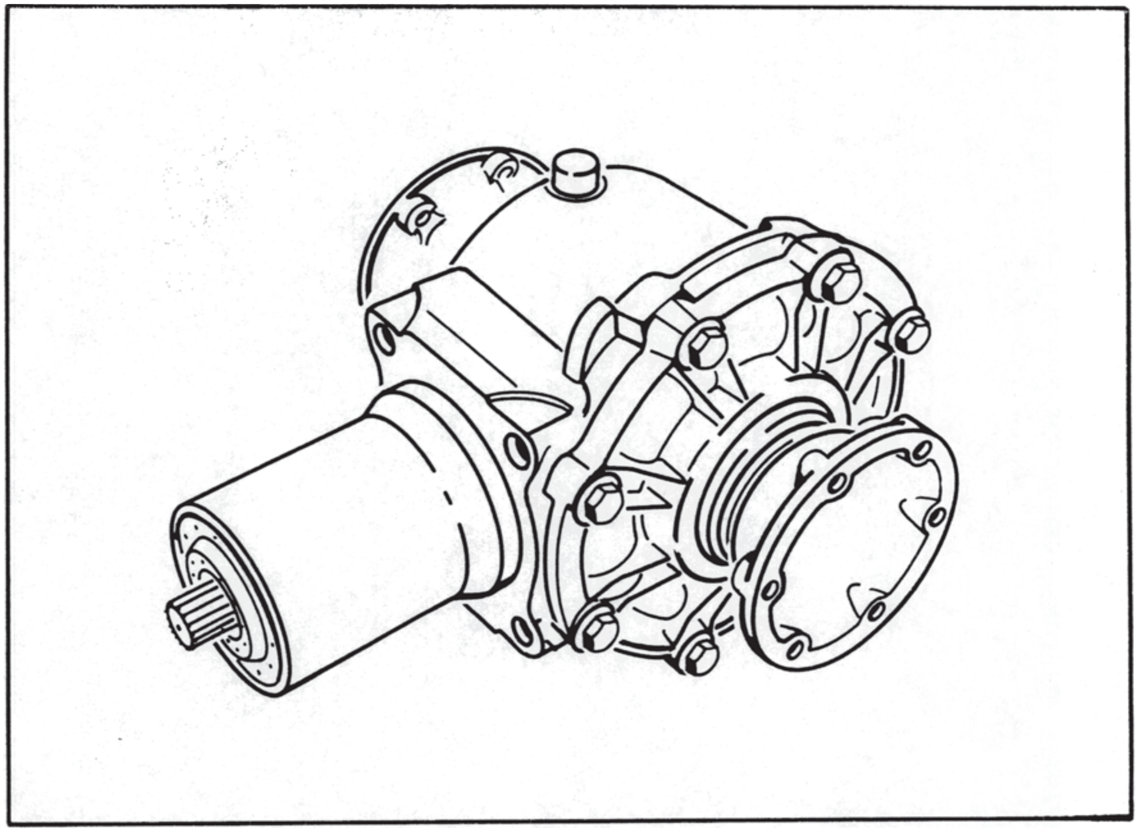
Torque specifications for manual transmission, front axle final drive, transmission suspension and central tube

Location	Thread	Tightening torque Nm (ftlb)
Oil drain and oil filler plugs	M 22 x 1,5	30
Hexagon head nuts at: Front and side transmission cover, gear and transmission housings. Tensioning plate	M 8	23
Clamping plate to intermediate case	M 6	10
Hexagon head nut / input shaft	M 22 x 1,5	200
Hexagon head nut / input shaft	M 30 x 1,5	250
Hexagon head nut / output shaft	M 30 x 1,25	300
Hexagon head nut / shift fork	M 8	23
Reverse light switch to gear housing	M 18 x 1,5	35
Guide tube to transmission housing	M 6	10
Selector gate to tensioning plate	M 6	10
Collar nut / return gear II	M 8	23
Vent to transmission housing	M 14 x 1,5	35

Location	Thread	Tightening torque Nm (ftlb)
Hexagon head bolt / joint flange	M 10	44 (32)
Oil pan to tension plate	M 5 (microencapsulated)	6 (4)
Ring gear to differential housing (hexagon head bolt with ribbed seating surface)	M 12 x 1,25	200 (147)
Front axle final drive		
Oil filler plug	M 22	22 (16)
Oil drain plug	M 22	30 (22)
Final drive mount at rear axle		
Crossmember to body	M 10 x 70	46 (34)
Mount to crossmember (lock nut)	M 10	46 (34)
Mount to transmission (lock nut)	M 10	46 (34)
Final drive mount at front axle		
Front axle final drive mount to front axle crossmember	M 8	23 (17)
Front axle final drive mount to central tube	M 12	85 (63)
Central tube		
Double clamp to central shaft	M 8	35...40 (26...29)
Manual transmission to central tube	M 12	85 (63)
Front axle final drive to central tube	M 10	46 (34)

3 Technical Data

Front axle final drive



Type	Code letter	Equipment	Installed in:	Model Year
Z64/20			911 Carrera 4 worldwide	'95

General data	Front axle final drive Z64/20
Final drive ratio ($Z_2 : Z_1 = i$)	31 : 9 = 3.444
Final drive	Bevel drive without hypoid offset
Capacity	Approx. 0.6 liters hypoid oil 75 W 90 of API classification GL 5 (or MIL-L 2105 B)

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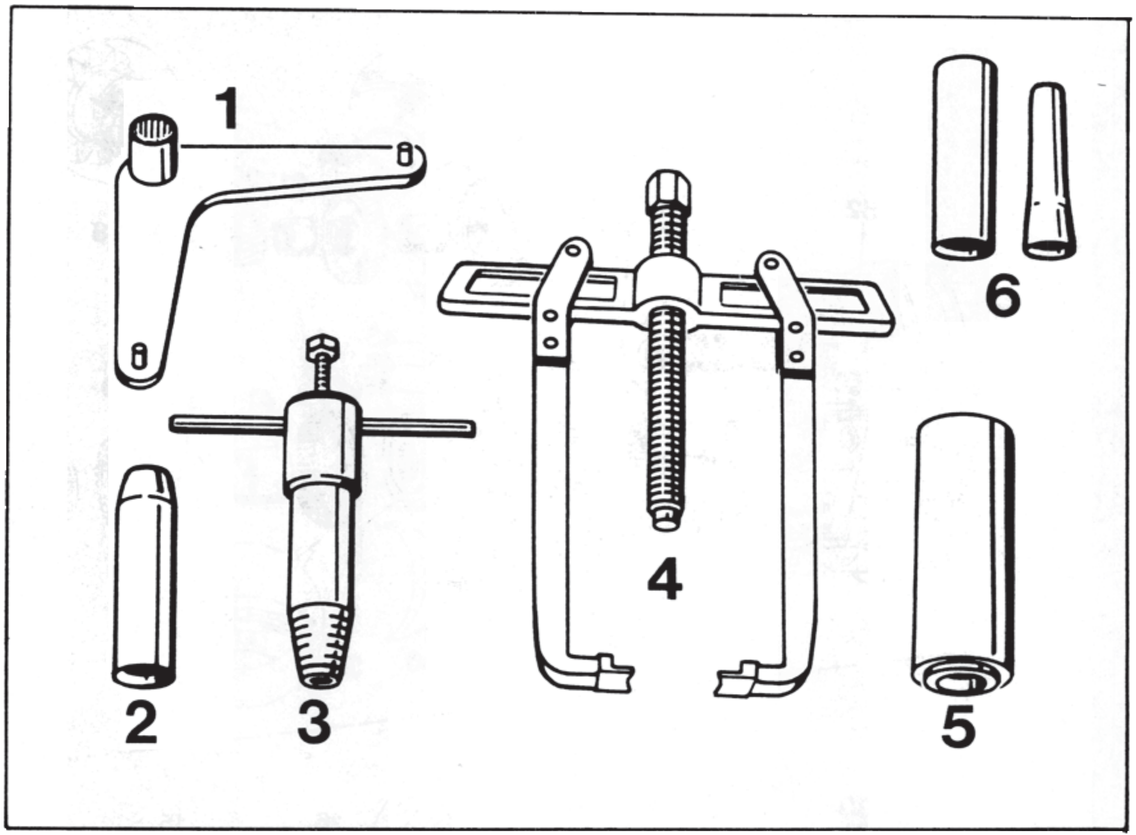
Tools



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No.	Designation	Special tool	Order number	Explanation
1	Bracket	9253	000.721.925.30	
2	Sleeve	9255	000.721.925.50	
3	Pulling tool	9251	000.721.925.10	
4	Puller	-	-	with arms of puller 9284
5	Thrust piece	9256	000.721.925.60	
6	Assembly tool	9547	000.721.954.70	

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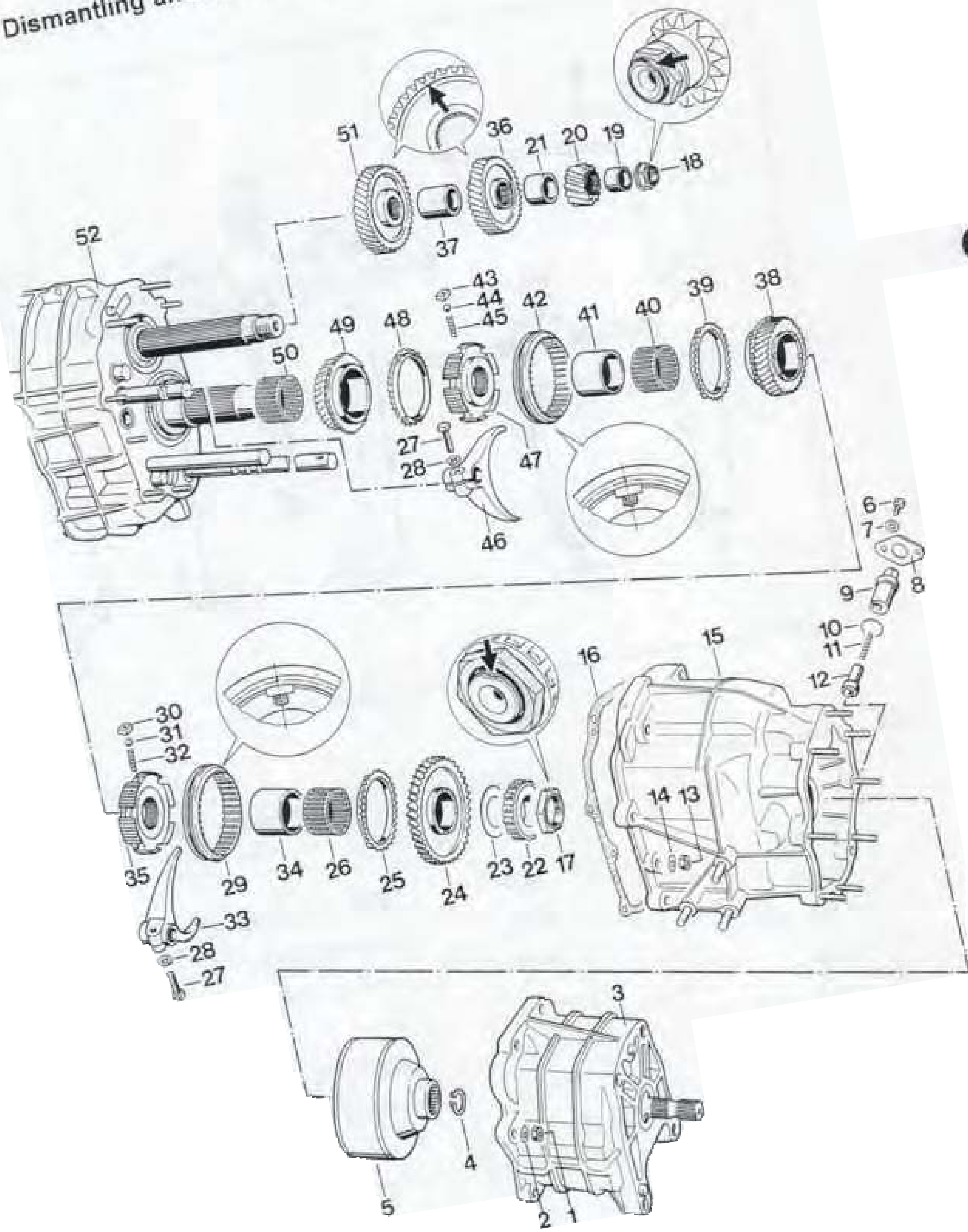

No.	Designation	Qty.	Note: Removal	Installation
1	Hexagon head nut	8		M_A = 23 Nm (17 ftlb.)
2	Washer	8		
3	Transfer casing	1		Seal between transfer casing and intermediate casing is made with Loctite 573
4	Snap ring	1	Remove with suitable pointed pliers	Install with Special Tool 9547
5	Viscous clutch	1		
6	Hexagon head bolt	2		Tighten to 10 Nm (7 ftlb.)
7	Washer	2		
8	Tensioning plate	1		
9	Eccentric bushing	1		Adjust
10	Seal	1		Replace
11	Thrust spring	1		
12	Locking bushing	1		
13	Hexagon head nut	10		Tighten to 23 Nm (17 ftlb.)
14	Washer	10		
15	Intermediate casing	1		
16	Gasket	1		Replace
17	Hexagon nut*	1	Lock input shaft with Special Tool 9253 and engage 6th gear	Tighten to 300 Nm (221 ftlb.). Upset flange to lock
18	Hexagon nut*	1	Lock input shaft with Special Tool 9253 and engage 6th gear	Tighten to 200 Nm (147 ftlb.). Upset flange to lock
19	Bearing inner race	1	Pull off across fixed gear No. 20	Heat to approx. 120 °C
20	Fixed gear (Reverse)	1		
21	Spacer sleeve	1		
22	Cylindrical roller bearing	1	Pull off across loose gear No. 24	Heat to approx. 120 °C
23	Thrust washer	1		

Printed in Germany - 20, 1997

No.	Designation	Qty.	Note: Removal	Installation
24	Loose gear (Reverse)	1		
25	Synchronizer ring	1	Mark for reinstallation	Check for wear. Fit with the same gear-wheel (Cogs must face driver dogs)
26	Needle bearing cage	1	Mark for reinstallation	Fit with the same gear-wheel
27	Hexagon head bolt	2		Tighten to 23 Nm (17 ftlb.)
28	Washer	2		
29	Selector sleeve	1	Lift off along with shift fork No. 33. Take care not to lose synchromesh parts.	Center the centerpunch marks relative to the dri-ver dogs. Offset side faces loose gear No. 24
30	Driver dog	3		Domed end faces se-lector sleeve
31	Ball	3		
32	Spring	3		
33	Shift fork (Reverse)	1		Adjust so that play is ba-rely felt at the selector sleeve when reverse is engaged. When neutral is engaged, the synchroni-zing ring must be able to rotate freely
34	Inner race**	1	Mark for reinstallation. Pull off across guide sleeve No. 35	Heat to approx. 120 °C
35	Guide sleeve (with snap ring)	1		Open end of snap ring must not be located in the driver dog area. Install in correct position complete with selector sleeve and shift fork (Snap ring faces loose ge-arwheel No. 38)

No.	Designation	Qty.	Note: Removal	Installation
36	Fixed gear (5th gear)	1		Identification groove faces fixed gear No. 20. Do not confuse with fixed gear No. 51
37	Spacer sleeve	1		
38	Loose gear (5th gear)	1		Do not confuse with loo-se gear No. 49
39	Synchronizing ring	1	Mark for reinstallation	Check for wear. Fit with the same gearwheel. (Cogs face driver dogs)
40	Needle roller bearing cage	1	Mark for reinstallation	Fit with the same gear-wheel
41	Inner race**	1	Mark for reinstallation. Pull off with arms of Special Tool 9284 across loose gear No. 49	Fit with the same gear-wheel. Heat to approx. 120 °C
42	Selector sleeve	1		Center the centerpunch marks relative to the dri-ver dogs
43	Driver dog	3		Domed side faces selector sleeve
44	Ball	3		
45	Spring	3		
46	Shift fork (5th and 6th gears)	1		Adjust. In neutral positi-on, selector sleeve must be set exactly in the middle between the loose gearwheels
47	Guide sleeve	1		Install complete with se-lector sleeve and shift fork
48	Synchronizing ring	1	Mark for reinstallation	Check for wear. Fit with the same gear (Cogs face driver dogs)

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No.	Designation	Qty.	Note: Removal	Installation
49	Loose gear (6th gear)	1		Do not confuse with loo-se gear No. 38
50	Needle roller bearing cage	1	Mark for reinstallation	Fit with the same gear-wheel
51	Fixed gear (6th gear)	1		Identification groove faces fixed gear No. 36. Do not confuse with fixed gear No. 36
52	Transmission	1		

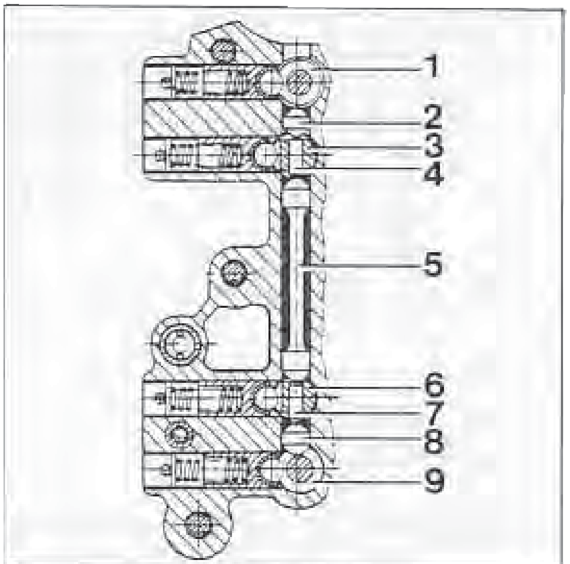
* Transmission shafts without recesses for securing the hexagon nuts have been installed since September 1995.
Self-locking hexagon nuts are used on these shafts, and these nuts must **always** be replaced in every
transmission repair.

** A result of tolerances, the bearing inner rings (no. 34 and 41) may either from a force fit on the shaft or have a certain amount of play.

Dismantling and assembly notes

Note

If the shift rods are moved across the neutral or gear latching positions when the transmission is dismantled or assembled, the small intermediate locks may drop out inadvertently.



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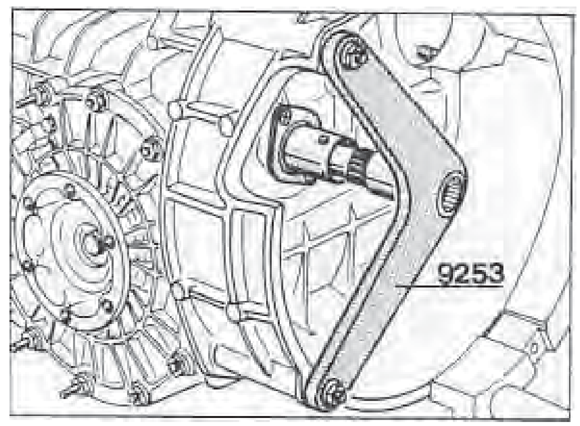
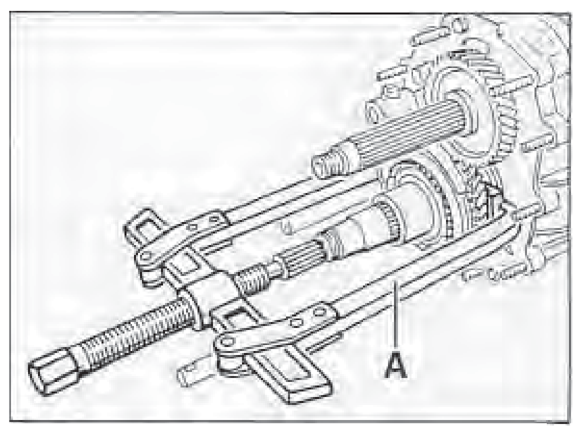
4 and 7 = Intermediate locks

Dismantling

1. Engage 6th gear, lock drive shaft with Special Tool **9253** and unscrew hexagon head nuts for output and input shafts.



2. Engage 4th gear and pull off inner race of needle roller bearing (5th gear).



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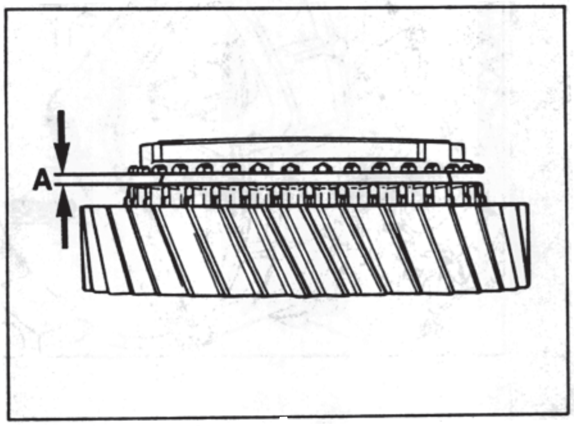
A = Arms of puller No. 9284

Assembly

1. Check synchronizing rings by pushing rings onto tapers of gearwheels and measuring gap „A“ with a feeler gauge.

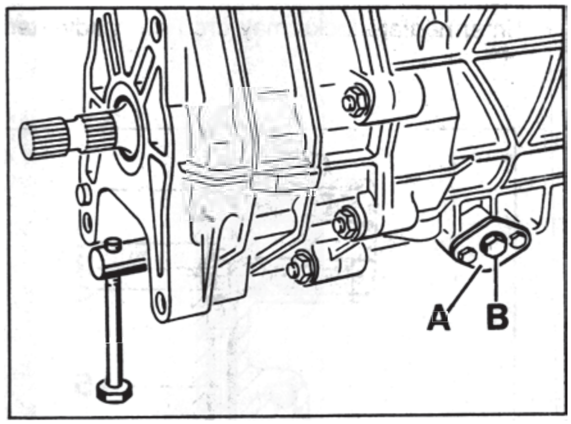
Installation dimension (new) = 0.9 mm min.
Wear limit = 0.6...0.7 mm



518-35

2. Engage 4th gear and fit all gearwheels.

3. Adjust inner shift rod until all gears may be preselected freely without notching. To adjust, undo hexagon head bolts of tensioning plate and rotate eccentric bushing.



2014-34

A = Tensioning plate
B = Eccentric bushing

4. To check, shift through all gears, using a long M 8 bolt that is screwed into the inner shift rod.

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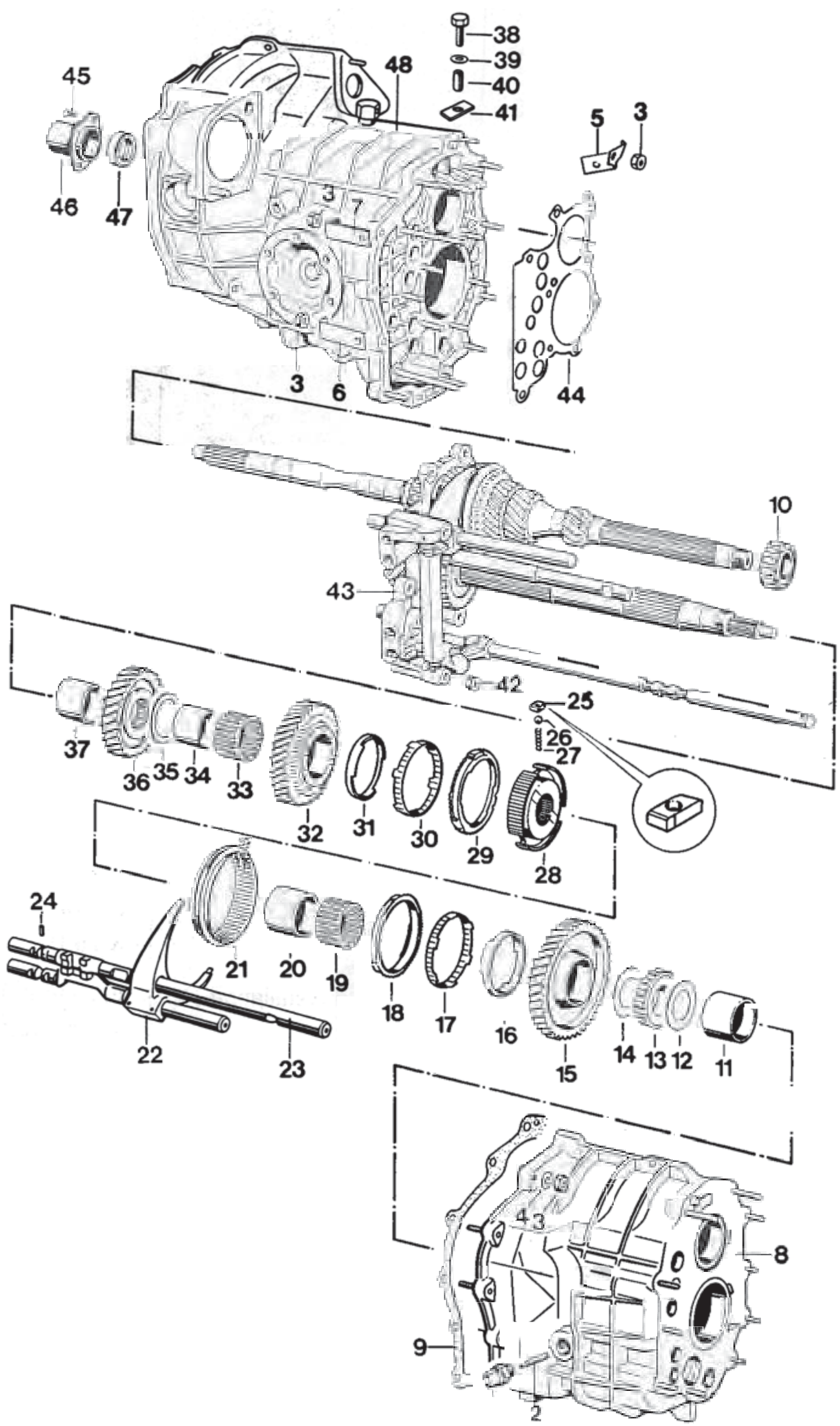

No.	Designation	Qty.	Note: Removal	Installation
1	Reverse light switch	1		Tighten to 35 Nm (26 ftlb.)
2	Plunger	1		Stepped end faces switch
3	Hexagon head nut	12		Tighten to 23 Nm (17 ftlb.)
4	Washer	10		
5	Retaining bracket	1	deleted	
6	Retaining bracket (straight)	1		
7	Retaining bracket (domed)	1		
8	Gear housing	1		
9	Gasket	1		Replace
10	Cylindrical roller bearing	1	Pull off	Heat to approx. 120° C
11	Inner race	1	Mark for reinstallation. Pull off across loose gear-wheel No. 15. Observe clearance at reverse shift rod	Fit with the same gear-wheel. Heat to approx. 120°C
12	Thrust washer	1		
13	Cylindrical roller bearing	1		Heat to approx. 120° C
14	Thrust washer	1		
15	Loose gearwheel (1st gear)	1		
16	Friction ring	1	Mark for reinstallation	Fit with the same gear-wheel
17	Tapered ring	1	Mark for reinstallation	Fit with the same gear-wheel. Tabs must engage in the cutouts in the loose gearwheel

No.	Designation	Qty.	Note: Removal	Installation
18	Synchronizing ring	1	Mark for reinstallation	Check for wear. Fit with the same gearwheel. Drivers must engage in the cutouts in the tapered ring. Three lugs face driver dogs
19	Needle roller bearing	1	Mark for reinstallation	Fit with the same gear-wheel
20	Inner race	1	Shift rods in neutral position. Pull out shift rod for reverse gear. Pull off across loose gearwheel No. 32. Mark for reinstallation.	Fit with the same gear-wheel. Heat to approx. 120 °C
21	Shift sleeve	1		Insert complete with guide sleeve and shift rods. The missing tooth of the internal teeth of the guide sleeve (No. 28) must be aligned exactly above the oil bore of the output shaft. For further notes, refer to page 35 - 213
22	Shift rod with pinned shift fork	1		
23	Shift rod (reverse)	1		
24	Spacer	1		Apply stiff grease to insert into shift rod
25	Driver dog	3		Place into correct position
26	Ball	3		
27	Spring	3		

No.	Designation	Qty.	Note: Removal	Installation
28	Guide sleeve	1		Missing tooth of internal teeth must be placed exactly above oil bore of output shaft
29	Synchronizing ring	1	Mark for reinstallation	Check for wear. Fit with the same gearwheel. Drivers must engage into the cutouts in the tapered ring. The lugs face the driver dogs.
30	Tapered ring	1	Mark for reinstallation	Fit with the same gear-wheel. Tabs must engage into the cutouts in the loose gearwheel
31	Friction ring	1	Mark for reinstallation	Fit with the same gear-wheel
32	Loose gearwheel (2nd gear)	1		
33	Needle roller bearing	1	Mark for reinstallation	Fit with the same gear-wheel
34	Inner race	1	Mark for reinstallation. Pull off across fixed gear-wheel No. 36	Fit with the same gear-wheel. Heat to approx. 120 °C
35	Thrust washer	1		
36	Fixed gearwheel (3rd gear)	1		Large flange faces thrust washer No. 35
37	Spacer sleeve	1		
38	Hexagon head bolt (micro-sealed)	1		Must always be replaced. Tightening torque 6 Nm (4 ftlb.)
39	Washer	1		
40	Spacer sleeve	1		

No.	Designation	Qty.	Note: Removal	Installation
41	Retaining plate	1		
42	Hexagon head nut	10		Tighten to 23 Nm (17 ftlb.)
43	Tensioning plate with gear set	1		
44	Adjusting washer "S_3"	X	Note number and thickness for reinstallation	Redetermine thickness if required
45	Oval-head screw	2		Tighten to 10 Nm (7 ftlb.)
46	Guide tube	1		
47	Shaft seal	1	Refer to page 35 - 1	Do not fit until gear set has been fitted (refer to page 35 - 1)
48	Transmission housing	1		

Note

Due to the tolerances (transition fit), the inner bearing rings (nos. 11, 20 and 34) may have clearance or press-fit on the shaft.

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Dismantling and assembly notes

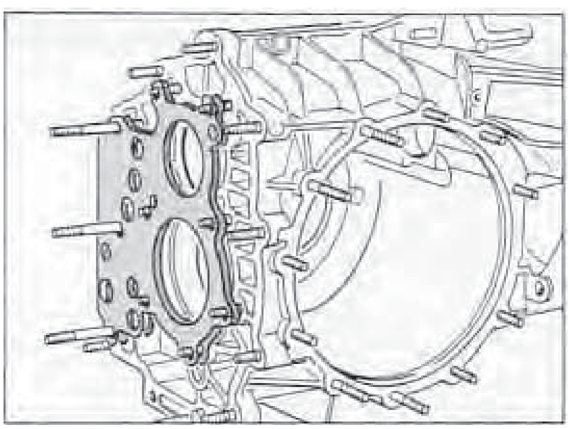
Dismantling

Note

To facilitate assembly, do not remove the complete gear set assembly but partially dismantle the installed drive pinion.

Assembly

1. The number of adjusting shims "S3" noted during dismantling or the number of adjusting shims noted when the drive pinion was adjusted should be placed onto the studs in the housing until the equivalent thickness is obtained.



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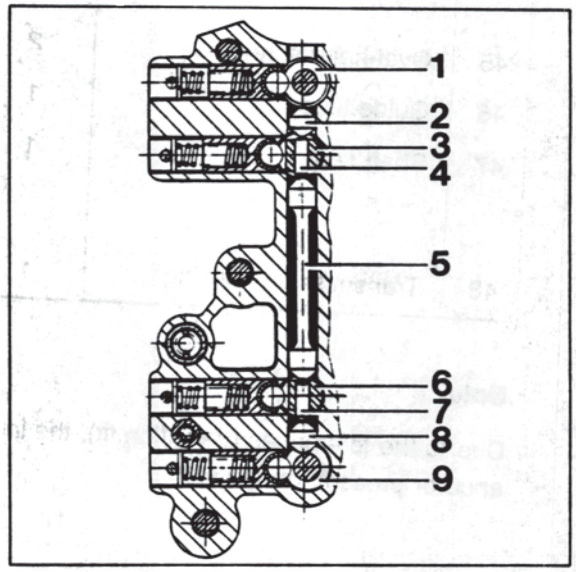
2. Engage 4th gear and assemble fully preassembled gear set to internal selector rod.

3. Tighten tensioning plate lock nuts to 23 Nm (17 ftlb).

Note

Do not move shift rods across the neutral or gear stop position as this may cause the small intermediate locks to drop out inadvertently.



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4 and 7 = Intermediate locks

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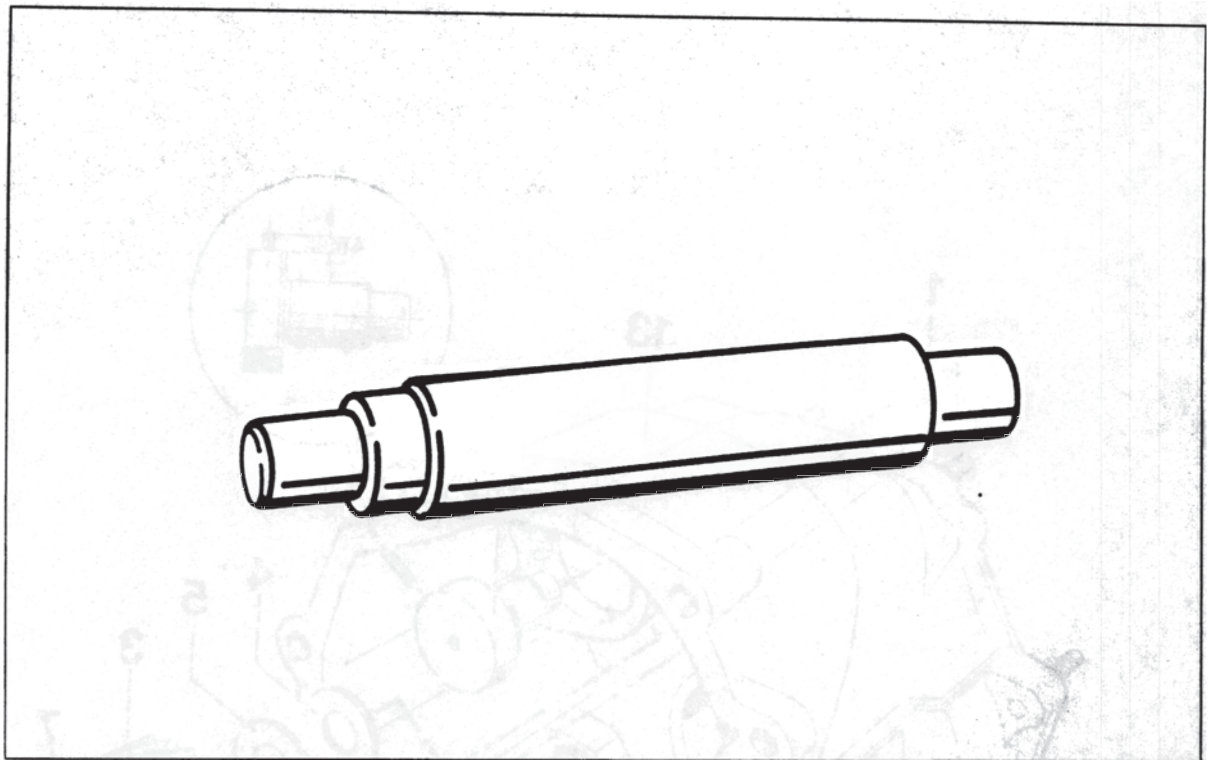
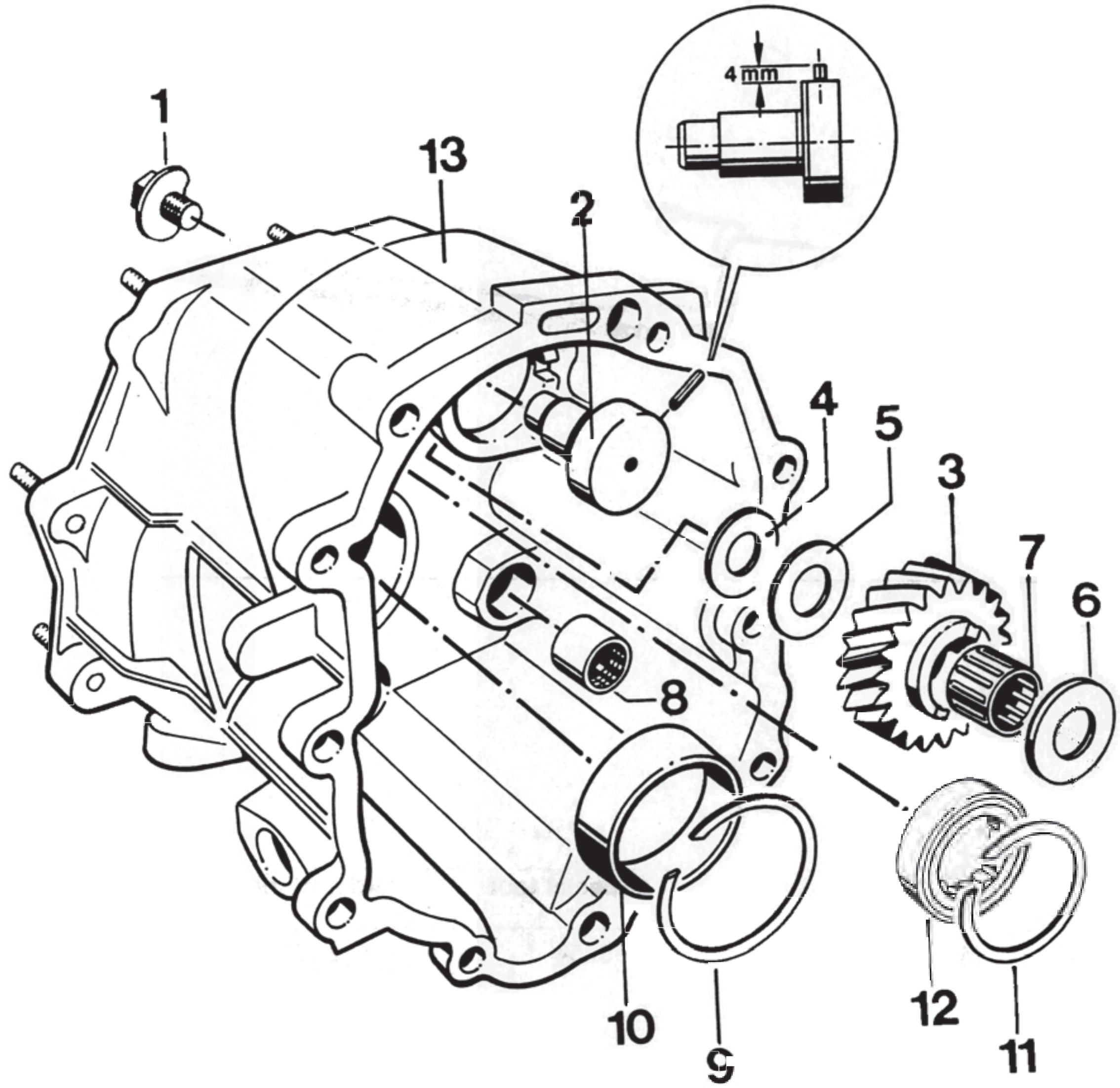


No.	Designation	Special tool	Order number	Explanation
	Mandrel	9254	000.721.925.40	

Dismantling and assembling intermediate casing



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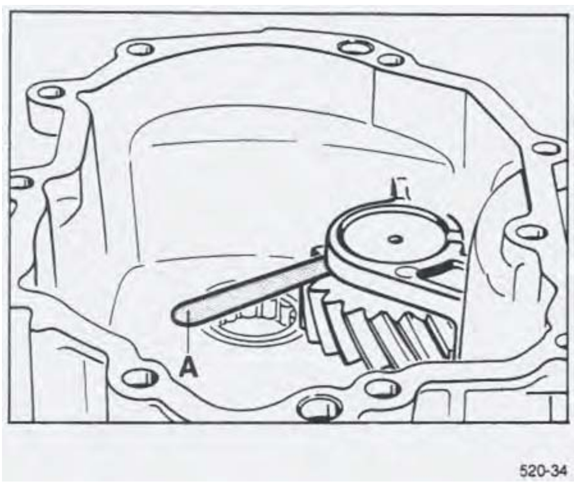
No.	Designation	Qty.	Note:	
			Removal	**Installation**
1	Hexagon head bolt with washer	1		M_A = 23 Nm (17 ftlb.)
2	Pin with roll pin	1		Install in correct position
3	Reverse idler gear	1		Small flange faces hexagon head bolt (item No. 1)
4	Thrust washer (2.0 mm thick)	1		
5	Thrust washer (1.5 mm thick)	1		Do not confuse with washer No. 4
6	Thrust washer (1,5 mm thick)	1		Do not confuse with washer No. 4
7	Needle roller assembly	1		
8	Ball sleeve	1	Push out with suitable drift or a length of pipe (e.g. VW 423)	Working from inside, press in flush across lettered side using 9254
9	Snap ring	1		
10	Bearing outer race	1	Heat housing to approx. 120 °C	Heat housing to approx. 120 °C
11	Snap ring	1		
12	Cylindrical roller bearing	1	Heat housing to approx. 120 °C and pull out with suitable internal puller (e.g. Schrem 30 - 40)	As No. 10
13	Housing	1		

Notes on assembly

1. Reassemble reverse idler gear with thrust washers and bolt in correct position (refer to exploded view). With thrust washers and bolt located correctly, the end clearance of the reverse idler gear is 0.15...0.35 mm.



A = Feeler gauge

2. Check end clearance of reverse idler gear with feeler gauge.

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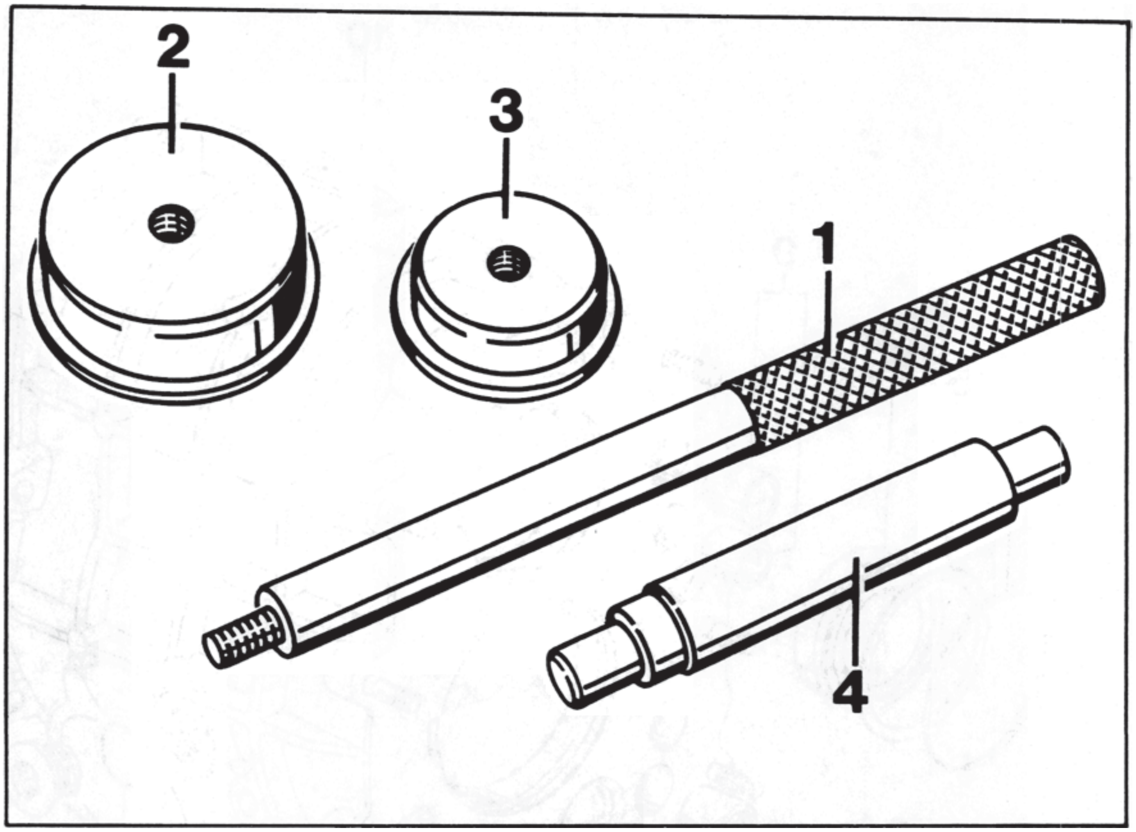
Tools



No.	Designation	Special tool	Order number	Explanation
1	Mandrel	P 254	000.721.254.00	
2	Thrust piece	P 254 a	000.721.254.10	
3	Thrust piece	P 254 b	000.721.254.20	
4	Mandrel	9254	000.721.925.40	

Printed in Germany - IX, 1994

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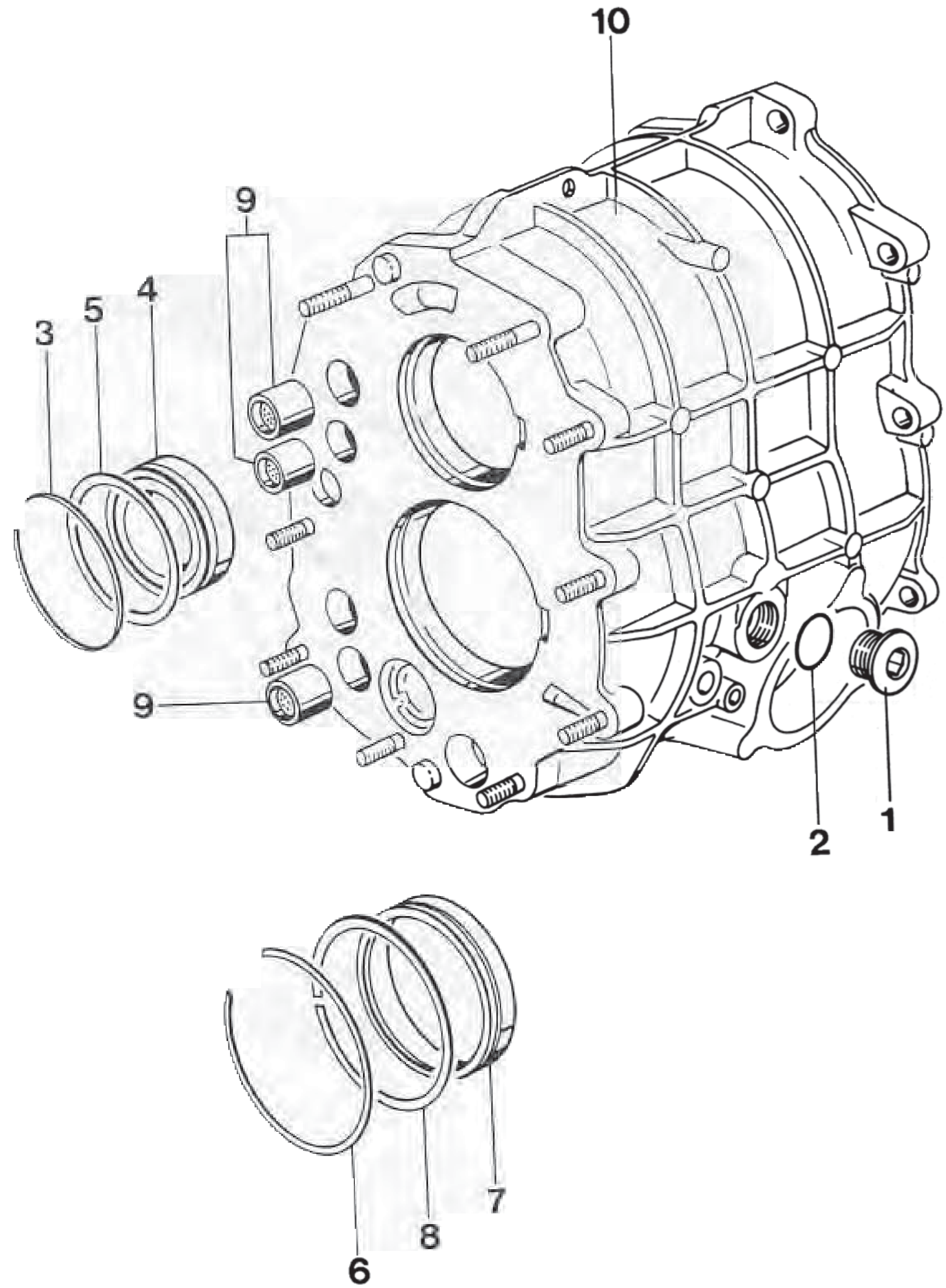

No.	Designation	Qty.	Note: Removal	Installation
1	Plug	1		Torque: 30 Nm (22 ftlb.)
2	Seal	1		Replace
3	Retaining ring	1		
4	Bearing outer race	1	Working from inside, press out with Special Tools P 254 and P 254 b	Press in with Special Tools P 254 and P 254 b
5	Snap ring	1		
6	Retaining ring	1		
7	Bearing outer race	1	Working from inside, press out with Special Tools P 254 and P 254 b	Press in with Special Tools P 254 and P 254 b
8	Snap ring	1		
9	Ball sleeve	3	Press out with suitable mandrel	Press in flush with Special Tool 9254
10	Gear housing	1		

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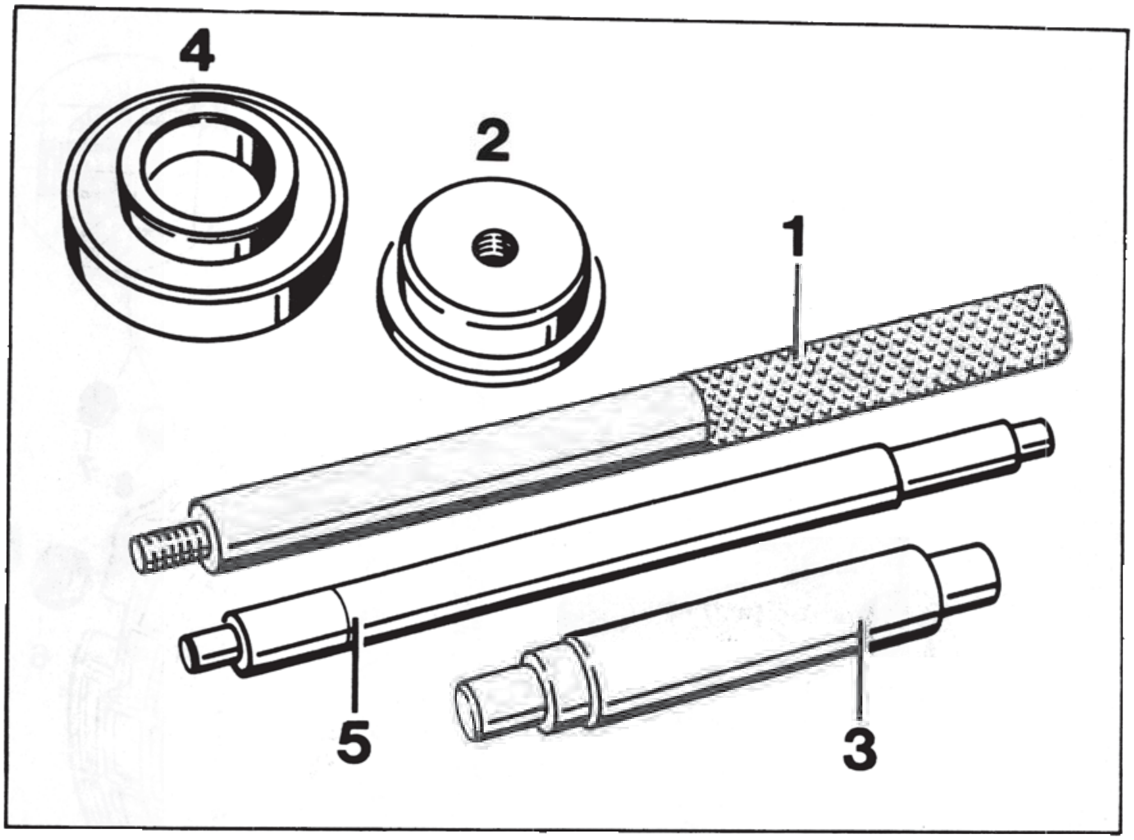
Tools



No.	Designation	Special tool	Order number	Explanation
1	Mandrel	P 254	000.721.254.00	
2	Thrust piece	P 254 b	000.721.254.20	
3	Mandrel	9254	000.721.925.40	
4	Thrust piece	9252	000.721.925.20	
5	Mandrel	9515	000.721.951.50	

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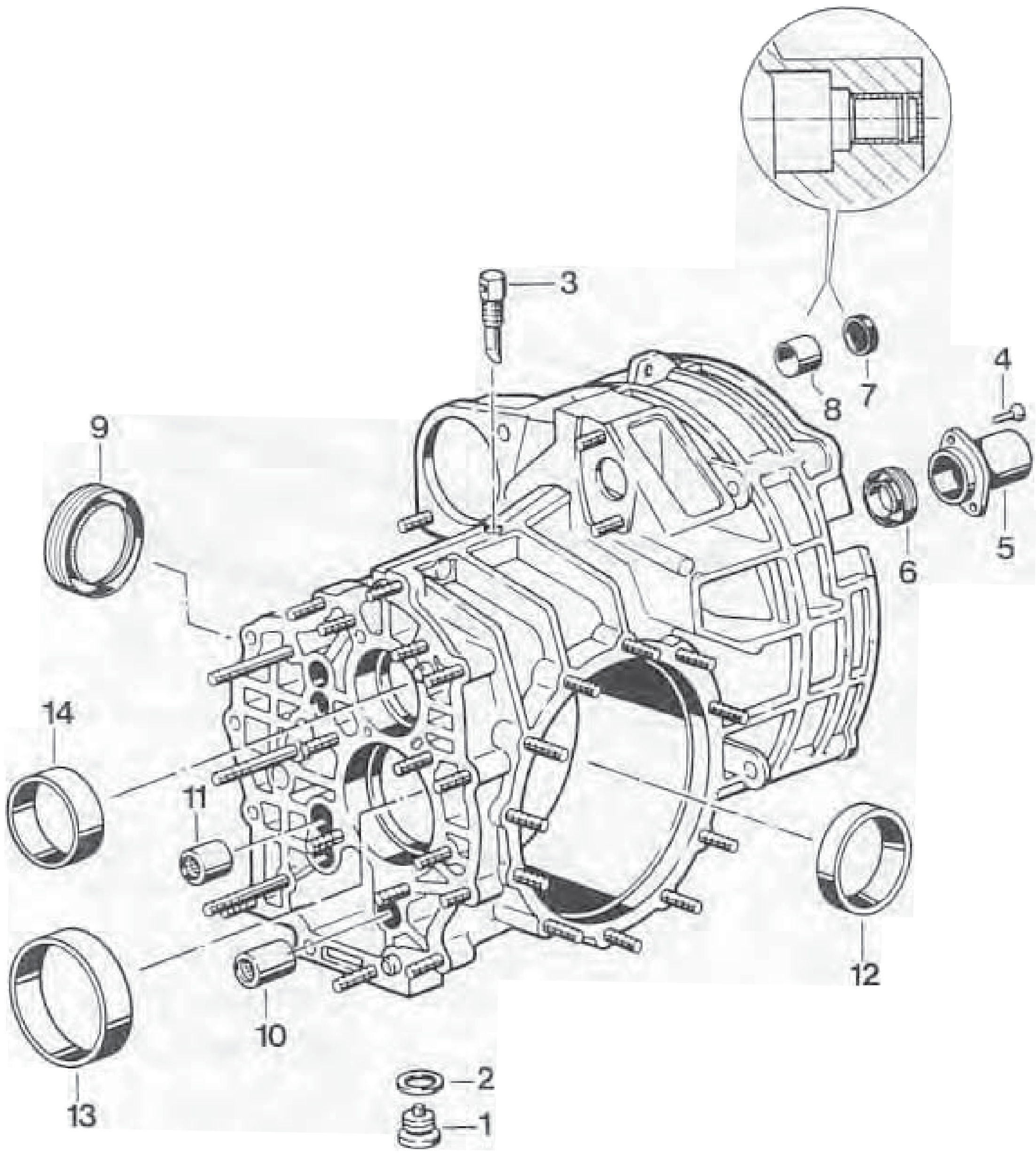


No.	Designation	Qty.	Note: Removal	Installation
1	Plug	1		Clean, tighten to 30 Nm (22 ftlb.)
2	Seal	1		Replace
3	Vent	1		Tighten to 35 Nm (26 ftlb.). The hole in the hexagon head must face the transfer casing
4	Oval-head screw	2		Tighten to 10 Nm (7 ftlb.)
5	Guide tube	1		
6	Shaft seal	1		Do not fit until the gear set has been fitted (also refer to page 35 - 201)
7	Cover	1		
8	Bushing	1	Push out with drift 9515, working from inside towards outside	Do not grease or oil and do not clean with solvents (e.g. benzene). Push in from inside with drift 9515 until it is seated against the stop.
9	Shaft seal	1		Push in with Special Tool 9252 until it is seated against the stop. Pace space between dust lip and sealing lip with grease (e.g. Liqui Moly Pu 53)
10	Ball sleeve (long)	1	Pull out with suitable internal puller (e.g. Schrem 14 - 20)	Press in flush with Special Tool 9254
11	Ball sleeve (short)	4	Pull out with suitable internal puller (e.g. Schrem 14 - 20)	Press in flush with Special Tool 9254

No.	Designation	Qty.	Note: Removal	Installation
12	Bearing outer race	1	Heat transmission housing to approx. 120 °C and remove race with suitable drift	Heat transmission housing to approx. 120 °C and press in with suitable thrust piece
13	Bearing outer race	1	Heat transmission housing to approx. 120 °C and remove race with suitable thrust piece (e.g. VW 513)	Heat transmission housing to approx. 120 °C and press in with suitable thrust piece (e.g. 9247/4) until it is seated against the stop
14	Bearing outer race	1	Heat transmission housing to approx. 120 °C and pull put with suitable internal puller (e.g. Schrem 50 - 60)	Heat transmission housing to approx. 120 °C and press in with Special Tools P 254 and P 254 b until it is seated against the stop
15	Transmission housing	1		

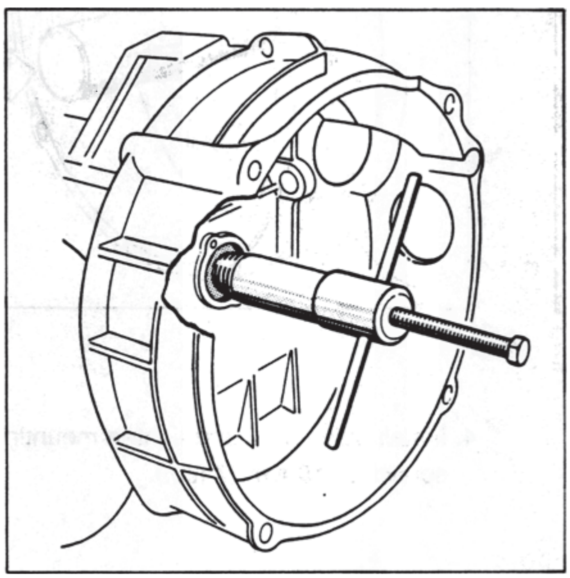
35 50 19 Removing and installing input shaft oil seal

Removing

1. Remove engine/transmission assembly and separate transmission from engine.

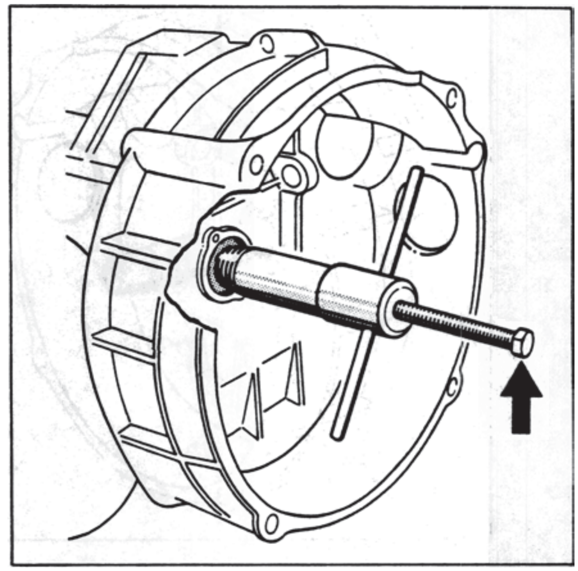
2. Remove release bearing guide tube.

3. Screw Special Tool **9251** firmly into the oil seal.



1652-34

4. Screw in the hexagon-head bolt and pull out oil seal.



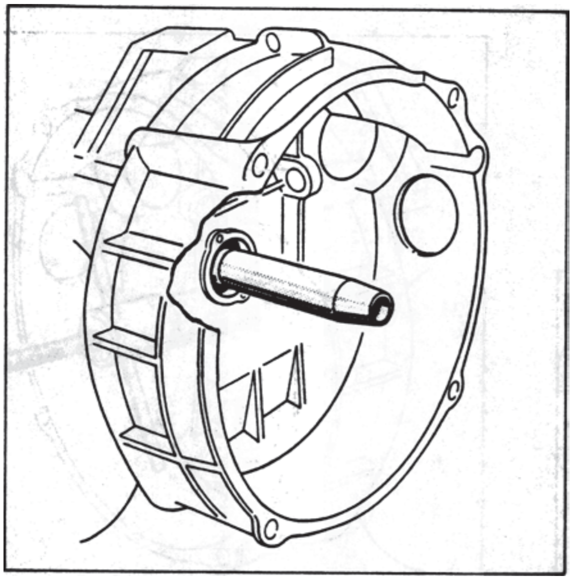
1653-34

Note

If the helical tension spring jumps out when removing the seal, use a wire hook to pull it off the input shaft.

Installing

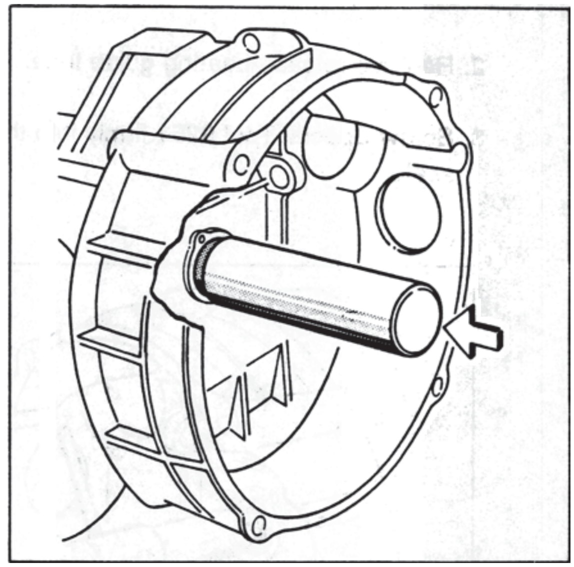
1. Push assembling sleeve **9255** onto the input shaft splines.



1654-34

2. Pack oil seal area between dust lip and sealing lip with grease (e.g. Liqui Moly Pu 53).

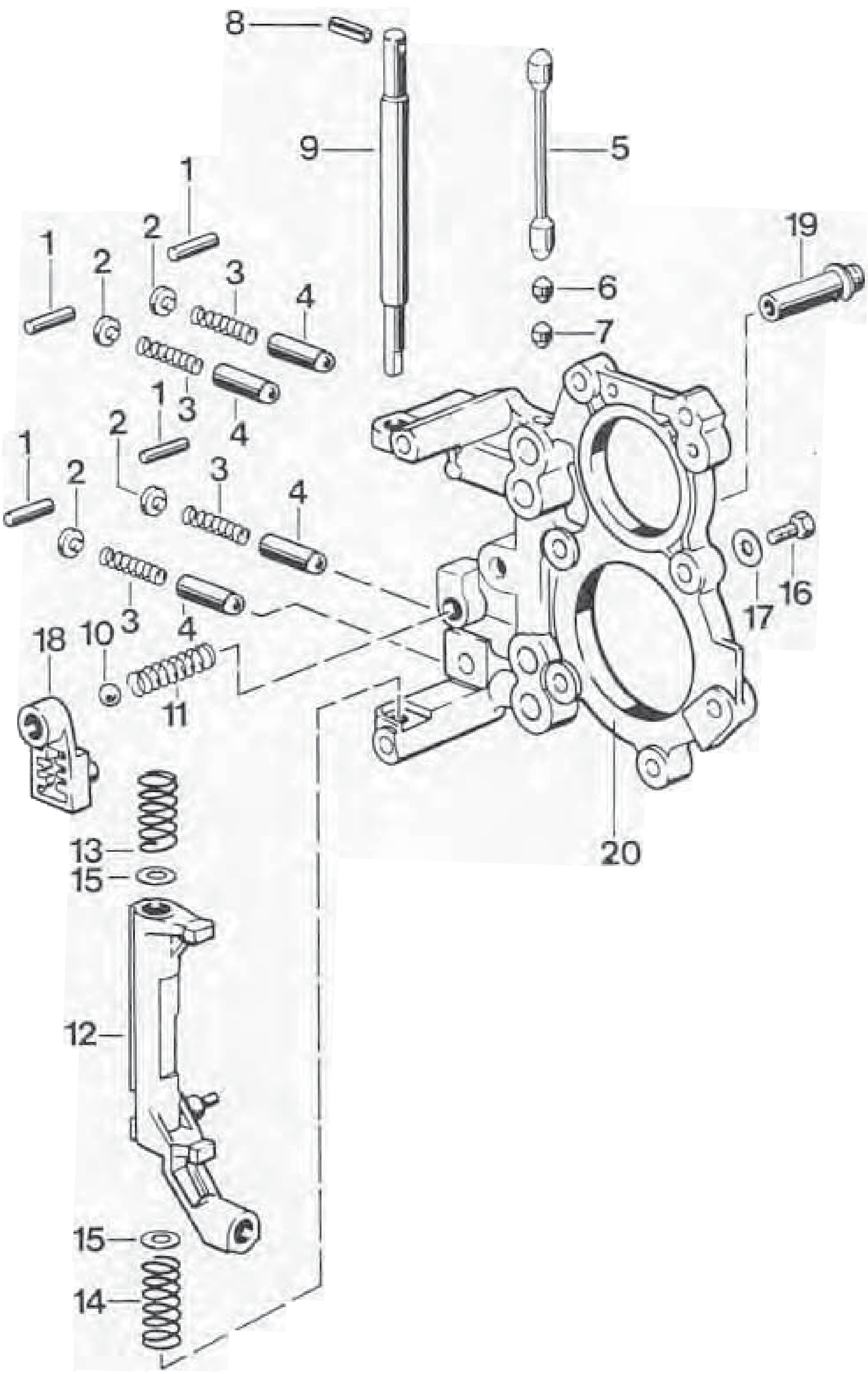
3. Use Special Tool **9256** to drive the oil seal into place.



1655-34

4. Install guide tube and tighten mounting screws to **10 Nm** (7 ftlb.).

35 19 37 Dismantling and assembling tensioning plate



No.	Designation	Qty.	Note: Removal	Installation
1	Straight pin	4	With the shift rods fitted, the springs (No. 3) are under load	
2	Washer	4		
3	Thrust spring	4		
4	Locking bush	4		
5	Lock (long)	1		
6	Lock (short)	1		
7	Lock (short)	1		
8	Roll pin	1		
9	Bearing shaft	1		Install in correct position, use 8 mm dia. locating mandrel to locate relative to tensioning plate hole
10	Ball	1		
11	Thrust spring	1		
12	Deflection lever	1		
13	Thrust spring	1	Mark for reinstallation	Free length = 51.3 + 0.5 mm wire thickness = 1.5 mm. Do not cnfuse with spring No. 14
14	Thrust spring	1	Mark for reinstallation	Free length = 72.6 + 0.5 mm wire thickness = 1.1 mm. Do not confuse with spring No. 13
15	Shim	2		

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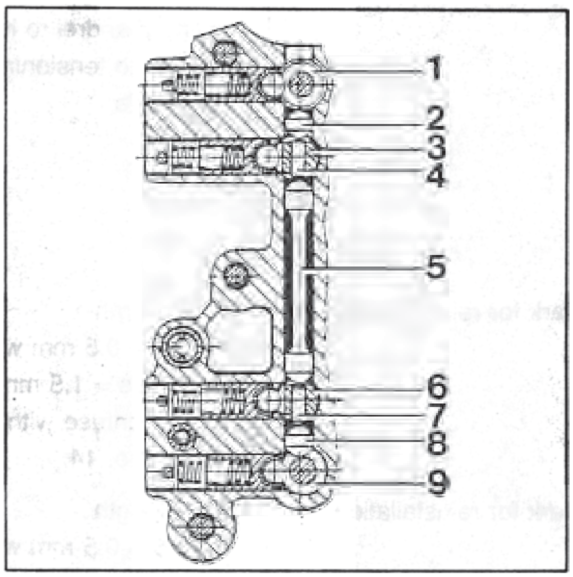
No.	Designation	Qty.	Note: Removal	Installation
16	Hexagon head bolt	1		Tighten to 10 Nm (7 ftlb.)
17	Washer	1		
18	Selector gate	1		
19	Adapter sleeve with snap ring	1	Press out with suitable drift	Press in with suitable drift until it is seated against the stop
20	Tensioning plate	1		

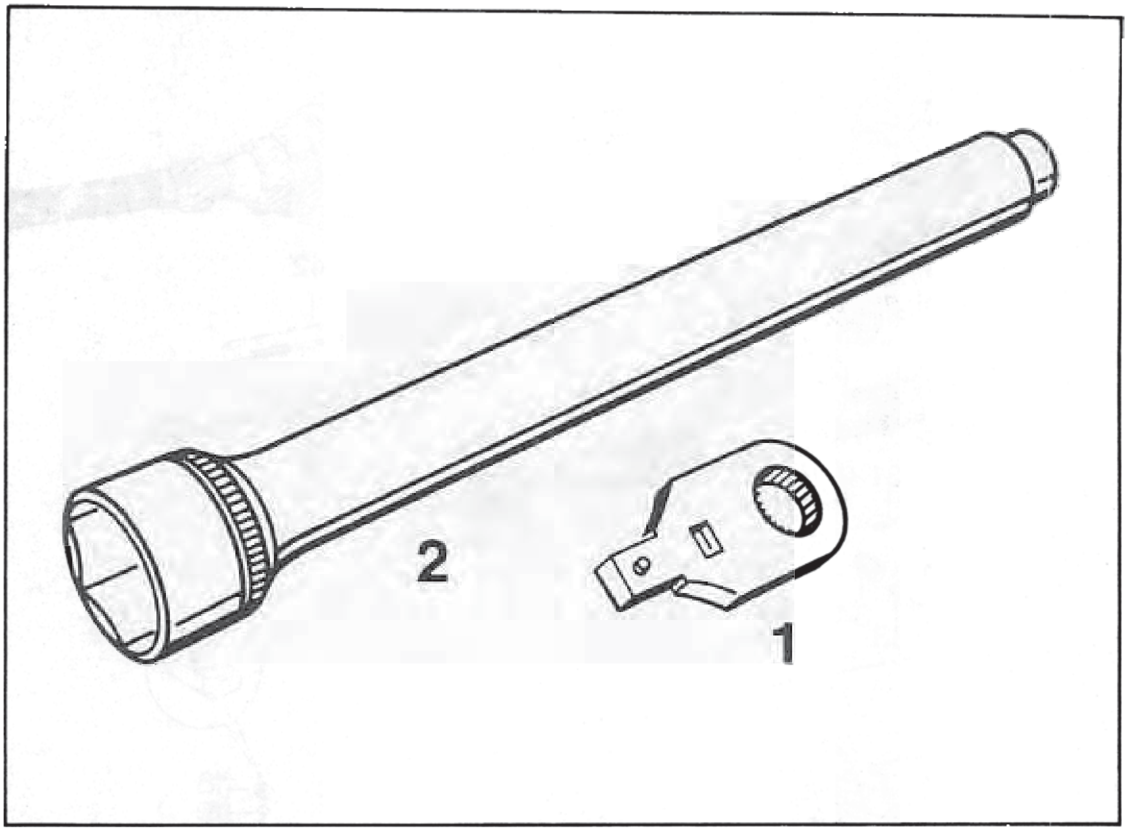
Installation position of the locks



1709-35

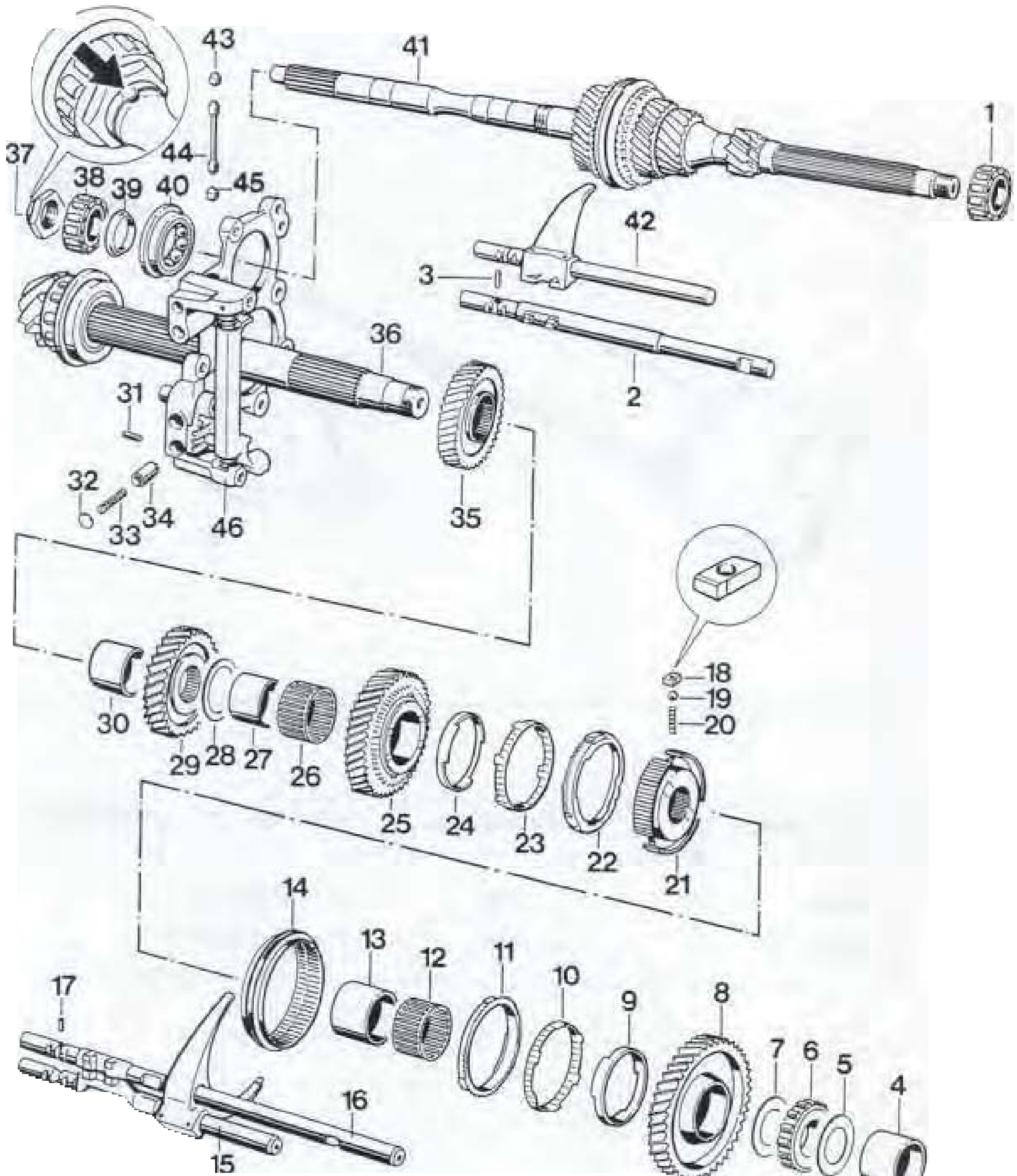
35 40 19 Removing and installing input shaft

Tools



No.	Designation	Special tool	Order number	Explanation
1	Insert	9282	000.721.928.20	
2	Socket	9105	000.721.910.50	

35 40 19 Removing and installing input shaft



No.	Designation	Qty.	Note: Removal	Installation
1	Cylindrical roller bearing	1		Heat to approx. 120 °C
2	Shift rod (5th and 6th gear)	1	Shift rods in neutral position	
3	Spacer	1		Coat with stiff grease to insert
4	Inner race	1		Fit with the same gear-wheel. Heat to approx. 120 °C
5	Thrust washer	1		
6	Cylindrical roller bearing	1		Heat to approx. 120 °C
7	Thrust washer	1		
8	Loose gearwheel (1st gear)	1		
9	Friction ring	1		Fit with the same gear-wheel
10	Tapered ring	1		Fit with the same gear-wheel. Tabs must en-gage into the cutouts in the loose gearwheel
11	Synchronizing ring	1		Check for wear. Fit with the same gearwheel. Drivers must engage in the cutouts in the tape-red ring. Three lugs face the driver dogs.
12	Needle roller bearing	1		Fit with the same gear-wheel
13	Inner race	1		Fit with the same gear-wheel. Heat to approx. 120 °C

No.	Designation	Qty.	Note: Removal	Installation
14	Shift sleeve	1		Insert complete with guide sleeve and shift rods. Make sure the missing tooth of the internal teeth of the guide sleeve (No. 21) is aligned exactly above the oil bore of the output shaft. The circumferential identification groove must face 2nd gear. The centerpunch marks must be centered relative to the balls (see page 35 - 213)
15	Shift rod with pinned shift fork	1		
16	Shift rod (reverse)	1		
17	Intermediate lock	1		Coat with stiff grease to insert
18	Driver dog	3		Install in correct position
19	Ball	3		
20	Spring	3		
21	Guide sleeve	1		Missing tooth of the internal splines must be exactly above the oil bore of the output shaft
22	Synchronizing ring	1		Check for wear. Fit with the same gearwheel. Drivers must engage into the cutouts in the tapered sleeve. Three lugs face the driver dogs.

No.	Designation	Qty.	Note: Removal	Installation
23	Tapered ring	1		Fit with the same gear-wheel. Tabs must engage into the cutouts in the loose gearwheel
24	Friction ring	1		Fit with the same gear-wheel
25	Loose gearwheel (2nd gear)	1		
26	Needle roller bearing	1		Fit with the same gear-wheel
27	Inner race	1		Fit with the same gear-wheel. Heat to approx. 120 °C
28	Thrust washer	1		
29	Fixed gearwheel (3rd gear)	1		Large collar faces thrust washer No. 28
30	Spacer sleeve	1		
31	Straight pin	4		
32	Washer	4		Guide lug faces spring
33	Thrust spring	4		
34	Latch	4		
35	Fixed gearwheel (4th gear)	1		Large collar faces four-point bearing
36	Output shaft	1		
37	Flange nut*	1	Undo with Special Tools 9282 and 9105	Tighten to 250 Nm (184 ftlb.). Upset the flange to lock
38	Cylindrical roller bearing	1	Press off across 2nd gear fixed gearwheel	Heat to approx. 120 °C
39	Bearing inner race	1		Heat to approx. 120 °C

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No.	Designation	Qty.	Note: Removal	Installation
40	Four-point bearing	1		
41	Output shaft	1		Insert complete with pinned shift rod / shift fork (No. 42)
42	Shift rod with pinned shift fork	1		
43	Lock (short)	1		
44	Lock (long)	1		
45	Lock (short)	1		
46	Tensioning plate	1		

Transmission shafts without recesses for securing the hexagon nuts have been installed since September 1995.
Self-locking hexagon nuts are used on these shafts, and these nuts must **always** be replaced in every transmission repair.

Removal and installing notes

Removal

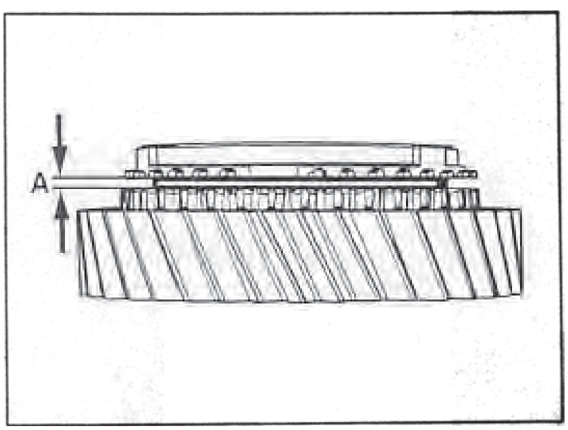
Note

Parts No. 1 to 30 are removed with the tensioning plate remaining fitted (refer to page 34 - 209).

Installation

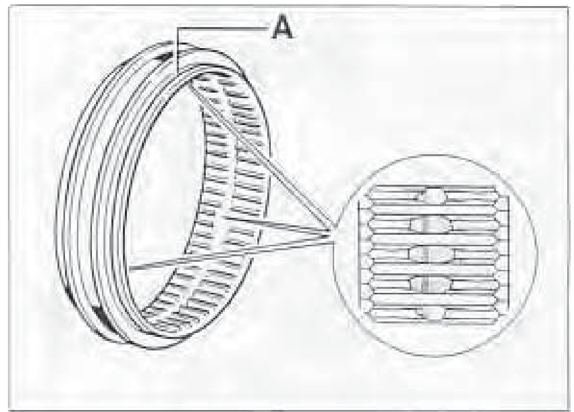
1. Using a suitable flat iron bar, clamp tensioning plate in a vise in such a manner that the hole for the shift rod locks is horizontal.

2. Check synchromesh of 1st and 2nd gears. To do so, place friction ring, tapered ring and synchronizing ring in correct position onto gearwheel. Check gap "A" with a feeler gauge.
   Installation dimension (new) = 1.5 to 2.0 mm
   Wear limit = 1.2 mm

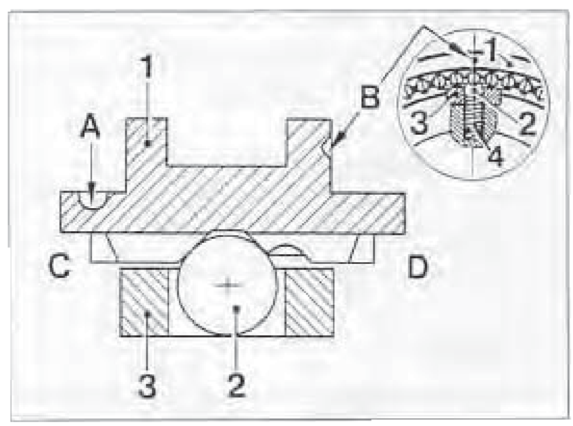


1701-35

3. Place shift sleeve onto guide sleeve so that centerpunch marks "B" are centered relative to the balls.
   In addition, the circumferential identification groove "A" must face 2nd gear.



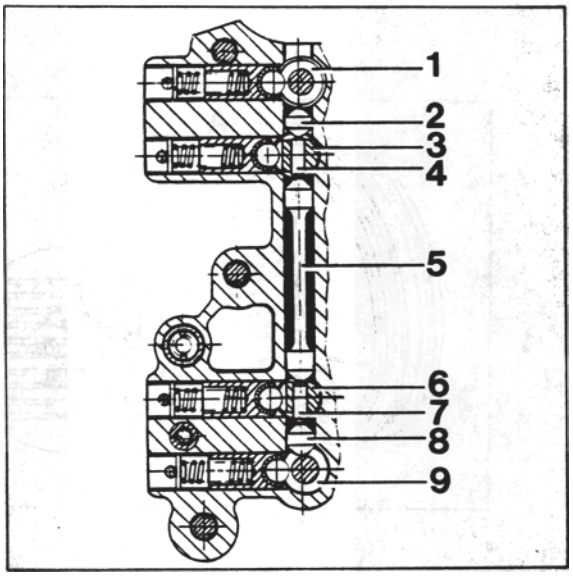
A = Identification groove (must face 2nd gear)



1906-35

1 = Shift sleeve
2 = Ball
3 = Driver dog
4 = Spring
A = Identification groove
B = Centerpunch mark
C = 2nd gear side
D = 1st gear side

4. Observe installation position of locks.



1709-35

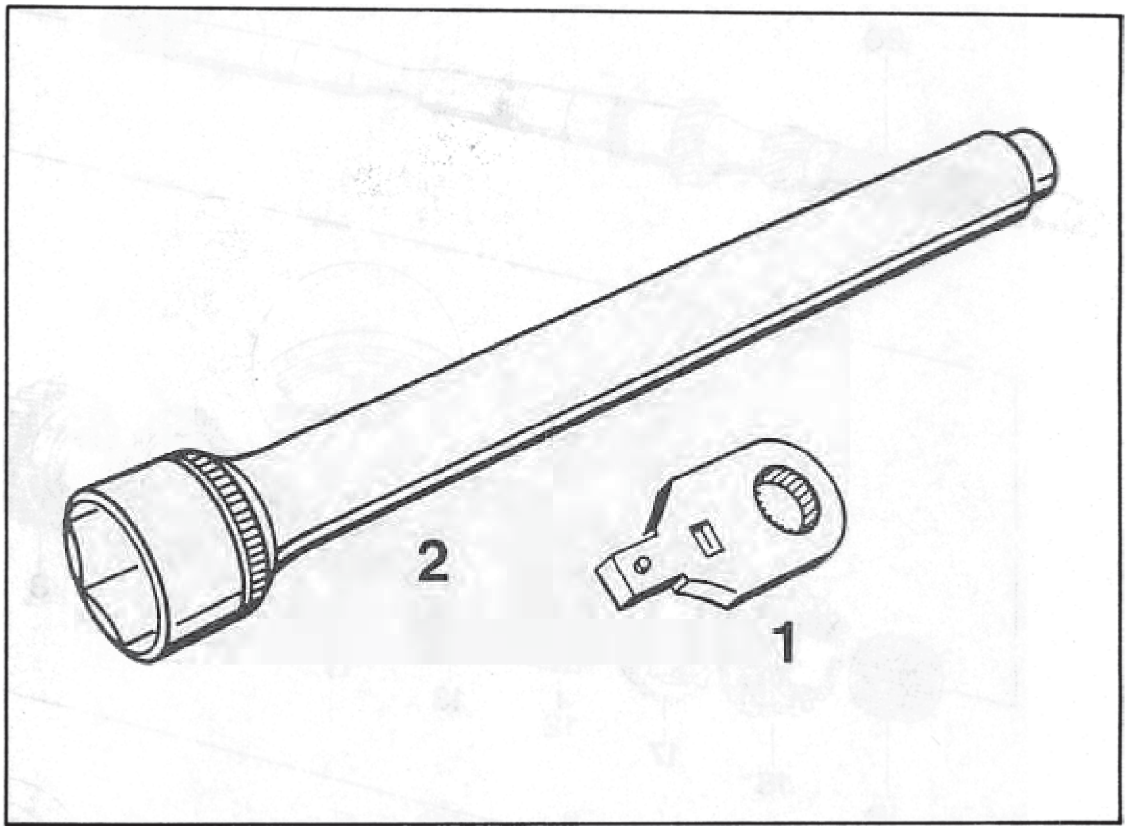
1 = Shift rod 3rd and 4th gear
2 = Lock (short)
3 = Shift rod 5th and 6th gear
4 = Intermediate lock
5 = Lock (long)
6 = Reverse shift rod
7 = Intermediate lock
8 = Lock (short)
9 = Shift rod 1st and 2nd gear

Note

After fitting the shift rods, do not move them across the neutral or gear latch positions as this may cause the small intermediate locks to drop out inadvertently.
To avoid inadvertent movement of the shift rods, lock shift rods by engaging 3th gear.

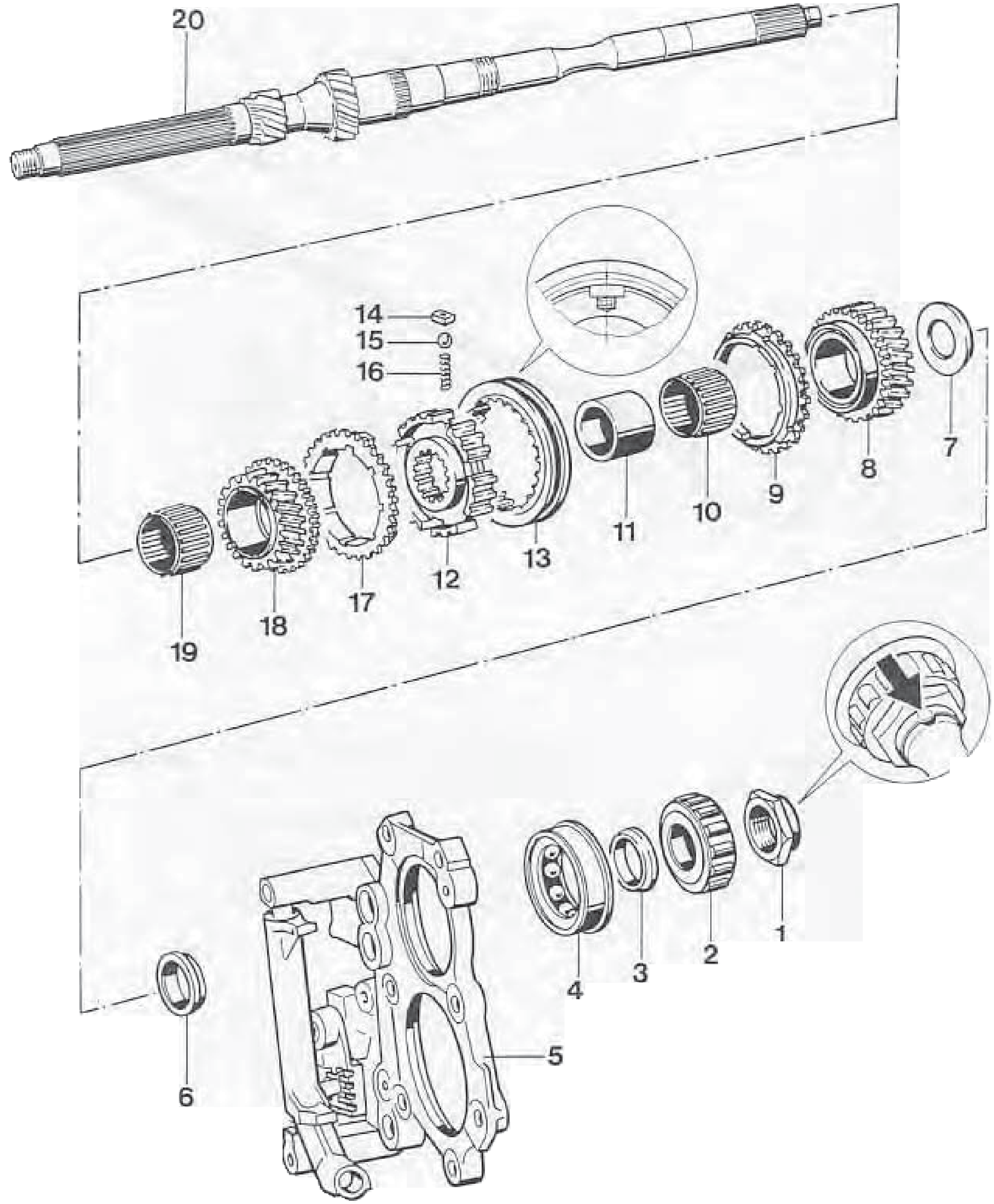
35 40 37 Dismantling and assembling input shaft

Tools



No.	Designation	Special tool	Order number	Explanation
1	Insert	9282	000.721.928.20	
2	Socket	9105	000.721.910.50	

35 40 37 Dismantling and assembling input shaft



No.	Designation	Qty.	Note: Removal	Installation
1	Hexagon nut*	1	Undo with Special Tools 9282 and 9105	Use Special Tools 9282 and 9105 and tighten to 250 Nm (184 ftlb.). Upset flange to lock
2	Cylindrical roller bearing	1	Press off with suitable separating device (e.g. Kukko 17-1) across 2nd gear fixed gearwheel	Heat to approx. 120 °C
3	Bearing inner race	1	Press off with suitable separating device (e.g. Kukko 17-1) across 2nd gear fixed gearwheel	Heat to approx. 120 °C
4	Four-point bearing	1		
5	Tensioning plate	1		Clamp in a vise (use protective jaws), insert lock (long), engage 5th gear and install input shaft with pinned shift rod/shift fork
6	Bearing inner race	1	Press off with suitable separating device (e.g. Kukko 17-1)	Heat to approx. 120 °C
7	Thrust washer	1		Large, face-ground side faces needle cage
8	Loose gearwheel (4th gear)	1		Replace only in pairs
9	Synchronizing ring	1	Mark for reinstallation	Check for wear, install in correct position using the same gearwheel (lugs face the driver dogs)

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No.	Designation	Qty.	Note: Removal	Installation
10	Needle-roller assembly	1	Mark cage	Install with the same gear-wheel
11	Inner race	1		Heat to approx. 120 °C
12	Guide sleeve	1	Remove complete with shift sleeve	Install complete with shaft sleeve and syn-chromesh components
13	Shift sleeve (3rd and 4th gear)	1	Make sure synchromesh components do not pop out.	Observe installation posi-tion, install complete with guide sleeve and synchro-mesh compo-nents. Center the center-punch marks relative to the driver dogs
14	Driver dogs	3		Install in correct position, domed side faces shift sleeve
15	Ball	3		
16	Spring	3		
17	Synchronizing ring	1	Mark for reinstallation	Check for wear, install in correct position with the same gearwheel (lugs face the driver dogs)
18	Loose gearwheel (3rd gear)	1		Replace only in pairs
19	Needle-roller assembly	1	Mark for reinstallation	Fit with the same gear-wheel
20	Drive shaft	1		

* Transmission shafts without recesses for securing the hexagon nuts have been installed since September 1995.
Self-locking hexagon nuts are used on these shafts, and these nuts must **always** be replaced in every repair.

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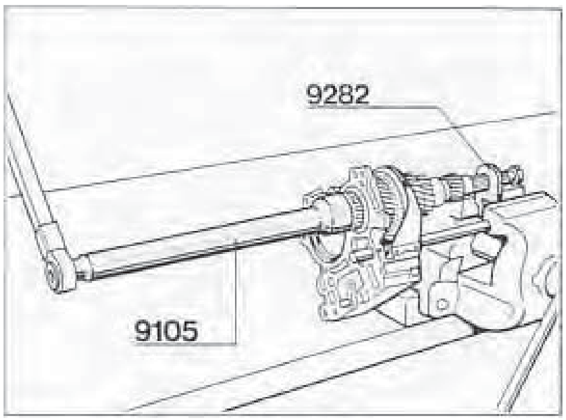
Dismantling and assembling notes

Dismantling

1. Mount retaining plate **9282** in vise, fit input shaft and undo hexagon-head nut with Special Tool **9105**.



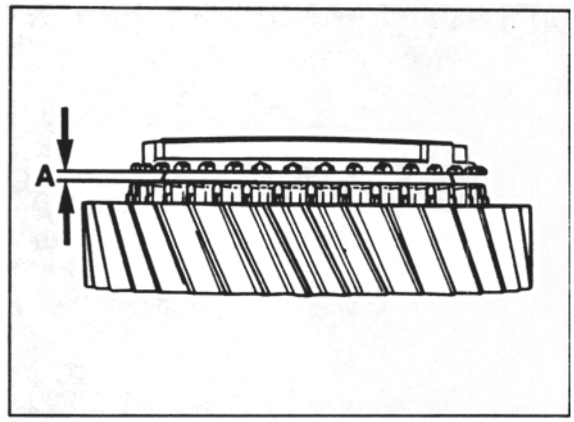
535-35

2. Use a suitable tool (e.g. Kukko 17 - 1) to press all parts off the input shaft over the 2nd gear wheel.

Assembling

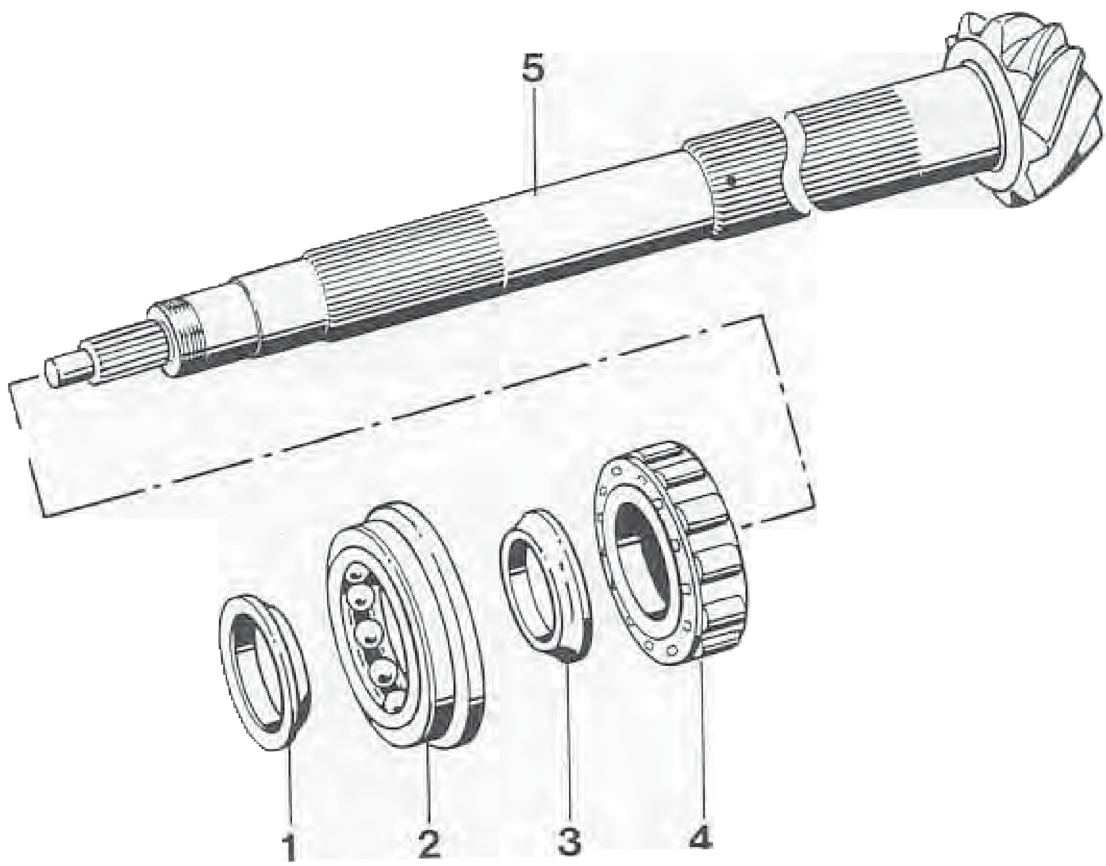
1. To inspect synchronizing rings, press rings onto the gear wheel tapers and use a feeler gauge to measure gap "A".

Assembly dimension (new)	= 0.9 mm min.
Wear limit	= 0.6 to 0.7 mm



518-35

35 59 37 Dismantling and assembling output shaft

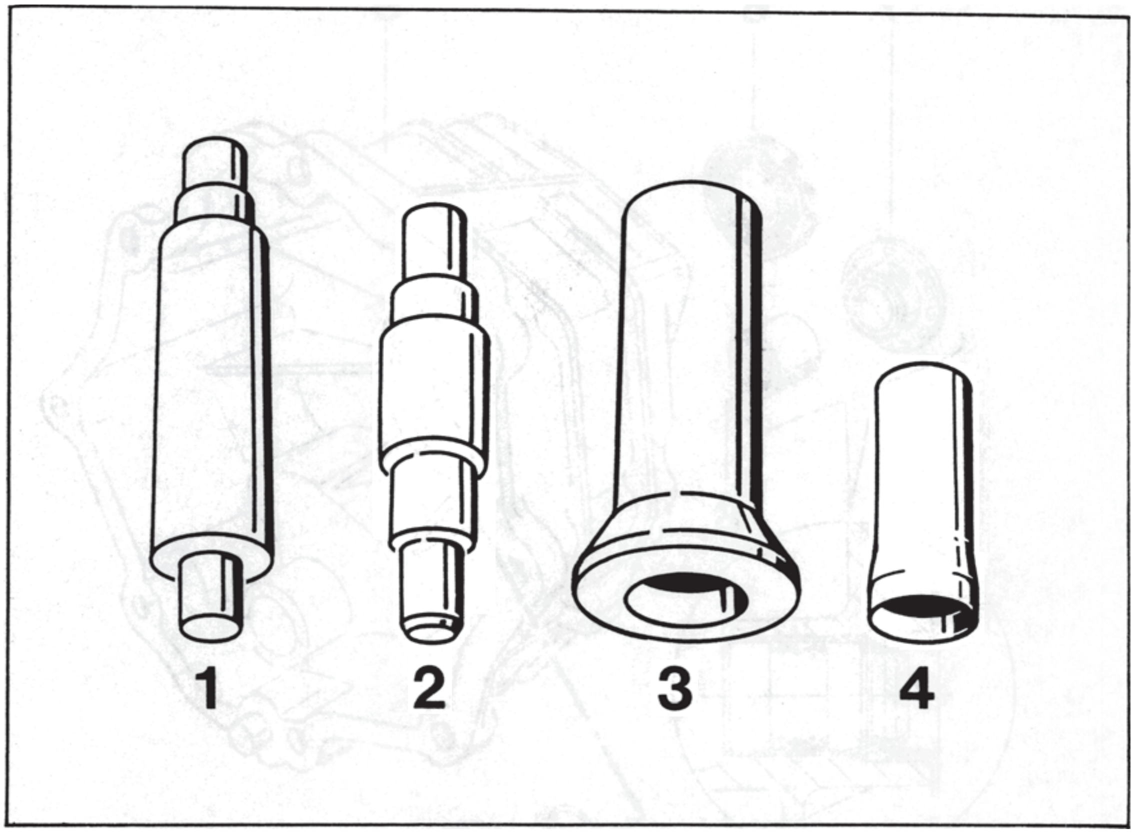


2012-35

No.	Designation	Qty.	Note: Removal	Note: Installation
1	Bearing inner race	1	Mark for reinstallation, press off with suitable separating device (e.g. Kukko 15 - 17)	Do not confuse with inner race No. 3 , heat to approx. 120 °C and press into place
2	Four-point bearing	1		
3	Bearing inner race	1	Mark for reinstallation, press off with suitable separating device (e.g. Kukko 15 - 17)	Do not confuse with inner race No. 1, heat to approx. 120 °C and press into place
4	Cylindrical roller bearing	1	Press off with suitable separating device (e.g. Kukko 15 - 17)	Heat to approx. 120 °C and press into correct position using a suitable pipe section (e.g. VW 519)
5	Output shaft	1		Observe matching number. Readjust if required

39 66 37 Dismantling and assembling transfer casing

Tools



No.	Designation	Special tool	Order number	Explanation
1	Mandrel	9254	000.721.925.40	
2	Mandrel	9223	000.721.922.30	
3	Thrust piece	9234	000.721.923.40	
4	Assembly sleeve	9575	000.721.957.50	

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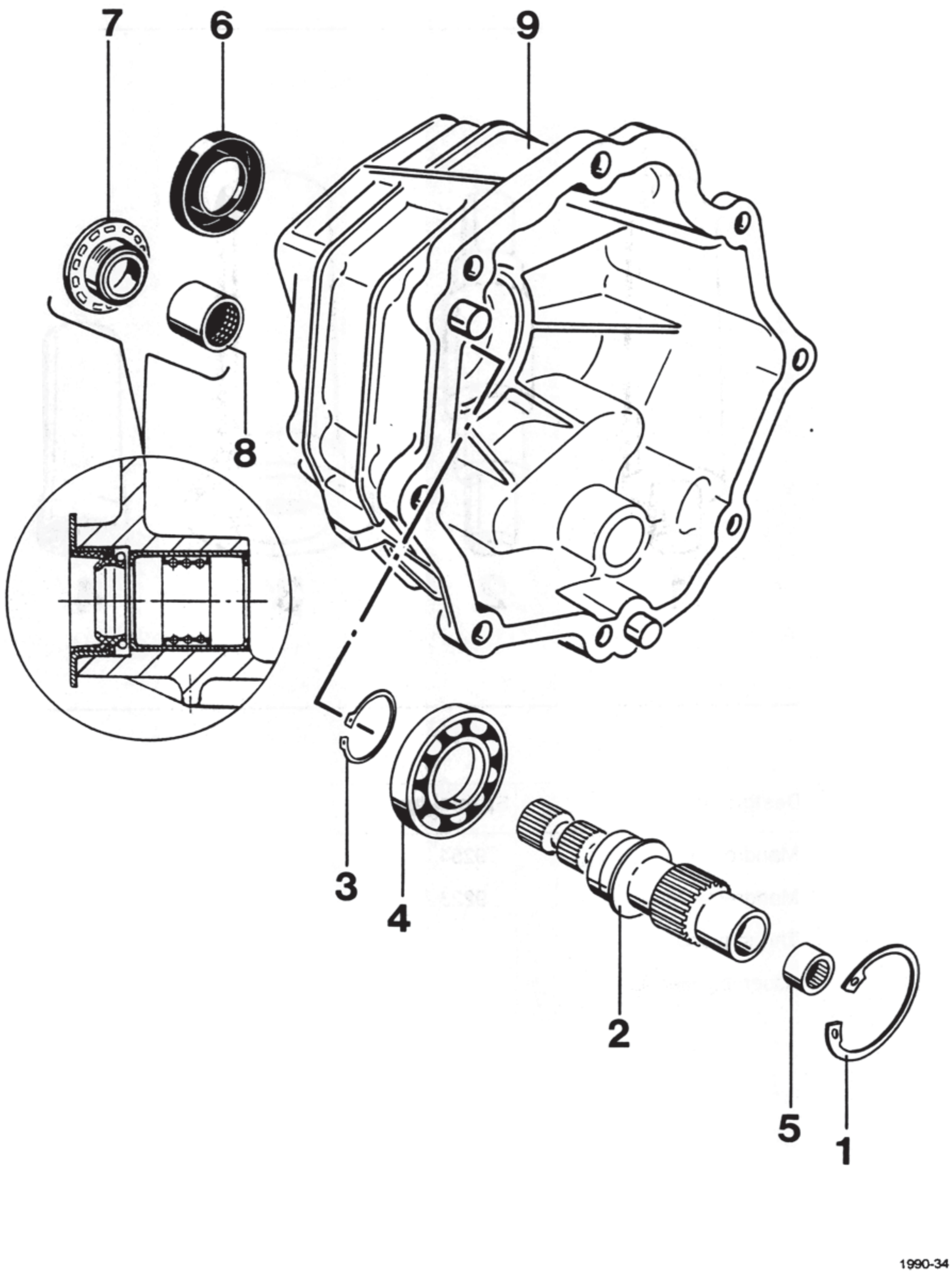
39 66 37 Dismantling and assembling transfer casing



No.	Designation	Qty.	Note: Removal	Installation
1	Snap ring	1		
2	Output shaft	1		
3	Snap ring	1		
4	Deep-groove ball bearing	1	Press off	Heat to approx. 120 °C
5	Needle roller bearing sleeve	1	Pull out with internal puller	Replace, drive in flush with suitable drift (e.g. P 361)
6	Oil seal	1		Replace, drive in with Special Tool 9575 and 9234 after fitting the output shaft
7	Oil seal	1		Replace, pack space between dust lip and sealing lip with grease (e.g. Liqui Moly Pu 53), push in to stop with Special Tool 9254
8	Ball sleeve	1	Press out with suitable drift or pipe section (e.g. VW 423)	Replace, drive home into correct position using Special Tool 9223
9	Housing	1		

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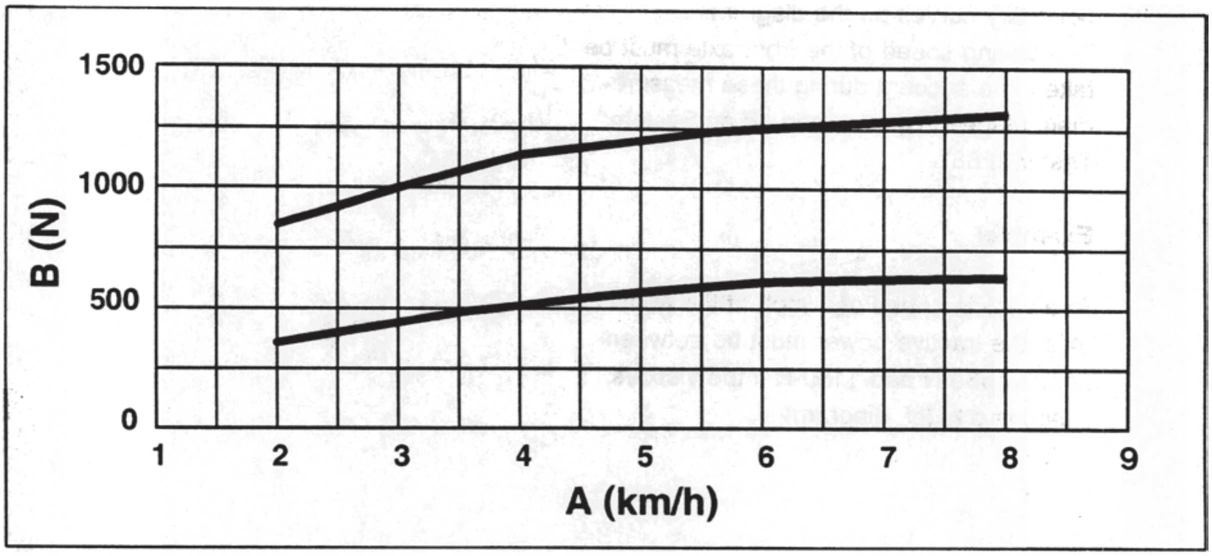
39 60 01 Checking operation of installed viscous clutch



2019-39

A = Driving speed of front axle in kilometers per hour
B = Pulling power of front wheels in Newton (N)

Test conditions:

To check, viscous clutch must be at room temperature

Test duration approx. 45 seconds (Determine measurement after 20 seconds)

Repeat measurement after viscous clutch has cooled off for 1 hour

1. Connect system tester and select „Actual values " menu (ABS speed) (Refer to Vol. VIII, page 45 - 37).

2. Place front wheels of vehicle onto brake dynamometer.

3. Switch off engine, engage parking brake and shift transmission into neutral position.

4. When the rollers have started, switch on ignition and press key > of system tester. The tester will then return to the point where diagnosis was interrupted.

5. Set front wheels into motion with dynamometer rollers **(max. 5 mph)** and determine tractive power of front wheels after 20 seconds.

Note

When measuring the wheels individually, add measurements obtained for both front wheels.

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5. The viscous clutch is operative if the tractive power of the front wheels is within the boundary curves on the diagram.
   The driving speed of the front axle must be taken into account during these measurements (speed can be read off on System Tester 9288).

   Example:

   At a vehicle speed of 3 mph at the front axle, the tractive power must be between approx. 580 N and 1180 N if the viscous clutch is o.k. (cf. diagram).

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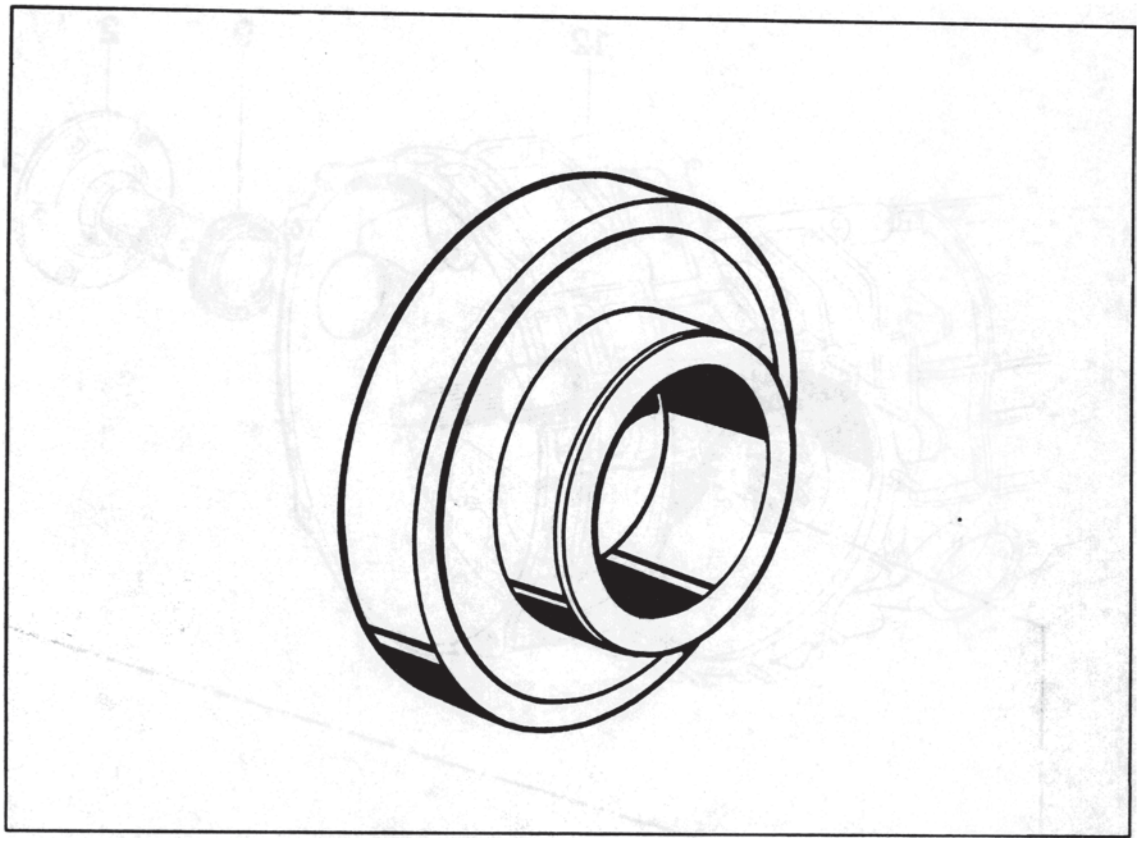
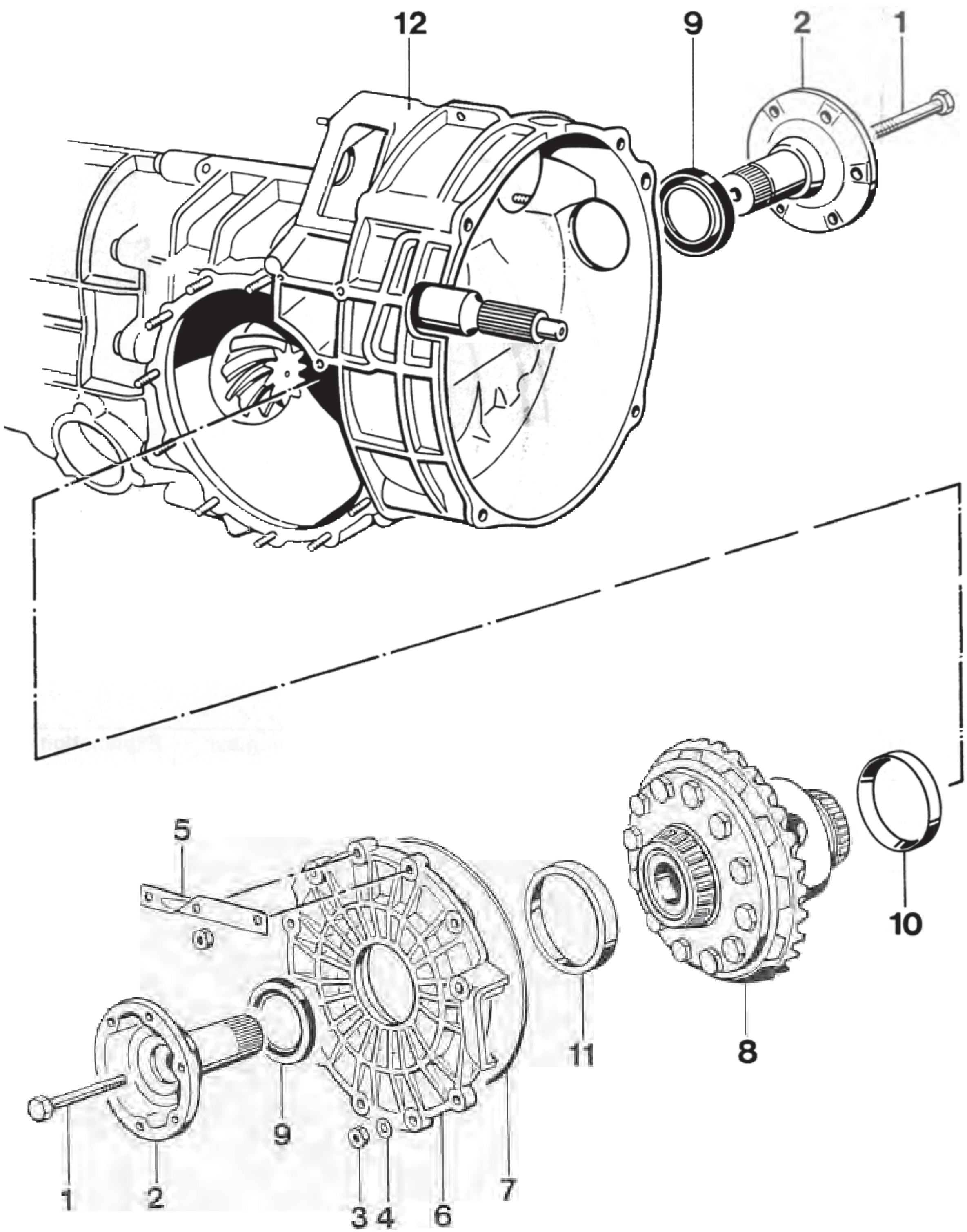
39 40 19 Removing and installing differential lock

Tools



No.	Designation	Special tool	Order number	Explanation
	Thrust piece	9252	000.721.925.20	

39 40 19 Removing and installing differential lock

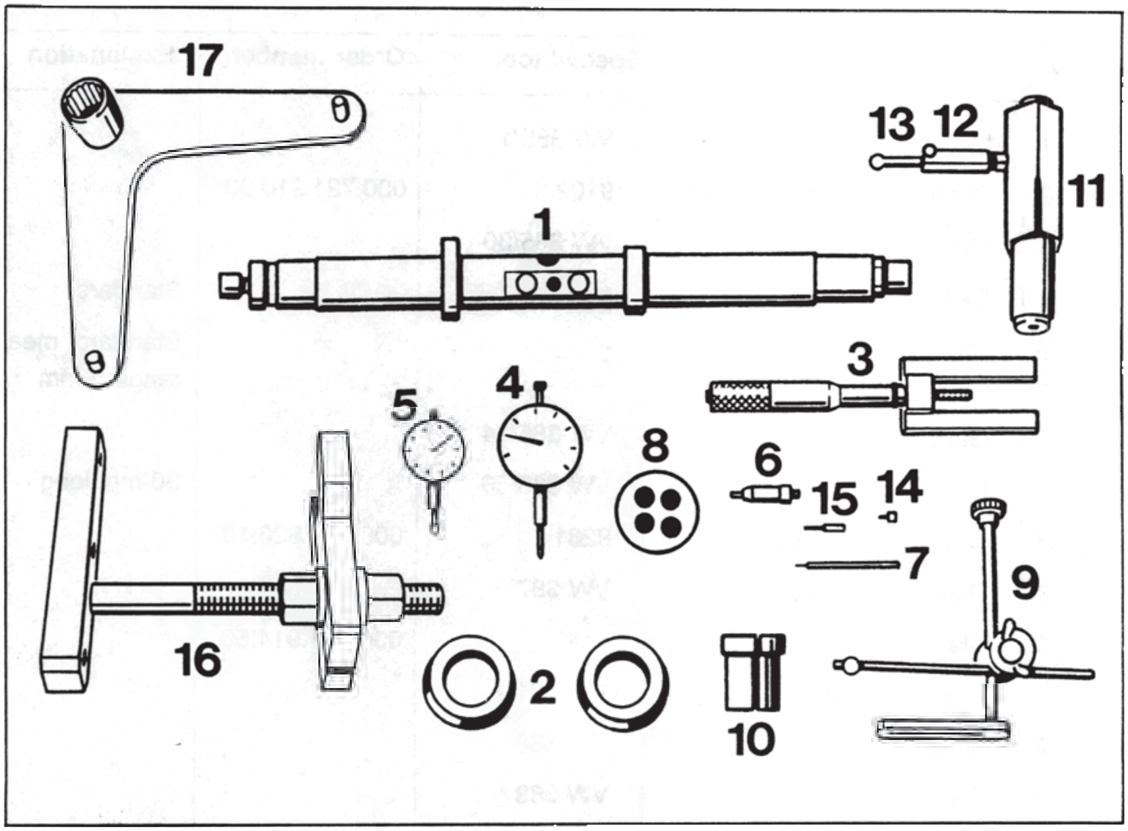


No.	Designation	Qty.	Note: Removal	Installation
1	Hexagon head bolt	2		Tighten to 44 Nm (32 ftlb.)
2	Joint flange*	2		
3	Hexagon head nut	11		Tighten to 23 Nm (17 ftlb.)
4	Washer	11		
5	Holder	1		
6	Cover	1		
7	O-ring	1		Replace, oil lightly, do not twist
8	Differential or limited-slip differential	1		Readjust if required
9	Seal*	2		Pack space between dust and sealing lips with grease (e.g. Liqui Moly Pu 53). Use thrust piece 9252 to press in until it is seated against the stop
10	Bearing outer race	1	Pull out with suitable internal puller (e.g. Kukko 21 - 8)	Press in with suitable thrust piece
11	Bearing outer race	1	Pull out with suitable internal puller (e.g. Kukko 21 - 9)	Press in with suitable thrust piece
12	gear box	1		

* The halfshaft flange and seal ring can also be removed and installed with the transmission installed.

39 08 15 Adjusting drive set

Tools



39 08 15 Adjusting drive set

Tools

No.	Designation	Special tool	Order number	Explanation
1	Measuring mandrel	VW 385/1		
2	Centering disks	9109	000.721.910.90	
3	Master gauge	VW 385/30		
4	Dial gauge	-		Standard
5	Dial gauge	-		Standard, measuring range 3 mm
6	Gauge plunger	VW 385/14		
7	Dial gauge extension	VW 385/56		30 mm long ·
8	Gauge block plate	9281	000.721.928.10	
9	Dial gauge bracket	VW 387		
10	Clamping sleeve	9145	000.721.914.50	
11	Adjusting device	VW 521/4		
12	Measuring lever	VW 388		
13	Gauge plunger	VW 388		
14	Dial gauge extension	VW 382/10		6.0 mm long
15	Dial gauge extension	VW 385/15		9.3 mm long
16	Clamping tool*	9577	000.721.957.70	
17	Holder	9253	000.721.925.30	

Practical procedure when readjusting the drive set

If it is necessary to adjust drive pinion and ring gear, follow the below sequence to ensure an efficient working procedure:

1. Determine the total thickness of shims "Stot" (S_1 plus S_2) for the specified preload on the tapered roller bearings/differential.

2. Determine the thickness of shim "S_3".

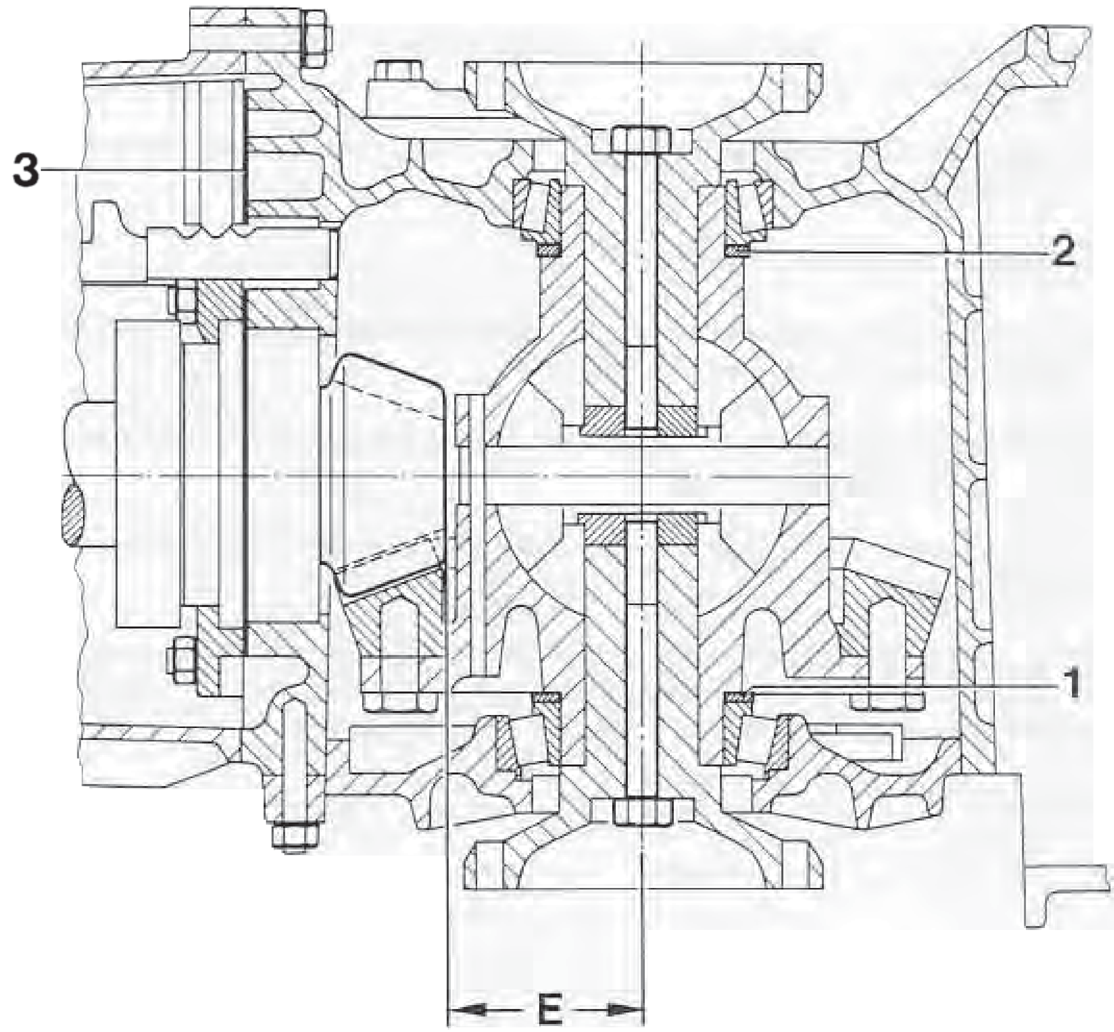
3. Split the total shim thickness "Stot" into S_1 and S_2 so that the specified circumferential backlash is present between ring gear and drive pinion.

The aim of this adjustment is to restore the smoothest running position which has been achieved on test equipment in the production line.

To achieve correct results, greatest possible cleanliness for all assembly work and measuring procedures is essential.

When assembling the final drive assembly, it is only necessary to readjust drive pinion and ring gear or drive set if components have been replaced which have a direct influence on the adjustment. Refer to the following table to avoid unnecessary adjustment procedures.

Adjust: / Replaced component	Ring gear ($S_1 + S_2$)	Drive pinion (S_3)
Transmission case	x	x
Lateral transmission cover	x	
Large cylindrical roller bearing and four-point bearing for drive pinion	x	x
Drive set	x	x
Differential housing	x	
Tapered roller bearing for differential	x	

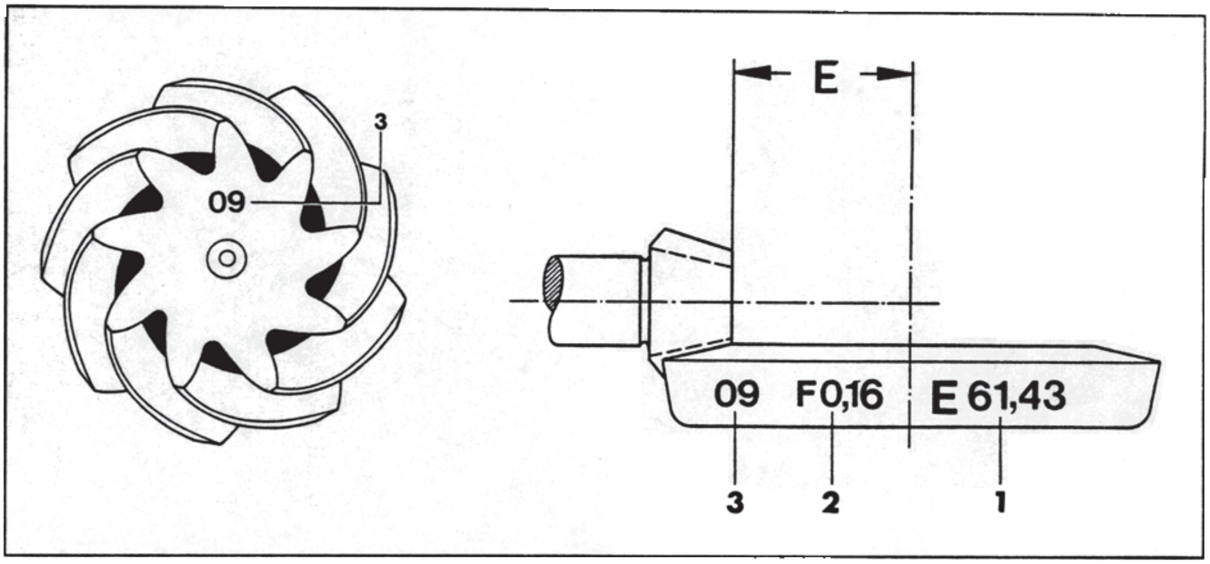


1 – Shim S_1
2 – Shim S_2
3 – Adjusting shim S_3
E – Setting value

Correct results may only be achieved if assembly work and measuring procedures are carried out carefully and with maximum cleanliness.

General

The setting of drive pinion and ring gear is a determining factor for the service life and smooth running of the rear-axle drive. Drive pinions and ring gears that have been checked for good tooth contact pattern and low noise in both directions of rotation on special test equipment are therefore matched during prodution. The position at which smoothest running can be achieved is determined by shifting the drive pinion axially, and embossed on the ring gear as setting value "E".

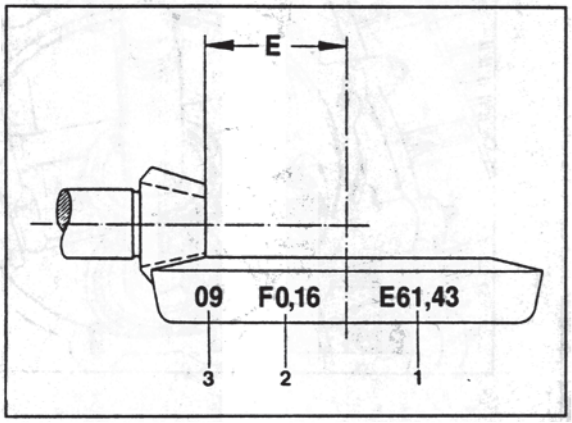


1 = setting "E" (e.g. 61.43 mm)
2 = circumferential backlash "F" (e.g. 0.16 mm)
3 = matching number

39 08 15 Adjusting drive pinion

Note

The setting value "E" is indicated on the ring gear.



217-39

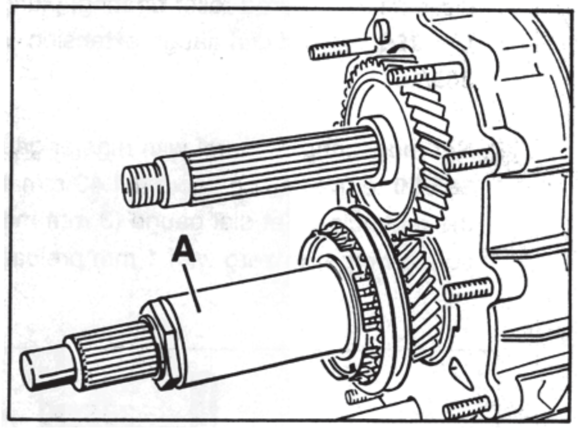
1 = Setting value "E"

1. Install complete gear set without "S3" shims and tighten all tensioning plate hexagon-head nuts to **23 Nm** (17 ftlb.).

2. Fit gear housing and locate with three nuts.

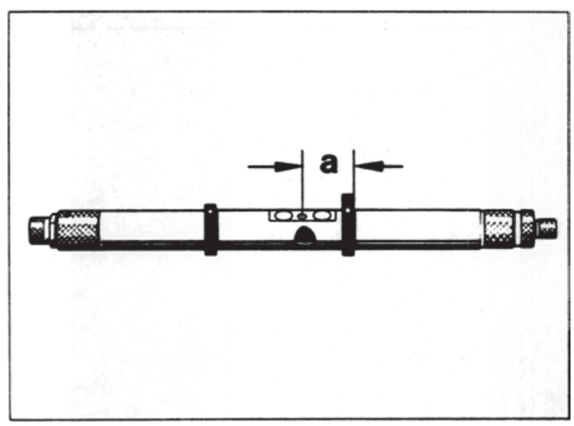
3. Install and engage sixth gear.

4. Block input shaft with Special Tool **9253** and tighten drive pinion collar nut to **300 Nm** (221 ftlb.).



A = Suitable pipe section

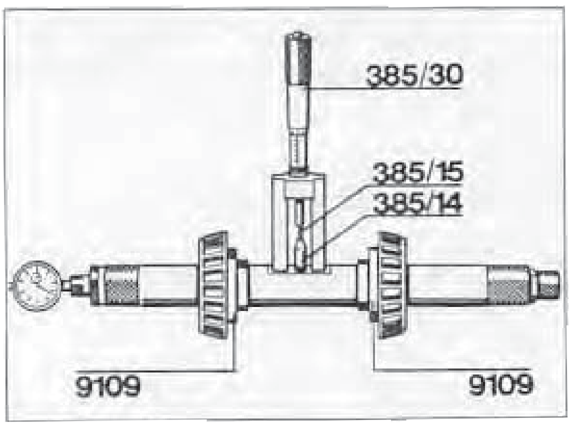
5. Set adjusting ring of measuring mandrel **VW 385/1** to dimension "a".



a = approx. 65 mm

6. Assemble measuring mandrel with centering disks **9109**, tapered roller bearing, plunger **VW 385 /14** and dial gauge extension **VW 385/15**.

7. Set measuring mandrel with master gauge **385/30** to the setting value (61.43 mm in the example). Set dial gauge (3 mm measuring range) to zero with 1 mm preload.



543-39

8. Put gauge block plate **9281** on drive pinion head and insert measuring mandrel into transmission case. Dial gauge extension is located in the area of the gauge block plate.

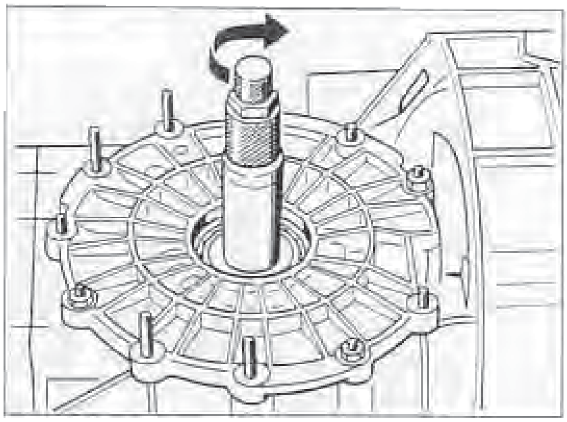
544-39

9. Fit lateral transmission cover without O-ring and tighten crosswise with 4 nuts.

Note

Do not use a hammer when fitting the lateral transmission cover (the gauge block plate held by magnets might fall off). Fit cover in installation position only by tightening the nuts uniformly.

10. Pull second centering disk with spindle towards the outside until the measuring mandrel can just be turned by hand.



545-39

11. Turn measuring mandrel carefully until the dial gauge extension is vertical to the face of the drive pinion head. At this point, the pointer of the dial gauge reaches maximum deflection (reverse point) and the dial gauge must be read.

Note

The measured value always deviates from the set dimension clockwise (the smaller pointer on the dial gauge is between 1 and 2), i.e. if the dial gauge is set with a preload of 1 mm, the value deviating from 1 is taken as shim thickness "S_3".

Example:

If the small pointer on the dial gauge is between 1 and 2 and the large pointer indicates 0.37 mm, then 0.37 mm is the shim thickness (with 1mm gauge preload) to be inserted. Always round up or down to the nearest 0.05 mm (e.g. 0.37 mm to 0.35 mm).

12. After inserting the necessary shims, check the setting value "E" again. A deviation of ± 0.03 mm is permissible.

Adjusting ring gear

Determine total shim thickness "S tot." ($S_1 + S_2$).

The ring gear must be adjusted, if the:

transmission case,
lateral transmission cover,
tapered roller bearing for differential,
differential housing or drive set
have been replaced.

Note

The drive pinion must be removed to determine the preload of the differential tapered roller bearings.

1. Make sure that the bearing outer races of the tapered roller bearings are well seated in the transmission case or lateral transmission cover, respectively.

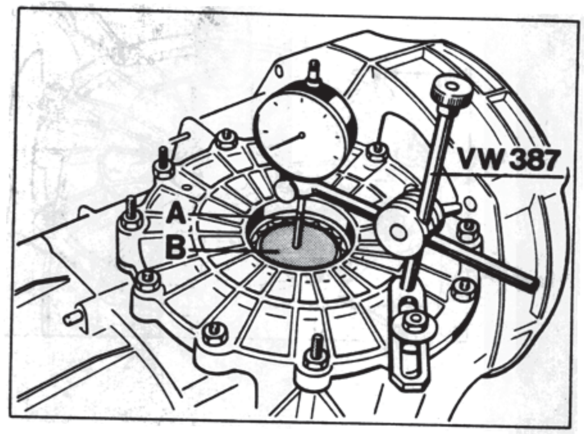
2. Fit one spacer ring (2.5 mm thick) on the ring gear side and on the opposite side of the differential to be used.

3. Insert differential into transmission case and rotate several times.

4. Fit lateral transmission cover without seal and tighten all hexagon-head nuts to **23 Nm** (17 ftlb.).

5. Put gauge block plate **VW 385/17** on the collar of the differential.

6. Fasten universal dial gauge holder **VW 387** with dial gauge and extension to the case and set to 0 with 2 mm preload.



546-39

A = Dial gauge extension (approx. 30 to 40 mm long)
B = Gauge block plate VW 385/17

7. Move differential up and down. Read off backlash on the dial gaug and note.

Note

Do not turn differential while measuring backlash as this will give an incorrect reading.

8. Calculate "S tot.".
   "S tot." = Fitted shim thickness
   + Measured value
   + Pressure fit of tapered roller bearing

Example

Thickness of shims inserted	5.00 mm
Measured value	0.75 mm
Pressing (constant value)	0.40 mm
"S tot."	6.15 mm

9. Remove differential, pull off both tapered roller bearings and split calculated shim thickness "S tot." as follows.
   Selcect spacer S_1 0.70 mm thinner and S_2 0.70 mm thicker as a starting point for subsequent adjustment of the backlash.

Example

Total shim thickness of spacers
$S_1 + S_2 = 6.15$ mm

Thickness of spacer S_1

$$\frac{6.15\text{ mm}}{2} = 3.075\text{ mm}$$
$$-0.700\text{ mm}$$
$$2.375\text{ mm}$$

Thickness of spacer S_2

$$\frac{6.15\text{ mm}}{2} = 3.075\text{ mm}$$
$$+0.700\text{ mm}$$
$$3.775\text{ mm}$$

Note

Spacers are available in thicknesses of 1.6 to 3.1 mm in increments of 0.10 mm.

By using a 0.25 mm shim, the shim thicknesses may be graduated in increments of 0.05 mm.

The calculated shim thicknesses must be rounded up or down for plausible dimensions that will not alter the total thickness S1 and S2.

Example:

Calculated thicknesses

$S_1 + S_2 = 2.375 + 3.775 = 6.15$ mm

Rounded thicknesses

$S_1 + S_2 = 2.35 + 3.80 = 6.15$ mm

Measure shims with a micrometer in several places. Permissible deviation 0.02 mm. Also check shims for burrs and damage.

Adjusting circumferential backlash

Note

The backlash to be set is embossed on the ring gear.

1. Mount gear set using shims "S_3" determined while adjusting the drive pinion.

Make sure that the collar nut of the drive pinion is tightened to **300 Nm** (221 ftlb.) before measuring backlash.

2. Insert differential with tapered roller bearing and shims (S_1 + S_2) into the housing.

3. Fit lateral transmission cover and tighten all hexagon-head nuts to **23 Nm** (17 ftlb.).

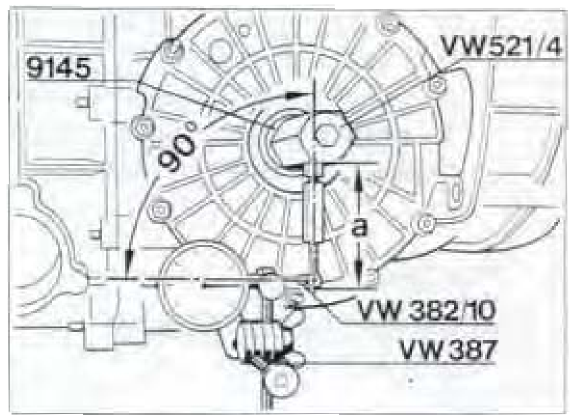
Always make sure that there is a certain amount of backlash when tightening the nuts. Never allow the drive pinion to seize.

4. Assemble measuring lever **VW 388** and adjusting device VW 521/4 and adjust lever length to 80 mm with the plunger. Refer to dimension "a" in the picture.

5. Insert adjusting device with clamping sleeve (Special Tool 9145) into the differential and clamp firmly.

6. Rotate differential in both directions several times to settle the tapered roller bearings.

7. Fit universal dial gauge holder with flat extension in such a way as to produce a right angle between dial gauge axis and lever.



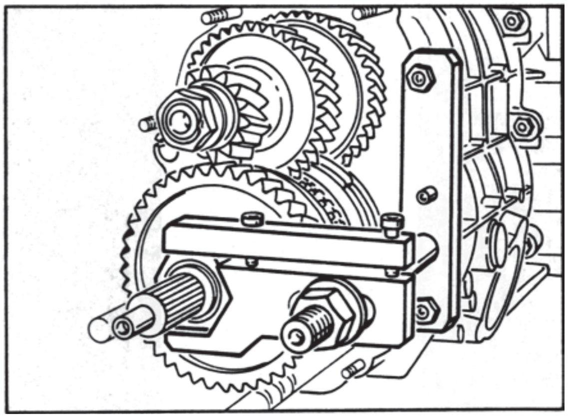
548-39

Dimension "a" = approx. 80 mm

8. Turn ring gear carefully at the clamping screw of the adjusting device as far as the stop and set the dial gauge to zero. Turn back ring gear and read off circumferential backlash. Note down the reading.

Note

When carrying out measurements, the drive pinion must be blocked with Special Tool 9562.



1710-39

9. After turning the ring gear a further 90°, repeat measuring procedures three times. The measured values must not deviate from one another by more than 0.03 mm.

Note

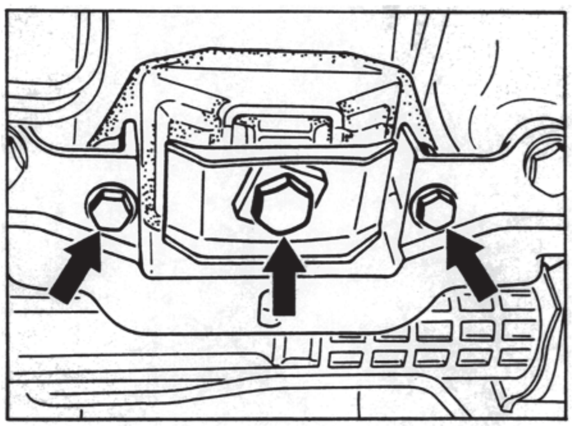
The backlash to be adjusted is embossed on the ring gear. A deviation of
± 0.03 mm is permissible

10. If the required backlash cannot be obtained, replace spacers (S_1 + S_2) again. The total shim thickness ("S tot.") must not be altered, however.

39 88 19 Removing and installing front-axle final drive

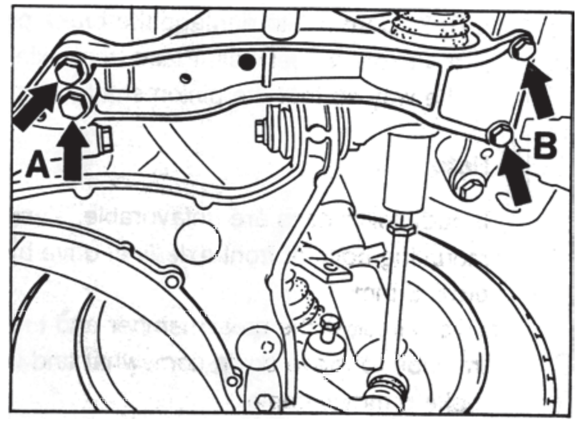
Removal

1. Remove front and center underside panel.
2. Unclip power steering lines from steering gear.
3. Separate drive shafts with Special Tool **9581** at transmission end.
4. Screw out mounting bolts of transmission mount, raise front axle final drive and take out mounts.



1963-39

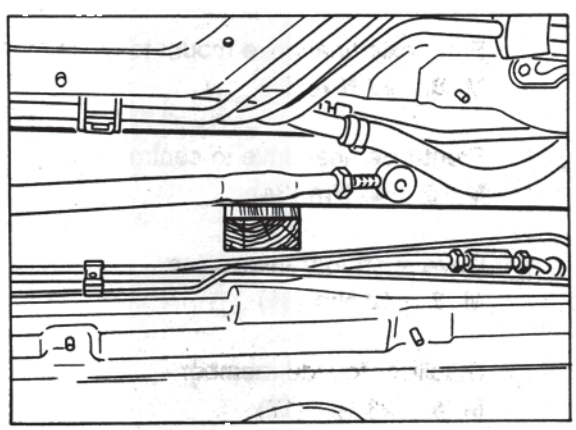
5. Lift front-axle final drive and take out final drive mount.
6. **Screw out** mounting bolts "A" of side member and **slacken** bolts "B" only (by approx. 5 mm).



1964-39

A - Remove bolts
B - Slacken bolts only (approx. 5 mm)

7. Push stabilizer bar forward below fuel tank.
8. Screw out central tube to front axle final drive mounting bolts, pushing central tube to the left and right and locating tube with suitable wooden block. Take care not to damage the pipings.



1965-39

9. Push front axle final drive out of splines and take out from below at an oblique angle. Take care not to damage the brake pipe at the spare wheel well. Place front axle out of the way so that the pinion shaft faces up.

Note

If body tolerances are unfavorable, slacken mounting bolts of front axle final drive by approx. 5 mm.
This will allow the crossmember and the central tube to move down somewhat and will make removal easier.

Installation

1. Check universal-joint shaft for true running (see page 40 - 103).

2. Check front-axle final drive oil and top up if required.

3. Measure front axle.

4. Tightening torques: (= ftlb)

Front-axle final drive mount to central tube
M 12 85 Nm (63)

Front-axle final drive mount to cross member
M 8 23 Nm (17)

Front-axle final drive to central tube
M 10 46 Nm (34)

Drive shaft to transmission
M 8 42 Nm (31)

Stabilizer to side member
M 8 23 Nm (17)

Stabilizer to stabilizer mount
M 10 46 Nm (34)

Side member to body / cross member
front / rear
M 12 90 Nm (66) **/ M 10 46 Nm** (34)

cross member to body
outer / inner
M 12 105 Nm (77) **/ M 10 48 Nm** (35)

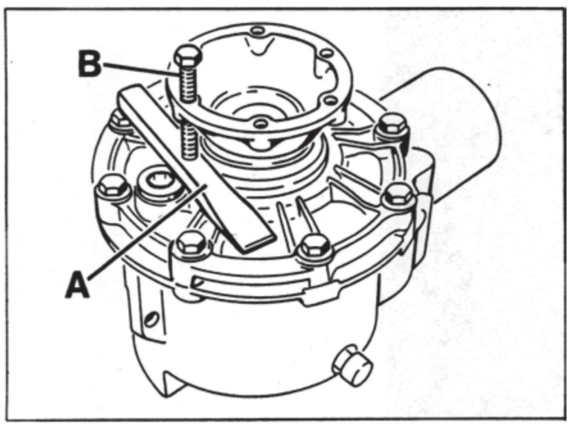
39 59 19 Removing and installing oil seal of halfshaft flange (front axle final drive)

Note

The seals may also be replaced with the front axle final drive remaining installed.

Removal

1. Remove halfshaft flange by placing a chisel or spacer „A“ below the halfshaft flange and turning bolt „B“ to pull out halfshaft flange. In case the halfshaft flange is tilted, screw another bolt into the opposite hole.



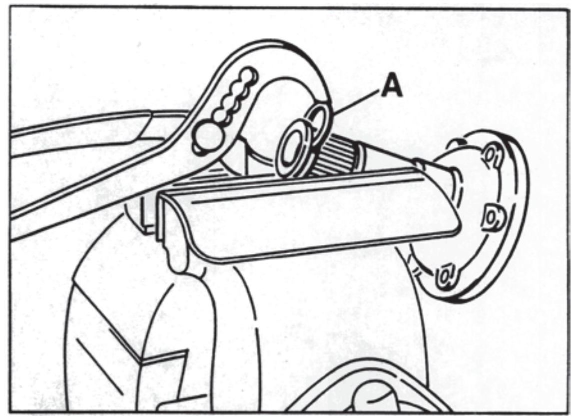
1993-39

2. Lever out seal with a suitable tool.

Installation

1. Pack space between dust and grease lips with grease (e.g. Liqui Moly Pu 53) and drive seal home to stop, using Special Tool **9537**.

2. The snap ring of the halfshaft flange must always be replaced. Use protetive jaws to mount flange in a vise and press out snap ring with a new snap ring „A“.



1994-39

A = New snap ring

3. Grease snap ring liberally and press in half-shaft flange with a suitable drift.

39 55 19 Removing and installing output shaft oil seal (Front axle final drive)

Removal

1. Remove front axle final drive (also refer to page 39 - 223).

2. Lever out seal with Special Tool **VW 681**.

Installation

1. Using Special Tool **9545**, press in seal to stop.

39 03 19 Removing and installing central tube

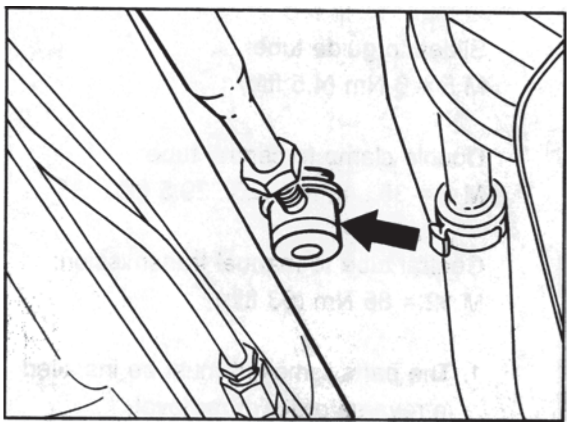
Removal

1. Remove centre console.

2. Remove underside panels.

3. Remove fit bolt for gearshift rod coupling.

4. Lift guide tube off ball joint.

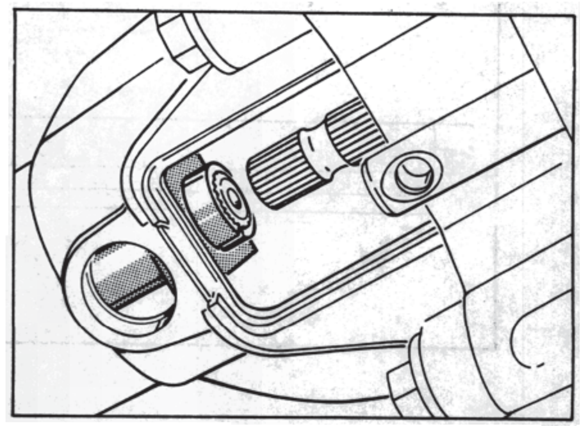


2238-39

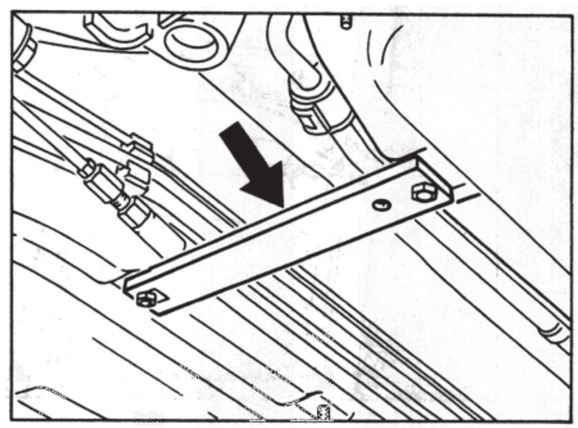
5. Remove shift lever with gearshift rod and guide tube.

6. Remove front axle final drive. (see page 39 - 225).

7. Completely unscrew the two mounting screws of the clamping sleeve and push it forwards on the central tube.



8. Apply flat steel parts (made in workshop) to support central tube.



2022-10

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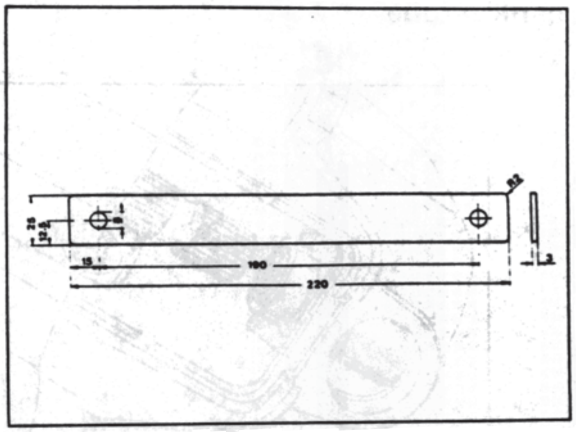
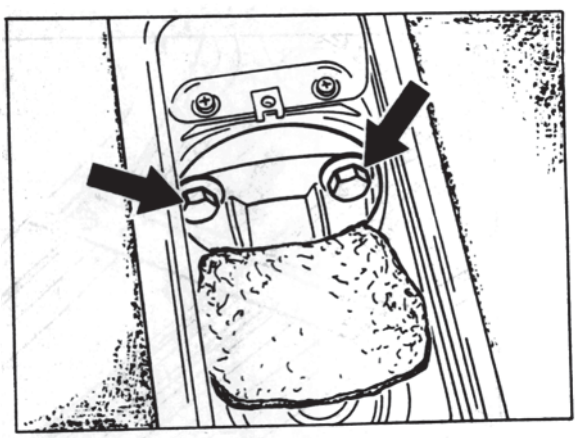


2029-10

9. Unscrew manual transmission mounting screws (the top two screws can be reached from the passenger compartment).



2025-10

Two persons are required for the removal of the central tube.

Installation

Torque specifications

Front axle final drive and suspension
(see page 39 - 226)

Frame to tunnel:
M 6 = 10 mm

Gearshift rod to transmission - internal shift rod:
M 8 = 23 Nm (17 ftlb)

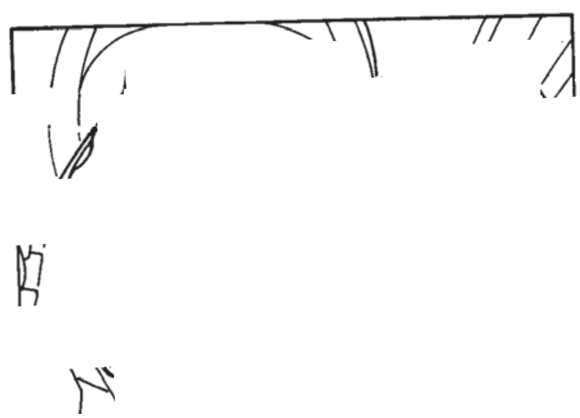
Slides to guide tube:
M 5 = 6 Nm (4.5 ftlb)

Double clamp to central tube:
M 8 = 35...40 Nm (26...29.5 ftlb)

Central tube to manual transmission:
M 12 = 85 Nm (63 ftlb)

1. The parts removed must be installed in reverse order of removal.

2. Make sure that the centering pins on the transfer casing are properly positioned.



2240-39

3. Place insulation in correct position on tunnel.

4. Apply sliding compound (e.g. Contifix) to central tube in area of insulation and push central tube in carefully, making sure that the insulation is properly positioned.

5. Check adjustment of gearshift. (see page 34 - 31).

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Repair Manual

911 Carrera
(993)

Volume III:
Transmission
Automatic

Dr. Ing. h.c. F. Porsche Aktiengesellschaft

Preface

Structure

The "Technical Literture" for the "911 Carrera (993)" model is basically structured as before, i.e. the structure follows the familiar repair groups.

A new feature is that the structure includes the main groups **0 to 9** and the main group **D**.

Main groups:	0	Complete vehicle – General
	1	Engine
	2	Fuel, exhaust, engine electrical system
	3	Transmission
	4	Chassis
	5	Body
	6	Body equipment, outside
	7	Body equipment, interior
	8	Air conditioning
	9	Electrical system
	D	Diagnosis

Layout

The layout in the below items remains unchanged throughout the repair manual

1. Table of tightening torques
2. Special tools required
3. Exploded views
4. Legends for the exploded views
5. Assembly notes / use of special tools

As a new feature, however, the former item 6 (Repair group diagnosis) is no longer filed in the volume corresponding to the respective repair group. The **Diagnosis test plans / diagnosis procedures** have been combined in a **separate Diagnosis volume** broken down according to the main groups 0 to 9.

Another new feature is that the contents of the "Service Information Technik" are indicated in the Repair Manual. This brochure concentrates on a description of the design and function of components and of the new features introduced for a particular model year.

Service Number

All major repair procedures and repair descriptions are identified by a two- or four-digit **Service Number** completed by two additional digits to identify the work that corresponds to the first six digits of the working position number in the Working Times and Damage Catalog.

Example: 30 37 37 Dismantling and assembling clutch control shaft

Explanation: **30 37 37** 50 (full working position number)

Repair group
here: Clutch, control

Component designation
here: Clutch control shaft

Activity
here: Dismantling and assembling

Index
here: Removed

Presentation in the various documents

30 37 37 50	Working position no. from **Working Times and Damage Catalog**, consisting of repair group, component designation, activity and index
30 37 37	Six-digit number in **Repair Manual**, consisting of repair group, component designation and activity
	Service number in **Service Information**, consisting of repair group and component designation

Goal

The introduction of a service number in the "technical literature" is intended to facilitate standardization and positive identification to allow direct cross-referencing among the various documents. This is of particular importance with regard to the use of electronic media.

Survey of contents of Service Information Technik '95

The Service Information gives a detailed description of the technical features of the new 911 Carrera.

III Transmission Automatic Transmission

3 Transmission

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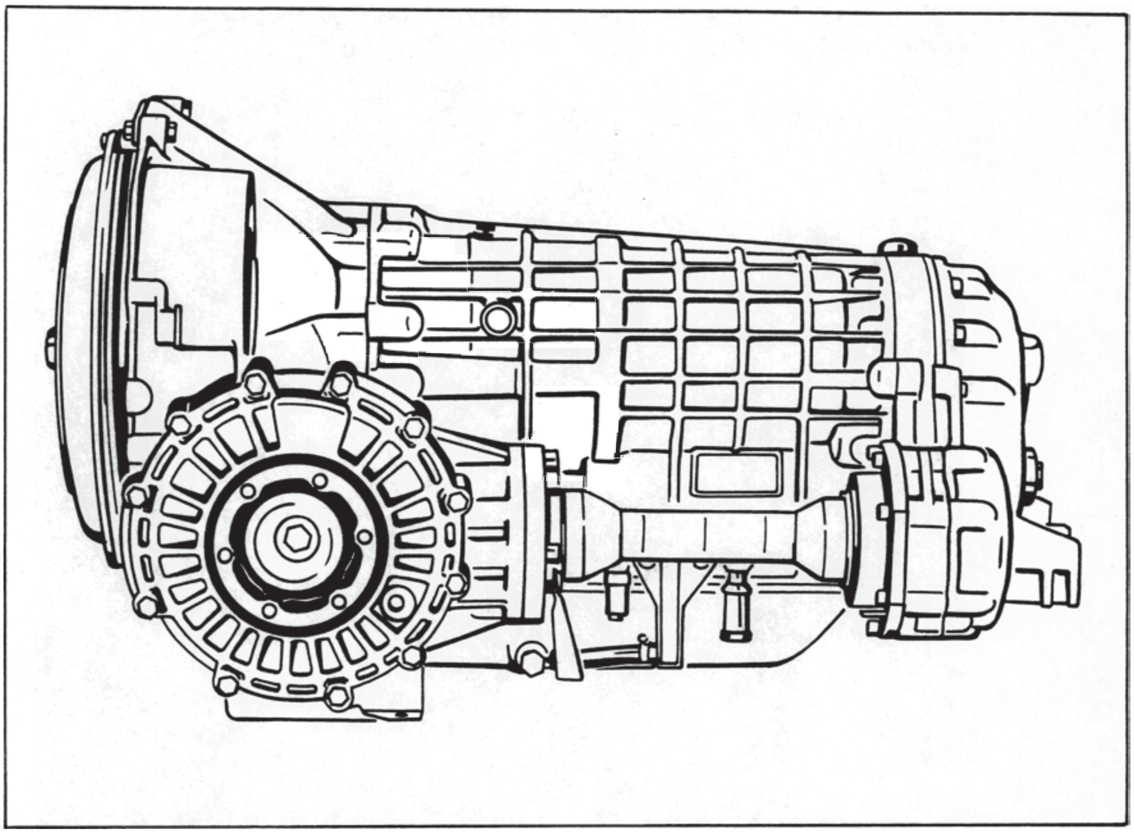
3 Technical Data

4-speed Tiptronic transmission A50



Type	Code letter	Version	Installed in	Model year
A 50/04		4-speed	911 Carrera worldwide except USA and Taiwan	'94 / '95
A 50/05		4-speed	911 Carrera USA, Taiwan	'94 / '95

3 Technical Data

General data	A50/04	A50/05
Type	fully automatic 4-speed planetary transmission (Tiptronic)	
Gear ratios		
spur gear	1.100	1.100
1st gear	2.479	2.479
2nd gear	1.479	1.479
3rd gear	1.000	1.000
4th gear	0.728	0.728
reverse	2.086	2.086
final drive	hypoid bevel gear with 15 mm offset	
final drive ratio	9:33 = 3.667	9 : 32 = 3.556
stall speed	2300 - 400	2300 - 400
oil volume for final drive		approx. 0.9 l multi-grade transmission oil 75 W 90 API specification GL5 (**MIL-L 2105 B**), or SAE 90
oil volume for automatic transmission with torque converter		total volume approx. 9.5 l oil change approx. 3.5 l ATF-Dexron II D

3 Technical Data

Torque specifications for Tiptronic transmission

Location	Thread	Tightening Torque Nm (ftlb.)
Multifunctional switch to transmission	M 6 x 25	10 (7)
Selector lever to selector shaft	M 8 x 1	15 (11)
Long halfshaft flange to transmission housing	M 8	23 (17)
Short halfshaft flange to differential	M 10 x 60	46 (34)
Plug to rear transmission housing	M 22 x 1.5	50 (37)
Rear transmission housing to automatic transmission	M 10	46 (34)
Front transmission cover to intermediate plate	M 10 x 35 M 8	46 (34) 23 (17)
Intermediate plate to automatic transmission	M 8	23 (17)
Drive pinion bearing assembly to front transmission cover	M 8	23 (17)
Fastening nut to helical gear	M 40 x 1.5	250 (184)
Guide part for parking lock to housing	M 6 x 20	10 (7)
Plug to ATF pan	M 14 x 1.5	40 (30)
Banjo bolt to ATF pan	M 12 x 1.5	40 (30)
Banjo bolt to housing	M 14 x 1.5	40 (30)
ATF pan to housing	M 6	6 (4)

Location	Thread	Tightening torque Nm (ftlb.)
ATF strainer to hydraulic control unit	M 6 x 65	
Plug to ATF quick-fill adapter	M 14 x 1.5	30 (22)
Hydraulic control unit to transmission	M 6	
Hexagon nut for transmission socket		12 (9)
ATF indicator tube to transmission	M 6 x 4	
Adapter of hydraulic control unit to transmission housing	M 6	
Pressure regulator and solenoid valve mount to control unit	M 6	
Solenoid valves to hydraulic control unit	M 5 x 12	
ATF pump to housing	M 6	
Oil drainage and filling plug	M 22 x 1.5	50 (37)
Side transmission cover to housing	M 8 x 35	23 (17)
Bearing cover to bearing assembly	M 6 x 15	
Drive pinion bearing assembly to housing	M 10 x 35	50 (37)
Plug for ATF ducts	M 14 x 1.5	25 (18)
Fastening nut to bearing assembly	M 36 x 1.5	250 (184)
Crown wheel to differential housing	M 10 x 1.25	85 (63), and Loctite 262

3 Technical Data

Torque specifications for transmission suspension

Location	Thread	Tightening torque Nm (ftlb.)
Transmission support to body	M 10 x 70	46 (34)
Transmission support to transmission (fastening nut)	M 12 x 1.5	85 (63)
Side member to transmission	M 12 x 1.5 x 65	85 (63)
Side member to transmission support (fastening nut)	M 10	30 (22)
Console to transmission	M 8 x 35	23 (17)

Torque specifications for ATF lines and cooler

Location	Thread	Tightening torque Nm (ftlb.)
Bracket to headlight holder	M 6	10 (7)
Console to wheel house	M 8	23 (17)
Tension strut to console	M 6	10 (7)
Bar to ATF cooler	M 6	10 (7)
ATF cooler to engine oil cooler	M 6	10 (7)
Horn holder to wheel house	M 6	10 (7)
ATF lines to transmission (union nut)	M 18	30 (22)
Joints on ATF lines (union nuts)	M 18	30 (22)

3 Technical data

Torque specifications for gear selecting system

Locaion	Thread	Tightening torque Nm (ftlb.)
Lock nut to clevis of selector lever cable	M 5	6 (4)
Selector lever mount to body	M 6 x 16	10 (7)
Holder for selector lever cable to transmission	M 8	23 (17)
Cable slide housing to switch plate (Keylock)	M 4	2.5 (2)
Keylock cable to ignition lock	M 10 x 1	2.5 (2)
Shiftlock to selector lever housing	M 5	6.5 (5)
Lift solenoid to Shiftlock housing	M 4	2.5 (2)

Removing and installing the torque converter

Removing

1. Remove transmission.

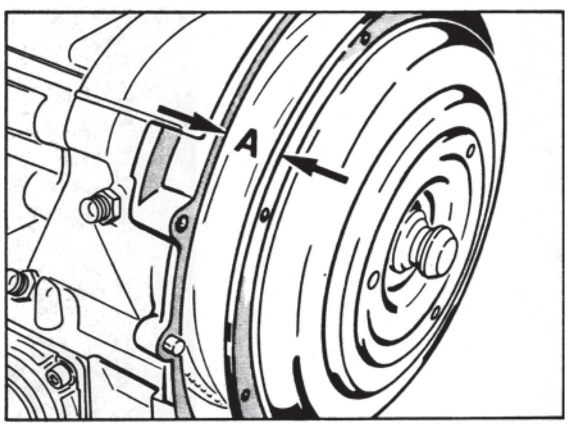
2. Remove converter, with transmission in horizontal position.

Note

Do not damage converter bearing assembly and rotary shaft seal.

Installing

1. Carefully insert converter, with transmission in horizontal position. Turn the converter to and fro until the gear toothing engages and the installation position is reached.



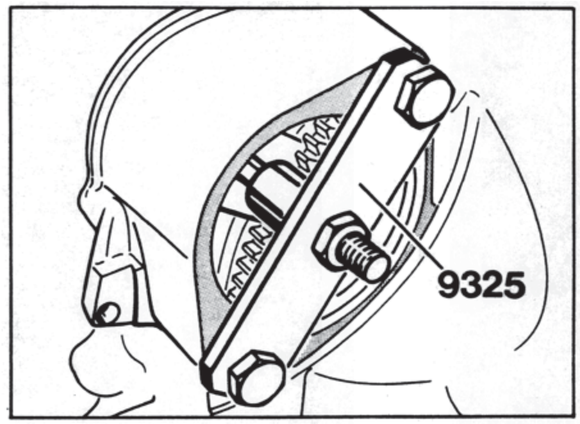
412-32

A = approx. 25 mm

Note

If the torque converter is not installed in the correct position, both the torque converter and the ATF pump may be damaged when the engine is connected to the transmission.

2. Secure converter against falling out with special tool **9325**



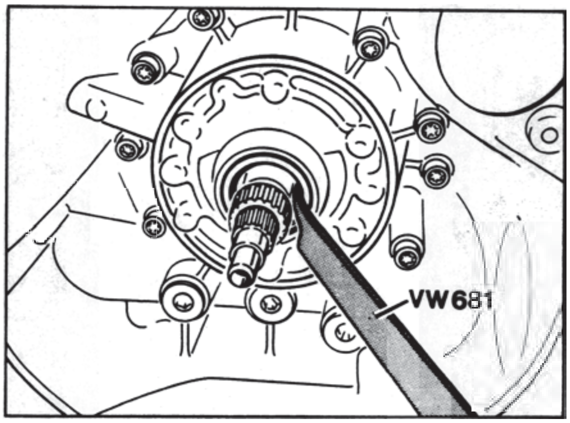
413-32

32 47 19 Removing and installing torque converter seal ring

Removing

1. Remove transmission and converter.

2. Lever out sealing ring with **VW 681**



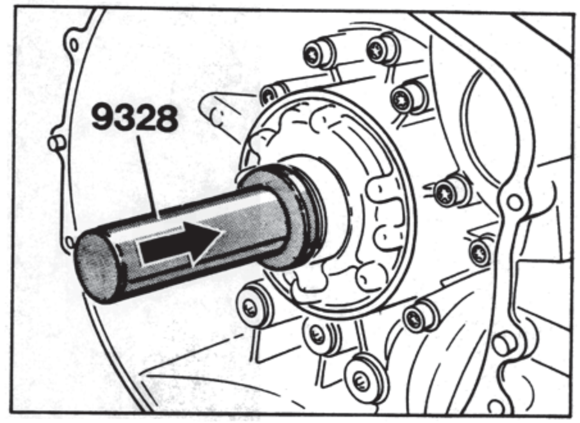
419-38

Installing

Installation takes place in reverse order.

1. Wet sealing lip with ATF.

2. Press in sealing ring with special tool **9328** as far as it will go.



420-38

Test point	DTC	Title	Fault effect	Page
31	70	Fault in torque converter clutch	Torque converter clutch always open	37 - 85

Note
Diagnosis of the torque converter clutch is active as from the **1997** model.

Fault, fault code	Possible causes, elimination, notes
Test point 31 **Torque converter fault** Fault code 70	**Torque converter clutch always open** **Fault possibility: mechanical/hydraulic fault in transmission** 1) Check ATF level and correct if necessary (refer to 911 Carrera (993) Workshop Manual, Page 37 - 101). 2) Erase fault memory and perform a test drive. The diagnostic test conditions are achieved if: - the torque converter clutch is electrically closed - engine speed < 3008 rpm - engine torque > 200 Nm (148 ftlb) - ATF-temperature between 40° C and 95° C 3) Read out fault memory again. The following areas have to be checked if the fault is still present: - ATF supply - torque converter - hydraulic control unit (jammed spool valves) - transmission (slipping clutches)

Checking the ATF fluid level

The prescribed fluid level is extremely important for perfect functioning of the automatic transmission.

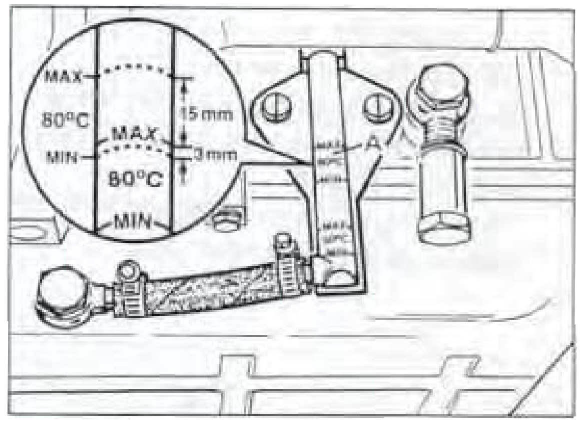
Preconditions for checking:

- Transmission underbody cladding removed
- Vehicle must be horizontal
- Engine operating at idling speed
- Hand brake applied
- Selector lever in position "P"
- ATF temperature 80°C

Check ATF level at 80°C.

Note

The ATF capacity was increased by 0.5 l. The ATF level therefore rises and the 80°C check marks move further up on the oil level tube. Refer to imaginary and dotted lines in the close-up insert.
When checking the ATF level, make sure the fluid level is between those two lines (maximum level **15 mm above** the **80°C MAX mark** present, lowest level approx. **3 mm below** the **80°C MAX mark** present).



1958-38

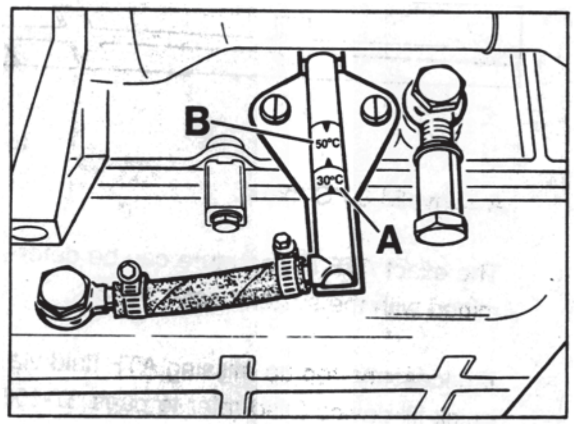
A = invalid 80°C mark

The exact ATF temeprature can be determined with the system tester 9288.

If necessary, top up missing ATF fluid via the quick-fill device (also refer to page 37-103).

Modifications from model year '95

Since model year '95, a new oil level tube with **50°C** markings has been fitted.
The ATF fluid level should be checked using the same procedure as before but at an ATF temperature of **50°C**.
The liquid level must be within the 50°C indication range (see B in illustration).



2036-38

A = indication range for 30°C ATF temperature
B = indication range for 50°C ATF temperature

37 02 55 Changing ATF fluid

Capacity: approx. 9.5 l
Change quantity: approx. 3.5

Oil type:
ATF-Dexron IID

The ATF fluid must be changed and the ATF strainer cleaned every 40,000 km

When changing the ATF fluid, the vehicle must be horizontal and the engine switched off.

Drain ATF fluid, remove ATF pan and ATF strainer (refer to page 38-113).

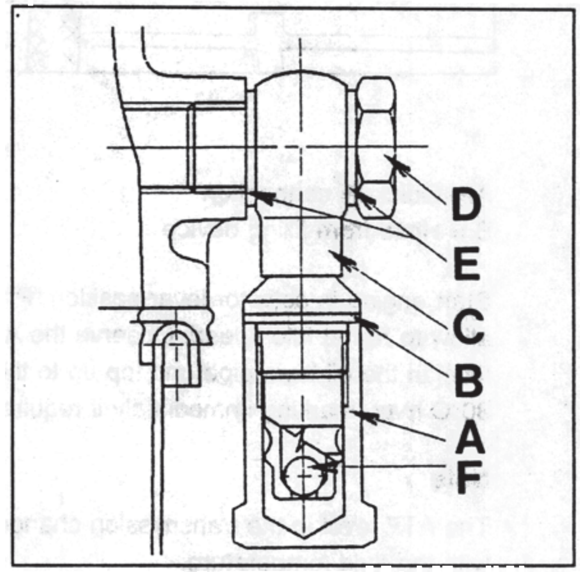
Thoroughly clean the strainer and pan.

Fit the ATF strainer with a new O-ring. Tighten the fixing screws with **8 Nm (6 ftlb)**.

Fit the ATF pan with seal. Tighten the fixing screws with **8 Nm (6 ftlb)**.

Fill with ATF fluid:

First, fill ATF fluid up to the 30°C max. mark via the quick-fill connection with the engine stationary.



391-38

A = Hexagon cap nut (tightening torque 30 Nm = 22 ftlb)
B = Sealing ring (replace)
C = Quick-fill connection

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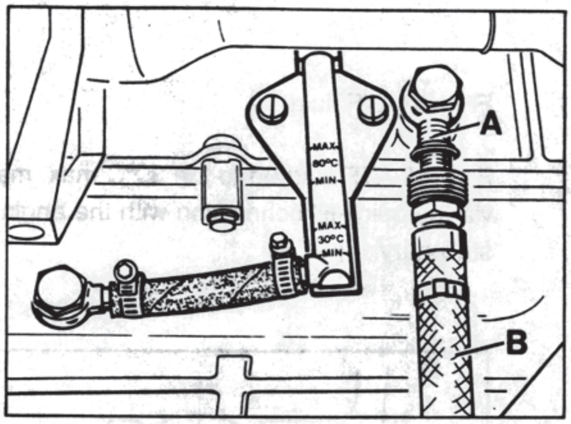


388-38

A = Quick-fill connection
B = Hose from filling device

Start engine in selector lever position "P" and allow to run at idle speed. Observe the ATF level in the oil level pipe and top up to the 30°C max. marking immediately if required.

Note

The ATF level in the transmission changes with the fluid temperature.

Drive the transmission warm and check the ATF fluid at 80° C (from mod. '95 at 50° C). **See note on page 37 - 101.**

The exact ATF temperature can be determined with the system tester 9288.

37 31 19 Removing and installing multifunctional switch on transmission

Removal

1. Set selector lever to position "N".

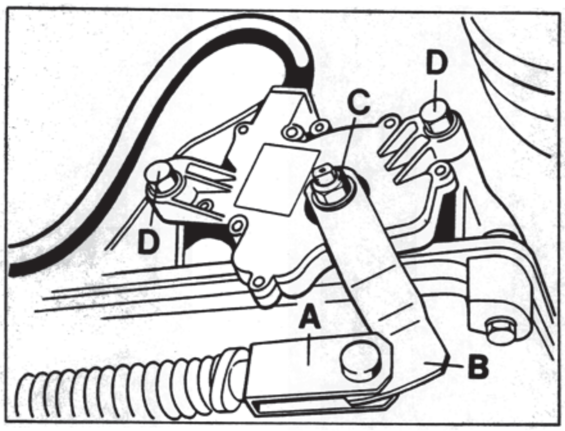
2. Remove transmission undertray.

3. Remove rear underside panel.

4. Remove left rear hot air pipe.

5. Disconnect selector lever cable from actuating lever.

6. Remove actuating lever.

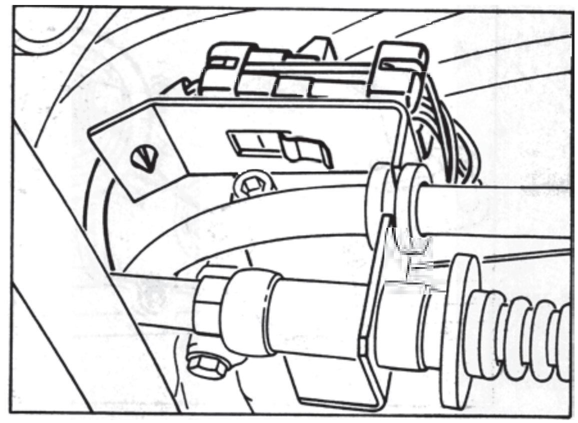


381-37a

A = selector lever cable
B = actuating lever
C = hexagon nut (M 8 x 1) with washer
D = fastening screws

7. Press retaining lugs for wire retainer "A" together and lift holder out upwards.

8. Detach, unlock and disconnect connector.



1881-37

A = wire retainer

9. Unscrew fastening screws for multifunctional switch completely and remove switch.

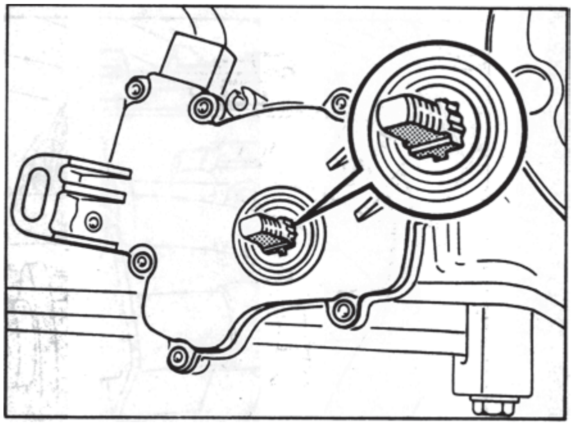
Installation

For installation, proceed in reverse order.

Tightening torques:

Multi-functional switch to transmission = 10 Nm
Actuating lever to selector shaft = 15 Nm

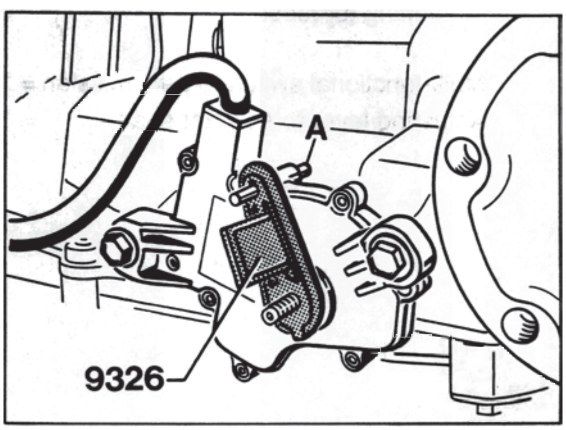
1. Set selector shaft to position "N" (turn shaft anti-clockwise up to the stop and then back two clicks) and place switch in the correct position.



1884-37

2. Adjusting multifunctional switch.

Push pointer of special tool **9326** onto the selector shaft and turn the switch until the locating pin can be pushed into the fixing hole of the switch. Tighten the mounting screws to **10 Nm** (7 ftlb.) in this position.



A = locating pin

2. Check, and if necessary adjust, setting of selector lever cable.

37 15 15 Adjsuting cable for selector device

1. Move selector lever to position "P".

2. Set multi-function switch to position "P". To do so, press actuator lever of switch back up to stop.

3. Set cable length at clevis so that the bolt can be installed free from stress.

4. Check adjustment by shifting through all the gears and confirming that gear is displayed on speedometer. In addition change gate from "D" to "M". This must be possible with one shmooth, straightline movement.

5. Mount snap ring for bolt on actuator lever.

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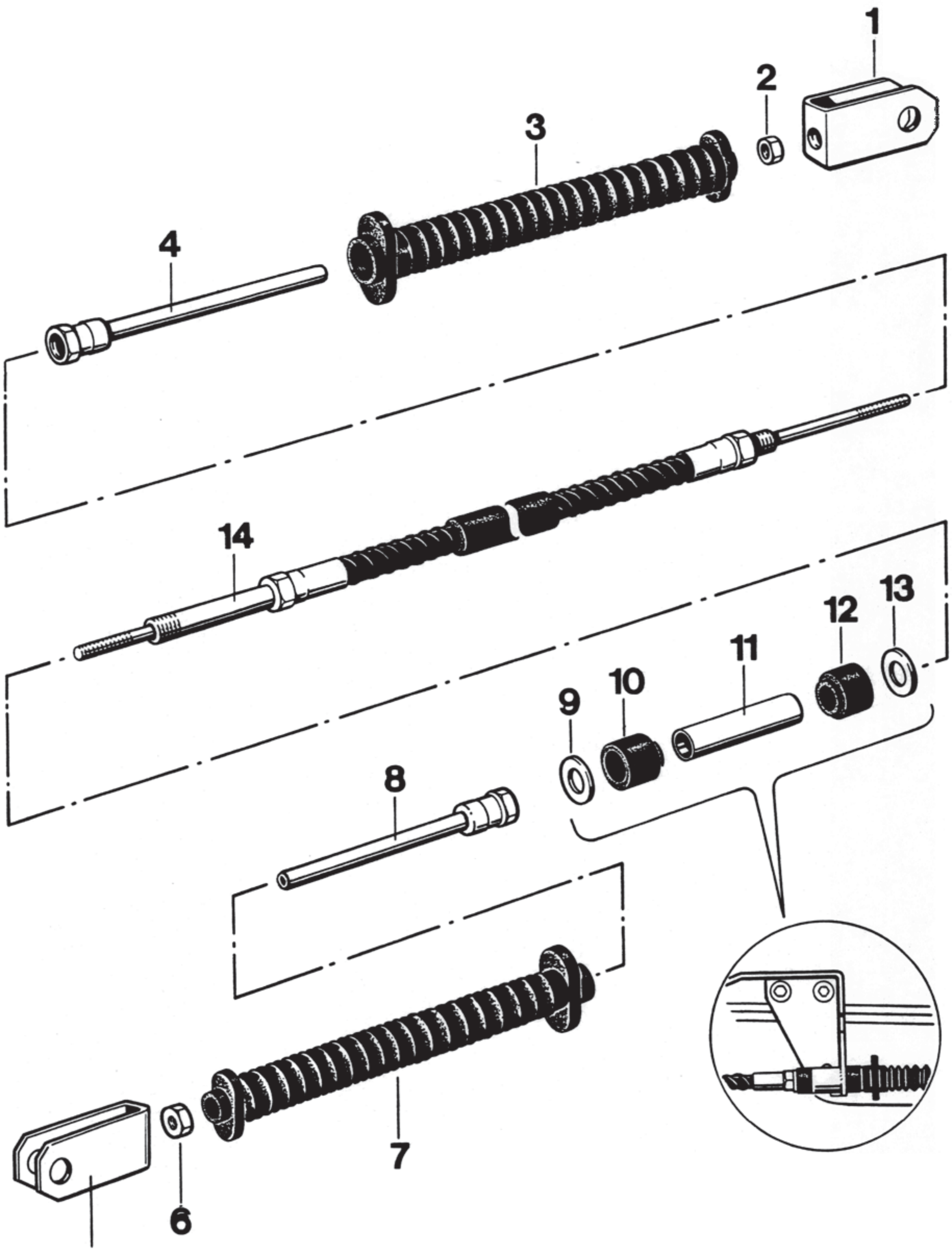
37 15 19 Removing Installing cable for selector mechanism



No.	Designation	Qty.	Note: Removal	Installation
1	Fork head	1		Screw on tol half length of thread on cable
2	Hexagon nut	1		Tighten to 5 Nm (4.4 ftlb)
3	Galter seal	1		
4	Guide tube	1		
5	Fork head	1		
6	Hexagon nut	1		Tighten to 6 Nm (4.4 ftlb)
7	Gaiter seal	1		
8	Guide tube	1		
9	Washer	1		
10	Rubber mount	1		Install in correct position
11	Spacer tube	1		
12	Rubber mount	1		Install in correct position
13	Washer	1		
14	Cable	1		Readjusrt

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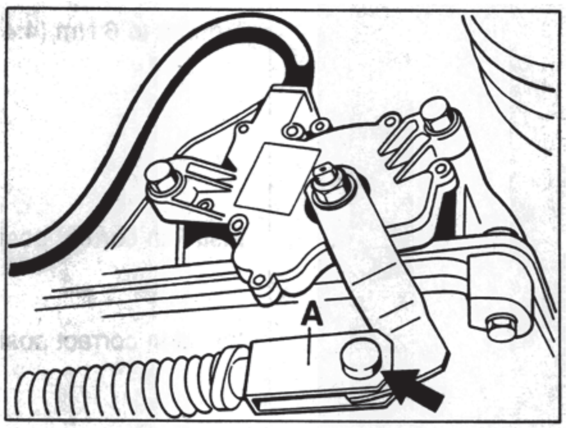
Instructions for removal and installation

Removal

1. Remove transmission undertray and underside panel.

2. Disconnect cable on operating lever and remove fork head.

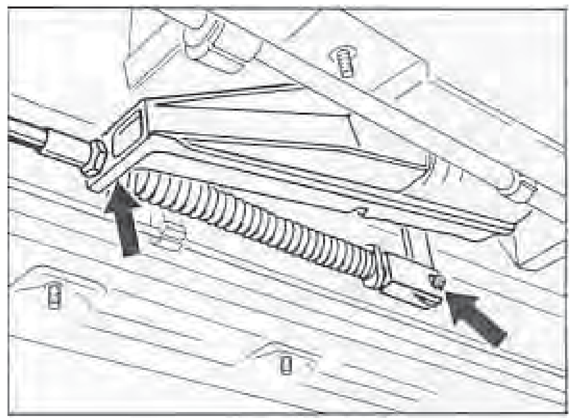


381-37

A = Fork head

3. Disconnect guide tube on bracket.

4. Disconnect cable on selector lever casing and disconnect guide tube.



1066-37

Installation

1. Installation is carried out in reserve order.

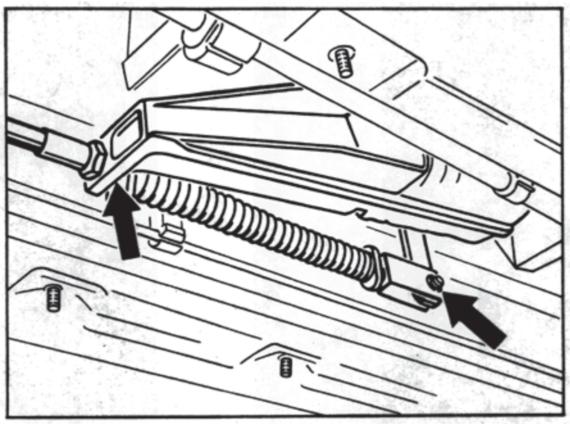
2. Adjust calbe for selector mechanism (see page 37 - 107).

37 10 19 Removing and installing gear selecting system

1. Disconnect battery.

2. Remove center underside panel

3. Disengage selector lever cable from deflection lever and undo guide tube.

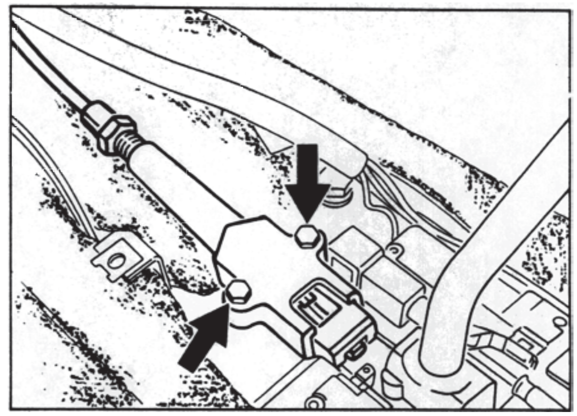


1066-37

4. Unscrew release button and pull off selector knob.

5. Remove center console.

6. Disconnect cable valve body from switch plate (only for keylock models).



1067-37

7. Disconnect connectors for switch plate.

8. Unscrew four mounting screws (M 6) and take out selector lever operator from above.

Installation

Tigtening torques:

Gear selecting system to body
= 10 Nm (7 ftlb)

Cable valve body to
switch plate = 2.5 Nm (2 ftlb)

1. Install in reverse order.

2. Press selector knob manually until is up against the stop, making sure the twist lock engages in the cutout in the selector lever.

3. Check release button for smooth operation. It must return into the home position by itself.

4. Check selector lever cable adjustment and readjust if required.

5. Check operation of keylock and shiftlock

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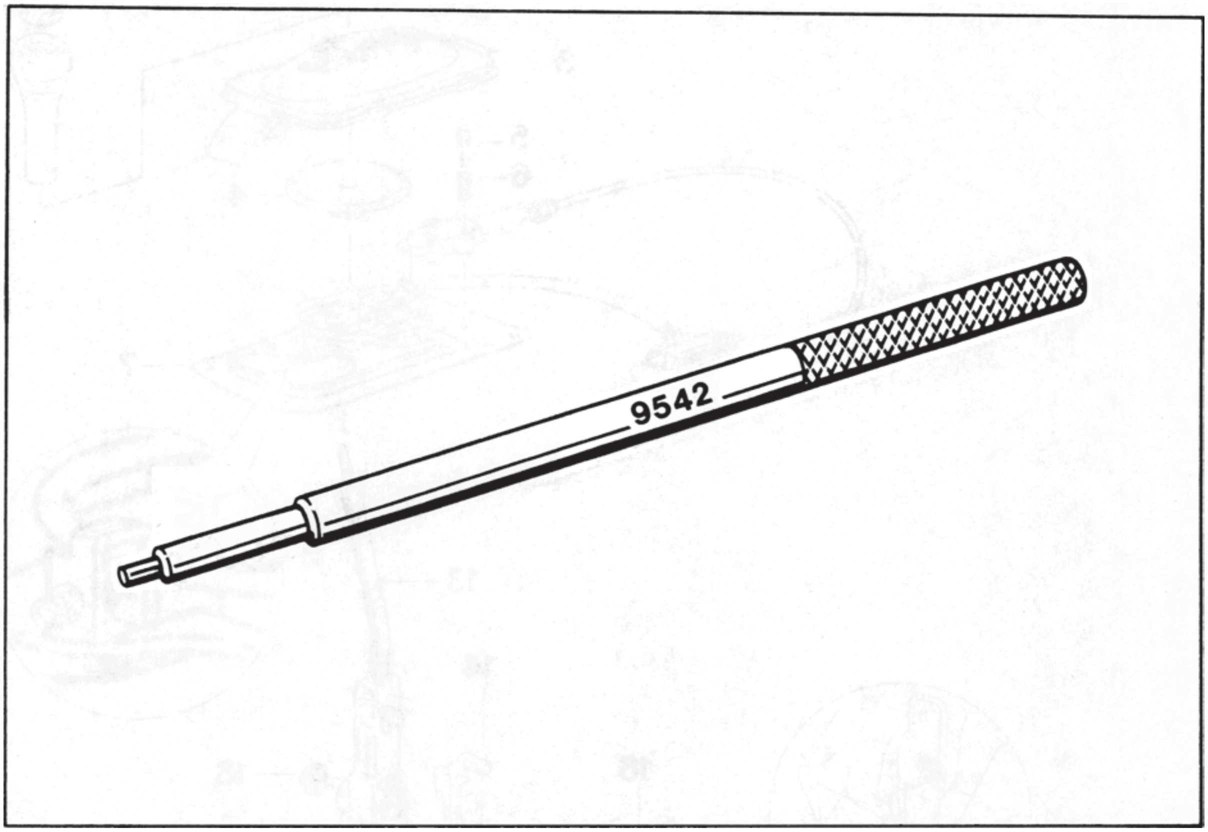
37 10 37 Dismantling and assembling gear selecting system

Tools



No.	Designation	Special tool	Order number	Explanation
	Assembly mandrel	9542	000.721.954.20	

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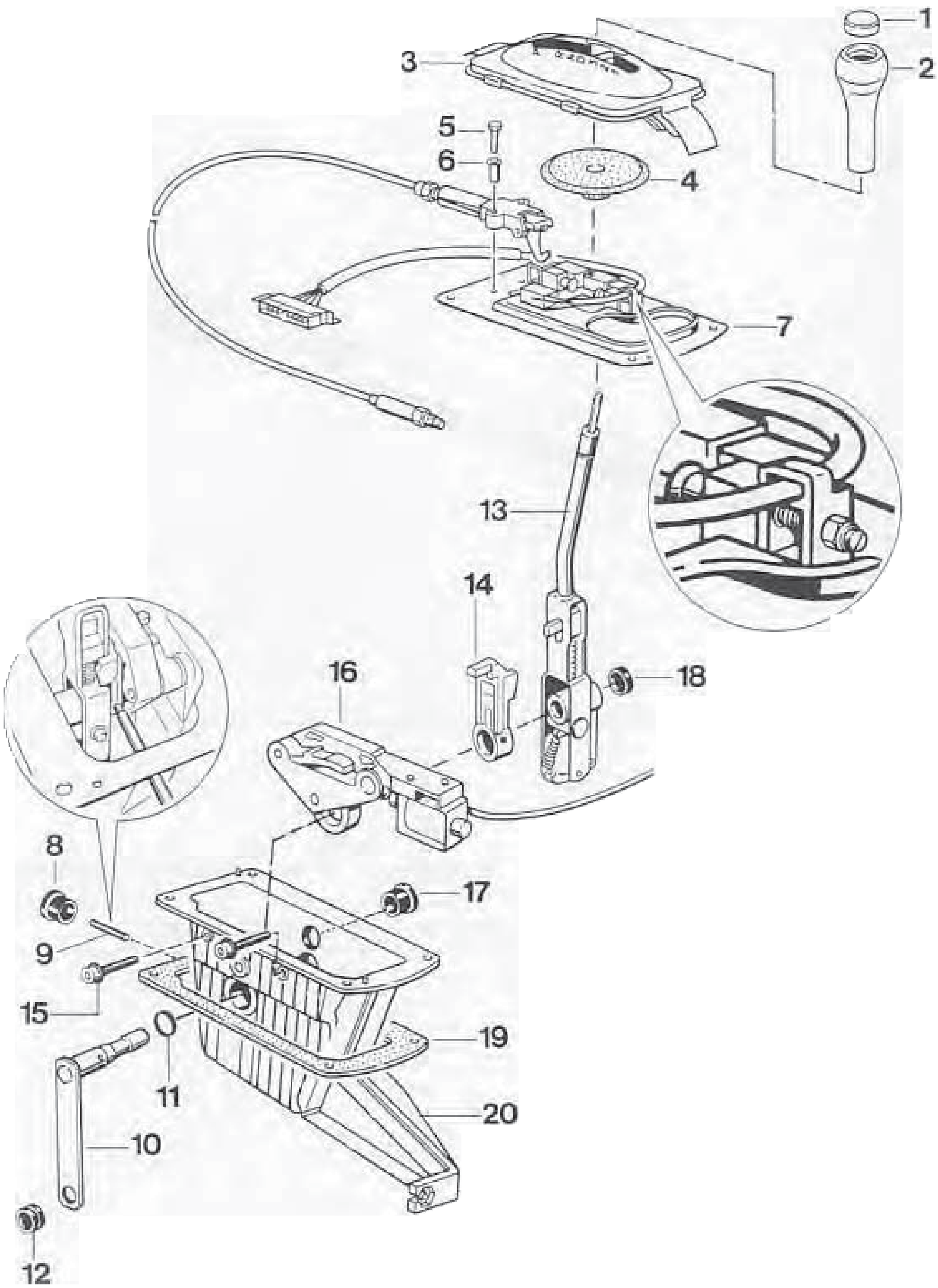
37 10 37 Dismantling and assembling gear selecting system



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No.	Designation	Qty.	Note: Removal	Note: Installation
1	Release button	1	Screw off manually	Must return to home position automatically after it has been actuated
2	Selector knob	1	Pull off manually	Push up to stop in correct position. Twist lock must engage in cutout in selector lever
3	Shroud	1	Can only be removed from below with the center console removed	
4	Cover	1		
5	Hexagon head screw	2		Tighten to 2.5 Nm (2 ftlb)
6	Sleeve	2		
7	Switch plate	1		
8	Plug	1		
9	Tensioning sleeve	1	Drive out using Special Tool 9542	Bore of driver and relay shaft must match
10	Deflection lever	1		
11	Seal	1		
12	Rubber mount	1		
13	Selector lever	1	Shift into manual speed selection gate	
14	Driver	1		
15	Hex socket head bolt	2		Tighten to 6.5 Nm
16	Shift-Lock	1		
17	Plug	1		
18	Cover	1		
19	Gasket	1		
20	Housing	1		

Note

Coat all sliding surfaces with low-temperature grease (e.g. Shell S 6508)

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Notes on assembly:

Note

Change from "D" to "M" and from "M" to "D". Stright-line movement without catching must be possible. In addition, there may be up to 0.4 mm play on the selector lever in the + and – direction with "M" selected. Adjustments can be made using the selector lever reset switch (see exploded drawing, item 7).

37 87 19 Removing and installing solenoid for shiftlock

Note

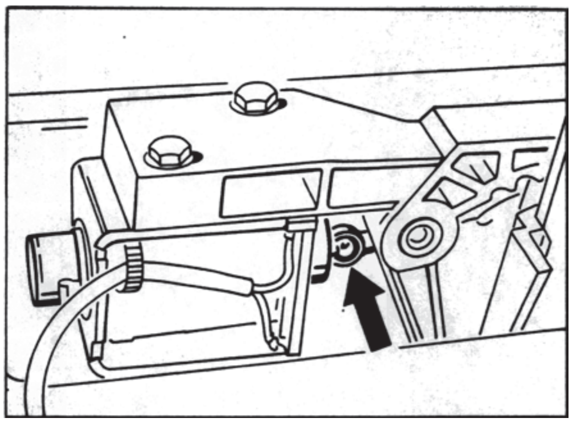
When checking the solenoid electrically, be sure to observe correct polarity
Terminal 1 = Positive
Terminal 2 = Negative

Removal

1. Remove center console and gear selecting system.

2. Remove switch plate.

3. Using a suitable tool, press connecting rod carefully off the solenoid.



4. Screw out mounting screws and take off solenoid.

Installation

1. Set selector lever to "1" position.
2. Grease ball and ball socket with low-temperature grease.

3. Clip connecting rod to solenoid, retaining the connecting rod in correct position using a suitable wire hook or marking tool and pushing the free lift solenoid carefully into the ball socket.

4. Using sleeves and hexagon head bolts, fit solenoid to gate in such a manner that it remains free to slide in an axial direction.

5. Adjusting the solenoid:

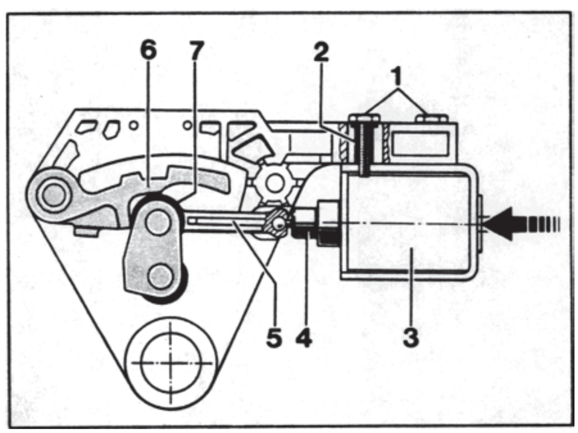
   Set selector lever to position „P".

   Slide lift solenoid all the way back in the slots of the gate.

   Push iron core from the solenoid towards the pawl until it contacts the stop and locate it in this position.

   Slide the actuated solenoid axially until the idler contacts the stop of the pawl.

   Tighten hexagon head bolt to 2.5 Nm (2 ftlb) in this position.



1 - Hexagon head bolt
2 - Sleeve
3 - Solenoid
4 - Iron core
5 - Connecting rod
6 - Pawl
7 - Idler

6. Check operation of shiftlock.

37 13 19 Removing and installing keylock bowden cable

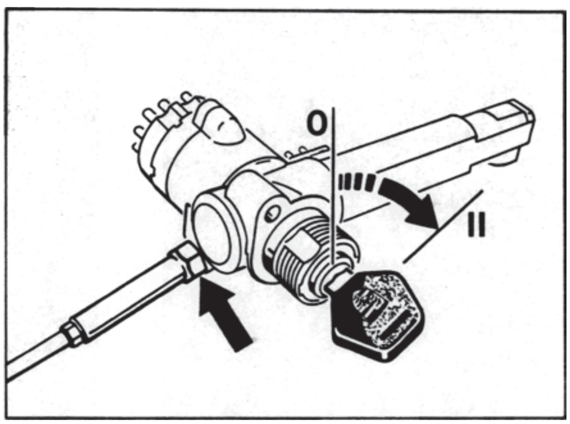
Removal

1. Disconnect battery.
2. Remove complete center console, knee guard and side nozzle.
3. Undo Central Information System and leave it supended on the wiring.
4. Turn ignition lock to position „2" (Ignition on).

Note

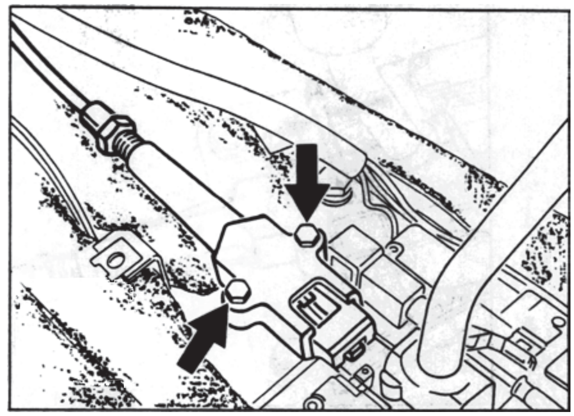
The ignition lock must be in position „2". If it is left in any other position, both the lock and the bowden cable may be damaged.

5. Unbolt bowden cable from ignition lock.



1068-37

6. Undo mounting screws of valve body.



1067-37

7. Disengage bowden cable from pedal floorboard and from bracket for center console.

Installation

1. Assemble in reverse order, observing the following points.
2. Turn ignition lock to position „2" (Ignition on) and fit bowden cable to ignition lock.
   Tightening torque: 2.5 Nm (2 ftlb)
3. Fit bowden cable valve body using sleeves and hexagon head bolts.
   Tightening torque: 2.5 Nm (2 ftlb)
4. Set selector lever to position „P" and turn ignition lock to position „0".

Note

If the ignition lock cannot be turned to the 0 position, the bowden cable must be readjusted.

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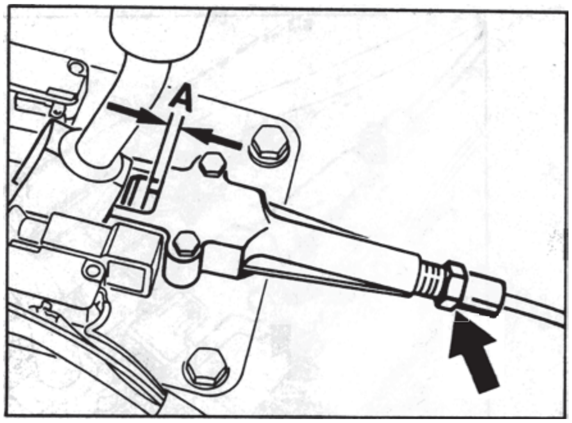
5. Adjust bowden cable, turning the cable sleeve on the valve body until the lock slide reaches a setting of 2 + 0.5 mm (refer to Fig.).



1081-37

A = 2 + 0.5 mm

6. Check operation of keylock and shiftlock.

37 13 01 Checking keylock and shiftlock

Checking the keylock (ignition key lock)

Selector lever position	Position of release button	Keylock operation	Ignition key
P	not actuated	no	rotary, may be pulled off
P	actuated	yes	cannot be turned to pulloff position
R-N-D-3-2-1	not actuated actuated	yes	cannot be turned to pulloff position

Checking the keylock (selector lever lock)

Ignition key position	Release button status	Keylock operation	Selector lever
Pulled off or pulled position	locked	yes	locked
Position 1 or 2	not locked	no	not locked

Checking the shiftlock

Selector lever position	Ignition	Shiftlock operation	Brakes	Selector lever
P-R-N-D-3-2-1	off	no	actuated not actuated	not locked
P and N	on	yes	not actuated	locked
P and N	on	yes	actuated	not locked

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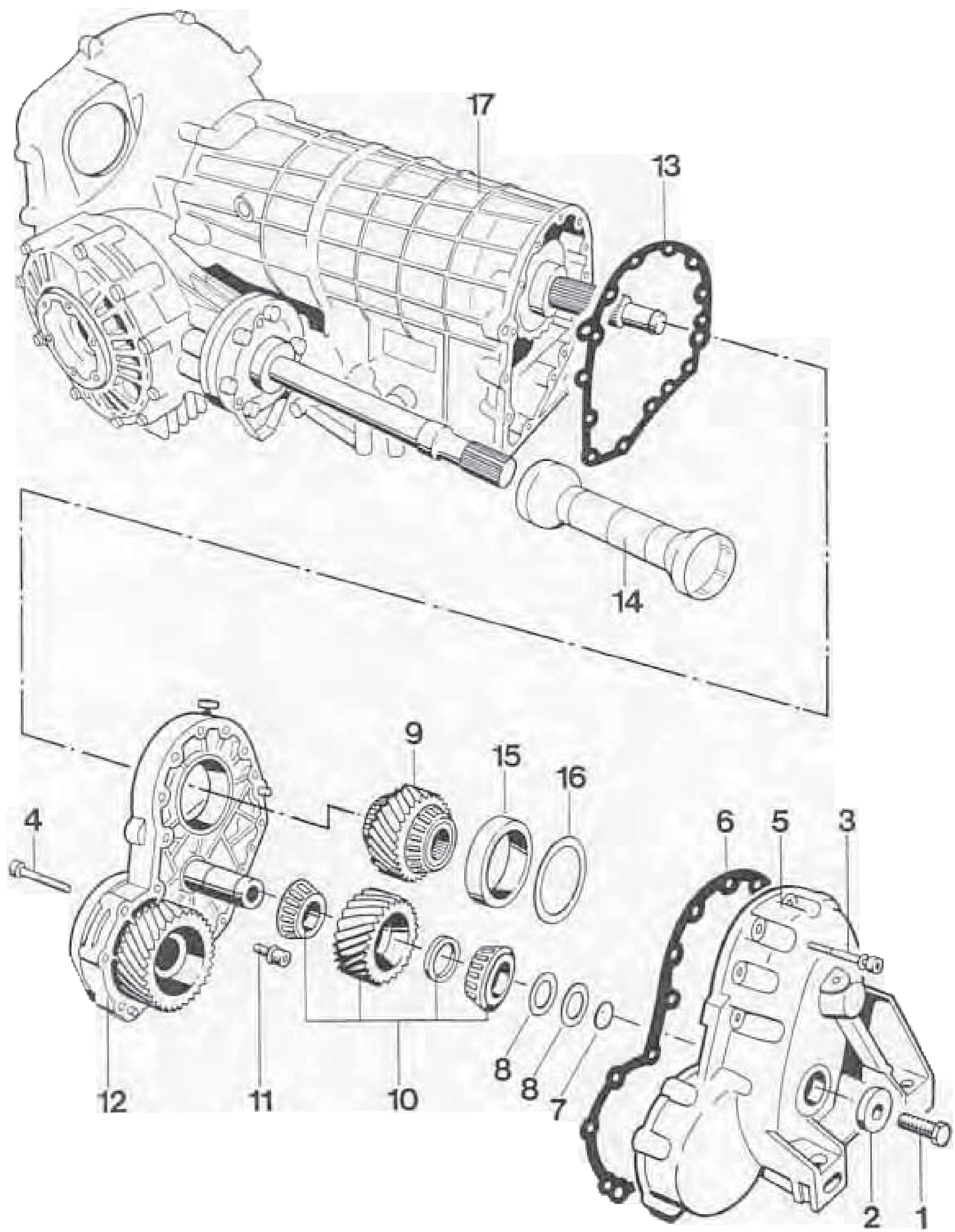
37 48 19 Removing and installing the intermediate plate



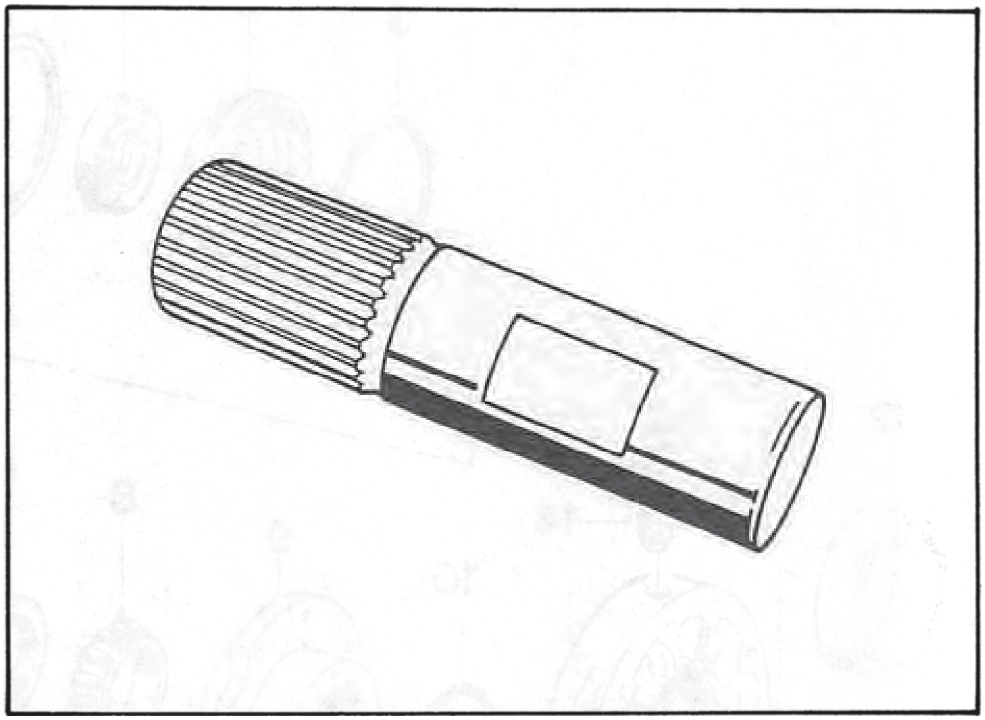
No. No.	Designation	Qty.	Note: Removal	Installation
1	Hexagon screws	1		Tighten with 46 Nm
2	Washer	1		
3	Fillister head screw	11		Tighten with 23 Nm
4	Fillister head screw	6		Tighten with 23 Nm
5	Front transmission cover	1		
6	Seal	1		Replace
7	O-ring	1		Replace, oil with ATF
8	Shim	X	Note thickness for re-installation	
9	Gear wheel with tapered-roller bearings	1		
10	Gear wheel with bearing assembly	1		Set by the manufacturer.
11	Fillister head screw	2		Tighten with 23 Nm
12	Intermediate plate	1		
13	Seal	1		Replace
14	Protective tube	1		Large diameter to final drive
15	Taper roller bearing outer race	1	Remove with internal puller (e.g. Schrem 60 - 70)	Heat transmission cover to approx. 120 deg. C and press in to stop
16	Adjusting shim	X	Record thickness for reinstallation	
17	Automatic transmission with final drive	1		

Note

The reduction gear is only available as a complete set (intermediate plate, transmission cover and adjusted spur gears). It is not necessary to adjust the tension on the tapered roller bearing.

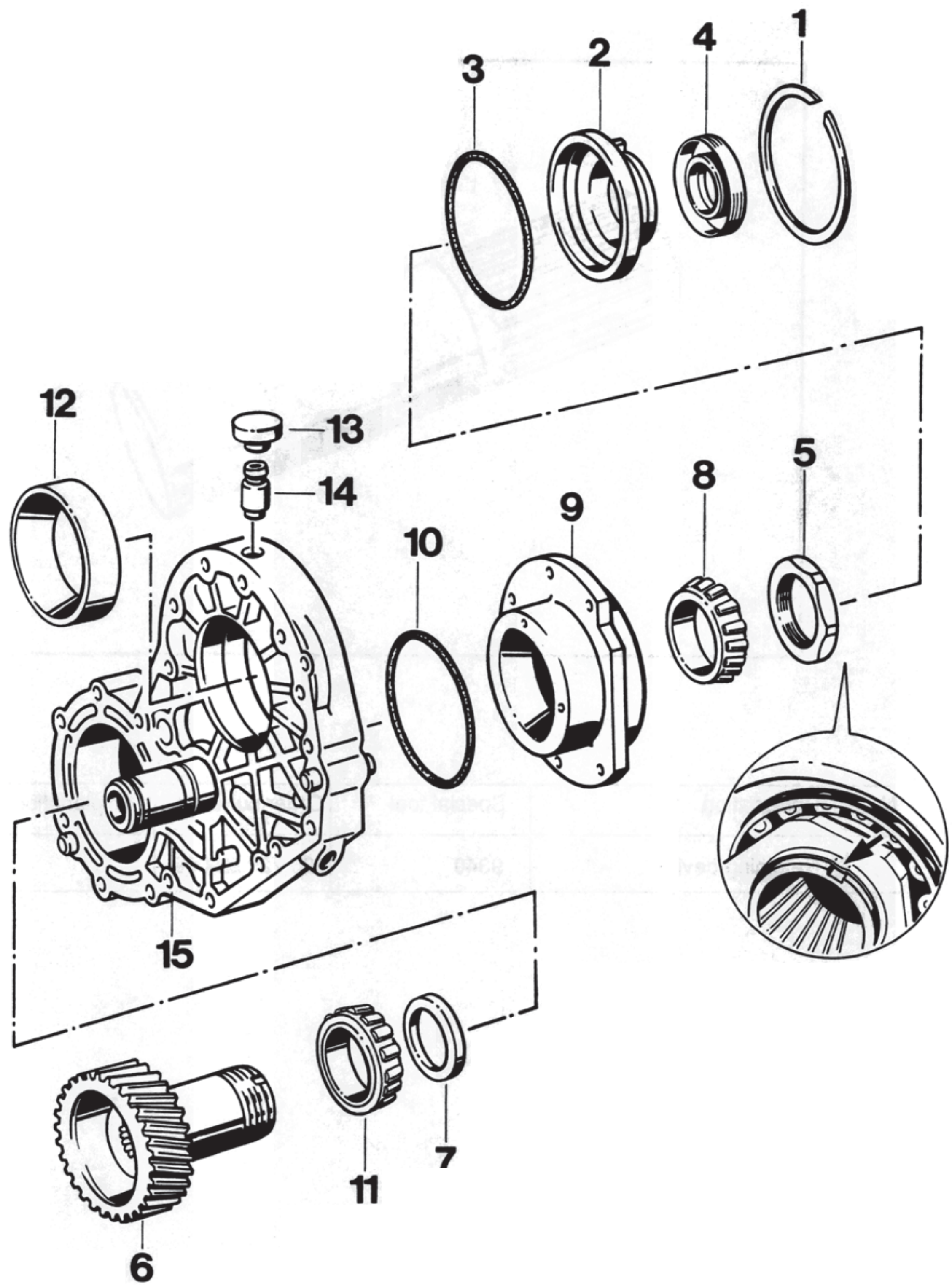
37 48 37 Dismantling and assembling intermediate plate

Tools



No.	Designation	Special tool	Order number	Explanation
	Retaining device	9340	000.721.934.00	

34 48 ‌7 D ma ‌g and assembling intermediate plate



No.	Designation	Qty.	Note: Removal	Note: Installation
1	Snap ring	1		
2	Bearing cover	1	Grab at lugs to lift out	
3	Round seal	1		Replace, coat with ATF fluid
4	Shaft seal	1		Fitting depth 2.0 ± 0.5 mm
5	Lock nut	1	Fit Special Tool 9340 into vise. Put intermediate plate into position and undo nut.	Tighten to 250 Nm (184 ftlb). Lock by upsetting the flange (2 x 180°)
6	Helical gear	1	Press out using a hydraulic press.	Replace only as a set (along with intermediate gear and drive gear)
7	Adjuster ring*	X	Record thickness for reassembly	Thickness can only be determined by manufacturer
8	Inner race of taper roller bearing*	1	Mark for reassembly	Heat to approx. 120°C and press on
9	Bearing cover *	1		
10	Round seal	1		Replace, coat with ATF fluid
11	Inner race of taper roller bearing*	1	Remove across assembly bore of helical gear. Mark for reassembly.	Heat to approx. 120°C and press into place
12	Outer race of taper roller bearing	1		Heat intermediate plate to approx. 120°C and press into place
13	Breather cover	1	Lever off	
14	Breather tube	1	Pull out	Press in to stop
15	Intermediate plate	1		

Note

The parts identified by an * have been preadjusted by the manufacturer.

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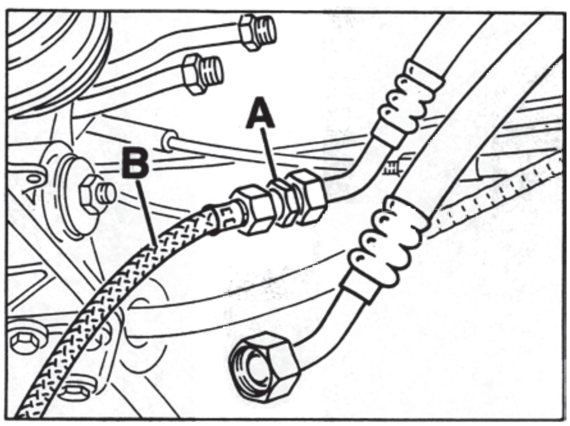
38 60 29 Flushing ATF cooler and lines

Information

If the ATF is carbonized, or if there is sludge or evidence of lining abrasion in the ATF pump, it is not sufficient merely to repair or replace the gearbox, the ATF cooler and line system must be flushed with ATF.

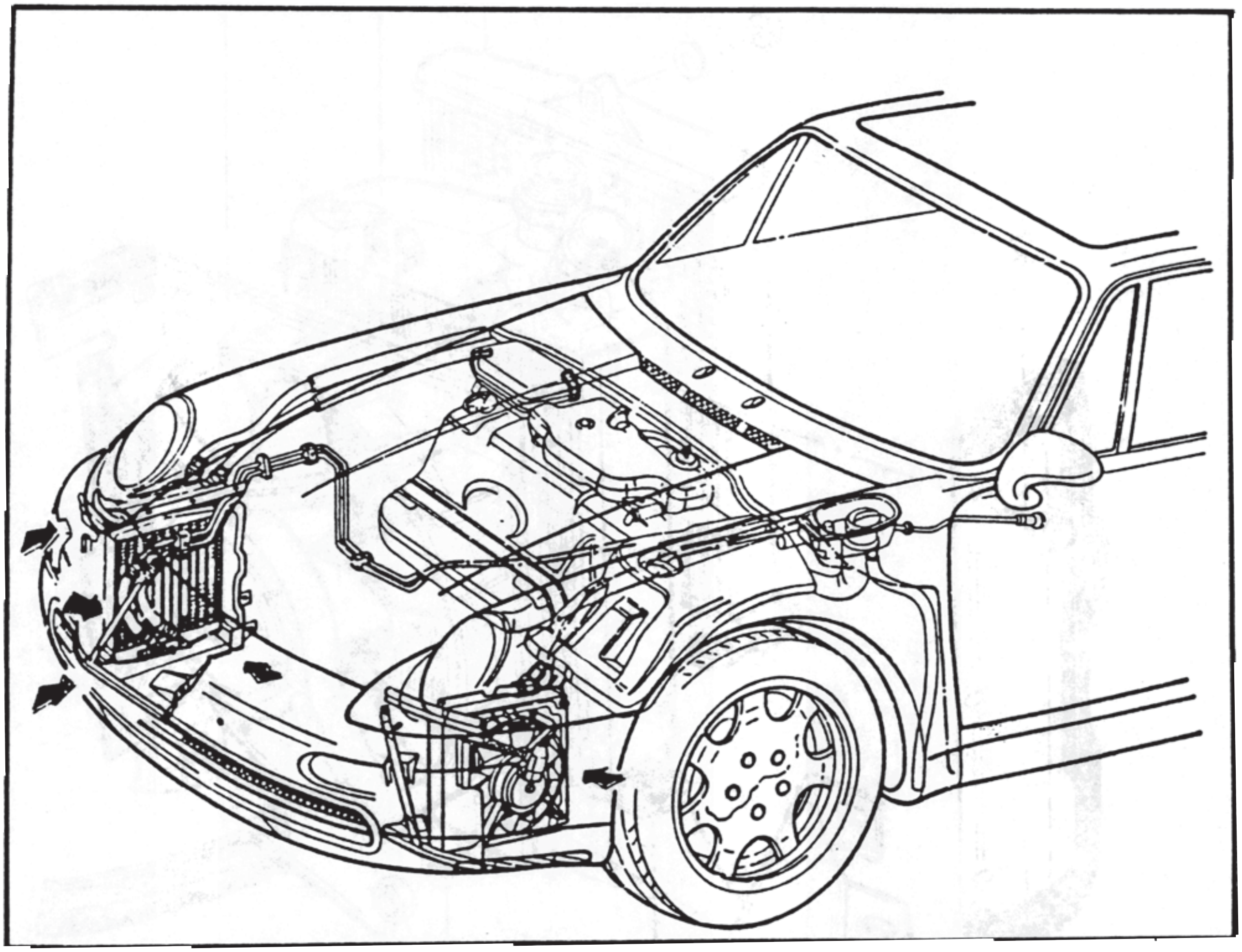
Attach additional hose of ATF filling device (see Workshop Manual Group 3/4) using special tool **9355/1** to ATF line with conventional twin connecting piece and flush out cooler and line system using filling device. Fluid must not be split on the ground.



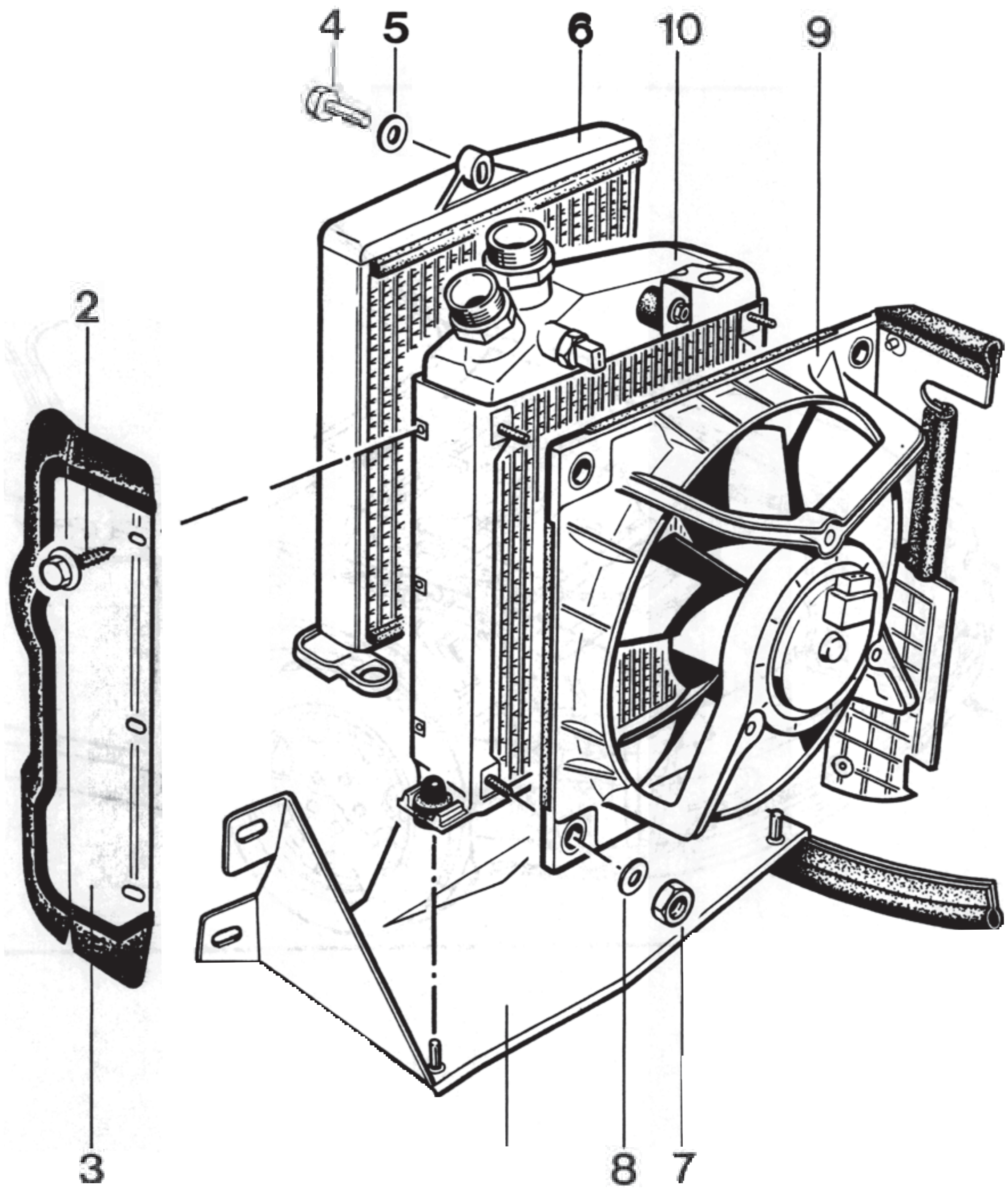
1883-37

A = Special tool 93551
B = Additional hose

38 60 Removing nd insta ng ATF cooler



38 60 R m ving and sta ling ATF coole



No.	Designation	Qty.	Note: Removal	Installation
1	Bracket	1		
2	Washer-and-screw assembly	3		
3	Air deflector	1		
4	Hexagon screw	1		Tighten to 10 Nm (7.3 ftlb)
5	Washer	1		
6	ATF cooler	1		

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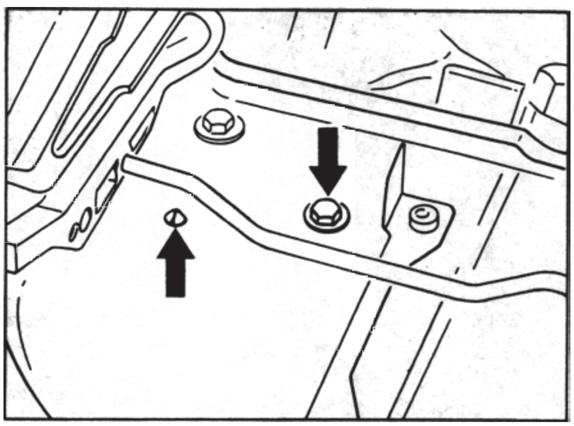
38 60 19 Removing and installing ATF cooler

Notes

The ATF cooler is installed in the wheel house in front of the right front wheel. It is mounted on the engine oil cooler and cooled by the two-stage electric fan of the engine oil cooler.

Removal

1. Remove right headlight, unclip wire retainer and unscrew hexagon head screw for cooler bracket.

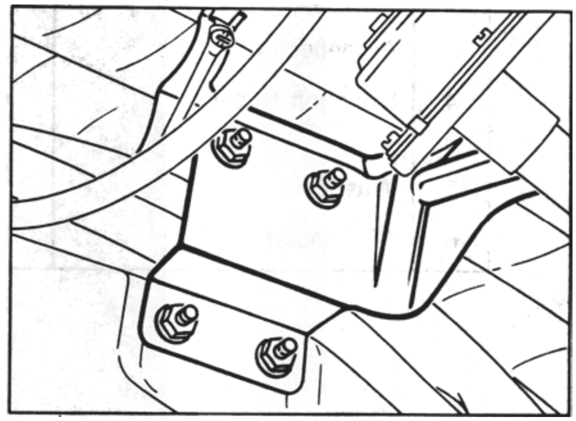


1877-38

2. Remove front wheel housing liner and lower part of front spoiler.

3. Pull connector off electric fan and remove indicator mount by turning it to the left (bayonet lock).

4. Unscrew horn mount from wheel house.

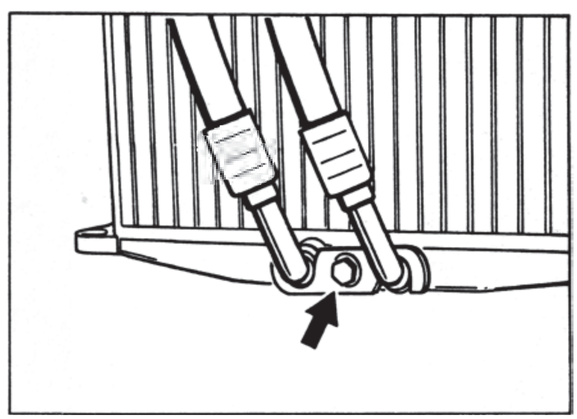


1878-38

5. Remove console. To do so, unscrew three hexagon nuts (M 8) from wheel house and one (M 6) for tension strut.

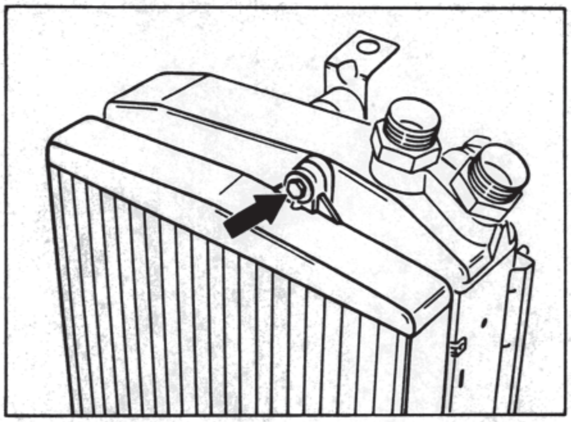
6. Remove air baffle.

7. Disconnect ATF lines from cooler.



1879-38

8. Unscrew hexagon head screw and remove ATF cooler (illustration shows cooler removed).



487-38

Note

Do not disconnect oil lines for engine oil cooler. The cooler remains in the wheel house.

Installation

Tightening torques, Nm (ftlb.

Bracket to headlight holder	= 10 (7)
Console to wheel house	= 23 (17)
Tension strut to console	= 10 (7)
ATF cooler to engine oil cooler	= 10 (7)
Bar to ATF cooler	= 10 (7)
Horn holder to wheel house	= 10 (7)

1. Adopt the reverse procedure for installation.

2. Replace O rings for ATF lines on cooler.

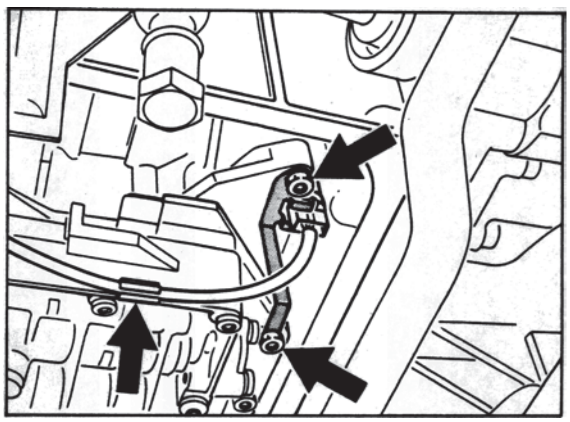
3. Check that the rubber edging of the fan housing and the console is correctly positioned.

4. Check, and if necessary top up, ATF level. (see page 37 - 101).

38 17 19 Removing and installing the inductive speed sensor

Removing

1. Remove the transmission underbody cladding and ATF pan (refer to page 38 - 113).
2. Remove the holder for the inductive sensor and pull out sensor



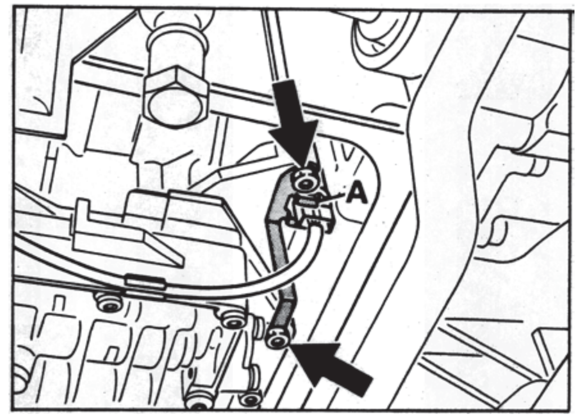
390-38a

Installing

Tightening torque:
Holder to control unit = 8 Nm

Installation takes place in reverse order.

Insert the sensor and mount the holding plate so that the lugs engage in the groove on the connector.



386-38b

A = Connector groove

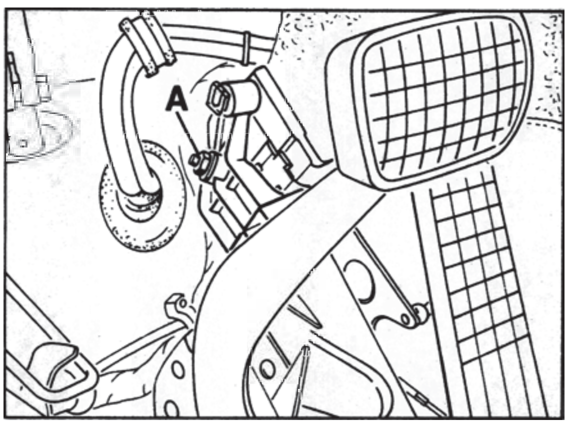
38 90 19 Removing and installing kickdown switch

Removal

The kickdown switch is installed on a console in front of the accelerator pedal.

1. Remove floor board.

2. Remove kickdown switch with mount, unplug connector and remove switch (pressing the retaining lugs).



2244-38

A = self-locking nut

Installation

1. Install the parts removed in reverse order.

2. Use new self-locking nut for mount.

3. Place kickdown switch in installation position. With the mounting nut loosened, the mount with switch must be pushed until the actuator arm touches the console when the switch is operated.

4. Tightening torque: mount to console: M 6 = 10 Nm (7.5 ftlb)

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38 90 15 Adjusting kickdown switch

Prerequisites:

The idle position of the accelerator cable must be correctly adjusted.

Kickdown switch in installation position. (see page 38 - point 3).

1. Connect system tester 9288.
2. Unhook pushrod from accelerator pedal.
3. Switch on system tester and select throttle valve in DME /actual values menu.
4. With the pushrod unhooked, push the accelerator pedal down to the stop (throttle valve open up to stop) and read **throttle position 1** off on system tester.

Note

With the throttle valve open (accelerator pedal fully depressed), the position is 84° ± 30.

5. Hook pushrod back onto accelerator pedal.
6. Push gas pedal down as far as possible **without** operating kickdown switch and read off **throttle position 2** on system tester.
   The position indicated must be 3° less than position 1 (tolerance ± 10).

Note

If the angle is too large, set the pushrod to a shorter position.
If the angle is too small, set the pushrod to a longer position.

After resetting the length of the pushrod, check the angle. It must not be smaller than 79°.

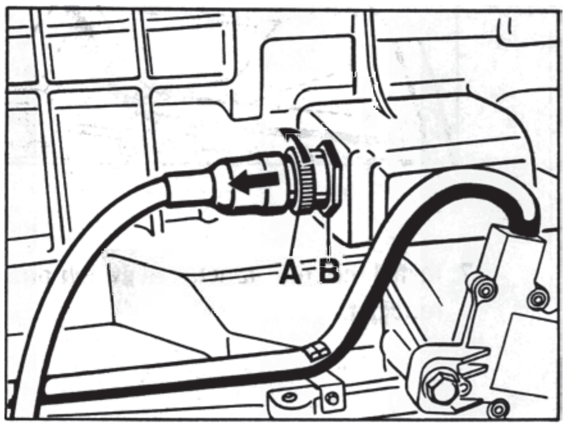
38 18 19 Remov. and installing the wiring harness for the transmission

Removing

1. Remove the transmission underbody cladding.

2. Remove multi-functional switch (see page 37-105).

3. Disconnect the connector from the transmission socket. To do this, turn the bayonet lock to the left and disconnect the connector:



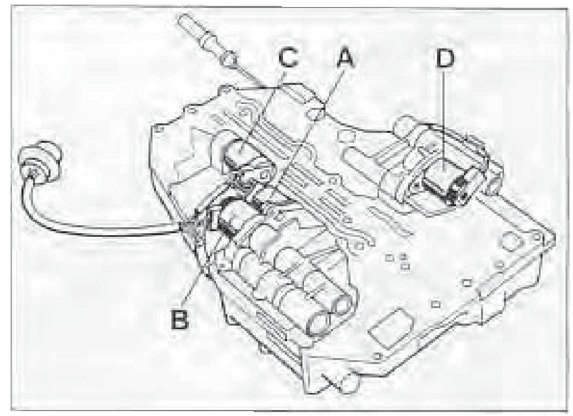
387-38a

A = Bayonet lock
B = Hexagon nut (a/f 30)

4. Unscrew the hexagon nut for the transmission socket with a suitable extension.

5. Remove hydraulic control unit with wire harness (see also page 38-113).

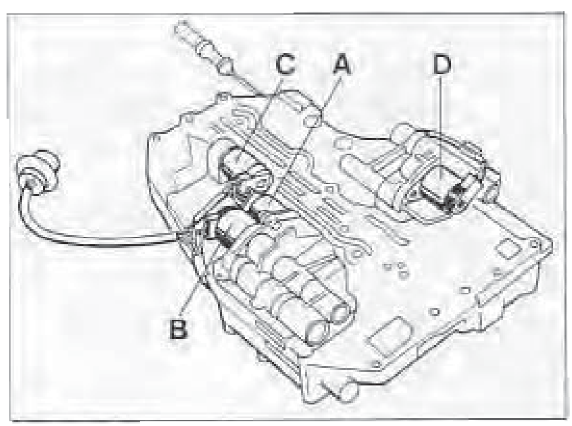
6. Mark the push-on sleeves for re-installation and pull off from the solenoid valves.



383-38

Installing

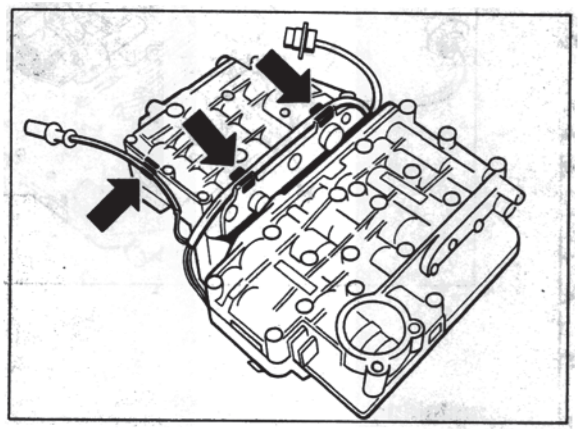
1. Push the push-on sleeves for the solenoid valves up to the stop. Pay attention to cable colors.



383-38

	Solenoid valves	Cable colors
A	Solenoid valve 1	(grey-violet)
B	Solenoid valve 2	(green-violet)
C	Solenoid valve 3	(red-violet)
D	Pressure regulator	(blue-violet)

2. Route wiring harness and hang in cable clamps.



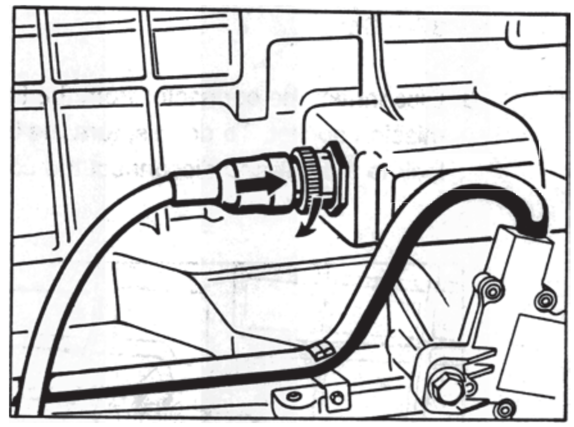
384-38

3. Place hydraulic control unit on a suitable surface (e.g. transmission jack) at installation height.

4. Insert the socket with **new O-ring** so that the flattened side faces upwards. Tighten hexagon nut with **12 Nm (9 ftlb)**.

5. Install hydraulic control unit.

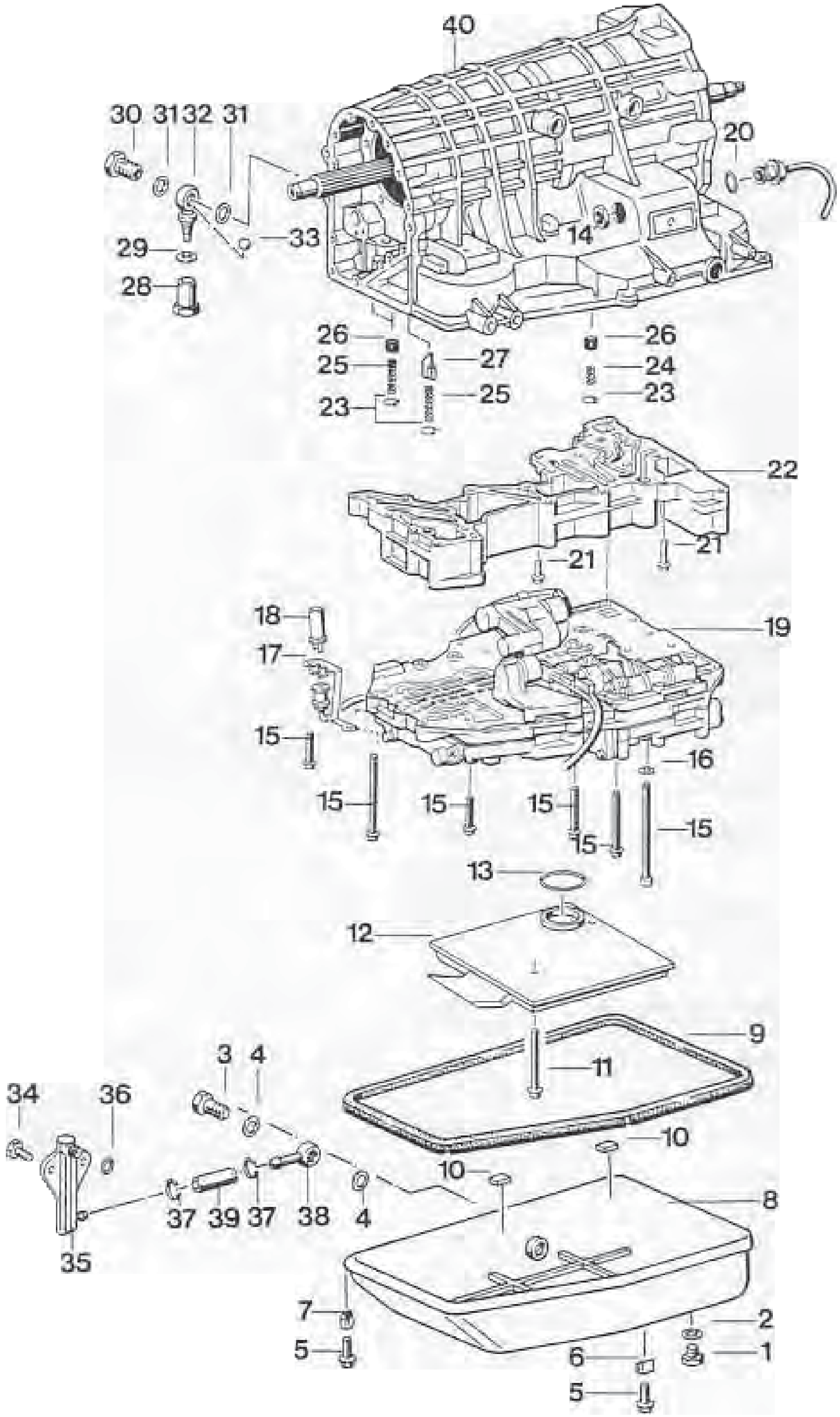
6. Connect wiring harness with transmission socket. To do this, carefully insert the connector in the socket (fits only in one position) and lock by turning the bayonet lock to the right.



387-38b

7. Install the multi-functional switch and readjust.

38 77 19 Dismantling and assembling hydraulic control unit



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No	Designation	Qty.	Note: Removal	Installation
1	Plug	1		Tighten to 40 Nm (29 ftlb)
2	Seal	1		Replace
3	Banjo bolt	1		Tighten to 40 Nm (29 ftlb)
4	Seal	2		Replace
5	Hexagon head bolt	6		Tighten to 6 Nm (4 ftlb)
6	Bracket (straight leg)	2		Short legs must force on the ATF pan
7	Bracket (curved leg)	4		Short legs must force on the ATF pan
8	ATF pan	1		
9	Gasket	1		
10	Magnet	2		Place into grooves in ATF pan
11	Pan head screw (M 6 x 65)	3		Tighten to 8 Nm (6 ftlb)
12	ATF strainer	1		
13	Round seal	1		Replace. Make sure that position is correct
14	Hexagon nut	1		Tighten to 12 Nm (9 ftlb)
15	Pan head screw	14		Observe correct length, tighten to 8 Nm (6 ftlb)
16	Spring washer	1		
17	Bracket	1		
18	Inductive rpm pickup	1		
19	Hydraulic control unit	1		The straight surface on the harness socket must point towards the outside

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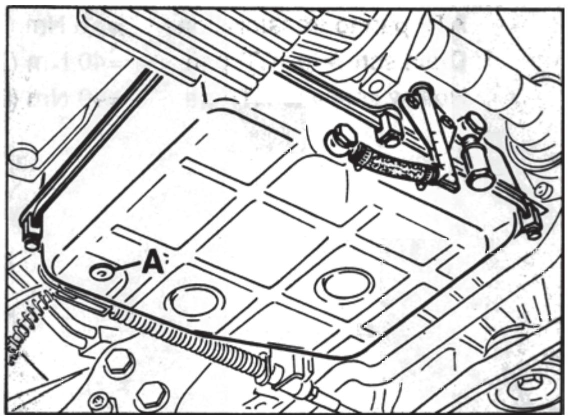
38 77 19 Removing and installing the hydraulic control unit

Removing

The transmission wiring harness remains on the transmission.

1. Remove the transmission underbody cladding.

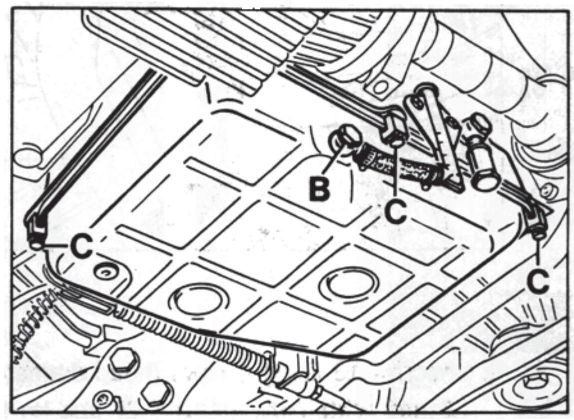
2. Drain off ATF fluid.



386-38a

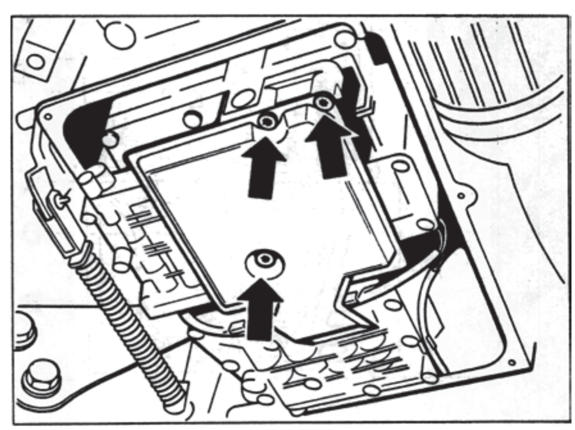
A = Drain screw with sealing ring

3. Remove ATF pan. To do this, unscrew hollow screw for oil level pipe and six fixing screws.



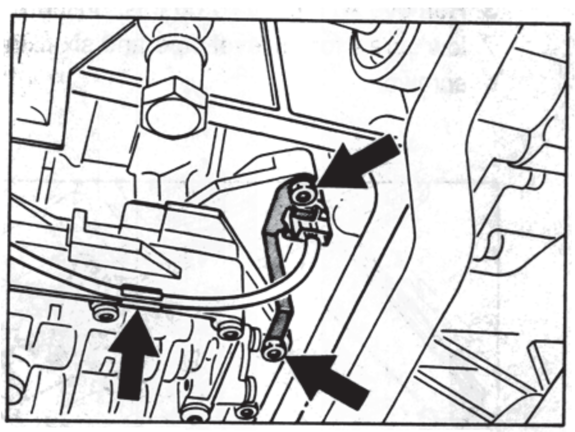
B = Hollow screw
C = Fixing screws

4. Remove ATF strainer with **Torx insert T 27.**



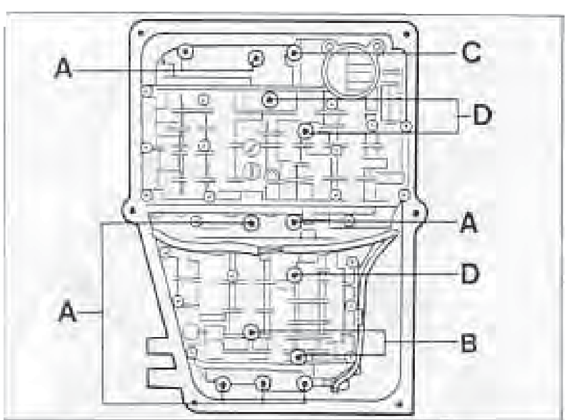
382-38

5. Remove inductive speed sensor and pull wiring harness out of holding clamps.



390-38a

6. Unscrew 13 fixing screws (head diameter 12 mm) **with Torx insert T 27** and lower hydraulic control unit only so far as to guarantee that the wiring harness is not subjected to any tension.
   Place the hydraulic control unit on a suitable surface (e.g. transmission jack).



399-38

Note

The hydraulic control unit must not be suspended from the wire harness.

7. Mark the push-on sleeves for re-installation and pull off from the solenoid valves.

8. Pull the wiring harness out of the holding clamps and remove the control unit.

Installing

Installation takes place in reverse order.

1. Tightening torques:

Control unit to transmission	= 8 Nm (6 ftlb)
ATF strainer to control unit	= 8 Nm (6 ftlb)
ATF pan to transmission	= 6 Nm (4 ftlb)
Drain screw to ATF pan	=40 Nm (29 ftlb)
Hollow screw to ATF pa	=40 Nm (29 ftlb)

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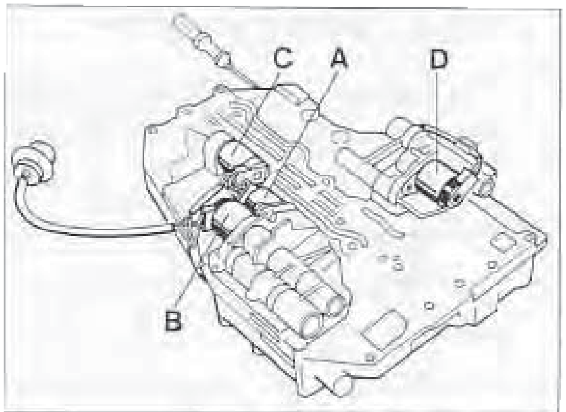
2. Push on push-on sleeves for solenoid valves up to the stop. Pay attention to cable colors.

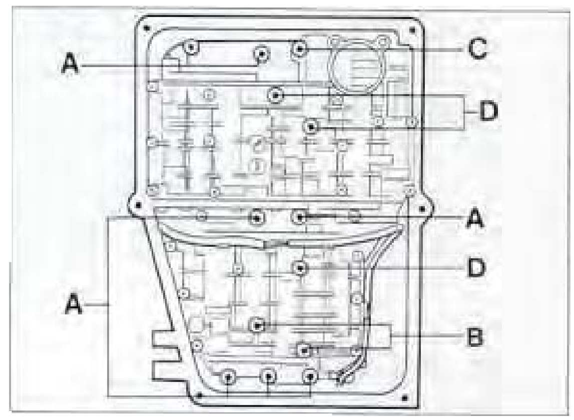


383-38

	Solenoid valves	Cable colors
A	Solenoid valve 1	(grey-violet)
B	Solenoid valve 2	(green-violet)
C	Solenoid valve 3	(red-violet)
D	Solenoid valve (pressure controler)	(blue-violet)

3. Mount the hydraulic control unit so that the pin of the notched disk projects into the recess of the selector slide.

4. Screw in the fixing screws for the hydraulic-control unit and counter slightly. Pay attention to screw lengths.



399-38

A = Screw length 80 mm
B = Screw length 65 mm
C = Screw length 115 mm
D = Screw length 60 mm

5. Position hydraulic control unit. To do this, move notched disk to position 1 (1st gear) and push hydraulic control unit back until it rests against the notched disk. Tighten fixing screws with **8 Nm** in this position.

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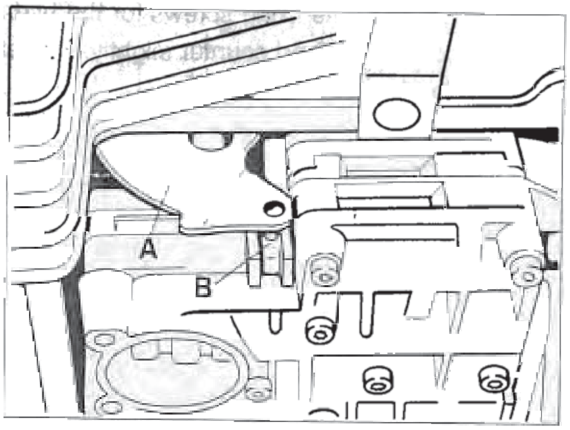
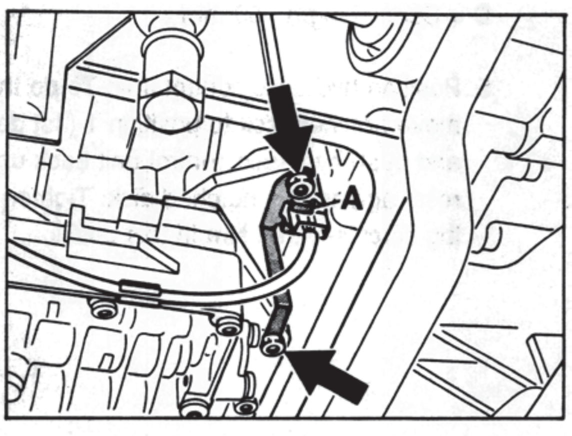


385-38

A = Notched disk
B = Selector slide

6. Insert pulse sensor and mount holding plate so that the lugs engage in the connector grooves.



390-38b

7. Fit ATF strainer with O-ring. Tightening torque **8 Nm**.

8. Place two magnets in the beads of the ATF pan, fit seal and secure the pan with the holding brackets so that the short legs press onto the ATF pan.

Note

The two holding brackets with the straight legs must be mounted at the side.

9. Screw in ATF drain screw with new sealing ring. Tightening torque **40 Nm**.

10. Screw in hollow screw for oil level pipe with new sealing rings. Tightening torque **40 Nm**.

11. Fill with ATF fluid (refer to page 38-103).

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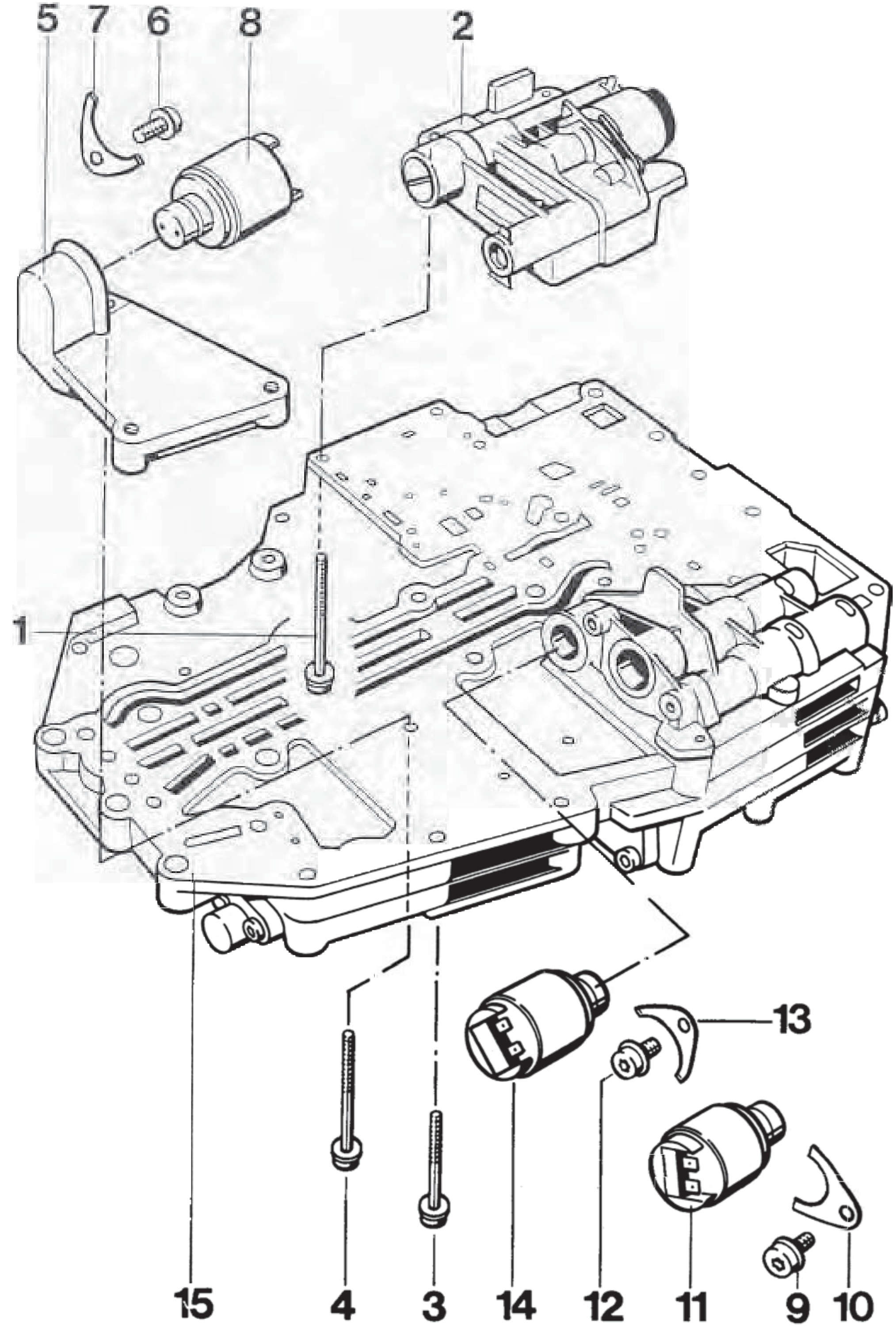
38 89 20 Removing and installing solenoid valves



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No.	Designation	Qty.	Note: Removal	Installation
1	Fillister head screw	5	Remove with Torx insert T 27	Tighten with 5 Nm (4 ftlb)
2	Housing with pressure regulator	1		Set by the manufacturer, only replace complete
3	Fillister head screw	2	Remove with Torx insert T 27	Tighten with 5 Nm
4	Fillister head screw	1	Remove with Torx insert T 27	Tighten with 5 Nm
5	Holder	1		
6	Fillister head screw	1	Remove with Torx insert T 27	Tighten with 5 Nm
7	Holding plate	1		Fit in correct position, lugs point to holder No. 5
8	Solenoid valve 3	1	Mark for re-installation	Do not confuse with sole-noid valves Nos. 11 and 14
9	Fillister head screw	1	Remove with Torx insert T 27	Tighten with 5 Nm
10	Holding plate	1		Fit in correct position, lugs point to housing
11	Solenoid valve 2	1	Mark for re-installation	Do not confuse with sole-noid valves Nos. 14 and 8
12	Fillister head screw	1		Tighten with 5 Nm
13	Holding plate			Fit in correct position, lugs point to housing
14	Solenoid valve 1	1	Mark for re-installation	Do not confuse with sole-noid valves Nos. 11 and 8
15	Hydraulic control unit	1		

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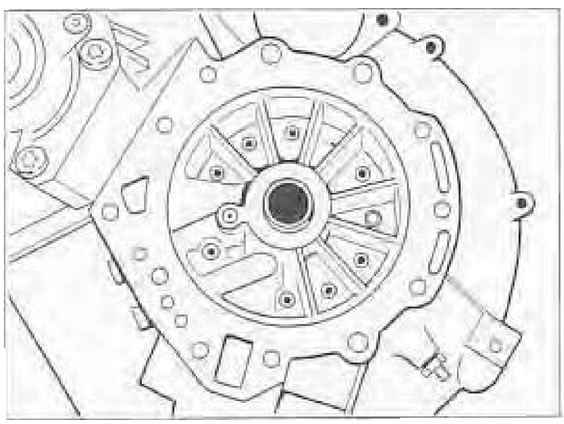
38 56 19 Removing and installing the ATF pump

Removing

1. Remove transmission.

2. Remove torque converter and final drive.

3. Unscrew fixing screws with **Torx insert T27** and remove pump. To do this, screw in two screws opposite each other and carefully drive out the pump by gentle blows on the screw heads

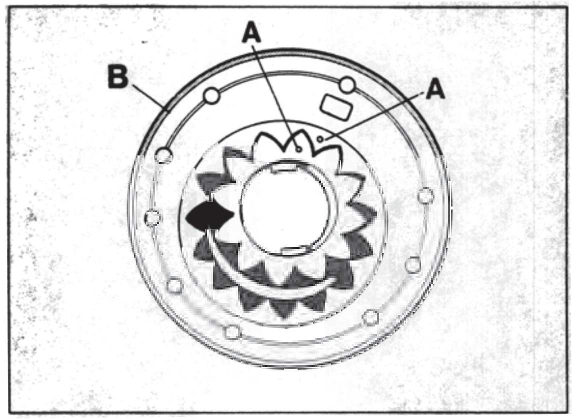


406-38

Installing

1. Check bearing bush for run-in scores or damage. The pump must be replaced if there are signs of damage.

2. Oil both pump wheels with ATF fluid and place in the housing so that both installation markings are visibly facing up.

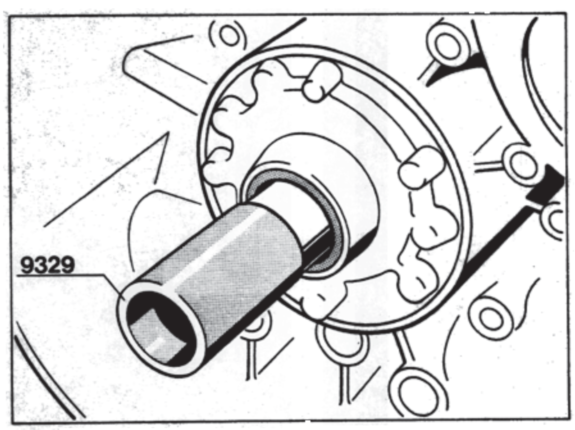


405-38

A = Installation markings
B = O-ring

3. Install pump with new O-ring and centering sleeve. Tighten fixing screws with **10 Nm**.

4. Check pump for easy operation. It must be possible to turn the pump by hand with special tool **9329** without it catching.



421-38

38 10 05 Determining the end clearance

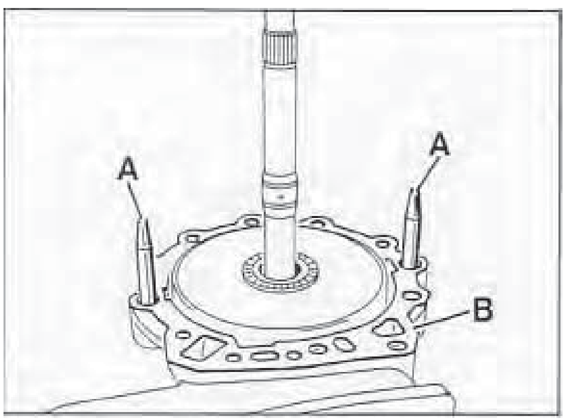
Specification: 0.2...0.4 mm

Note

Check the end clearance whenever the transmission has been reassembled and readjust if required, using adjusting washer No. 12 (refer to page 39 - 111).

1. Assembly transmission (complete with spur gear drive and front transmission cover).

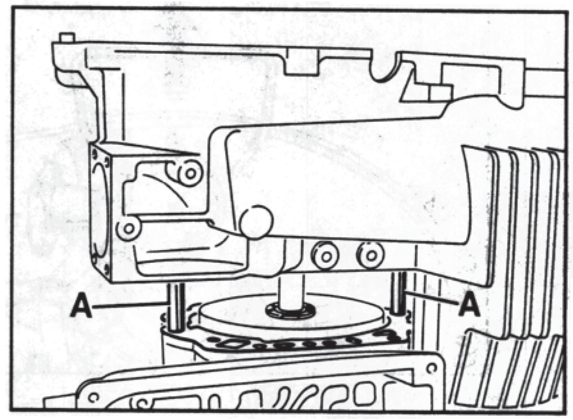
2. Screw centering pins **9321** into transmission case and apply some grease (vaseline) to stick paper gasket to sealing surface.



964-38

A - Centering pins **9321**
B - Gasket

3. Using some grease (use vaseline), stick the removed adjusting washer to the final drive and put housing carefully into position.

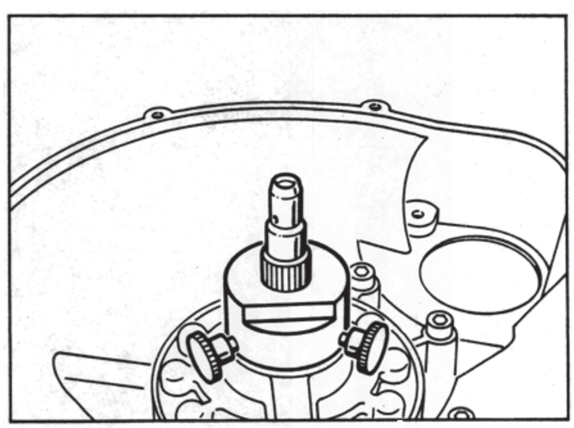


961-38

A - Centering pins **9321**

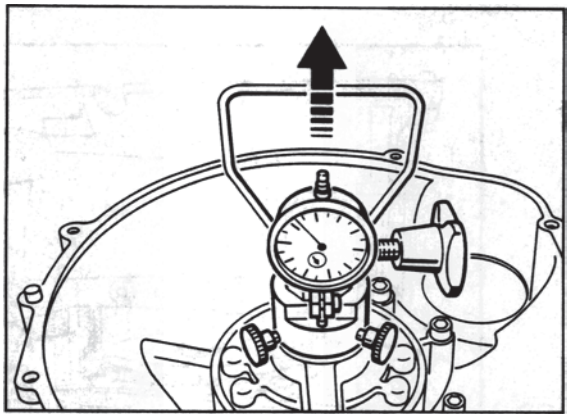
4. Tighten all mounting screws to 46 Nm (34 ftlb).

5. Mount measuring sleeve of Special Tool **9338** with three mounting screws on the stator shaft in such a manner that no play remains.



962-38

6. Slide measuring device of Special Tool **9338** over drive shaft teeth and tighten with clamping screw so that it cannot be tilted.



963-38

7. Set measuring sleeve to zero with a certain preload.

8. Determine end clearance by pulling the handle. Repeat measurement several times.

Note

If a deviation is detected, remove final drive again and fit a thinner or thicker adjusting washer as required.
Recheck end clearance afterwards.

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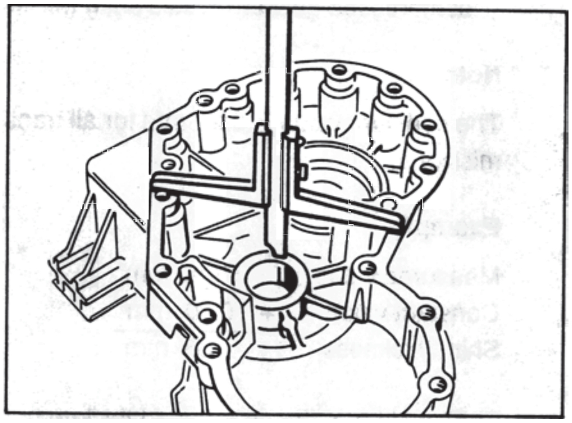
38 91 05 Adjusting the preload of the spur gear taper roller bearings

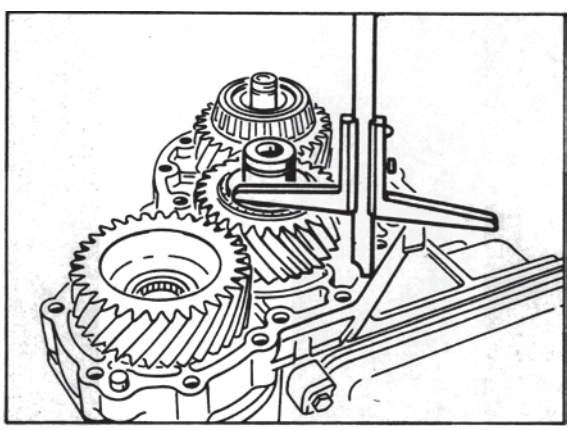
Adjusting spur gear II (intermediate gear)

1. Determine and record dimension "a" (e.g. 45.90 mm).



1030 - 39

2. Fit complete spur gear II and determine dimension "b" (e.g. 44.65 mm). Record measured value.



1031 - 39

3. Determine shim thickness by deducting dimension "b" from dimension "a" and adding a constant value of 0.22 mm (preload and thickness of compressed gasket).

Note

The constant value is 0.22 mm for all transmissions.

Example

Dimension "a" e.g.	45.90 mm
Dimension "b" e.g.	– 44.65 mm
	1.25 mm
Constant	+ 0.22 mm
Shim thickness	1.47 mm

Note

Always round shim thickness up or down to the nearest 0.05 mm figure.

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Adjusting spur gear I (drive gear)

1. Remove intermediate plate.

2. Remove adjusting shim (refer to page 37 - 108, No. 16).

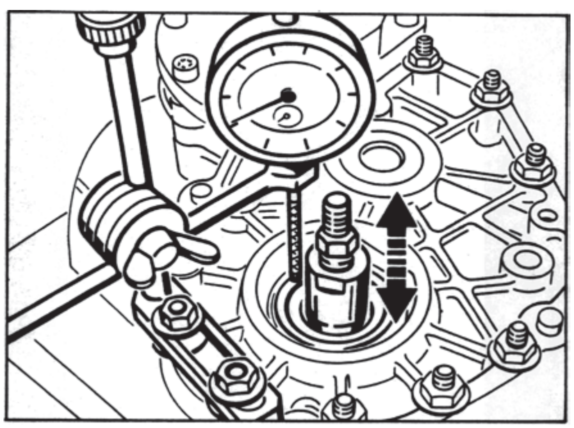
3. Remove spur gear II (intermediate gear) for measurement.

4. Bolt up cover with intermediate plate (but without gasket).
   Tighten all screws and bolts to 23 Nm (17 ftlb).

5. Internal puller (e.g. Schrem 20 - 30) into spur gear teeth.

6. Fit dial gauge holder VW 387 with dial gauge and zero out dial gauge with a preload of 2 mm.

7. Move spur gear I up and down on internal puller and read off play on dial gauge (e.g. 1.18 mm).



1029 - 39

A = Dial gauge extension
B = Internal puller

Note

Do no turn or tilt the spur gear when measuring the clearance. Repeat measuring process several times.

8. Determine shim thickness. Measured value plus 0.20 mm (preload and thickness of compressed gasket) equals shim thickness

Note

The constant value is 0.20 mm for all transmissions.

Example

Measured value		1.18 mm
Constant value	+	0.20 mm
Shim thickness		1.38 mm

9. Fit a shim of the determined thickness (1.38 mm in our example).

Note

Always round shim thickness up or down to the nearest 0.05 mm figure.

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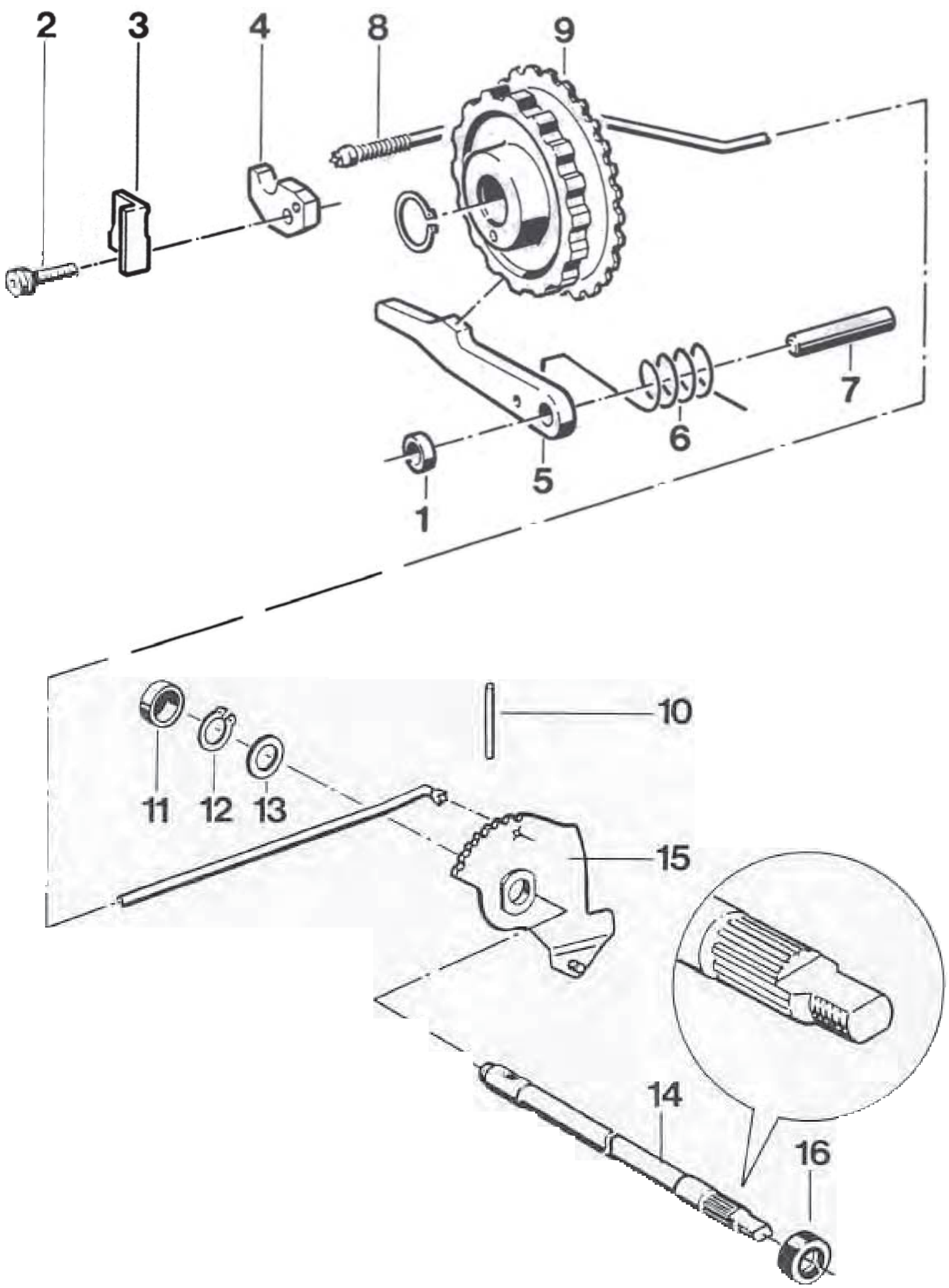
38 74 37 Disassembling and assembling the parking lock



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No.	Designation	Qty.	Note: Removal	Installation (= ftlb)
1	Bushing	1		
2	Fillister head screw	1	Remove with Torx insert T27	Tighten with 10 Nm
3	Guide plate	1		
4	Guide piece	1		
5	Catch	1		
6	Spring	1		Insert in correct position
7	Pin	1		
8	Circlip	1		
9	Parking lock wheel	1		Make sure that the square ring is correctly seated
10	Clamping pin	1		
11	Protective cap	1	Drive out to the outside by gentle blows on shaft No. 14	Replace
12	Circlip	1		
13	Shim ring	1		
14	Shaft	1	Mark installation position	Insert in correct position
15	Notched disk	1		
16	Rotary shaft seal	1	With transmission in built-in condition, remove multi-functional switch and carefully lever out with a suitable screwdriver	Wind plastic insulating tape around the shaft toothing as an assembly aid, slightly oil sealing lip and press in flush

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Work instructions for disassembling and assembling

Disassembling

1. Remove transmission.

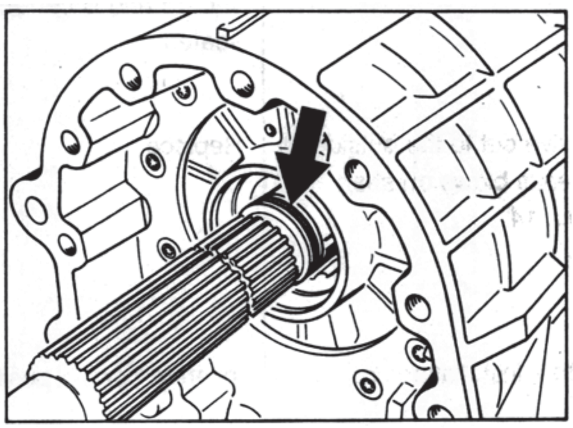
2. Remove intermediate plate.

Note

Part Nos. 11 to 15 can be removed only when the final drive and the ATF pan have been dismantled.

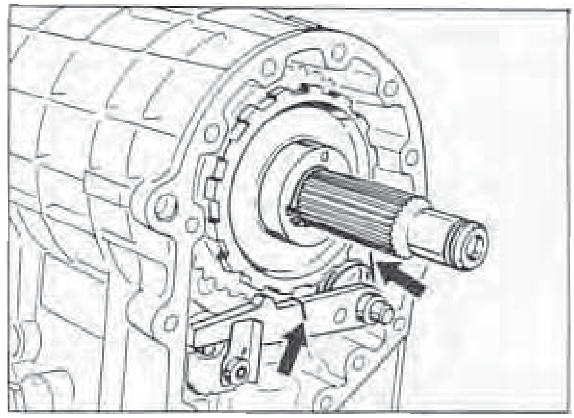
Assembly

1. Replace O-ring on output shaft.



417-37

2. Insert spring for catch in correct position.



418-37

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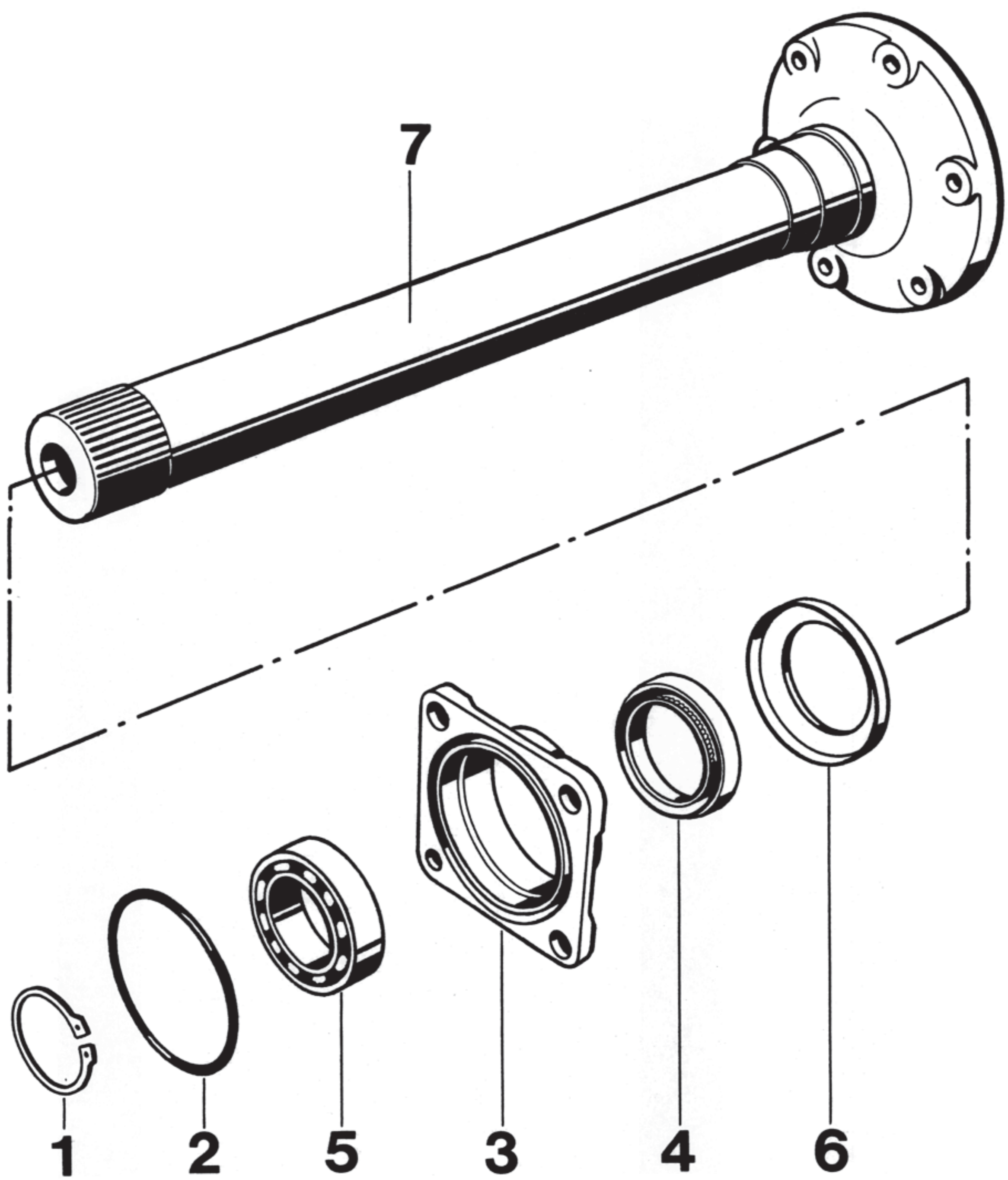
39 25 37 Disassembling and assembling the long joint flange



No.	Designation	Qty.	Note: Removal	Installation
1	Circlip	1		
2	O-ring	1		Replace
3	Bearing cap	1		
4	Rotary shaft seal	1		Pack space between dust lip and sealing lip with grease (e.g. Shell 8420) and press in flush with suitable thrust piece
5	Ball bearing	1	Press off jointly with bearing cap	Press in until it bottoms with a suitable pressure piece
6	Protective ring	1		
7	Joint flange	1		

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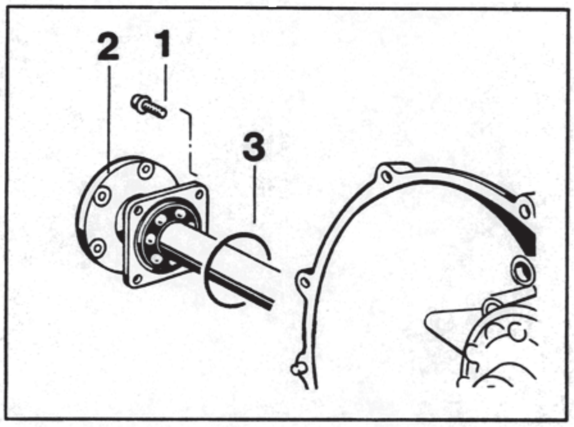
39 25 19 Removing and installing long halfshaft flange

With transmission installed

Removal

1. Remove drive shaft (see page 42 - 17).

2. Unscrew pan head screws of halfshaft flange using special tool **9330** and pull out flange.



2184-39

1 = pan head screw
2 = halfshaft flange
3 = O-ring

Installation

1. Install the parts in the reverse order of dismantling

2. Replace O-ring. Slightly oil new O-ring.

3. Tighten pan head screws to **23 Nm** (17 ftlb).

39 26 19 Removing and installing short halfshaft flange

With transmission installed

Removal

Note

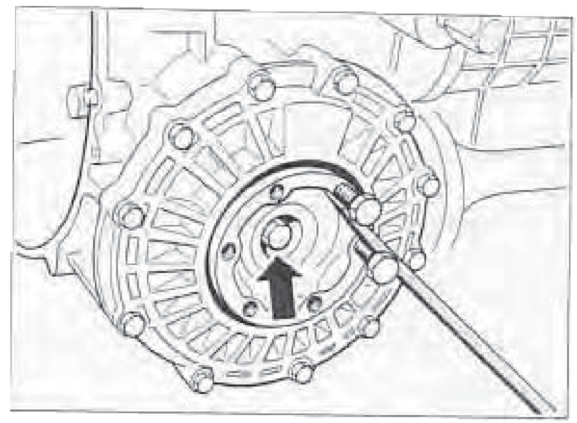
The halfshaft flange can only be removed if the suspension is partially disconnected.

1. Remove right rear wheel, engine / transmission guard and rear underside panel.
2. Remove heating pipe.
3. Remove control arm cover.
4. Disconnect drive shaft from transmission flange.
5. Partially disconnect suspension (see page 42 - 17 from point 4).

Note

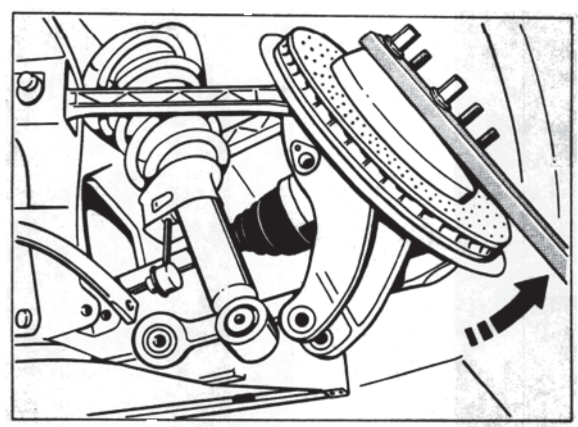
The drive shaft need not be disconnected from the wheel.

6. Unscrew fastening bolt for halfshaft flange (the illustration shows the transmission removed).



408-39

7. Lift wheel carrier using a suitable lever and take out flange (2nd person required).



2085-42

Installation

1. Install the parts in the reverse order of removal.

2. Tighten screws to specified torque figures.

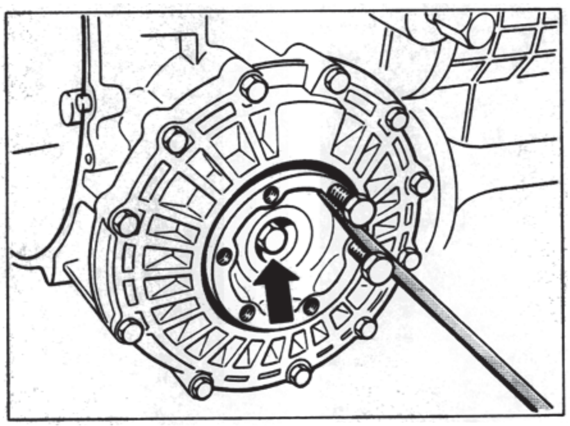
39 22 19 Removing and installing the rotary shaft seal for the short joint flange

Removing

Note

The rotary shaft seal can also be replaced with the transmission in built-in condition.

1. Unscrew the hexagon screw for the joint flange and remove flange.



408-39

2. Lever out rotary shaft seal with **VW 681**

Installing

1. Press in rotary shaft seal flush with suitable pressure piece.

2. Tighten hexagon screw for joint flange with **46 Nm (34 ftlb)**.

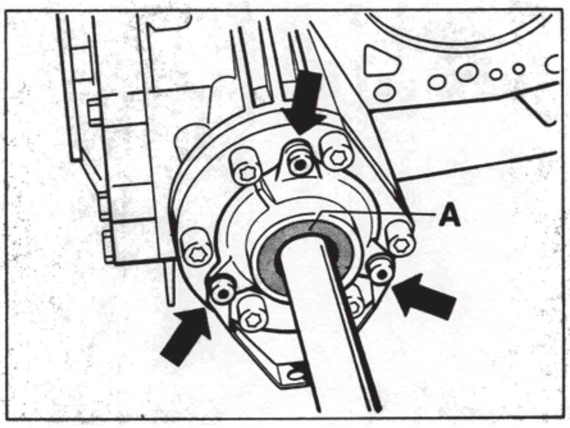
39 28 19 Removing and installing drive pinion seal rings

1. Drain ATF

2. Remove engine with gearbox (do not unbolt engine from gearbox.

3. Remove intermediate plate
(see page 37 - 125).

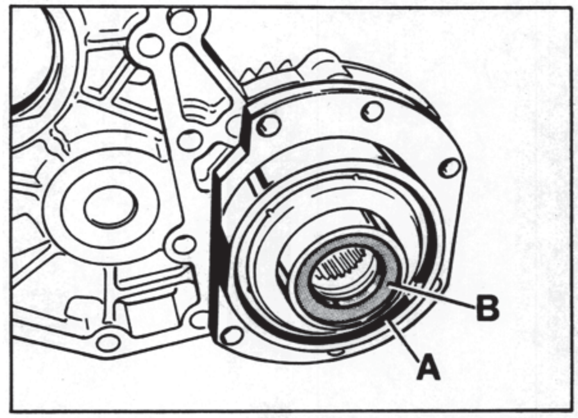
4. Remove bearing cap with **Torx Insert T 27** and replace rotary shaft seal. Pack space between dust lip and sealing lip with grease (e.g. Shell 8420).
Press-in depth 2.0 ± 0.5 mm.



A = Rotary shaft seal 422-39

5. Fit bearing cap with new O-ring and tighten fixing screws with **10 Nm (7.5 ftlb).**

6. Remove snap ring for bearing cap at intermediate plate and pull out cap.



423-39

A = Snap ring

B = Rotary shaft seal

7. Replace rotary shaft seal.
Pack space between dust lip and sealing lip with grease (e.g. Shell 8420).
Press-in depth 2.0 ± 0.5 mm

8. Fit new O-ring and wet with ATF.

9. Insert bearing cap and fit snap ring.

10. Fill with ATF.

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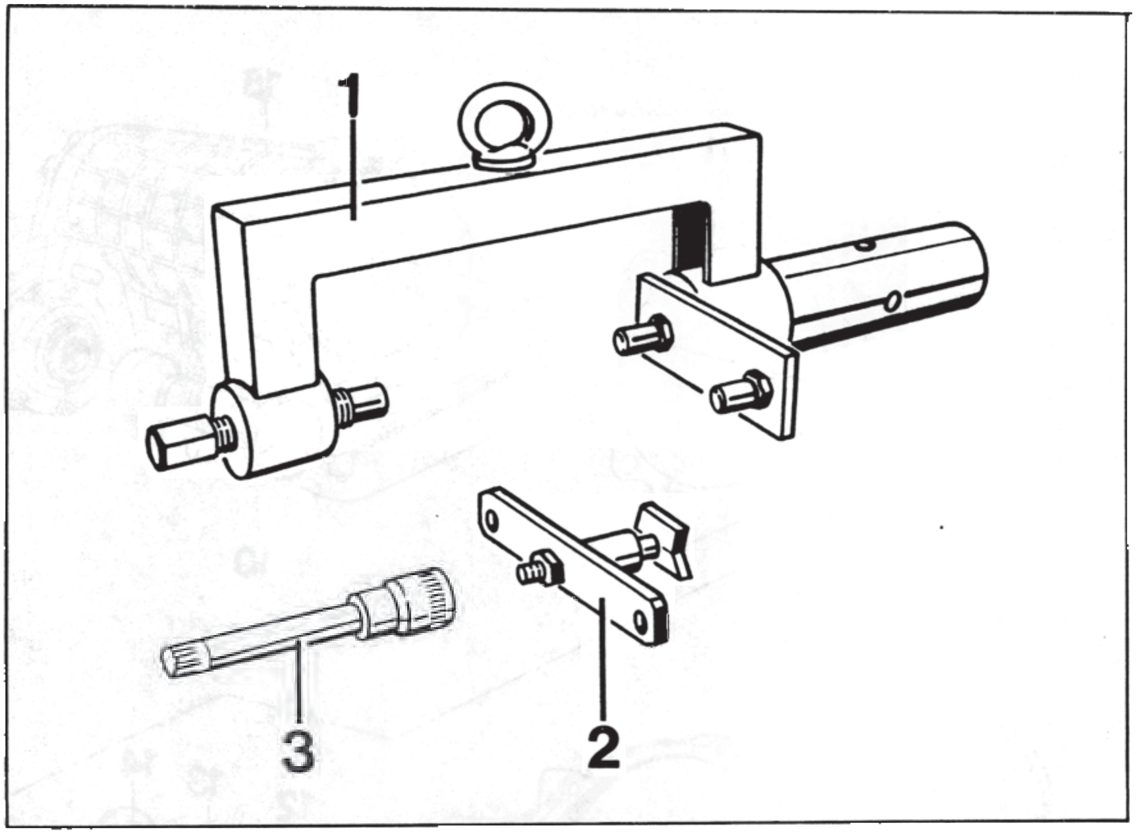
39 01 19 Removing and installing rear transmission case

Tools



No.	Designation	Special tool	Order number	Explanation
1	Transmission holder	9324	000.721.932.40	
2	Holding device	9325	000.721.932.50	
3	socket key insert	9330	000.721.933.00	

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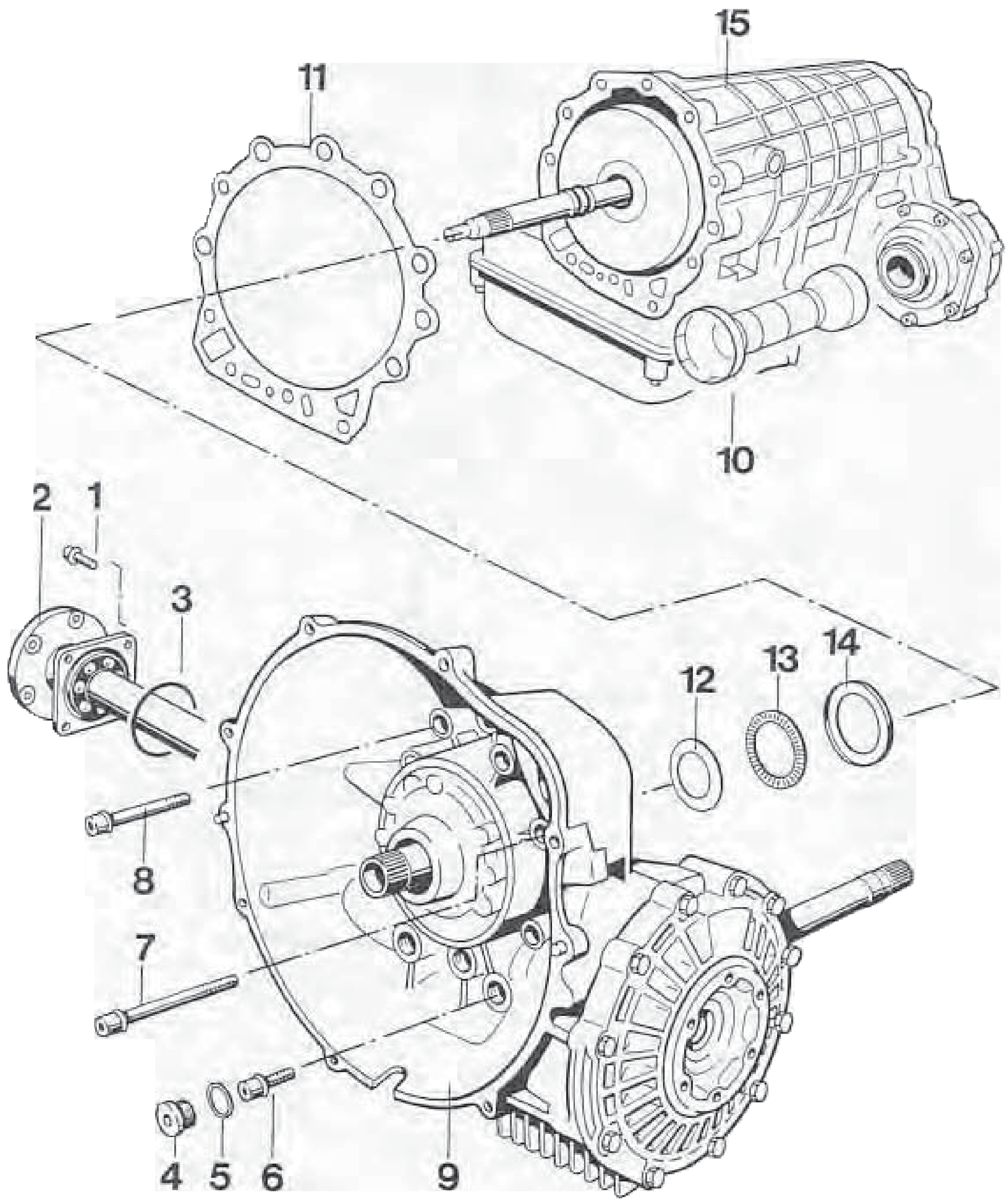
39 01 19 Removing and installing final drive



424-37

No.	Designation	Qty.	Note: Removal	Installation (= ftlb)
1	Fillister head screw	4	Use Special Tool 9330 to remove	Tighten witht 23 Nm (17)
2	Joint flange	1		
3	O-ring	1		Replace, oil slightly
4	Screw plug	3	Remove with Torx insert T55	Tighten with 50 Nm (36)
5	Sealing ring	3		Replace
6	Fillister head screw	3	Remove with Torx insert T50	Tighten with 46 Nm (34)
7	Fillister head screw	3	Remove with Torx insert T50	Tighten with 46 Nm (34)
8	Fillister head screw	6	Remove with Torx insert T50	Tighten with 46 Nm (34)
9	Rear transmission case	1		
10	Protective tube	1		Large diameter to final drive
11	Seal	1		Replace, glue to case with a small quantity of grease (vaseline)
12	Shim*	X	Note thickness for re-installation	Redertermine thickness if required (refer to page 38 - 171)
13	Needle cage	1		
14	Angle ring	1		Fit in correct position
15	Automatic transmission	1		Pay attention to installation position of clutch A. Make sure that the square drive shaft rings are correctly fitted. Coat the drive shaft with a small quantity of grease in the area of the square rings.

* Must be checked and, if required, corrected after each transmission installation.

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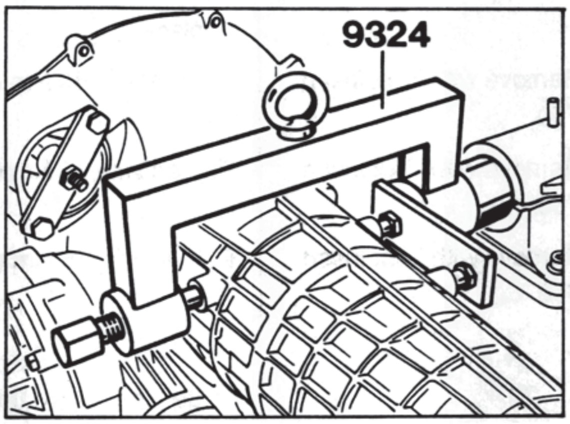
Assembly instructions for removal and installation

Removal

1. Remove the transmission and torque converter.

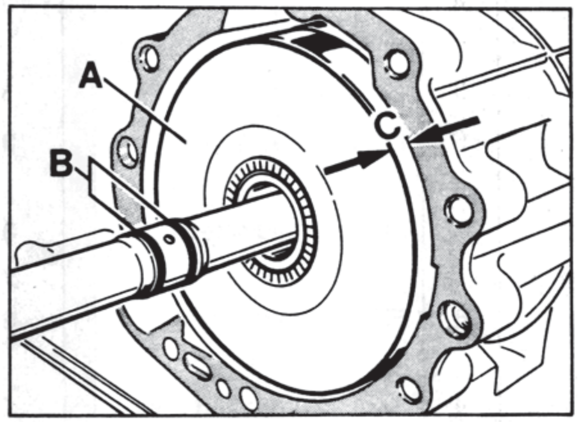
2. Secure transmission on assembly block with holding device **9324**.



415-37

Installation

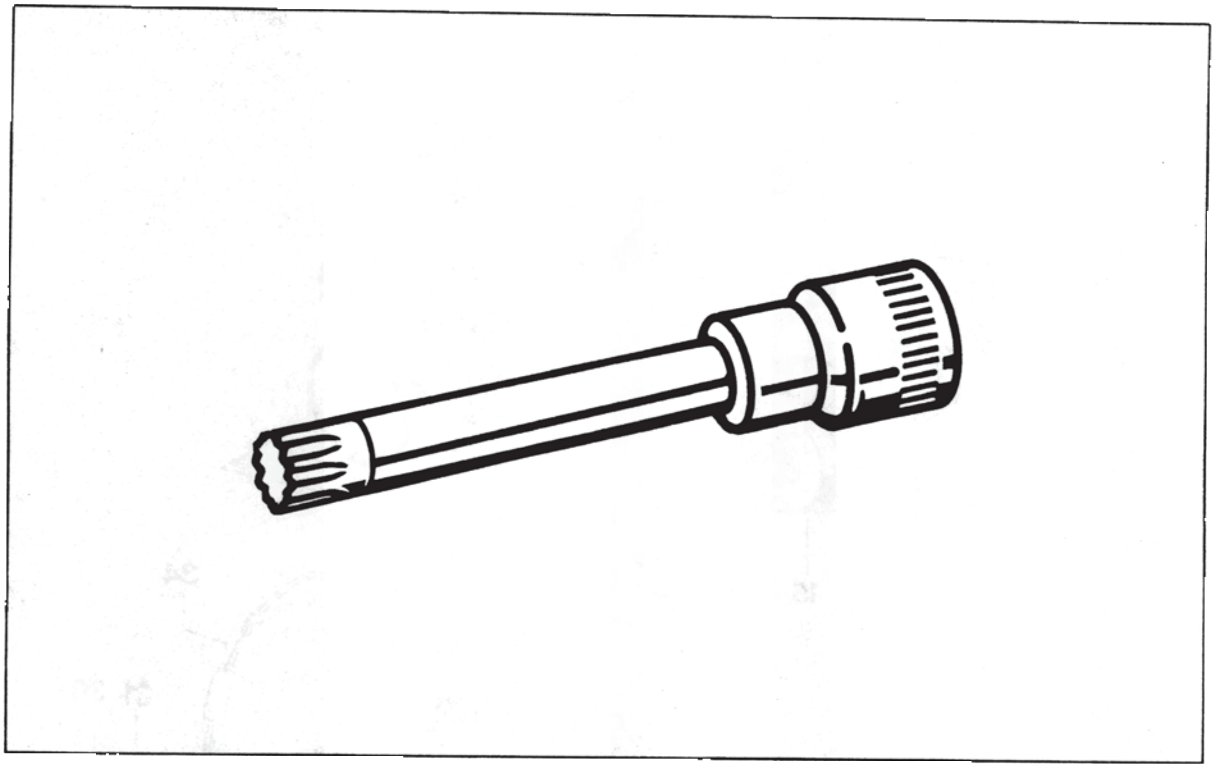
1. Check the installation position of clutch A. The installation depth has been reached when the distance **"C" is approx. 8.5 mm.**



416-37

A = Clutch A
B = Square rings
C = Installation depths

39 09 19 Removing and installing differential and drive pinion



No.	Designation	Special tool	Order number	Explanation
	Socket	9330	000.721.933.00	

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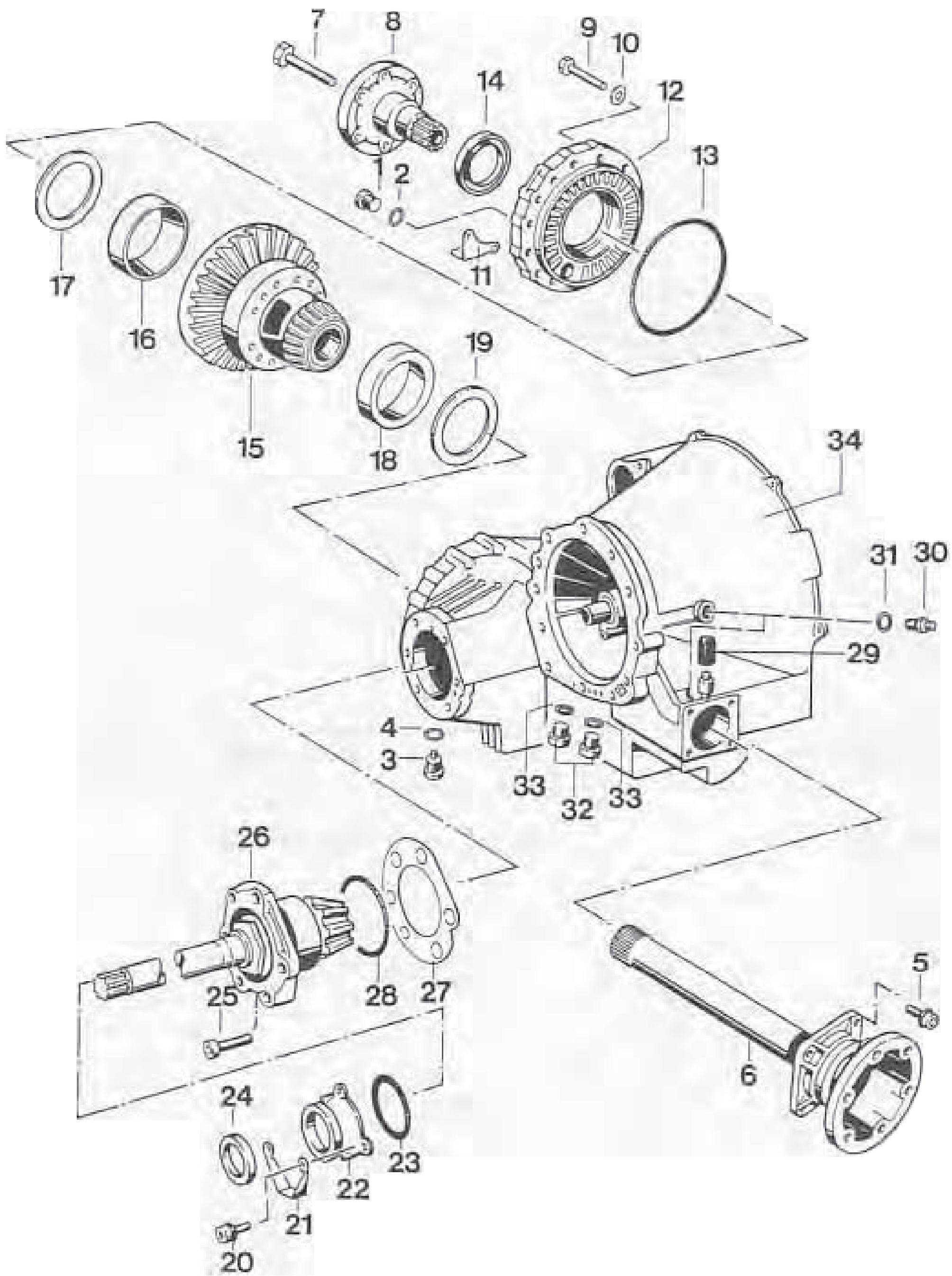
39 09 19 Removing and installing differential and drive pinion



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No.	Designation	Qty.	Note: Removal	Installation
1	Plug	1		Tighten to 50 Nm (37 ftlb)
2	Seal	1		Replace
3	Plug with solenoid	1		Tighten to 50 Nm (37 ftlb)
4	Seal	1		Replace
5	Pan head screw	4	Remove with Special Tool 9330	Tighten to 23 Nm (17 ftlb)
6	Halfshaft flange	1		For dismantling, refer to page 39 - 102
7	Hexagon head bolt	1		Tighten to 46 Nm (34 ftlb)
8	Halfshaft flange	1		
9	Hexagon head bolt	11		Tighten to 23 Nm (17 ftlb)
10	Spring washer	11		
	Bracket	1		
12	Transmission side cover	1		
13	Round seal	1		Replace, oil lightly
14	Shaft seal	1	Replace	Pack space between dust lip and sealing lip with grease (e.g. Shell 8420) and press in flush
15	Differential	1		
16	Taper roller bearing outer race	1		
7	Adjusting shim "S_1"	X	Record thickness for refitting	Redetermine thickness if required
18	Taper roller bearing outer race	1		
19	Adjusting shim "S_2"	X	Record thickness for refitting	Redetermine thickness if required
20	Pan head screw	3		Tighten to 10 Nm (7 ftlb)

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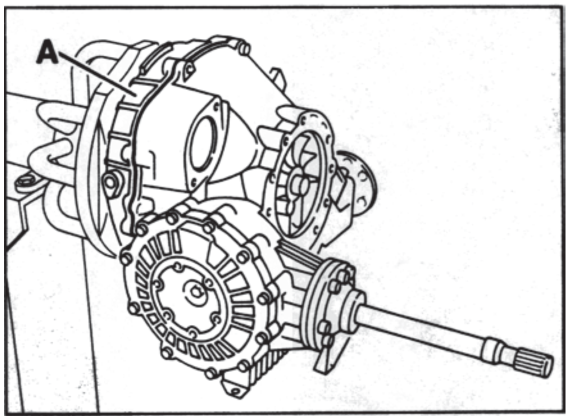
No.	Designation	Qty.	Note: Removal	Installation
21	Bracket	1		
22	Bearing cover	1		
23	Round seal	1		Replace
24	Shaft seal	1		Replace. Pack space between dust lip and sealing lip with grease (e.g. Shell 8420). Press in to depth of 2.0 ± 0.5 mm
25	Pan head screw	6		Tighten to 50 Nm (37 ftlb)
26	Drive pinionm with bearing assembly	1	To drive out, use a plastic hammer to apply light blows on the drive pinion head	Observe matching number, readjust if required
27	Adjusting shim "S_3"	X	Record thickness for reassembly	Redetermine thickness if required
28	Round seal	1		Replace, oil lightly
29	Breather	1		
30	Screw-in flange	2		Tighten to 35 Nm (26 ftlb)
31	Seal	2		Replace
32	Plug	2		Tighten to 25 Nm (18 ftlb)
33	Seal	2		Replace
34	Final drive	1		

Removal note

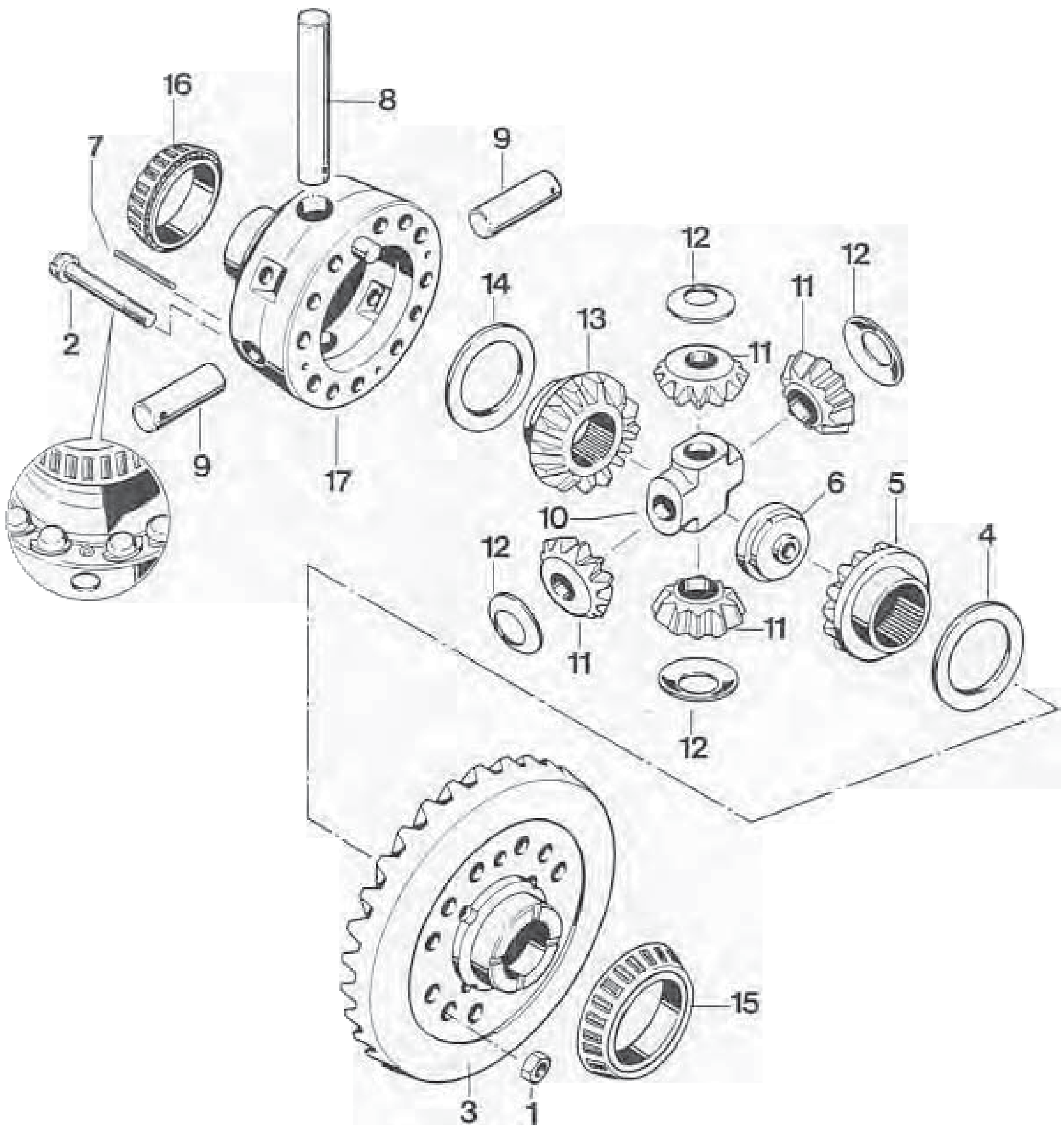
Mount rear transmission case with converter housing on assembly support.



965-39

A - Converter housing (spare part)

39 09 37 Dismantling and assembling differential



960-39

No.	Designation	Qty.	Note: Removal	Installation
1	Hexagon nut	12		replace. Thread must be dry and free from grease. Secure with Loctite 262. Tightening torque: 85 Nm (62.7 ftlb)
2	Lock screw	12		replace. Thread must be dry and free from grease. Install in correct position.
3	Ring gear	1	Separate from housing by applying light blows with a plastic hammer	Observe matching number. Readjust if required
4	Thrust washer	1		
5	Shaft bevel gear	1		
6	Nut	1		
7	Roll pin	3		Press in place in correct position
8	Stud (long)	1		Lock with roll pin
9	Stud (short)	2		Lock with roll pin
10	Cross fitting	1		
11	Bevel gear	4		
12	Thrust washer	4		
13	Shaft bevel gear	1		
14	Thrust washer	1		
15	Taper roller bearing inner race	1	Pull of with suitable puller, or remove ring gear and take out from inside through bores	Heat to approx. 120° C and press on
16	Taper roller bearing inner race	1	Pull off with P 263	Heat to approx. 120° C and press on
17	Housing	1		Fit centering pin with Loctite 262

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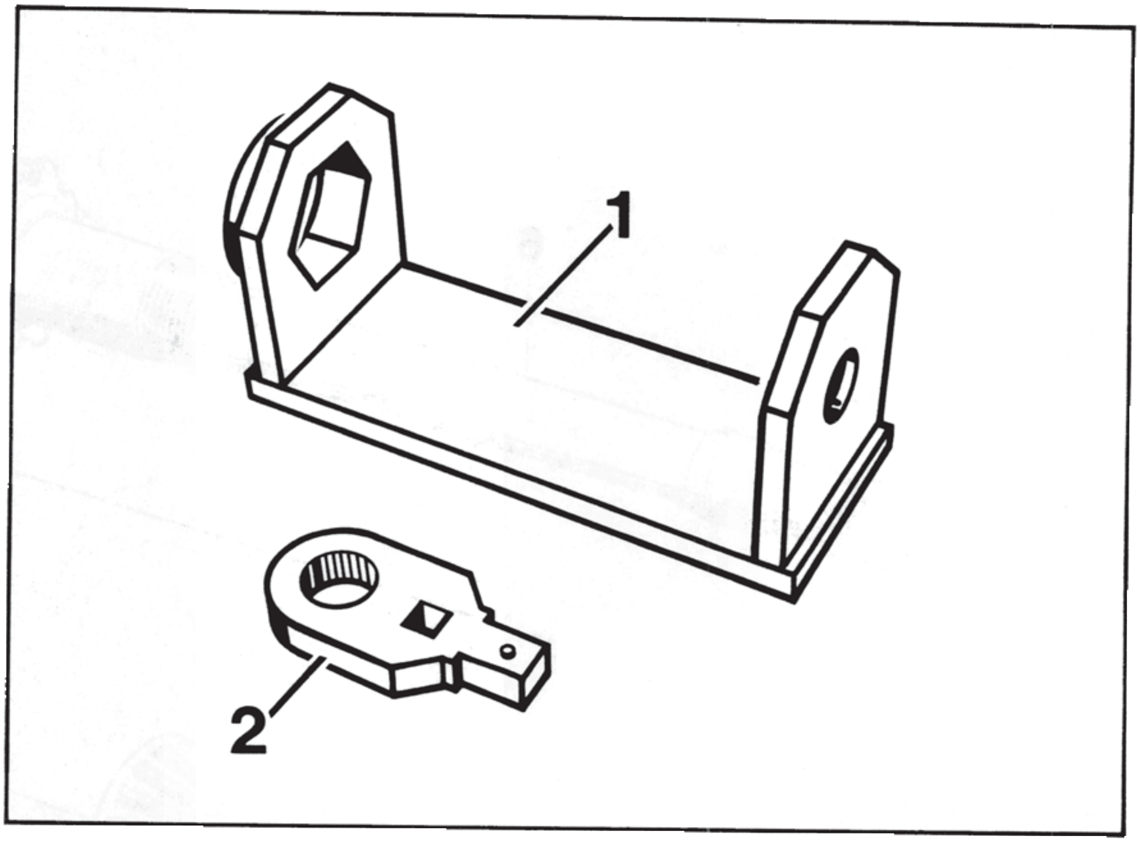
39 30 19 Dismantling and assembling drive pinion



967-39

No.	Designation	Special tool	Order number	Explanation
1	Retainer bracket	9337	000.721.933.70	
2	Insert	9282	000.721.928.20	

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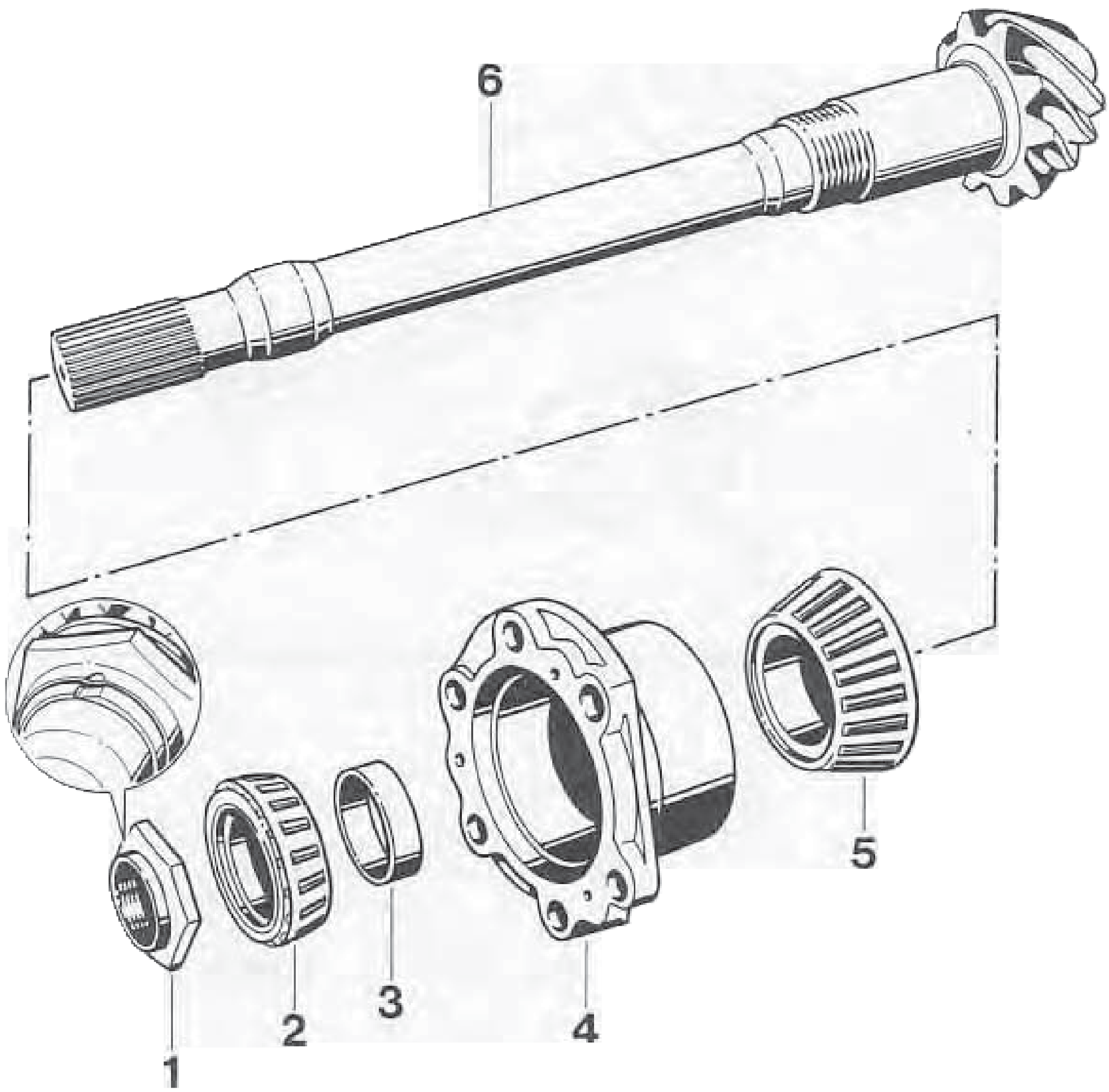
39 30 19 Dismantling and assembling drive pinion



No.	Designation	Qty.	Note: Removal	Installation
1	Lock nut	1	Undo with Special Tool **9337** and **9282**	Tighten to 250 Nm (184 ftlb) and secure by upsetting the flange in two places
2	Taper roller bearing inner race	1	Press off with bearing flange	Heat to approx. 120° C and press on
3	Adjusting ring	X		
4	Bearing flange	1		Only available pread-justed as a complete spare assembly (items 2 to 5)
5	Taper roller bearing inner race	1	Press off with separating device	Heat to approx. 120 °C and press on
6	Drive pinion	1		Readjust if required, observe matching number

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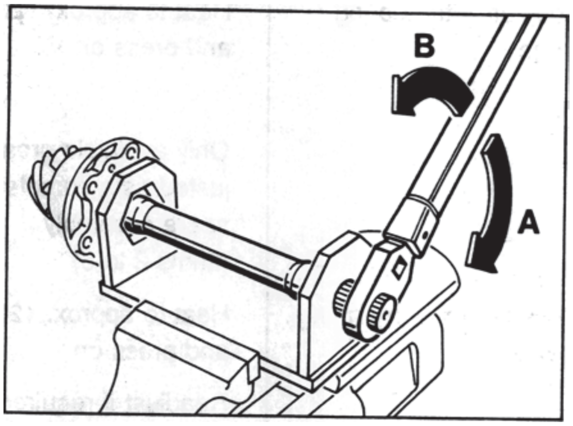
Notes on removal

Dismantling

Undo lock nut with Special Tools **9337** and **9282**.

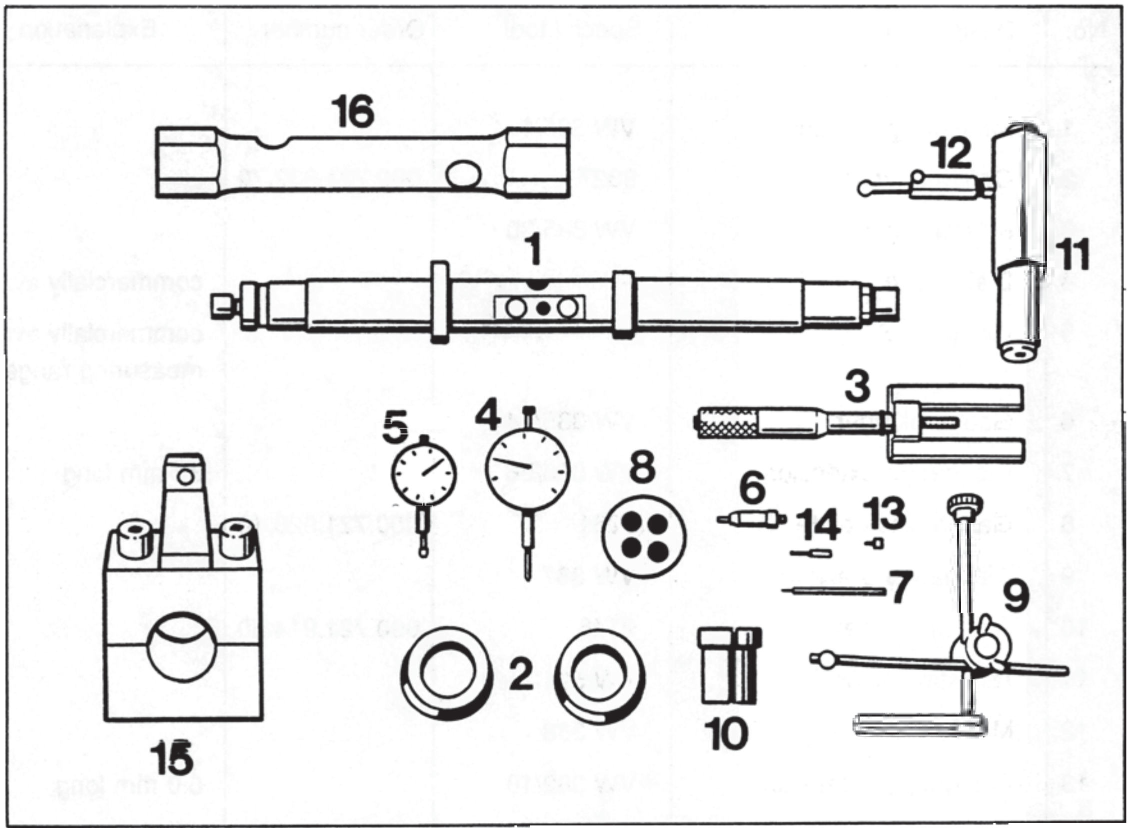


968-39

A - Undoing
B - Tightening

39 08 15 Adjusting drive set

Tools



Adjusting drive set

Tools

No.	Designation	Special tool	Order number	Explanation
1	Measuring mandrel	VW 385/1		
2	Centering discs	9327	000.721.932.70	
3	Master gauge	VW 385/30		
4	Dial gauge	–		commercially available
5	Dial gauge	–		commercially available, measuring range 3mm
6	Gauge plunger	VW 385/14		
7	Dial gauge extension	VW 385/56		30 mm long
8	Gauge block plate	9281	000.721.928.10	
9	Dial gauge bracket	VW 387		
10	Clamping sleeve	9145	000.721.914.50	
11	Adjusting device	VW 521		
12	Measuring lever	VW 388		
13	Dial gauge extension	VW 382/10		6.0 mm long
14	Dial gauge extension	VW 385/53		14 mm long
15	Clamping device	9339	000.721.933.90	
16	Socket wrench (24 mm A/F)	–		commercially available (e.g. Stahlwille No. 10 750)

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Practical procedure when readjusting the drive set

If it becomes necessary to adjust drive pinion and ring gear, follow the below sequence to ensure an efficient working procedure:

1. Determine the total shim thickness "Stot" (S_1 plus S_2) for the specified preload on the taper roller bearings/differential.

2. Determine the thickness of shim "S_3".

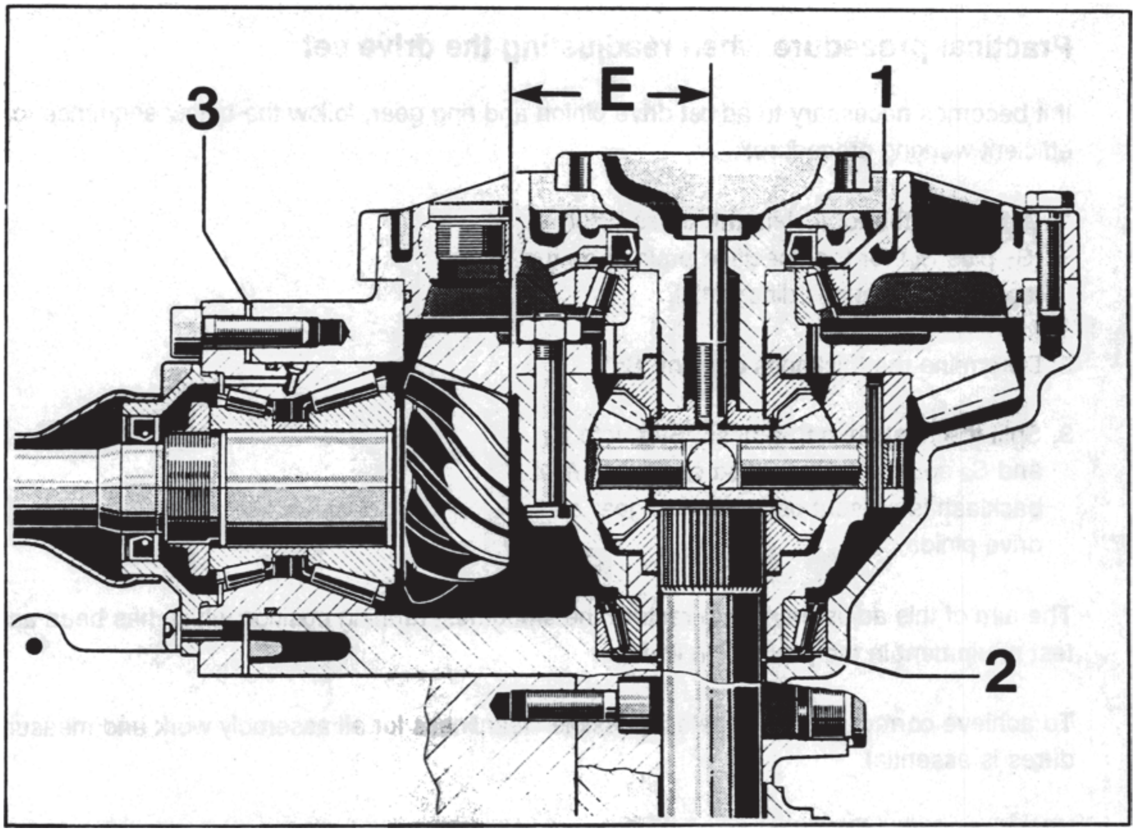
3. Split the total shim thickness "Stot" into S_1 and S_2 so that the specified circumferential backlash is present between ring gear and drive pinion.

The aim of this adjustment is to restore the smoothest running position which has been achieved on test equipment in the production line.

To achieve correct results, greatest possible cleanliness for all assembly work and measuring procedures is essential.

When assembling the final drive assembly, it is only necessary to readjust drive pinion and ring gear or drive set if components have been replaced which have a direct influence on the adjustment. Refer to the following table to avoid unnecessary adjustment procedures!

Adjust: / Replaced component	Ring gear (S_1 + S_2)	Drive pinion (S_3)
Rear transmission case	x	x
Transmission side cover	x	
Bearing assembly for drive pinion	x	x
Drive set	x	x
Differential housing	x	
Taper roller bearing for differential	x	



945-39

1 – Spacer S_1
2 – Spacer S_2
3 – Adjusting shim S_3
E – Adjustment dimension

Correct results can only be achieved if assembly work and measuring procedures are carried out carefully and with maximum cleanliness.

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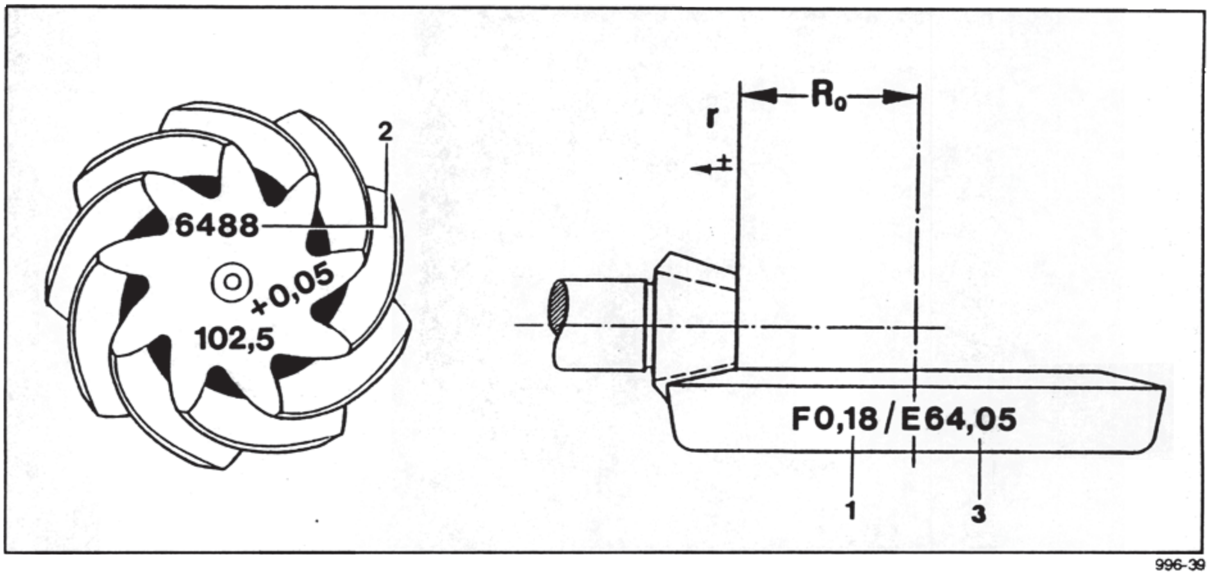
Adjusting drive set

General

The setting of drive pinion and ring gear is a determining factor for the service life and smooth running of the rear-axle drive. Drive pinions and ring gear that have been checked for good tooth contact pattern and low noise in both directions of rotation on special test equipment are therefore matched during production. The position at which smoothest running can be achieved is determined by shifting the drive pinion axially, with the ring gear being kept within the tolerance of the prescribed tooth backlash. The deviation "r" from the specified design dimension "Ro" is measured, added to the design dimension "Ro" and engraved on the ring gear as setting value "E".



Ro - design dimension (64.00 mm)
r - deviation r
1 - Backlash "F" (e.g. 0.18 mm)
2 - Matching number
3 - Setting value "E" (Ro + r)

All other characters are used for adjustment in production.

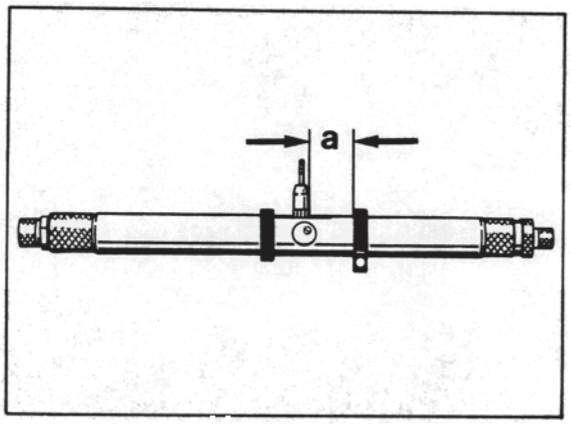
Adjusting drive pinion

Note

The setting dimension "E" is indicated on the ring gear.

1. Install drive pinion **without** shims "S_3" and tighten all pan head screws of bearing assembly to 50 Nm (37 ftlb).

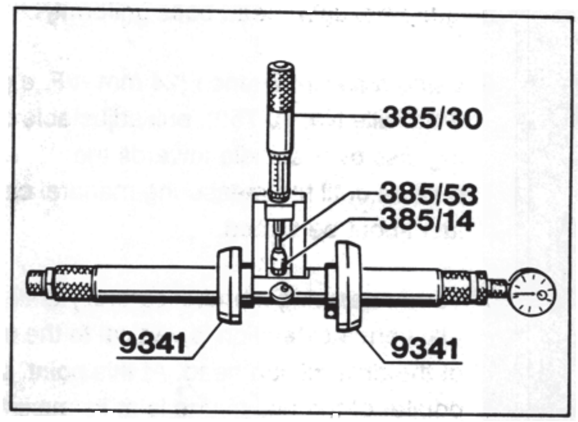
2. Rotate adjustable stop ring along with spindle towards measuring plunger as far as it will go and set second setting ring to dimension"a".



969-39

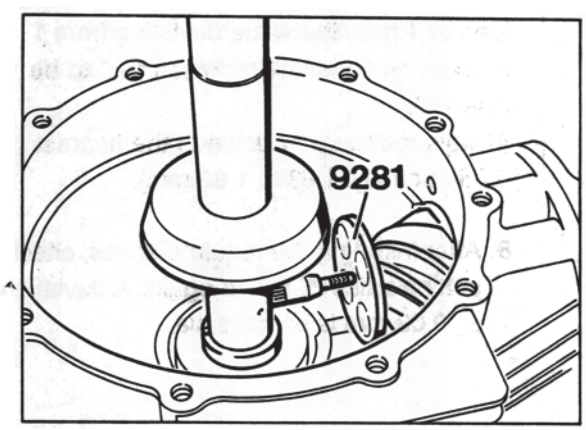
a = 30 mm

3. Assemble measuring mandrel and set with master gauge **VW 385/30** to setting dimension "E" (64.05 mm in the example).
   Set dial gauge (3 mm measuring range) to zero with 1 mm preload.



970-39

4. Put gauge block plate **9281** on drive pinion head and insert measuring mandrel with dial gauge towards transmission side cover into transmission case. Dial gauge extension points towards center of drive pinion.



5. Fit transmission side cover without shaft seal and sealing ring and tighten crosswise with 4 hexagon head bolts.

Note

Do not use a hammer when fitting the transmission side cover (the gauge block plate held by magnets might fall off). Locate cover in correct installation position only by tightening the hexagon head bolts uniformly.

6. Using a socket wrench (24 mm A/F, e.g. Stahlwille No. 10 750), pull adjustable centering disc over spindle towards the outside until the measuring mandrel can just about be turned.

7. Turn measuring mandrel carefully until the dial gauge extension is vertical to the face of the drive pinion head. At this point, the pointer of the dial gauge is at its maximum deflection (reversing point) and the dial gauge must now be read.

Note

The measured value always deviates from the set dimension in clockwise direction (small pointer on the dial gauge is between 1 and 3), i.e. if the dial gauge is set with a preload of 1 mm, the value deviating from 1 is taken as the shim thickness "S_3" to be inserted.
Always round up or down to the nearest 0.05 mm (e.g. 1.63 to 1.60 mm).

8. After inserting the required shims, check the setting value "E" once again. A deviation of ± 0.03 mm is permissible.

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Adjusting ring gear

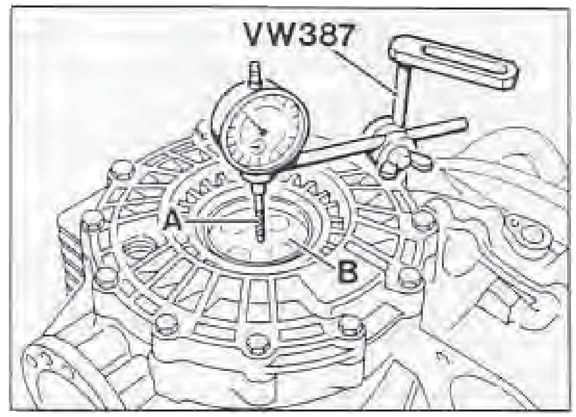
Determining total shim thickness "Stot." ($S_1 + S_2$)

The ring gear must be readjusted if the transmission case, transmission side cover, taper roller bearing for differential, differential housing or drive set have been replaced.

Note

The drive pinion must be removed in order to determine the preload of the differential tapered roller bearings.

1. Remove adjusting shim "S_1" (in transmission side cover).
2. Adjusting shim "S_2" remains in the transmission case.
3. Make sure that the bearing outer races of the tapered roller bearings are well seated in the transmission case or in the transmission side cover.
4. Insert differential into transmission case and rotate several times.
5. Fit transmission side cover without seals and tighten all hexagon head bolts to **23 Nm (17 ftlb)**.
6. Place gauge block plate **9281** on the collar of the differential.
7. Fasten universal dial gauge holder **VW 387** with dial gauge and extension to the case and set to 0 with 2 mm preload.



973-39

A - Dial gauge extension (approx. 30 mm long)
B - Gauge block plate 9281

8. Using a suitable tool, move differential up an down.
   Read off backlash on the dial gauge and note.

Note

Do not turn differential while measuring backlash as this will give an incorrect reading.

9. Remove adjusting shim "S_2" and determine thickness using a micrometer.
10. Calculate "Stot".
    "Stot." = Thickness of adjusting shim "S_2"
    + measured value
    + pressure fit of taper roller bearings

Example

Thickness of adj. shim "S_2"	1.70 mm
Measured value	0.91 mm
Press fit (constant value)	0.24 mm
"Stot"	2.85 mm

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11. Spread calculated shim thickness "Stot" as follows.
    To start with the backlash adjustment, the thickness of adjusting shim "S_1" is reduced by 0.40 mm while the thickness of adjusting shim "S_2" is increased by 0.40 mm.

Example

Total shim thickness of adjusting shims

$S_1 + S_2 = 2.85$ mm

Thickness of adjusting shim "S_1"

$$\frac{2.85\ \text{mm}}{2} \qquad \begin{array}{r} 1.425\ \text{mm} \\ -\ 0.40\ \ \text{mm} \\ \hline 1.025\ \text{mm} \end{array}$$

Thickness of adjusting shim "S_2"

$$\frac{2.85\ \text{mm}}{2} = \begin{array}{r} 1.425\ \text{mm} \\ +\ 0.40\ \ \text{mm} \\ \hline 1.825\ \text{mm} \end{array}$$

Note

The adjusting shims are avail. in thickneses of 1.0...2.0 mm in increments of 0.05 mm.

The shim tichknesses calculated must be rounded up or down for plausible dimensions that will not alter the total shim thickness S_1 and S_2.

Example

Calculated shim thickness

$S_1 + S_2 = 1.025 + 1.825 = 2.85$ mm

Rounded down shim thickness

$S_1 + S_2 = 1.00 + 1.85 = 2.85$ mm

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Adjusting circumferential backlash

Note

The backlash to be set is embossed on the ring gear.

1. Drive pinion set using the shims "S_3" determined while adjusting the drive pinion and tighten all mounting screws to 50 Nm (37 ftlb).

Note

Make sure the collar nut of the drive pinion is tightened to 250 Nm (184 ftlb).

2. Fit the adjusting shims (S_1 + S_2) determined into the transmission case and the transmission side cover, respectively.

3. Fit differential and transmission side cover and tighten all hexagon head bolts of the cover to 23 Nm (17 ftlb).

Note

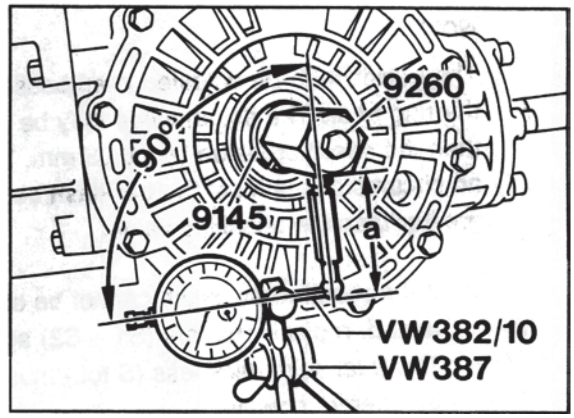
Always make sure that there is a certain amount of backlash when tightening the hex bolts. Never allow the drive pinion to bind.

4. Assemble measuring lever **VW 388** and adjusting device **VW 521/4** and adjust lever length to 80 mm with the plunger. Refer to dimension "a" in the picture.

5. Insert adjusting device with clamping sleeve (Special Tool 9145) into the differential and clamp firmly.

6. Rotate differential in both directions several times to settle the tapered roller bearings.

7. Fit universal dial gauge holder with flat extension in such a way as to produce a right angle between dial gauge axis and lever.



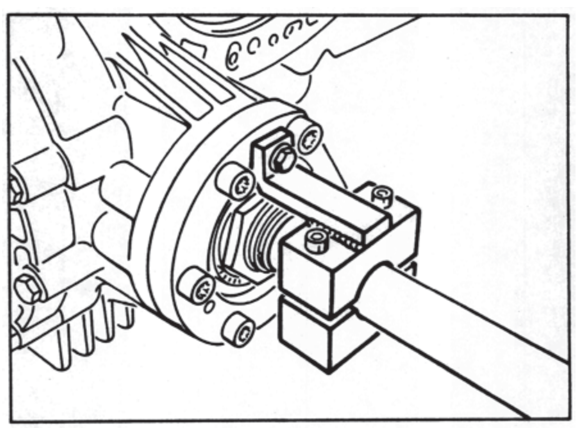
972-39

Dimension "a" = approx. 80 mm

8. Turn ring gear carefully at the clamping screw of the adjusting device up to the stop and set the dial gauge to zero. Turn back ring gear and read off circumferential backlash. Note the reading.

Note

When carrying out measurements, the drive pinion must be blocked with Special Tool **9339**.



1129-39

9. After turning the ring gear a further 90° each, repeat measuring procedures three times. The measured values must not deviate from one another by more than 0.05 mm.

Note

The backlash to be adjusted is embossed on the ring gear. The actual value may be less than the specified value by - 0.05 mm. Under no circumstances must the backlash be greater than the specified value.

10. If the required backlash cannot be obtained, replace spacers (S1 + S2) again. The total shim thickness (S tot.) must not be altered, however.

Note

Changing the shim thickness of "S1" or "S2" by 0.05 mm shim results in a change of backlash by approx. 0.1 mm.

Printed in Germany – V, 1994

Repair Manual

911 Carrera
(993)

Volume IV:
Chassis

Dr. Ing. h.c. F. Porsche Aktiengesellschaft

Preface

Structure

The "Technical Literture" for the "911 Carrera (993)" model is basically structured as before, i.e. the structure follows the familiar repair groups.

A new feature is that the structure includes the main groups **0 to 9** and the main group **D**.

Main groups:	0	Complete vehicle – General
	1	Engine
	2	Fuel, exhaust, engine electrical system
	3	Transmission
	4	Chassis
	5	Body
	6	Body equipment, outside
	7	Body equipment, interior
	8	Air conditioning
	9	Electrical system
	D	Diagnosis

Layout

The layout in the below items remains unchanged throughout the repair manual

1. Table of tightening torques
2. Special tools required
3. Exploded views
4. Legends for the exploded views
5. Assembly notes / use of special tools

As a new feature, however, the former item 6 (Repair group diagnosis) is no longer filed in the volume corresponding to the respective repair group. The **Diagnosis test plans / diagnosis procedures** have been combined in a **separate Diagnosis volume** broken down according to the main groups 0 to 9.

Another new feature is that the contents of the "Service Information Technik" are indicated in the Repair Manual. This brochure concentrates on a description of the design and function of components and of the new features introduced for a particular model year.

Service Number

All major repair procedures and repair descriptions are identified by a two- or four-digit **Service Number** completed by two additional digits to identify the work that corresponds to the first six digits of the working position number in the Working Times and Damage Catalog.

Example: 30 37 37 Dismantling and assembling clutch control shaft

Explanation: **30 37 37** 50 (full working position number)

Repair group
here: Clutch, control

Component designation
here: Clutch control shaft

Activity
here: Dismantling and assembling

Index
here: Removed

Presentation in the various documents

30 37 37 50	Working position no. from **Working Times and Damage Catalog**, consisting of repair group, component designation, activity and index
30 37 37	Six-digit number in **Repair Manual**, consisting of repair group, component designation and activity
30 37	Service number in **Service Information**, consisting of repair group and component designation

Goal

The introduction of a service number in the "technical literature" is intended to facilitate standardization and positive identification to allow direct cross-referencing among the various documents. This is of particular importance with regard to the use of electronic media.

IV Chassis

The Repair Manual of the 911 Carrera (993) also includes the 911 Carrera 4 manual (993 four-wheel drive). The 911 Carrera (993) is the basic model covered by the repair operations described in this Manual. "911 Carrera (993)" is also indicated in the header of each page.

Descriptions of repair operations that deviate for the 911 Carrera 4 will be included after the respective 911 Carrera section. The repair descriptions of both models are separated by a cover page. All pages included after the cover page (separation sheet) have the "911 Carrera 4" heading. To facilitate distinction, the page numbering will start with 100.

4 Chassis

40 Front Wheel Suspension, Drive Shaft

42 Rear Wheel Suspension, Drive Shaft

Printed in Germany - 16, 1996

Printed in Germany - 16, 1996

Printed in Germany - 15, 1995

Survey of contents of Service Information Technik '95

The Service Information gives a detailed description of the technical features of the new 911 Carrera.

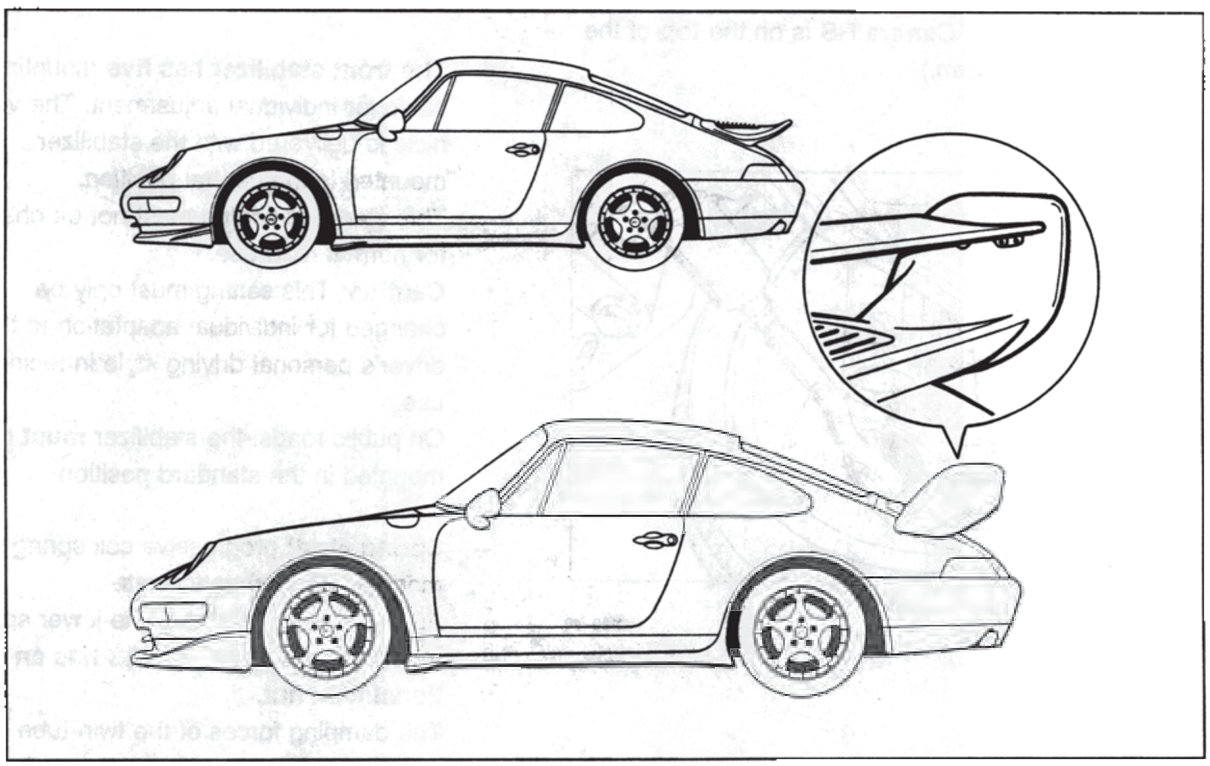
4 Chassis- overview 911 Carrera RS

General

The 911 Carrera RS (993) is produced in a **basic version** (M002) and a **Clubsport version** (M003)

Both versions (M 002 and M 003) are lower than the 911 Carrera.

The 911 Carrera RS (M 002 and M 003) can be recognized by additional spoilers at the front and a fixed rear spoiler.
The M 002 and M 003 are fitted with **rear spoilers** of different types and sizes.
The **basic version M 002** (upper vehicle) is equipped with a small fixed spoiler.
The **Clubsport version M 003** (lower vehicle) has a large fixed spoiler with an adjustable wing. In addition, the Clubsport version is fitted with a welded rollover cage.
Caution: The wing is set to the lowest (horizontal) position for road use. Adjustment of the wing to individual driving styles is only possible for racing use.
On public roads, the wing **must** be set to the lowest position.



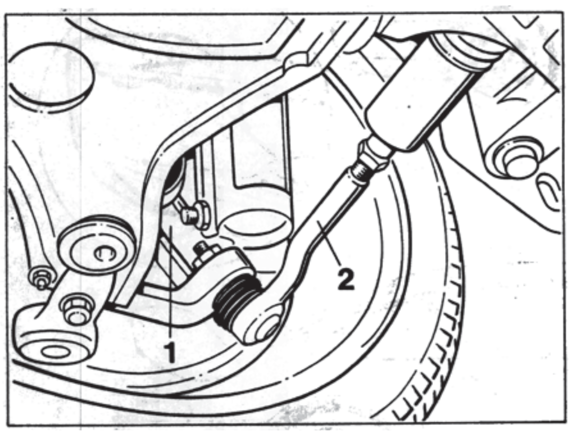
Chassis overview (M 002 / M 003)

The running gear of the Carrera RS (993) is based on that of the 911 Carrera. Only the changes which have been made are listed below.

Front axle / steering

Modified wheel carrier no. 1
(lower mounts for control arm and tie rod).

Tie rod no. 2. with less curvature.
The tie rod ball joint is mounted on the wheel carrier the other way round (on the Carrera, the fastening nut is on the **bottom** of the steering arm. The fastening nut on the Carrera RS is on the **top** of the steering arm.)



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Power steering gear with modified ratio.
Carrera (993) = 16.48 : 1 (left hand drive)
Carrera RS = 18.25 : 1 (left hand drive)
A connecting brace is installed between the steering mounting points.
Caution: For assembly work, you must take account of the changed position of the steering gear mounting screws in connection with the connecting brace.

Steering wheel: three-spoke steering wheel without airbag, diameter 360 mm (Momo).
The airbag steering wheel with a diameter of 380 mm is available as an option.

Control arms with harder rubber metal mounts.

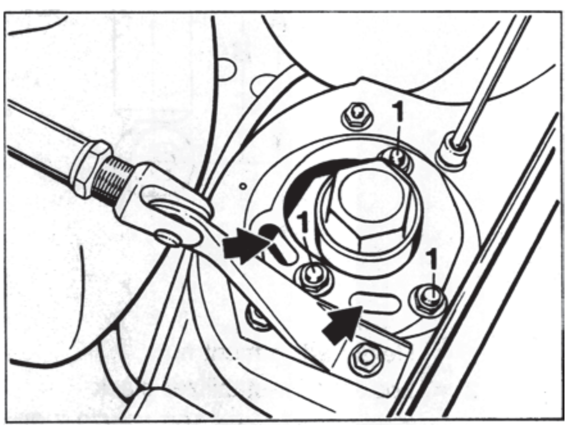
The front stabilizer has **five** mounting holes for individual adjustment. The vehicle is delivered with the stabilizer mounted in the central position.
This standard setting must not be changed for normal road use.
Caution: This setting must only be changed for individual adaptation to the driver's personal driving style in racing use.
On public roads. the stabilizer **must** be mounted in the standard position.

Spring strut: progressive coil spring with modified (higher) spring rate.
As with the 911 Carrera, the lower spring mount is adjustable. **The RS has an additional lock nut.**
The damping forces of the twin-tube shock absorber are lower than on the earlier Carrera RS (964) (more comfortable ride).

The spring strut mount has a Unibal joint. This can be used to set the camber from the normal value to a racing setting. For adjustment, there are two slots (arrows) in the upper part and three bolts (no. 1) in the lower part of the mount.
The increase in camber if the slots are used is about - 1° 30'. Fine adjustment by about ± 20' is possible by moving the joint in the slots.
Caution: The racing setting must be used only for racing.
For use on public roads, the camber **must** be set to the standard position.

Note

The suspension brace shown is standard equipment on the Clubsport version (M 003). It is also available as an option for the basic version (M 002).



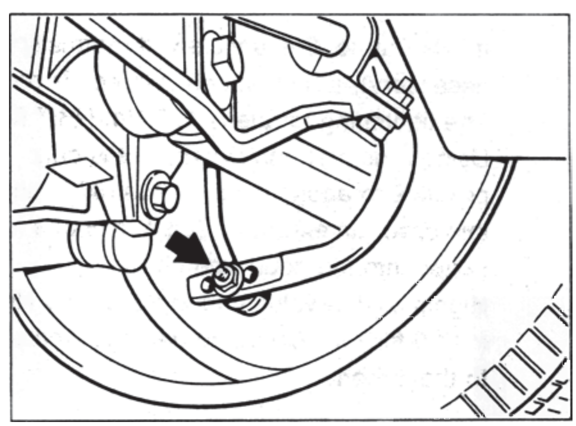
2187/1 -40

Rear axle

To obtain greater camber (up to - 3°30') for motorsports use, the slot in the **rear axle side part** near to the camber arm is longer.
The stroke of the camber eccentric is **2 mm longer** to provide a greater adjustment range.
The **rubber metal mounts** (subframe mounts) on the side parts are harder.

The rubber metal mounts for arms 5 (lower A-arm) and 4 (caster arm) are also harder than on the standard vehicle.

The stabilizer, diameter 20 mm, has **three adjustment positions**. The vehicle is delivered with the stabilizer in the central position (arrow).
The stabilizer position must not be changed for normal road use.
Caution: The stabilizer position must only be changed for racing use.
For use on public roads, the stabilizer **must** be set to the standard position.



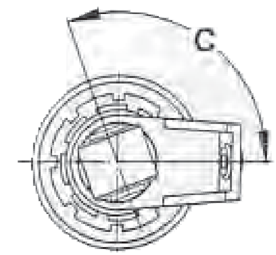
2192 - 42

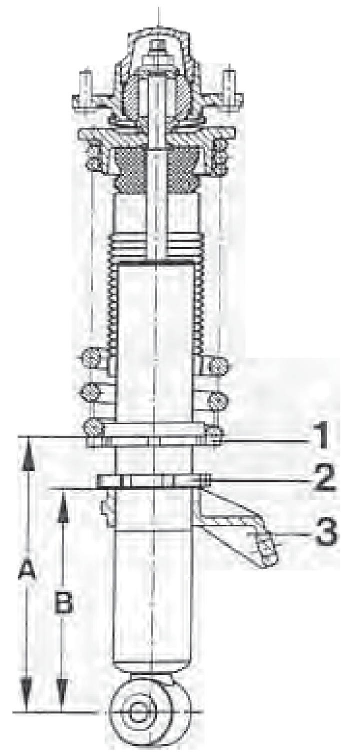
The spring strut mount is equipped with a Unibal joint.

The rear axle spring strut is equipped with a threaded sleeve and an adjustment nut (no. 1) for height adjustments.
In addition, the stabilizer block (no. 3) (support for stabilizer mount) is attached to the thread. The height of the stabilizer block is adjustable and it is equipped with a lock nut (no. 2).
The stabilizer block must only be adjusted for racing purposes. The purpose of adjustment is to ensure that sufficient space is still available for the stabilizer mount if the vehicle height is changed (only for racing) and that the stabilizer mount can be installed without stress.
With the vehicle height specified for road use (see page 44 - 3), the stabilizer block **does not need to be adjusted.**
The stabilizer block is also correctly **adjusted** for replacement shock absorbers (dimensions B and C).

Note

If lock nut no. 2 is unscrewed (normally not necessary), a normal hook wrench is required. The tightening torque is 100 Nm (73.7 ftlb). Using a normal hook wrench, it is only possible to apply about 50 Nm (36.9 ftlb). In this case, an extension (tube) must be inserted into the hook wrench.
Higher torque values up to about 200 Nm (147.5 ftlb) will cause no damage whatsoever to the thread.





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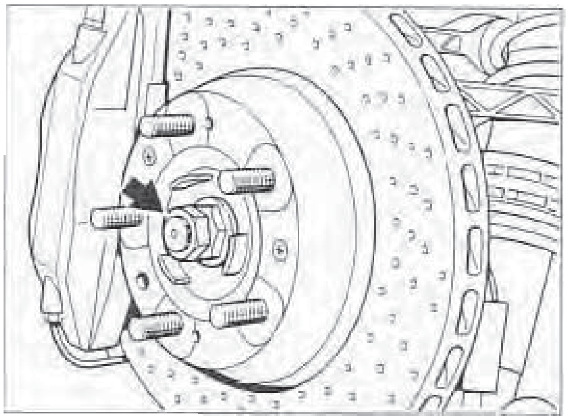
1 = Height adjustment nut
2 = Lock nut for stabilizer block
(tightening torque 100 Nm/73.7 ftlb)
3 = Stabilizer block

Dimension **A** = Pre-setting for production (182 ± 1 mm). For the specified vehicle height, the actual dimension may be different. If the shock absorber is replaced, the actual dimension must be transferred to the new part.

Dimension **B** = 147.5 ± 0.5 mm
Dimension **C** = 110.5 degrees

The 911 Carrera RS has the **drive shaft** of the 911 Turbo. In addition, there is a lock nut on the wheel (arrow).



2194 - 42

Wheels and tires

The 911 Carrera RS is fitted with **three-part 18-inch wheels** (for summer tires only). For winter tires, 17-inch wheels must be used. For tire pressures, see page 44 - 1.

Wheel alignment

The settings and adjustment procedures for front and rear axles are different in some respects from those for the 911 Carrera (993). For settings, see pages 44 - 3 to 44 - 5. For alignment measurements on the 911 Carrera RS, see page 44 - 19 / 44 - 20.

Brakes - general

The RS is equipped with dual-circuit brakes (front/rear axle split) **with a hydraulic brake booster**. ABS and the dynamic limited-slip differential system (**with ABD and limited-slip differential)** are standard equipment.

Front wheel brakes

With the exception of the brake disk, the brakes from the 911 Turbo (993) are fitted (perforated brake disk, red four-piston light alloy brake caliper, brake pads with wear warning contacts on both sides).
In contrast to the 911 Turbo, a **single-part brake disk** is fitted.

Rear wheel brakes

With the exception of the brake calipers, the brakes of the 911 Turbo (993) are used (perforated brake disk, red four-piston light alloy caliper, brake pads with wear warning contacts on both sides).
The four piston light alloy brake calipers have pistons with diameters of 2 x 36 mm and 2 x 30 mm (911 Turbo diameter 4 x 28 mm).

Proportioning valve

The reduce the brake pressure at the rear axle and to adapt the brake pressure to wheel load distribution, two proportioning valves (for left and right brake) are installed.
Switchover pressure 40 bar
Reduction factor 0.46
(Marking 5 ↓ 40).

Brake booster / hydraulic pump

As with the 911 Carrera 4 and the 911 Turbo, an electro-hydraulic brake booster system is used.
Caution: boost coefficient 3.6 : 1.
Carrera 4 and 911 Turbo (993) 4.8 :1.

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4 Notes for Carrera RS repair instructions

General

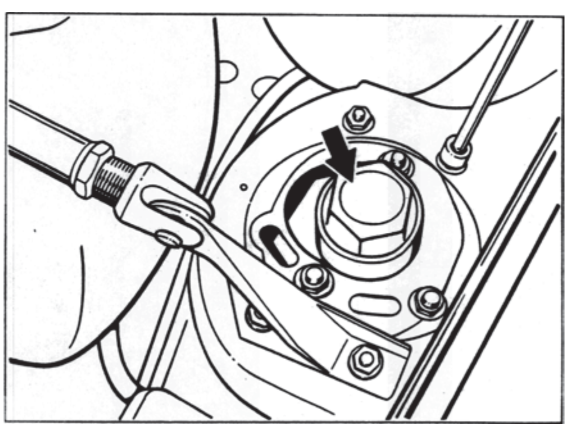
The repair, adjustment and assembly descriptions given in the repair manual for the 911 Carrera (993, rear-wheel drive) also form the basis for repair work on the 911 Carrera RS. Only repair procedures which are different for the Carrera RS are specifically described in this Repair Manual.

Note on torque specification values

Most of the tightening torque values for the 911 Carrera also apply to the 911 Carrera RS.
Differences in torque values and additional torque specifications are given in the tables of the appropriate repair groups for the 911 Carrera (993, rear-wheel drive).

Assembly work on front spring strut

Do not loosen the cap of the spring strut mount (arrow) when the vehicle is standing on its wheels.



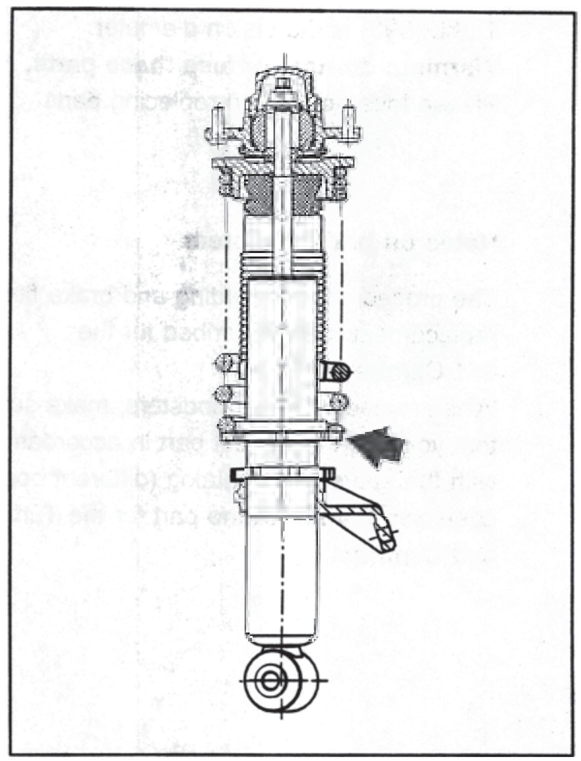
2187/2 - 40

Assembly work on rear spring strut

Do not loosen the cap of the spring strut mount when the vehicle is standing on its wheels.

Adjustment work on rear spring strut

To adjust the height of the vehicle, you need a normal hook wrench.
To adjust the height, turn the adjustment nut (arrow).
If the height is set to the value specified for road use (page 44 - 3), the stabilizer block does not need to be adjusted.
The stabilizer block is also correctly set for replacement shock absorbers. For further details, see page 4 - 4.



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Notes on removal of drive shaft

When pressing the **drive shaft** out of the wheel hub, place a disk between the drive shaft and the extractor to prevent damage to the vent pipe.

Notes on wheel alignment

The settings and adjustment procedures for front and rear axles are different in some respects from those for the 911 Carrera (993).
For settings, see pages 44 - 3 to 44 - 5.
For alignment measurements on the 911 Carrera RS, see page 44 - 19 / 44 - 20.

Notes on rear brakes

The only difference between the rear wheel brake calipers of the Carrera RS and the 911 Turbo (993) is the piston diameter.
Warning: do not confuse these parts.
Please take note when replacing parts.

Notes on brake boosters

The procedure for bleeding and brake fluid replacement is as described for the 911 Carrera (993).
When replacing brake boosters, make sure that you use the correct part in accordance with the spare parts catalog (different boost coefficient) **and not** the part for the Turbo and Carrera 4).

Notes on steering

Modified tie rod.
Modified steering gear ratio.
Carrera RS = 18.25 : 1 (left-hand drive)
Carrera (993) = 16.48 : 1 (left-hand drive).
When replacing parts use the correct part in accordance with the spare parts catalog.

4 Checks / notes for Carrera RS

Note

The inspection instructions and notes apply both to the basic version M 002 and to the Clubsport version M 003.

Platform lifts / test rigs

When driving onto platform lifts and wheel alignment platforms, make sure that there is sufficient ground clearance for the spoilers and sill trims.

Wheel alignment systems

The vehicle can only be driven onto wheel alignment platforms if additional ramps are used.
For example, 959 drive-on ramps are suitable. Platforms without inclination should not be used. For wheel alignment measurements on the 911 Carrera RS, see pages 44 - 19 and 44 - 20.

Notes on brake testing

Drive very carefully onto the **brake tester**, especially as the springs are compressed. This should prevent "grounding" to a large extent. Depending on the design of the brake tester, the elastic rubber lip of the front spoiler may gently make contact with the ground as the front axle enters the tester. The spoiler will immediately resume its normal position and no damage will be caused.
The spoilers for brake ventilation should still have a clearance of a few millimeters.
There are no problems with driving the rear axle onto the tester.

Notes on dynamometers

Dynamometers normally do not cause any problems. The front spoilers for brake ventilation are only bent over slightly as the vehicle dips into the front roller set. The spoilers then return to their normal position and no damage is caused.
The rotation of the front rollers cannot cause any damage as these rollers are only turned for four-wheel drive vehicles.

Front and rear stabilizer adjustment

The front and rear stabilizers have five (front) and three (rear) mounting holes for individual adjustment.
The stabilizer is set to the central position.
This standard setting must not be changed for normal road use.
Caution: This setting must only be changed for individual adaptation to the driver's personal driving style in racing use.

Spoiler adjustment

The additional wing of the Clubsport version M 003 is set to the lowest (horizontal) position for road use.
The wing must not be set to any other position except for racing.
On public roads, the wing must always be set to the lowest position.

Racing camber values

Racing camber must not be set at the front or rear except for use on race circuits.
For use on public roads, only the values stated on pages 44 - 4 and 44 - 5 may be set.

4 Stabilizer allocation

	Front axle	Rear axle
911 Carrera / 911 Carrera 4		
RoW standard	21 mm	18 mm
RoW M 030	22 mm	20 mm
USA standard and long-distance running gear (M 032)		
first version, up to Feb. 10, 1994*	21 mm*	18 mm*
modified / current version	20 mm	17 mm
USA M 030	22 mm	20 mm
911 Carrera 4 S (Turbo-Look)		
RoW standard	20 mm	18 mm
RoW M 030	22 mm	20 mm
USA standard	20 mm	17 mm
USA M 030	22 mm	18 mm
911 Carrera RS		
M 002 / M 003	23 mm**	20 mm**
911 Turbo		
RoW	22 mm	21 mm
USA	22 mm	19 mm

Please refer to Technical Information Gr. 4, No. 5/94. When stocks have been used up, only the front axle stabilizer with 20 mm diameter and the rear axle stabilizer with 17 mm diameter will be available. When replacing stabilizers, the combination of 20 mm front axle and 17 mm rear axle stabilizers must be installed together.

** Adjustable (front 5 positions, rear 3 positions)

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40 Tightening torques for front axle

Caution: Do not apply grease to **Dacromet-type** screws and bolts (aluminum-color appearance).

Location	Thread	Tightening torque Nm (ftlb.)
Crossmember		
Crossmember to body		
outer	M 12 x 1,5	105 (77)
inner	M 10	48 (35)
Transmission shift support plate to crossmember	M 8	23 (17)
Central tube / Front-axle final drive		
Front-axle dinal drive to central tube	M 10	46 (34)
Transmission mount (rubber-metal mount)		
to front-axle cross member	M 8	23 (17)
to transmission (central tube)	M 12 x 1,5	85 (63)
Drive shaft		
to front-axle final drive	M 8	42 (31)
to wheel hub	M 22 x 1,5	460 (340)
Crossmember		
to body (front)	M 12 x 1,5	90 (66)
to crossmember (rear)	M 10	46 (34)
A-arm / joint carrier		
A-arm front to side member	M 12 x 1,5	110 (81)
A-arm rear to side member	M 12 x 1,5	85 (63)

Location	Thread	Tightening torque Nm (ftlb.)
Joint carrier to		
A-arm		
Caster eccentric	M 10	65 (48)
Mounting	M 12 x 1.5	120 (88)
Joint carrier to wheel carrier (ball joint)	M 12 x 1.5	75 (55)
Cooling air duct for brake to A-arm	M 6	10 (7)
Spring strut / wheel carrier		
Strut to wheel carrier		
upper bolt (camber adjuster)	M 12 x 1.5	120 (88)
lower bolt	M 14 x 1.5	200 (147)
Lock nut for height adjustment not to spring strut (Carrera RS only)	M 64 x 1.5	50
Spring strut mount to body	M 8	33 (24)
Spring strut mount - inner section to outer section (Carrera RS only)	M 10	64
Cap** of spring strut mount (Carrera RS only)	M 50 x 1.5	180**
Strut support mount to piston rod	M 14 x 1.5	80 (59)
Brake protection plate to wheel carrier	M 6	10 (7)
Brake caliper to wheel carrier*	M 12 x 1.5	85* (63)
Rpm sensor to wheel carrier	M 6	10 (7)
Retaining plate for wheel bearings to wheel carrier	M 8	37 (27)
Wheel hub to wheel carrier	M 22 x 1.5	460 (339)

* Replace bolts (only on front axle) whenever the screw connection has been undone

** Do not unscrew while vehicle is standing on its wheels. Use new cap after dismantling.

Location	Thread	Tightening torque Nm (ftlb.)
Stabilizer bar		
to side member	M 8	23 ((17)
Stabilizer mount to wheel carrier and stabilizer bar	M 10	46 (34)
Steering		
(for values not indicated, refer to Repair Group 48)		
Tie rod (ball joint) to steering arm	M 12 x 1.5	75 (55)
Universal joint (steering shaft) to steering gear	M 8	23* (17)
Steering gear to crossmember		Tightening torque and note in Steering Repair Group
Wheel mount		
Wheel to wheel hub	M 14 x 1.5	130 (96)

* Replace set screws whenever they have been removed

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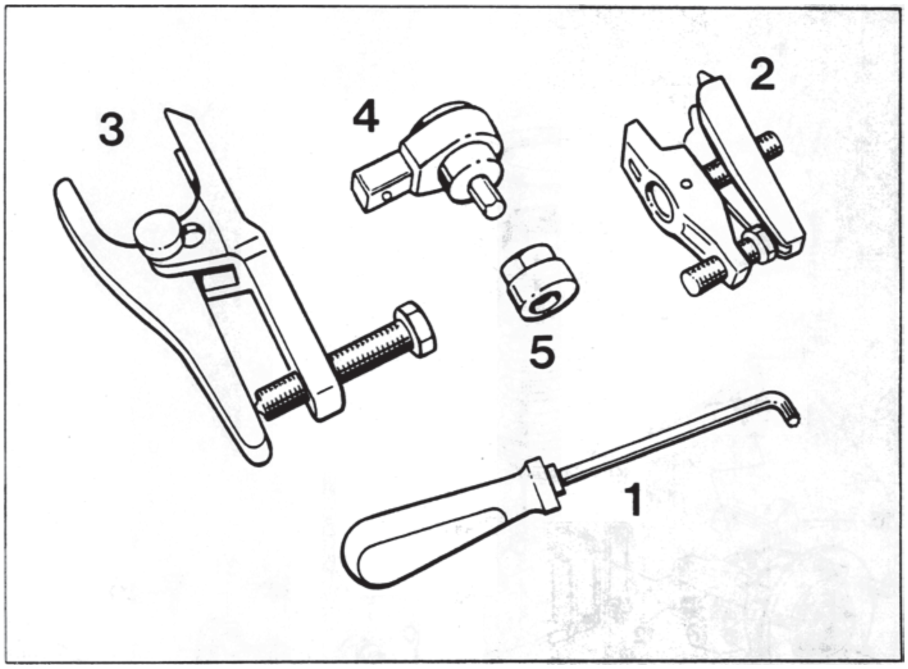
40 05 37 Dismantling and assembling suspension

Tools



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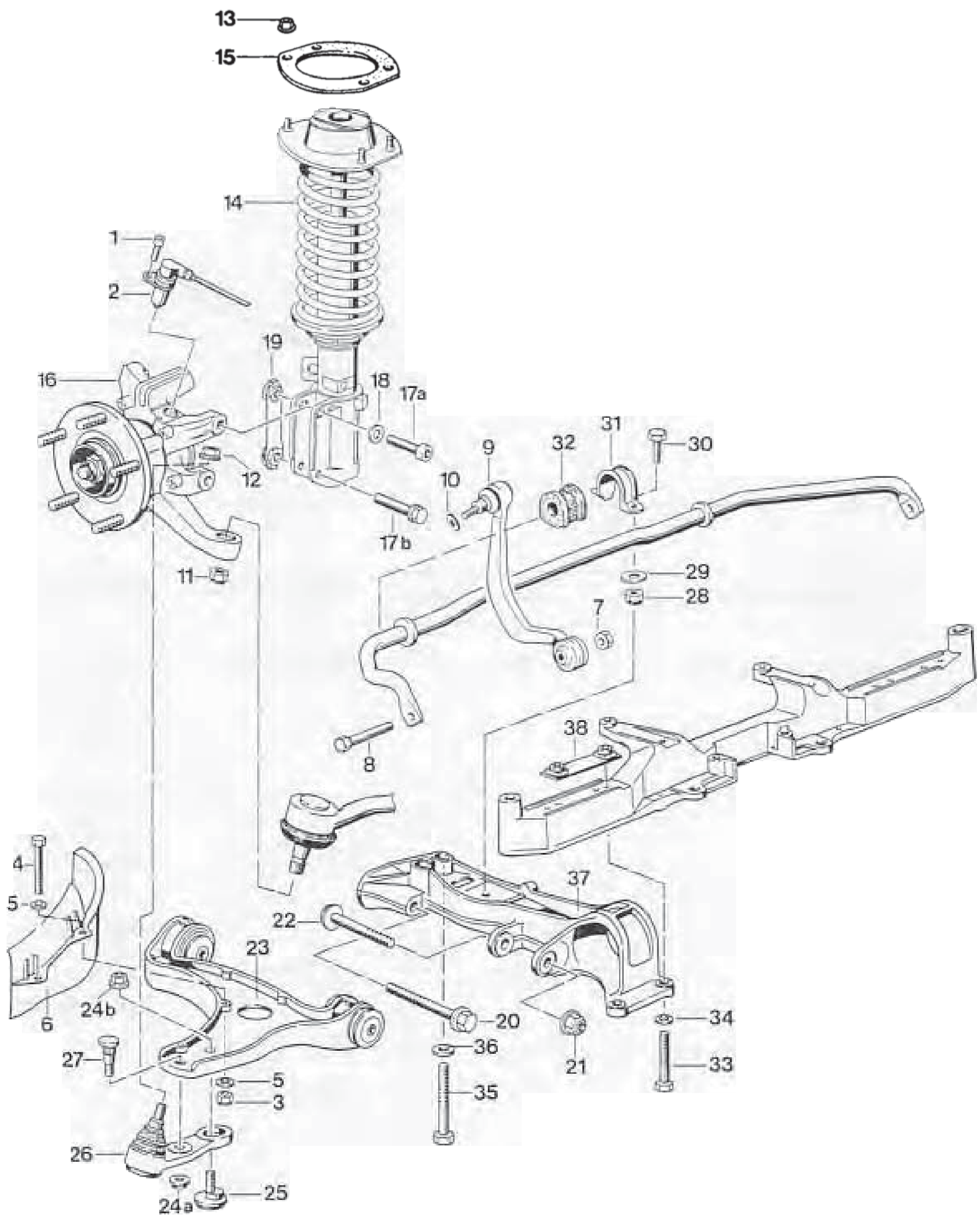
No.	Designation	Special tool	Order number	Explanation
1	Torx screwdriver	9546	000.721.954.60	To lock the ball joints (tie rod and joint carrier) during assembly and dis-assembly
2	Tie rod puller			Commercially available, e.g. Nexus 168-1 used in conjunction with 12 mm cap nut (refer to page 40-11)
3	Puller (ball joint puller)	9560	000.721.956.00	To press out the ball joint of the wheel carrier
4	Reversible ratchet	9265/1	000.721.926.51	
5	Eccentric insert	9265	000.721.926.50	

40 05 37 Dismantling and assembling suspension



No.	Designation	Qty.	Note: Removal	Installation
1	Pan-head screw	1		Tighten to 10 Nm (7 ftlb.)
2	Rpm sensor	1		Coat stem with Molykote Longterm.
3	Lock nut	2		Replace. Tighten to 10 Nm (7 ftlb.).
4	Screw	2		
5	Washer	4		
6	Air guide	1		
7	Lock nut	1		Replace. Tighten to 46 Nm (34 ftlb.).
8	Screw	1		
9	Stabilizer mount (Figure shows M 030 mount. Standard running gear = mount with 2 ball joints)	1		Observe usage acc. to spares catalog when ordering spare parts. Coat threads of ball pin (mounting on wheel carrier) with Optimoly TA. Tighten to 46 Nm (34 ftlb.).
10	Washer	1		Replace.
11	Lock nut	1		Replace. Tapers of ball joint and steering arm must be free from grease. Tighten to 75 Nm (55 ftlb.).
12	Lock nut	1	Press off ball joint of joint carrier with Special Tool 9560 after having coated puller and rubber boot of ball joint with tire assembly compound.	Replace. Tapers of ball joint and steering arm must be free from grease. Tighten to 75 Nm (55 ftlb.).
13	Collar lock nut	4		Replace. Tighten to 33 Nm (24 ftlb.).

No.	Designation	Qty.	Note: Removal	Note: Installation
14	Spring strut	1	The wheel carrier does not have to be unbolted to remove the strut, and the subsequent parts (No. 17 to No. 19) do not have to be removed either.	
15	Gasket	1		Replace.
16	Wheel carrier	1		If the wheel carrier has been removed from the strut, the wheel alignment must be checked and/or adjusted as required.
17a	Pan-head screw M 12	1		Replace.
17b	Hexagon head bolt M 14	1		Replace. Tightening torque (Nm/ftlb.): M 12 = 120 Nm (88) M 14 = 200 Nm (148)
18	Washer	1		Replace. Seating surface free from grease.
19	Cage with collar nuts	1		Replace.
20	Hexagon-head flange bolt M 12 x 1.5 10.9 120 mm long	1		Tighten to 105 Nm (77 ftlb.).
21	Collar lock nut M 12 x 1.5	1		Replace. Tighten to 85 Nm (63 ftlb.).
22	Hexagon head flange bolt M 12 x 1.5, 95 mm long	1		

No.	Designation	Qty.	Note: Removal	Installation
23	Control arm	1		If the joint carrier (No. 26) was removed from the control arm, the wheel alignment must be checked and/or adjusted as required. Caution: Right-hand and left-hand parts are different. No welding or straightening is permitted on those components. **When ordering spare parts, observe usage acc. to parts catalog to avoid confusion with 964 parts (refer to page 40-12).**
24a 24b	Lock nut M 12 Lock nut M 10	1 1	Undo only when replacing the control arm or joint carrier	Replace after removal. Tightening torque: Knurled bolt: M 12 = 140 Nm (103 ftlb.), Caster eccentric: M 10 = 80 Nm (59 ftlb.).
25	Caster eccentric	1		
26	Joint carrier (ball joint)	1		Tapers of ball joint and wheel carrier must be free from grease. Do not confuse with 964 part when ordering spare parts. Identification: **993 = olive-colored and stamped with a 993 mark**. Bore diameter of mounting at wheel carrier = **12** mm. **964 = gold-colored.** Bore diameter (mounting) = **10** mm.

No.	Designation	Qty.	Note: Removal	Installation
27	Knurled bolt	1		Install in correct position and press into the **correct control arm (LHD and RHD)**.
28	Lock nut	1		Replace. Tighten to 23 Nm (17 ftlb.).
29	Washer	1		
30	Hexagon head bolt	1		
31	Clamp	1		
32	Stabilizer support	1		Observe correct usage (acc. to spares catalog) when ordering spare parts. Assemble with tire assembly compound or Omnis 32 (supplied by DEA).
33	Hexagon head bolt M 10	2		Tighten to 46 Nm (34 ftlb.).
34	Washer	2		
35	Hexagon head bolt M 12 x 1.5	2		Tighten to 90 Nm (66 ftlb.).
36	Washer	2		
37	Side member	1		When ordering spare parts, observe usage acc. to spares catalog to avoid confusion with 964 parts (also refer to page 40-12).
38	Threaded plate	1		

Dismantling and assembly notes

Dismantling

1. Remove front wheel and underside panel

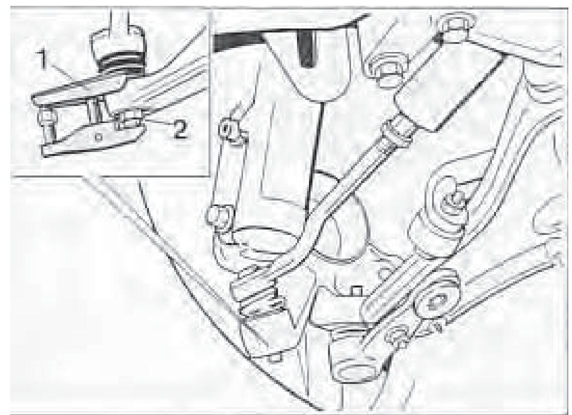
2. Open combination connector on strut and pull out connectors.
   Unclip wiring from strut. Remove rpm sensor.

3. Disconnect brake pipe from brake hose at strut and unbolt brake caliper.
   Before carrying out this operation, press down brake pedal with pedal holder to prevent brake fluid from flowing in from the reservoir.
   Cover or plug brake hose and brake pipe (to avoid ingress of dirt).
   Remove retaining spring from brake hose.

4. Remove brake cooling air duct from control arm.
   Unbolt stabilizer mount from stabilizer bar and wheel carrier.

5. Undo lock nuts from tie rod ball joint and wheel carrier ball joint.
   Use Special Tool 9546 (Torx screwdriver) to prevent rotation when undoing the lock nuts.

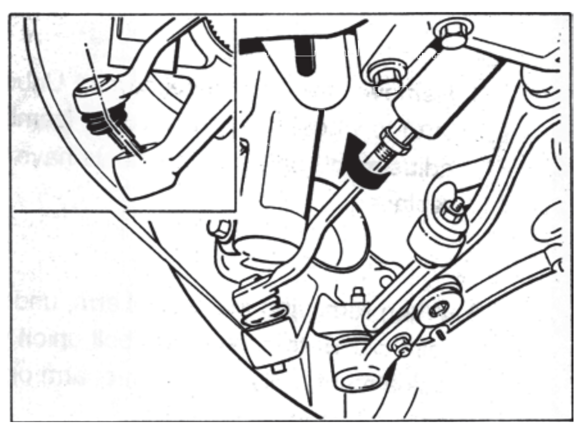
6. Press tie tod ball joint out of steering arm.
   Use corresponding puller, e.g. Nexus 168-1 (No. 1) in conjunction with 12 mm cap nut (No. 2 / of Special Tool VW 267 a).



1703-40

Note

Start by turning tie rod towards the front (arrow). Then angle off ball joint (ball pin) according to Figure and extend it this position.

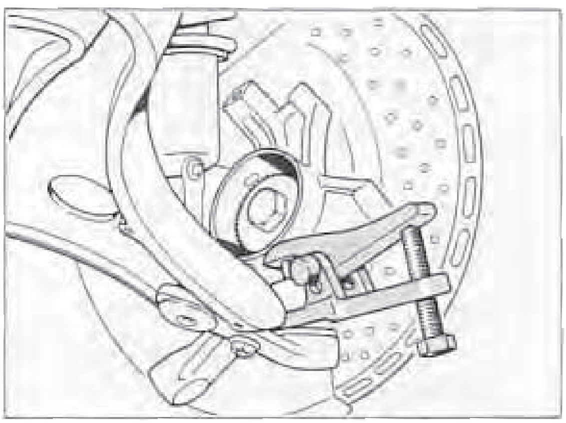


1704-40

7. Press off joint carrier (ball joint on wheel carrier) with separator (ball joint separator) **– Special Tool 9560.**

Note

To prevent the rubber boot of the ball joint from being damaged, coat rubber boot and puller with tire assembly compound in this area. Then place puller into position from the front.



1705-40

8. Remove strut and wheel carrier. Unbolt strut-to-wheel carrier bolt union (camber adjustment) only if components have to be replaced.

9. When removing the control arm, undo the joint carrier-to-control arm bolt union (caster adjustment) only if the control arm or joint carrier has to be replaced.

Assembly

1. Assemble in reverse order. Before reassembly, check all parts visually, comparing with new parts if required.
   No welding or straightening is permitted on suspension components.
   Do not grease Dacromet-type nuts and bolts (aluminum color appearance).
   Observe tightening torques.

2. To avoid confusion when replacing components (**993 and 964 parts** and, in certain cases, right-hand and left-hand parts), observe **parts usage** acc. to spares catalog. **In addition,** check parts prior to assembly referring to the identification mark / casting number or the **inscribed** part number (identification feature).

   993 parts = casting number starting with 993.
   964 parts = casting number starting with 964.

   Spare part for left-hand side :
   3rd group of part number = **odd** digit.
   Spare part for right-hand side:
   3rd group of part number = **even** digit.
   Example:
   Right-hand part (control arm) = 993. 341. **018.** 01.
   Left-hand part (control arm) = 993. 341. **017.** 01.

Note

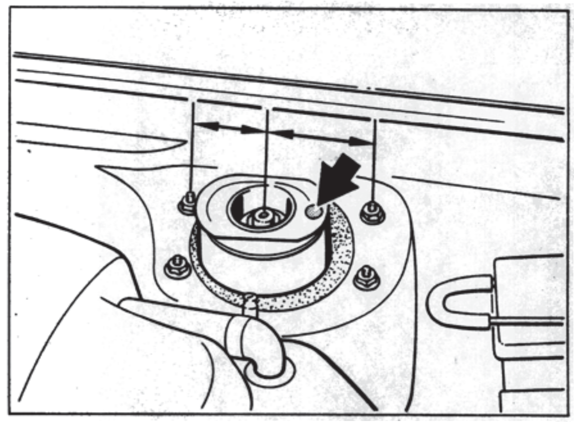
The following front-axle parts or adjacent parts differ from each other **only in minor details:**

- Side member
- Control arm with mounting bolts / mounting nut
- Joint carrier
  993 = Olive-colored. Bore diameter of wheel carrier mount = 12 mm.
  964 = Gold-colored.
  Bore diameter (mount) = 10 mm
- Stabilizer bar / stabilizer bar mount
- Vibration damper
- Tensioning disc (ABS gear)
  964 = 45 teeth
  993 = 48 teeth
- Steering gear
- Brake booster with bracket

3. When fitting the control arm, start by screwing in the control arm mounting bolts only lightly.
   Caution: Do not tighten the bolts until the vehicle rests on its wheels.

4. When tightening the lock nuts of the tie rod ball joint and the wheel carrier ball joint, use Special Tool 9546 (Torx screwdriver) to lock.

5. Install spring strut mount in correct position relative to strut dome, i.e. the red color dot (arrow) must point towards the front (strut mount is **not** symmetrical). This causes the damper piston rod to be offset towards the rear.



1706-40

6. Bleed front brake circuit.

7. After assembling components or replacing parts that affect the ride height, the suspension alignment must be checked completely (vehicle height and wheel alignment).
   When replacing parts or undoing bolt unions that affect the wheel alignment only, check and/or adjust the wheel alignment.

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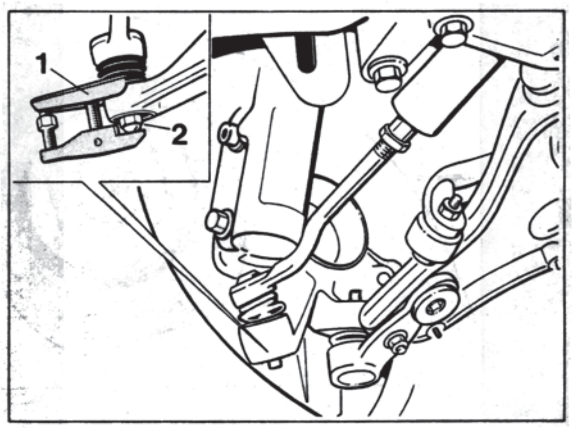
40 88 10 Replacing spring strut mount seals

1. Raise vehicle. Take off both front wheels.

2. Unscrew lock nut from tie rod ball joint. If required, use Special Tool 9546 (Torx screwdriver) to lock.

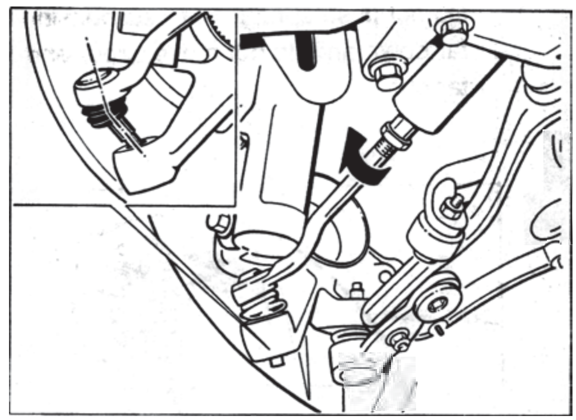
3. Press tie rod ball joint off the steering arm. Use suitable puller, e.g. Nexus 168-1 (No. 1), in conjunction with 12 mm cap nut (No. 2 / from Special Tool VW 267 a).



1703-40

Note

Start by turning tie rod forward (arrow). Then angle off ball joint (ball pin), observing drawing, and pull out in this position.



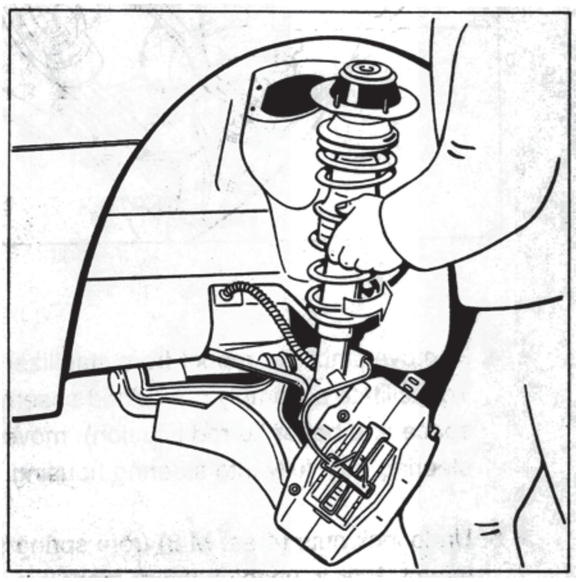
1704-40

4. Remove stabilizer mount from stabilizer bar. To facilitate assembly (for added assembly space and better tie rod position), move steering rack fully into steering housing.

5. Undo lock nuts (4 ea. M 8) from spring strut mount. Before undoing them, mark installation position of strut mount (position of four flange lock nuts).

6. Turn spring strut until the brake disc **points inside towards the rear** (arrow).
   Then press spring strut / suspension down and pivot upper end out of fender area.

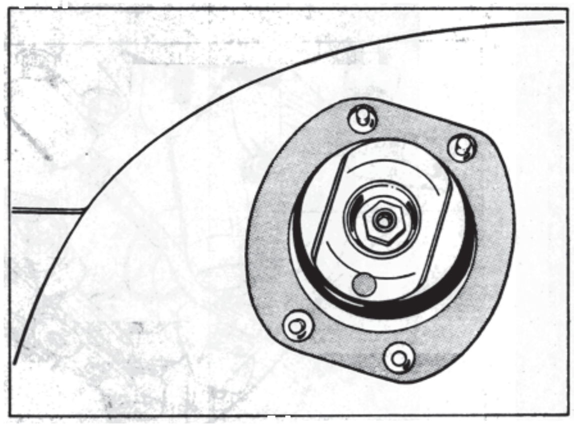
   Caution: Make sure **the brake hose** and the electrical wiring are **not** under tension (risk of damage).
   Do not push spring strut / suspension too far down and do not move upper end too far out.



1821-40

7. Remove old seal. If required, a second mechanic should help with removal.
   Remove seal residue from spring strut turret and from body panels.

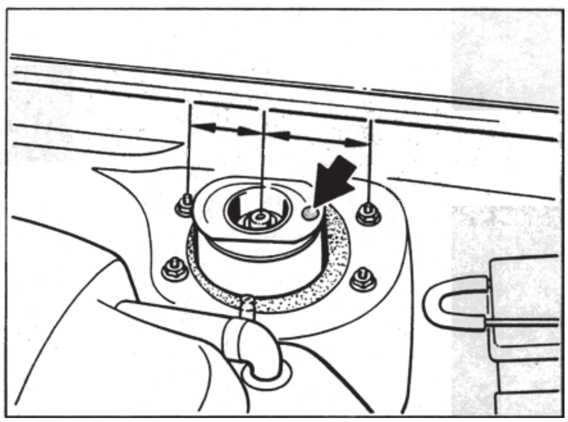
8. Bond new seal **correctly** in place:
   The threaded studs of the mount must be **centered** in the seal holes.
   If this precaution is not observed, the seal may be squeezed at the studs.



1822-40

9. Install spring strut mount to strut turret in correct position, i.e. the red color dot (arrow) must point forwards (strut mount is **not** symmetrical). This is the reason why the shock absorber piston rod is offset somewhat towards the rear.
   Use new lock nuts.
   Align spring strut with marks applied (position of four flange lock nuts) before tightening.

   Tightening torque 33 Nm (24 ftlb.).



1706-40

Note

Do not grease threads (except for wheel mounting bolts) during reassembly.

10. Repeat assembly operations (items 2 to 9) on other side of axle.

11. Fit stabilizer mount and tie rods. Replace lock nuts.
    When tightening the lock nuts of the tie rod ball joint, use Special Tool 9546 (Torx screwdriver) to lock.

    Observe tightening torques:
    Tie rod ball joint **to**
    steering arm = 75 Nm (55 ftlb.).
    Stabilizer mount **to**
    stabilizer bar = 46 Nm (34 ftlb.).

12. Fit wheels (130 Nm / 96 ftlb.)).

Note

No suspension alignment is required if the seal is replaced in accordance with the above assembly instructions as the wheel alignment values will change only to a negligeable extent. The front-axle toe setting (total setting) will only change within a maximum of 5'.

40 85 19 Removing and installing front spring strut

Removal

1. Jack up vehicle. Remove front wheel.

2. Open connector unit on spring strut and pull out connectors.
   Unclip electrical cable from spring strut.

3. Disconnect brake line on spring strut from brake hose. Before doing so, fix brake pedal in depressed position using pedal lock to prevent brake fluid from flowing from reservoir.
   Cover or close brake hose and brake line (to keep dirt out). Remove retaining spring from brake hose.

4. Release bolts connecting spring strut to wheel carrier.
   Release fastening nuts (4 x M 8) on spring strut mount and remove spring strut.

Important Note

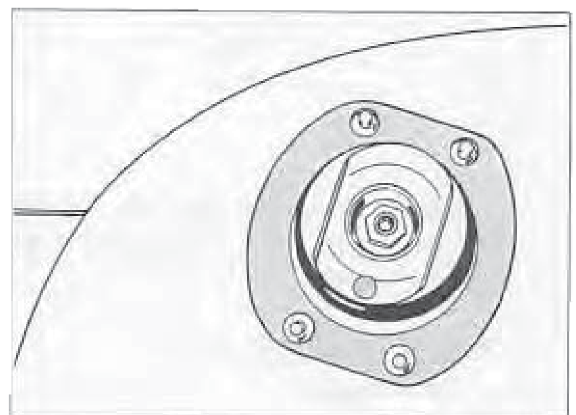
To prevent damage to the tie rod ball joint at the steering end, do not pull the suspension **too far down when** extending the strut (**do not pull down** until the stop of the tie rod ball joint is reached).
Tie suspension immediately out of the way with a piece of wire or a tie-wrap (suspend at the top) after removing the strut.

Installation

1. Observe specified tightening torque values.

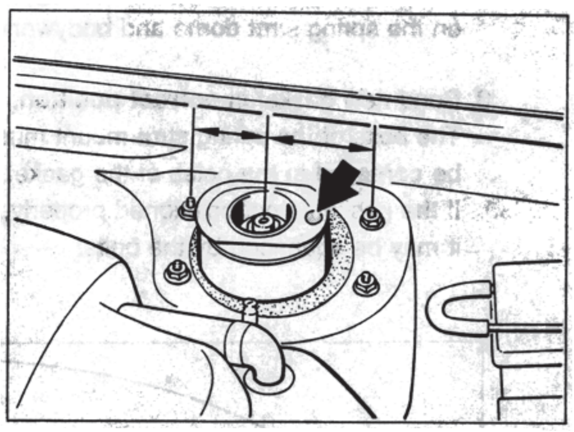
2. Check gasket for spring strut mount and replace if necessary. To do so, remove the old gasket and any remains of the gasket on the spring strut dome and bodywork.

3. Bond new gasket in **correct position.**
   The bolts of the spring strut mount must be **centered** in the holes of the gasket
   If the gasket is not positioned properly, it may be squashed by the bolts.



1822-40

4. Insert spring strut in vehicle.
   Position the spring strut mount correctly on the spring strut dome. The red dot (arrow) must point to the front (the spring strut mount is **not** symmetrical). In this position, the shock absorber piston rod is offset to the back.
   Use new fastening nuts.



1706-40

5. Replace mounting bolts and cage with fastening nuts for bolting spring strut to wheel carrier.

6. Bleed front brake circuit.
   Install wheel.

7. Check and, if necessary adjust, front axle wheel alignment values.

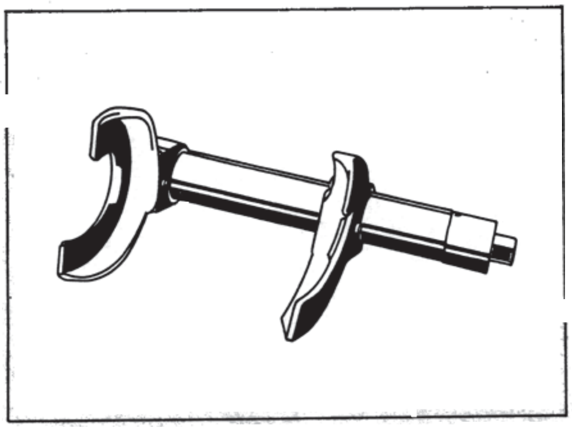
Note

In the case of assembly work or the replacement of parts which may affect the height of the vehicle, a complete suspension alignment check (vehicle height and wheel alignment) must be carried out.

40 Dismantling and assembling front spring strut

Dismantling spring strut

Compress coil spring using a coil spring compressor tool (e.g. a Klann tool) until the piston rod is unloaded.



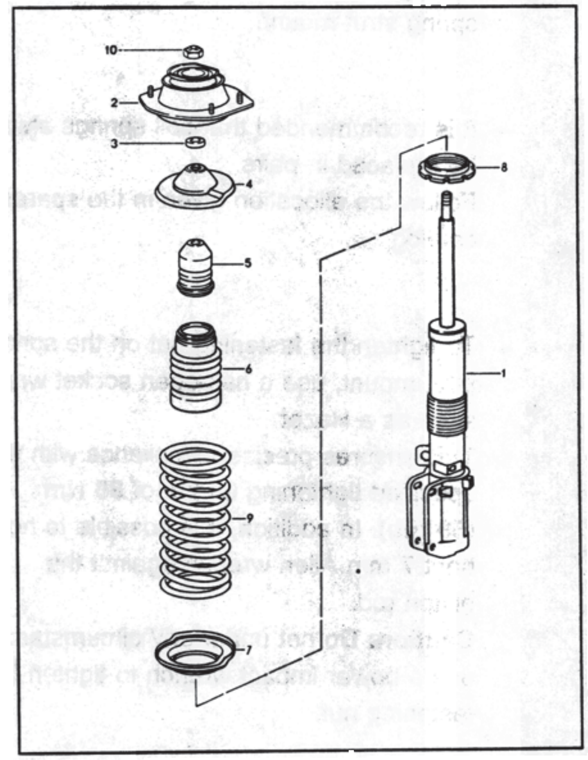
770-42

To loosen the bolting between piston rod and spring strut mount, hold a 7 mm Allen wrench against the piston rod.
Caution: Do not under any circumstances use a power impact wrench to loosen or tighten the fastening nut.

Remove all parts from the piston rod.

Note

When installing new parts, follow the allocation given in the spares catalog.



Assembling spring strut

- Use new fastening nut for attaching piston rod to spring strut mount.

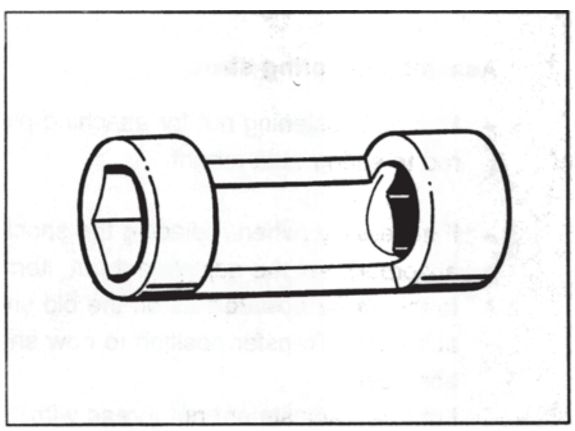
  If necessary (when replacing the shock absorber), set the adjustment nut, item 8, to the **same position** as on the old shock absorber. (Transfer position to new shock absorber).
  Lubricate adjustment nut thread with Optimoly **TA**.

  Shock absorbers of different makes must not be installed on the same axle.

In the case of progressive coil springs **the tighter winding** must point towards the spring strut mount.

– It is recommended that coil springs always be replaced in pairs.
  Follow the allocation given in the spares catalog.

To tighten the fastening nut on the spring strut mount, use a half-open socket wrench such as a Hazet
This ensures precise compliance with the specified tightening torque of **80 Nm (59 ftlb)**. In addition, it is possible to hold a bent 7 mm Allen wrench against the piston rod.
Caution: Do not under any circumstances use a power impact wrench to tighten the fastening nut.

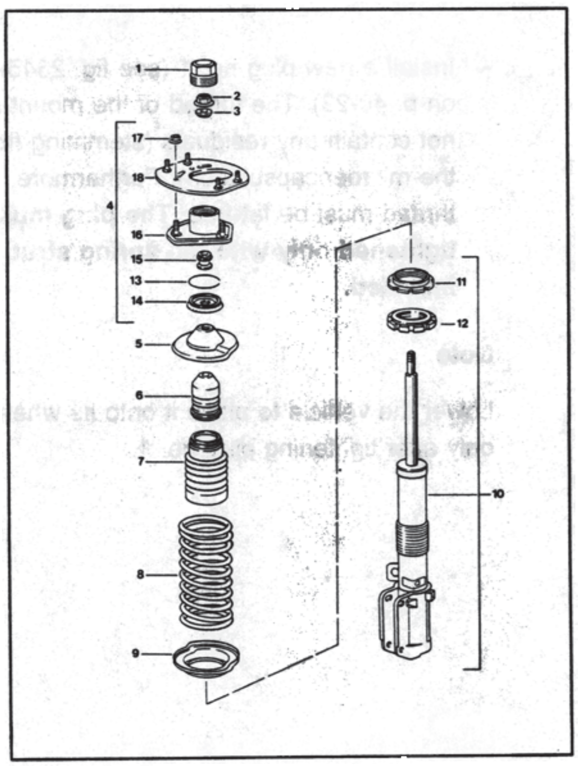


40 Carrera RS - Disassembling and assembling spring strut, front

Important note

Remove plug no. 1 with the vehicle lifted before removing the spring strut.

When replacing the vibration damper or the coil spring, do not separate the upper part and the lower part of the bracket, nos. 18 and 16, respectively, but remove the entire assembly no. 4.



2345-40

Disasembling spring strut

– To separate the connection - piston rod to spring strut mount - use a 7 mm Allen key for locking the piston rod.
  Important: Do not use an impact screw-driver to slacken and tighten fastening nut no. 2.

– To remove fastening nut no. 2 completely, preload coil spring using a spring clamp until there is no more load on the pistion rod.
  In some cases, it is possible to preload the spring coil manually (dependent on position of adjusting nut no. 11).

– Remove all parts from the piston rod.

Assembling spring strut

– **Observe parts assignment according to the spare parts catalog when installing new parts.**

– Replace nut no. 2 fastening the piston rod to the spring strut mount.

– If necessary (when replacing the vibration damper), set adjusting nut no. 11 **to the same position as on the old vibration damper (transferring adjusting dimension to the new damper)** to prevent nut no. 12 from working loose (locking). Apply Optimoly **TA** to the thread of the adjusting nut.

The narrow winding of the spring coil must face the spring strut mount.

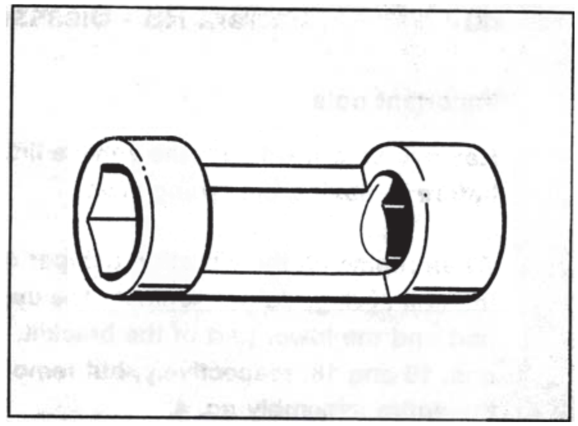
– It is recommended to replace the coil springs in pairs.
  Observe assignment in accordance with spare parts catalog.

– If necessary (when replacing the mount), fit parts no. 13 / 14 / 15 to mount no. 16 (chart 2345-40 on p. 40-23).

Note

On mounts that have run dry, the bearing cup can be greased using **Autol Top 2000**.
Manufacturer:
Autol-Werke
Paradiesstr. 14
97080 Würzburg
Germany

To tighten the fastening nut on the spring strut mount, use an open-jawed socket key insert, e.g. by Hazet.
Thus the required tightening torque of **80 Nm** can be set exactly. Furthermore, locking the piston rod using a 7 mm Allen key is possible this way.
Important: Do not use an impact screw-driver to tighten the fastening nut.



2047-40

– Install a **new** plug no. 1 (see fig. 2345-40 on p. 40-23). The thread of the mount must not contain any residuals (stemming from the microencapsulation). Furthermore, the thread must be fat-free. **The plug must be tightened only with the spring strut installed.**

Note

Lower the vehicle to place it onto its wheels only after tightening plug no. 1.

42 Tightening torques for rear axle

Caution: Do not apply grease to **Dacromet-type bolt unions** (aluminium-color appearance).

Location	Thread	Tightening torque Nm (ftlb.)
Suspension subframe/crossmember		
Subframe (side parts) to body (rubber-metal mount)	M 12 x 1.5	120 (88)
Crossmember **upper** (2 parts)		
Bolt connection to side parts	M 12 x 1.5	85 (63)
Center bolt connection of 2 sections	M 10	65 (48)
Crossmember **rear** to side parts	M 12 x 1.5	120 (88)
Crossmember **front** to side parts	M 10	65 (48)
Rear axle trailing arm		
Arm **2** (toe link)		
to wheel carrier	M 12 x 1.5	85 (63)
to crossmember (eccentric)	M 12 x 1.5	100 (74)
Arm **1/5** (lower link)		
to suspension subframe	M 12 x 1.5	85 (63)
to suspension subframe	M 14 x 1.5	200 (147)
to wheel carrier	M 12 x 1.5	75 (55)
Arm **3** (camber link)		
to wheel carrier	M 12 x 1.5	75 (55)
to suspension subframe (eccentric)	M 12 x 1.5	85 (63)
Arm **4** (caster link)		
to wheel carrier	M 12 x 1.5	75 (55)
to suspension subframe (eccentric)	M 12 x 1.5	85 (63)

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Location	Thread	Tightening torque Nm (ftlb.)
Wheel carrier		
Wheel bearing to wheel carrier	M 8	23 (17)
Rpm sensor to wheel carrier	M 6	10 (7)
Brake protection plate to wheel carrier	M 6	10 (7)
Brake disc to wheel hub	M 6	5 (4)
Brake disc to wheel carrier	M 12 x 1.5	85 (63)
Spring strut		
to body	M 8	33 (24)
to wheel carrier (arm 2)	M 12 x 1.5	85 (63)
Damper to mount (piston rod)	M 12 x 1.5	58 (43)
Cap** of spring strut mount (Carrera RS only)	M 50 x 1.5	180**
joint block /lock nut** to spring strut (Carrera RS only)	M 52 x 1.5	100***
Wheel mounting		
Wheel to wheel hub	M 14 x 1.5	130 (96)

When stocks of 8.8 bolts have been used up, only 10.9 bolts will be available.

Do not unscrew while vehicle is standing on its wheels. Use new cap after dismantling.

*** Do not unscrew. See note on page 4 - 4.

Location	Thread	Tightening torque Nm (ftlb.)
Drive shaft		
to transmission	M 10	81 (60)
to wheel hub Fastening nut	M 22 x 1.5	460 (339)
lock nut*	M 22 x 1.5	200* (147*)
Stabilizer bar		
to crossmember	M 8	23 (17)
to stabilizer mount	M 10	46 (34)
Stabilizer mount to spring strut	M 10	46 (34)

* Additional lock nut on 911 Carrera RS. Bevel on lock nut faces fastening nut.

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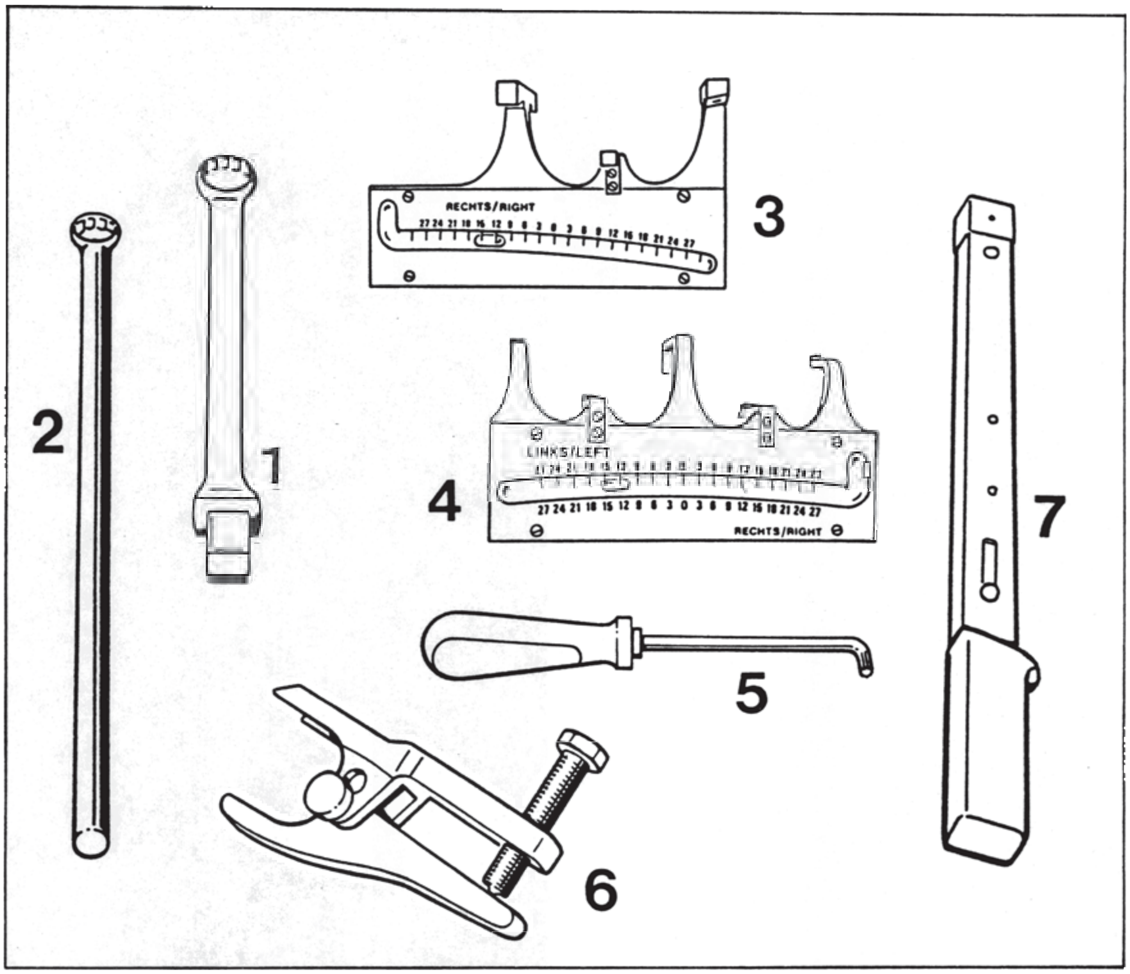
42 03 37 Dismantling and assembling suspension

Tools

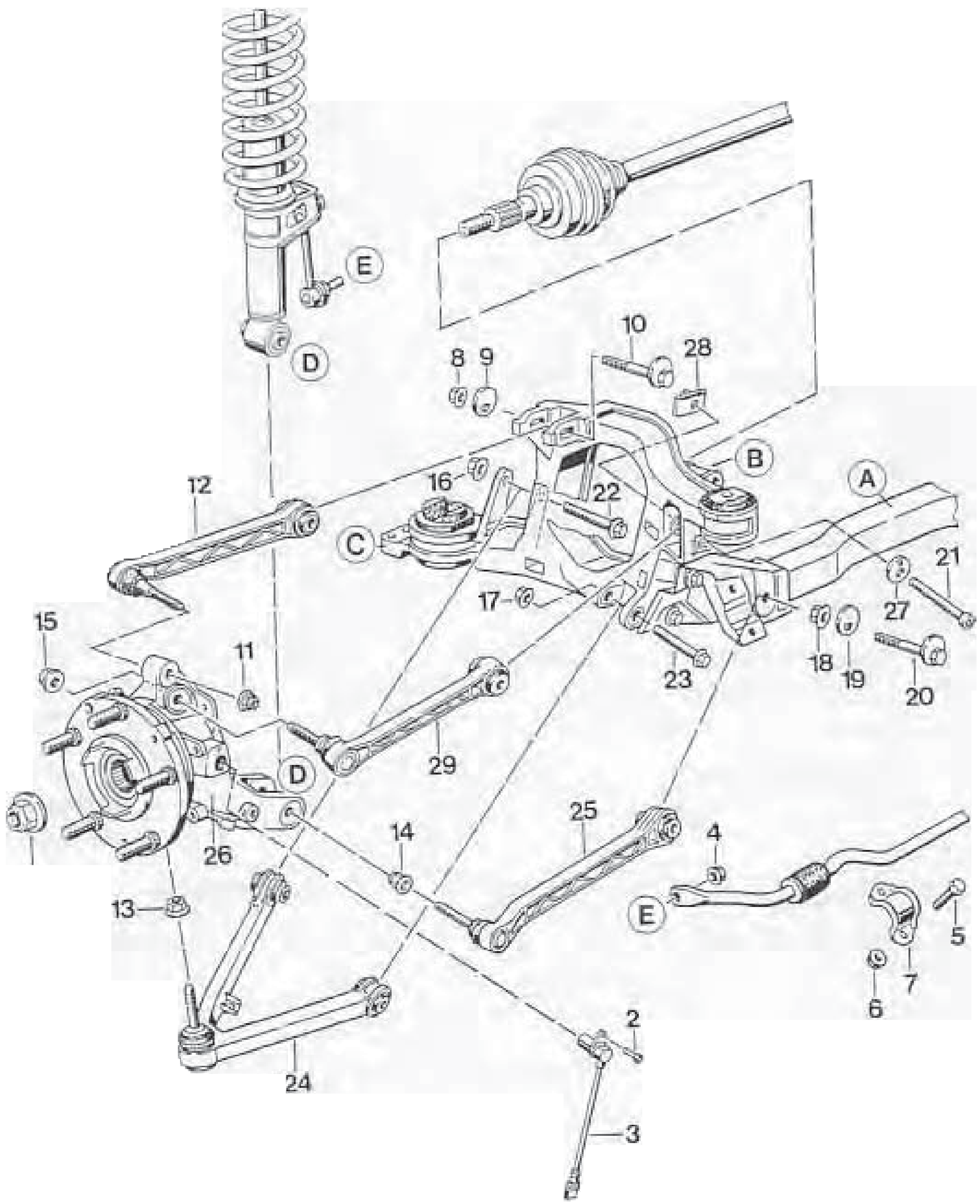


1842-42

Tools

No.	Designation	Special tool	Order No.	Explanation
1	Insert for torque wrench	9558	000.721.955.80	For rear-axle camber adjustment. Used to slacken and tighten the lock nut. **Caution:** A lock nut tightening torque of **85 Nm** (63 ftlb.) is equivalent to **approx. 65 Nm** (48 ftlb.) at the torque wrench
2	Retaining wrench	9557	000.721.955.70	Use in conjunction with Special Tool 9558. Used to lock at camber eccentric
3	Measuring tool (angle measuring tool) for kinematic change of toe-in	9549	000.721.954.90	For rear-axle control arm 1/5 (lower arm) on left and right side
4	Measuring tool (angle measuring tool) for kinematic change of toe-in	9550	000.721.955.00	For rear-axle control arm 2 (toe control arm) on left and right side
5	Torx screwdriver	9546	000.721.954.60	Used to lock the ball joints during assembly and dismantling
6	Extractor tool (Ball joint puller)	9560	000.721.956.00	Used to press out the ball joints at the wheel carrier
7	Torque wrench			Commercially availiable tool, use with No. 1. **Caution: Observe changed tightening torque when insert No. 1 is used**

Dismantling and assembling suspension



A = Rear crossmember **B / C = Upper or front crossmember mount**

To ensure clarity, the **front crossmember (C area)** and the **upper crossmember (B area)** are not marked. **These components as well as the rear crossmember (A)** do **not** have to be removed.

No.	Designation	Qty.	Note: Removal	Installation
1	Lock nut	1	Actuate the brakes when undoing the lock nut.	Replace. Coat threads, nut support face and drive shaft splines with Optimoly HT. Tighten to 460 Nm (340 ftlb.)
2	Pan-head screw	1		Tighten to 10 Nm (7 ftlb.)
3	Rpm sensor	1		Coat stem with Molykote Longterm
4	Lock nut M 10	1	Use an open-ended wrench to lock at ball joint of stabilizer mount	Replace. Tighten to 46 Nm ((34 ftlb.)
5	Hexagon head bolt	2		
6	Lock nut	2		Replace. Tighten to 23 Nm (17 ftlb.)
7	Retaining bracket	1		
8	Lock nut M 12	1	Mark position of camber eccentric (No. 10) for reinstallation before undoing the lock nut	Replace. Tightening torque 85 Nm (63 ftlb.). Also observe item 5 on page 42 - 14.
9	Eccentric washer	1		
10	Camber eccentric	1		Observe items 2 and 5 on page 42 - 13/14. Install in same position as before removal (acc. to markings)
11	Lock nut	1		Replace. Tighten to 75 Nm (55 ftlb.).
12	Control arm 3 (camber arm)	1		No welding and straightening is permitted on this component
13	Lock nut M 12	1	Start by slackening only. Observe assembly notes on page 42 - 11/12.	Replace. Tighten to 75 Nm (55 ftlb.).

No.	Designation	Qty.	Note: Removal	Installation
14	Lock nut M 12	1	Start by slackening only. Observe assembly notes on page 42 - 11/12.	Replace. Tighten to 85 Nm (63 ftlb.).
15	Lock nut M 12	1	Start by slackening only. Observe assembly notes on page 42 - 11/12.	Replace. Tighten to 75 Nm (55 ftlb.).
16	Lock nut M 14	1		Replace. Tighten to 200 Nm (147 ftlb.).
17	Lock nut M 12	1		Replace. Tighten to 85 Nm (63 ftlb.). Tighten in zero position only (page 44 - 14)
18	Lock nut M 12	1	Mark position of toe eccentric (No. 20) relative to crossmember before undoing	Replace. Tightening torque 100 Nm (74 ftlb.). Also observe item 5 on page 42 - 14.
19	Eccentric washer	1		
20	Toe eccentric	1		Observe items 2 and 5 on page 42 - 13/14. Install in same position as before removal (acc. to markings)
21	Pan-head screw M 12	1	Mark position of eccentric washer (No. 27) before undoing the screw. Start by slackening only. Observe assembly notes on page 42 - 12.	Tightening torque 85 Nm (63 ftlb.). Also observe item 5 on page 42 - 14
22	Hexagon head bolt M 14	1		
23	Hexagon head bolt M 12	1		
24	Control arm 1/5	1		No welding and straightening is permitted on this component.

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No.	Designation	Qty.	Note: Removal	Installation
25	Control arm 2 (camber arm)	1		No welding and straightening is permitted on this component.
26	Wheel carrier	1		Tapers of control arm 1/5, arm 3 and arm 4 to wheel carrier and control arm must be grease-free
27	Eccentric washer	1		Install in same position as before removal (acc. to markings).
28	Captive nut	1		
29	Control arm 4	1		No welding and straightening is permitted on this component.

Dismantling and assembly notes

Dismantling

1. Remove rear wheel, engine guard for engine/transmission and rear underbody panel.

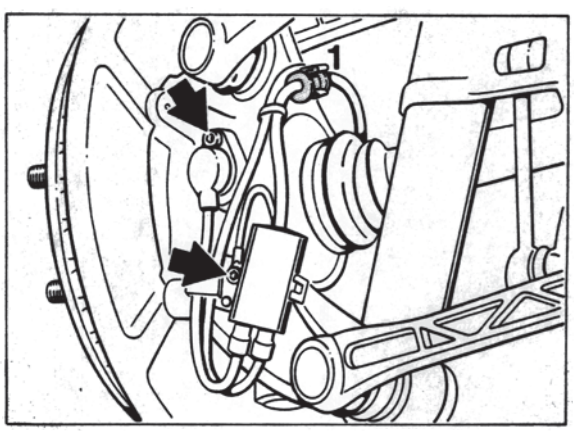
2. Undo drive shaft mounting at wheel, actuating the brakes at the same time.

Note

As considerable force is needed to move the drive shaft in the teeth of the wheel hub, push the drive shaft out of the hub using a wheel hub puller (see p. 42-17). At this stage, it is not yet possible to pull the drive shaft out completely.

3. Remove cover from control arm 1/5 (unclip).

4. Remove mounting screw from ground lead and rpm sensor combination plug (arrows) at wheel carrier.
   Unclip wires from wheel carrier (No. 1) and on handbrake cable.
   Remove rpm sensor.



1843-42

5. Remove brake caliper from wheel carrier and suspend inside wheel housing.

6. Undo stabilizer mount from stabilizer bar (lock with open-ended wrench). Remove stabilizer clamp.

Note

The stabilizer mount remains assembled to the strut. It is **not** necessary to remove the stabilizer.

7. Remove handbrake cable (observe note **before removal**).
   Procedure:

   Remove cassette box and cover above handbrake lever.

   Separate lock nut and adjustment nut (No. 1) from tie rod (No. 2) and unbolt completely.

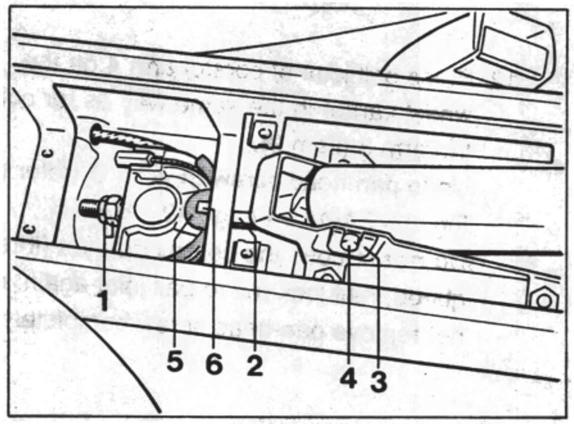
   Remove retainer (No. 3) from support pin (No. 4) of handbrake lever and remove support pin.

   Take out handbrake lever (complete with pull rod).

   Disengage tab washer (No. 5) of handbrake cables from retaining lug (No. 6) on upper and lower side.

   Disconnect corresponding handbrake cable and pull out of guide in rearward direction.

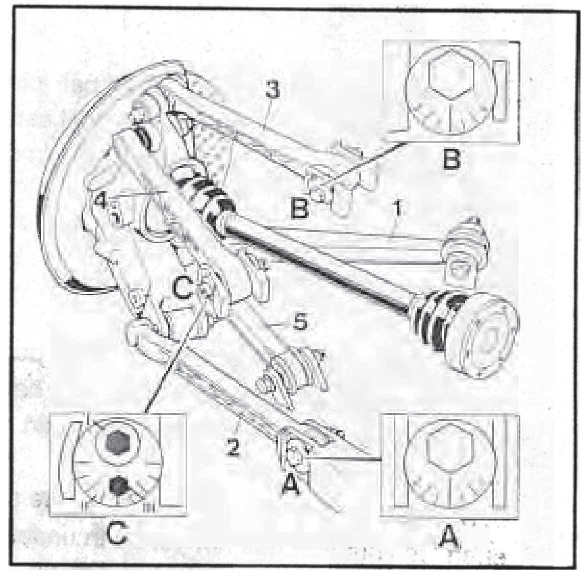
The handbrake cable may remain installed when the wheel bearing, the wheel carrier or the wheel hub is replaced.
In this case, unbolt brake disc and parking brake assembly instead.



1844-42

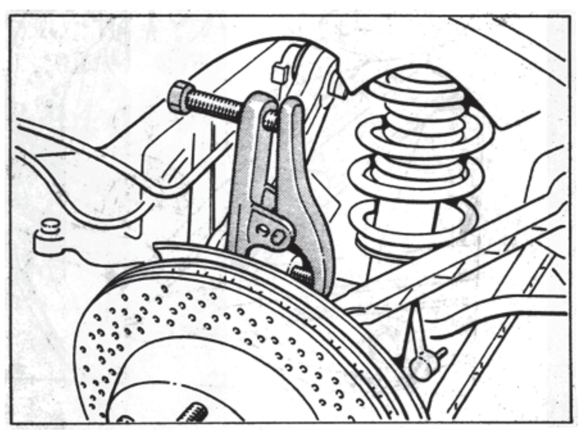
8. **Mark position** of eccentric bolts **A and B** as well as eccentric washer **C II** for reinstallation.
   Then remove eccentric **B.**

Eccentric bolts **A** and **B** are **identical.**
The eccentric bolts A and B must therefore be marked in such a way that they may be refitted to the **correct** control arm during reassembly.



1445A-44

9. Remove control arm **3**, undoing lock nut on wheel carrier and **pressing off ball joint with Special Tool 9560.**
   Then (after having removed control arm 3) **unbolt all** control arms **from wheel carrier.** (Do not yet unscrew lock nuts completely)
   When undoing the lock nuts, use Special Tool 9546 **to prevent the assembly from turning.**



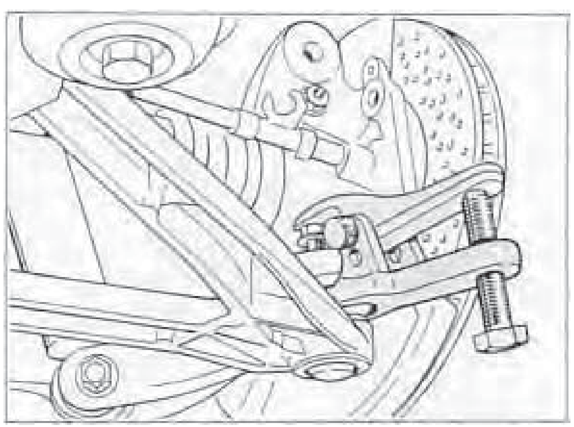
1846-42

10. Using Special Tool 9560, press ball joint off the control arm **1/5** at the wheel carrier. Then undo inner mounting (2 bolts on sub-frame).
    Do **not yet** remove the control arm.

Note

When pulling off the ball joint, increase puller force by applying a driving force (apply hammer blows to a copper drift in the ball pin area) if required.
In addition, the puller must force on the slackened lock nut that has not yet been undone completely (to protect threads and Torx).
To press off, undo lock nut only far enough to allow it to protrude slightly beyond the threads of the ball pin.

Caution: If additional driving force (copper drift) is applied to increase the puller force, check seating of steel bushing in the wheel carrier of control arm 1/5. If the seating is not correct, press or drive bushing in again until it is seated correctly (observe splines).



1847-42

11. Remove eccentric from control arm **2** (toe control arm) and pivot control arm out of crossmember in downward direction.
    The control arm remains attached to the wheel carrier / spring strut, however (lock nut is slackened).

12. Press ball joint of control arm **4** off the wheel carrier in the same way as for control arm 3 (item 9).
    Undo pan-head screw **in area C** (refer to Fig. 1445A-44 on page 42-11).
    Do **not** remove the control arm yet (if required, refit lock nut to ball joint again; do not remove pan-head screw completely).

13. Remove control arm **1/5** (lower control arm).

14. Remove control arm **2**, control arm **4** and wheel carrier.

Note

After extracting the drive shaft out of the wheel carrier, suspend it immediately in a horizontal position at the spring strut.

Assembly

1. Assemble in reverse order. Check all parts visually before assembly. If in doubt, compare with new parts.
   No welding or straightening operations are permitted on these suspension components.

2. Check condition of threads and **grade** of camber and toe eccentric.
   Specified grade: 10.9 (Initial version was 8.8 grade; observe spares catalog). The grade is indicated on the bolt head.
   Replace eccentrics if required (if threads are not o.k. or if they are to 8.8 specification).
   Transfer position marks to new eccentrics in such cases.

3. Dacromet-type bolt unions (aluminum color) must not be greased. Observe tightening torques.
   Caution: Observe item 5 when tightening the bolt unions on the subframe (page 42 - 14).

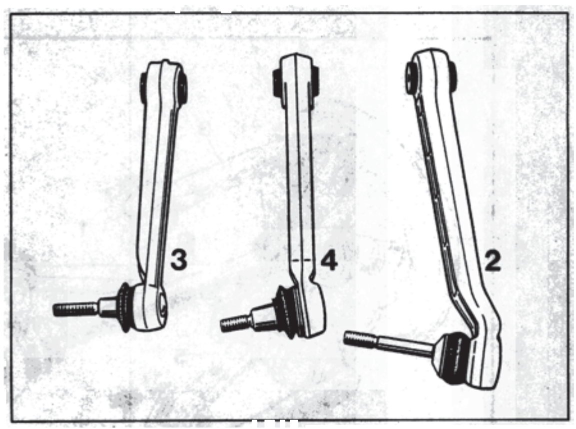
4. Control arms 2, 3 and 4 may be identified by the casting numbers or by their shape (visual inspection).

Identification marks (visual)

Control arm 2:
Longer than control arm 3 and control arm 4.

Control arm 3:
Shortest control arm. Straight shape in ball joint section.

Control arm 4:
Longer than control arm 3. Angled in ball joint section. Taper of ball joint stud is **greater** than on control arm 3.

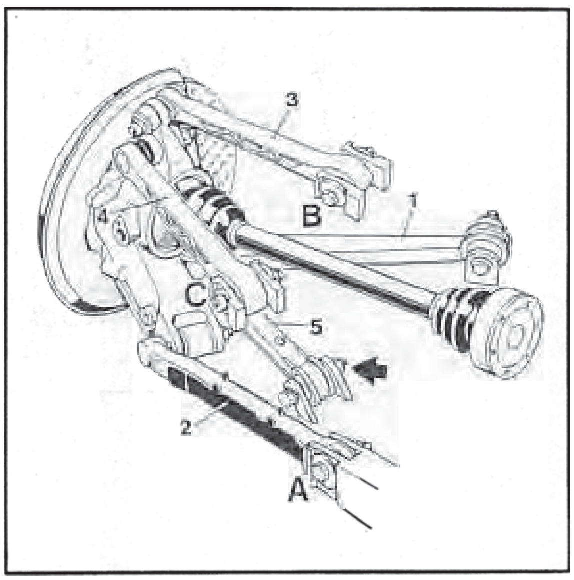


1848-42

5. Tighten bolts in **A / B / C sections** and bolt of **control arm 5** (arrow) **in center position**. The bolts in the **A, B, C** area should at this stage only be tightened to approx. 80% of the specified torque (as they must be undone again for suspension alignment). **Zero position:** Control arm 2 and the rear crossmember must form a horizontal line. To establish the **zero position,** raise wheel carrier with general-purpose jack.

Note

The above bolts may also be tightened after the vehicle is placed on its wheels and has been jounced several times by approx. 25 mm.



1845-42

6. Fit handbrake cable or refit parking brake assembly and brake disc. Adjust parking brake (page 46-13).

7. Carry out suspension alignment (wheel settings). Be sure to observe correct **adjustment sequence** (page 44 - 13).

8. Install cover of control arm 1/5 and the respective underbody panels.

42 21 19 Removing and installing drive shaft (manual transmission)

Important notes

With regard to drive shaft installation and removal, there are considerable differences in the configuration between transmission types and the sides of the vehicle. Separate descriptions are therefore given for:

the **left** drive shaft of manual transmission vehicles = vehicle on wheels

the **right** drive shaft of manual transmission vehicles = partial dismantling of suspension

the drive shafts of Tiptronic vehicles = partial dismantling of suspension
See description from page 42 - 17.

Removing and installing left drive shaft

1. Drive vehicle onto **drive-on ramp** or measurement platform.

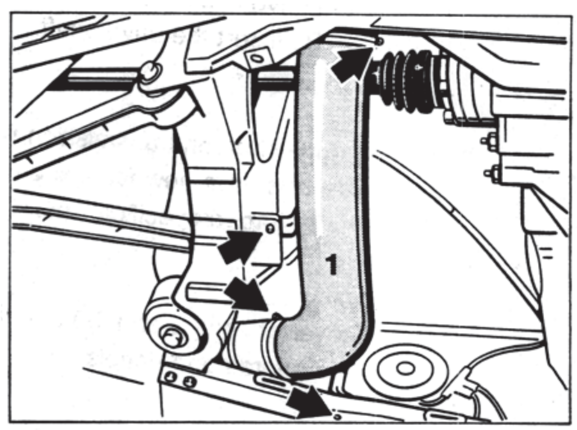
2. Remove hup cap. Loosen drive shaft from wheel. When doing so, also apply the brakes.
   Caution: After loosening the drive shaft, you must not drive or move the vehicle. Otherwise, the wheel bearing may be damaged.

Note

As considerable force is needed to move the drive shaft in the teeth of the wheel hub, loosen the drive shaft using a copper drift.
With **unfavorable** tolerances, it may be necessary to push the drive shaft out of the hub
using a wheel hub puller (e.g. a Klann or Schrem tool) (see p. 42-17).
On the 911 Turbo, a ventilation tube is inserted in the joint on the wheel.
To prevent damage to the ventilation pipe when pressing the drive shaft out of the wheel hub, insert a pressure piece, e.g. VW 295A, between the puller spindle and the drive shaft.
Note: At this stage, it is **not yet possible** to pull the drive shaft out completely.

3. Remove engine guard from engine/transmission and rear underside panel. Remove cover from control arm 1/5 (unclip).

4. Remove heating pipe (no. 1).



2082-42

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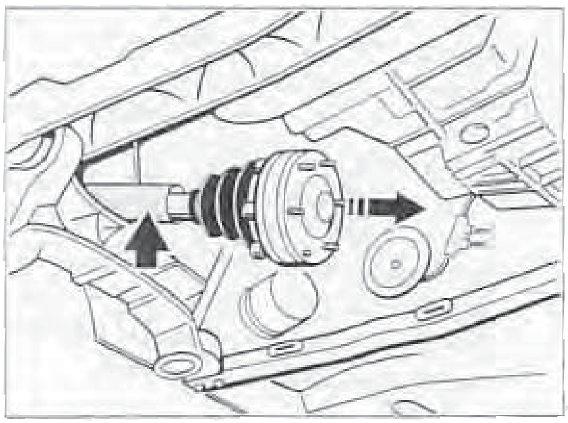
5. To prevent damage to the drive shaft, place a protective tube on the drive shaft (arrow). Unbolt drive shaft from transmission flange (pan head screws) and pull out drive shaft. If necessary, pull the vehicle down slightly onto the springs to pull the drive shaft out.



2083-42

6. To install the drive shaft, proceed in reverse order. Carry out a visual inspection of all parts before starting installation. Grease the drive shaft teeth with Optimoly HT. Insert the drive shaft.

7. Tighten drive shaft on transmission flange and wheel hub. Use new fastening nut. Comply with torque specifications.

8. Install cover of control arm 1/5 and the underside guards and panels.

Removing and installing right drive shaft

The procedure is the same as for Tiptronic vehicles.
See description from page 42-17.

42 21 19 Removing and installing drive shaft (vehicles with Tiptronic)

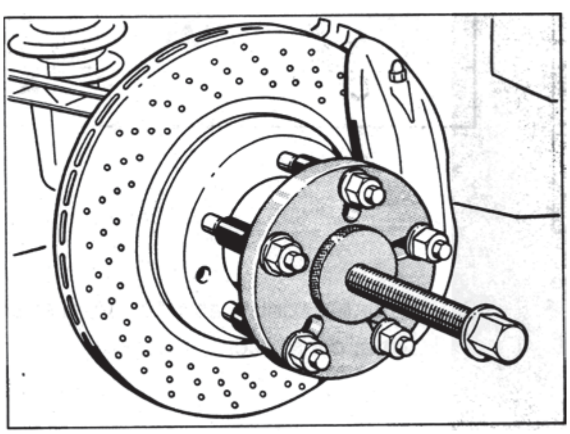
Removal

1. Remove rear wheel, engine guard from engine/transmission and rear underside panel.

2. Loosen drive shaft from wheel. When doing so, also apply the brakes.

Note

As considerable force is needed to move the drive shaft in the teeth of the wheel hub, loosen the drive shaft using a copper drift.
With unfavorable tolerances, it may be necessary to push the drive shaft out of the hub using a wheel hub puller (e.g. a Klann or Schrem tool).
On the 911 Turbo, a ventilation tube is inserted in the joint on the wheel.
To prevent damage to the ventilation pipe when pressing the drive shaft out of the wheel hub, insert a pressure piece, e.g. VW 295A, between the puller spindle and the drive shaft.
Note: At this stage, it is **not yet possible** to pull the drive shaft out completely.

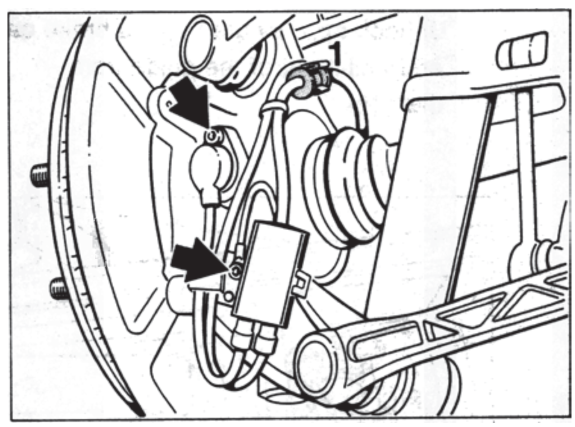


2084-42

3. Remove cover from control arm 1/5 (unclip). Remove heating pipe.

Before removing the right drive shaft, disconnect holder from oil line (M6 screw) on transmission. Pull oil line slightly down when removing and inserting drive shaft.

4. Release fastening screws of connector unit/grounding cable and speed sensor from wheel carrier (arrow). Unclip lines from wheel carrier (no. 1) and parking brake cable. Remove speed sensor.



1843-42

5. Remove brake caliper from wheel carrier and hang it up in wheel arch.

6. Disconnect stabilizer mount from stabilizer (holding open jaw wrench against bolt).
   Remove stabilizer clamp.

Note

The stabilizer mount must remain attached to the spring strut. The stabilizer must **not** be removed.

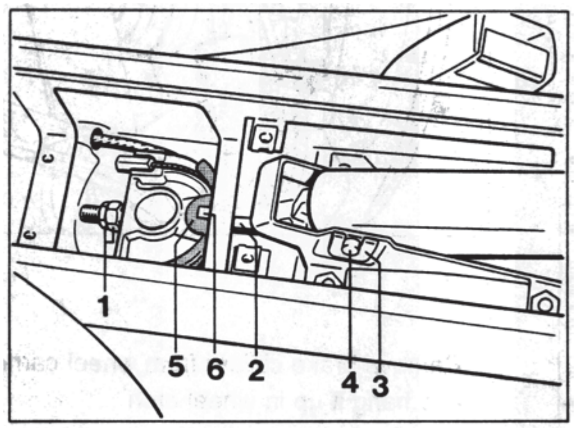
7. Dismantle parking brake cable.
   To do so:
   - Remove cassette box and trim panel above parking brake lever.
   - Loosen and completely unscrew lock nut and adjustment nut (No. 1) from arm (No. 2).

   Remove safety clip (No. 3) from support pin (No. 4) of parking brake lever and remove support pin.

   - Remove parking brake lever (with arm)

   - Unhook tab washer (no. 5) for parking brake cables from retaining lug (No. 6) - at top and bottom.

   - Unhook appropriate parking brake cable and pull it out of the guide from the back.

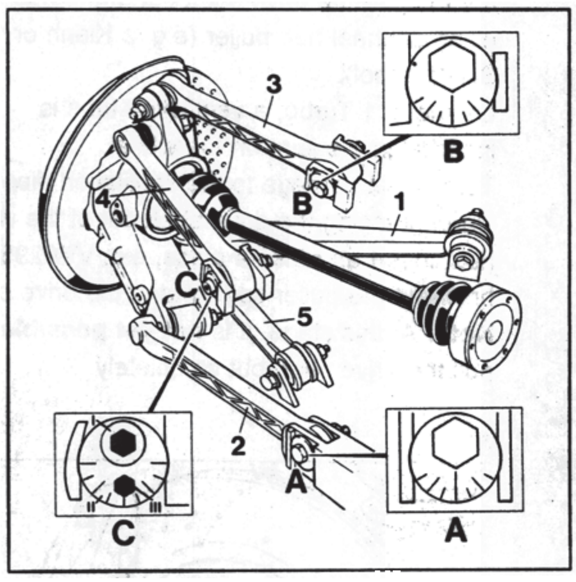


1844-42

8. **Remove** control arm **2** (toe control arm).
   Caution: Before loosening the bolts, **mark** the position of eccentric bolt **A** for installation, so that a complete **measurement of vehicle alignment is not necessary.**
   When loosening the ball joint, hold a Torx screwdriver (special tool 9546) against the wheel carrier.

Note

If necessary for removing **control arm 2** from the wheel carrier/spring strut eye, lift the wheel carrier slightly using a universal jack.



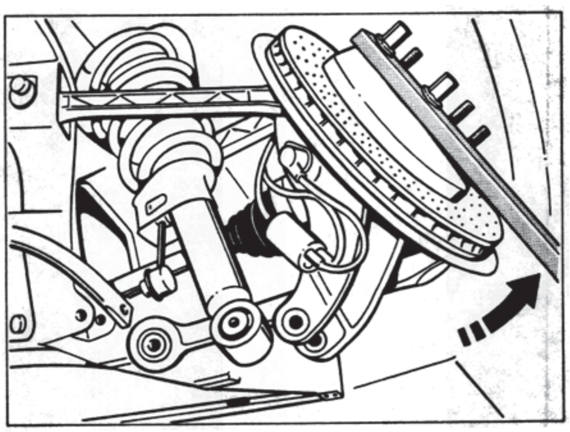
9. Disconnect control arm **1/5** from subframe (internal connection / 2 screws).

10. Unscrew pan head screws of drive shaft from transmission flange.

Note

To prevent damage to the drive shaft, place a protective tube on the drive shaft.

11. Mount a suitable lever on the wheel hub. Using the lever, lift the wheel carrier and swing it out at the bottom. Pull out the drive shaft in this position (2nd mechanic required).
    Depending on tolerances, it may also be necessary to turn the wheel carrier in the direction of toe-in with the lever.



2085-42

Installation

1. To install the drive shaft, proceed in reverse order. Carry out a visual inspection of all parts before starting installation.
   Grease the drive shaft teeth with Optimoly HT. First step:
   Insert the drive shaft.

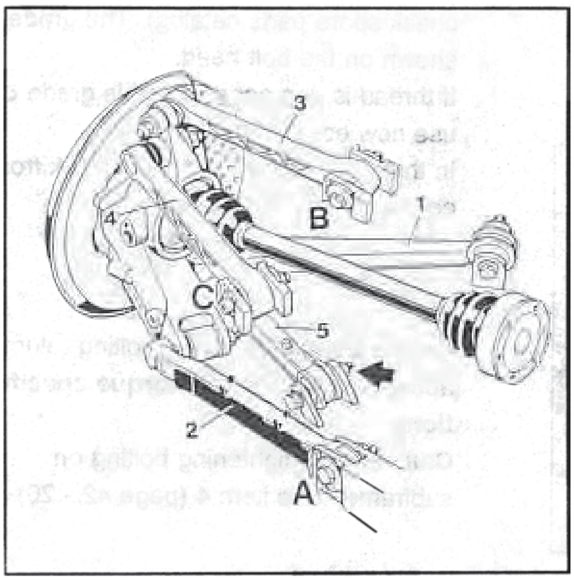
2. Check thread condition and **grade** of eccentric bolt.
   Required grade 10.9 (grade first used 8.8 / check spare parts catalog). The grade is shown on the bolt head.
   If thread is damaged or bolt is grade 8.8, use new eccentric bolt.
   In this case, transfer position mark from old eccentric bolt to new bolt.

3. Do not grease Dacromet bolting (aluminum appearance). **Observe torque specifications.**
   Caution: For tightening bolting on subframe, note item 4 (page 42 - 20).

4. Tighten bolts in area **A** (eccentric bolt) and bolt of control arm **5** in **reference position**). **Reference position:** Control arm 2 and the rear cross member must form a horizontal line. To establish **reference position,** lift wheel carrier with universal jack.

Note

The bolts mentioned above can also be tightened when the vehicle is on its wheels and has been pushed up and down about 25 mm a few times.



5. Install parking brake cable and adjust parking brake (p. 46-13). Install brake caliper.

6. Tighten drive shaft on transmission flange and wheel hub. Use new fastening nut.

7. Install cover of control arm 1/5 and the underside guards and panels.

Note

If drive shafts are installed and removed in accordance with these instructions, alignment measurements are not necessary as there are only minor changes in wheel alignment. The max. change in toe-in per rear wheel is 5'.

42 71 19 Removing and installing rear spring strut

Removal

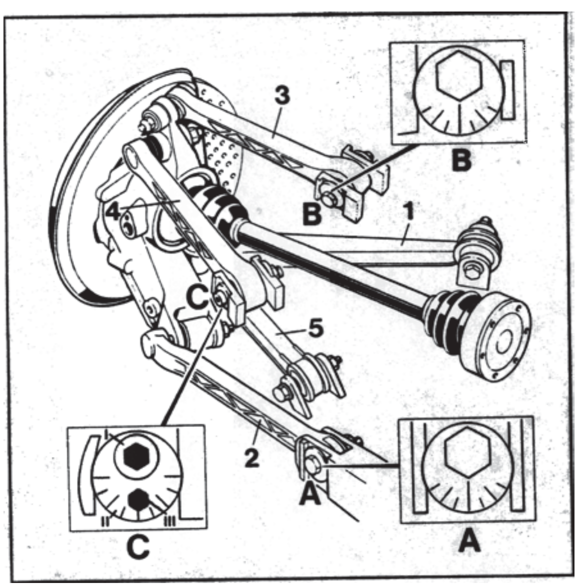
1. Remove rear wheel, engine guard from engine/transmission and rear underside panel.

2. Disconnect stabilizer mount from stabilizer (holding open jaw wrench against bolt). The stabilizer mount must remain attached to the spring strut. Remove stabilizer clamp.

3. Loosen control arm **2** (toe control arm) (do not remove it completely at this state. **Procedure:**

 Mark the position of eccentric bolt **A** (eccentric toe bolt) for installation. **Then** swing the eccentric bolt and control arm 2 out of the cross member from below.

 Loosen control arm 2 from wheel carrier (do not remove control arm yet. When loosening the fastening nut hold Torx screwdriver (special tool 9546) against the ball joint bolt.

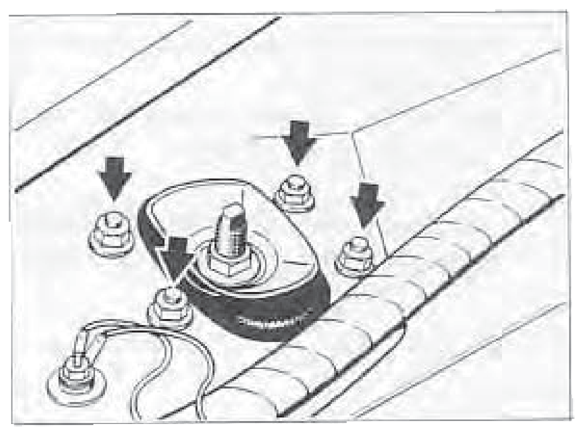


1445A-44

4. To prevent damage to the drive shaft, place a protective tube on the drive shaft (the drive shaft may rest on the subframe (rear axle side part) after removal of the spring strut).

5. To remove the left spring strut, first remove the heater blower. To remove the right spring strut, first remove the air filter.

6. Release M 8 fastening nuts (4 in all) from spring strut mount.



2086-42

7. Now remove control arm **2** completely and pull spring strut out of spring strut dome.

Installation

1. Do not grease bolts or screws. Observe torque specifications.

2. Mount spring strut on body. Use new fastening nut. Precise compliance with the specified tightening torque of 33 Nm (24.5 ftlb) is essential.

3. Install heating blower or air filter.

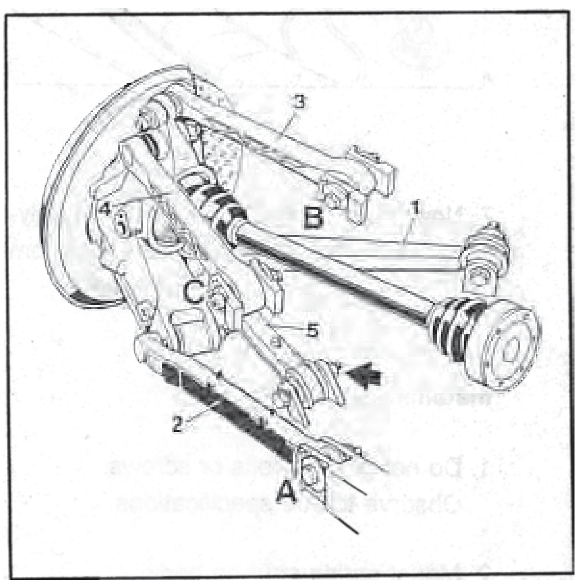
4. Mount spring strut on wheel carrier.
   (Insert control arm 2).

5. Install **control arm 2** on cross member.

Note

Before installing control arm 2 on cross member, check thread condition and **grade** of eccentric bolt. **Required grade 10.9** (grade first used 8.8 / check spare parts catalog). The grade is shown on the bolt head. If thread is damaged or bolt is grade 8.8, use new eccentric bolt..
In this case, transfer position mark from old eccentric bolt to new bolt.

Caution: Before tightening the eccentric bolt (area A), read the following instructions.



1845-42

6. Tighten eccentric bolt (area A) in **reference position**.
   Reference position: Control arm 2 and the rear cross member must form a horizontal line.
   To establish **reference position,** lift wheel carrier with universal jack.

Note

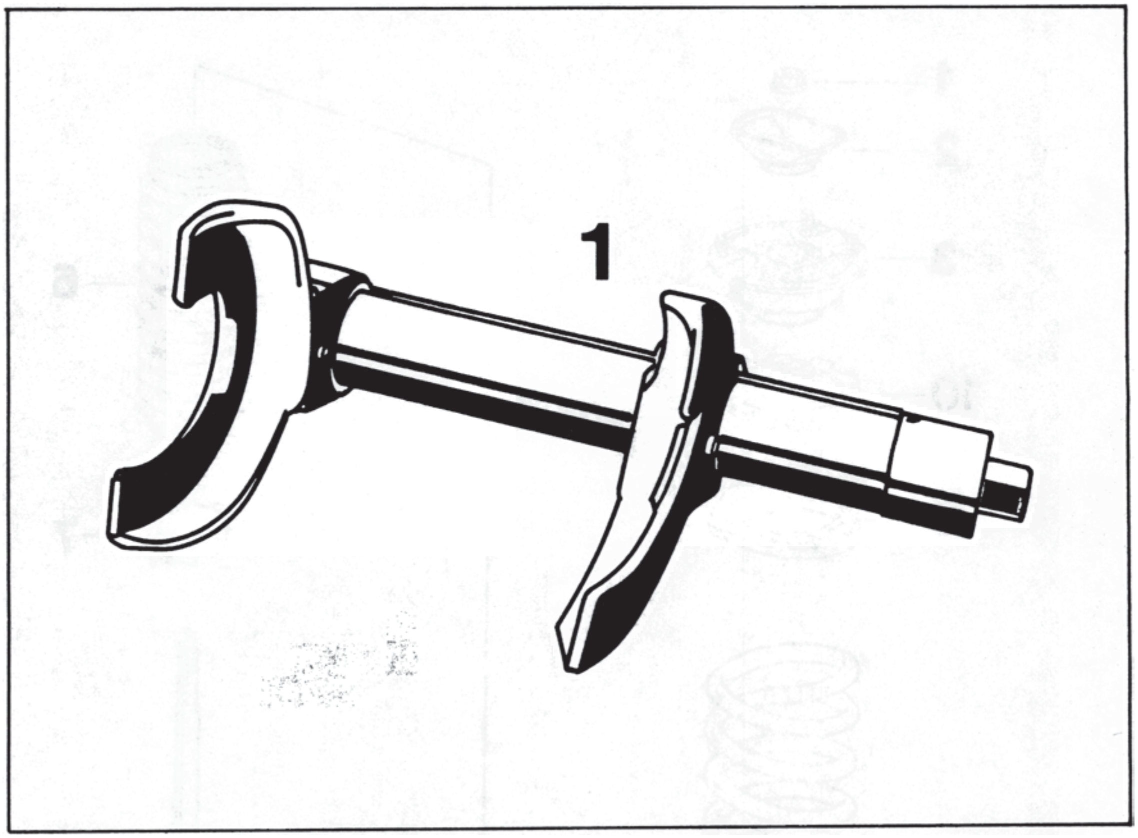
The eccentric bolt can also be tightened when the vehicle is on its wheels and has been pushed up and down about 25 mm a few times.

7. Following the installation of new parts which affect vehicle height, a suspension alignment check must be made.

8. Install underside guards and panels.

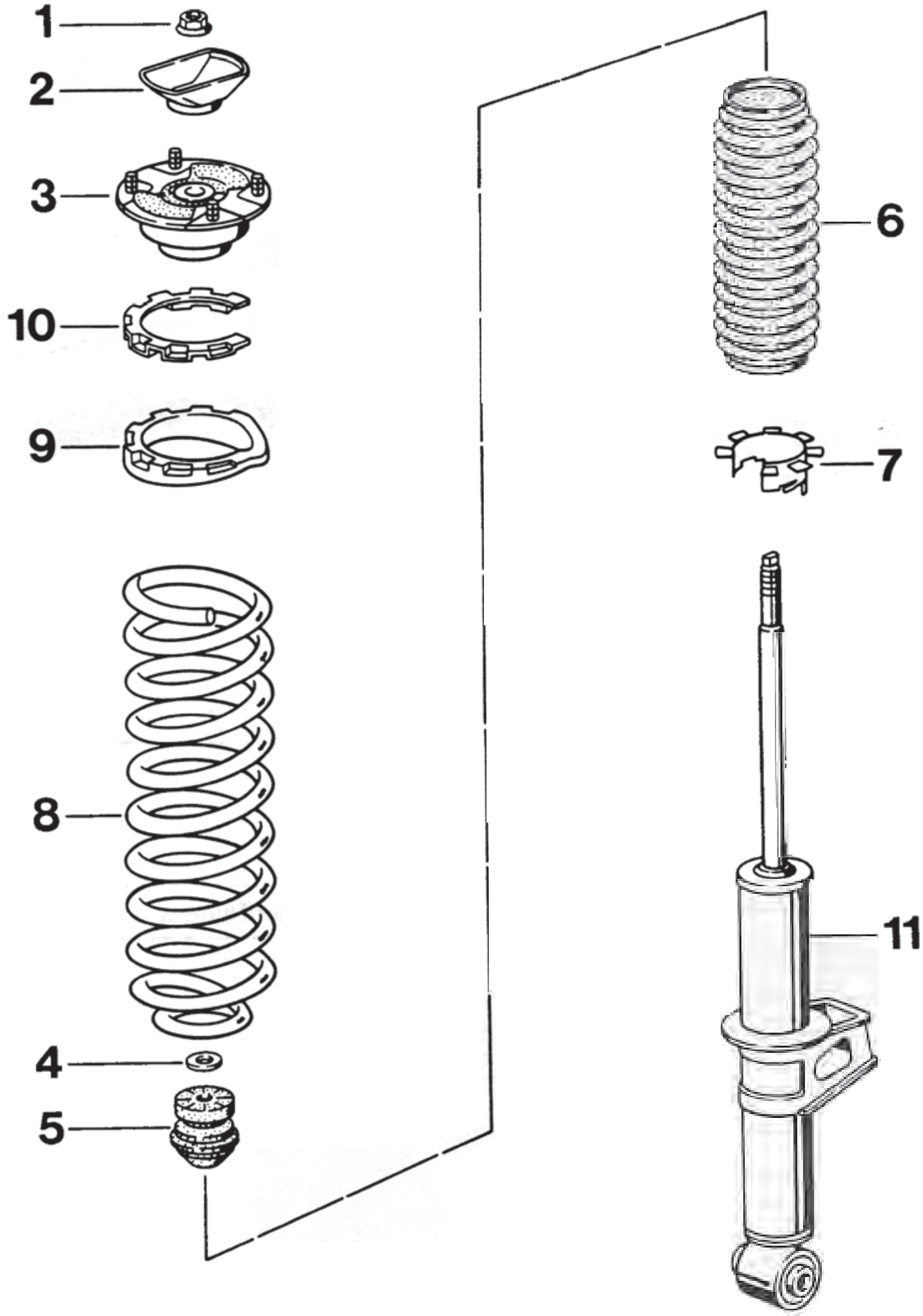
42 Dismantling and assembling rear spring strut

Tools



No.	Designation	Special tool	Order Number	Explanation
1	Spring compressor tool e.g. Klann tool			proprietary

42 Dismantling and assembling rear spring strut



No.	Designation	Qty.	Note: Removal	Installation
1	Fastening nut M 12 x 1.5	1	Before loosening fastening nut, compress coil spring using coil spring compressor tool. When loosening nut, hold wrench against piston rod.	Use new fastening nut. Tighten to 58 Nm. **Firstly,** position shock absorber eye correctly relative to spring strut mount (No. 3). (Page 42-30).
2	Stop plate	1		Install in correct position (3 recesses).
3	Spring strut mount	1	Remove complete assembly (mount with intermediate section (7) and spring support (9)).	Mounts for left and right sides are identical. Mounts are marked R=right and L=left for positioning (see p. 42-30).
4	Washer	1		
5	Helper spring	1		Mount on bellows (6).
6	Bellows	1		
7	Mount (support clip)	1		Install in correct position (p. 42-29). First, position the coil spring on the shock absorber.
8	Coil spring	1		Observe allocation in spares catalog.
9	Spring support	1		

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No.	Designation	Qty.	Note: Removal	Installation
10	Intermediate section	1		Observe allocation (p. 24-27). Install in correct position with spring support (p.42-28).
11	Shock absorber	1		Observe allocation in spares catalog. For difference between right and left part see p. 42-28.

Notes on assembly and dismantling

Dismantling

Compress coil spring using a coil spring compressor tool until the piston rod is unloaded.

To loosen the bolting between piston rod and spring strut mount, hold a 7 mm open-end wrench against the piston rod. **Caution:** Do not under any circumstances use a power impact wrench to loosen or tighten the fastening nut.

Remove all parts from the piston rod.

Note

When installing new parts, follow the allocation given in the spares catalog.

Preparatory work and notes on assembly

- Use new fastening nut when attaching piston rod to spring strut mount.

  Vibration dampers of different makes must not be installed on the same axle.

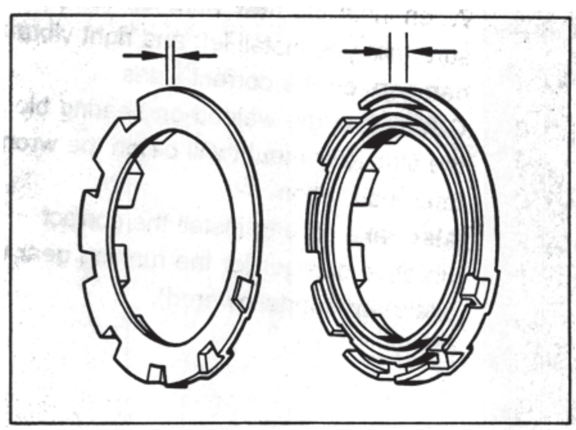
- It is recommended that coil springs always be replaced in pairs.

Note

If new coil springs are installed, it may be necessary to use a different intermediate section.
Intermediate sections with the following thicknesses are available:
3.0 mm, 5.5 mm and 8 mm.

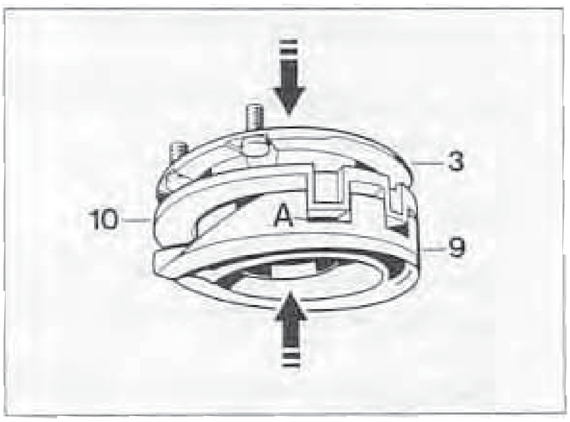
Select the intermediate section in accordance with the tolerance group of the coil spring (color coding/colored lines on spring).

1 line = 8.0 mm intermediate section
2 lines = 5.5 mm intermediate section
3 lines = 3.0 mm intermediate section



2087-42

Press intermediate section (10) into the correct position in the spring support (9) and install spring strut mount (3).
In the correct position, no recess (A) on the spring support must be left vacant.



2089-42

Install bellows on helper spring.

- Position **vibration damper** at eye in vise (use protective jaws).

Note

When installing new vibration dampers, make sure that you install left and right vibration dampers on the correct sides.
Otherwise, the welded-on bearing block for the stabilizer mount will be on the wrong side after installation.
Also take care to install the correct vibration damper for the running gear version (standard/sports/lowered).

Distinguishing features of left and right vibration damper

Spare part for left side -
odd third group in part number

Spare part for right side -
even third group in part number

Example

Part no. for left vibration damper:
993.333.051.00

Part no. for right vibration damper:
993.333.**052**.00

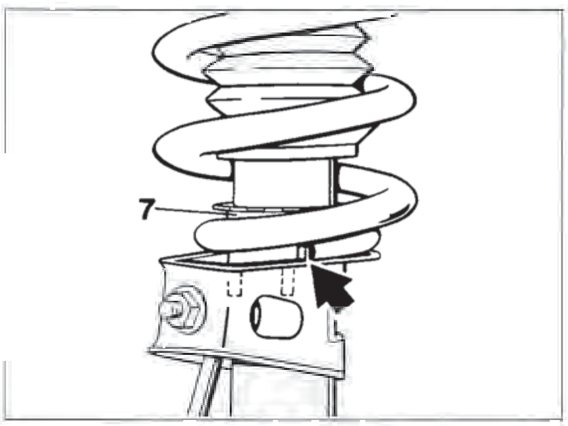
- Compress coil spring using coil spring compressor tool.

Assembly

Position end of coil spring on vibration damper stop (arrow).

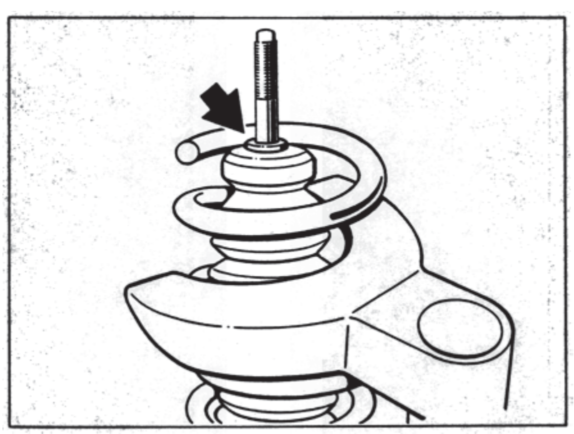
Press support clip (7) through bottom winding of spring, taking care that the two tabs are in the correct position.

Push helper spring/bellows assembly onto piston rod.



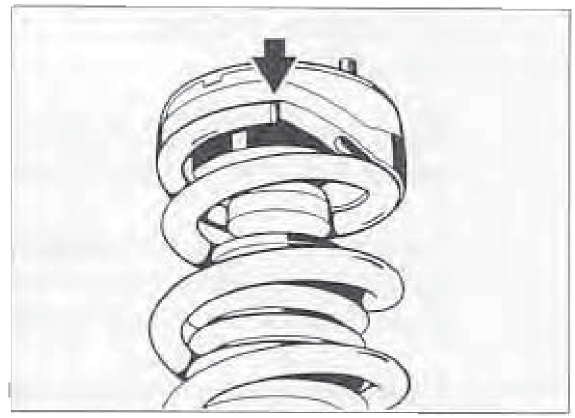
2090-42

Push washer (arrow) onto piston rod up to stop.



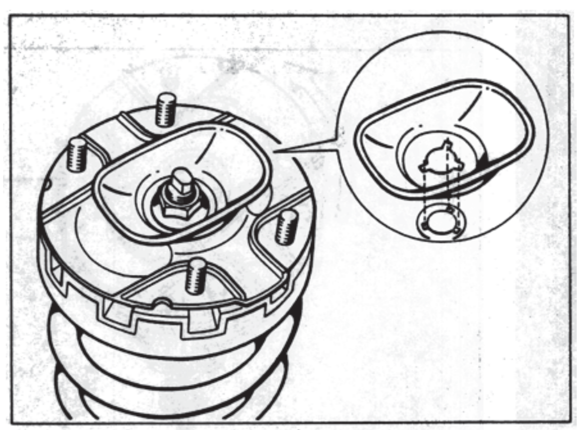
2091-42

– Position spring strut mount (mount/intermediate section/spring support assembly) on piston rod in such a way that the end of the coil spring touches the stop on the spring support (arrow).



2092-42

– Position stop plate correctly (three recesses) on spring strut mount. Tighten fastening nut (use new part) onto piston rod **until about 1 or 2 turns of the thread** can still be seen above the nut.



2093-42

– **Position spring strut mount as follows** (position spring strut mount correctly relative to shock absorber eye).

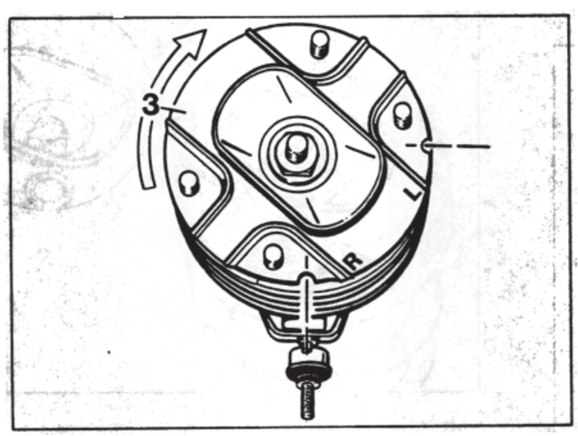
The left and right spring strut mounts are identical. There are therefore **two** markings on the mounts, **R (Right)** and **L (Left)**.

Before positioning, check whether you are positioning a left or right shock absorber.

The **right mount** is correctly positioned if the marking **R (Right)** is in line with the center of the stabilizer mount ball joint bolt.

The **left mount** is correctly positioned if the marking **L (Left)** is in line with the center of the stabilizer mount ball joint bolt.

To position the mount, turn it to the right. Turn the mounting bolt using a suitable lever.
Caution: Only turn it to the right (clockwise) and only turn the spring strut mount. Do not under any circumstances turn the spring support.



2094-42

– After the spring strut mount has been positioned correctly and the coil spring is in contact with the stops, tighten the fastening nut. To tighten the fastening nut, hold a 7 mm open-end wrench against the piston rod.
Tightening torque: 58 Nm, (43 ftlb.).
Caution: Do not under any circumstances use a power impact wrench to tighten the fastening nut.

42 Carrera RS - Disassembling and assembling spring strut, rear

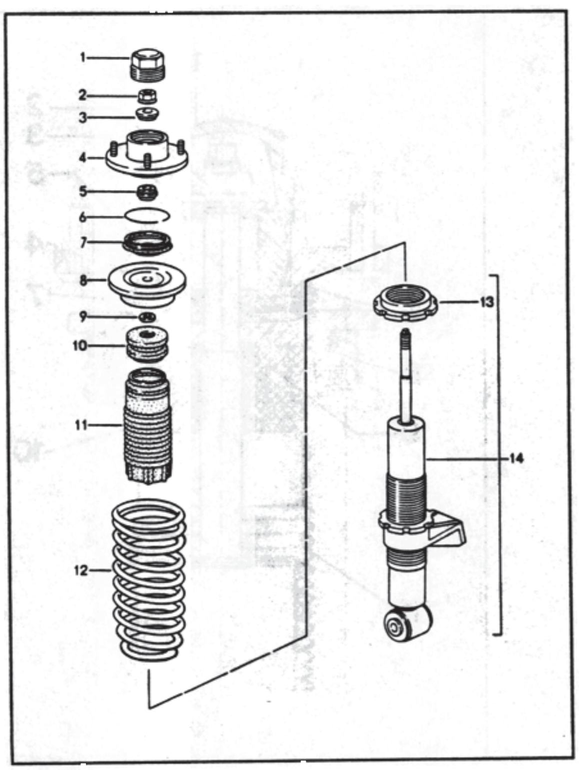
Disassembling

Remove plug no. 1 using the **modified** special tool VW 457 (see note on page 42-33).

- Preload coil spring using a spring tensioning device – e.g. by Klann –, until there is no load on the piston rod.

To separate the connection - piston rod to spring strut mount - use a 7 mm open-jawed wrench for locking the piston rod. **Important:** Do not use an impact screw-driver to slacken and tighten fastening nut no. 2.

Remove all parts from the piston rod.



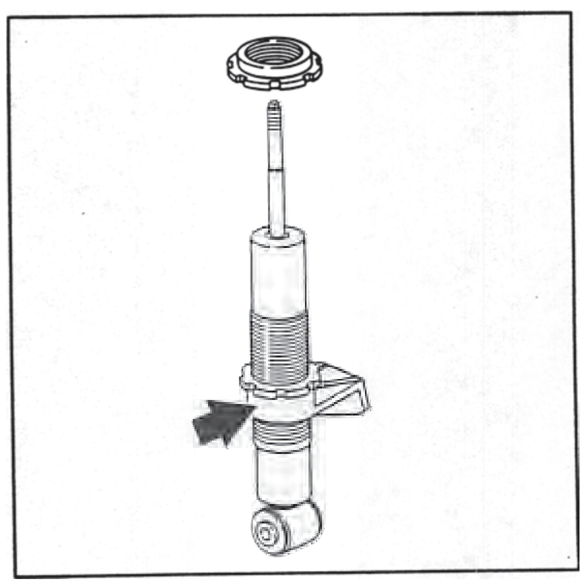
2346-42

Preliminary work and assembly notes

- Observe parts assignment according to the spare parts catalog when installing new parts.
- Replace fastening nut no. 2 (ribbed collar nut).
- It is recommended to replace the coil springs in pairs.
- When replacing the vibration damper, set nut no. 11 for height adjustment **to the same position** as on the old vibration damper (transferring adjusting dimension to the new damper).
  Apply Optimoly **TA** to the thread of the adjusting nut.

Note

On spare dampers, the stabilizer mount (arrow) is pre-set. For adjusting dimensions and notes see page 4 - 4.



2346/1-42

- Fit protective bellow to additional spring.

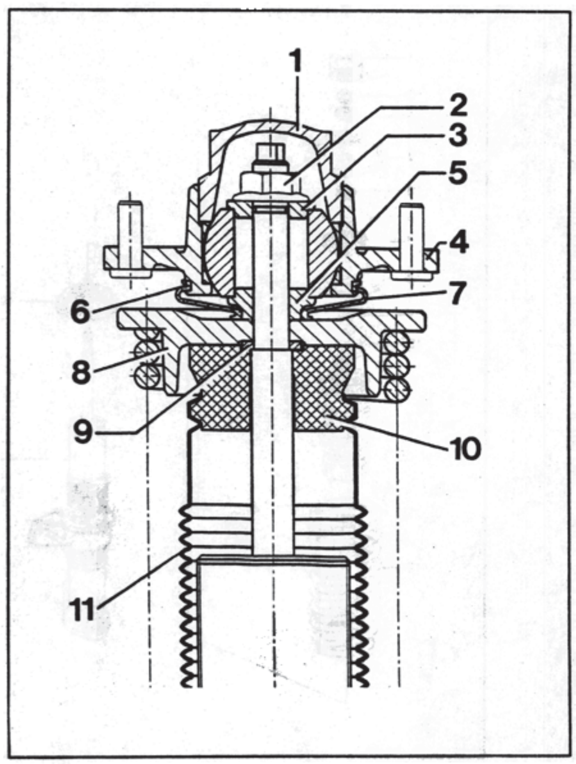
Mount shock absorber eye onto a vise to clamp **vibration damper** (use protective jaws).

Preload coil spring using spring tensioning device.

On mounts that have run dry, the bearing cup can be greased using Autol Top 2000.
Manufacturer:
Autol-Werke
Paradiesstr. 14
97080 Würzburg
Germany

Assembling

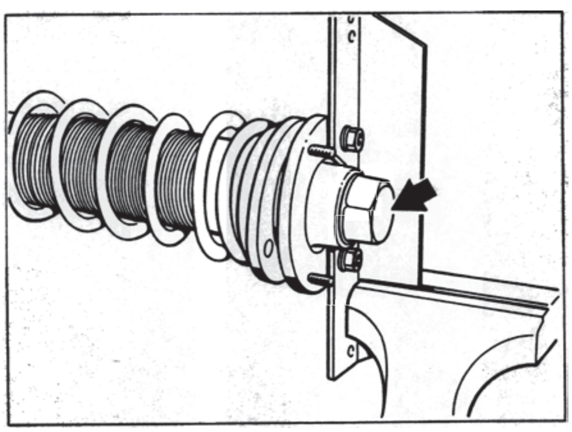
- Push the assembly consisting of protective tube and additional spring onto the piston rod.
- Push shim no. 9 onto the piston rod up to the stopper.
- Fit coil spring to vibration damper.
  The narrow winding of the spring coil must face the spring strut mount.
  Fit spring retainer no. 8 to the end of the coil spring.
- Fit spring strut mount (assembly of mount no. 4 / spacer sleeve no. 5 / bellows no. 7 / retainer spring no. 6) to the piston rod.
  Imporant: Observe installation position of spacer sleeve no. 5.



2350-42

- Fit spacer sleeve no. 3 **in correct position**. Turn **new** fastening nut (collar nut) on the piston rod. Use a 7 mm open-jawed wrench for locking the piston rod when tightening the fastening nut.
  Tightening torque 58 Nm.
  Important: Do not use an impact screw-driver to tighten the fastening nut.

- **Install new plug (arrow).**
  The thread of the mount must not contain any residuals (stemming from the microencapsulation). Furthermore, the thread must be fat-free. To tighten the plug with a tightening torque of 180 Nm, screw the modified special tool VW 457 to the spring strut mount, then load the special tool on a vise.
  The modifications to the special tool are described at the end of this page.

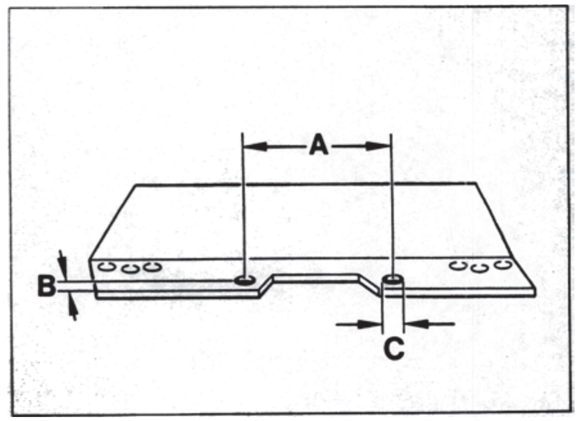


2374-42

- Position the **spring strut mount for installation** (observe correct position of the spring strut mount relative to the shock absorber eye).
  Important: Do not damage the bellows no. 7 when turning the mount. If necessary, turn the bellows as well when turning the mount.

Modifications to special tool VW 457

To modify the special tool, **drill two holes** into a take-up rail applying the following dimensions.



2375-42

A = 83.15 mm

B = 10 mm

C = 8.5 mm Ø

44 Wheels and tires

Tire condition / tire pressure

Tires are safety-relevant items that are only capable of meeting the requirements imposed if they are run at the correct tire pressure and with sufficient tread depth.

The tire pressures indicated are minimum pressures. The tires must never be run at lower pressures since this affects roadholding adversely and may lead to severe tire damage.

Valve caps protect the valve against dust and dirt and therefore help prevent leaks. Always screw on caps tightly and replace missing caps.

For safety reasons, do not limit tire checks to checking the tire pressure but also check for sufficient tread depth, ingress of foreign objects, pinholes, cuts, tears and bulges in the sidewall (cord breakage)!

Tire pressure of cold tires (approx. 20° C.)

911 Carrera / 911 Carrera S / 911 Carrera 4 and 911 Carrera 4S (Turbo-Look)

16-inch wheels
(Summer tires and winter tires)

front	2.5 bar excess pressure
rear	3.0 bar excess pressure

17-inch wheels
(Summer tires and winter tires)

front	2.5 bar excess pressure
rear	2.5 bar excess pressure

Collapsible spare tire

front/rear	2.5 bar excess pressure

911 Carrera RS (M 002 / M 003)

M 002 = basic version /
M 003 = Clubsport version

Summer and winter tires

(Winter tires = 17-inch wheels
summer tires = 18-inch wheels)

front	2.5 bar
rear	3.0 bar

Folding spare wheel

front / rear	2.5 bar

Tire and wheel survey

For a tire and wheel survey for summer and winter tires, refer to the relevant Technical Information (TI), Group 4.
When replacing summer tires, you must ensure that the specification number is correct. The specification no. N2, N1 or N0 distinguishes summer tires which have been specially approved by Porsche from other tires of the same type and size.

Notes on tire fitting

When fitting tires, make sure that they are installed in the correct dircetion, i.e. with the inside facing inwards etc.

Mounting wheel on vehicle

See page 44-24.
Tighten to 130 Nm (96 ftlb)

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44 Suspension alignment settings

The following specifictions refer to the curb weight to DIN 70020. This means: Full fuel tank, spare tire and tools in vehicle.

Differing settings for U.S. vehicles are given in brackets.

Carrera RS versions: M002 = basic version / M003 = Clubsport version
Information on alignment of the Carrera RS: Page 44 - 19 ff.

Vehicle height

		RoW: Standard (USA: Standard)	RoW: Sport (USA: Sport)	Carrera S /4S RoW (Carrera S /4S USA	Carrera RS M002/M003
Front-axle height From road contact surface to outer hexagon head bolt of "cross member to body" mounting (as on 964) Fig. – Measuring point p. 44-12	mm	154 ± 10 (174 ± 10)	144 ± 10 (174 ± 10)	144 ± 10 (174± 10)	124 ± 10
Max. left-to-right difference	mm	5	5	5	5
Rear-axle height from road contact surface to rear mating face of bottom of subframe Fig. – Measuring point p. 44-12	mm	147 ± 10 (157 ± 10)	127 ± 10 (157 ± 10)	127 ± 10 157 ± 10)	107 ± 10
Max. left-to-right difference	mm	5	5	5	5
Max. front axle to rear axle height difference (also refer to p. 44-11 in General section)	mm	10	10	10	10
Max. left-to-right wheel load difference on front and rear axle	kg	20	20	20	20

Suspension values

The following specifications refer to the curb weight to DIN 70020. This means: Fuel tank full, spare wheel and tools in vehicle.

Differing settings for U.S. vehicles are given in brackets.

Carrera RS versions: M002 = basic version / M003 = Clubsport version
Information on alignment of the Carrera RS: Page 44 - 19 ff.

Front axle

	RoW: Standard (USA: Standard)	RoW: Sport (USA: Sport)	Carrera S / 4S RoW (Carrera S/ 4S USA)	Carrera RS M002/M003
Toe, unpressed (total)	+ 5' ± 5'	+ 5' ± 5'	+ 5' ± 5'	+ 5' ± 5'
Toe difference angle at 20° steering lock	− 1° ± 30' (− 40' ± 30')	− 1° 45' ± 30' (− 40' ± 30')	− 1°45' ± 30' (− 40' ± 30')	− 1°27' ± 30'
Camber (with wheels in straight-ahead position)	− 20' ± 10'	− 20' ± 10'	− 20' ± 10'	− 1° ± 10'
max. left-to-right difference	10'	10'	10'	10'
Caster*	5°20' + 15' − 30'	5°20' + 15' − 30'	5°20' + 15' − 30'	5°20' + 15' − 30'
max. left-to-right difference	15'	15'	15'	15'

Try to achieve the specified caster setting (5°20')

Suspension alignment settings

The following specifications refer to the curb weight to DIN 70020. This means: Fuel tank full, spare wheel and tools in vehicle.

Differing settings for U.S. vehicles are given in brackets.

Carrera Rs versions: M002 = basic version / M003 = Clubsport version
Information on alignment of the Carrera RS: Page 44 - 19 ff.

Rear axle

	RoW: Standard (USA: Standard)	RoW: Sport (USA: Sport)	Carrera S / 4S RoW (Carrera S / 4S USA)	Carrera RS M002/M003
Toe per wheel	+ 10' ± 5'**	+ 10' ± 5'**	+ 10' ± 5'	+ 15' ± 5'***
max. left-to-right difference	10'	10'	10'	10'
Camber	– 1° 10' ± 15'**	– 1°10' ± 15'	– 1°10' ± 15'	–1°20' ± 10'
max. left-to-right difference	20'	20'	20'	20'
Kinematic toe-in change max. difference between steering arm angle 2 and steering arm angle 5	1.5 SKE*	1.5 SKE*	1,5 SKE*	1,5 SKE*

* SKE = scale unit. Measure and read off in center of bubble level.

** Changed values are also retroactive in effect (as of start of series).
Previous values: toe setting per wheel = + 15' ± 5' / camber = – 55' ± 15'

***The ideal value (+ 15' per wheel) should be aimed for.

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44 Measuring card

Important notes

Since electronic wheel alignment equipment combined with printers is used virtually in all workshops today, a sample measuring card is hardly ever required anymore.

To allow the measuring results to be documented in specific isolated cases, a copy of the measuring card shown on page 44 - 6a may be used.

The measuring cards can be used for all 911 vehicles from model '94, including 911Carrera (993), 911 Carrera 4 (993), 911 Turbo (993) and 911 Carrera RS (993).

The following fact should therefore be observed during operation:

Measuring cards cannot be ordered for the 911 Carrera (993), **model '94 onward**

Make a copy of the measuring card shown on page 44 - 6a.

Before making measurements, enter general data, vehicle version and the missing specifications (page 44 - 3 to 44 - 5) in the copied measuring card.
Actual values that are identical for all versions have already been entered into this card.

Make **as-received measurement** (actual condition) and enter readings into the measuring cards.

After adjustment (if required), enter actual values into the **Measurement as delivered** column.

Porsche Suspension Alignment

Customer No.:	Repair Order No.:
Customer:	Vehicle Identification No.:
Street:	Registration No.:
Town:	Date of 1st registration:
Phone:	Mileage: km/miles
Measurement made by:	Date / signature
Vehicle: Porsche 911 from model 94 (993)	**Version:**
Measuring requirements (Vehicle weight): Curb weight to DIN 70020. This means: Full fuel tank, spare wheel and tools in vehicle.	
Reason for measurement:	
Tire make: Size/type: Front	Rear

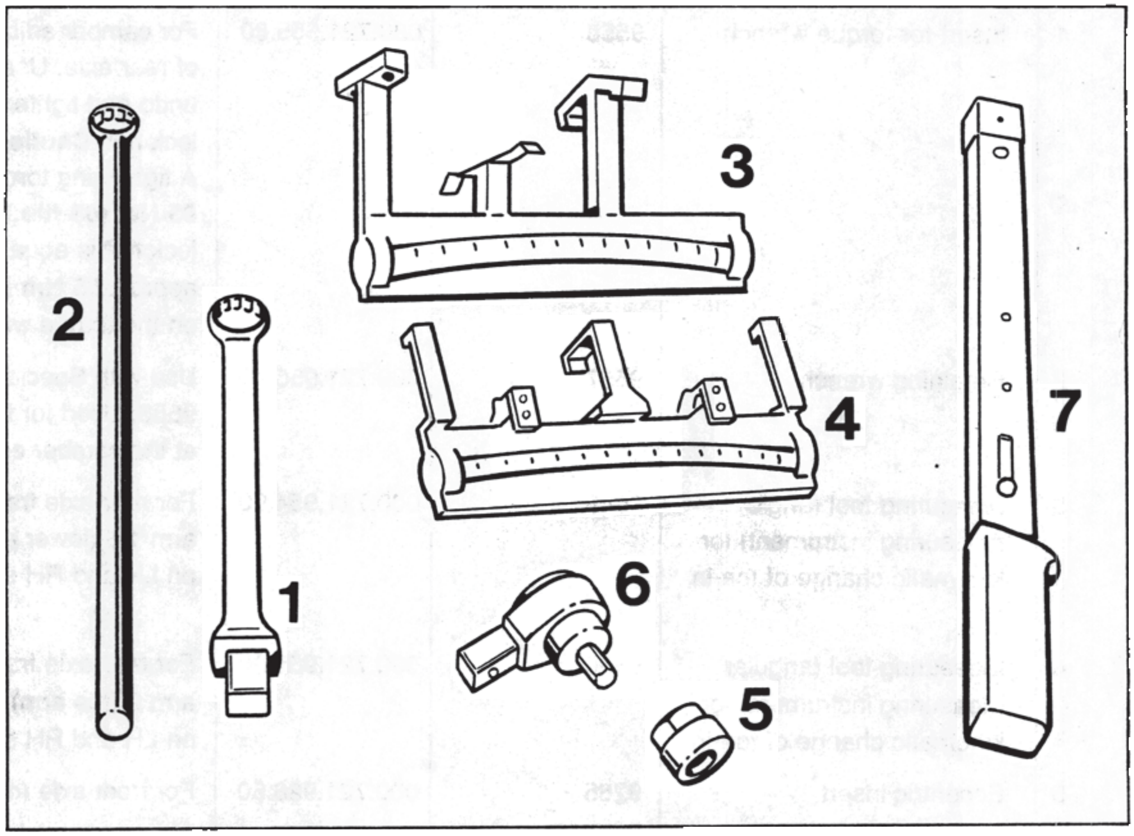
	Front left	Front right	Rear left	Rear right
Tire pressure (cold tires) bar				
Tire/wheel (possibly damaged) Tire - tread depth (mm)				

			Measurement **as received**	Specifications max. difference LH/RI	Measurement **as delivered**
Vehicle height / wheel load	Height/wheel load front (mm / kg)	left	/		/
		right	/	5 mm / 20 kg	/
	Height/wheel load rear (mm / kg)	left	/		/
		right	/	5 mm / 20 kg	/
Rear axle	Camber	left			
		right		20'	
	Toe-in	left		+0°10'/ +0°05' - 0°05'	
		right		(not valid for RS)	
		total		+0°20'/ +0°10' - 0°10 (not valid for RS)	
	Kinematic toe-in correction	left	scale units*	Angular diff. **L2 / L5**	scale units*
		right	scale units*	max. 1.5 scale units*	scale units*
	Driving axis angle			+0°00'/ +0°10' - 0°10'	
Front axle	Caster	left		+5°20'/ +0°15' - 0°30'	
		right		15'	
	Toe difference angle	left			
		right			
	camber	left			
		right		10'	
	Toe-in	left		+0°03'/ +0°03' - 0°03'	
		right			
		total		+ 0°05'/ + 0°05' - 0°05'	

* SKE = scale units. Special tools 9549 and 9550 are needed for measurement. The reading must be taken at the center of the level (bubble).

44 Alignment of complete suspension

Tools



1442-44

Tools

No.	Designation	Special tools	Order number	Explanation
1	Insert for torque wrench	9558	000.721.955.80	For camber adjustment of rear axle. Used to undo and tighten the lock nut. **Caution:** A tightening torque of **85 Nm (63 ftlb.)** of the lock nut is equal to approx. **65 Nm (48 ftlb.)** on the torque wrench
2	Retaining wrench	9557	000.721.955.70	Use with Special Tool 9558. Used for locking at the camber eccentric
3	Measuring tool (angle measuring instrument) for kinematic change of toe-in	9549	000.721.954.90	For rear-axle trailing arm 1/5 (lower arm) on LH and RH side
4	Measuring tool (angular measuring instrument) for kinematic change of toe-in	9550	000.721.955.00	For rear-axle trailing arm 2 (toe arm) on LH and RH side
5	Eccentric insert	9265	000.721.926.50	For front axle (camber)
6	Reversible ratchet	9265/1	000.721.926.51	For front axle (camber)
7	Torque wrench			Standard, to be used with nos. 1 and 6. **Caution: Observe tightening torque modification for insert no. 1**

Suspension alignment

General

The main difference of the suspension alignment of the 911 Carrera (993) with regard to that of the 911 Carrera 2/4 (964) is in the operating procedures for the rear axle.
Except for minor details (new tie-rods, steering gear, different settings and tightening torques), the adjustment procedures are the same as on the 911 Carrera 2/4 (964).

In addition to toe-in and camber, the **kinematic toe-in change** must also be checked and adjusted, if required, by changing the steering arm position (steering arm angle) on the new multi-link rear axle. This **additional** (indirect) measurement is performed with Special Tools **9549 and 9550** mounted to arm 1 / 5 (lower arm) and arm 2 (toe arm). The specified adjustment sequence must be observed at all times (p. 44 - 13).

Also make sure that the max. admissible front-to-rear height difference of 10 mm is not exceeded. No specifications exist for older models.

Check wheel alignment with an optical or electronic alignment tester. The measuring procedures are described in the operating instructions of the alignment tester used. The following requirements must be fulfilled prior to checking the suspension alignment:

Vehicle at curb weight according to DIN 70020, i.e. vehicle is roadworthy, with full fuel tank, spare wheel and tools

Drive joint and wheel bearing clearance must be correct (wheel bearing clearance cannot be adjusted)

– Specified tire pressure, fairly even tread depth.

If both the front and rear alignment has to be checked, **start by checking and adjusting the rear wheel alignment**. The camber specifications for the front axle refer to the straight-ahead position of the wheels. When adjusting the camber setting, steering wheel and steering gear must be in center position.

Before adjusting the suspension settings of the front and rear axles, make sure* the height adjustment is checked with the vehicle at DIN curb weight. If wheel load scales are available, the height adjustment feature allows the left-to-right wheel load difference to be kept to a minimum. The wheel load difference is adjusted by modifying the height tolerance. The left-to-right wheel load difference should preferably kept as small as possible.

* after operations that cause changes in height or if the height was incorrect.

Important information for suspension alignment operations

When checking/adjusting the suspension alignment, observe the following items:

Height adjustment/wheel load change

Changing the height on one side will simultaneously cause a change in wheel load. **A wheel load change on one wheel will also change the wheel loads of the other wheels.**

The wheel load is increased by increasing the installed spring preload on one side (raising the vehicle).

The wheel load is reduced by reducing the installed spring preload on one side (lowering the vehicle).

Wheel load changes are always transmitted diagonally on the other side of the axle. In other words, when the wheel load is reduced or increased on one wheel, the same happens on the diagonally opposite wheel.

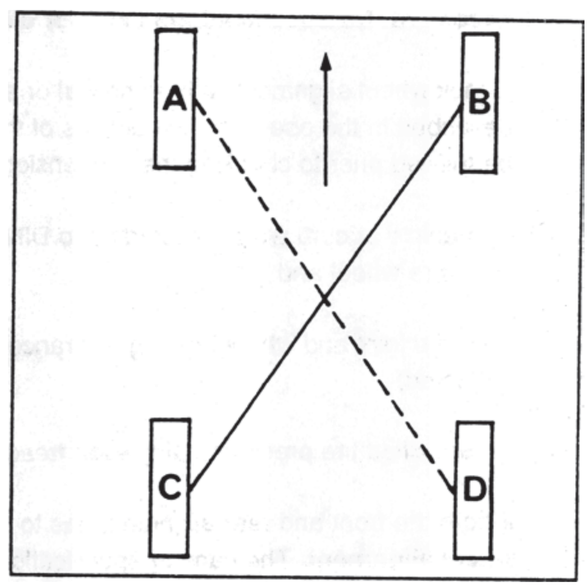
Example

Front right spring preload B is increased.

This causes the wheel load

- to increase at the left rear C and right front B

- to decrease at the right rear D and left front A



44-3

The left to right wheel load difference should be as small as possible on the front and rear axles (less than 20 kg, 44 lbs.) whenever possible).

Checking / adjusting the height

General

Adjust the height **on the front axle** at the adjustment nuts on the lower spring retainer (as on 964).

For height adjustment **on the rear axle,** the strut must be removed to allow other spacers to be inserted at the upper spring retainers.

The **max. admissible front-to-rear deviation of 10 mm from the specified height** must not be exceeded, i.e. the height at the front axle must not be exceeded by 10 mm (full positive tolerance) if the height at the rear axle is 10 mm below the specification (full negative tolerance). **The general rule is:** Use the mean value of the front-axle measurements **vs.** the mean value of the rear-axle measurements as a basis for calculation.

Note

The height adjustment feature of the front axle may be used to:

1. Correct differences in the left-to-right wheel loads. When the height is correct, the wheel load differences are within a specified range if the coil springs of each axle have an identical installation length (installed spring preload).
   Tolerance ± 1 mm.
   Wheel load scales may be used to keep the wheel load differences as small as possible. The left-to-right tolerance on the front and rear axles must be below 20 kg.

2. Any excessive height differences between front axle and rear axle can only be compensated (within the acceptable tolerance range) at the front axle.

Front axle

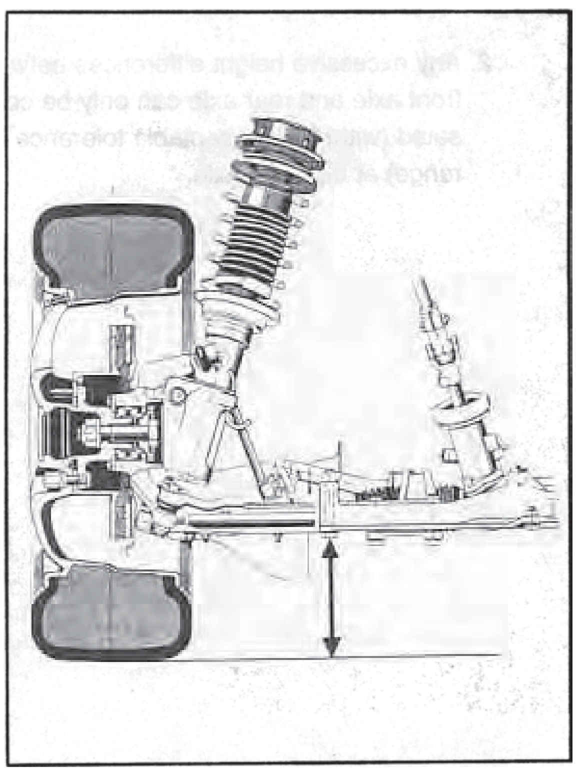
Park car on a level surface or on the test station to **check the ride level height** (roadworthy vehicle, fuel tank full, with spare wheel and tools in car). Jounce vehicle and rear and front axle 2 or 3 times and let the springs return the car to its normal height.

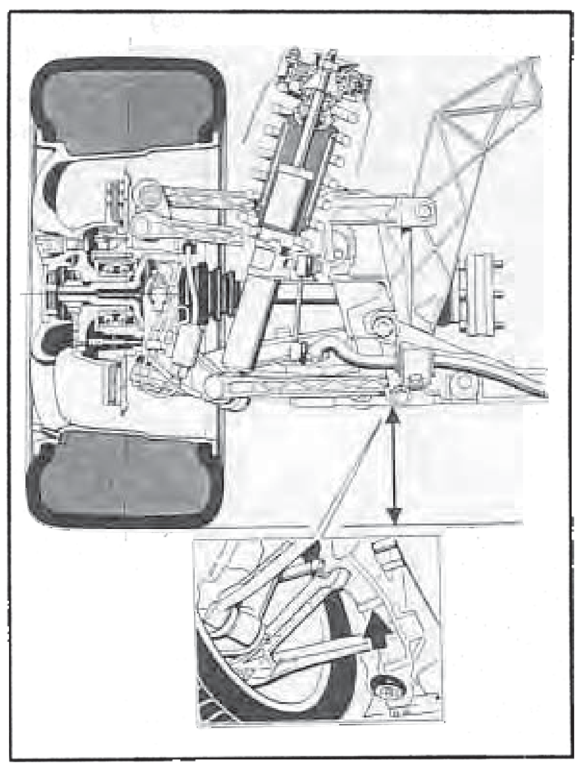
Measure distance from road contact surface point to bottom of bolt head of outer cross-member-to-body bolt connection.
For front axle and rear axle specifications, refer to page 44 - 3.
The ride level height at the front axle is adjusted by turning the adjusting nut on the lower spring retainer. Use a hook wrench or Special Tool VW 637/2 (lever) for this adjustment.

Adjusting nut (of front axle)
- turn to the right = vehicle is raised
- turn to the left = vehicle is lowered

Rear axle

Measure from road contact surface to rear mating face on the bottom of the suspension subframe! The ride level height of the rear axle is corrected by modifying the spacer thickness at the upper spring retainers.
The struts must be removed for this operation.





Wheel geometry

Notes

Check and adjust wheel adjustment values only when the specified requirements are met (page 44 – 9, General).

If the wheel alignment is measured at the front and rear, start by checking and adjusting the rear axle.
For specifications, refer to p. 44 - 4 / 44 - 5.
Tighten nuts and bolts to the specified torque after adjustment. For tables, refer to Repair Groups 40 and 42.

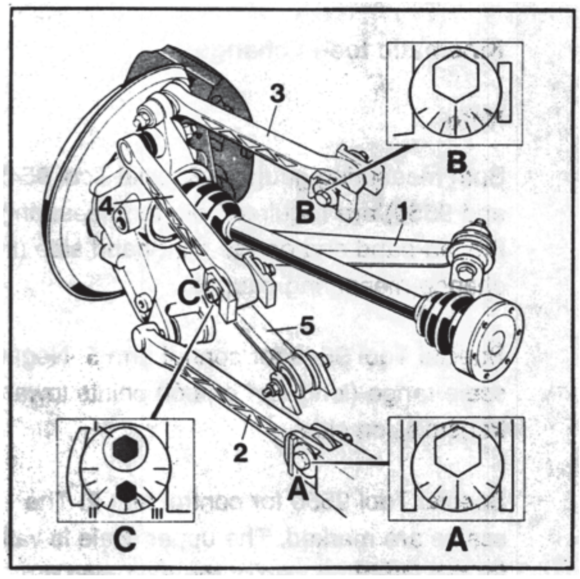
Rear axle

Prepare the car for checking and adjusting the wheel alignment values. Place front wheels on rotary tables etc. Jounce vehicle and rear and front axle 2 or 3 times and let the springs return the car to its normal height.

Adjusting sequence (to be observed by all means):

1. Toe-in. Adjust at control arm 2 – **eccentric A**.
2. Camber. Adjust at control arm 3 – **eccentric B**.
3. Kinematic change of toe-in.
Adjust at control arm 4 – **area C.** To adjust, mount the Special Tools (measuring gauges) 9549 and 9550 to control arm 2 and control arm 5 (page 44-14).
Adjust at control arm 4 – area C – at eccentric washer II.

I = Mounting bolt
II = Eccentric washer
III = Hexagon socket for rotation of eccentric washer no. II.



Adjusting toe-in

With the underbody paneling removed, turn eccentric A as required.
If **only the toe-in** has to be corrected (camber o.k.), the kinematic toe-in change **does not** have to be checked.

Adjusting camber

Remove cover of control arm 1/5 (bottom control arm). Rotate eccentric B as required. To undo the lock nut, use Special Tool **9558** in conjunction with a torque wrench. Use Special Tool **9557** to lock at eccentric B.
If the camber setting has been corrected, the kinematic toe-in change will have to be checked as well.
When tightening the lock nut with Special Tool 9558, **observe the following: 85 Nm (63 ftlb.)** at the lock nut corresponds to a setting of **approx. 65 Nm (48 ftlb.)** at the torque wrench.

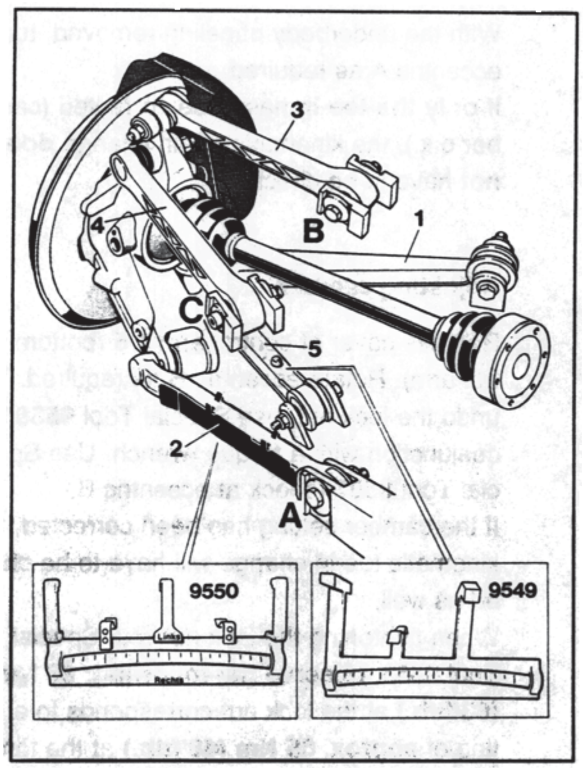
Kinematic toe-in change

Note

Both measuring gauges (Special Tool 9549 and 9550) are required both for measuring on the left-hand and on the right-hand side (interchange measuring gauges).

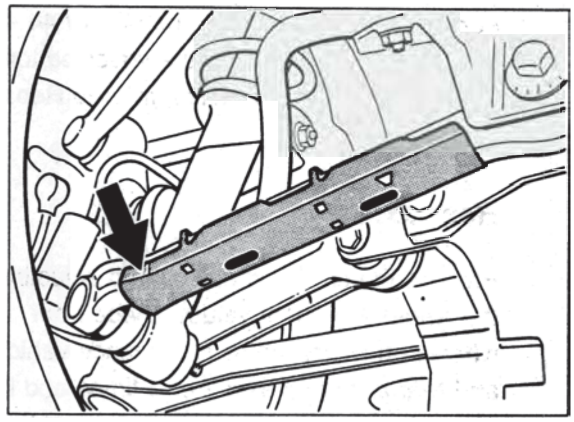
Special Tool 9549 for control arm 5. Negative scale range (long end of tool) points towards transmission side.

Special Tool 9550 for control arm 2. The scales are marked. The upper scale is valid for the left-hand side of the axle, and the lower scale is valid for the right-hand side of the axle.



1445A-44

Check **cover of control arm 2** for correct fit. When no excessive force is applied, the cover must not shift by more than 10 mm (move to the left and right by applying only light force). Replace cover if required. Trapezoidal end of cover (arrow) must point towards wheel side.

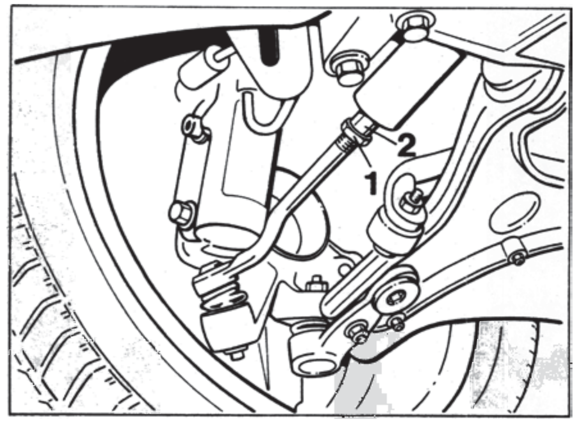


1463-44

Mount **Special Tool 9550 to control arm 2** (measuring surfaces must be free from dirt). 2 cutouts in the control arm cover help to locate the Special Tool correctly (refer to fig. 1463-44).
Center out cover (move to the left and right without applying any force).
Then locate cover in the center position and continue by centering out Special Tool 9550 as well. This prevents the measuring gauge from entering the radius range of the control arm (arrow no. 2) as this would give an incorrect measurement reading.
Also make sure the measuring arms (arrows No. 1) are in perfect contact with the control arm.

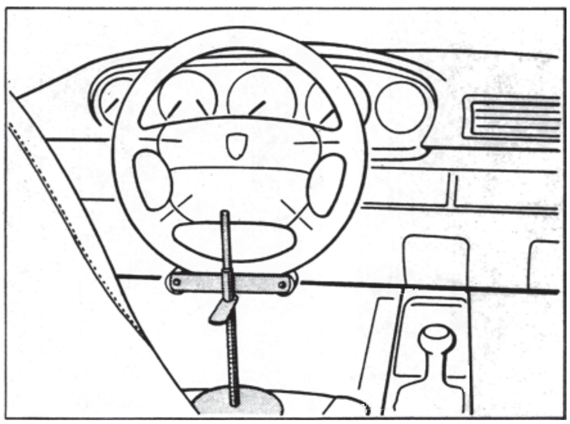
Adjusting toe-in

Preliminary operations: Check if the steering wheel is offset with regard to the steering gear by removing the underside paneling and centering the steering gear with Special Tool 9116. Try to achieve the optimum value when repositioning the steering wheel if required. **Then remove Special Tool 9116.**



1451A-44

Clamp steering wheel **in center position using the steering wheel holder**.

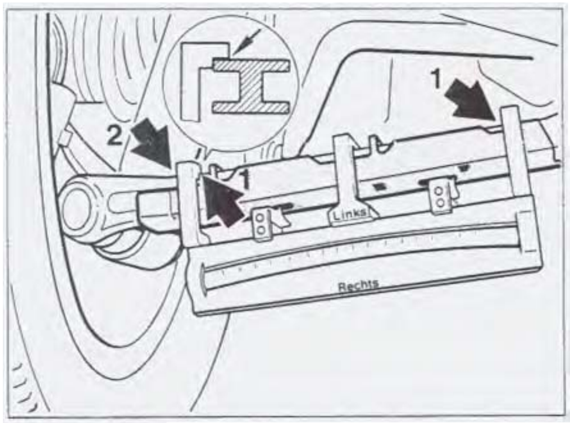


1450-44

After undoing the lock nut (No. 1), adjust toe-in at the tie rods.
Make sure the respective bellows **is not twisted** (damaged).

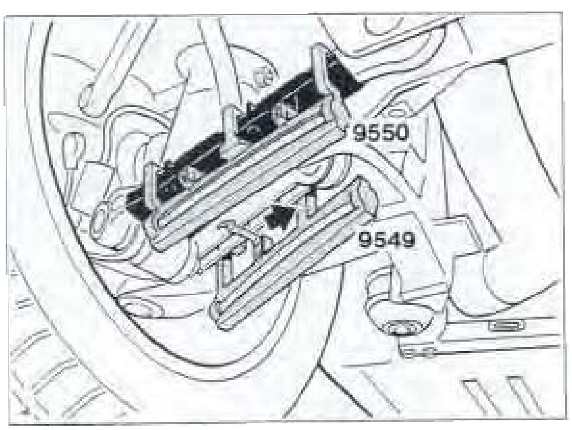
Toe difference angle

The toe difference angle cannot be adjusted (modification is only possible if the steering arms are replaced).



1446-44

Mount **Special Tool 9549 to control arm 5** in such a manner (measuring surfaces must be free from grease) that the negative range of the scale (long end of tool) points towards the transmission side.
Start by placing tool against the support point (support lug) on the wheel side. The inner measuring arm must contact the control arm (arrow). If required, straighten spring on Special Tool somewhat.



1447-44

Read off figures on both Special Tools. Both figures may deviate from each other by **not more than 1.5** scale units.
Measure and read off at the center of the bubble level.

If required, align both bubble levels (numerical values) with each other. **In this position, the kinematic toe-in change is adjusted correctly.**
Adjust at control arm 4 (caster control arm / refer to fig. 1445A-44).
To adjust, turn the eccentric washer after undoing the fastening bolt (area C).
When adjusting the kinematic toe-in change, make sure the **camber values remain within the admissible tolerance range.**

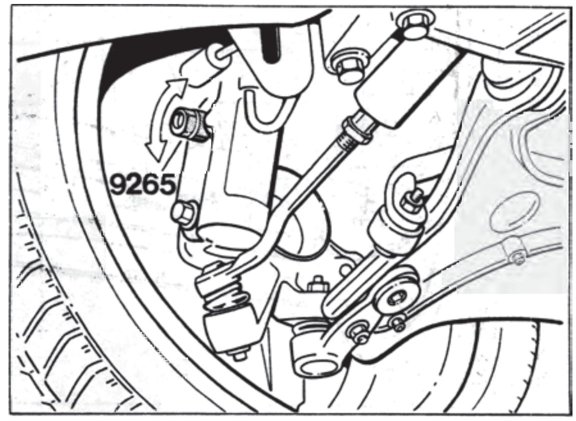
Fit Special Tool 9549 and 9550 to the **opposite side of the rear axle.**
Proceed with measurements and adjustments on this side of the axle as described above.
Special Tool 9549 is mounted to switchover position while the orientation of Special Tool 9550 remains the same as on the opposite side of the axle.

Front axle

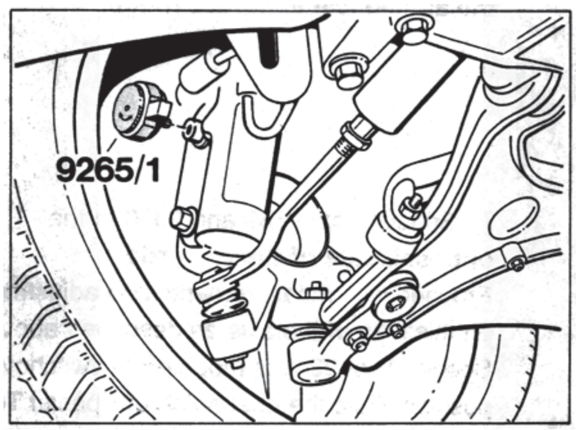
The adjustment operations on the front axle differ only in details (adjustment values, tightening torques, new tie rods) from those of the 911 Carrera 2/4 (964).

Adjusting camber

Camber is adjusted by turning the spring strut with regard to the wheel carrier. To adjust, undo both fastening bolts. Use **Special Tool 9265/1** in combination with a torque wrench for the upper fastening bolt.



1449-44

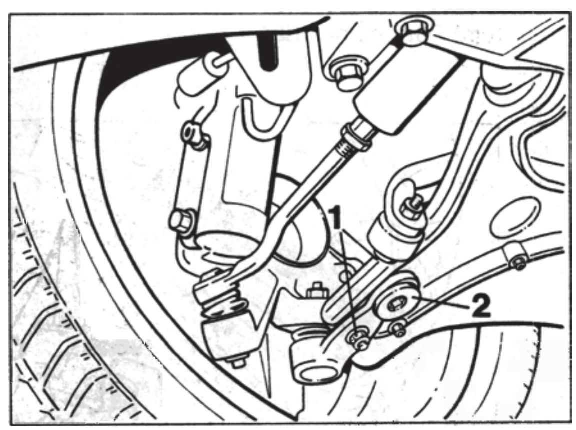


1448-44

Place eccentric insert **9265** on the upper bolt head of the fastening bolt (cylindrical bolt) and adjust camber by turning the insert.

Adjusting caster

Undo bolt connection of joint carrier to A-arm (2 lock nuts / no. 1).
Adjust caster by turning the caster eccentric (no. 2). This moves the joint carrier in forward or backward direction.



1451-44

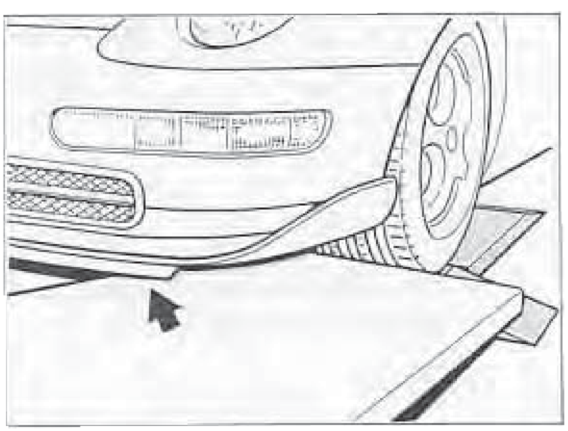
44 Wheel alignment measurements on 911 Carrera RS

The following text only describes points which are different from the 911 Carrera. Details of alignment measurements on 911 Carrera vehicles are given on pages 44 - 7 to 44 - 17.

Differences for Carrera RS

Changed settings (see pages 44-3 to 44-5).

When driving onto the platform, additional ramps, such as those needed for the 959, must be used. Otherwise, the front spoiler (arrow) would touch the ground. Platforms without inclination are not suitable.



2188 - 44

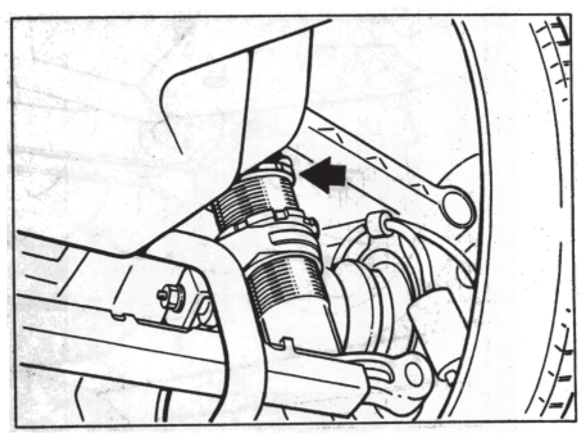
Depending on the equipment used, spoiler adapters with lengths of 50 or 100 mm are required for the sensors of **electronic** wheel alignment testers. Without these adapters, data cannot be transmitted from the right to the left.
With the wheel alignment testers recommended by Porsche, which have a special **spoiler test program**, 100 mm spoiler adapters are needed for the rear axle. Check the operating instructions of the wheel alignment tester.

Adjusting height of front axle:
As with the 911 Carrera, the height of the lower spring mount is adjustable. However, the **Carrera RS has an additional lock nut**.

The height of the rear axle can be adjusted using the adjustment nut(s) on the spring strut(s).

Note

On the 911 Carrera (993), the spring struts must be removed for rear axle height adjustments. Different shims must be positioned on the upper spring retainers.



2191/1 - 42

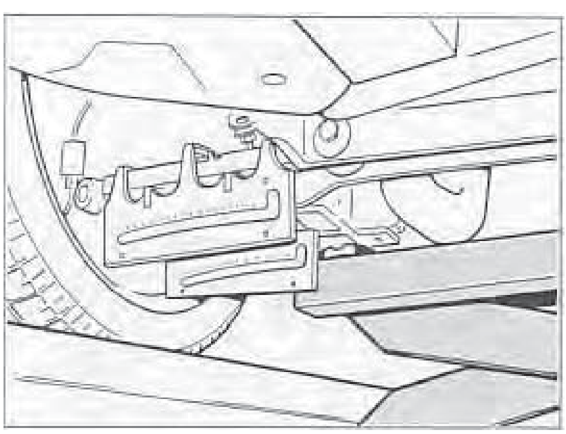
Max. wheel load difference left/right on front and rear axle 20 kg (as for 911 Carrera).

Setting rear axle camber:
As for 911 Carrera.

Note

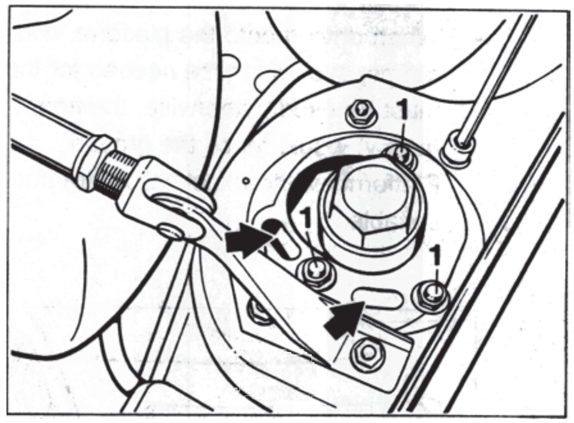
In order to obtain more camber (up to - 3° 30') for racing use, the slot in the side part near to the camber arm is longer.
To allow a greater adjustment range, the **stroke of the camber arm has been increased by 2 mm**.

To adjust the **kinematic toe-in change** on the rear axle, the stabilizer must be removed.
The vehicle must then be lifted until control arms 2 (track arms) are about horizontal using an axle lift unit positioned at the center. This is essential for installing and reading the levels.
The setting procedure itself is the same as for setting the kinematic toe-in change on the 911 Carrera.



2193 - 44

Setting front axle camber:
As for 911 Carrera.
Caution: The **racing camber setting** available on the Carrera RS must be used **only** on the race circuit. The spring strut mount can be set from **normal** (as shown on the drawing) to racing camber.
Three bolts and nuts (no. 1) and two slots (arrows) in the upper part of the mount are used to change the camber.
The camber is increased by - 1° 30'. Fine adjustment by ± 20' is possible using the slots.



2187 /1 - 40

After adjustment and assembly work, check all wheels for free running.

44 Checking wheel rims

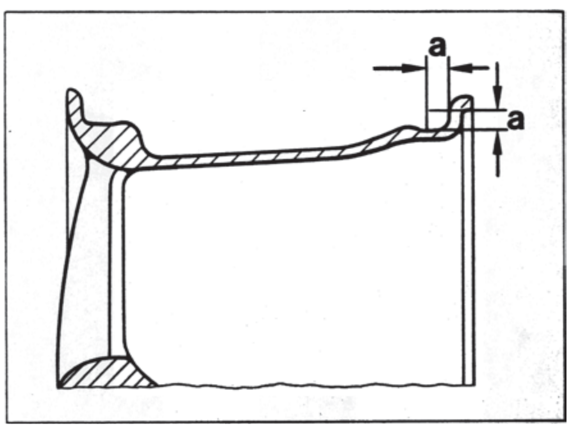
Checking radial and lateral runout

Radial and lateral runout must be measured at the points on the inside of the wheel rim shown on the following drawing (dimension "a").

The **maximum** allowable radial and lateral runout on **light alloy wheels** is **0.7 mm.**

The **maximum** allowable radial and lateral runout on **wheels with tires** is **1.25 mm.** Values lower than 1.0 mm (preferably around 0.5 mm) should be aimed for.
See also page 44-23.

Caution: Welding and straightening work on light alloy wheels is not allowed.

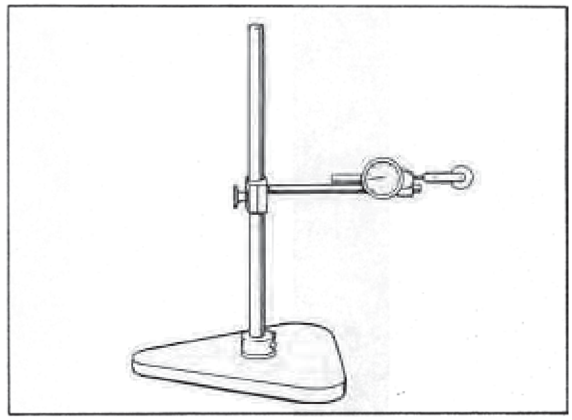


2273-44

Dimension "a" = 8 mm

Note

For measurements on wheels with or without tires, use a tire runout gage, e.g. V.A.G 1435.



2272-44

44 General tire fitting instructions

Each time a tire is changed, a new rubber valve must be used.
Steel valves (on technology wheels) need not always be replaced when a tire is changed (see page 44-26).
Valve supports are **not** used.

Caution: when fitting tires, make sure that they are fitted in the right direction (with the inside on the inside).

When fitting tubeless tires, it is important to check the contact surfaces of the tire and the rim for cleanliness and any damage. It should be noted that the bead base provides the seal on a tubeless tire. If the side of the bead is used for sealing, air may escape from the tire during hard driving.

When fitting tire beads, use only the tire fitting lubricants specified below.
If an unsuitable lubricant is used for tire fitting, the following problems may occur: twisting of tire on rim, breakage of bead bundle during fitting and damage to the wheel rim surface by corrosive materials.
Caution: use only TIP TOP Universal, order no. 593 0601 (3.5 kg pot), or Contifix.
If you use Contifix, apply it to the tire bead sparingly (to prevent twisting on the rim). If possible, the vehicle should not be driven for 24 hours following tire fitting or matching.

To prevent the tires from turning on the rims in operation, please inform your customers that they should avoid extremely hard acceleration and braking during the first 100 to 200 km with **new or newly installed tires**.
It may be useful to mark the position of the tire on the wheel rim.

The tire must not turn more than 20 mm on the rim. This is the absolute maximum. If this value is exceeded, the optimum results achieved by wheel balancing will be impaired.

For optimally smooth running it may be beneficial or in some cases even necessary to turn the tire to a better position on the rim (matching).
The difference between **uncontrolled** and **controlled matching** is explained below.

Uncontrolled matching: Turn the tire 90° or 180° on the tire to obtain acceptably smooth running (runout, imbalance and distribution of balance weights).
Controlled matching: For controlled matching, a wheel balancer with matching program is used. The results obtained in terms of smooth running (runout, imbalance and distribution of balance weights) are normally better than with uncontrolled matching.

Maximum allowable radial and lateral runout on **light alloy wheels 0.7 mm.**
Maximum allowable radial and lateral runout on **wheels with tires 1.25 mm.**
Values lower than 1.0 mm (preferably around 0.5 mm) should be aimed for.

Following tire fitting, pump the tubeless tires up to approx. 3 bar (max. 3.75 bar) gage pressure without valve inserts to ensure that they are properly seated on the rims.
At a pressure of no more than 3.75 bar, the tire beads must come up from the well and cross the hump of the bead seat to prevent breakage of the bead bundle. If necessary, interrupt work and lubricate all contact surfaces well with tire lubricant. Then repeat this procedure.
Screw in valve insert and pump tire up to specified pressure (page 44-1).

Prior to static balancing, check the radial and lateral runout of the wheel.
See page 44 - 23 for maximum limits and matching procedure.

When replacing a damages tire, the difference between the tread depth on the two tires of one axle must **not be more than 30 %.**

A summary of summer and winter wheels and tires is given in Technical Information (TI), Group 4.
When replacing summer tires, make sure that the new tires have the code N1, N2 or N0. These codes distinguish summer tires approved by Porsche from other versions of the same tire type and size.

Age of tires

Especially high-speed ZR tires should not be too old. **Tires older than 6 years must not be used.**
The age of the tire is indicated by the manufacturer's code which follows the DOT designation. The production date is at the end of the code (last three digits). From 1990 to 1999, the three-digit code is **followed by a triangle** in some cases (distinguishing feature).

Example:
DOT DM CP 05 Y **279**
27 = production week **27**
9 = production year 198**9**

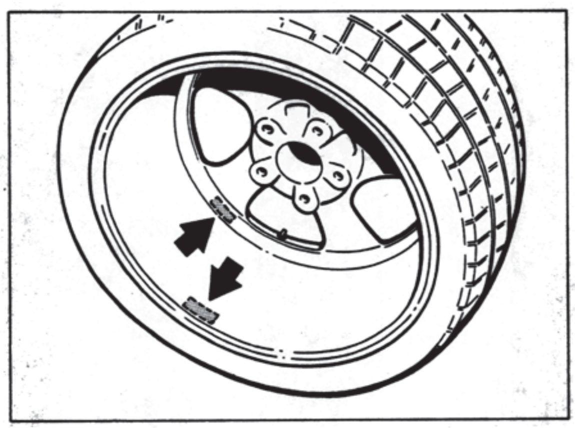
Installing wheel on vehicle

Previous design: the security wheel nut is installed opposite the valve.
From September 1995: The security nut is no longer installed in a special position **in production. In after-sales service,** the **previous** practice for tire fitting may be continued.
Irrespective of the position of the security wheel nut, it may be useful to mark the bolt opposite the valve before removing the wheel. This will ensure that optimum balancing results (achieved using finish balancers) will not be affected by tire fitting.

Balance weights

Balance weight type: adhesive weights as before (no special type required). See spare parts catalog.

Positioning: Install both weights on the inside (arrows)*. The outer weight must not be attached to the conical section. Just behind the wheel disk there is a cylindrical section intended for the installation of balance weights.



2122-44

* Note program selection and operating instructions of balancer

44 Technology wheel / Turbo-Look Design wheel

General

Technology wheels are hollow-spoke wheels. A new process is used to produce these wheels. The wheel rim and disk are two separate components which are joined by friction welding.
With this new Porsche process, the wheel disk is **also hollow.**

The wheel disk of **Turbo-Look Design wheels** is **not hollow.**

Distinguishing features of Technology and Turbo-Look Design wheels:

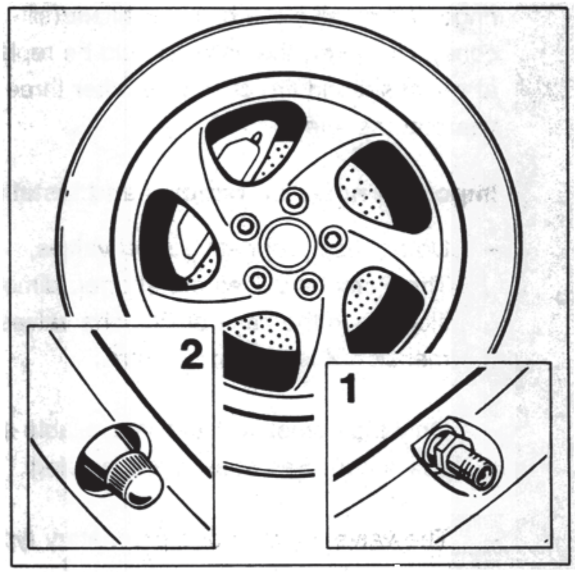
1. **Valve.**
   The Technology wheel **(No. 1)** has a steel valve, diameter approx. 8 mm.
   The Turbo-Look Design wheel **(No. 2)** has a rubber valve, diameter approx. 11.3 mm.
   For additional distinguishing features on outside of valve, see illustration.

2. **Part number** on the inside of the wheel disk.
   See spare parts catalog!

Allocation (as of August 1995)

Technology wheels:
Turbo (993) and special equipment for Carrera from model year 1996. The rear axle rim offset is **65 mm on the Carrera** and **40 mm on the Turbo.** The rim offset is stamped on the inside of the wheel disk. The tire sizes are also different.
The rim offset and tire sizes for the **front** wheels are identical for Turbo and Carrera.

Turbo-Look Design wheels:
Carrera 4S. Rim offset and tire size as for Turbo.



2278-44

For removing and installing steel valves of Technology wheels see page 44-26.

Pressure for tire fitting

When the tire is filled to seat the bead, the pressure must not exceed 3,75 bar. If necessary, interrupt work and lubricate all contact surfaces well with tire lubricant. Then repeat this procedure.

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Removing steel valves of Technology wheels

General

It is not necessary to replace the steel valve each time the tire is changed as the seal rings of the valve are highly resilient (silicone). However, the valve should be replaced at every second tire change or after three years at the latest.

Important notes on removal and installation

Do not use proprietary steel valves. The Porsche valves are shorter (dimension X). In the case of Porsche valves, dimension X is approx. 43 mm.

Only the complete valve is available as a spare part. See spare parts catalog.

The valve insert is of a proprietary type.

Valve cap No. 1 is equipped with a seal (air-tight). Do not use a proprietary valve cap.

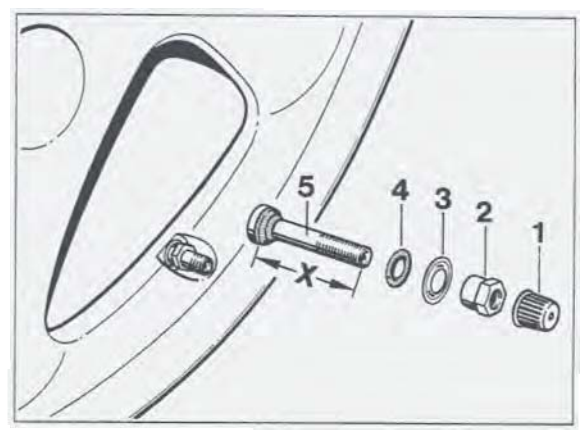
The shank of the fastening nut no. 2 **must face the valve base.** Otherwise the valve will not be firmly seated.

Observe the position of washer no. 3 (arrow). If the washer is incorrectly installed, the O-ring will be damaged. This may cause more serious damage.

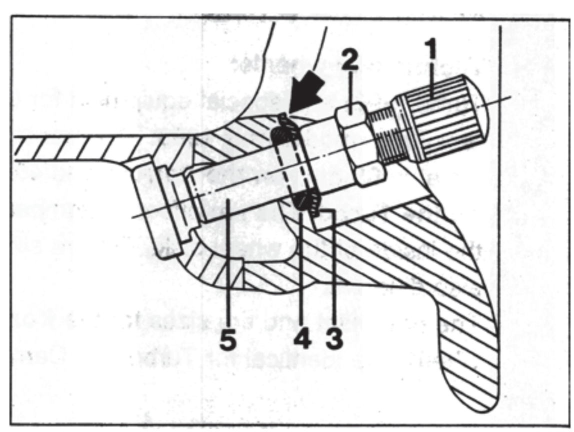
When loosening and tightening fastening nut No. 2, you must **hold a screwdriver against** the valve base.
There is a slot for a screwdriver in the valve base.

Installation

Insert valve no. 5 with base seal (already installed) into wheel. Push O-ring no. 4 carefully onto valve from outside.
Install washer no. 3 in correct position (arrow). The O-ring will then fit into the recess on the washer.
Install fastening nut no. 2 with shank facing valve base.
Tighten fastening nut with **3.5 ± 0.5 Nm** (2.2 ± 0.4 ftlb) using a torque wrench.
When tightening nut, **hold a screwdriver against** the valve base.

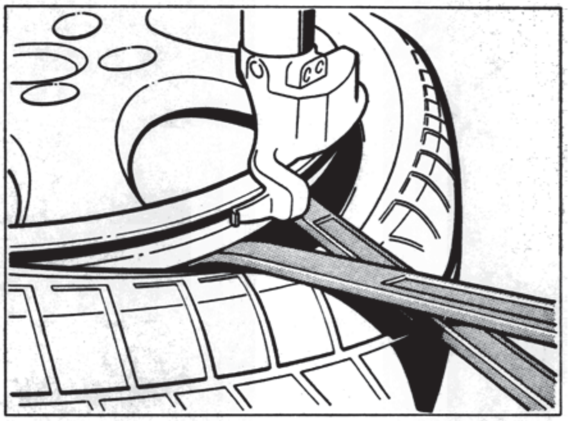


2128-44

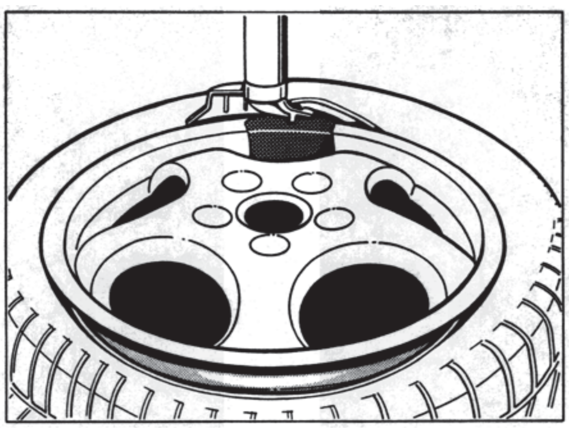


2150-44

Lift the **first side** over the fitting head (Fig. 1017-44). Place a cloth or piece of leather between wheel and tire lever to make work easier. In addition, you should make sure that the tire is held against the removal head in the well (Fig. 1018-44). Use special tool 9539 for this purpose.



1017-44



1018-44

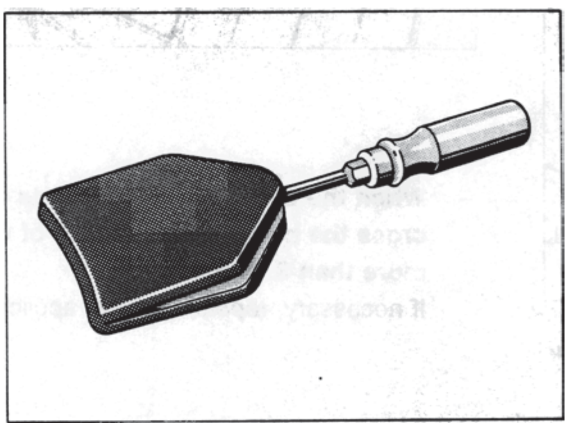
Remove the **second side** in the normal way.

44 Tire fitting using conventional machines

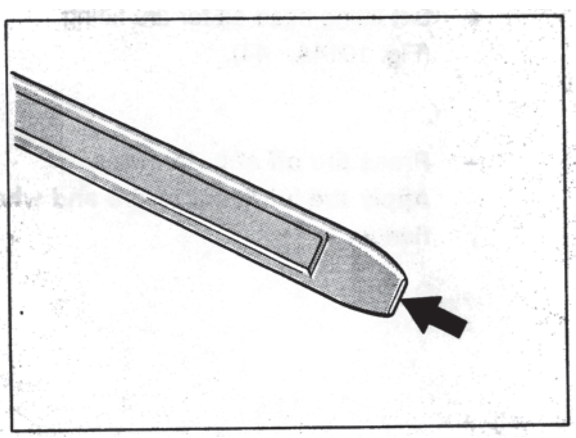
Notes / tools

In order to prevent any damage to the paintwork, the rim flange should be covered with masking tape following tire removal.

For tire removal and installation, a retaining tool, special tool 9539, is required. In addition, the end of the tire lever should be flattened and then rounded (see arrow).



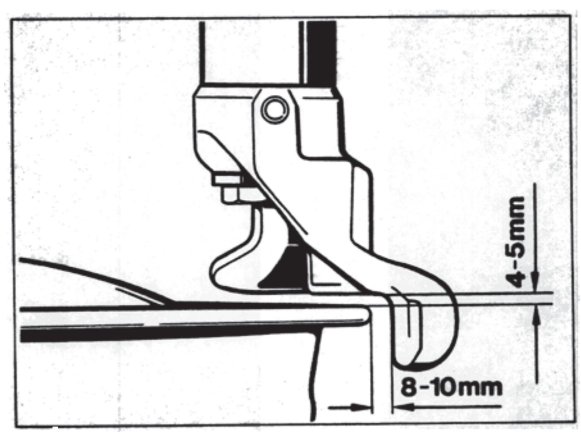
1012 - 44



Tire fitting

Insert wheel in machine and apply tire lubricant to inside of wheel and both tire beads.
Before a tire is installed, the rubber valve must always be replaced. It is not always necessary to replace steel valves (see page 44-26).
When fitting tires, make sure that they are fitted in the right direction (with the inside on the inside).
Caution:
Use only TIP TOP Universal, order no. 593 0601 (3.5 kg pot), **or** Contifix as a tire lubricant.
See the **important notes** on these tire lubricants on page 44-23.

Set installation tool to correct spacing.

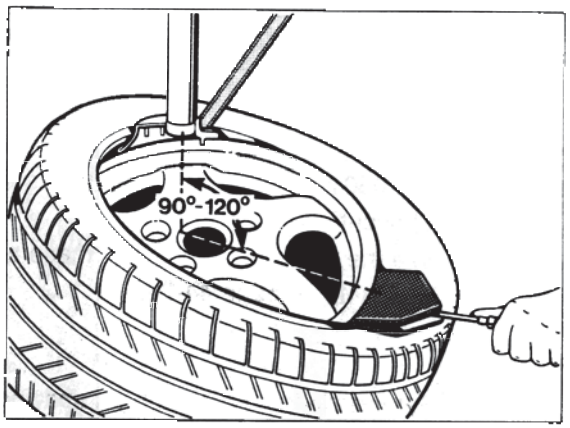


1014A - 44

Fit the first tire bead in the normal way.

Before you install the **second bead,** the fitting arm should be **opposite the valve.** Then place the second bead as flat as possible on the wheel, guide it over the fitting head and hold it in place using special tool 9539 at an angle of 90 - 120°.

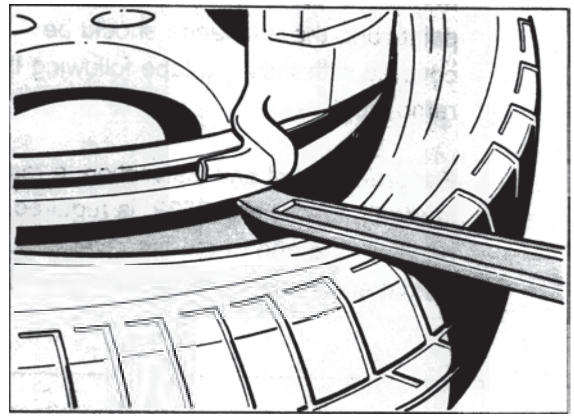
During the turning and installation of the **second bead,** a second tire lever and special tool 9539 must be held against the tire bead in the well.



1015 - 44

Note

Depending on the wheel/tire combination, **it may be necessary to apply the additional tire lever** below the hump.



1016 - 44

When the tire is filled, the beads must cross the hump at a pressure of no more than 3.75 bar gage
If necessary, repeat lubricant application.

Tire removal

Set fitting head as for tire fitting (Fig. 1014A - 44).

Press tire off at both sides.
Apply tire lubricant to tire and wheel flange.

Printed in Germany - 16, 1996

45 Important information on ABS 5 and ABS 5 / ABD

General

The Porsche 911 Carrera (993) is supplied as standard equipment with ABS 5 (5th generation) or optionally (M number) with ABS 5/ABD. **ABD** = **A**utomatic **B**rake **D**ifferential.

Diagnostics and system check of **both** systems are carried out with System Tester 9288.

The pulse wheels of the front axle (tensioning discs) and the pulse rings of the rear axle have 48 teeth. The versions used on the 911 Carrera 2/4 (964) had 45 teeth. This difference should be observed when fitting spare parts to avoid confusion.

The brake pipes are fitted with different threads at the hydraulic unit and at the adapter (M 12 x 1 and M 10 x 1).
This prevents or reduces the risk of the brake pipes being interchanged.
The adapter is located in the left-hand upper section of the spare wheel well.

Differences between ABS 5 and ABS 5 / ABD

ABS 5 = **3-channel system**
(for schematic diagram, refer to page 45 - 2)

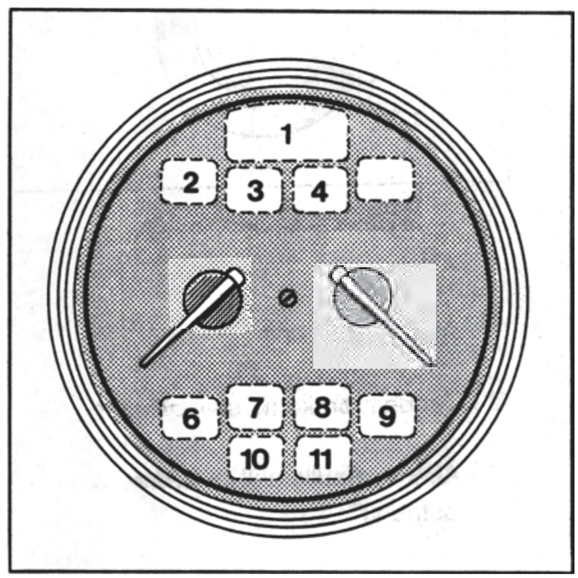
ABS 5 / ABD = **4-channel system**
(for schematic diagram, refer to page 45 - 3).

The major differences between ABS 5 and ABS 5 / ABD **are as follows:**

Brake power controller at hydraulic unit:
ABS 5 = **1** ea.
ABS 5 / ABD = **2** ea.

Number of brake pipes at adapter (in left-hand upper area of spare wheel well):
ABS 5 = **3** brake pipes.
ABS 5 / ABD = **4** brake pipes.

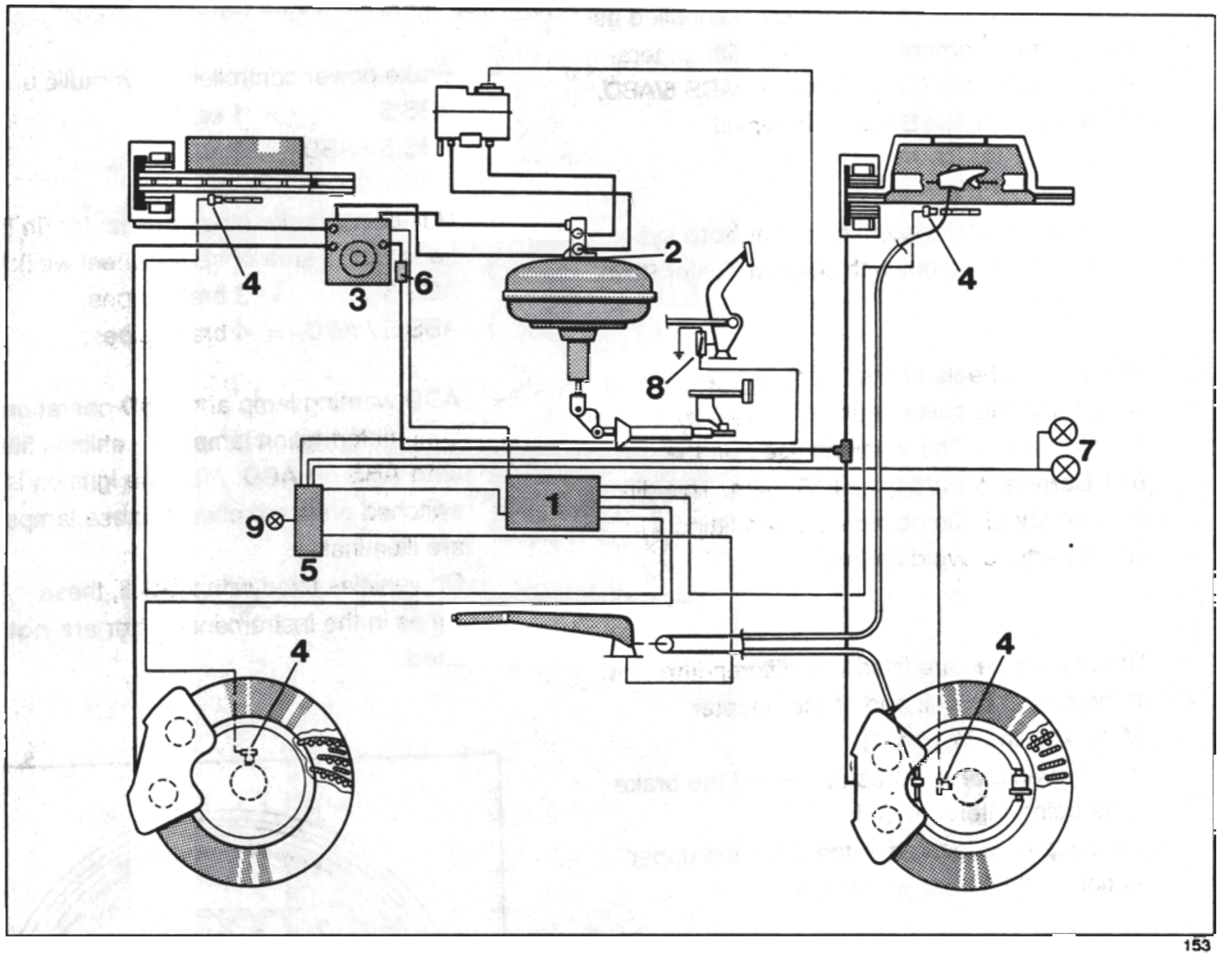
ABD warning lamp and **ABD** operation lamp (information lamp) on vehicles fitted **with ABS 5 / ABD**. After the ignition is switched on (lamp check), these lamps are illuminated.
On vehicles fitted with **ABS 5,** these lamps in the instrument cluster **are not used.**



201

2 - ABD information lamp
3 - ABD warning lamp

Schematic diagram - ABS 5 (3-channel system)



1 - ABS control unit

2 - Tandem brake master cylinder

3 - ABS hydraulic unit (**3** hydraulic outputs)

4 - ABS sensors

5 - Central Information System

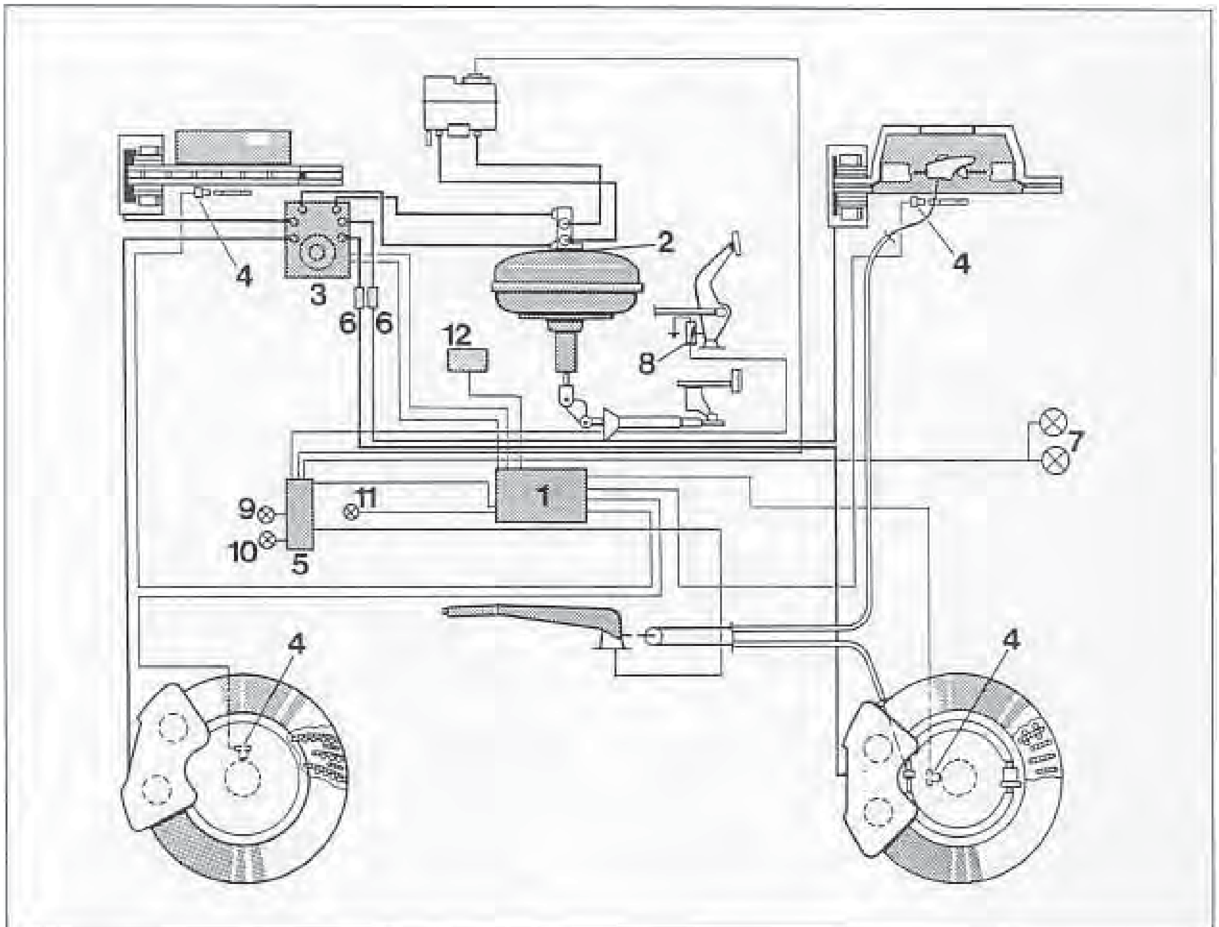
6 - Brake power controller (**1**)

7 - Brake light

8 - Brake light switch

9 - ABS warning lamp

Schematic diagram - ABS 5 / ABD (4-channel system)



1 - **ABS/ABD** control unit

2 - Tandem brake master cylinder

3 - **ABS/ABD** hydraulic unit (**4** hydraulic outputs)

4 - ABS sensors

5 - Central Information System

6 - Brake power controller (**2**)

7 - Brake light

8 - Brake light switch

9 - ABS warning lamp

10 - **ABD warning lamp**

11 - **ABD operation warning lamp**

12 - **DME control unit**

45 Location of ABS 5 and ABS 5 / ABD components

Rpm sensor

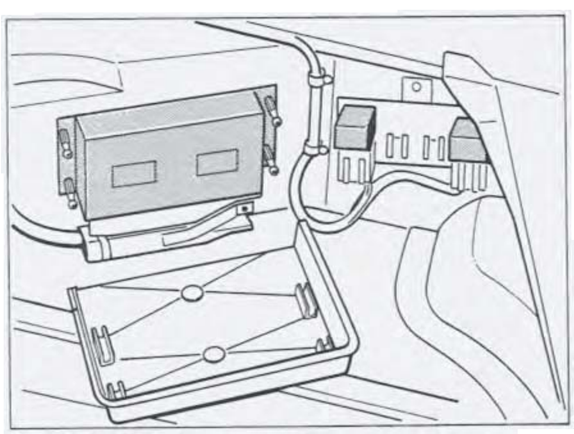
The rpm sensors are inserted into the wheel carriers and are held in place with one 6 mm bolt each. The front and rear rpm sensors are **different.**
Identification features: Part number indicated on rpm sensor wire.

Control unit (ABS 5 and ABS 5/ABD)

The control unit is fitted in the right-hand front side of the luggage compartment with 4 ball pins. These four ball pins also serve to hold the control unit cover in place. A rubber seal is used to provide sealing of the cover.
The control units may be identified by the part number and by a self-adhesive sticker with a colored edge.
ABS 5 – Sticker with **black** edge.
ABS 5 / ABD – Sticker with **yellow** edge.

Note

To keep the plugging cycles of the control unit plug as low as possible, the control unit was located in a suitable position. The plug needs **not** be pulled off for diagnostics or system tests.



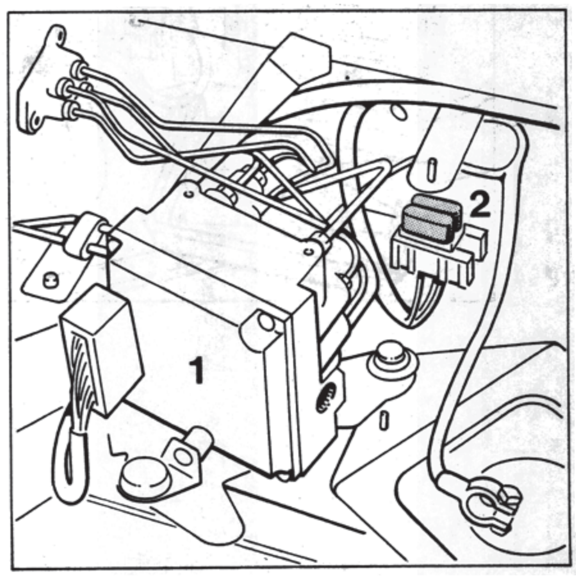
1773-45

Fuses

1. A 60 A Maxifuse is used to protect the return pump and the solenoids.
   The fuse is located on a separate fuse carrier (No. 2). This fuse carrier is fitted in the luggage compartment next to the battery **below** the cover for the hydraulic unit.

Note

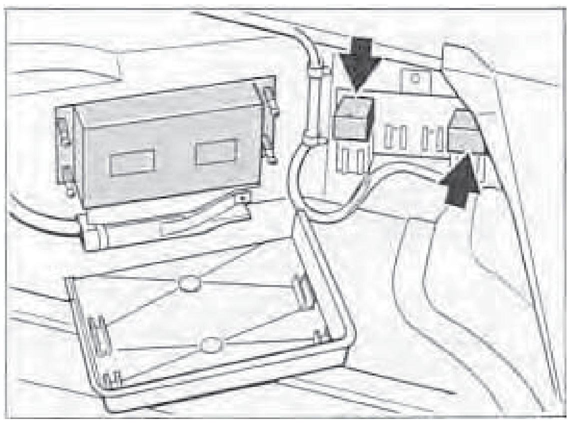
The second 60 A Maxifuse is used to protect the DME.



2. The voltage supply to the control units (ABS 5 and ABS 5 / ABD) is protected by a 10 A fuse (No. 16) at the Central Electrical System.

Relays

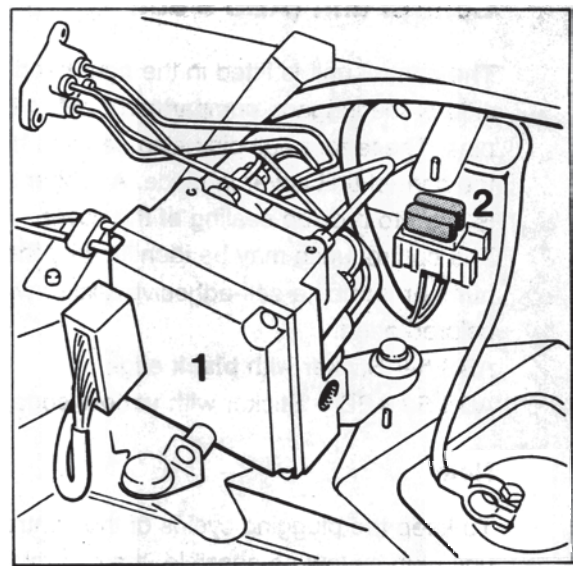
The scavenge pump relay (R 65) and the solenoid relay (R68) are located in the luggage compartment on the right-hand wheel housing next to the ABS 5 or ABS 5 / ABD control unit, respectively.
Both relays are identical 50 A power relays. The R 65 and R 68 identifications are indicated on the relay **cover**.



1773A-45

Hydraulic unit

The hydraulic unit (No. 1) is located in the left-hand front area of the luggage compartment as before.
The ABS 5 hydraulic unit features **three** hydraulic outputs (3-channel system).
The ABS 5 / ABD hydraulic unit features **four** hydraulic outputs (4-channel system).



1772-45

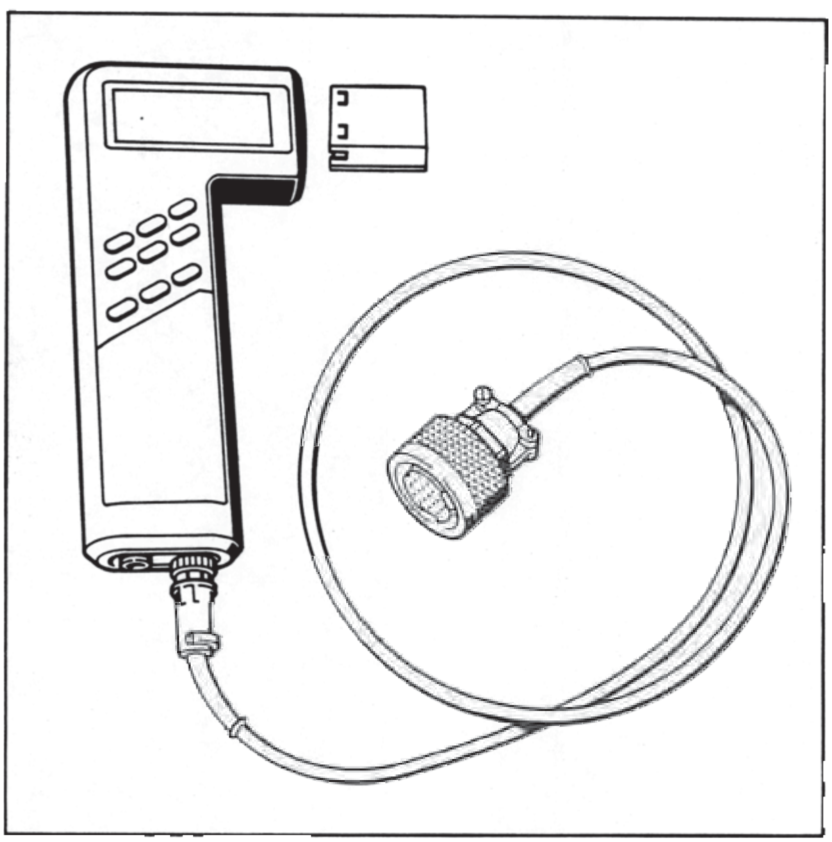
45 ABS 5 test with System Tester 9288

Importaint notes on the ABS 5 and ABS 5 / ABD systems

When carrying out operations on the hydraulic unit, the rpm sensors and the wire assembly, or when replacing units, a **system check (operational check)** with System Tester 9288 must be carried out. This may be required e.g. after accident repairs. This check ensures that confusion of electrical wires and hydraulic lines is avoided and that **correct system operation** is ensured. When replacing certain brake pipes, e.g. at the intermediate section (in the upper left spare wheel well), **a system check must also** be run. Inadvertent bending of the brake pipes may cause the hydraulic connections to be incorrect in spite of the presence of different threads (M12 x 1 and M 10 x 1).

2. If a fault is displayed, (and if no assembly operations have been carried out before) **diagnosis and troubleshooting** are also carried out with System Tester 9288. To run the test, select System ABS 5 or ABS 5 / ABD, respectively, and read out the fault memory. The relevant menus (page 45-9) may then be used to locate the fault.

Tools



855-03

Tools

No.	Designation	Special tool	Order number	Explanation
	System Tester 9288	9288	000.721.928.80	
	with			
	connection wire	9288/1	000.721.928.81	
	and			
	corresponding	928 DV	000.721.928. DV	German
	program module	928 GV	000.721.928. GV	English
	from version 5.0 / 9.93	928 FV	000.721.928. FV	French
	(language-dependent)	928 IV	000.721.928. IV	Italian
		928 EV	000.721.928. EV	Spanish
		928 SV	000.721.928. SV	Swedish
		928 JV	000.721.928. JV	Japanese

ABS 5 and ABS 5 / ABD menus

1 = Fault memory

2 = Drive links

3 = Actual values

1 = Static test

2 = System check

3 = Bleeding

Note

ABS 5 includes only **5** menus.
3= **Bleeding** is omitted.

Scope of application of menus

Item 1: Fault memory

Used for fault detection / troubleshooting.

Item 2: Drive links

Used for troubleshooting. Drive links (actuators) may be triggered with System Tester 9288.

Item 3: Actual values

Used for troubleshooting. Actual values may be retrieved with System Tester 9288.

Item 1: Static test

Electrical test of the system (preliminary check), e.g. after replacement of relays or if plugs have been disconnected.
Caution: This test cannot **under any circumstances** replace the system check as the electrical wires and hydraulic lines are not tested for incorrect connection. In addition, the **mechanical** operation of the solenoids is **not** tested.

Item 2: System check

After carrying out specific repair and/or assembly operations on the ABS 5 or ABS 5 / ABD (refer to p. 45-7), a system check (operational test) **must** be run with System Tester 9288. This test is **menu-controlled.**
Caution: Certain individual test steps must be **completed within 30 seconds** as the test will otherwise be aborted.

Item 3: Bleeding

Only for vehicles with **ABS 5 / ABD.**
Not used on vehicles with ABS 5 .
Used to bleed the ABD circuit of the hydraulic unit after replacing the hydraulic unit. May also be used if pedal travel is excessive, provided the system has previously been bled perfectly.

Note

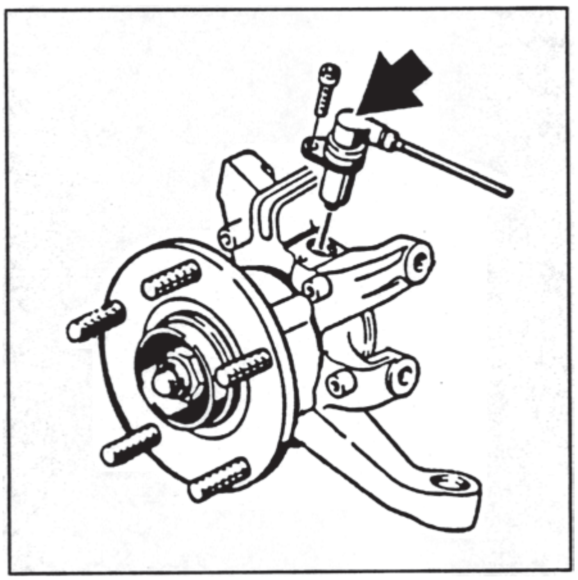
The menu-driven testing procedure and troubleshooting are described in Vol. VIII, Diagnosis.

45 11 19 Removing and installing front speed sensor

Removal

1. With the ignition switched off, open the connector assembly on the spring strut and unplug the connector for the speed sensor.

2. Unscrew the mounting bolt (Allen bolt) and remove the speed sensor.



2198 - 45

Important notes

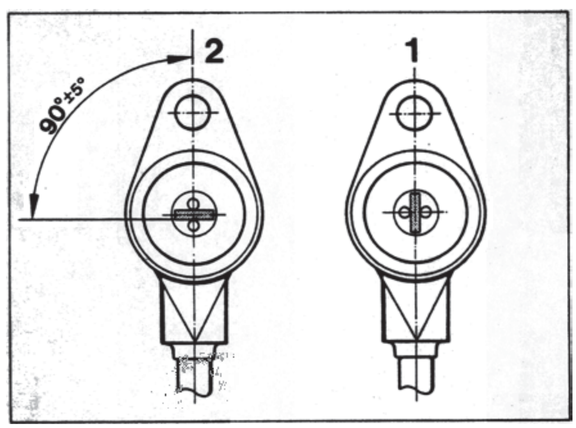
Before installing the speed sensor, make sure that there are no metal chips on the magnetic blade.

The spacing between speed sensor and pulse generator wheel is determined by the design and cannot be adjusted.

Installation

1. Apply Molykote Longterm to the speed sensor and the hole in the wheel carrier.

   Caution: There is **no O-ring** between the speed sensor and the wheel carrier. In addition, the front and rear speed sensors must not be confused with each other. Otherwise, the blade of the speed sensor will be offset 90 degrees from the pulse edge.
   Distinguishing feature: Spare part no. marked on the speed sensor lead and position of mounting hole in relation to blade.
   1 = Front axle speed sensor
   2 = Rear axle speed sensor.



1959 - 45

2. Insert speed sensor in wheel carrier without applying any force and tighten the Allen bolt with 10 Nm (7.4 ftlb).

Printed in Germany - 12, 1995

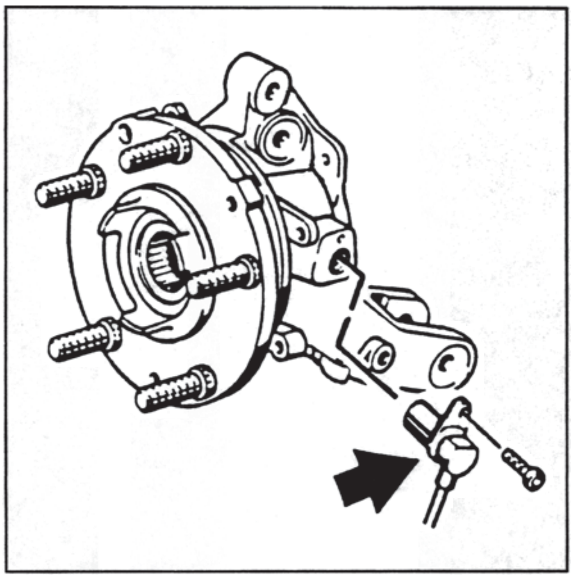
3. If the speed sensor is removed or replaced because of an ABS / ABD malfunction or in the course of repairing accident damage, the sensor must be tested using system tester 9288, menu "actual values" item "speed".
   Description in Repair Manual,
   p. 45 -37 / 45 - 38, Vol. VIII, Diagnosis.

45 15 19 Removing and installing rear speed sensor

Removal

1. With the ignition switched off, open the connector assembly on the wheel carrier and unplug the connector for the speed sensor.

2. Unscrew the mounting bolt (Allen bolt) and remove the speed sensor.

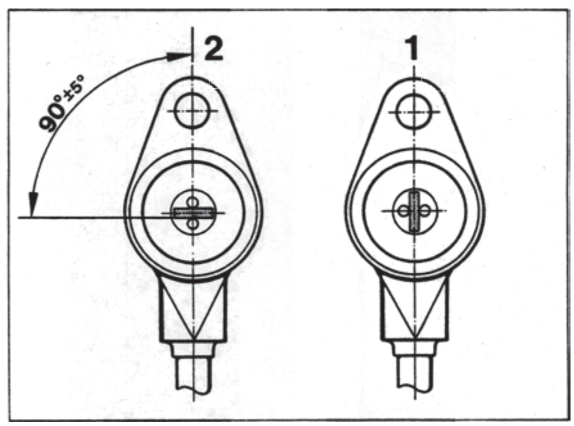


2199 - 45

Installation

1. Apply Molykote Longterm to the speed sensor and the hole in the wheel carrier.

   Caution: There is **no O-ring** between the speed sensor and the wheel carrier. In addition, the front and rear speed sensors must not be confused with each other. Otherwise, the blade of the speed sensor will be offset 90 degrees from the pulse edge.
   Distinguishing feature: Spare part no. marked on the speed sensor lead and position of mounting hole in relation to blade.
   1 = Front axle speed sensor
   2 = Rear axle speed sensor.



1959 - 45

2. Insert speed sensor in wheel carrier without applying any force and tighten the Allen bolt with 10 Nm (7.4 ftlb).

3. If the speed sensor is removed or replaced because of an ABS / ABD malfunction or in the course of repairing accident damage, the sensor must be tested using system tester 9288, menu "actual values" item "speed".
   Description in Repair Manual,
   p. 45 -37 / 45 - 38, Vol. VIII, Diagnosis.

46 Tightening torques for mechanical brake system

Location	Thread	Tightening torque Nm (ftlb.)
Brake caliper* to front and rear axle	M 12 x 1,5	85* (63)
Brake disc to wheel hub (front and rear axle)	M 6	5 (4)
Brake cover plate to front and rear axle	M 6	10 (7)
Rpm sensors to front and rear axles	M 6	10 (7)
Ball joint to brake pushrod	M 12 x 1,5** M 10***	17** (13) 35*** (26***)
Wheel to wheel hub	M 14 x 1,5	130 (96)

Replace mounting bolts on front axles whenever they have been undone

Vacuum brake booster

*** Hydraulic brake booster

46 Technical data 911 Carrera / 911 Carrera S

Designation		Remarks, dimensions	Wear limit
Service brake (foot-operated)		Hydraulic dual circuit brtake system with front/rear axle brake circuit division. Vacuum brake booster, inboard vented, drilled brake discs with four-piston fixed calipers on front and rear axle. ABS standard. ABS /ABD* available optionally	
Brake booster (vacuum)	dia.	9 in.	
Boost ratio		3.15	
Brake master cylinder	dia. front	23.81 mm	
	dia. rear	23.81 mm	
	Stroke	22.5 / 13 mm	
Brake power controller**			
Switchover pressure reducing factor		40 bar - 0.46	
Brake disc dia.	front	304 mm	
	rear	299 mm	
Effective brake disc dia.	front	251 mm	
	rear	246 mm	
Piston dia. in brake caliper	front	2 x 44 + 2 x 36 mm	
	rear	2 x 34 + 2 x 30 mm	
Brake pad area	front	250 cm^2	
	rear	172 cm^2	
Total brake pad area		422 cm^2	
Pad thickness	front	approx. 11.0 mm	2 mm
	rear	approx. 12.0 mm	2 mm

ABD = Automatic Brake Differential

Vehicles w. ABS = 1 brake power controller, vehicles w. ABS/ABD = 2 brake power controllers

Designation	Remarks, dimensions	Wear limit
Brake pad thickness, **new**		
front	32 mm	
rear	24 mm	
Brake discs		
Minimum thickness* **after machining**		
front	30.6 mm	30.0 mm
rear	22.6 mm	22.0 mm
Thickness tolerance of brake disc, max.	0.02 mm	
Lateral runout of brake disc max.	0.05 mm	
Lateral runout of wheel hub max.	0.04 mm	
Lateral runout of brake disc when installed, max.	0.09 mm	
Max- peak-to-valley surface roughness of brake disc after machining max.	0.006 mm	
Pushrod play (measured at brake pedal plate)	approx. 8 mm	
Parking brake	mechanical drum brake acting on both rear wheels	
Brake drum dia.	180 mm	181 mm
Brake shoe width	25 mm	
Brake pad thickness	4.5 mm	2 mm

* Brake discs may only be machined symmetrically, i.e. uniformly on both sides.

46 Technical data Carrera RS

The following values apply to the basic version M 002 and the Clubsport version M 003.

Designation		Remarks, dimensions	
Service brake (foot-operated)		Hydraulic dual circuit brtake system with front/rear axle brake circuit division. Hydraulic brake booster, inboard vented, drilled brake discs with four-piston fixed calipers on front and rear axle. ABS/ABD* as standard equipment	
Brake booster		hydraulic	
Boost ratio		3.6	
Brake master cylinder	dia. front	25.4 mm	
	dia. rear	25.4 mm	
	Stroke	17/15 mm	
Switchover pressure (2 units) reducing factor		40 bar - 0.46	
Brake disc dia.	front	322 mm	
	rear	322 mm	
Effective brake disc dia.	front	259,6 mm	
	rear	268,4 mm	
Piston dia. in brake caliper	front	2 x 44 + 2 x 36 mm	
	rear	2 x 36 + 2 x 30 mm	
Brake pad area	front	302 cm^2	
	rear	250 cm^2	
Total brake pad area		552 cm^2	
Pad thickness	front	approx. 11.0 mm	2 mm
	rear	approx. 11.0 mm	2 mm

ABD = Automatic Brake Differential

The following values apply to the basic version M 002 and the Clubsport version M 003.

Designation	Remarks, dimensions	
Brake pad thickness, **new**		
front	32 mm	
rear	24 mm	
Brake discs Minimum thickness* **after machining**		
front	30.6 mm	30.0 mm
rear	22.6 mm	22.0 mm
Thickness tolerance of brake disc, max.	0.02 mm (new 0.01 mm)	
Lateral runout of brake disc max.	0.05 mm	
Lateral runout of wheel hub max.	0.04 mm	
Lateral runout of brake disc when installed, max.	0.09 mm	
Max- peak-to-valley surface roughness of brake disc after machining max.	0.006 mm	
Pushrod play (measured at brake pedal plate)	approx. 8 mm	
Parking brake	mechanical drum brake acting on both rear wheels	
Brake drum dia.	180 mm	181 mm
Brake shoe width	25 mm	
Brake pad thickness	4.5 mm	2 mm

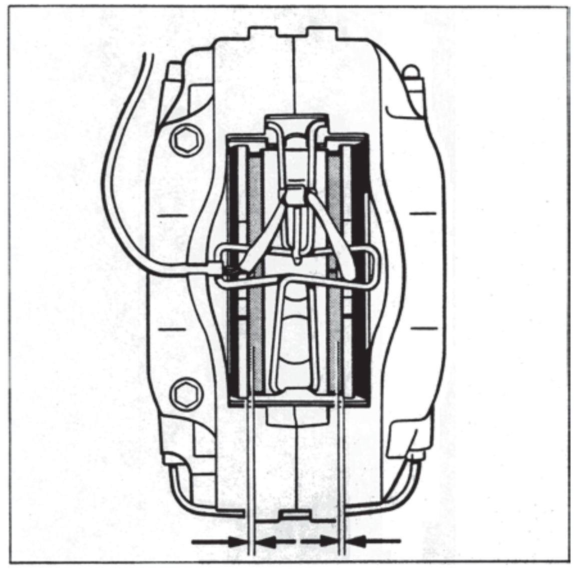
* Brake discs may only be machined symmetrically, i.e. uniformly on both sides.

46 Checking thickness of brake pads

Note

When the brake pad wear warning lamp lights up or when a remaining pad thickness of 2 mm has been reached, all brake pads of the respective axle must be replaced.

If brake pad wear is indicated by the wear warning lamp, the warning contact (sender complete with wire and connector) must be replaced at the same time. Replacement of the warning contact can be avoided by replacing the brake pads at the latest when they are worn to a thickness of 2.5 mm. If the warning contact wire has been ground down to the bare core, the contacts must be replaced. Replacement is not necessary, however, if rubbing wear is limited to the plastic part of the warning contact only.



578-46

1. Remove **rear wheel** to check the brake pads.
   The front brake pads may be inspected with the wheels remaining fitted.

2. Check brake pads visually for wear.

The wear limit has been reached if the pad is worn down to a remaining thickness of 2 mm.

46 36 20 Removing and installing front brake pads

Note

The brake pads are replaced as on the other Porsche models with four-piston fixed calipers. The operations are therefore only described in brief. The following instructions, however, should be observed at all times:

Use correct brake pad quality (refer to spare parts catalog).

Replace damping plates whenever the brake pads are replaced.

The damping plate are provided with an adhesive backing and a protective sheet. **This protective sheet must be removed prior to installation.**

Never apply grease to the brake back-plates (backs of brake pads).

Removal

Compress cross spring in the middle and disengage it from its seat. **At the same time, i.e. before compressing the cross spring, press the spring in the holder area towards the brake disc (release spring).** This prevents damage to the holder plate.

Move out warning contact on brake caliper and pull warning contact out of brake pad backing plate.

Note

Replace warning contacts if wire core is exposed or ground through. If grinding marks are limited to the plastic section of the warning contact, the contact may be reused.

Pull out brake pads with brake pad impact puller. **Be sure to observe** the following notes:

Move out brake pads along with damping plates. If this is not possible (depending on the degree of wear of the brake pads), use a spatula to separate the damping plates from the pad backing plate prior to removal of the pads.
In both cases, start by resetting the brake pads as far as possible using a piston retracting tool. If required, draw off some brake fluid from the reservoir prior to this operation.

Installing

If required, use retracting tool to push pistons back into home position.

Clean seating and guide surface of brake pads inside the caliper with white spirits and a cylindrical brush or special brush. **Take care not to damage the dust caps of the brake pistons.**

Fit **new damping plates** to the pistons. As the damping pads are provided with an adhesive backing and a protective sheet, the **protective sheet must be removed** before fitting the plates.

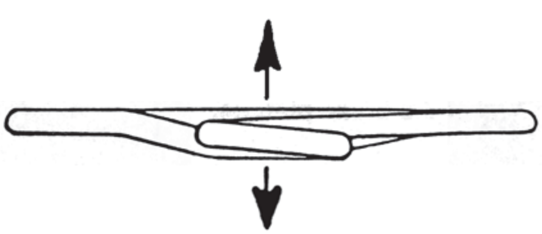
Install brake pads. **Observe correct brake pad quality.**

Note

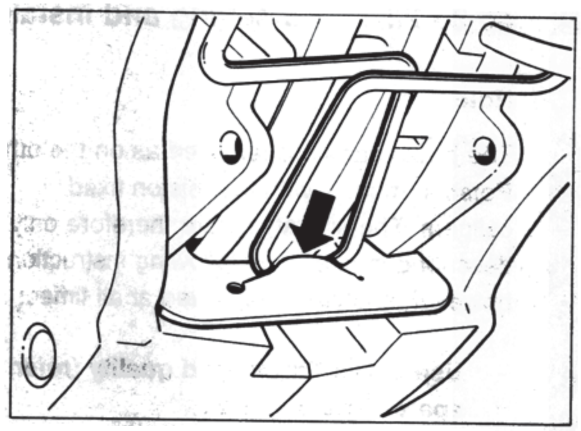
Never apply grease to the brake pad back-plates (back of brake pads). To prevent the brake pads from corroding in the caliper, however, the seating and guide surfaces are protected by a thin grease coat.
Use Optimoly HT (Cu paste) or Plastilube (supplied by Schillings, Postfach 1703, D-73431 Aalen) for this purpose.

Lubricate attachment eyes of the cross spring with Optimoly **TA** or Plastilube.
If required, install new cross spring in such a manner that the flat side points towards the brake disc. **Make sure the cross spring (arrow) engages correctly. Do not use force to push the spring into its seat (risk of damaging the holder).**

Brake disc



Outside



1102-46

Engage warning contact lever and warning contact. If necessary, disengage the cross spring again for this purpose.

With the vehicle stationary, operate brake pedal firmly several times to move the brake pads into the position corresponding to their operating position.
Then check brake fluid level and top up if required.

Running in the brake pads

New brake pads require a running-in period of approx. 200 kms (120 miles). It is only after this period that they reach an optimum friction and wear coefficient. During this period, use of the brakes for full braking from high speeds should be limited to emergency situations only.

46 38 20 Removing and installing rear brake pads

Note

The brake pads are replaced as on the other Porsche models with four-piston fixed calipers. The operations are therefore only described in brief. The following instructions, however, should be observed at all times:

Use correct brake pad quality (refer to spare parts catalog).

Replace damping plates whenever the brake pads are replaced.

The damping plates are provided with an adhesive backing and a protective sheet. **This protective sheet must be removed prior to installation.**

Never apply grease to the brake back-plates (backs of brake pads).

Note

Replace warning contacts if wire core is exposed or ground through. If grinding marks are limited to the plastic section of the warning contact, the contact may be reused.

Pull out brake pads with brake pad impact puller. **Be sure to observe** the following notes:

Move out brake pads along with damping plates. If this is not possible (depending on the degree of wear of the brake pads), use a spatula to separate the damping plates from the pad backplate prior to removal of the pads.
In both cases, start by resetting the brake pads as far as possible using a piston retracting tool. If required, draw off some brake fluid from the reservoir prior to this operation.

Removal

Compress cross spring in the middle and disengage it from its seat. **At the same time, i.e. before compressing the cross spring, press the spring in the holder area towards the brake disc (release spring).** This prevents damage to the holder plate.

Move out warning contact on brake caliper and pull warning contact out of brake pad backplate.

Installing

If required, use retracting tool to push pistons back into home position.

Clean seating and guide surface of brake pads inside the caliper with white spirits and a cylindrical brush or special brush. **Take care not to damage the dust caps of the brake pistons.**

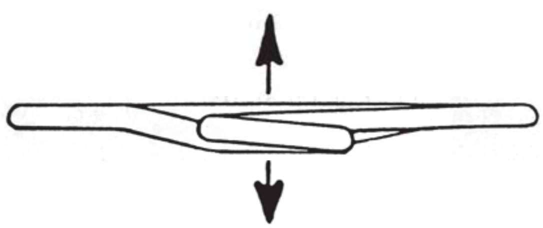
Fit **new damping plates** to the pistons.
As the damping pads are provided with an adhesive backing and a protective sheet, the **protective sheet must be removed** before fitting the plates.

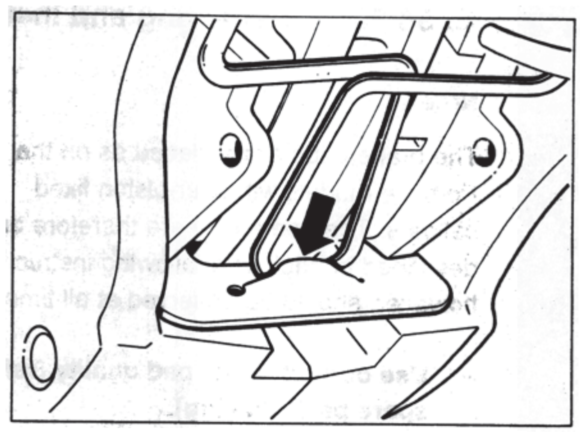
Install brake pads. **Observe correct brake pad quality.**

Note

Never apply grease to the brake pad back-plates (back brake pads). To prevent the brake pads from corroding in the caliper, however, the seating and guide surfaces are protected by a thin grease coat.
Use Optimoly HT (Cu paste) or Plastilube (supplied by Schillings, Postfach 1703, D-73431 Aalen) for this purpose.

Lubricate attachment eyes of the cross spring with Optimoly **TA** or Plastilube.
If necessary, install new cross spring in such a manner that the flat side points towards the brake disc. **Make sure the cross spring (arrow) engages correctly. Do not use force to push the spring into its seat (risk of damaging the holder).**





1102-46

Engage warning contact lever and warning contact. If necessary, disengage the cross spring again for this purpose.

With the vehicle stationary, operate brake pedal firmly several times to move the brake pads into the position corresponding to their operating position.
Then check brake fluid level and top up if required.

Running in the brake pads

New brake pads require a running-in period of approx. 200 kms (120 miles). It is only after this period that they reach an optimum friction and wear coefficient. During this period, use of the brakes for full braking from high speeds should be limited to emergency situations only.

46 11 15 Adjusting brake pushrod

The brake pedal does not have a stop.
The fixed clearance in the brake booster is ensured by the fact that the brake pedal does not have any support in the neutral position when the brake pushrod is adjusted correctly. When the brake pedal is actuated manually, a pushrod clearance **of approx. 8 mm** can be felt at the pedal plate.

When the pushrod is adjusted at the pivot (3), the position of the brake pedal changes as well. In this case, the stop light switch adjustment should therefore be checked as well.

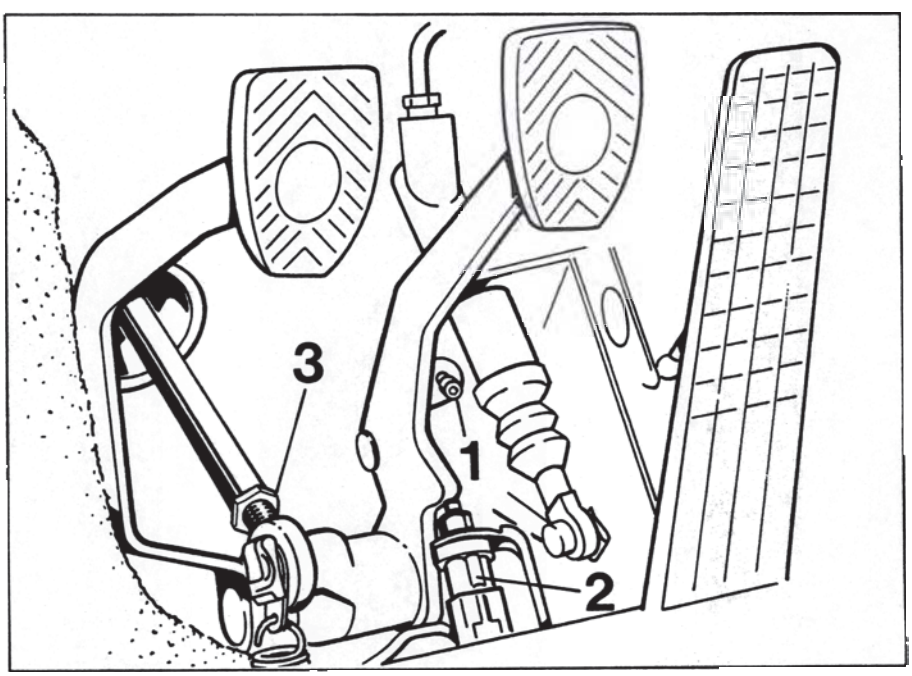
The brake pushrod is adjusted correctly when the brake pedal plate is approximately at the same height (± 3 mm) as the clutch pedal plate. (With clutch pedal in neutral position).

Checking stop light switch adjustment

The stop light must light up after a pedal travel of 6-16 mm (measured to the center of the pedal plate).

If the stop light comes on at a pedal travel of less than 6 mm, turn the stop light switch (2) to the right until it is actuated within the tolerance range. (Take care not to damage the electrical wiring and connector) If the adjustment range of the brake light switch is not sufficient, adjust the brake pedal at the pivot of brake pushrod 3 (by shortening the pushrod).

If the stop light switch lights up after a pedal travel of more than 16 mm, adjust the brake pedal at the pivot of the brake pushrod (by increasing the pushrod length) until the stop light switch is actuated within the tolerance range.



1452-46

46 83 16 Adjusting parking brake shoes

Includes: Adjusting parking brake shoes and parking brake cables

Checking free travel of the parking brake lever

The parking brake is fitted with asbestos-free brake linings. As a rule, the parking brake fitted with asbestos-free brake linings must never be adjusted in such a manner that the lining has to "grind itself free" during operation.

If the brakes do not show any effect when the parking brake lever is pulled up by more than 4 notches using medium force, the parking brake must be adjusted.

Adjusting parking brake

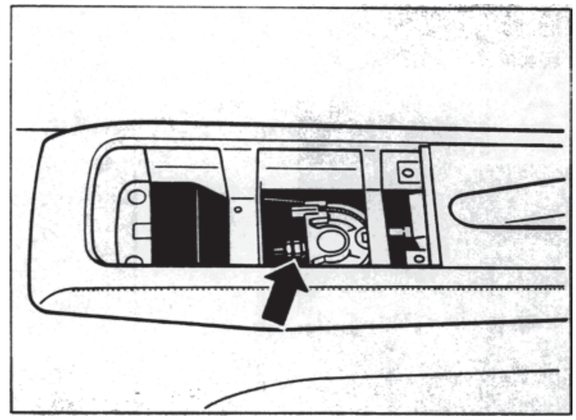
1. Remove rear wheels.

2. Release parking brake lever and push back brake pads of rear axle until the brake disc rotates freely.

3. Undo adjusting nuts at the turnbuckle (arrow) until the cables are no longer under tension.

Note

Remove the cassette box behind the parking brake lever to gain access to the turnbuckle. The fastening screw is located below the rubber insert.



576-46

4. Engage a screwdriver in the hole in the brake disc and adjust the adjuster until the wheel cannot be rotated anymore. Then back off adjuster until the wheel can be rotated freely. *Now back off (loosen) by two more notches.*

5. Pull up parking brake lever by two notches and turn adjusting nut on the turnbuckle until both wheels can just barely be turned manually.

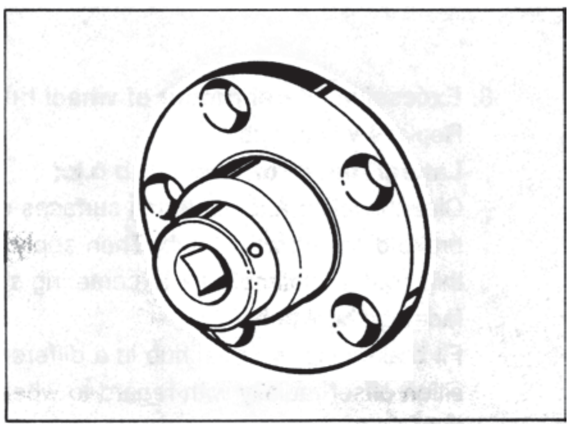
6. Release parking brake lever and check if both wheels rotate freely.

46 50 04 Measuring lateral runout of front brake discs

Concerns: Measuring thickness tolerance of brake discs

1. Measuring requirements: No tilt play of the wheel.

2. Fit adapter plate (Special Tool 9510/1) **to wheel hub.** Tightening torque of wheel nuts (mounting nuts) is 130 Nm (96 ftlb.).

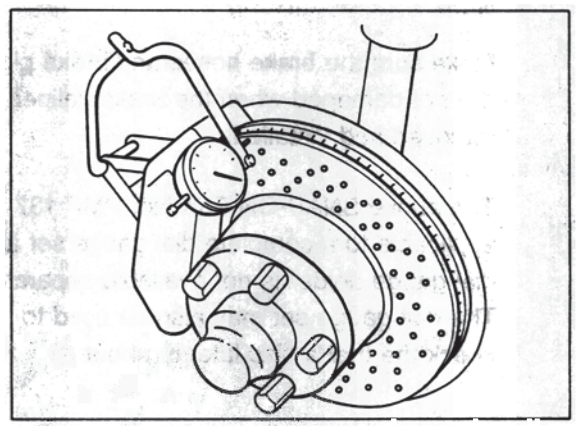


1035 - 46

3. Engage dial gauge holder, e.g. Ate Part No. 03.9314-5500.3/01, into the brake caliper, center out and mount by turning the wing screw.
   Retract brake pads somewhat if the brake disc cannot be rotated freely.
   Do not damage lug for cross spring at the retaining plate of the four-piston fixed calipers when fitting the dial gauge holder.

If required, fit dial gauge holder with Ate conversion kit, Part No. 03.9314-5510.3/01 (longer wing screw and bracket for dial gauge if necessary).

4. Fit dial gauge with a slight preload. Place measuring pointer on largest diameter of brake surface outside of perforation.



1036B-46

5. Rotate brake disc and read off runout on dial gauge.
   Max. permissible lateral runout of fitted brake disc: **0.09 mm.**

Lateral runout of removed brake disc:	**max. 0.05 mm**
Lateral runout of wheel hub:	**max. 0.04 mm.**

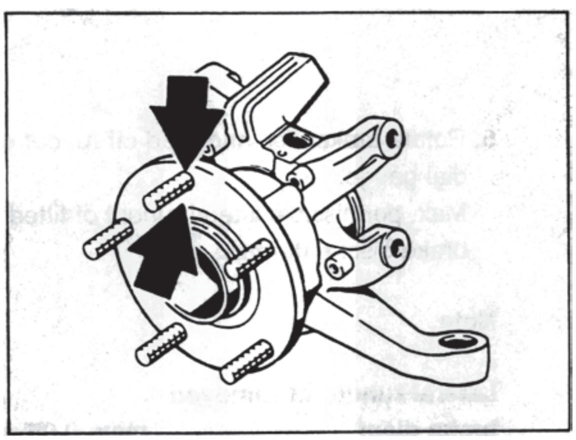
6. If the lateral runout of the brake disc exceeds 0.09 mm, remove the brake disc and check lateral runout of wheel hub. Before dismantling, mark position of disc on wheel hub.

7. Check runout of wheel hub as follows: Measure once outside (arrow) and once inside **wheel stud area (5-point measuring process)** of hub face.
   To fit the dial gauge, use either a universal dial gauge holder, e.g. by SNAP - ON (Part No. PMF 137), or a **modified (extended)** dial gauge holder - VW 387.

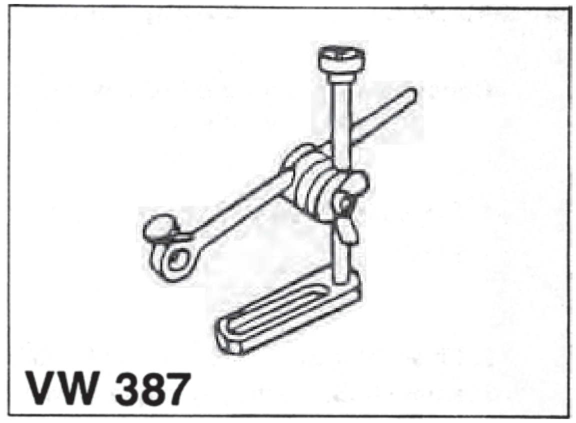
Note

Make sure the brake hoses and brake pipes are not damaged when the brake caliper is removed and installed.

The above SNAP-ON Part No. PMF 137 is applicable to a complete dial gauge set as the dial gauge holder is not available separately. The dial gauge set may also be used to check the brake disc lateral runout.



1601-46



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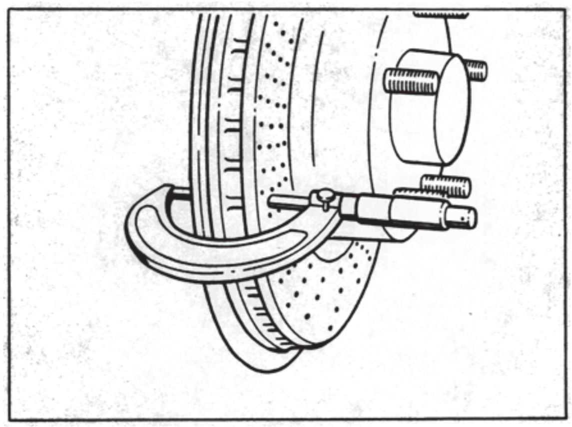
8. **Excessive lateral runout of wheel hub:**
   Replace wheel hub.
   Lateral runout of wheel hub o.k.:
   Clean leveling and centering surfaces of brake disc and wheel hub. Then apply a thin coat of Optimoly TA to centering surface of wheel hub.
   Fit brake disc to wheel hub in a different position offset radially with regard to wheel hub.
   Repeat measurement with adapter plate fitted (Special Tool 9510/1).
   If the lateral runout is still in excess of 0.09 mm, the brake disc must be replaced.

Note

If the brake disc runout has been reduced by offsetting the brake disc radially with regard to the wheel hub, one 6 mm countersunk head screw may be omitted if two 6 mm screws had been fitted.

Measuring thickness tolerance of brake disc

Measure brake disc thickness in approx.
8 places within the braking surface (outermost track) using a micrometer.
Thickness tolerance of brake disc:
max. 0.02 mm (New disc: max. 0.01 mm)



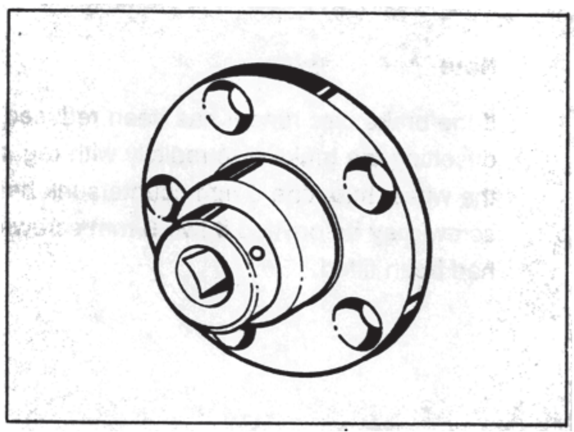
1040B-46

46 53 04 Measuring lateral runout of front brake discs

Concerns: Measuring thickness tolerance of brake discs

Measuring requirements: No tilt play of the wheel.

2. Fit adapter plate (Special Tool 9510/1) **to wheel hub**. Tightening torque of wheel nuts (mounting nuts) is 130 Nm.



46

3. Engage dial gauge holder, e.g. Ate Part No. 03.9314-5500.3/01, into the brake caliper, center out and attach by turning the wing screw.
   Retract brake pads somewhat if the brake disc cannot be rotated freely.
   Do not damage lug for cross spring on the retaining plate of the four-piston fixed calipers when fitting the dial gauge holder.

If required, fit dial gauge holder with Ate conversion kit, Part No. 03.9314-5510.3/01 (longer wing screw and bracket for dial gauge if necessary).

4. Fit dial gauge with a slight preload. Place measuring pointer on largest diameter of brake surface outside of perforation.

5. Rotate brake disc and read off runout on dial gauge.
   Max. permissible lateral runout of fitted brake disc: **0.09 mm.**

Lateral runout of removed brake disc:	**max. 0.05 mm.**
Lateral runout of wheel hub:	**max. 0.04 mm.**

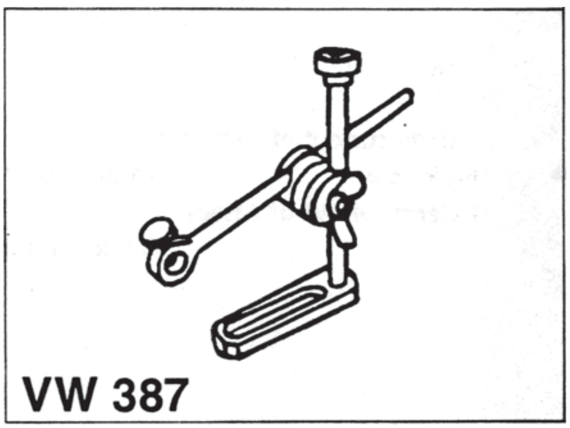
6. If the lateral runout of the brake disc exceeds 0.09 mm, remove the brake disc and check lateral runout of wheel hub. Before dismantling, mark position of disc on wheel hub.

7. Check runout of wheel hub as follows: Measure once outside (arrow) and once inside wheel stud area (5-point measuring process) of hub face. To fit the dial gauge, use either a universal dial gauge holder, e.g. by SNAP - ON (Part No. PMF 137), or a **modified (extended)** dial gauge holder - VW 387.

Note

Make sure the brake hoses and brake pipes are not damaged when the brake caliper is removed and installed.

The above SNAP-ON Part No. PMF 137 is applicable to a complete dial gauge set as the dial gauge holder is not available separately. The dial gauge set may also be used to check the brake disc lateral runout.



1039 - 46

8. **Excessive lateral runout of wheel hub:** Replace wheel hub.
   Lateral runout of wheel hub o.k.: Clean leveling and centering surfaces of brake disc and wheel hub. Then apply a thin coat of Optimoly TA to centering surface of wheel hub.
   Fit brake disc to wheel hub in a different position offset radially with regard to wheel hub.
   Repeat measurement with adapter plate fitted (Special Tool 9510/1).
   If the lateral runout is still in excess of 0.09 mm, the brake disc must be replaced.

Note

If the brake disc runout has been reduced by offsetting the brake disc radially with regard to the wheel hub, one 6 mm countersunk head screw may be omitted if two 6 mm screws had been fitted.

Measuring thickness tolerance of brake disc

Measure brake disc thickness in approx. 8 places within the braking surface (outermost track) using a micrometer.
Thickness tolerance of brake disc:
max. 0.02 mm (New disc: max 0.01 mm).

46 50 02 Checking front brake discs (wear assessment)

Includes:

1. **Visual inspection for cracks and crack assessment.**

2. **Checking brake discs for mimimum thickness.**

General

Two criteria may dictate replacement of drilled (perforated) brake discs:

1. **Advanced stage** of cracking in drilled (perforated) friction disc.

2. Disc thickness is below minimum due to wear (material abrasion caused by friction).

Both types of disc wear usually occur in service. **Normally,** brake discs will have to be replaced if the brake disc thickness is below minimum.
Only in rare cases **(if brakes are subjected to racing-like loads for longer periods** or if the friction surface is exposed to heavy temperature fluctuations) will perforation cracks **progress far enough** to require premature disc replacement.
Both condition criteria are described separately in the following sections.

1. Visual inspection for cracks and crack assessment

Note

Perforation cracks are caused by material fatigue due to severe, repeatedly fluctuating heat expansion. Disc temperature fluctuations of this nature that occur especially under racing conditions produce radial cracks in the perforation holes of the friction disc due to material fatigue (alternating thermal expansion). These cracks, on the other hand, will reduce tension in the friction disc to a certain extent, i.e. **crack growth continues only very slowly**.

The maximum admissible perforation hole crack length is 5 mm.

Further growth of perforation hole cracks or cracks at the edges of the friction disc impair braking comfort and reduce disc strength. For this reason, the components affected should be replaced as a precautionary measure.

Checking brake discs for cracks

The brake discs have to be replaced (as a precaution) in the following cases: Length of perforation hole cracks is **more than 5 mm** (this means that no service life reserves remain if brakes continue to be subjected to severe loads) **and/or** if **cracks appear at the edge of the brake disc** (reduction of braking comfort and of breaking strength).

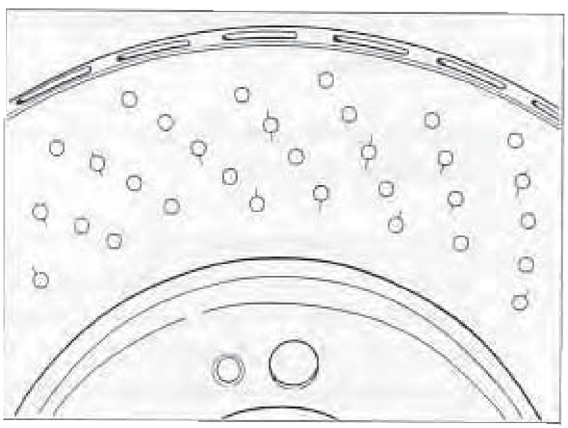
For examples of crack assessment, refer to page 46-22.

Examples of cracks assessment

Note

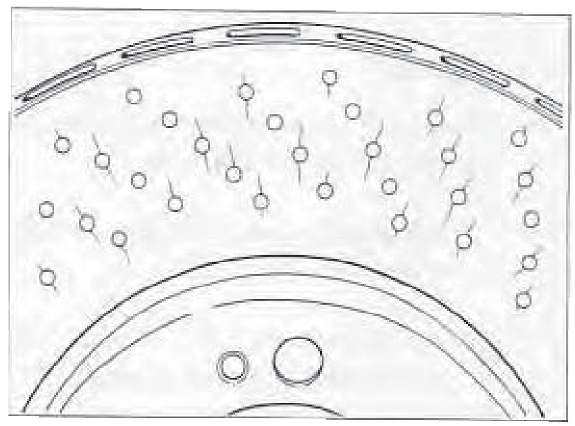
The crack thickness has been highlighted (to make identification easier) and therefore the cracks better visible than they actually are.

Shows a disc subjected to above-average loads; may ***remain in vehicle,*** *however, without any risk.*



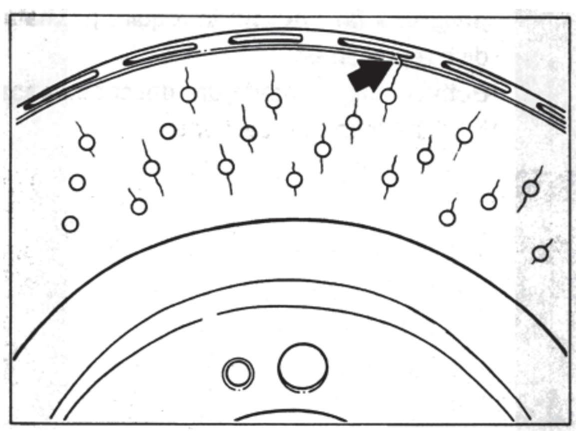
1978A-46

Some of the perforation hole cracks are more than 7 mm long. Brake disc is ***not*** *suitable for service any more.*
Condition after 1,200 shock brake applications.
(Minimum target: 200 shock brake applications).



1978B-46

Brake disc with cracks at edge of friction disc (911 Turbo brake disc); disc is ***not*** *suitable for service anymore.*



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2. Checking brake disc minimum thickness

Notes

Along the innermost and outermost friction disc tracks that **have no holes,** wear of the corresponding brake pad friction area is **lowest** - compared to the center hole area - **if the brakes are subjected to high** contact pressures. As a result, **less severe** braking will lead to a corresponding increase of surface pressure in these areas and, hence, to increased friction disc wear.
The natural ratio of heavy to light braking will produce the typical wear profile of a perforated friction disc in virtually every case (inner and outer, smooth friction edge zone shows greatest wear / refer to Fig. 1979I-46).

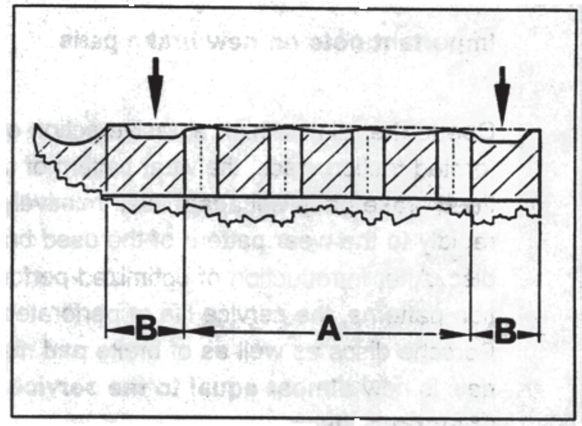
As opposed to smooth brake discs where the smallest thickness is measured in the disc center (effective frictional radius), **the minimum thickness** of **perforated brake discs** must always be measured at the inner or outer **track of the friction disc** that is worn to the greatest extent.

Checking minimum brake disc thickness

Use a suitable micrometer to measure the smallest brake disc thickness at one of the two smooth friction edge zones (at the friction edge zone that is worn to the greatest extent).

For the wear limit (minimum thickness), refer to the "Technical Data".

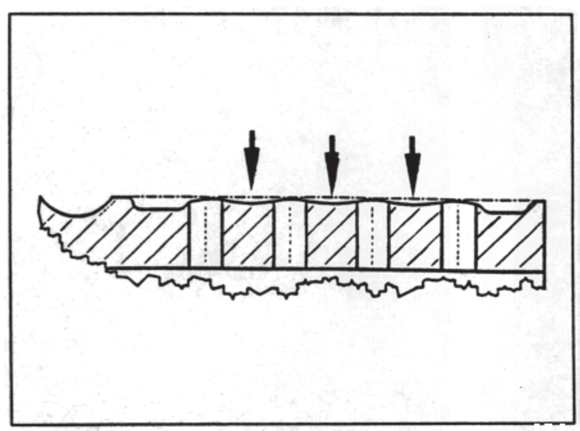
Observe important note on new brake pads on page 46 - 24.



Arrows = area of greatest wear on brake disc friction area
A = perforated friction area
B = smooth friction edge area

Example for area of greatest wear

The figure below shows the typical wear groove pattern (arrows) of a perforated 993 brake disc that was driven up to the wear limit under severe long-term operation (test operation).



Important note on new brake pads

Due to the relative high abrasive action of perforated friction discs, the wear pattern of newly fitted brake pads will adapt itself relatively rapidly to the wear pattern of the used brake disc. After introduction of optimized perforation patterns, the service life of perforated Porsche discs as well as of brake pad materials is now **almost equal to the service life of smooth discs.**

46 53 02 Checking rear brake discs (wear assessment)

Includes:

1. **Visual inspection for cracks and crack assessment.**

2. **Checking brake discs for minimum thickness.**

General

Two criteria may dictate replacement of drilled (perforated) brake discs:

1. **Advanced stage of cracking** in drilled (perforated) friction disc.

2. Disc thickness is below minimum due to wear (material abrasion caused by friction).

Two types of disc wear usually occur in service. **Normally,** brake discs will have to be replaced if the brake disc thickness is below minimum.
Only in rare cases **(if brakes are subjected to racing-like loads** for longer periods or if the friction surface is exposed to heavy temperature fluctuations) will perforation cracks **progress far enough** to require premature disc replacement.
Both condition criteria are described separately in the following sections.

1. Visual inspection for cracks and crack assessment

Note

Perforation cracks are caused by material fatigue due to severe, repeatedly fluctuating heat expansion. Disc temperature fluctuations of this nature that occur especially under racing conditions produce radial cracks in the perforation holes of the friction disc due to material fatigue (alternating themal expansion). These cracks, on the other hand, will reduce tension of the friction disc to a certain extent, i.e. **crack grwoth continues only very slowly**.

The maximum admissible perforation hole crack length is 5 mm.

Further growth of perforation hole cracks or cracks at the edges of the frictions disc impair braking comfort and reduce disc strength. For this reason, the components affected should be replaced as a precautionary measure.

Checking brake discs for cracks

The brake discs have to be replaced (as a precaution) in the following cases: Length of perforation hole cracks is **more than 5 mm** (this means that no service life reserves remain if brakes continue to be subjected to severe loads) **and/or** if **cracks appear at the edge of the friction disc** (reduction of braking comfort and of breaking strength).

For example of crack assessment, refer to page 46-22.

2. Checking brake disc minimum thickness

Notes

Along the innermost and outermost friction disc tracks **that have no holes,** wear of the corresponding brake pad friction area is **lowest** - compared to the center hole area - **if the brakes are subjected to high** contact pressures. As a result, **less severe** braking will lead to a corresponding increase of surface pressure in these areas and, hence, to increased friction disc wear.
The natural ratio of heavy to light braking will produce the typical wear profile of a perforated friction disc in virtually every case (inner and outer, smooth friction edge zone shows greatest wear / refer to Fig. 1979I-46).

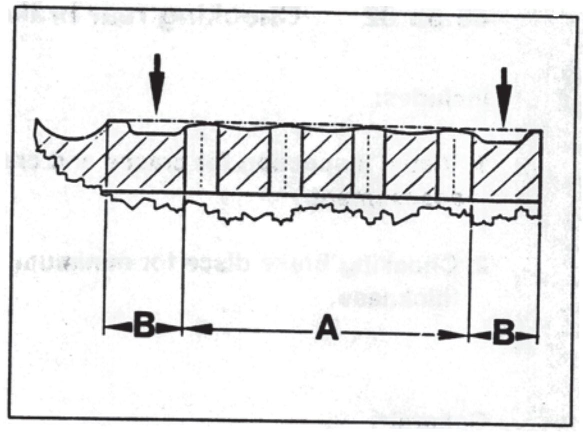
As opposed to smooth brake discs where the smallest thickness is measured in the disc center (effective frictional radius), **minimum thickness** of **perforated brake discs** must always be measured at **inner or outer track of the friction disc** that is worn to the greatest extent.

Checking minimum brake disc thickness

Use a suitable micrometer to measure the smallest brake disc thickness at one of the two smooth friction edge zones (at the friction edge zone that is worn to the greatest extent).

For the wear limit (minimum thickness), refer to the "Technical Data".

Observe important note on new brake pads on page 46 - 24.

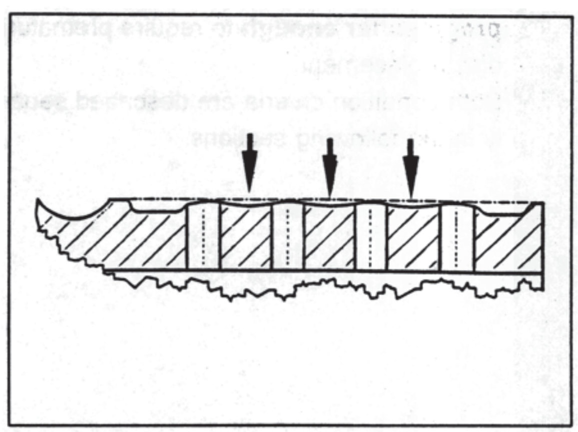


1979I-46

Arrows = area of greatest wear on brake disc friction area
A = perforated friction area
B = smooth friction edge area

Example of area of greatest wear

The figure below shows the typical wear groove pattern (arrows) of a perforated 993 brake disc that was driven up to the wear limit under severe long-term operation (test operation).



1979II-46

46 50 19 Removing and installing front brake disc

Removal

Take off front wheel.

2. Disconnect brake pipe from brake hose at spring strut and remove brake caliper. Before dismantling the brakes, push down brake pedal with pedal holder to prevent brake fluid from escaping from reservoir. Cover and plug brake hose and brake pipe (to prevent ingress of dirt). Remove retaining spring from brake hose.

3. After having undone the countersunk screw(s), take off brake disc. If the brake disc is binding and cannot be released even by applying light plastic hammer blows, screw two hexagon head bolts evenly into both 8 mm threads of brake disc and press off brake disc.

Installation

1. Check condition of all components and replace if required.

2. Clean end face and centering surface of brake disc and wheel hub. Apply a thin coat of Optimoly TA to centering surface of wheel hub.

3. Fit brake disc.

Be careful not to confuse right-hand and left-hand brake discs during reassembly.
The discs may be identified by their involute shape and part number. The part number is indicated on the brake disc.

Spare part for left-hand side -
3rd group number: uneven digit

Spare part for right-hand side -
3rd group number: even digit

Example:

Left-hand brake disc Part No.:
993.351.043.01

Right-hand brake disc Part No.:
993.351.044.01

4. Fit brake caliper. Tighten **new** bolts of brake caliper to 85 Nm.
   Check for correct routing of brake hose and brake pipe.
   Bleed front brake circuit.

Note

Replace the mounting bolts (front axle only) whenever the brakes have been dismantled.

46 53 19 Removing and installing rear brake disc

Removal

1. Take off rear wheel.

2. Remove brake caliper from wheel carrier and suspend caliper inside wheel housing (do not open hydraulic brake system).

3. Engage a screwdriver into the hole in the brake disc and turn adjuster in „slackening" direction.
   Lift off brake disc after removing countersunk screw(s).

Installation

1. Clean end face and centering surface of brake disc and wheel hub. Apply a thin coat of Optimoly TA to centering surface of wheel hub.

2. Fit brake disc (right and left-hand brake discs are identical).

3. Adjust parking brake shoes and parking brake cables (page 46 - 13).
   Fit brake caliper. Tighten mounting bolts to 85 Nm.

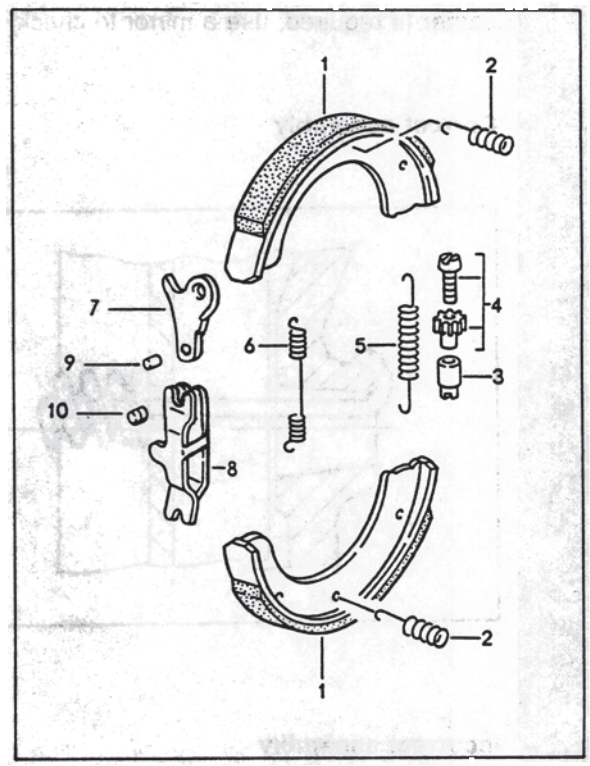
46 83 20 Removing and installing parking brake shoes

Removal

1. Take off rear wheel. Remove brake caliper from wheel carrier and suspend in wheel housing (do not open hydraulic brake system).

2. Engage a screwdriver into the hole in the brake disc and turn adjuster in "slackening" direction. Lift off brake disc after removing countersunk screw(s).

3. Remove compression springs (No. 2), adjuster (No. 3/4) and return spring (No. 5). Remove parking brake shoes and return spring (No. 6).



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Installation

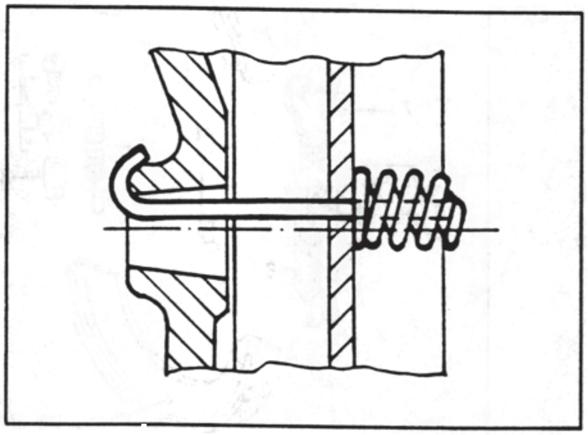
1. Apply a thin coat of grease to adjuster (No. 3/4), operating lever pin (spreader lever) and sliding surfaces of parking brake shoes.

2. Install operating lever (spreader lever), brake shoes, return springs, compression springs and adjuster.

Note

Make sure that the hooks (curved spring ends) of the compression springs are seated correctly around the flange of the wheel carrier (if required, use a mirror to check).

Correct assembly



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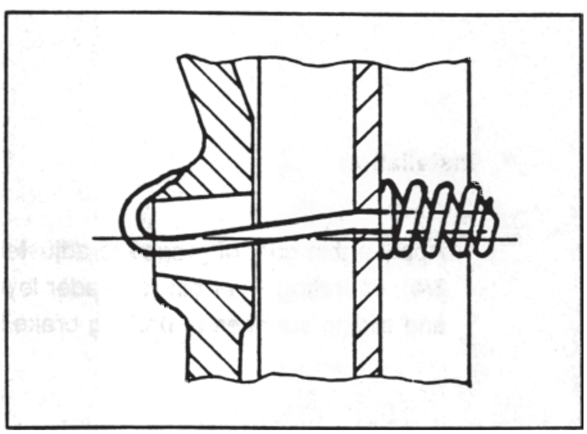
Incorrect assembly



764/1

3. Check parking brake shoes, adjuster, return springs, compression springs and spreader lever again for correct seating, making corrections as required.

4. Clean end and centering surfaces of brake disc and wheel hub. Apply a thin coat of Optimoly TA to centering surface of wheel hub.

5. Fit brake disc (right and left-hand brake discs are identical).

6. Adjust parking brake shoes and parking brake cables (page 46 - 13).
   Fit brake caliper. Tighten mounting bolts to 85 Nm.

47 Tightening torques for brake hydraulics

Location	Thread	Tightening torque Nm (ftlb.)
Booster circuit (Hydraulic brake booster)		
Brake pressure pipe to pressure accumulator, brake booster and pump unit	M 10 x 1	14 - 16 (steel pipes) (10 - 12)
Screw-on fitting (miniature measurement fitting to pressure accumulator	M 10 x 1	14 - 16 (10 - 12)
Pump unit mounting	M 6	10 - 13 (7 - 9.5)
Pressure warning switch to pump unit	M 25	26 (19)
Brake master cylinder circuits/ hydraulic unit		
Brake pressure pipe to brake master cylinder, brake hose, brake power controller, distributor unit, brake caliper and hydraulic unit.	M 10 x 1 M 12 x 1	12-14 (9-10) (copper pipe) 20 (15) (copper pipe)
Brake power controller to hydraulic unit	M 10 x 1	14 (10)
Hydraulic unit to bracket	M 6	10 (7; screw)
Hydraulic unit to body	M 6	4 (3; plastic nut)
Reservoir to body	M 6	10 (7)
Adapter to body	M 6	10 (7)

Location	Thread	Tightening torque Nm (ftlb.)
Brake caliper		
Connecting pipe to brake caliper	M 10 x 1	12 (9)
Bleeder screw to brake caliper	M 10 x 1	8 - 12 (6 - 9)
Brake booster unit with vacuum booster		
Brake booster (with mounting saddle and bracket) to side member	M 8	23 (17)
Brake booster to mounting bracket	M 8	23 (17)
Brake master cylinder to bracket and brake booster	M 8	23 (17)
Brake booster unit with hydraulic booster		
Brake booster to firewall	M 8	23 (17)
Brake master cylinder to brake booster adapter	M 8	23 (17)

* Do not remove adapter

47 Notes on four-piston fixed caliper

Assembly notes

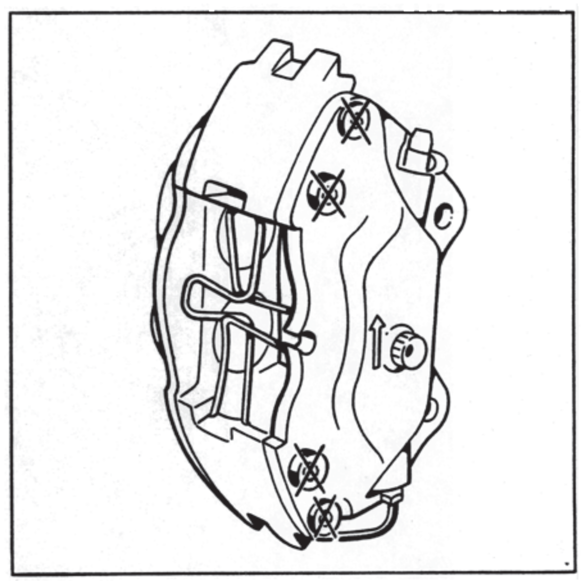
The brake caliper halves must not be separated from each other.

Piston seals, dirt scraper rings and spring plates may be replaced on an assembled fixed caliper.
To remove the spring plates, heat the mounting screws to approx. 150° C (300° F) with a hot air gun since the screws have been installed with locking cement. Use new screws for refitting.
These screws are attached to the repair kit.
The screw type has been changed and **Torx srews are now used instead of hexagon socket screws**. When stocks of the old kits have been used up, only kits with **Torx screws** will be available.
Caution: Apply **Loctite 222** to the screw threads. This applies to both types of screw. The bonding agent previously specified **must not be used.**
In the case of repair work, this also **applies retroactively to other brake calipers**.

Use Unisilikon TK 44 N 2 brake cylinder paste to fit the brake pistons. (This is also applicable **retroactively** for the repair **of other brake calipers**). Unisilikon paste is available from the Parts department (Part No. 000.043.117.00 / 50 g tube).

To be able to check the correct installation position of the brake calipers with the brake pads installed, the fixed calipers have an arrow indicating the direction of rotation of the brake disc.
The arrow is visible near the Porsche logo on the outside of the caliper, and above the brake pipe connection hole on the inside of the caliper.

When the brake calipers are removed, **the brake caliper mounting screws should be replaced on the front axle.**



1503-47

X = Never undo or tighten those screws

47 01 07 Bleeding the brakes (vacuum brake booster)

Caution: The description below applies only to vehicles with vacuum brake booster.

Important notes about brake fluid

Use only new brake fluid DOT 4.
Observe brake-fluid quality.

The brake fluid DOT 4 Type 200 used until now (change interval 3 years) is **no longer available** via the Porsche Parts Servie.

"**Super DOT 4**" brake fluid will be delivered instead. The **change interval** for this brake fluid is **2 years**.

Vehicles with brake systems filled with the previous brake fluid **must be filled with Super DOT 4 at the next scheduled brake-fluid change.**

This brake fluid is available under the following part number:
Container volume **1** litre = 000.043.203.**66**
Container volume **30** litres = 000.043.203.**67**

Miscibility of the brake fluids:
The brake fluid DOT 4 Type 200 used until now is **miscible** with Super DOT 4. This means that, until the next scheduled brake-fluid change, vehicles with brake systems filled with the previous brake fluid can be topped up with **Super DOT 4.**
Both brake fluids are coloured amber.

Note about water absorption:
As little as 2% water content in the brake fluid reduces the boiling point by approx. 60° C.

Procedure for bleeding

Fill reservoir to its top edge with new brake fluid. **Attach bleeding devie to the reservoir.**
Clamp the overflow hose / bleeding hose shut with a hose clamp. The overflow hose / bleeding hose has been omitted as of October 1995; refer to Technical Information, Group 4, No. 16/95.
Switch on the bleeding device. Bleed pressure approximately 1.5 bar.

Printed in Germany - 30, 1997

Proceed with bleeding the brake calipers.
Sequence: RH rear / LH rear / RH front / LH front.
Open each bleeding valve until clear, bubble-free brake fluid escapes. Make sure that both bleeder valves are bled at each brake caliper.

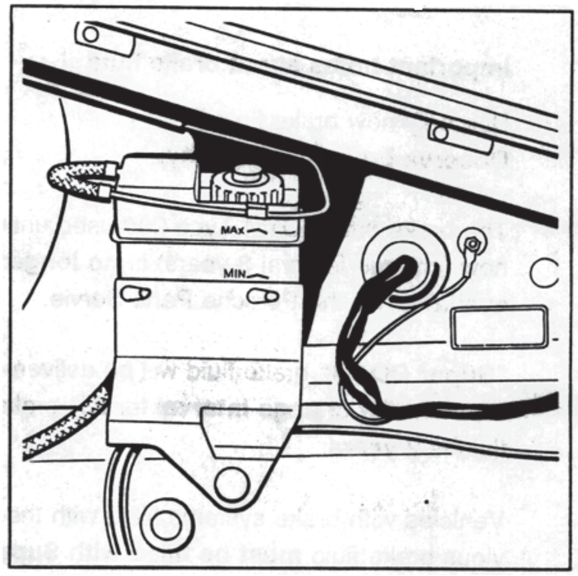
Use a recipient bottle to be able to check the escaping brake fluid for cleanliness, freedom from air bubbles and to check the quantity of brake fluid used.

Observe the following details when bleeding the brakes after fitting a new brake master cylinder: Open right-hand rear bleeder valves, then depress brake pedal several times. After depressing the pedal, keep it in the bottom position for 2 to 3 seconds and release pedal slowly. Repeat this procedure two or three times on the left rear / right front / right rear wheels. This causes all air bubbles to be removed from the brake master cylinder.

Note

Also carry out this operation if the hydraulic brake system has been drained virtually completely or if air is found to remain trapped in the system after bleeding (e.g. if pedal travel is excessive).
Caution: Double the pumping cycles on high-mileage vehicles or older vehicles but use only half the brake master cylinder stroke in these cases (to avoid damage to the master cylinder, i.e. primary cups).

Switch off and disconnect bleeding device.
Top up brake fluid if required.



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Note

When replacing the hydraulic unit on vehicles with ABD (**A**utomatic **B**rake **D**ifferential) **or if the hydraulic unit has been removed,** the ABD circuit (in the hydraulic unit) must be bled as well (refer to p. 47 - 7).

Bleeding the ABD Circuit

Preparatory operations: Bleed brakes in conventional manner (page 47 - 5/6)

Leave the bleeding device connected (switched on) to bleed the ABD circuit. Bleeding pressure approx. 1.5...2.0 bar. Overflow hose (for venting) on expansion tank is clamped off with a hose.

Connect **System Tester 9288** to the diagnostic socket. Switch on ignition. Select "Bleed" menu.

Open right-hand rear bleeder valve (use recipient bottle).

Press Start button on System Tester.
This causes certain functions in the hydraulic unit to be started (return feed pump, ASV valve and USV valve are triggered).
Bleed until the escaping brake fluid is free from air bubbles.
Additionally and during the whole bleeding process, depress brake pedal (at least 10 times) across the full pedal stroke (to the pedal stop) (pumping).
Warning: On high-mileage or older vehicles, double the pump cycles and use only half the brake master cylinder stroke (to avoid damage to the master brake cylinder/primary cup).

Close right-hand rear bleeder valve.
Then immediately actuate Stop button taste on System Tester.

Switch off ignition and disconnect System Tester.

Correct brake fluid level if required.

47 08 55 Changing brake fluid (Vacuum brake booster)

Caution: The description below is only applicable to vehicles with vacuum brake booster.

Important inforamtion

Use only new DOT 4 brake fluid. **Observe change intervals and specified brake fluid grade. Refer to Page 47 - 5 for further information.**
Total brake fluid change quantity **approx. 1 liter.**

Brake fluid changing precedure

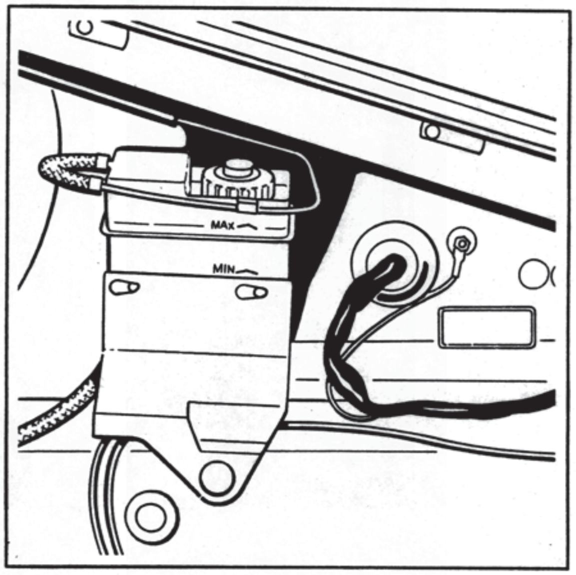
– Top up reservoir with fresh brake fluid to upper edge. **Connect bleeding device to reservoir.**
  Clamp the overflow hose / bleeding hose shut with a hose clamp. The overflow hose / bleeding hose has been omitted as of October 1995; refer to Technical Information, Group 4, No. 16/95.
  Switch on bleeding device. Bleeding pressure approx. 1.5 bar.

Proceed with brake fluid change on the brake calipers (no particular sequence required).
Open each bleeder valve until clear, bubble-free brake fluid escapes or until the specified change quality per caliper has been reached
(approx. 250 cm^3). Note that both bleeder valves have to be bled at each brake caliper.

Use a recipient bottle to be able to check the escaping brake fluid for cleanliness, freedom from air bubbles and to check the quantity of brake fluid used.

Also drain some brake fluid at the bleeder valve of the clutch slave cylinder (approx. 50 c.c.).

Switch off and disconnect bleeding device. Top up brake fluid if required.



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47 01 07 Bleeding the brakes (hydraulic brake booster)

Caution: The following description is only applicable to vehicles fitted with a hydraulic brake booster.

Important notes about brake fluid

Use only new brake fluid DOT 4.
Observe brake-fluid quality.

The brake fluid DOT 4 Type 200 used until now (change interval 3 years) is **no longer available** via the Porsche Parts Service.

"Super DOT 4" brake fluid will be delivered instead. The **change interval** for this brake fluid is **2 years.**

Vehicles with brake systems filled with the previous brake fluid **must be filled with SUPER DOT 4 at the next scheduled brake-fluid change.**

The brake fluid is available under the following part number:
Container volume **1** litre = 000.043.203.**66**
Container volume **30** litres = 000.043.203.**67**

Miscibility of the brake fluids:
The brake fluid DOT 4 Type 200 used until now is **miscible** with Super DOT 4. This means that, until the next scheduled brake-fluid change, vehicles with brake systems filled with the previous brake fluid can be topped up with **Super DOT 4.**
Both brake fluids are coloured amber.

Bleeding procedure / subdivision

1. **Bleeding the brake master cylinder circuits**
   (from page 47-12).
   Includes: Partial bleeding (simplified bleeding) of brake booster circuit (provided that **no** booster circuit components have been dismantled).
   If parts of the booster circuit have been dismantled, start by bleeding the booster circuit completely (from page 47-15).

2. **Bleeding the ABD circuit** (ABD = Automatic Brake Differential) in the hydraulic unit if the hydraulic has been replaced or removed (page 47-14).

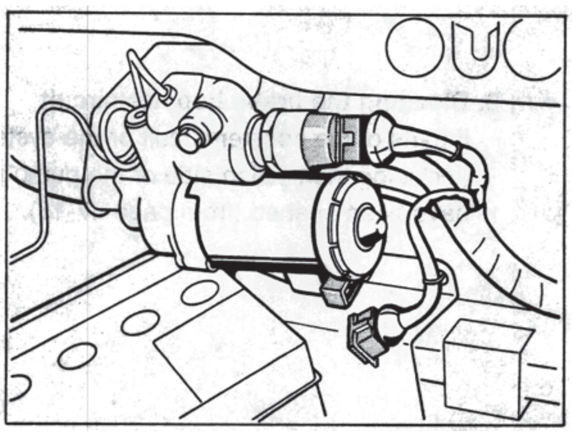
3. **Bleeding the brake booster circuit**
   if parts of the booster circuit or the system (including the suction side of the pump unit) have been opened (from page 47-15).

Re- 1: Bleeding the brake master cylinder circuits

Includes: Partial bleeding (simplified bleeding) of the brake booster circuit.

Important notes

Depressurize booster circuit prior to bleeding.
Do **not** depressurize **by actuating the brake pedal** but rather at the bleeding valve of the pressure accumulator.
Caution: Start by filling the accumulator completely (with ignition key in position 1, actuate brake pedal until pump starts to run). After the pump has switched off, **pull off electrical connector** and release pressure completely from accumulator vent valve. **Open bleeder valve slowly and keep bleeder hose in place.**
Caution: A pressure of up to 180 bar is present in the system.
Wear goggles and protective gloves!



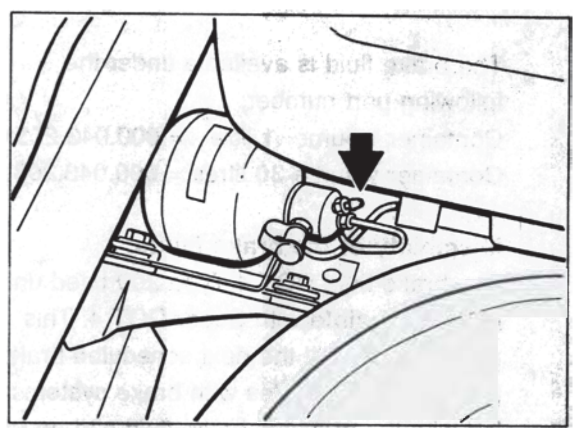
348-47

To allow the brake fluid to be changed in a rapid and practical manner, a filling and bleeding device should be used.

Bleeding procedure

After the pressure has been **released** from the booster circuit, top up with fresh brake fluid to upper edge of reservoir. **Connect bleeder device to reservoir.**
Connect overflow hose (block vent with hose clamp).
Switch on bleeder device. Bleeding pressure approx. 1.5 bar.

Bleed booster circuit partially as follows (simplified bleeding):
Open bleeder valve at pressure accumulator (use recipient bottle). Connect electrical connector to pump. As soon as the escaping brake fluid is free from air bubbles, pull off electrical connector and close bleeder valve.



1980-47

For the following bleeding processes, the booster circuit remains depressurized.

Proceed by bleeding the brake calipers. Bleeding sequence: Rear right / rear left / front right / front left.
Open each bleeder valve until clear, bubble-free brake fluid escapes. Note that each caliper must be bled at both bleeder valves.

Use a recipient bottle to allow the escaping brake fluid to be checked accurately for cleanliness and freedom from bubbles and to determine the quantity of brake fluid used.

After a new brake master cylinder has been fitted, proceed as follows during the bleeding process: Open rear right bleeder valves and depress brake pedal fully several times. Keep pedal depressed for 2 to 3 seconds each time and release pedal slowly.
Repeat this process in the following sequence: Rear left, front right / front left.
This allows all air bubbles to be removed from the brake master cylinder.

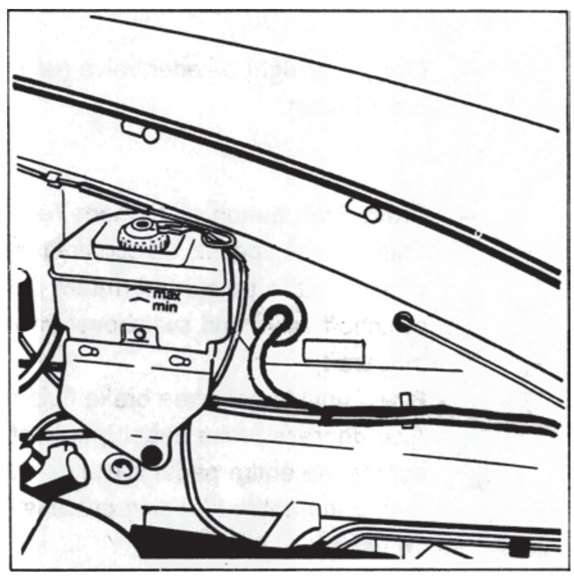
Also proceed in this manner if the hydraulic brake system has been drained virtually completely or if residual air remains in the system after bleeding has been completed (excessive pedal travel).
Caution: Double the pumping cycles on high-mileage vehicles or older vehicles but use only half the brake master cylinder stroke in these cases (to avoid damage to the master cylinder, i.e. primary cups).

Complete bleeding (continue with the next item) or continue by bleeding the ABD circuit, **if required** (refer to page 47 - 14).

Switch off and disconnect bleeder device.
Remove hose clamp from overflow hose (vent).

Fill pressure accumulator completely by reconnecting the electrical connector.

After the pump unit has switched off, check brake fluid level. **Never top up beyond the "Max. mark".**



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Re- 2: Bleeding the ABD circuit

Preparation: Bleed brakes in conventional manner (for master cylinder circuits, refer to p. 47-12 ...13).

The bleeder device remains connected (switched on) when the ABD circuit is bled. **In addition, the booster circuit must be depressurized.**
Bleeding pressure: approx. 1.5 to 2.0 bar.
Overflow hose (vent) is blocked with hose clamp at brake fluid reservoir.

Connect System Tester 9288 to diagnostic socket. Switch on ignition. Select "Bleed" menu.

Open rear right bleeder valve (use recipient bottle).

Press Start button on System Tester.
This causes specific functions in the hydraulic unit to be started (return pump, switchoff valve and switchover valve are triggered).
Bleed until bubble-free brake fluid escapes.
Also depress brake pedal (pump at pedal) across the entire pedal travel (to the stop) during the entire bleeding process (at least 10 times).
Caution: Double the pumping cycles on high-mileage vehicles or older vehicles but use only half the brake master cylinder stroke in these cases (to avoid damage to the master cylinder, i.e. primary cups).

Close rear right bleeder valve.
Then press Stop button immediately on System Tester.

Switch off ignition and disconnect System Tester.
Switch off and disconnect bleeder device.
Remove hose clamp from overflow hose (vent).

Fill pressure accumulator completely by reconnecting the electrical connector.

Correct brake fluid level after the pump unit has switched off. Never top up beyond the **"Max. mark"**.

Re- 3: Bleeding the brake booster circuit

Notes

The bleeding process includes two steps. The first step may be omitted in certain cases.

1st step: Preparatory operations for initial fitting or refitting.

2nd step: Bleeding the pressure accumulator.

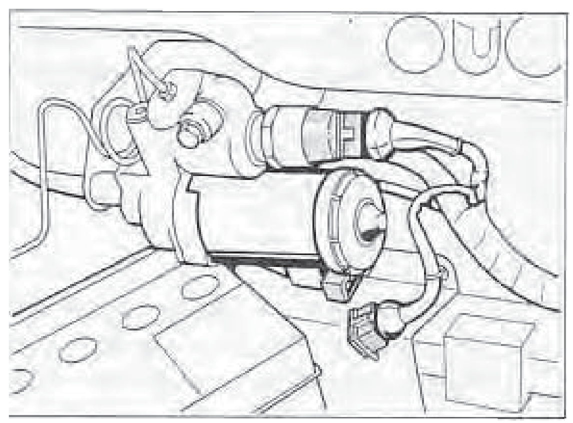
After replacing or removing the pump unit and pressure accumulator, follow these instructions carefully. If a different process is selected, the brake fluid may foam excessively.

Depressurize booster circuit before working on this cirucit (e.g. to remove or fit components).
To depressurize, pull off electrical connector from pressurizing pump (pump unit) (refer to drawing 348-47) and actuate brake pedal approx. 25 times. The system is depressurized as soon as the brake pedal feels hard when it is actuated.
To pull off and reconnect the electrical connector on the pressurizing pump, press on center of the connector locking clamp.

Preparatory operations for initial fitting or refitting: 1st step

This operation is only required if the pump unit and pressure accumulator have been replaced or refitted and if the suction line has been opened or if the reservoir was empty prior to the bleeding process.
In all other cases, start with the 2nd step (bleeding the pressure accumulator).

Make sure that the electrical connector has been pulled off at the pressurizing pump (pump unit).



348-47

Fill reservoir with fresh brake fluid up to the upper edge immediately after fitting the components.
Connect bleeder device to reservoir.
Block overflow hose (vent) with hose clamp. Switch on bleeder device.
Bleeding pressure approx. 1.5 bar.

Printed in Germany - 7, 1994

Note

While the bleeder device is connected, the brake pedal must not be depressed as the return line may otherwise be pushed out of the rubber plug of the brake booster.

Continue by bleeding the pressure accumulator.

Bleeding the pressure accumulator: 2nd step

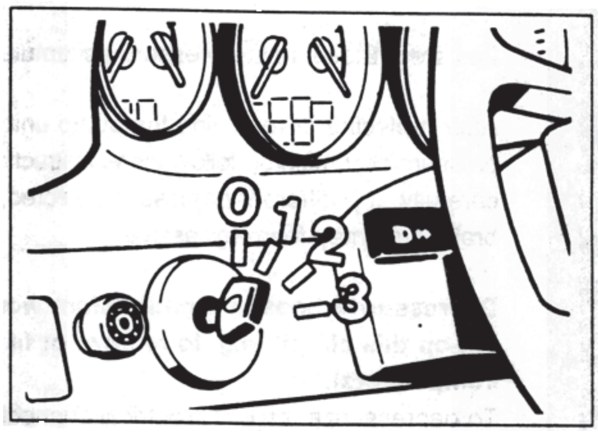
If step 1 has not been carried out, release any residual accumulator pressure as follows: Pull off the electrical connector from the pressurizing pump (pump unit) and open bleeder valve at the pressure accumulator slowly with the recipient bottle remaining connected. Make sure bleeder hose remains in place.

Caution:

A pressure of up to 180 bar is present at the bleeder valve of the pressure accumulator. Open bleeder valve very carefully. Make sure the bleeder hose is safely in place!
Wear goggles and protective gloves!

Unless this has already been done (if the system was already depressurized), connect recipient bottle **to pressure accumulator bleeder valve and open valve.**

Set ignition key to position 1 (required to start pump operation).
Connect electrical connector to pump. As soon as no bubbles are visible anymore at the transparent bleeder hose of the recipient bottle, disconnect electrical connector and close bleeder valve.



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Note

If the filler and bleeder device has not yet been connected, check fluid level of reservoir between the individual bleeding operations and top up with new brake fluid if required.

Fill pressure accumulator completely (bleeder valve closed). Connect electrical connector. As soon as the pump has switched off audibly, **pull off electrical connector** and release pressure completely at bleeder valve of pressure accumulator. Open bleeder valve slowly and keep bleeder hose firmly in place.
Caution: A pressure of up to 180 bar is present in the system.
Wear goggles and protective gloves!

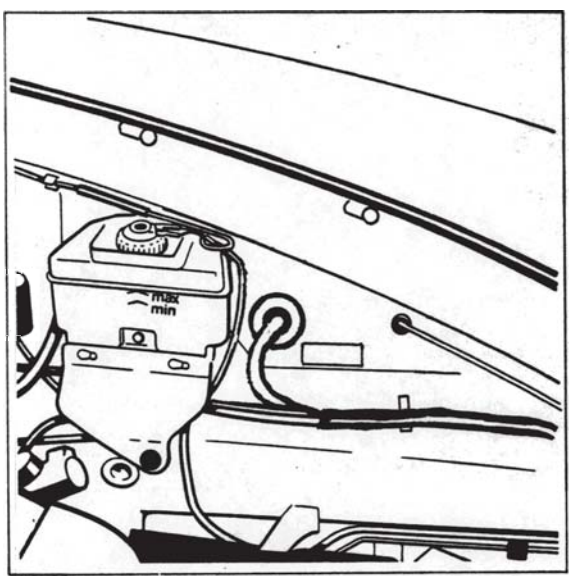
Repeat the latter operation (fill pressure accumulator completely and release accumulator pressure completely) once or twice (brake fluid must be free from air bubbles).

After making sure that all air bubbles have been evacuated by the bleeding process, tighten bleeder valve securely and reconnect electrical connector at pump.
Make sure that the connector engages correctly.

Switch off and disconnect bleeder device if it is still running and remove hose clamp from overflow hose (vent).

Operate brake pedal several times. (Make sure the bleeder device is not connected.)

After the pump unit has switched off, correct brake fluid level. **Never top up beyond the "Max. mark".**



2003-47

47 08 55 Changing the brake fluid (hydraulic brake booster)

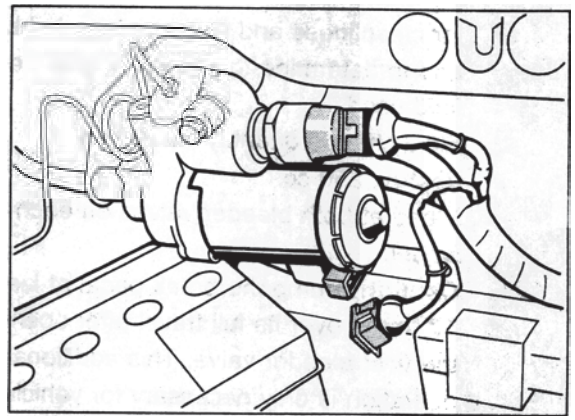
Important notes

Use only new DOT 4 brake fluid. **Observe correct fluid change intervals and fluid grade. Refer to Page 47 - 11 for further information.**
Total brake fluid quantity for brake fluid change **approx. 1.6 liters.**

Brake fluid change procedure

Important notes

Depressurize booster circuit before changing the brake fluid.
Do not depressurize by actuating the brake pedal but rather at the bleeding valve of the pressure accumulator. This will allow part of the old brake fluid to be drained.
Caution: Start by filling the accumulator completely (with ignition key in position 1, actuate brake pedal until pump starts to run). After the pump has switched off, **pull off electrical connector** and release pressure completely from accumulator vent valve. **Open bleeder valve slowly and keep bleeder hose in place.**
Caution: A pressure of up to 180 bar is present in the system.
Wear goggles and protective gloves!



348-47

To allow the brake fluid to be changed in a rapid and practical manner, a filling and bleeding device should be used.

If the booster circuit has not been depressurized completely, do not actuate the brake pedal while the bleeder device is connected.

Changing the brake fluid: 1st step

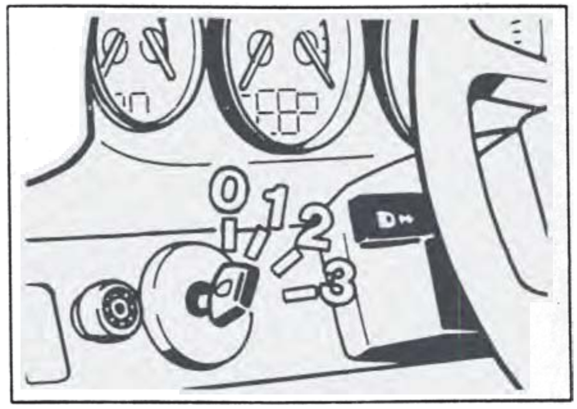
With the booster circuit depressurized, top up with fresh brake fluid to upper edge of reservoir. **Connect bleeder device to reservoir.**
Clamp the overlow hose / bleeding hose shut with a hose clamp. The overflow hose / bleeding hose has been omitted as of October 1995; refer to Technical Information, Group 4, No. 16/95.
Switch on bleeder device. Bleeding pressure: approx. 1.5 bar.

Use a recipient bottle to allow the escaping brake fluid to be checked accurately for cleanliness and freedom from bubbles and to determine the quantity of brake fluid used.
Fluid change quantity per wheel:
approx. 250 cc.
Bleed at both bleeder valves on each wheel.
Caution: Pump the break pedal at least **10 times** over its full travel after opening the **first** bleeder valve. This additional operation is only necessary for vehicles with hydraulic brake boosters and then only for the first bleeder valve.

Also drain some brake fluid from bleeder valve of clutch slave cylinder (approx. 50 cc).

Changing the brake fluid: 2nd step

With the bleeder device switched on, drain approx. 200 cc brake fluid at pressure accumulator. For this purpose, connect electrical connector to pressurizing pump with ignition key in position 1. As soon as the specified quantity has been drained, pull off connector and close bleeder valve.



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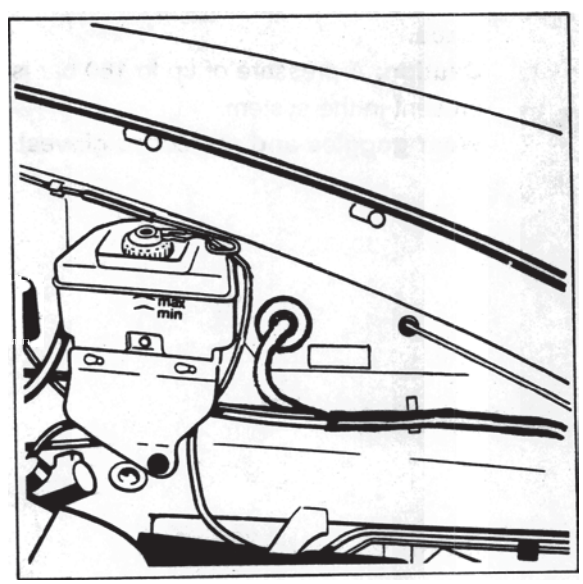
Switch off and disconnect bleeder device.
Remove hose clamp from overflow hose (vent).

Fill pressure accumulator completely by connecting the electrical connector.

After the pump unit has switched off, correct brake fluid level. **Never top up beyond the "Max. mark".**



2003-47

47 01 01 Pressure test on brake booster circuit

Overview

1. General

2. Pressure gauge connection

3. Tests

4. Nominal values / Notes

1. General

The pressure test on the brake booster circuit tests the following points:

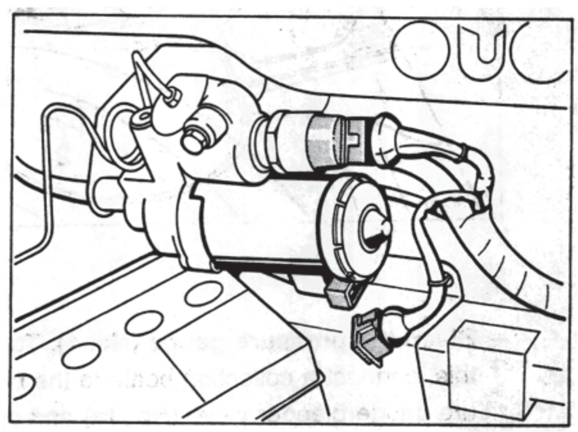
- Freedom from leaks of the booster circuit (any internal leak can thus be localized)

- Gas filling pressure of the pressure accumulator

  Switching points for the booster circuit (brake pressure warning lamp and operating pressure). This is controlled by the pressure warning switch of the pump assembly.

2. Pressure gauge connection

- Depressurize the booster circuit. To do this, disconnect the electrical plug at the pressure pump (pump assembly) and then press the brake pedal approx. 25 times. The system is depressurized as soon as the brake pedal feels hard when operated. In order to disconnect and plug the electrical plug onto the pressure pump, press in the center on the plug locking clip. The cover in the area of the pump unit need not be removed.



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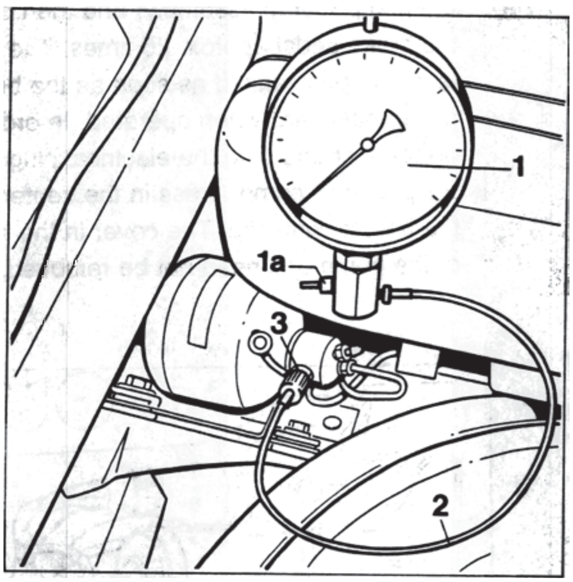
Printed in Germany - 13, 1985

- Connect pressure gauge 9509 (No.1) at the screw coupling (mini measuring connection No. 3) of the pressure accumulator with the high-pressure measuring line 9509/2 (No.2).



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– **Bleed the pressure gauge (No. 1).** To do this, connect a collection bottle to the pressure gauge bleeder valve (No. 1a) and open the valve.
  Move the ignition key to position 1 (necessary for pump operation).
  Plug the electrical plug onto the pump. **Disconnect the electrical plug and close the bleeder valve** as soon as no air bubbles are visible anymore at the transparent bleeder line of the collection bottle.

Note

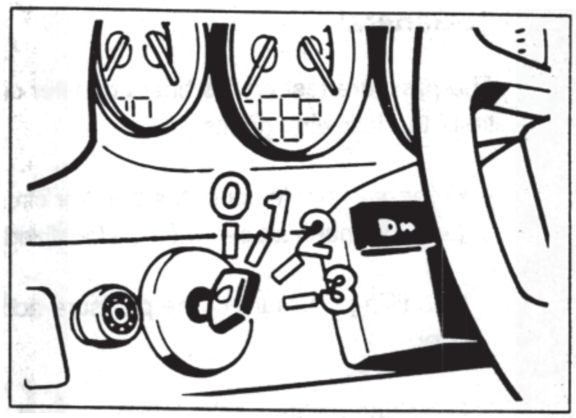
Before removing the manometer **after** the test, the booster circuit must be depressurized.

3. Tests

Note

Operation of the pump is regulated by means of the ignition key for testing purposes.

Position 0 = Pump off
Position 1 = Pump on until switched off by the pressure warning switch.



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– In ignition key position 0, plug the electrical plug onto the pump. Locate the pressure gauge in a position where it can be seen.

– For the tests, it is expedient to observe the following sequence:

a. Pressure accumulator - Gas filling pressure

b. Switching points for the brake pressure warning lamp

c. Cut-in and cut-out points of the pump

d. Leak test

Turn the ignition key to position 1 (pump starts up).

a. Gas filling pressure of the pressure accumulator.

Turn the ignition key to position 0 at approx. 100 bar.

Operate the brake pedal several times and observe the pressure gauge. When the indicator falls rapidly towards zero, the filling pressure of the pressure reservoir has been reached. For required values, see page 47-24.

Note

Sensitively operate the brake pedal shortly before the gas filling pressure is reached.

b. Checking the switching points for the brake pressure warning lamp.

Pressure build-up:

Start the engine and observe the warning lamp. Immediately turn the ignition key to 0 position at the instant when the warning lamp goes out. Read off the pressure on the pressure gauge.

Pressure reduction:

Produce a system pressure of approx. 140 bar. Disconnect the plug at the pressure pump.
Start the engine
Operate the brake pedal sensitively several times until the warning lamp lights up. Read off the pressure on the pressure gauge. Refer to Page 47 - 24 for nominal values.

c. Checking the switching points of the pressure pump

Cut-out pressure: Turn the ignition key to position 1. The electrical plug must be plugged onto the pressure pump for this.
Read off the pressure on the pressure gauge **immediately** after independent pump cut-out.

Cut-in pressure: Turn ignition key to position 1. Wait until the pump switches off independently if appropriate. Press the brake pedal as often as required until the pump starts up. Read off the pressure on the pressure gauge at this instant.
Refer to Page 47-24 for nominal values.

d. Checking the pressure loss of the booster circuit.

Turn the ignition key to position 1. Wait until the pump cuts out independently. Press the brake pedal as often as required until the pump starts up again. After independent cut-out of the pump, turn the ignition key to position 0 and disconnect the electrical plug at the pump. No longer operate the brake pedal. Measure the pressure drop over the course of time. Refer to Page 47 - 24 for permitted values.

Note

Depressurize the booster circuit before removing the pressure gauge.

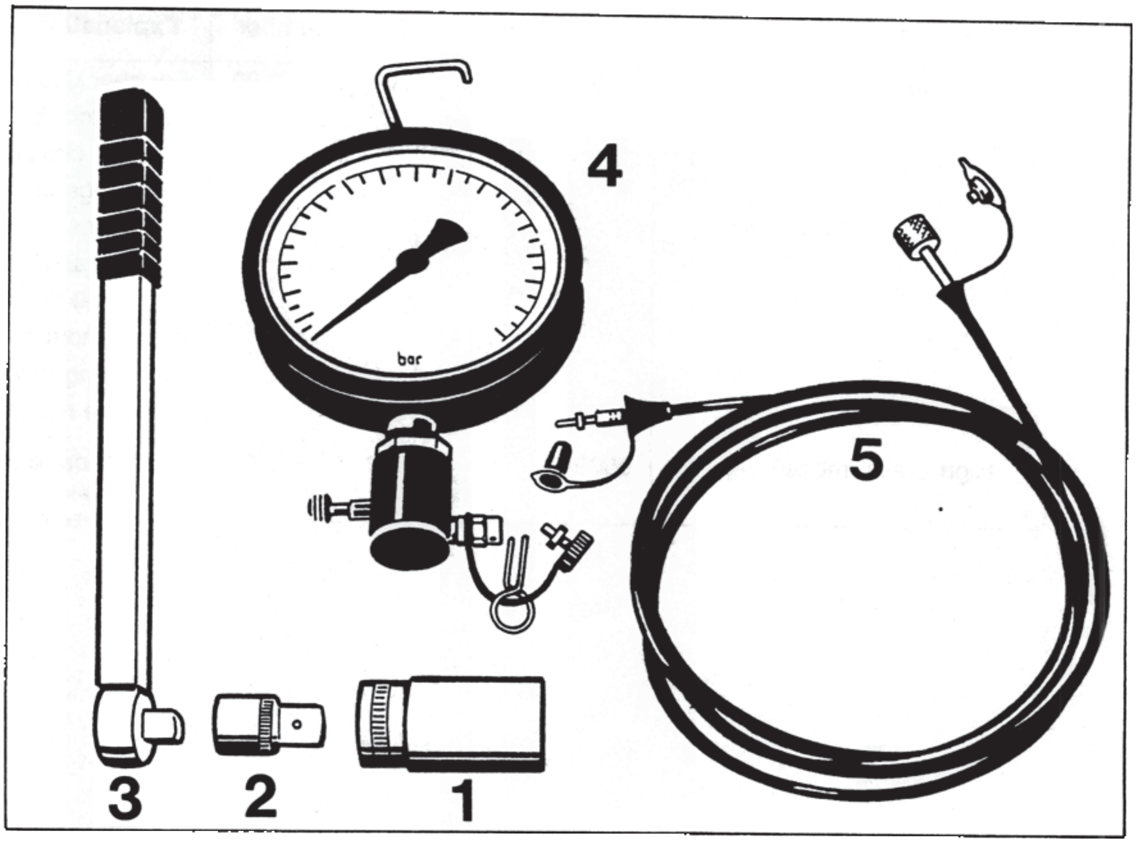
Printed in Germany - 13, 1985

4. Nominal values / Notes

Nominal values		Notes
Pressure accumulator - Gas filling pressure		Replace pressure accumulator if the gas filling pressure has reached or fallen below the wear limit.
new	80 ± 5 bar	
Wear limit	30 bar	
Switching points of the pressure warning switch		If the actual values deviate from the nominal values, replace the pressure warning switch
Brake pressure warning lamp warning point		
for pressure build-up	up to approx. 115 bar max. up to 133 bar	Read off the pressure immediately after independent cut-out of the pump
for presssure reduction	as from 105+2/–5 bar	
Cut-out point of the pump		
at the latest	at approx. 180 bar	
at the earliest	at approx. 160 bar	
Cut-in point of the pump		
(after pressure reduction)	140 + 5 / – 6 bar	
Freedom from leaks of the booster circuit Pressure drop, starting from the cut-out point of the pump (precondition: nominal value is achieved)		Fill the pressure accumulator completely 2 x previously (start the pump running again after 1st cut-out by operating the brake pedal). Then turn the ignition key to position 0 and disconnect the electrical plug at the pump. No longer operate the brake pedal now. External leak: Retighten lines or replace the corresponding parts.
not below 140 bar in 30 minutes not below 100 bar in 3 hours		Possible internal leaks: – Brake booster – Pump assembly First check the brake booster. To do this, dismantle the line at the pressure accumulator (in depressurized condition). Close off the pressure accumulator with a mini-measuring connection or suitable bleeder valve. Repeat the test. Then replace the localized/damaged parts and bleed the system. **Caution:** Wear protective goggles and protective gloves when decreasing the pressure via the bleeder valve.

47 66 19 Removing and installing pressure warning switch

Tools



No.	Designation	Special tool	Order number	Explanation
1	Socket wrench insert	9524	000.721.952.40	
2	Reducing adapter from 3/4" to 1/2" or 3/8" according to torque wrench used			available from automotive trade suppliers; to connect torque wrench with socket wrench insert
3	Self-releasing torque wrench covering torque range between 20 (15) and 30 Nm (22 ftlb)			available from automotive trade suppliers; Tightening torque for pressure warning switch 26 Nm (19 ftlb)

Printed in Germany - 15, 1995

Tools

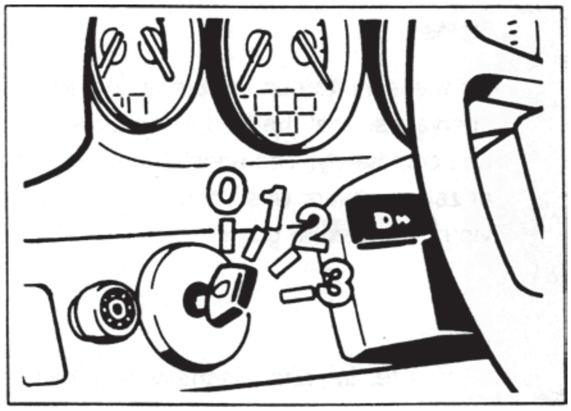
No.	Designation	Special tool	Order number	Explanation
4	Pressure gage	9509	000.721.950.90	For checking leakage and switching point (booster circuit pressure tests) together with measuring line 9509/2 (No. 5) or measuring line 9509/1 (-) on earlier cars without miniature measuring union on pressure reservoir
5	High press. measuring line	9509/2	000.721.950.92	connection to pressure reservoir

Printed in Germany - 15, 1995

Removing and installing pressure warning switch

Removing

1. With the ignition switch in position 0, pull off both plugs at the pump assembly.



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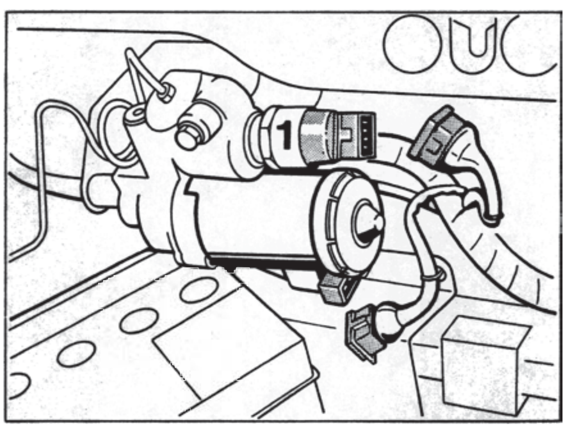


607-47

2. Evacuate all pressure from the system by pressing the brake pedal down about 25 times. The system is at zero pressure when the brake pedal feels hard as it is pressed.

3. Remove press. warning switch (No. 1 /Drawing 607-47) with special tool 9524. Prevent the pump assembly from turning while loosening the switch.
   Warning: first clean the area round the pressure warning switch and cover it with non-fluffy cleaning cloths to trap the small amount of residual brake fluid which emerges.

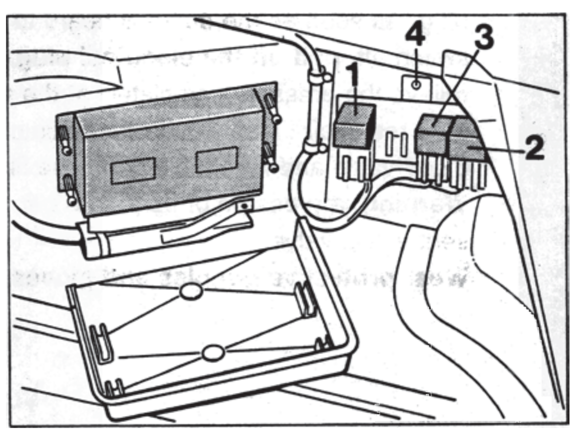
Installing

1. Screw in the pressure warning switch and tighten to a torque of 26 Nm (19 ftlb). Renew the O-ring if necessary. Prevent the pump assembly from turning while tightening.

Note

Wet the sealing ring with brake fluid only. Never use brake cylinder paste. Absolute cleanliness is essential. Use only non-fluffy cleaning cloths.

2. If there is an electrical fault at the pressure warning switch, always exchange hydraulic pump relay (no. 3) as well.



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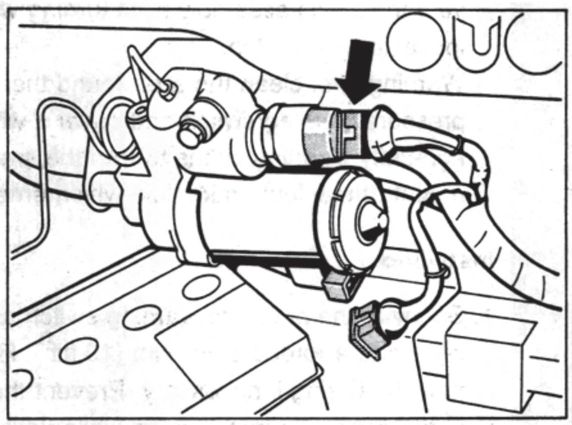
3. Attach plug to pressure warning switch (arrow).



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4. Partly bleed the booster circuit as follows:
   Open the bleed valve at the pressure reservoir. Attach the electrical plug to the pump. As soon as brake fluid emerges free from air bubbles, pull off the electrical plug and close the bleed valve.
   Next, charge the pressure reservoir completely. To do this, attach the electrical plug. As soon as the pump is heard to switch off, **pull off the electrical plug** and relieve the pressure completely at the pressure reservoir bleed valve. Slowly open the bleed valve and hold the bleed hose firmly.
   Warning: a pressure of up to 180 bar is present at the valve.
   Wear protective goggles and gloves.

5. Connect pressure gauge SW 9509 to the pressure reservoir and check the switching points of the pressure warning switch and also for leakage in the booster circuit.
   The precise working proced. and desired values are stated on Page 47 - 21...47 - 24 (Pressure tests on booster circuit).

Notes

If necessary, top up the brake fluid level at intervals so that the fluid reservoir is not drained completely. The booster circuit must be at zero pressure when connecting and removing the pressure gage.

6. After testing and assembly work has been completed, correct the brake fluid level (Page 47 - 20). with the pressure reservoir completely filled.

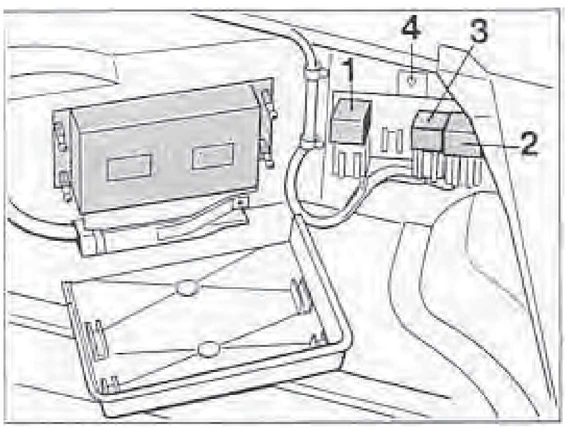
Printed in Germany - 15, 1995

47 90 19 Removing and installing relay for hydraulic pump

General

Three relays for controlling the return pump and the hydraulic pump (for the brake booster circuit) and for power supply to the solenoid valves in the hydraulic unit are installed on a mount in the front right part of the luggage compartment.

1 = Relay for return pump
2 = Relay for solenoid valves
3 = Relay for hydraulic pump
4 = Blind rivet



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Removal and installation

Remove and insert the relay (no. 3) with the ignition switched off.
Make sure that the connectors are firmly seated in the relay socket (the connectors may have slipped slightly down out of the relay socket).

Note

In order to remove the lid on the relay mount, the pin in the blind rivet must be pressed out and the mount must be completely removed. The pin can be removed by applying compressed air behind the mounting plate.

48 Tightening torques for steering

Location	Thread	Tightening torque Nm (ftlb.)
Steering gear to crossmember	M 8*	45* (33)
Tie rod (ball joint) to steering arm	M 12	65 (48)
Universal joint (steering shaft) to steering gear	M 8	23*** (17)
Tie rod to ball joint and joint fork (lock nut)	M 14	45 (33)
Tie rod to steering rack	M 14	70 (52)
Steering wheel to steering shaft	M 16	45 (33)
Steering outer tube to body**	M 6	10 (7)
Pressure and return line to steering gear	M 12	20 (15)
Pressure line to power pump	M 14	30 (22)
Pressure line to pressure line	M 14	25 (18)

Replace screws after every removal job. Use only genuine spare parts (microencapsulated screws). Since 1995, **12.9 screws have been used** (previously 10.9 screws). For replacement, **only 12.9 screws must be installed** on all 993 vehicles. The threads of the screws and the washers must be clean and fat-free. Remove microencapsulation residuals from the threaded bores required to fix the steering gear (use Aceton for cleaning, then blow out bores with compressed air).
Before tightening, screw down the screws evenly until the fastening clamps almost touch the cross member. During final tightening, **start with the screws for the short leg (of the cross member)** and pull them tight, so these surfaces will be the first to fit tightly.

** **Break off shear bolts after functional test (locking bolt of ignition lock) and visual inspection of all parts.**

*** Replace fit bolt whenever it has been undone.

Printed in Germany - 16, 1996

48 Checking and assembly operations on the power steering system

General

Damage to the power steering can be traced to lack of oil in the hydraulic system. Due to the high system pressure in the hydraulic cicuit, even minor leaks may cause fluid loss and damage to the power pump.

Grunting noises when turning the steering wheel or foaming in the reservoir are indicative of lack of oil and/or air drawn in. Before topping up the reservoir, however, repair any leaks remaining on the intake side and replace the defective part on the pressure side.

Important note

The rack-and-pinion steering gear and the power pump must not be repaired or dismantled.
The steering gear is available as a spare part. See spare parts catalogue.

Power steering pump toothed belt

The pretension of the toothed belt cannot be adjusted.

Checking the steering system for leaks (visual inspection)

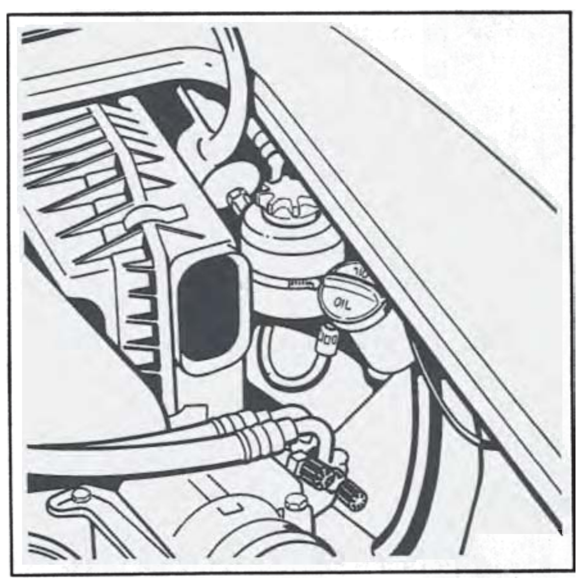
With the engine idling, turn the steering wheel to the stop position and keep it in this position. This causes the maximum possible line pressure to be built up.

Check all line connections for leaks in this position and retighten if required.

Test for approx. 10 sec. If the test is run for a longer time, allow a short break approx. every 10 seconds.

Checking fluid level in the power steering

The reservoir is fitted on the right in the engine compartment.



Check the fluid level* **with the engine idling and without operating the steering system.**
Correct fluid level:
In the case of reservoirs **with** a transparent upper section (first version used), the fluid level must be between the min. and max. marks on the reservoir.
If the reservoir does **not** have a transparent upper section, the level must be between the two marks on the dipstick attached to the lid. Unscrew the lid and wipe the dipstick clean. Screw the lid back on, remove it again and check the fluid level.

Bleeding the steering system

1. **To fill the whole system after fitting new steering assemblies, lines or heavy hydraulic fluid loss, start the engine briefly several times and switch off engine immediately after it has started. During this operation, the fluid level in the reservoir falls rapidly. The fluid level in the reservoir quickly decreases during this process, and hydraulic fluid* therfore must be filled in continously. Never allow the reservoir to be drawn empty.**

2. If the fluid level in the reservoir no longer falls when the engine is started briefly, start the engine and run it at idle speed.

3. Turn steering wheel several times rapidly from stop to stop to allow the air to escape from the cylinders. When the pistons have reached the end positions of their travel, do not pull harder on the steering wheel than would be required to turn the steering wheel (this helps to prevent unnecessary pressure build-up).

4. Observe fluid level during this operation. If level continues to fall, top up until the fluid level remains constant in the reservoir and until no air bubbles rise in the reservoir when the steering wheel is turned.

Note

The oil level in the reservoir must not rise by more than 10 mm when the engine is stopped. If the fluid levels deviate from each other by more than 10 mm when the engine is stopped or running, respectively, excessive air is trapped in the hydraulic fluid.

5. With the engine running at idle speed, top up to correct fluid level (between min. and max. marks) without turning the steering wheel.

*** Porsche started to fill the brake systems with Pentosin CHF 11 S (green) in March 1996. ATF was used before then. Pentosin and ATF are miscible. This means that Pentosin can be used to top up the fluid level in 993 vehicles before the aforementioned introduction date. On vehicles with Pentosin filling, always fill or top up the brake system with Pentosin.**

48 10 19 Removing and installing steering wheel (airbag)

Removal

1. Disconnect battery and cover terminal or battery.

2. Remove driver airbag unit, undoing both fastening screws with a socket Torx T 30 wrench.
   Disconnect connector at airbag unit and at steering wheel (for signal horn).

Note

Replace the fastening screws whenever they have been undone.
The airbag unit must always be stowed away with the padded side facing up.
When the airbag unit remains removed for a longer perdiod of time, it must be stored in a safe place.
Observe safety specifications.

3. Undo hexagon head nut and lift off complete with spring washer.

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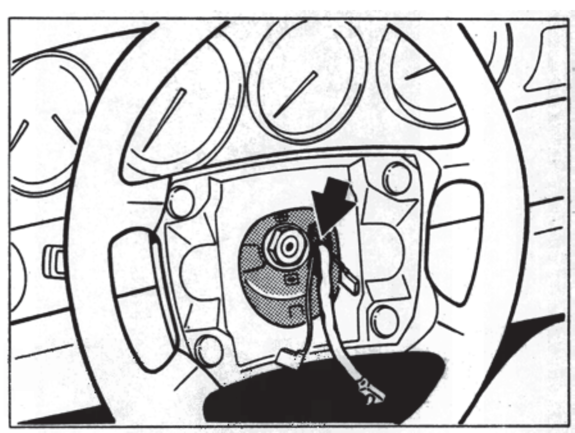
4. Turn wheel to straight-ahead position. Then mark position of steering wheel to steering shaft (for reassembly). Take off steering wheel (in straight-ahead position).

Note

To prevent **inadvertent turning of the contact unit (CU)** when the steering wheel is removed, the CU is locked automatically when the steering wheel is pulled back.
In the same manner, the CU is unlocked automatically when the steering wheel is placed back into position.

Installation

1. Fit steering wheel with the wheels in straight-ahead position or according to the dismantling marks in such a manner that the upper steering wheel spokes are horizontal.
   Caution: Do not trap the wire of the contact unit.



1602-48

2. Fit hexagon head nut with spring washer and tighten to 45 Nm (33 ftlb.).

3. Install driver's airbag. Use new fastening screws.
   Tightening torque: 10 Nm (7 ftlb.)

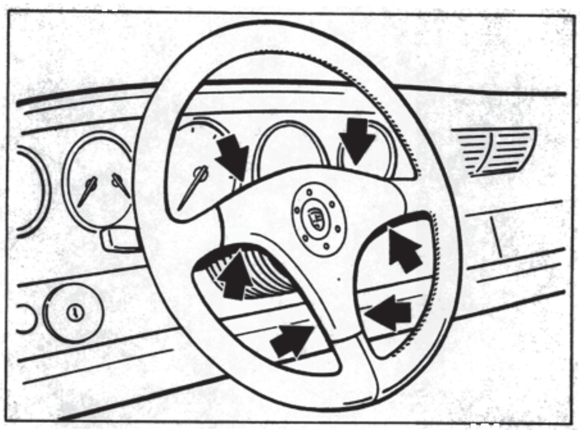
4. Check operation of signal horn.

48 10 19 Removing and installing Carrera RS steering wheel (Momo)

Removal

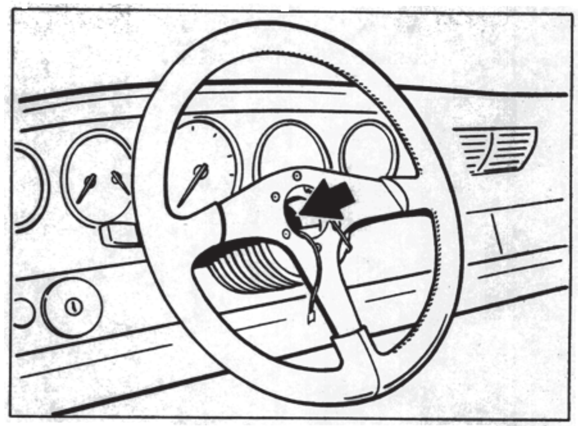
1. Remove the upholstered trim from the steering wheel (see following text).
   Caution: Do not dismantle the lid with the Porsche emblem.

   First pull (lift) the top and bottom of the horizontal spokes on the trim over the steering wheel spokes.
   Then pull the trim over the vertical (lower) spoke (lift it over the steering wheel spoke).
   Unplug horn connector from upholstered trim.



2195-48

2. Unscrew hexagonal nut (arrow / Fig. 2196-48) and remove it together with lock washer.



2196-48

3. Turn wheels of vehicle to straight ahead position.
   Then mark the position of the steering wheel in relation to the steering shaft (for re-installation). Take off steering wheel (in straight ahead position).

Installation

1. With the vehicle wheels in the straight ahead position (as marked during removal) install the steering wheel with the upper spokes horizontal.

2. Install hexagonal nut with lock washer and tighten with 45 Nm (33.2 ftlb).

3. Install upholstered trim. First press (lift) it over the upper (horizontal) spokes. Then press (lift) it over the lower (vertical) steering wheel spoke.

4. Check horn for correct functioning.

48 Replacing the steering in case of accident damage

A. General

Accidents or **driving conditions similar to accidents** may cause various types of damage to steering gears. **If the steering gear looks undamaged from the outside,** tracing of damage is sometimes difficult and requires considerable effort. This, however, constitutes an incalculable risk for the safety of the vehicle as it may lead to steering failure.

Due to the fact that a comprehensive check of all steering gear components requires considerable effort and is therefore not normally justifiable or even impossible to be carried out with standard shop equipment, the condition of other components that are easier to be checked must be considered as a **replacement solution**.

The following guidelines (item B) should be observed to decide if the steering gear of an accident vehicle requires replacement or may be used as it is.

B. Assessing the condition of the steering gear of an accident vehicle

The steering **may** remain on the car, **if all of the following conditions are met**:

No visible damage to front-axle components such as wheels, spring struts, wheel carriers, control arms, steering arms, tie-rods, front-axle crossmember, front-axle side members, steering shaft as well as body mounts of suspension components.

No inadmissible increase of torque and no binding or sticking when turning the steering gear from lock to lock. When turning the steering gear, the front wheels must move freely (i.e. front axle must be lifted); in addition, the engine must be off (no power supply to servo-pump).

Admissible tolerances of suspension alignment must not be exceeded.

The steering box **must be replaced or exchanged if any of the following points apply**:

Damage to steering gear is visible or can be felt

Burning damage (e.g. bellows of steering burnt)

Permanent deformation or cracking of:

Steering gear mounts

Tie rods

Steering arms

Spring struts
(except for 928)

Wheel carriers

Control arms

Front-axle side members

Front-axle crossmember

If the above criteria are **not** sufficient for a decision, it is recommended to exchange or replace the steering gear.

C. Exceptional regulations / order processing

If the **steering gear replacement proposal** by the shop is refused by the customer or insurance company for financial reasons, an expert, or if this is not possible in foreign countries, the importer should be consulted (to be charged to the refusing party). If a decision is made against the above guidelines, it is recommended to file a note to this effect and have it signed by the expert.

Power steering gears with no visible outside damage that require replacement will be availabe on an exchange basis at a later date (status 9/93).

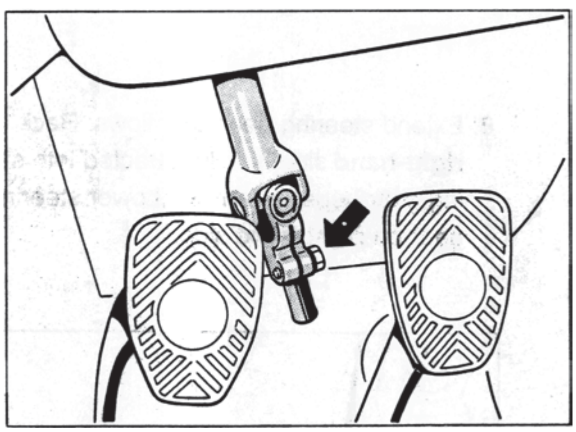
48 90 19 Removing and installing power steering gear

Removal

1. Separate universal joint (steering shaft) from steering gear. To do so, remove floorboard of pedal cluster. Undo clamping screw and push joint upwards.

Note

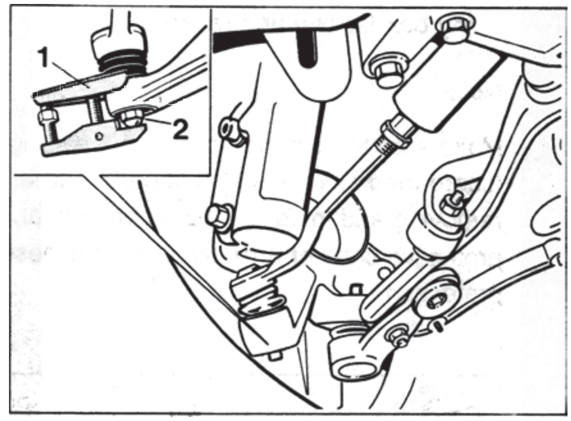
Fix or remove steering wheel in straight-ahead position of road wheels. If this requirement is not observed, the airbag contact unit must be brought into the center position after the steering gear has been fitted (p. 48-13).



1736-48

2. Remove underside panel.

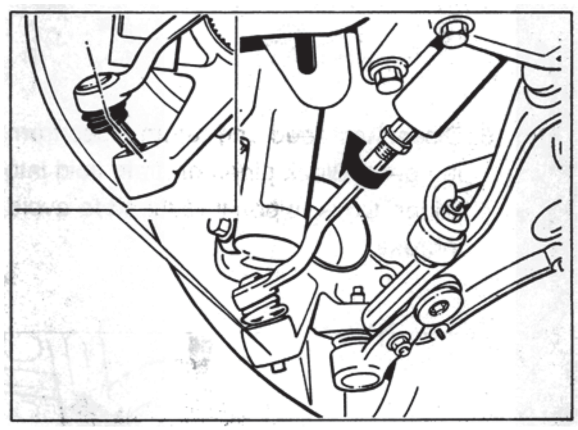
3. Press tie-rod ball joint off the steering arm. Use a suitable puller, e.g. Nexus 168-1 (no. 1), together with a 12 mm cap nut (no. 2 / Special Tool VW 267 a).



1703-40

Note

Start by turning tie-rod towards the front (arrow). Then angle off ball joint (ball pin) according to the Figure and extend it in this position.



1704-40

4. Repeat operation on other side.

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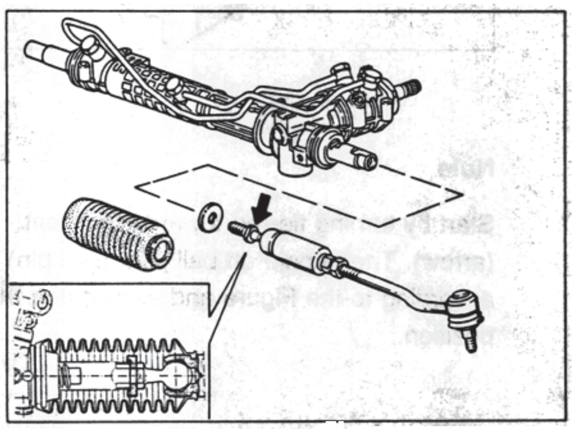
5. Undo right and left-hand tie rods from steering box (arrow) and remove tie rods.

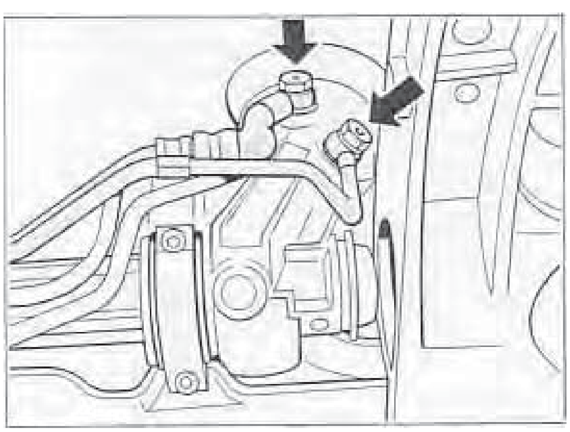
Note

Make sure the steering rack is not damaged (score marks) This is also important when removing and installing the steering gear. Use protective caps or a rubber or plastic hose for protection.



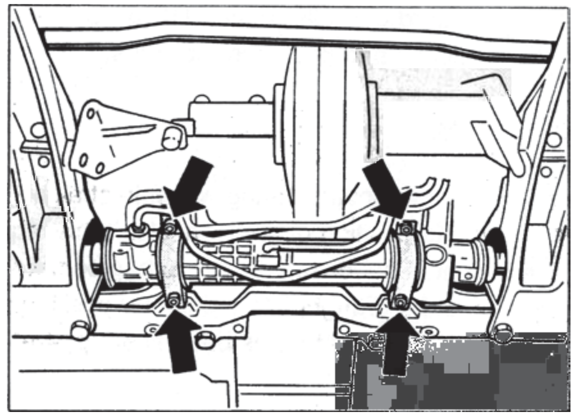
1737-48

6. Disconnect feed and return pipes from steering gear. Block pipes or drain fluid into container. Cover pipes if required to avoid dirt ingress.



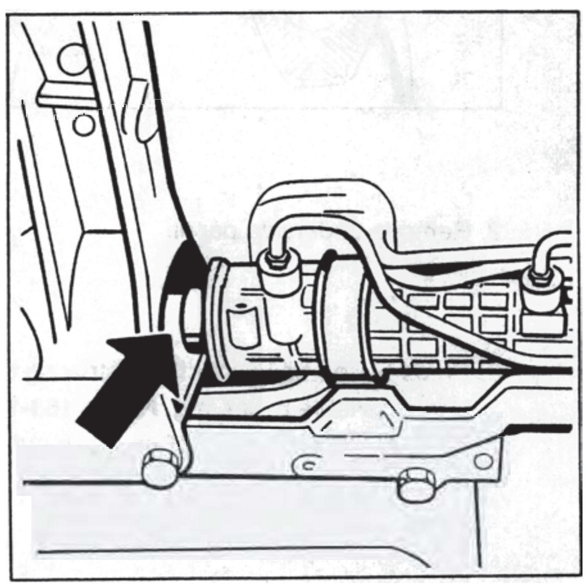
1738-48

7. Unclip power steering pipes from bracket in right-hand steering gear mount area.
Undo steering gear mounting bolts (arrows).



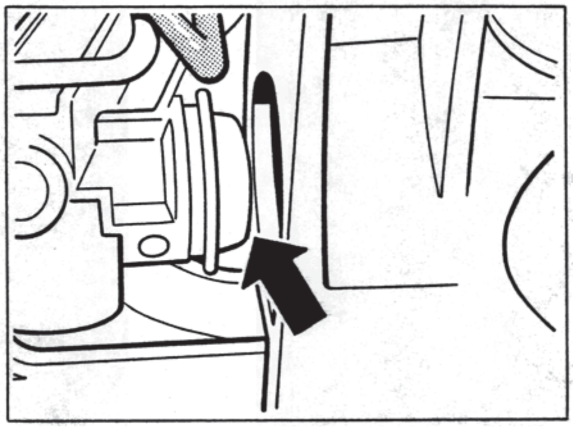
1739-48

8. Extend steering gear as follows: Rack on **right-hand** side is fully retracted into steering gear housing (arrow). Lower steering gear on **right-hand** side.



1740-48

9. Retract steering rack on **left-hand** side fully into steering gear housing (arrow), pulling or pushing (as required) on face of steering rack (take care not to damage the steering rack). Extend steering gear in rotary piston area and take out towards bottem.



1092-48

Installation

Install in reverse order. Be sure to **observe** the following points:

Replace steering gear mounting bolts and dowel screw of the steering shaft with new parts after each removal operation.
The threads of the bores and the washers must be clean and fat-free. Remove micro-encapsulation residuals from the threaded bores required to fix the steering gear (use Aceton for cleaning, then blow out bores with compressed air).
Important: Since 1995, 12.9 screws have been used (previously 10.9 screws). The 12.9 screws must be used retroactively.
For replacement, use only 12.9 screws.

Part numbers of 12.9 screws

Pan-head screw 8 x 60 = 999 218 102 09 (4 on vehicles without cross strut, 2 on vehicles with cross strut)

Pan-head screw 8 x 80 = 999 218 103 09 (2 on vehicles with cross strut)

Note

Observe the procedure for tightening the fastening screws for the steering gear strictly (see page 48-12).

Make sure that the steering rack is not damaged (score marks).

With the rack fully extended, coat steering rack with VW steering gear grease AOF 063 000 04.

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When replacing the steering gear, assemble the rubber mounts and mounting clamps with Omnis 32 (DEA).

Push universal joint (steering shaft) into correct position - with steering wheel and steering box and airbag contact unit (spiral spring) in center position.
Steering gear mounting bolts should only be screwed on lightly (facilitats assembly).
Observe notes for slider and airbag contact unit (p. 48 - 13).

Tighten fastening screws of steering gear as follows:
First screw down the screws evenly until the fastening brackets almost touch the cross member. During final tightening, **start with the screws for the short leg of the cross member and pull them tight**, so these surfaces will be the first to fit tightly. Tightening torque: 45 Nm.

After having tightened the steering gear mounting bolts, assemble the tie-rods with the steering gear (fig. 1737-48, p. 48-10).

After having reconnected the pressure lines, fill steering hydraulics and bleed the steering gear (p. 48 - 3 / 48 - 4).

Tighten all nuts and bolts to the specified torque.

Check toe-in and adjust if required.

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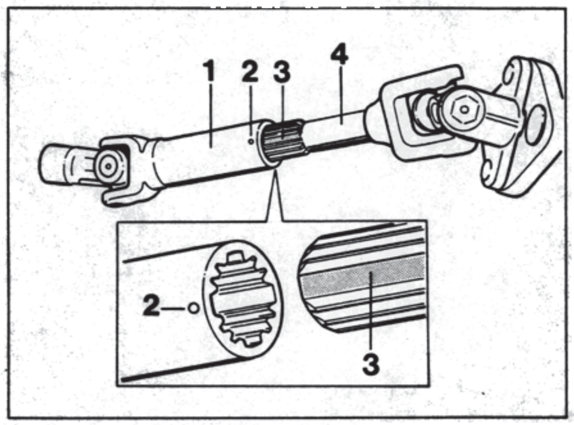
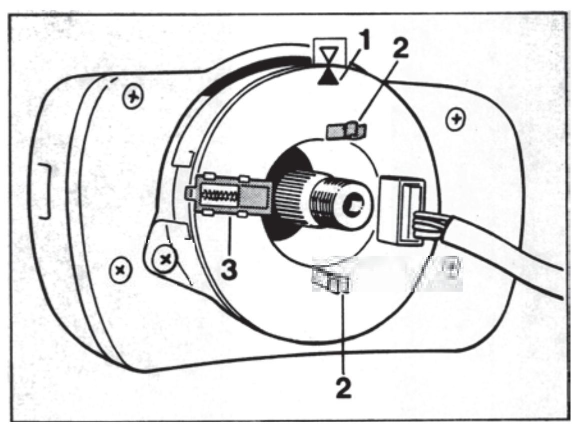
Notes for slider and airbag contact unit

1. If the slider no. 1, has been pulled off the steering shaft no. 4, the roll pin no. 2 must face the tooth cutout (no. 3) when the components are reassembled.



1396-48

2. If the steering wheel was **not located** in the specified position before the **steering** gear was removed, **the correct position of the contact unit** (wind-up spring) may no longer be present.
   If this is the case, remove the steering wheel and set the contact unit to the center position.
   If this requirement is not longer observed, the wind-up spring may be damaged.
   Center position: Start by placing the contact unit in the end stop position. Starting from the end stop position, turn back contact unit by two turns and continue turning to the center position mark.
   The exact center position is indicated by two arrows (No. 1).
   Before fitting the steering wheel, set the road wheel in the straight-ahead position (with steering shaft fitted to steering gear).



1741-48

1 = Center position mark (arrows)

2 = Drivers engaging into the steering wheel

3 = Lock (rotation lock) becoming effective afer removal of the steering wheel.

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