
Workshop Manual

911

Carrera 4

The workshop manual is only for the internal use of the Porsche Dealer Organization.

© 1988 Dr. Ing. h.c. F. Porsche
Aktiengesellschaft
Technical Service Department
D-7140 Ludwigsburg

All rights reserved – Printed in Germany

WKD 482520

List of Repair Groups Carrera 4

General	Technical Data	Page 0.1	
Repair Groups		Group	
Volume 1 Engine, Maintenance	Maintenance, Self-diagnosis	03	
	Engine, Crankcase, Suspension	10	
	Engine, Crankshaft, Pistons	13	
	Engine, Cylinder Head and Valve Drive	15	
	Engine, Lubrication	17	
	Engine, Cooling	19	
	Fuel Supply	20	
	Fuel System, Electronic Injection	24	
	Exhaust System/Emission Controls	26	
	Starter, Power Supply, Cruise Control	27	
	Ignition System	28	
	Diagnosis		
Volume II Transmission (manual)	Clutch, Controls	30	
	Clutch	32	
	Manual Transmission, Controls, Case	34	
	Manual Transmission, Gears, Shafts	35	
	Differential, Transaxle System, All-Wheel Drive	39	
Volume III Transmission (automatic)	Clutch, Controls	30	
	Torque Converter	32	
	Automatic Transmission, Controls, Case	37	
	Automatic Transmission, Gears, Shafts	38	
	Differential, Transaxle System	39	
Volume IV Chassis	Front Wheel Suspension	40	
	Rear Wheel Suspension, Axle Shaft	42	
	Wheels, Tires, Alignment	44	
	Antiblock System	45	
	Brakes, Mechanical	46	
	Brakes, Hydraulics, Regulator, Booster	47	
	Steering	48	
	Diagnosis		
Volume VI Body	Body-Front Section	50	
	Body-Center Section	51	
	Body-Rear Section	53	
	Lids	55	
	Doors	57	
	Electric Sunroof	60	
	Hardtop	61	
	Bumpers	63	
	Glasses, Window Control	64	
	Exterior Equipment	66	
	Interior Equipment	68	
	Seats	72	
	Seat Covers	74	
	Volume VI Heating, Ventilation, Air Condition Electrics	Heater	80
		Ventilation	85
Air Conditioner		87	
Diagnosis			
Instruments, Fuel Gauge, Alarm System		90	
Radio, Telephone, On-board-computer		91	
Windshield Wipers and Washer		92	
Exterior Lights, Lamps, Switches		94	
Interior Lights		96	
Diagnosis			
Volume VII	Wiring	97	
Electrics Wiring Diagrams			

	Page
Clutch, autom., torque converter	
Technical data	32 - 0101
Removing and installing the torque converter	32 - 101
Automatic transmission, controls, case	
Removing and installing the position switch on transmission	37 - 101
Adjusting cable for selector device	37 - 102a
Removing and installing cable for selector mechanism	37 - 102c
Removing and installing selector mechanism	37 - 102g
Dismantling and assembling selector mechanism	37 - 102i
Dismantling and assembling gear selecting system with keylock and shiftlock	37 - 102m
Removing and installing lift solenoid for shiftlock	37 - 102q
Removing and installing keylock bowden cable	37 - 102s
Checking keylock and shiftlock	37 - 102u
Removing and installing rear transmission case	37 - 103
Removing and installing the intermediate plate	37 - 107
Dismantling and assembling intermediate plate	37 - 110a
Disassembling and assembling the parking lock	37 - 111
Dismantling and assembling transmission	37 - 115
* Dismantling and assembling transmission	37 - 123
Automatic transmission, gears, shafts	
Checking the ATF fluid level	38 - 101
Changing ATF fluid and cleaning the ATF strainer	38 - 103
Flushing ATF cooler and lines	38 - 104a
Removing and installing ATF cooler	38 - 104c
Removing and installing the inductive speed sensor	38 - 105
Removing and installing the wiring harness for the transmission	38 - 107
Removing and installing the hydraulic control unit	38 - 109
Removing and installing solenoid valves	38 - 113
Removing and installing the rotary shaft seal for the ATF pump	38 - 117
Removing and installing the ATF pump	38 - 119

* No provisions are currently made for repair of the automatic section.

* Dismantling and assembling 4th gear tower	38 - 121
* Dismantling and assembling output shaft and freewheel	38 - 127
* Dismantling and assembling clutch E	38 - 131
* Dismantling and assembling brake F	38 - 137
* Dismantling and assembling brake pack CD with spider shaft	38 - 143
* Dismantling and assembling spider shaft	38 - 147
* Dismantling and assembling brake C, C' and D	38 - 151
* Dismantling and assembling clutch B	38 - 161
* Dismantling and assembling clutch A	38 - 167
* Determining the end clearance	38 - 171

Differential

Disassembling and assembling the long joint flange	39 - 101
Removing and installing the rotary shaft seal for the short joint flange	39 - 105
Sealing of the driving shaft	39 - 107
Removing and installing differential and drive pinion	39 - 109
Dismantling and assembling differential	39 - 115
Dismantling and assembling drive pinion	39 - 119
Adjusting drive set	39 - 123

Diagnosis

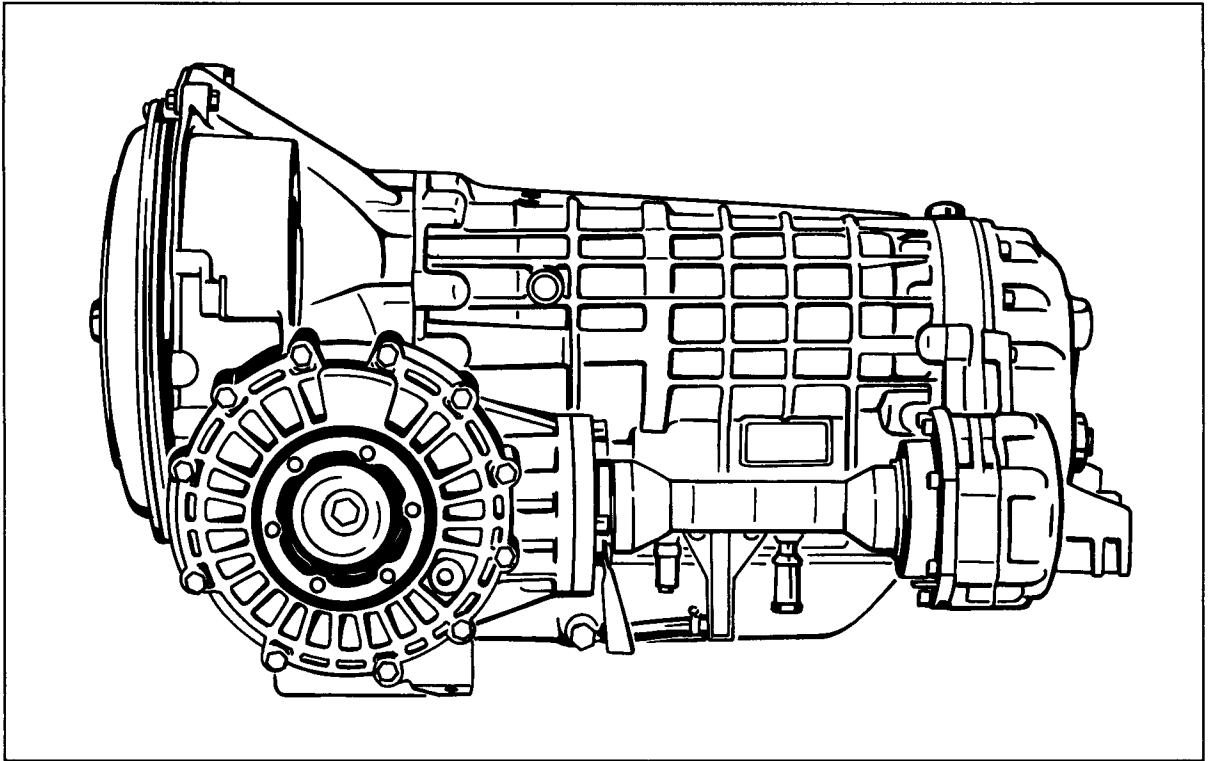
Tiptronic Diagnosis / Troubleshooting

Diagnosis Tiptronic	D37/38 - 101
Troubleshooting mechanical / hydraulic section	D38 - 101

* No provisions are currently made for repair of the automatic section.

Technical data

4-speed Tiptronic transmission A50



428-37

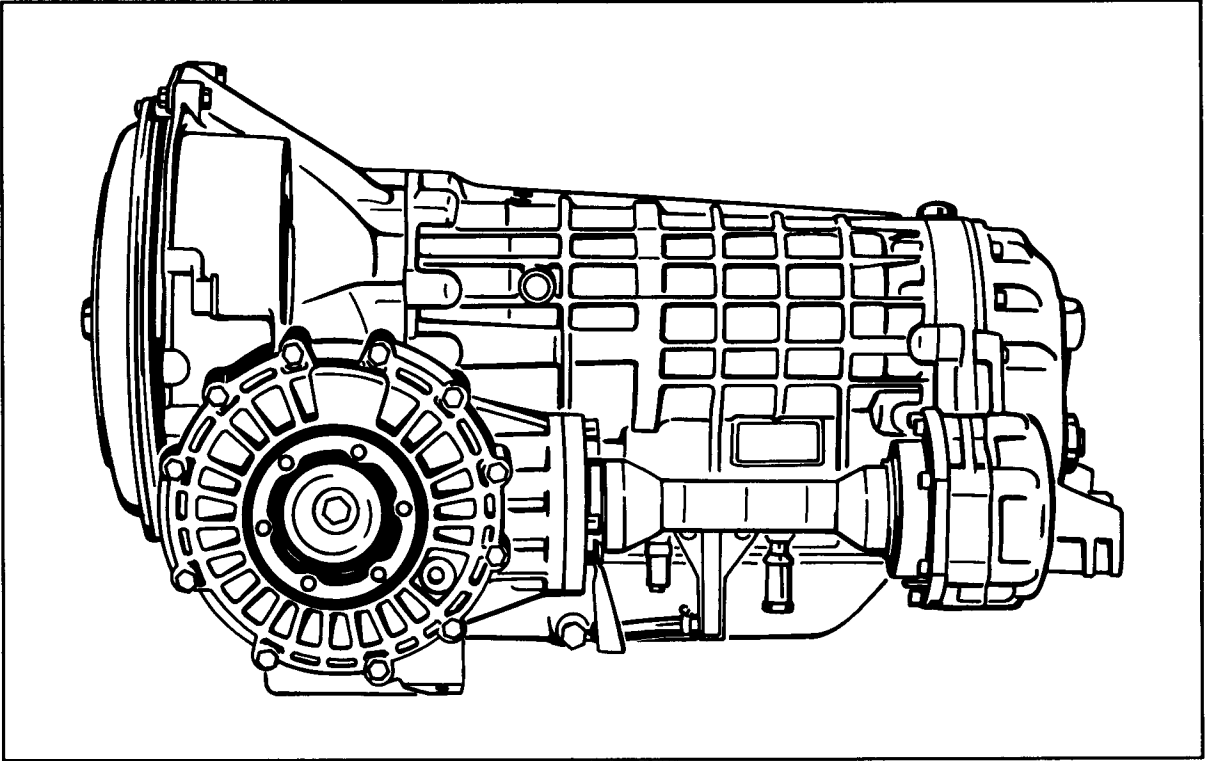
Type	Identification code	Equipment	Installed in	Model year
A50/01		4-speed	911 Carrera 2 worldwide	90

Technical data

General data	A50/01	
Design	fully-automatic 4-speed planetary transmission (Tiptronic)	
Ratio		
Spur pinion	1.100	
1st gear	2.479	
2nd gear	1.479	
3rd gear	1.000	
4th gear	0.728	
Reverse gear	2.086	
Final drive	Hypoid bevel gear with 15 mm offset	
Final drive ratio	9:33	$i = 3.667$
Stall speed	2300 \pm 200	
Capacity, rear axle final drive	approx. 0.9 l multi-grade transmission oil 75 W 90 API classification GL5 (MIL-L 2105 B), optionally SAE 90	
Capacity, automatic unit with converter	Total capacity approx. 9.0 l Change quantity approx. 3.0 l ATF-Dexron II D	

Technical data

4-speed Tiptronic transmission A50



428-37

Type	Identification code	Equipment	Installed in	Model year
A50/01		4-speed	911 Carrera 2 worldwide	90/91
A50/02		4-speed	911 Carrera 2 worldwide (except USA)	92/93/94
A50/03		4-speed	911 Carrera 2 USA	92/93/94

Technical data

General data	A50/01	A50/02	A50/03
Design	fully-automatic 4-speed planetary transmission (Tiptronic)		
Ratio			
Spur pinion	1.100		
1st gear	2.479		
2nd gear	1.479		
3rd gear	1.000		
4th gear	0.728		
Reverse gear	2.086		
Final drive	Hypoid bevel gear with 15 mm offset		
Final drive ratio	9:33	$i = 3.667$	9 : 32 $i = 3,555$
Stall speed	2300 – 400		
Capacity, rear axle final drive	approx. 0.9 l multi-grade transmission oil 75 W 90 API classification GL5 (MIL-L 2105 B), optionally SAE 90		
Capacity, automatic unit with converter	Total capacity approx. 9.5 l Change quantity approx. 3.5 l ATF-Dexron II D		

Removing and installing the torque converter

Removing

1. Remove transmission.
2. Remove converter, with transmission in horizontal position.

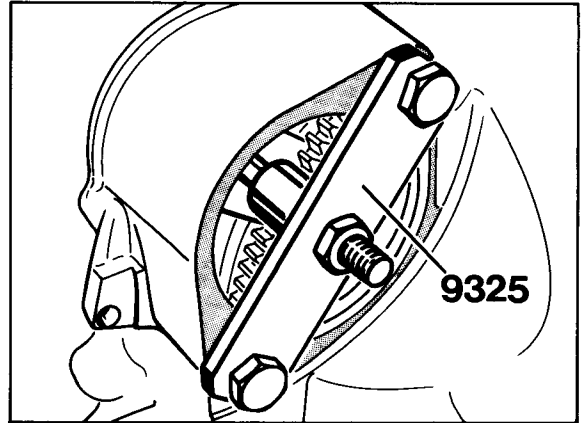
Note

Do not damage converter bearing assembly and rotary shaft seal.

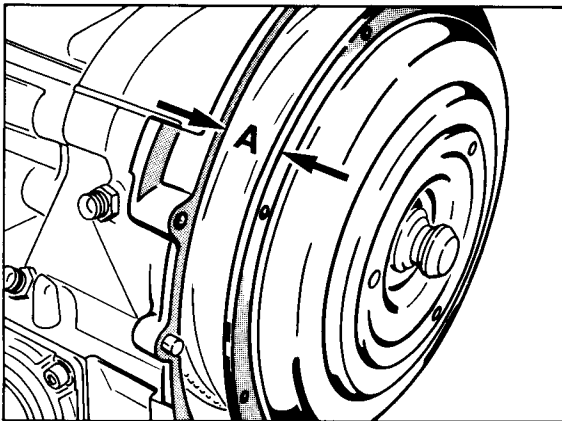
Installing

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

2. Secure converter against falling out with special tool 9325



413-32



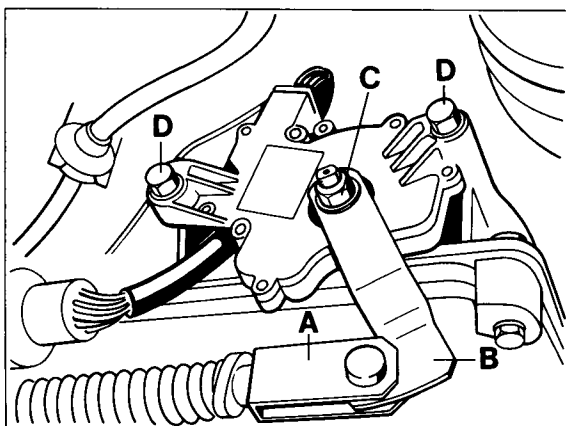
412-32

A = approx. 25 mm

Removing and installing the position switch on transmission

Removing

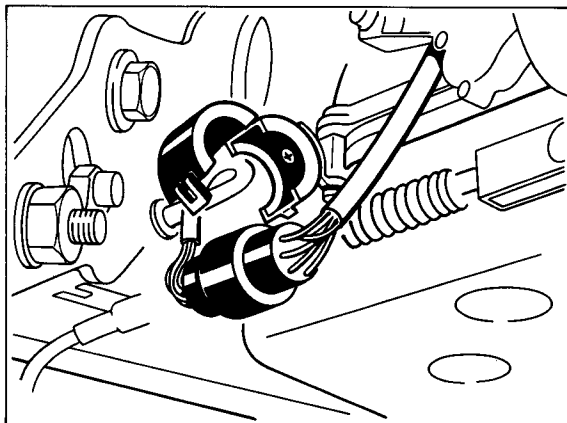
1. Move selector lever to position "N".
2. Remove transmission underbody cladding.
3. Disconnect selector lever cord pull at actuating lever.
4. Remove actuating lever.



381-37a

- A = Selector lever cord pull
 B = Actuating lever
 C = Hexagon nut (M 8 x 1) with washer
 D = Fixing screws

5. Unlock cable holder, remove plug-in connection and disconnect.



397-37

6. Unscrew fixing screws for position switch and remove switch.

Installing

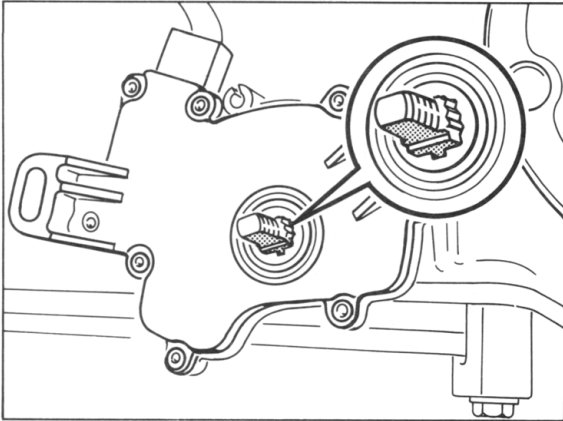
Installation takes place in reverse order.

Tightening torques:

- Position switch to transmission = 10 Nm
 Actuating lever to switching 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.

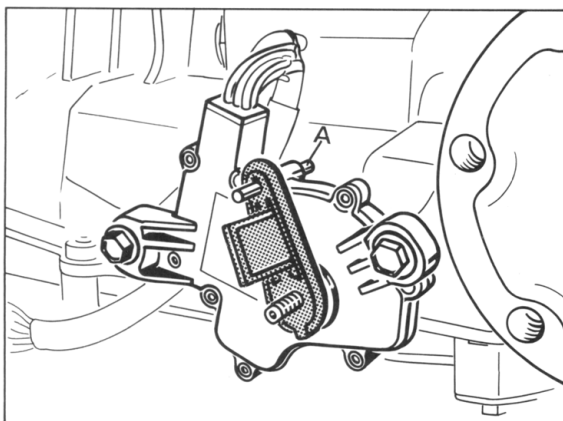
2. Check, and if necessary adjust, setting of selector lever cable.



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.



398-37

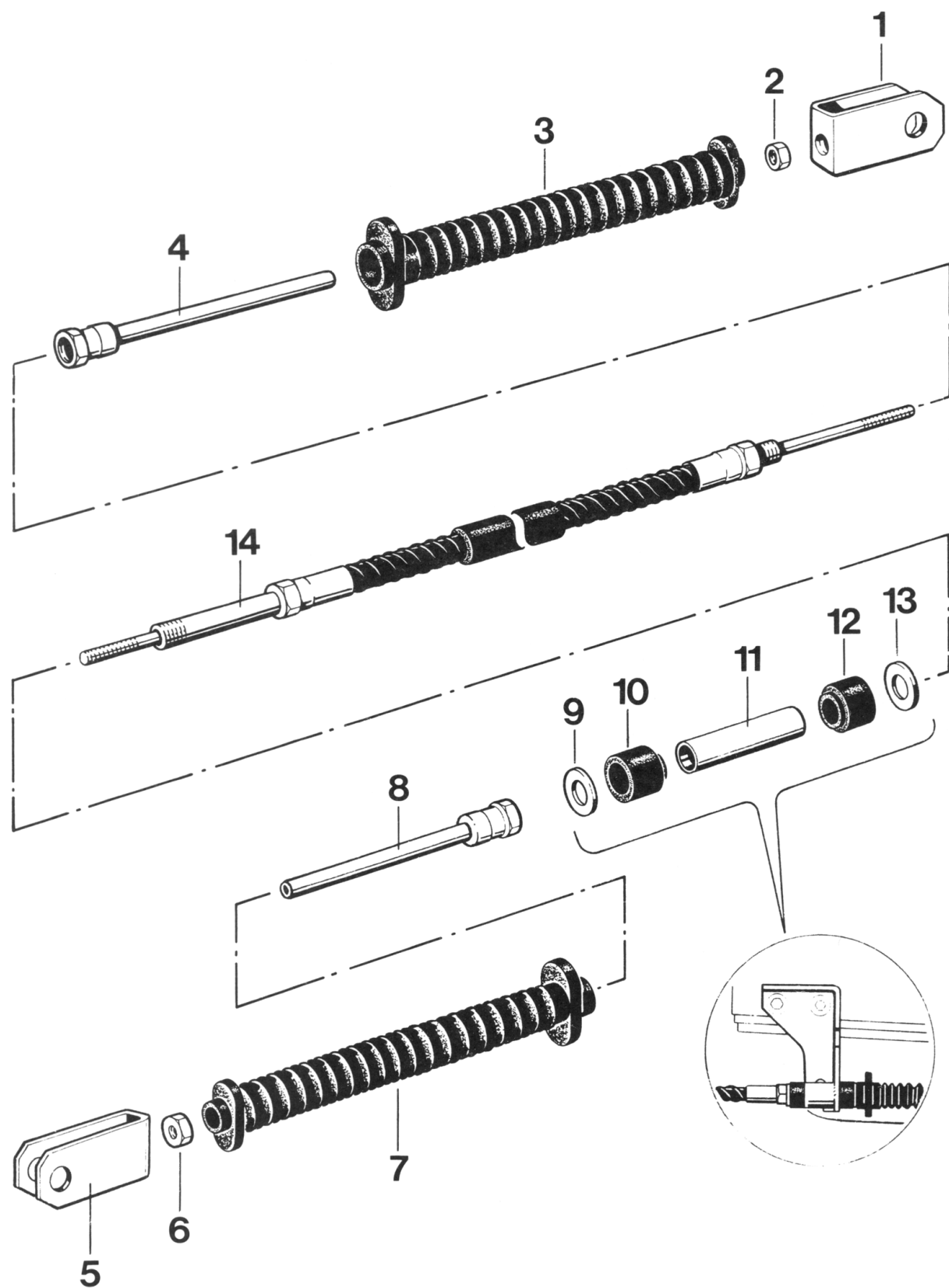
A = locating pin

Adjusting cable for selector device

1. Move selector lever to position "1".
2. Move multi-function switch to position "1" by pushing forward operating lever on switch by maximum amount.
3. Push cable forward and adjust position of fork head until bore holes of fork head and operating lever on gearbox lie exactly one over the other. From this position rotate fork head a further two turns onto thread of cable.
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 smooth, straightline movement.

Removing and installing cable for selector mechanism

Removing and installing cable for selector mechanism

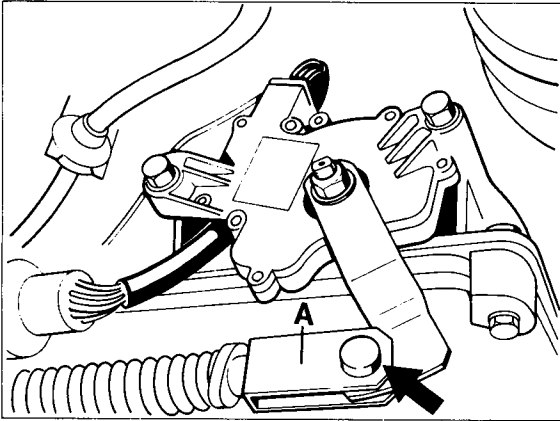


No.	Designation	Qty.	Note:	
			Removal	Installation
1	Fork head	1		Screw on to half length of thread on cable
2	Hexagon nut	1		Tighten to 6 Nm (4.4 ftlb)
3	Gaiter seal	1		
4	Guide tube	1		
5	Fork head	1		
6	Hexagon nut	1		Tighten to 6 Nm (4.4 ftlb)
7	Gaiter seal	1		
8	Guide tube	1		
9	Washer	1		
10	Rubber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

Instructions for removal and installation

Removal

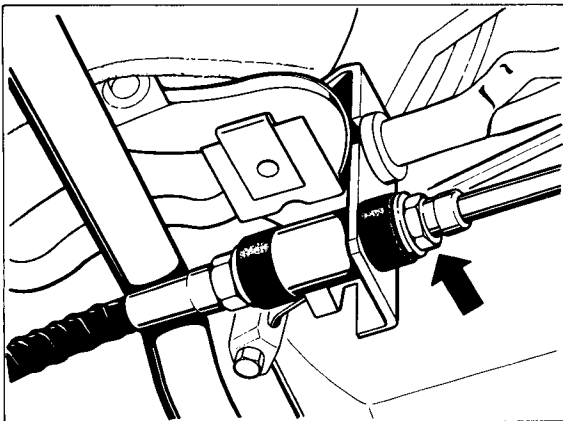
1. Remove underfloor paneling for gearbox and center underfloor paneling.
2. Disconnect cable on operating lever and remove fork head.



381-37

A = Fork head

3. Disconnect guide tube on bracket



494-37

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

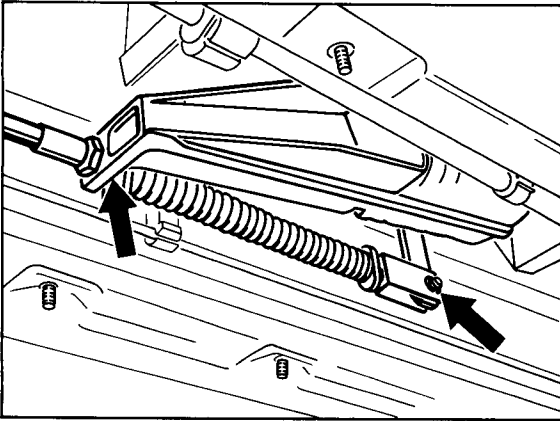
Installation

1. Installation is carried out in reverse order.
2. Adjust cable for selector mechanism (see P. 37 - 102a).

Removing and installing gear selecting system

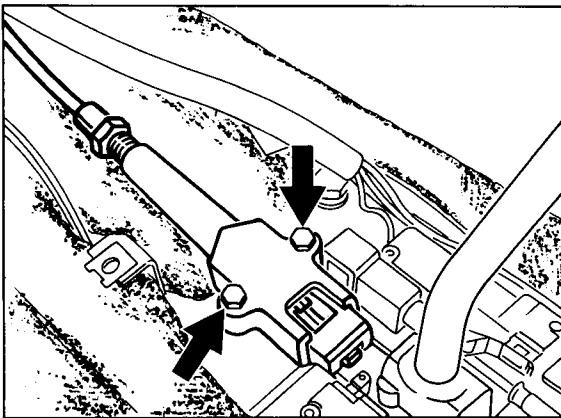
Removal

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

Tightening torques:

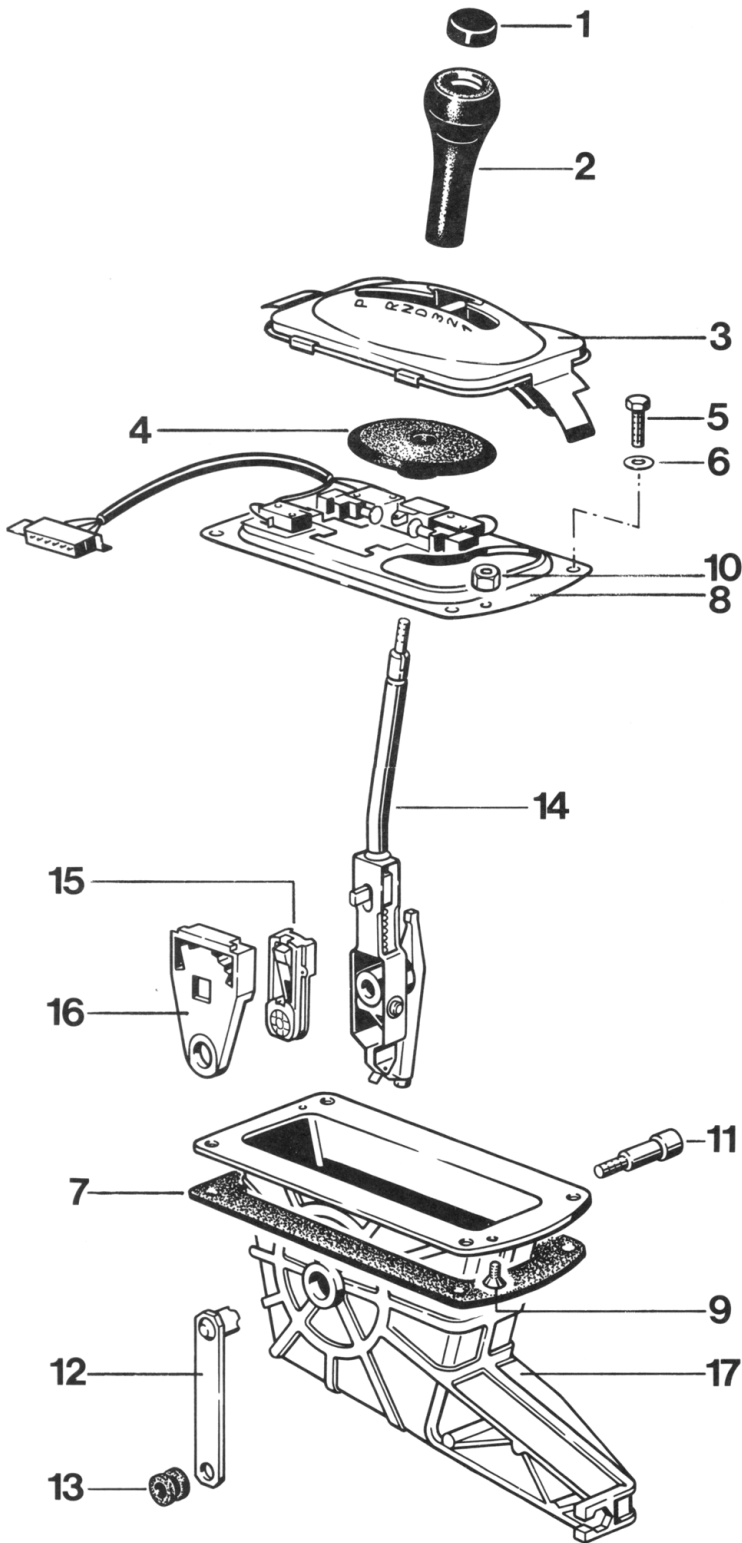
Gear selecting system to body = 10 Nm (7 ftlb)

Cable valve body to switch plate = 2,5 Nm (2 ftlb)

1. Install in reverse order.
2. Press selector knob manually until it 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 (if fitted).

Dismantling and assembling selector mechanism

Dismantling and assembling selector mechanism

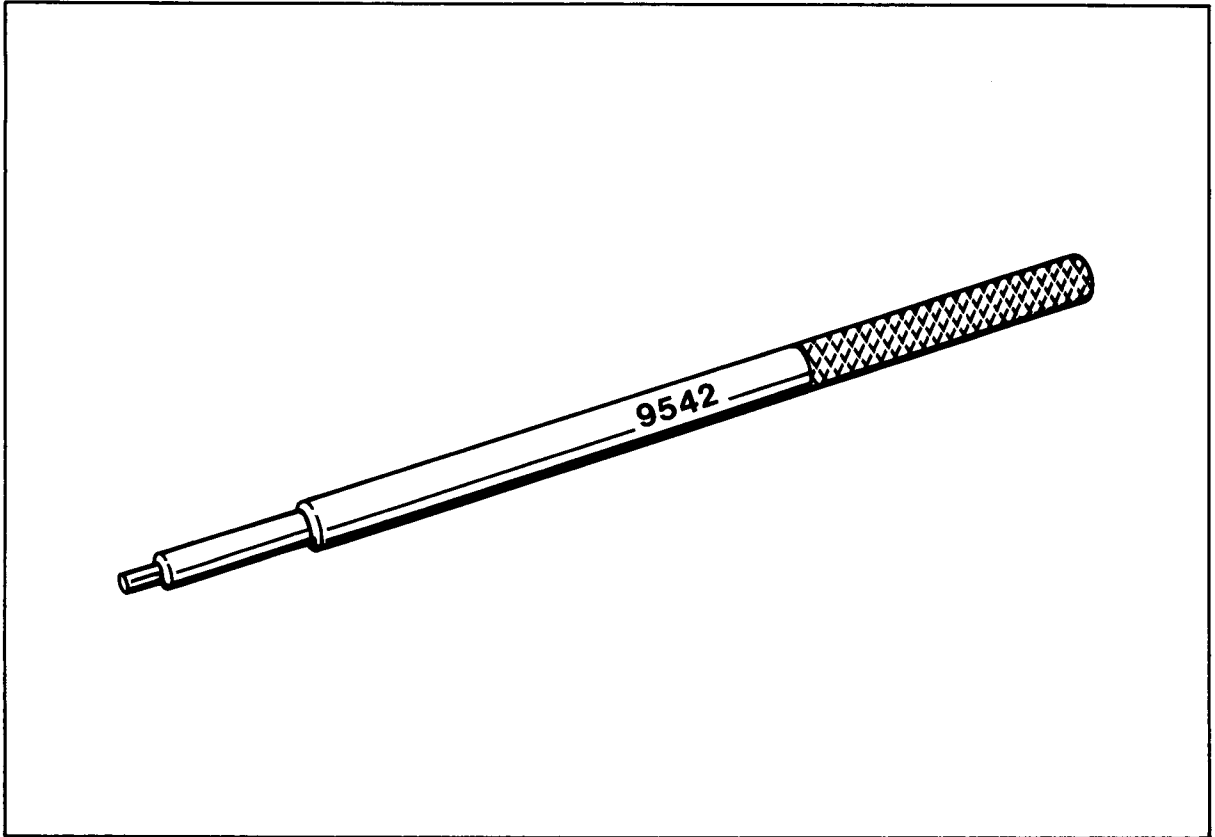


492-37

No.	Designation	Qty.	Note:	
			Removal	Installation
1	Unlocking button	1	Unscrew by hand	Must return automatically to original position after operation
2	Selector lever handle	1	Pull off by hand	Press on in correct position until properly in contact. Twisting lock must engage with lock on shift lever.
3	Cover panel	1	Can only be taken out from below and with center console removed	
4	Cover	1		
5	Hexagon screw	4		Tighten to 10 Nm (7.3 ftlb)
6	Washer	4		
7	Seal	1		
8	Hexagon nut	2		Tighten to 2 Nm (1.4 ftlb)
9	Flat-head screw	2		
10	Control plate	1		
11	Clamping screw	1		Tighten to 23 Nm (16.9 ftlb)
12	Reversing shaft	1		
13	Rubber mount	1		
14	Selector lever (complete)	1		
15	Lock	1		
16	Gate	1		Must engage in recess in control plate
17	Selector lever casing	1		

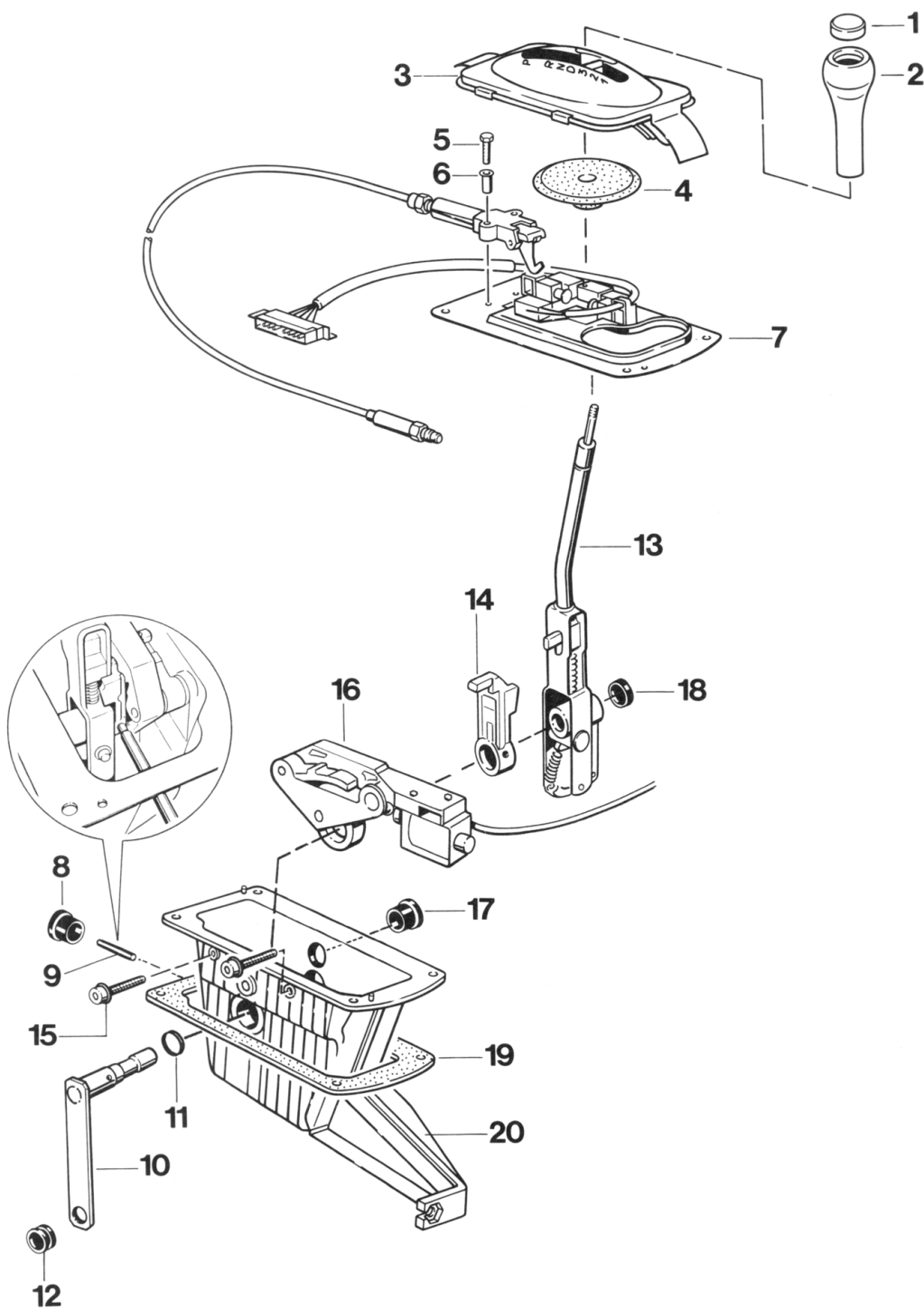
Note

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

Dismantling and assembling gear selecting system with keylock and shiftlock**Tools**

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

Dismantling and assembling gear selecting system with keylock and shiftlock



No.	Designation	Qty.	Note:	
			Removal	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)

Removing and installing lift solenoid for shiftlock

Note

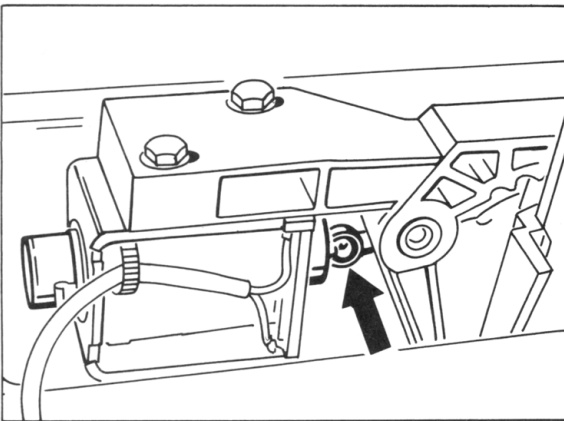
When checking the lift solenoid electrically, be sure to observe correct polarity

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 lift solenoid.



1085-37

4. Screw out mounting screws and take off lift solenoid.

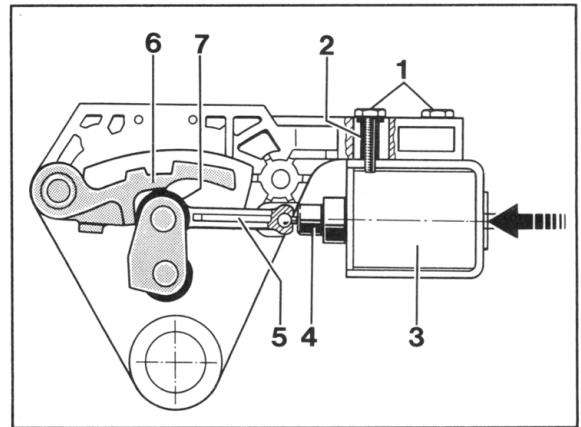
Installation

1. Set selector lever to "1" position.
2. Grease ball and ball socket with low-temperature grease.
3. Clip connecting rod to lift 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 lift solenoid to gate in such a manner that it remains free to slide in an axial direction.

5. Adjusting the lift 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 lift solenoid towards the pawl until it contacts the stop and locate it in this position.
- Slide the actuated lift solenoid axially until the idler contacts the stop of the pawl.
- Tighten hexagon head bolt to 2.5 Nm (2 ftlb) in this position.



1086-37

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

6. Check operation of shiftlock.

Removing and installing keylock bowden cable

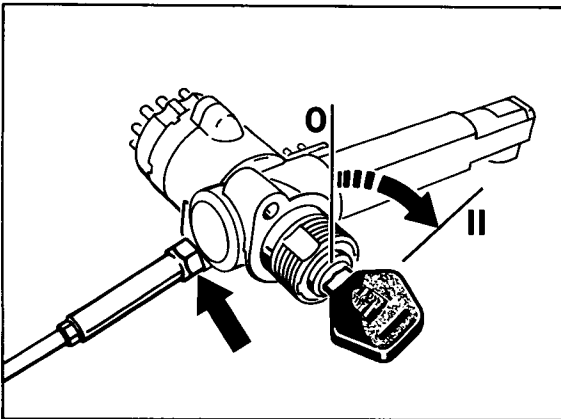
Removal

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

Note

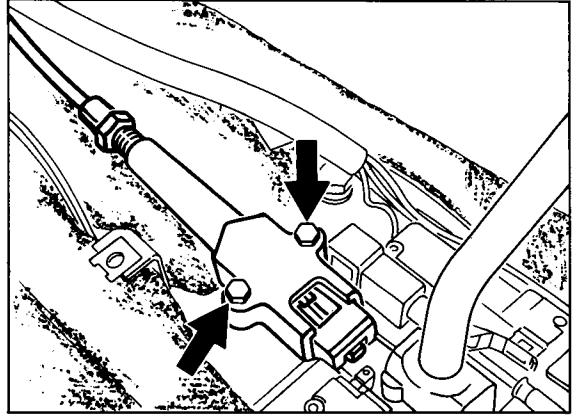
The ignition lock must be in position „2". If it is left in any other position, both the lock and the bowden cable may be damaged.

5. Unbolt bowden cable from ignition lock.



1068-3/

6. Undo mounting screws of valve body.



1067-37

7. Disengage bowden cable from pedal floor-board and from bracket for center console.

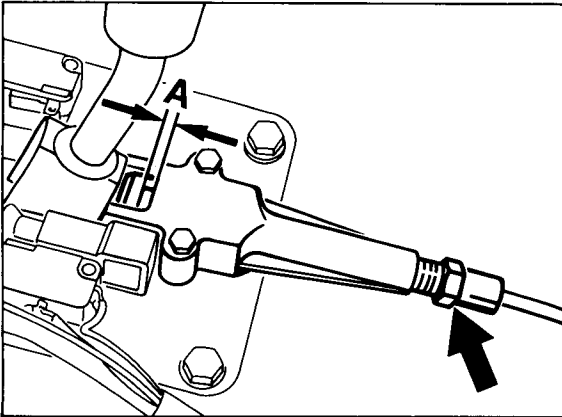
Installation

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 re-adjusted.

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

$$A = 2 + 0.5 \text{ mm}$$

6. Check operation of keylock and shiftlock.

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)

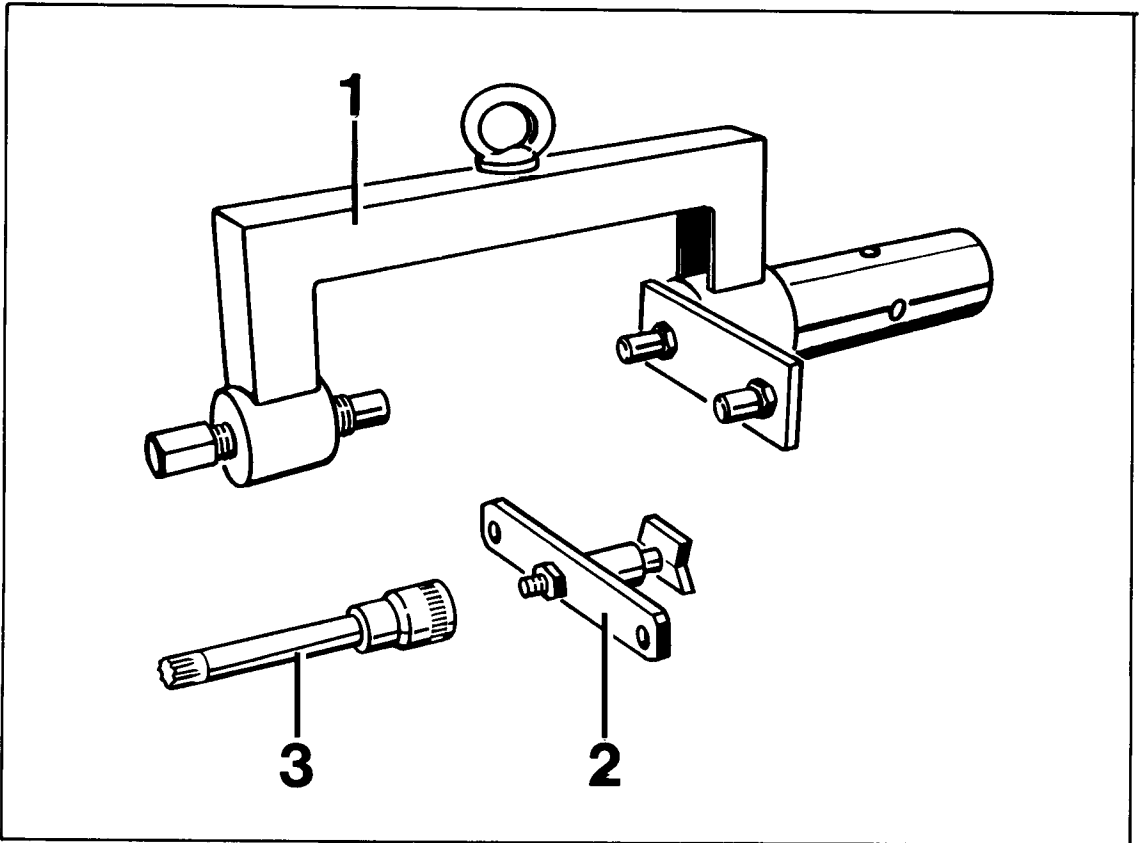
Ignition key position	Release button status	Keylock operation	Selector lever
Pulled off or pulled position	locked	yes	locked
Position 1 or 2	not locked	no	not locked

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

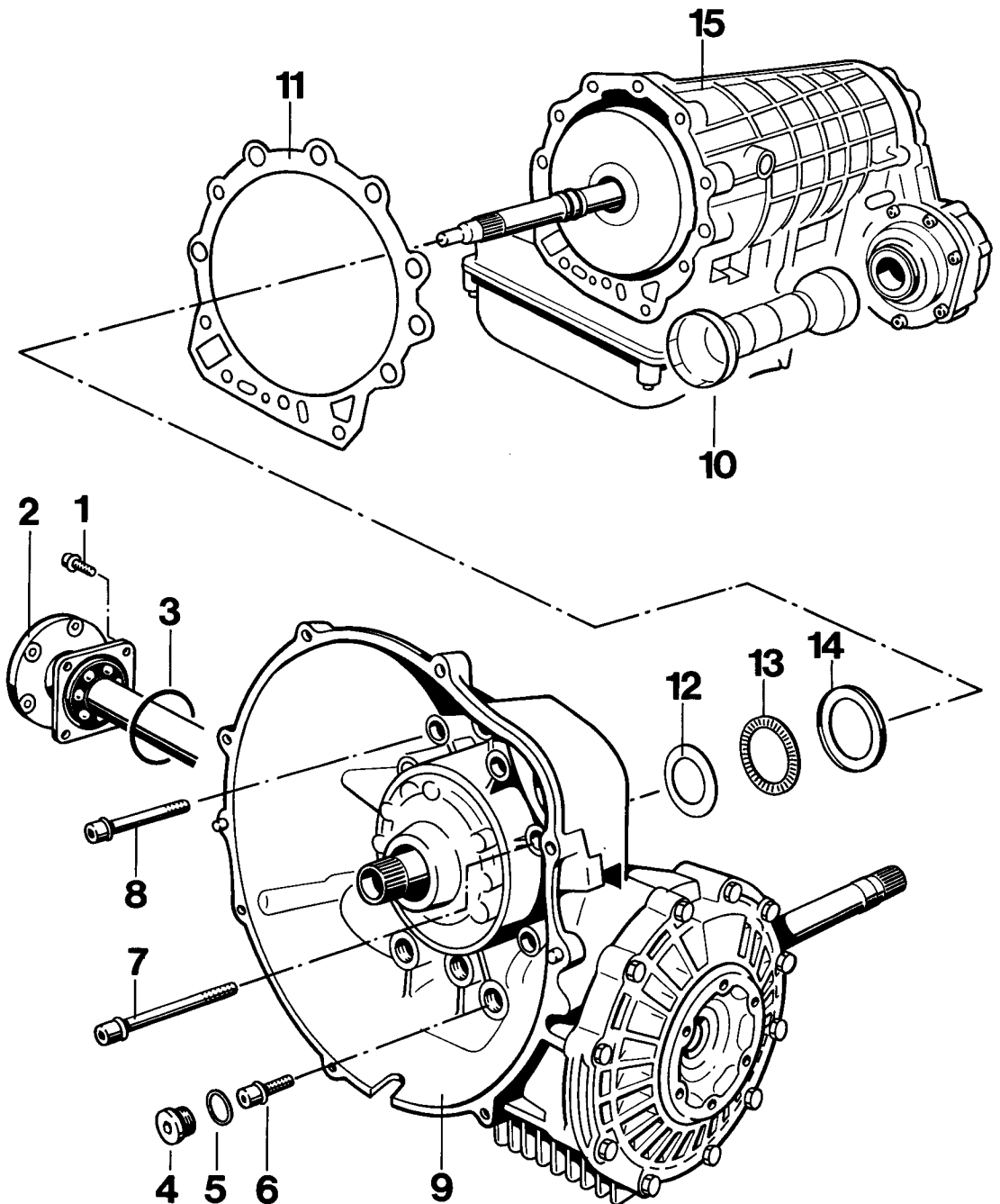
Removing and installing rear transmission case

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	

Removing and installing rear transmission case



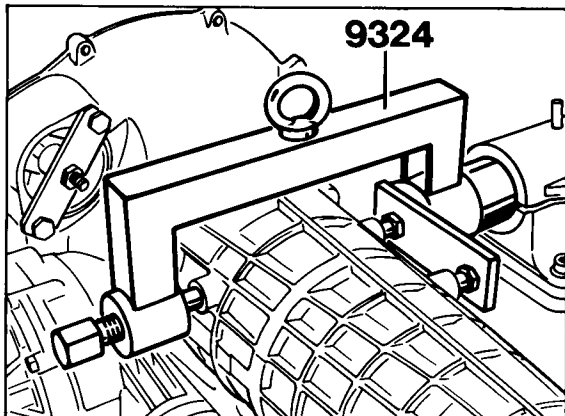
No.	Designation	Qty.	Note:	
			Removal	Installation (= ftlb)
1	Fillister head screw	4	Use Special Tool 9330 to remove	Tighten with 23 Nm (17)
2	Joint flange	1		
3	O-ring	1		Replace, oil slightly
4	Screw plug	3		Tighten with 50 Nm (36)
5	Sealing ring	3		Replace
6	Fillister head screw	3	Remove with Torx 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	Redetermine 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.

Assembly instructions for removal and installation

Removal

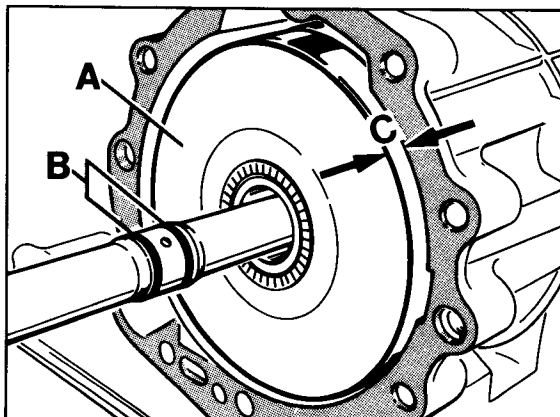
1. Remove the transmission and torque converter.
2. Secure transmission on assembly block with holding device 9324.



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

Removing and installing the intermediate plate

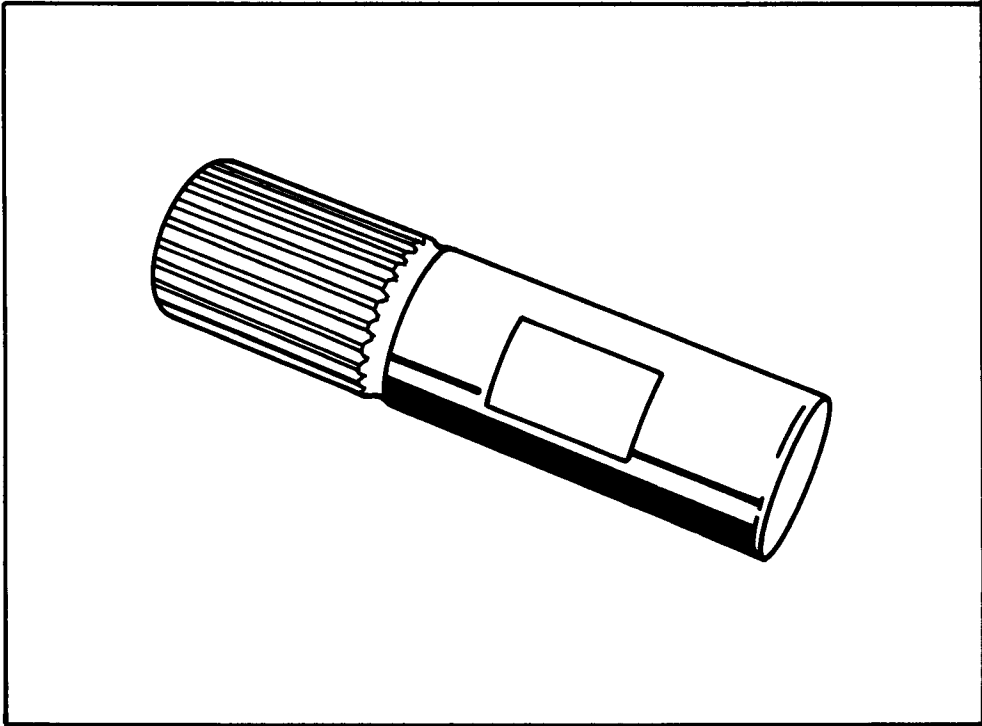
No.	Designation	Qty.	Note:	
			Removal	Installation
1	Hexagon screws	1		Tighten with 46 Nm
2	Washer	1		
3	Fillister head screw	11		Tighten with 23 Nm
4	Fillister head screw	6		Tighten with 23 Nm
5	Front transmission cover*	1		
6	Seal	1		Replace
7	O-Ring	1		Replace, oil with ATF
8	Shim	X	Note thickness for reinstallation	
9	Gear wheel with tapered-roller bearings*	1	Note correct position for reinstallation	Adjust preload if required
10	Gear wheel with bearing assembly*	1	Note correct position for reinstallation	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	Tapper roller bearing outer race	1	Remove with internal pul- ler (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	Redetermine thickness if required
17	Automatic transmission with final drive	1		

Note

The spur gear drive is only available as a complete set (intermediate plate, transmission cover and adjusted spur gears). No adjustment of the preload of the taper roller bearings is therefore required.

Dismantling and assembling intermediate plate

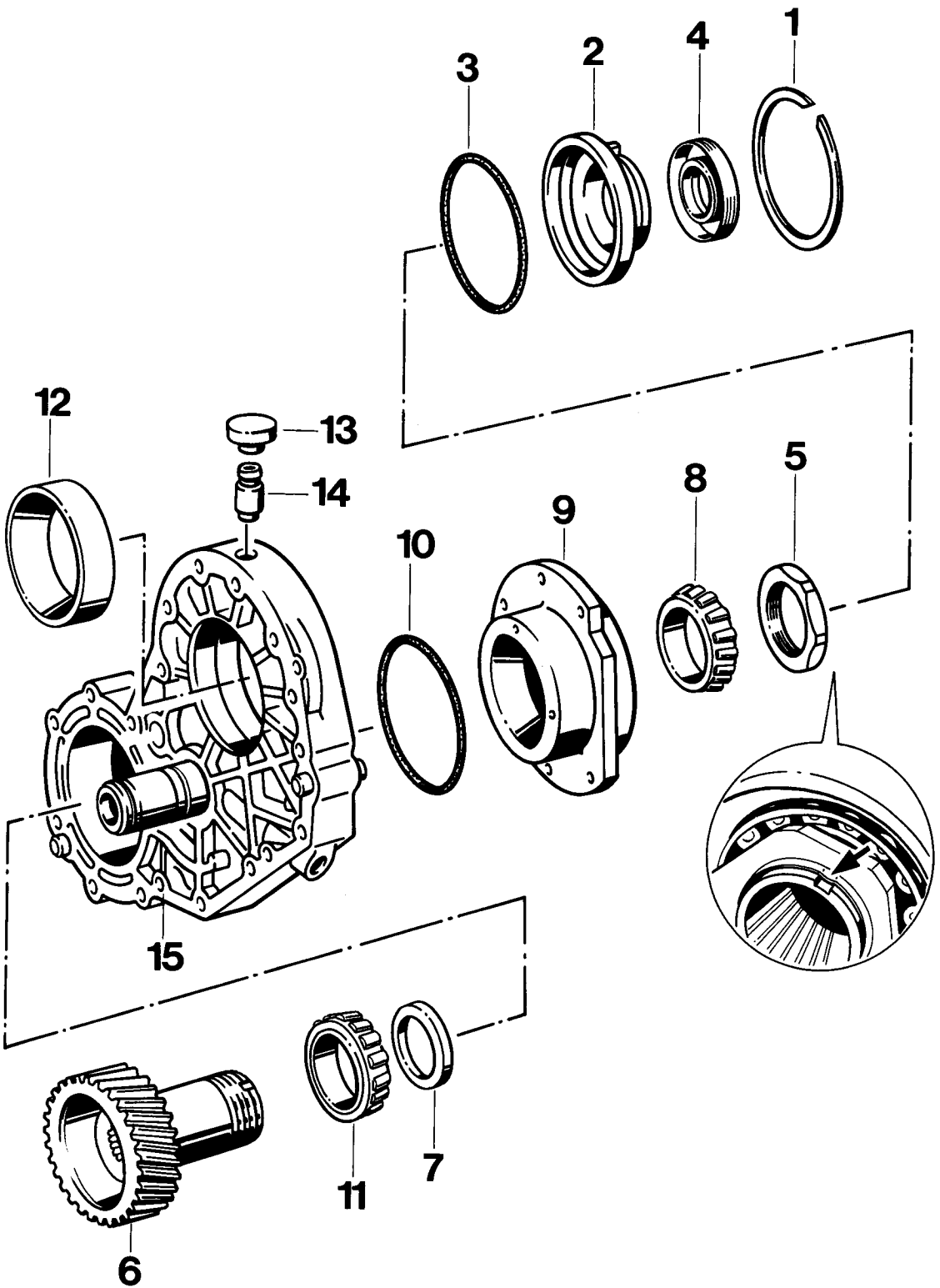
Tools



1027-37

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

Dismantling and assembling intermediate plate



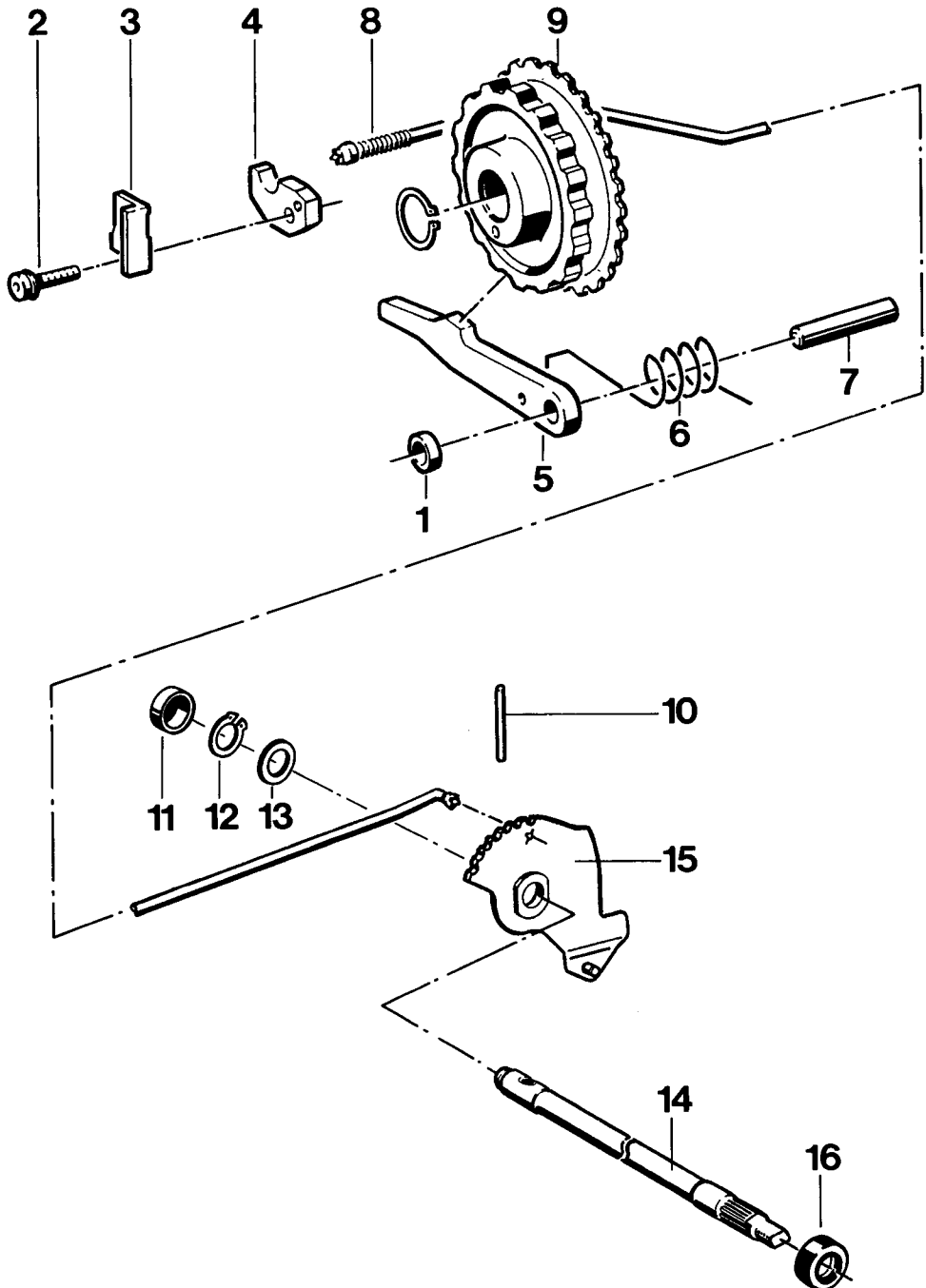
No.	Designation	Qty.	Note:	
			Removal	Installation
1	Snap ring	1		
2	Bearing cover	1	Grab at lugs to lift out	
3	Round seal	1		Replace, coat with ATF fluid
4	Shaft seal	1		Fitting depth 2.0 ± 0.5 mm
5	Lock nut	1	Fit Special Tool 9340 into vise. Put intermediate plate into position and undo nut.	Tighten to 250 Nm (184 ftlb). Lock by upsetting the flange (2 x 180°)
6	Helical gear	1	Press out using a hydraulic press.	
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.

Disassembling and assembling the parking lock

Disassembling and assembling the parking lock



No.	Designation	Qty.	Note:	
			Removal	Installation
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 position 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

Work instructions for disassembling and assembling

Disassembling

1. Remove transmission.
2. Remove intermediate plate.

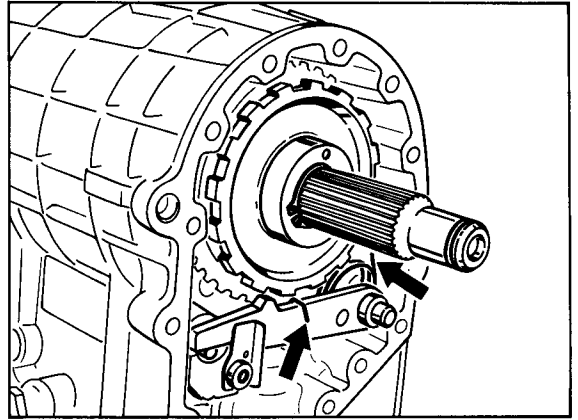
Note

Part Nos. 11 to 15 can be removed only when the rear transmission case and the ATF pan have been dismantled.

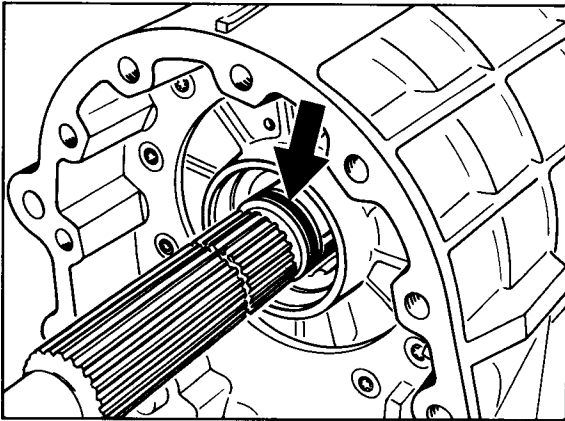
Assembly

1. Replace O-ring on output shaft.

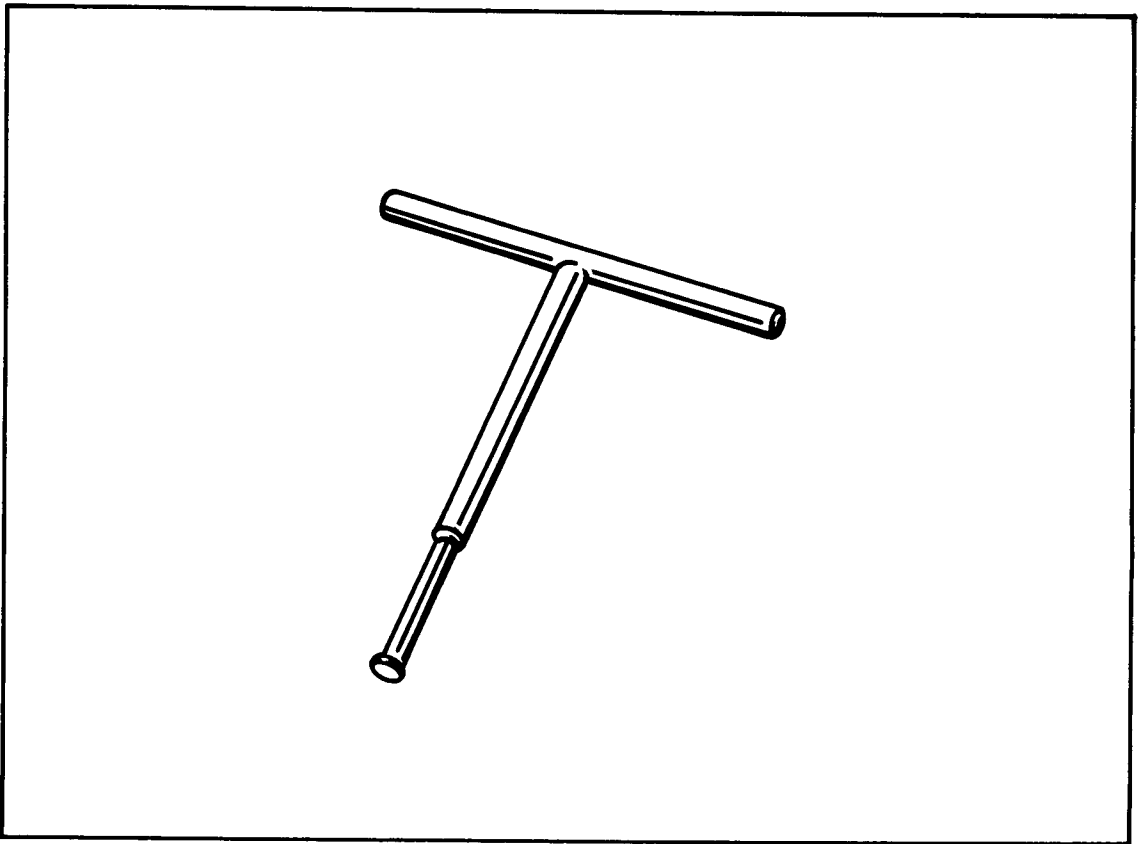
2. Insert spring for catch in correct position.



418-37

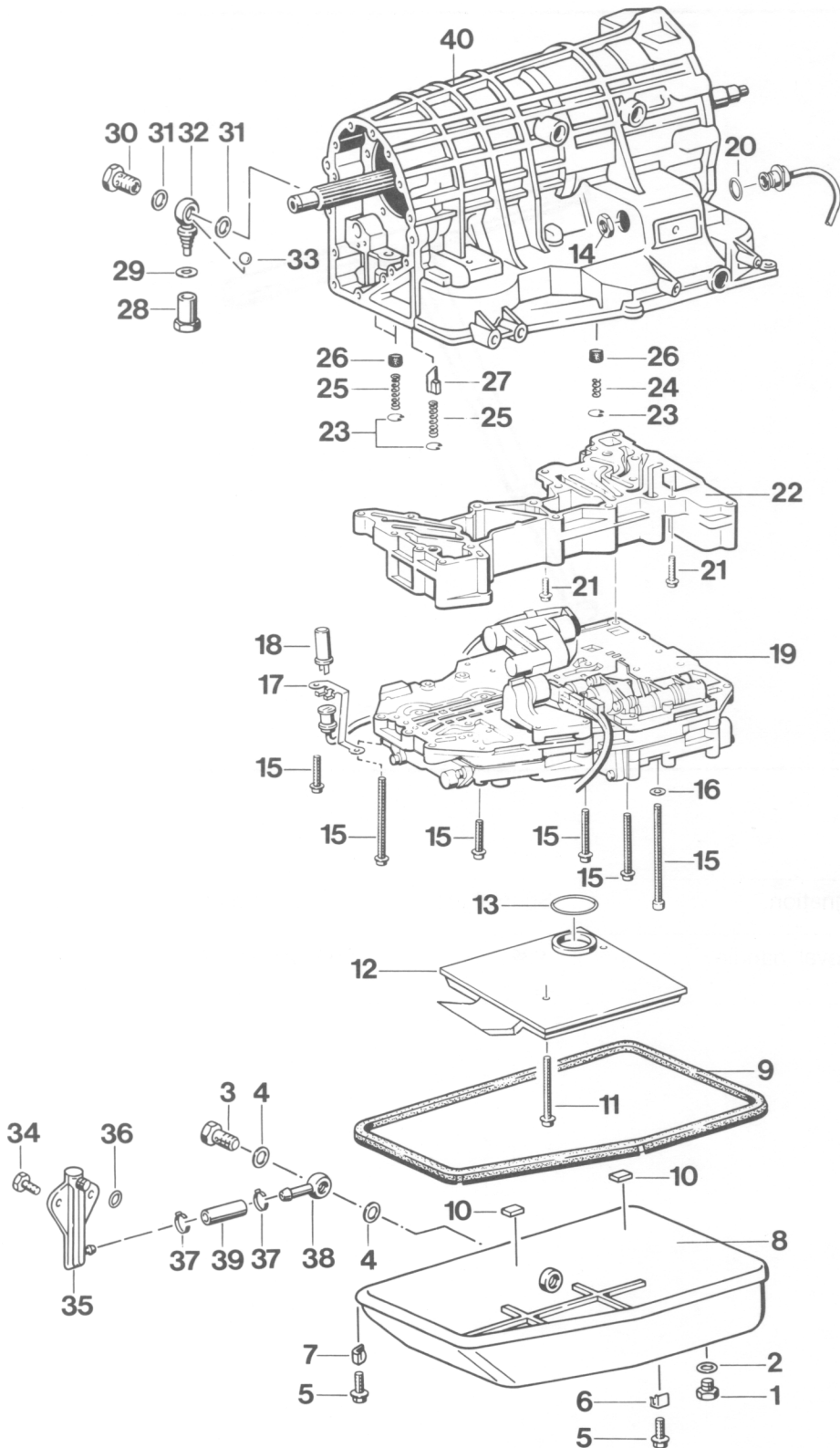


417-37

Dismantling and assembling transmission

No.	Designation	Special tool	Order number	Explanation
	Removal handle	9327	000.721.932.70	

Dismantling and assembling transmission



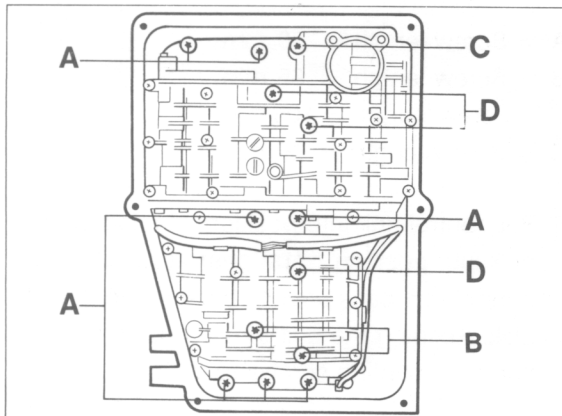
No.	Designation	Qty.	Note:	
			Removal	Installation
1	Plug	1		Tighten to 40 Nm (29 ftlb)
2	Seal	1		Replace
3	Banjo bolt	1		Tighten to 40 Nm (29 ftlb)
4	Seal	2		Replace
5	Hexagon head bolt	6		Tighten to 6 Nm (4 ftlb)
6	Bracket (straight leg)	2		Short legs must force on the ATF pan
7	Bracket (curved leg)	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
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 with wiring harness	1		The straight surface on the harness socket must point towards the outside
20	Round seal	1		Replace
21	Pan head screw	11		Observe correct length, tighten to 8 Nm (6 ftlb)
22	Adapter	1		
23	Snap ring	7		

No.	Designation	Qty.	Note:	
			Removal	Installation
24	Thrust spring (short)	4		
25	Thrust spring (long)	3		
26	Sealing sleeve	6	Pull out with Special Tool 9327	Press in to stop using a suitable mandrel
27	Sealing sleeve	1	Pull out with Special Tool 9327	Press in to stop, observ- ing correct position
28	Sealing nut	1		Tighten to 30 Nm (22 ftlb)
29	Seal	1		Replace
30	Banjo bolt	1		Tighten to 40 Nm (29 ftlb)
31	Seal	2		Replace
32	Flange	1		
33	Ball (6 mm dia.)	1		
34	Countersunk screw	2		Tighten to 5 Nm (4 ftlb)
35	ATF indicator tube	1		
36	Sealing ring	1		Replace
37	Hose clamp	2		
38	Flange	1		
39	Hose	1		
40	Transmission case	1		

Dismantling and assembly notes

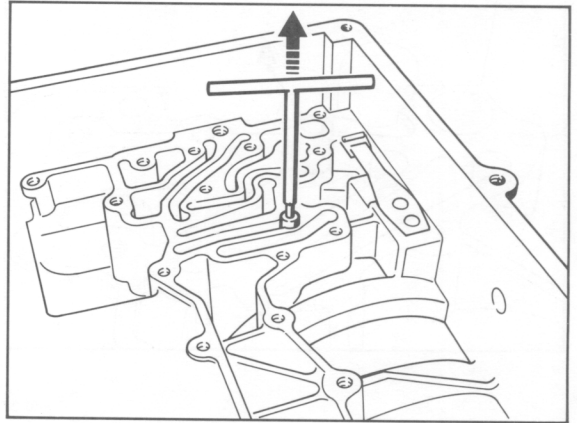
Dismantling

1. Remove and install rear transmission case (page 37 - 103).
2. Remove and install intermediate plate (page 37 - 107).
3. Remove and install parking lock (page 37 - 111).
4. Drain ATF fluid.
5. Unscrew 13 mounting screws (head dia. 12 mm) for hydraulic control unit and lift off control unit.



399-38

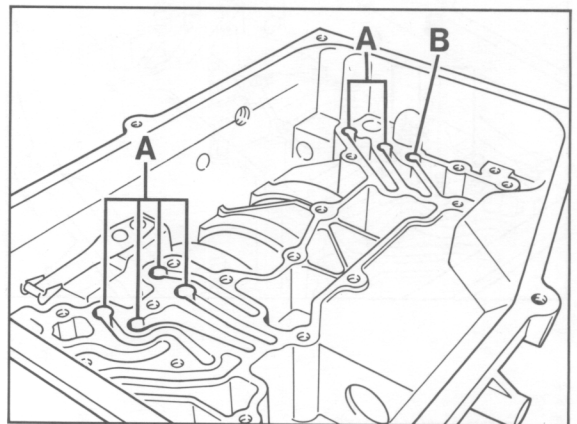
6. Pull sealing sleeves out of the bores, using Special Tool 9327.



838-37

Assembly

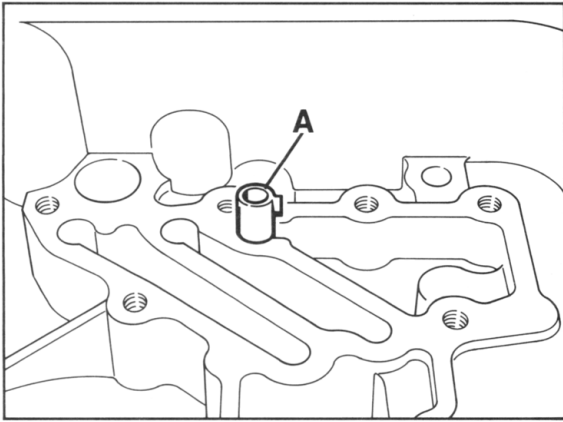
1. Using a suitable mandrel, press sealing sleeves into the bores of the transmission case. Make sure the sleeves are not tilted or damaged.



839-37

- A – short sealing sleeves
 B – bevelled sealing sleeve for lubrication pressure feed

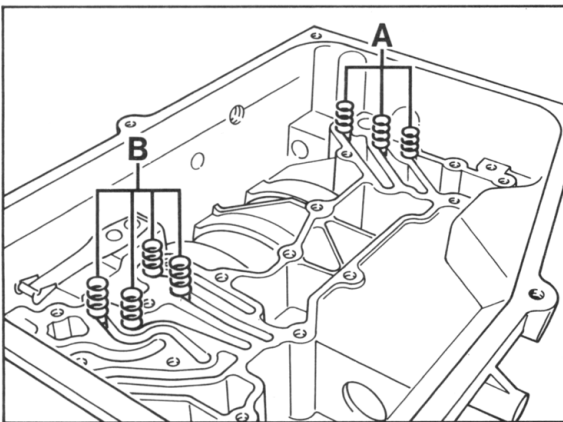
- Installation position of the bevelled sealing sleeve for lubrication pressure feed.



840-37

A - Sealing sleeve

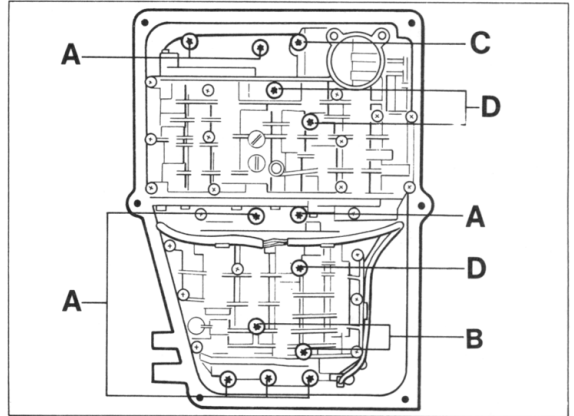
- Place thrust springs into position and locate with snap rings.



881-38

A - Long thrust springs
B - Short thrust springs

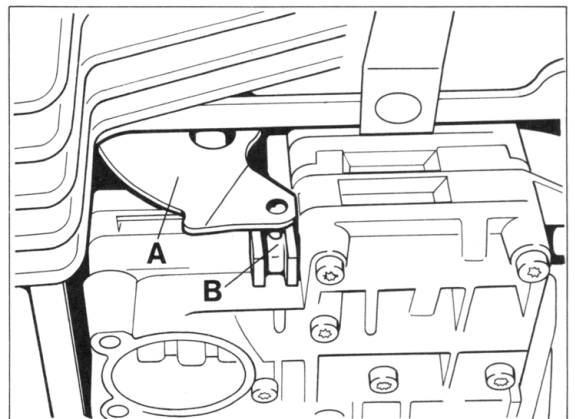
- Fit wiring harness to transmission case (straight surface on socket points to outside), place control unit into position and tighten all mounting screws lightly.



399-38

A = Screw length = 80 mm
B = Screw length = 65 mm
C = Screw length = 105 mm
D = Screw length = 60 mm

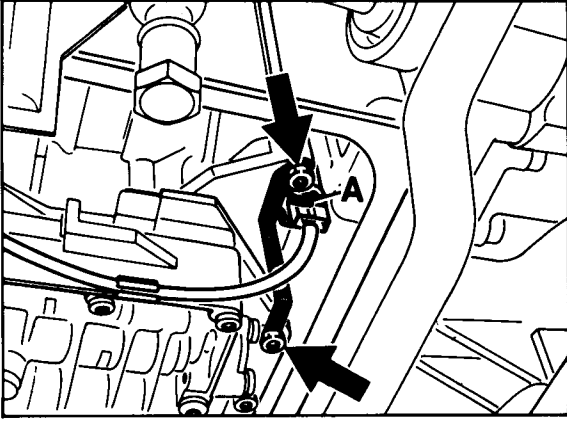
- Put control unit into position, placing detent disk into position 1 (1st gear) and pushing control unit back until it contacts the detent disk. Keeping the unit in this position, tighten mounting screws to **8 Nm**.



385-38

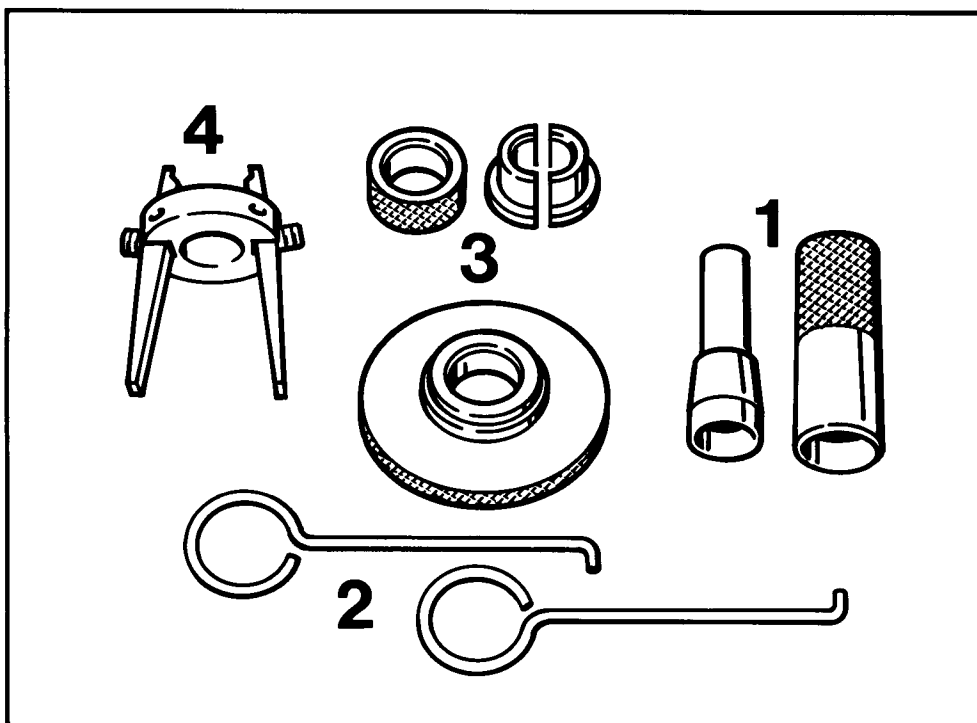
A - Detent disc
B - Selector valve

6. Place inductive rpm pickup into position and fit retainer plate in such a manner that the lugs engage into the grooves of the connector.



390-38b

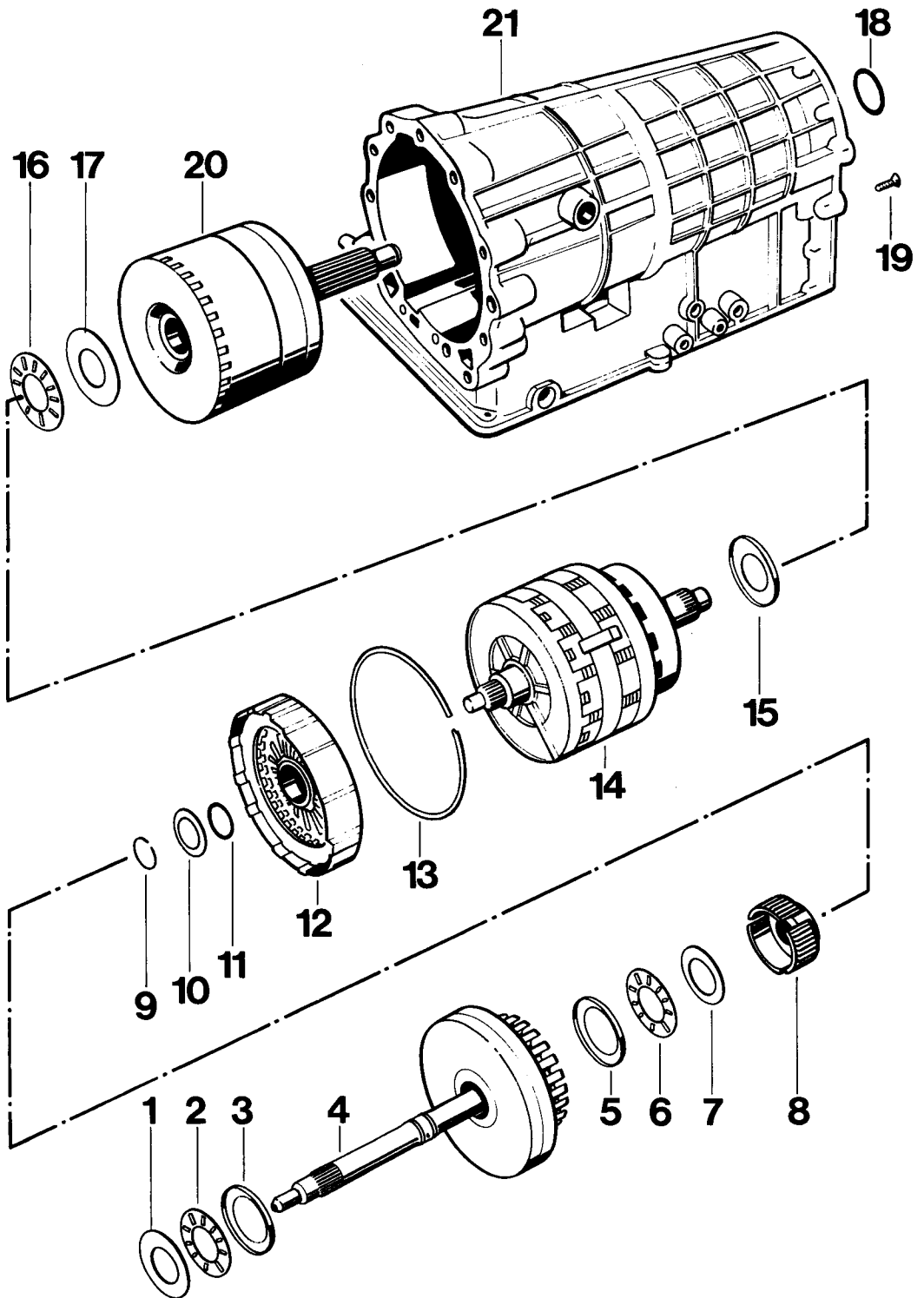
Dismantling and assembling transmission



897-37

No.	Designation	Special tool	Order number	Explanation
1	Assembly sleeve	9331	000.721.933.10	
2	Puller hook	9328/1	000.721.932.81	
3	Retaining device	9329/1	000.721.932.91	
4	Clamp	9334	000.721.933.40	

Dismantling and assembling transmission



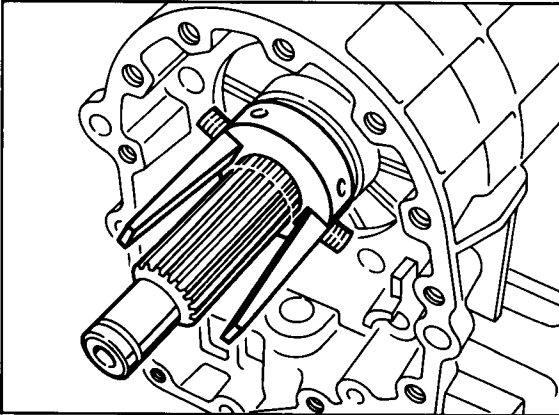
No.	Designation	Qty.	Note:	
			Removal	Installation
1	Adjusting shim	X	Record thickness for reassembly	Check shim thickness whenever the transmission has been dismantled and redetermine correct thickness as required (refer to page 38 - 171)
2	Axial needle roller cage	1		
3	Angled disc	1		Install in correct position
4	Drive shaft with coupling A	1	For dismantling and assembly, refer to page 38 - 168	
5	Angled disc	1		Use grease (vaseline) to stick to drive shaft in correct position
6	Axial needle roller cage	1		
7	Thrust washer	1		
8	Disc carrier	1		
9	Snap ring	1		
10	Support ring	1		
11	Round seal	1		Replace, fit with Special Tool 9331
12	Clutch B	1	Pull out using Special Tool 9328/1. For dismantling and assembly, refer to page 38 - 161	Check rectangular ring for correct position
13	Snap ring	1		
14	C/D pack	1	Lift out with Special Tool 9329/1 and place on Special Tool 9314. For dismantling and assembly, refer to page 38 - 143	Install with Special Tool 9329/1, making sure the 4 oil feed bores line up with the bores for the sealing sleeves
15	Angled disc	1		Use grease (vaseline) to stick to spider shaft, observing correct position
16	Axial needle roller cage	1		

No.	Designation	Qty.	Note:	
			Removal	Installation
17	Thrust washer	1		
18	Round seal	1		Replace
19	Countersunk screw (Torx bit TX 30)	10		Tighten to 10 Nm (7 ftlb). Observe correct tightening torque, otherwise pressure losses at the clutch may result
20	4th gear tower	1	Use Special Tool 9334 to lift out	Insert with Special Tool 9334 , making sure the three oil feed bores of cylinder E and transmission case line up with each other
21	Transmission case	1		

Dismantling and assembly notes

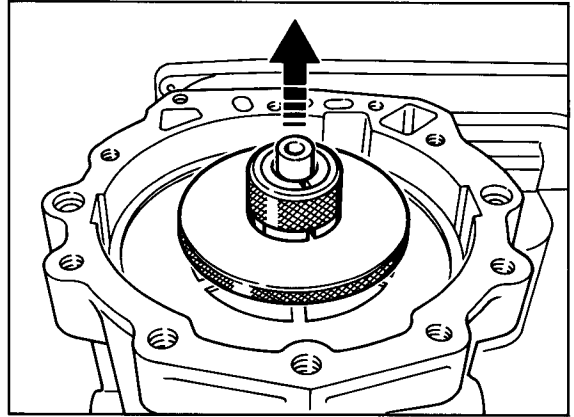
Dismantling

1. Remove round seal from output shaft and put Special Tool 9334 into place.



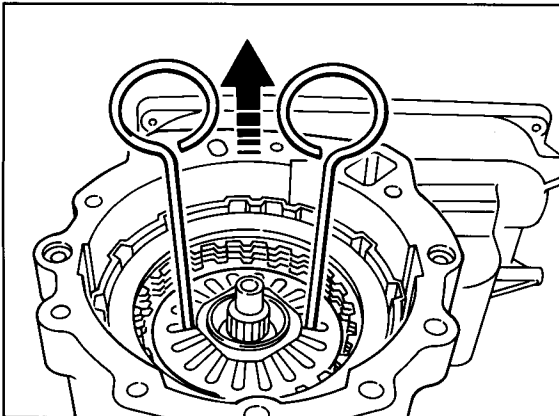
891-37

3. Take out entire brake pack C'/C/D using Special Tool 9329/1.



893-37

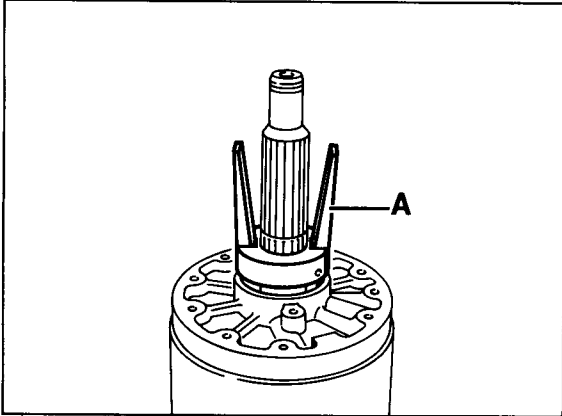
2. Pull out clutch B using Special Tool 9328/1, lifting clutch until a resistance is felt, press back down again and pull out in one go.



892-37

Assembly

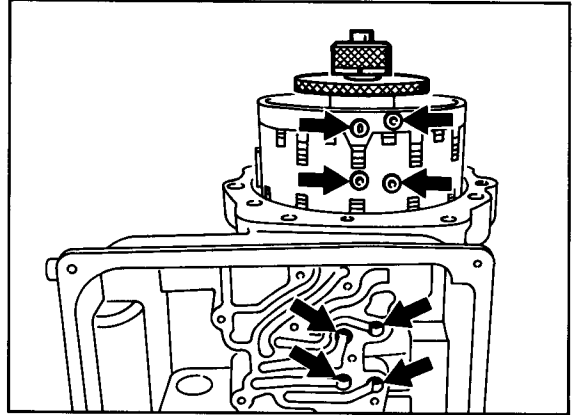
1. To prevent the preassembled 4th gear tower from separating again, allow Special Tool 9334 to engage into the groove of the round seal.



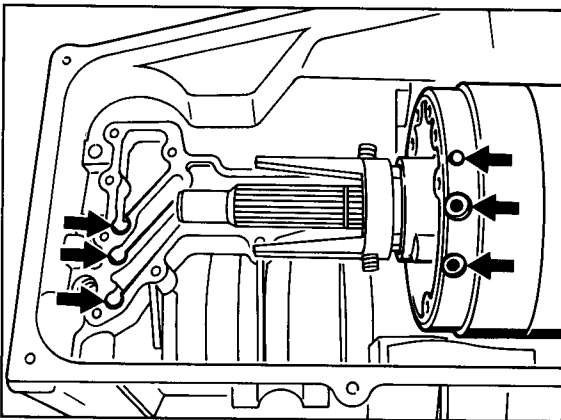
885-37

2. Place 4th gear tower minus planetary gear set and sun wheel into housing, observing correct position. The three oil feed bores of cylinder E and transmission case must line up.

3. Place axial needle roller cage, thrust washers, planetary set and sun wheel into place (refer to page 38 - 122).
4. Place brake pack C'/C/D with Special Tool 9329/1 into transmission case, making sure the 4 oil feed bores line up with the bores for the sealing sleeves.



895-37

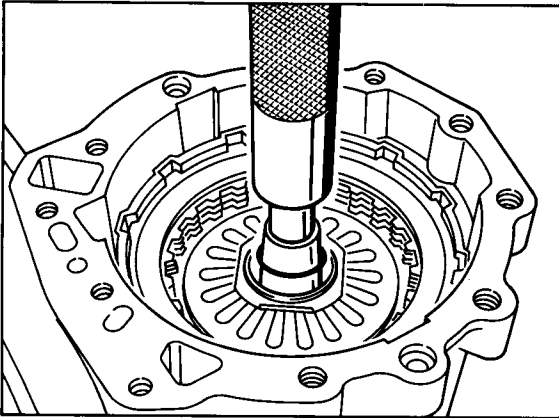


894-37

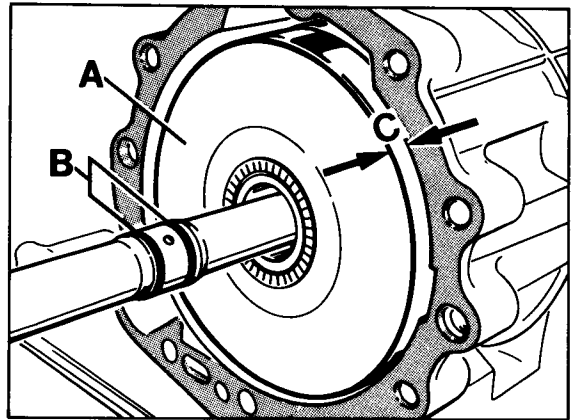
5. Place complete clutch assembly B into housing and press down to stop. Slip round seal onto inner part of Special Tool 9331 up to the taper and use outer section to push it in to stop.

Fit support ring and snap ring in the same way.

6. Place drive shaft complete with clutch A into housing and rotate cylinder A to and fro until the teeth, the disc carrier and the discs engage fully with each other. The correct position is achieved if the cylinder face protrudes by approx. 8.5 mm beyond the housing face.



914-37



416-37

- A - Clutch A
- B - Rectangular rings
- C - Fitting depth

Checking the ATF fluid level

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

Preconditions for checking:

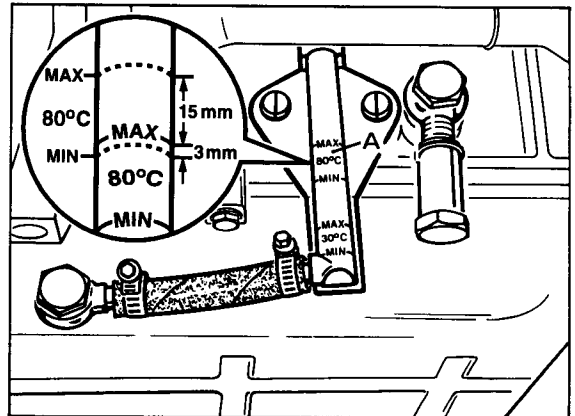
- Transmission underbody cladding removed
- Vehicle must be horizontal
- Engine operating at idling speed
- Hand brake applied
- Selector lever in position "P"
- ATF temperature 80°C

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 MIN mark** present).



1958-38

A = invalid 80°C mark

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

If necessary, top up missing ATF fluid via the quick-fill device (also refer to page 38-103).

Changing ATF fluid and cleaning the ATF strainer

Capacity: approx. 9.5 l

Change quantity: approx. 3.5 l

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 38-109).

Thoroughly clean the strainer and pan.

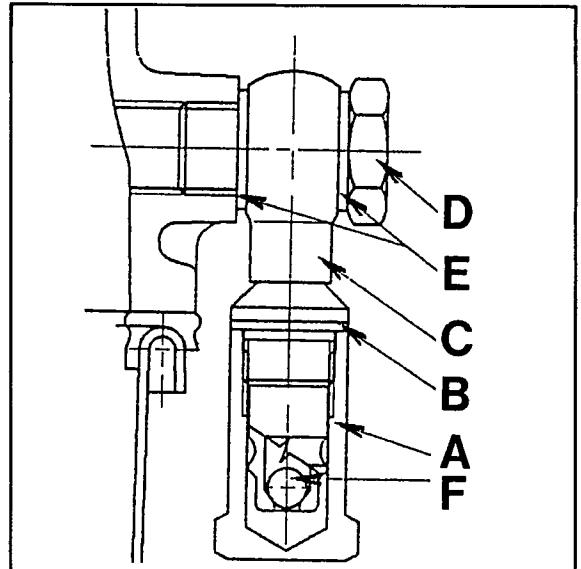
Fit the ATF strainer with a new O-ring.

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.

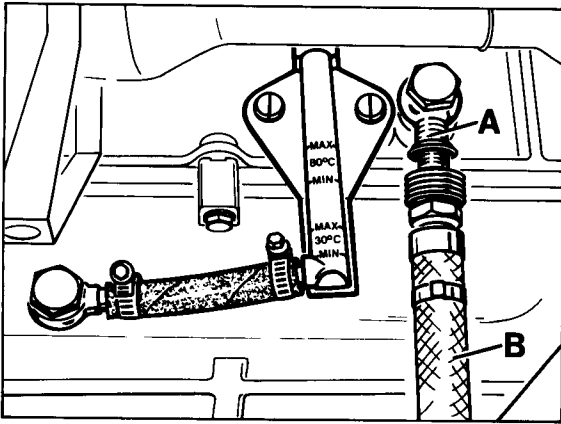


391-38

A = Hexagon cap nut (tightening torque
30 Nm = 22 ftlb)

B = Sealing ring (replace)

C = Quick-fill connection



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.

Be sure to observe the note on page 38-101.

Here, the fluid level must be between the 80°C min. and max. marks.

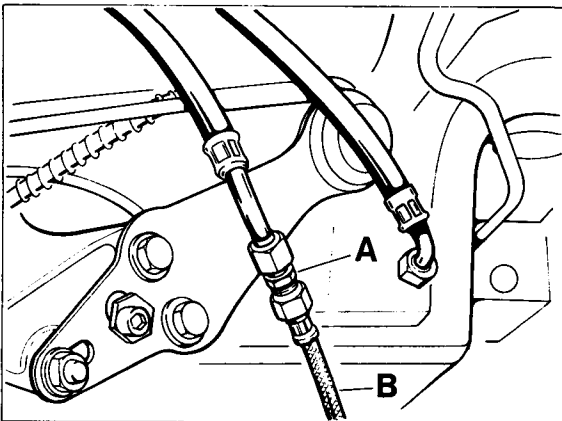
The exact ATF temperature can be determined with the system tester 9288.

Flushing ATF cooler and lines

Information

If the ATF is carbonized, or if there is sludge or evidence of lining abrasion in the ATF sump, 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) to ATF line with conventional twin connecting piece and flush out cooler and line system using filling device.



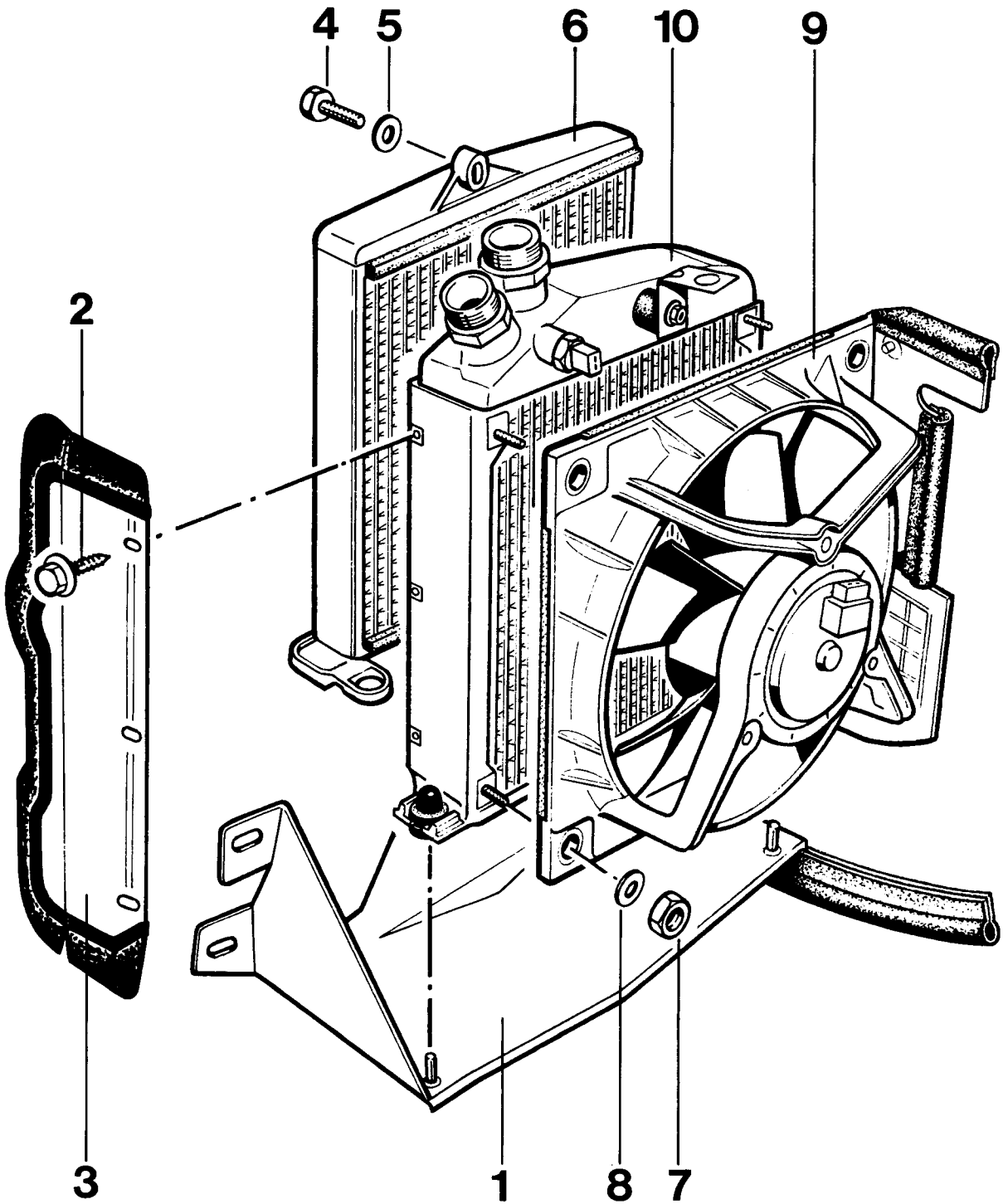
490-38

A = Twin connecting piece M 16 x 1.5
with conical seal

B = Additional hose

Removing and installing ATF cooler

Removing and installing ATF cooler



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		

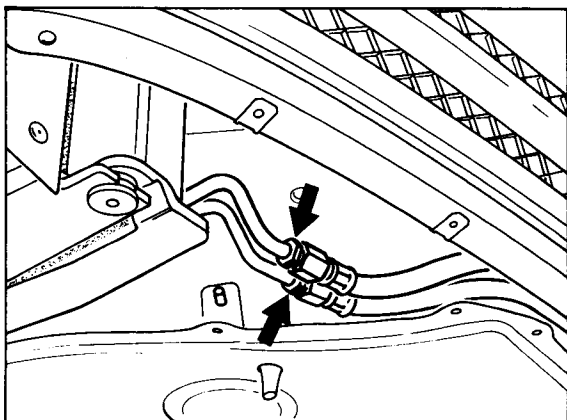
Removing and installing ATF cooler

Information

The ATF cooler is located in the wheel house in front of the front right-hand wheel. It is attached to the engine oil cooler and is ventilated by the engine oil cooler's two-stage electric blower.

Removal

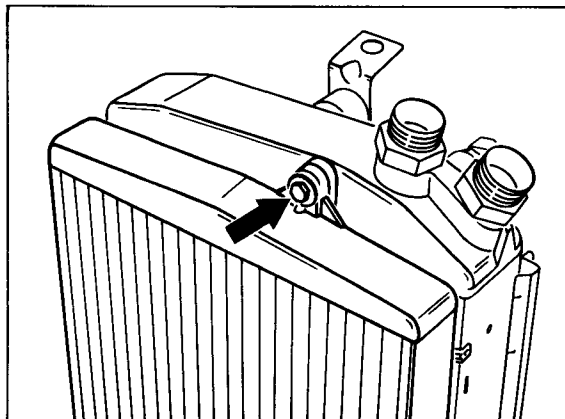
1. Remove front wheel house liner and lower panel
2. Disconnect ATF lines and seal with suitable plugs.



489-38

3. Unfasten retaining bracket on headlamp housing.
4. Remove bracket, undoing three self-locking hexagon nuts (M8) on the wheel arch and one (M6) for the diagonal brace.
5. Remove air deflector.

6. Remove hexagon screw and take out ATF cooler (illustration shows cooler removed).

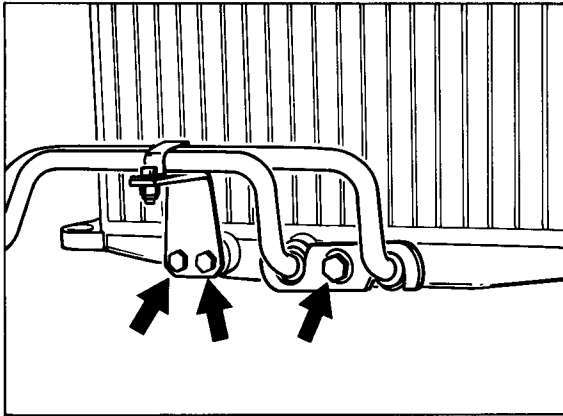


487-38

Note

Do not disconnect oil lines from engine oil cooler. Cooler remains in wheel house.

7. Remove ATF lines on cooler.



488-38

1. Installation is carried out in reverse order.

2. Replace O-rings for ATF lines on cooler.

3. Check that rubber edging strips on fan housing and bracket fit properly.

4. Check ATF level and if necessary top up.

Installation

Tightening torques: (= ftlb)

Connection ATF line = 30 Nm (22.0ftlb)

Retaining bracket to headlamp housing = 23 Nm (16.9 ftlb)

Bracket to wheel house = 23 Nm (16.9 ftlb)

Diagonal brace to bracket = 10 Nm (7.3 ftlb)

ATF cooler to engine oil cooler = 10 Nm (7.3 ftlb)

Bolt to ATF cooler = 10 Nm (7.3 ftlb)

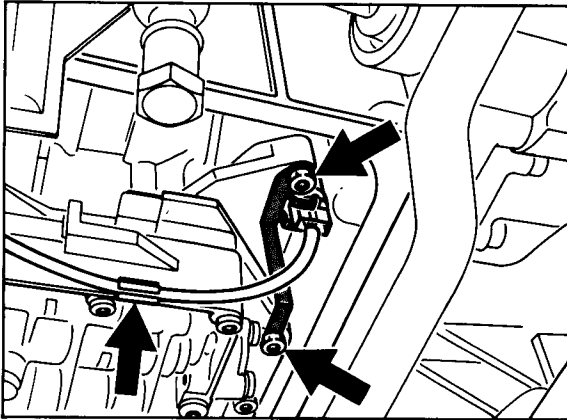
Retaining bracket to ATF cooler = 6 Nm (4.4 ftlb)

Retaining plate to retaining bracket = 3 Nm (2.2 ftlb)

Removing and installing the inductive speed sensor

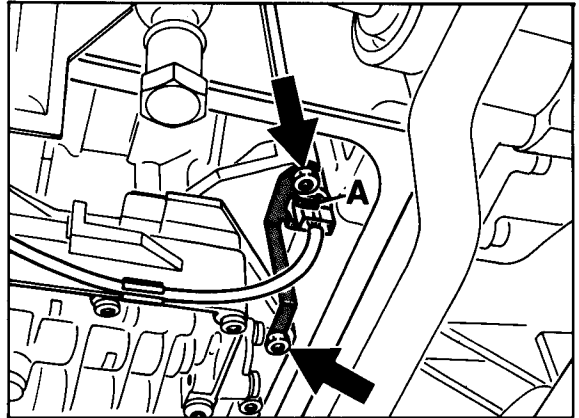
Removing

1. Remove the transmission underbody cladding and ATF pan (refer to page 38-109).
2. Remove the holder for the inductive sensor and pull out sensor.



390-38a

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



390-38b

A = Connector groove

Installing

Tightening torque:

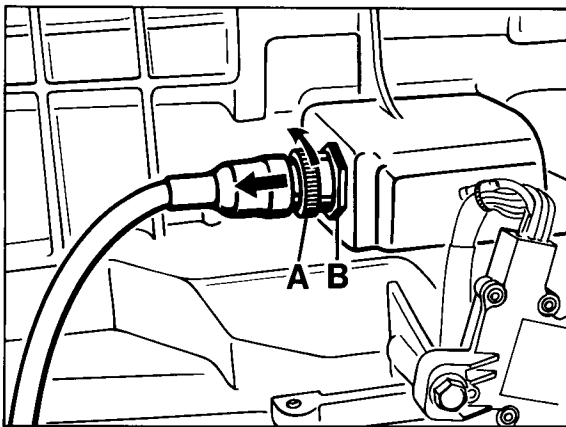
Holder to control unit = 8 Nm

Installation takes place in reverse order.

Removing and installing the wiring harness for the transmission

Removing

1. Remove the transmission underbody cladding.
2. Remove the position switch (refer to page 37-101).
3. Disconnect the connector from the transmission socket. To do this, turn the bayonet lock to the left and disconnect the connector:

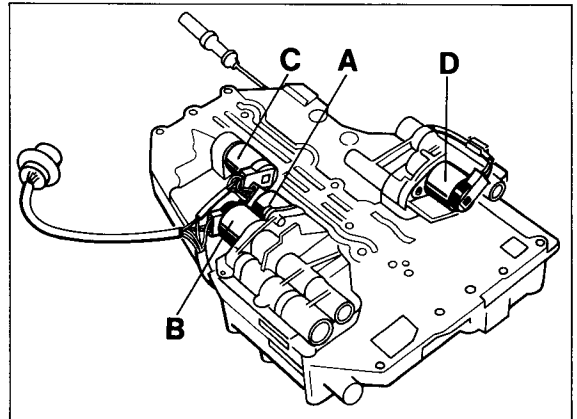


387-38a

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

4. Unscrew the hexagon nut for the transmission socket with a suitable extension.
5. Remove the hydraulic control unit with wiring harness (also refer to page 38-109).

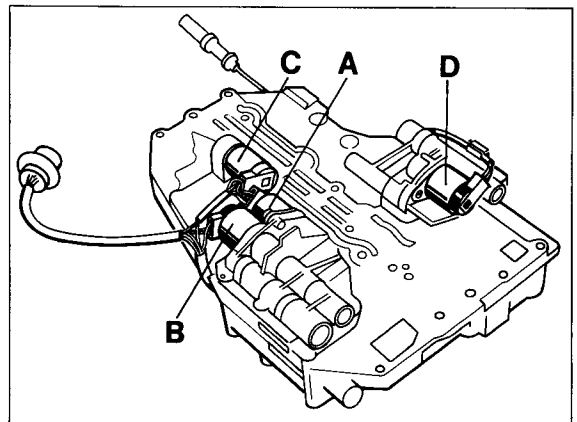
6. Mark the push-on sleeves for re-installation and pull off from the solenoid valves.



383-38

Installing

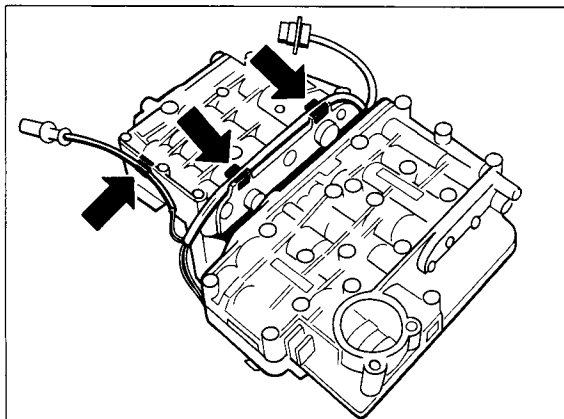
1. Push the push-on sleeves for the solenoid valves up to the stop. Pay attention to cable colors.



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.



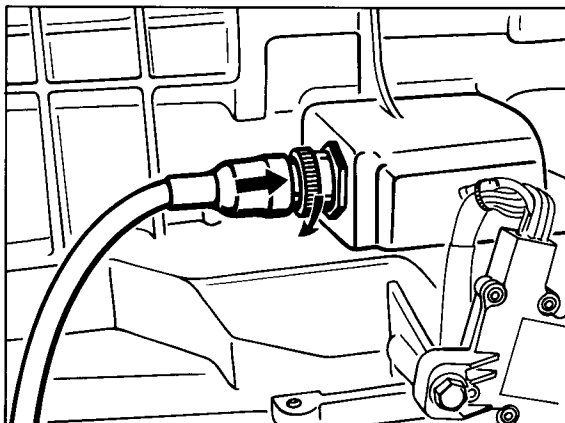
384-38

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

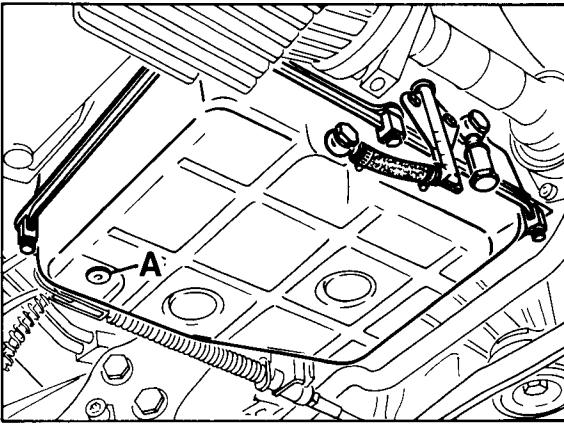
7. Install the position switch and readjust.

Removing and installing the hydraulic control unit

Removing

The transmission wiring harness remains on the transmission.

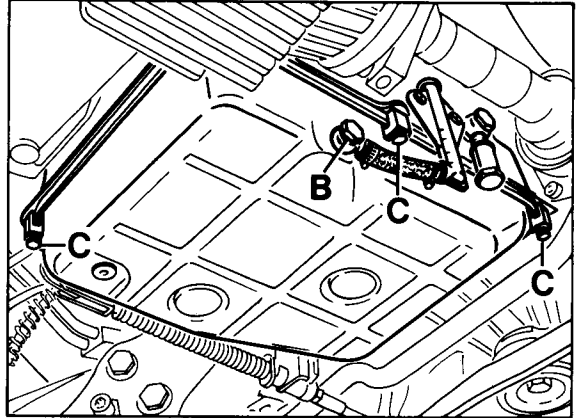
1. Remove the transmission underbody cladding.
2. Drain off ATF fluid.



386-38a

A = Drain screw with sealing ring

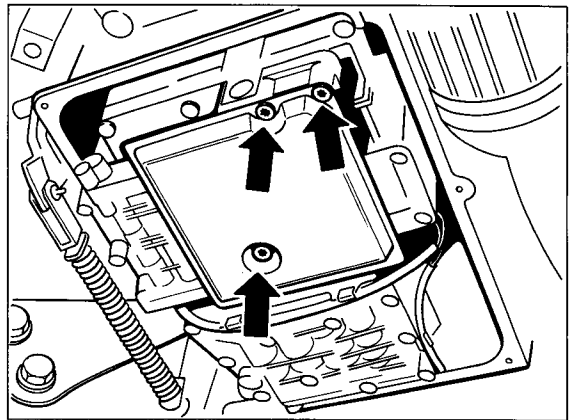
3. Remove ATF pan. To do this, unscrew hollow screw for oil level pipe and six fixing screws.



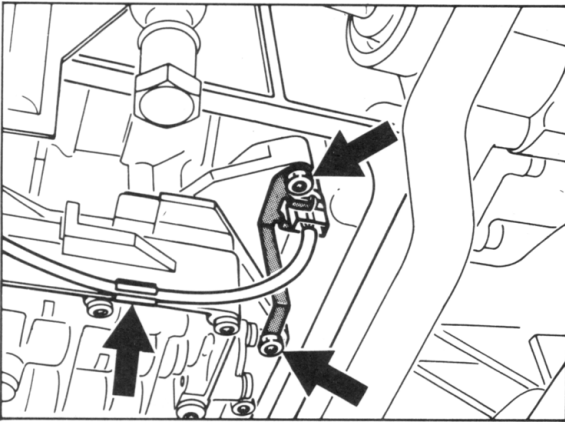
386-38b

B = Hollow screw
C = Fixing screws

4. Remove ATF strainer with Torx insert T 27.



382-38



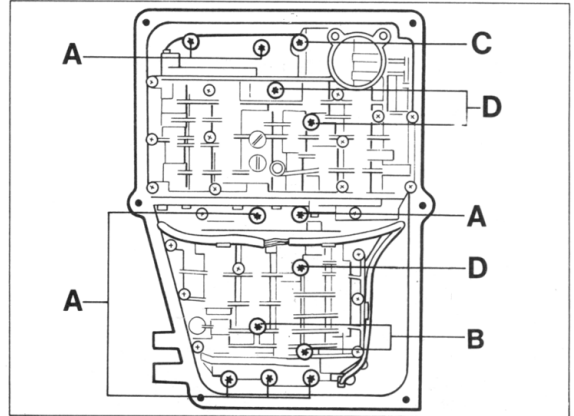
390-38a

6. Unscrew 13 fixing screws (head diameter 12 mm) **with Torx insert T 27** and lower control unit only so far as to guarantee that the wiring harness is not subjected to any tension.

Place the control unit on a suitable surface (e.g. transmission jack).

Note

Do not allow the control unit to hang from the wiring harness under any circumstances.



399-38

- A = Screw length 80 mm
 B = Screw length 65 mm
 C = Screw length 105 mm
 D = Screw length 60 mm

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

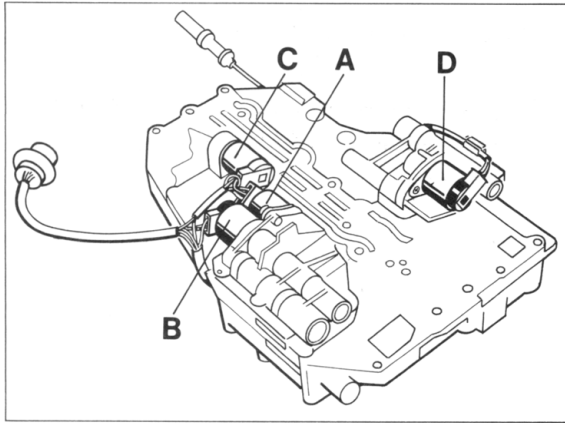
Installation takes place in reverse order.

1. Tightening torques:

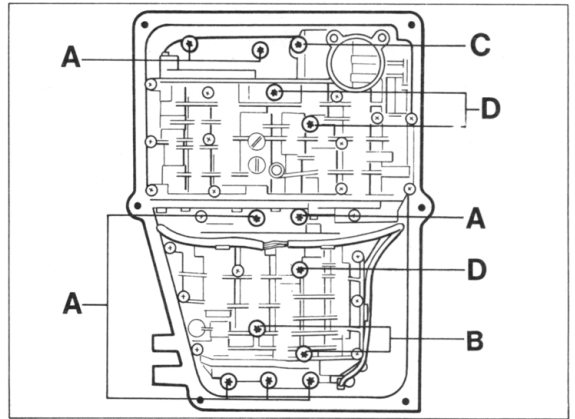
- Control unit to transmission = 8 Nm (6 ftlb)
 ATF strainer to control unit = 8 Nm (6 ftlb)
 ATF pan to transmission = 6 Nm (4 ftlb)
 Drain screw to ATF pan = 40 Nm (29 ftlb)
 Hollow screw to ATF pa = 40 Nm (29 ftlb)

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

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



383-38



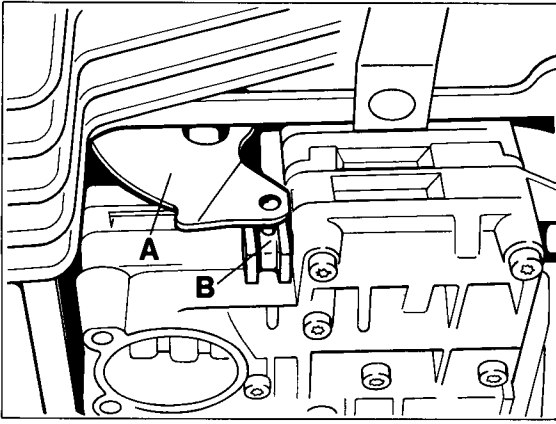
399-38

	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)

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

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

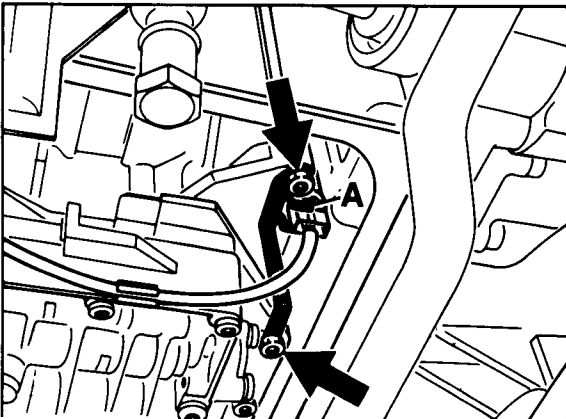
5. Position control unit. To do this, move notched disk to position 1 (1st gear) and push control unit back until it rests against the notched disk. Tighten fixing screws with **8 Nm** in this position.



385-38

A = Notched disk
B = Selector slide

6. Insert inductive speed 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.

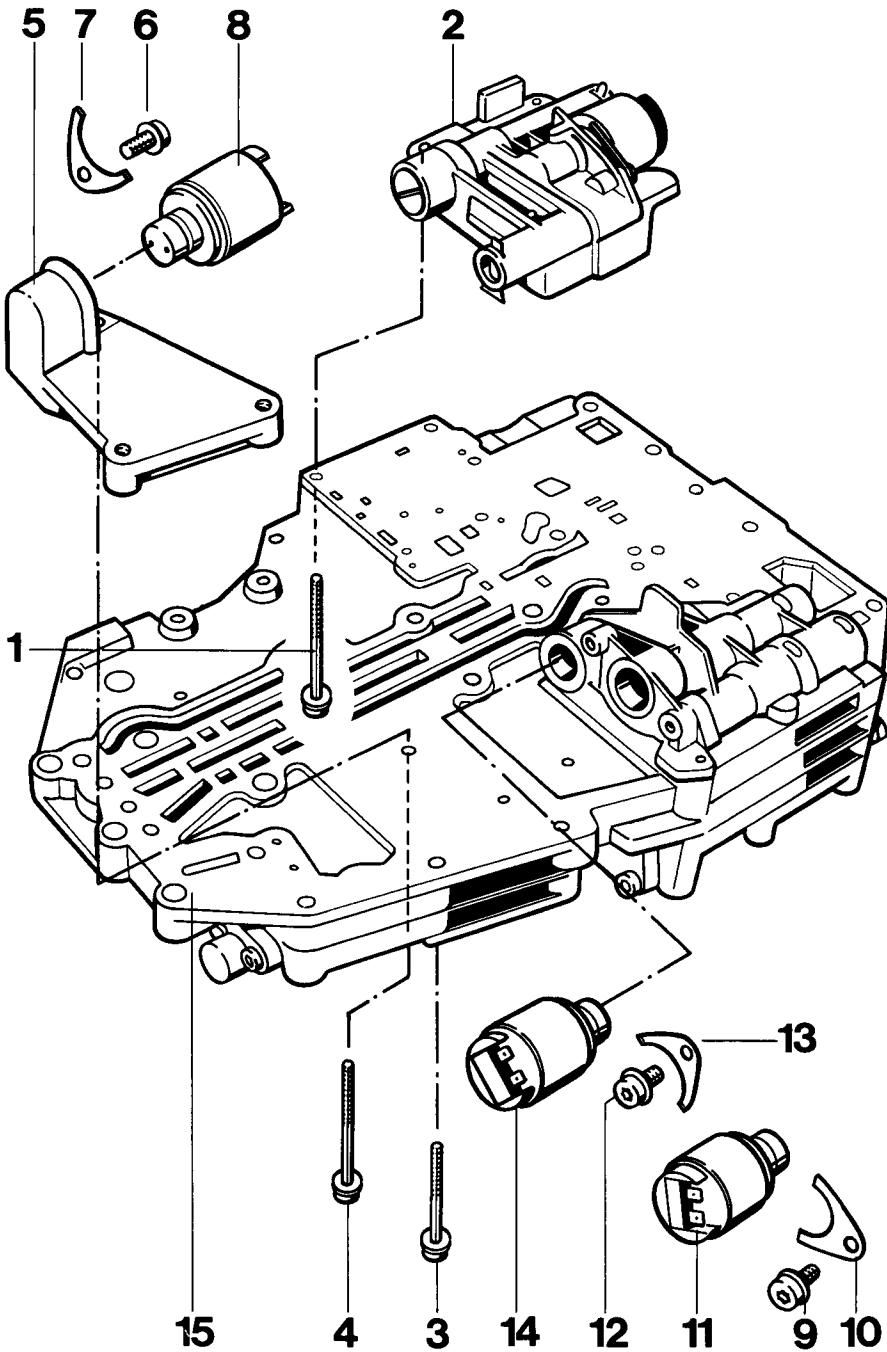
Note

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).

Removing and installing solenoid valves

Removing and installing solenoid valves



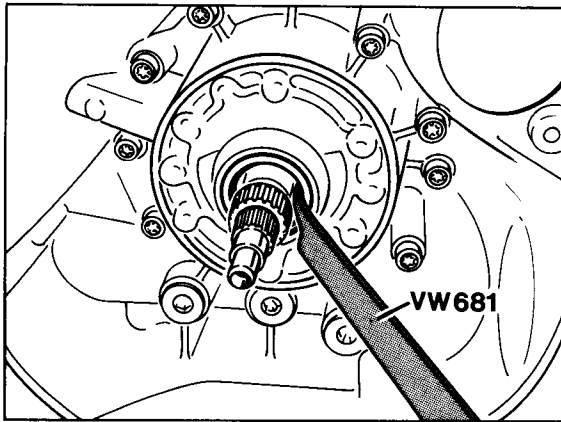
409-38

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 solenoid 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 solenoid 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 solenoid valves Nos. 11 and 8
15	Hydraulic control unit	1		

Removing and installing the rotary shaft seal for the ATF pump

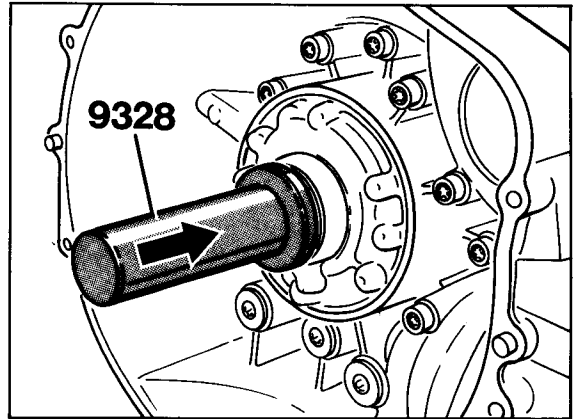
Removing

1. Remove transmission and converter.
2. Lever out sealing ring with **VW 681**



419-38

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



420-38

Installing

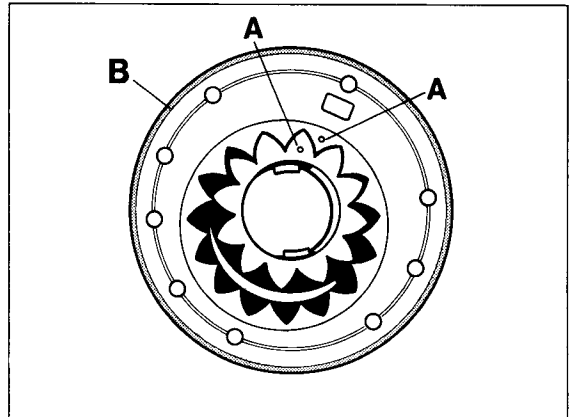
Installation takes place in reverse order.

1. Wet sealing lip with ATF.

Removing and installing the ATF pump

Removing

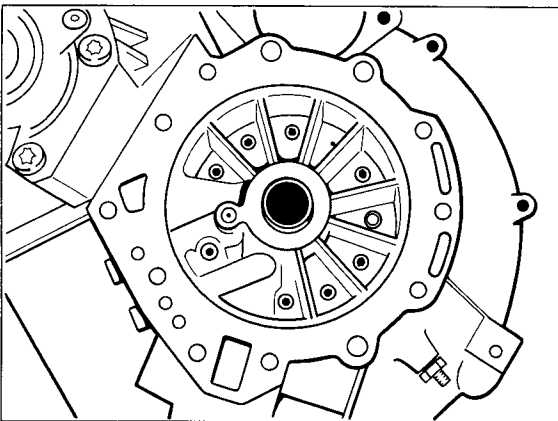
1. Remove transmission.
2. Remove torque converter and rear transmission case.
3. Unscrew fixing screws with **Torx insert T27** and remove pump. To do this, screw in two screws opposite each other and carefully drive out the pump by gentle blows on the screw heads



405-38

A = Installation markings
B = O-ring

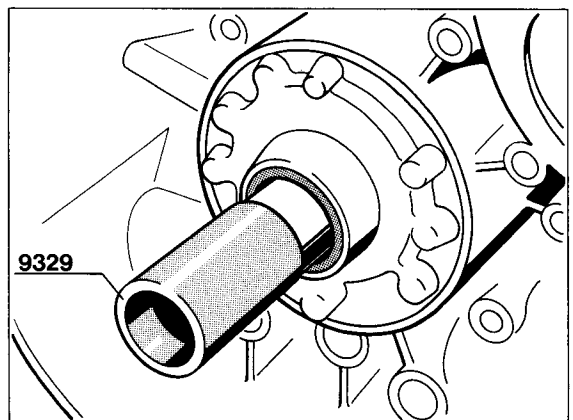
3. Install pump with new O-ring and centering sleeve. Tighten fixing screws with **10 Nm**.
4. Check pump for easy operation. It must be possible to turn the pump by hand with special tool **9329** without it catching.



406-38

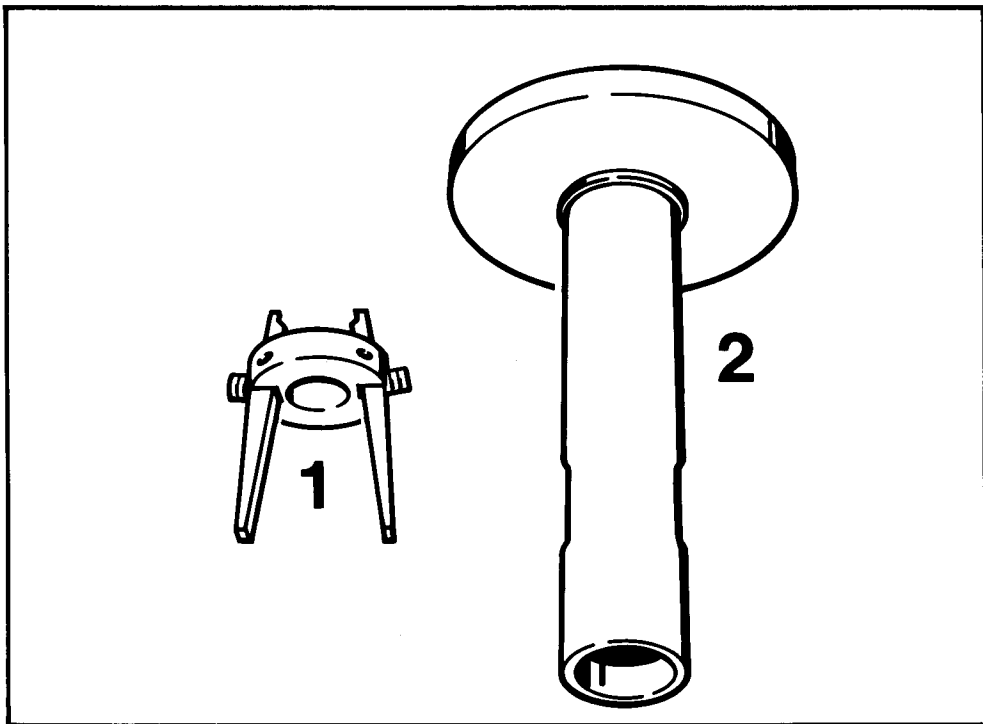
Installing

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.



421-38

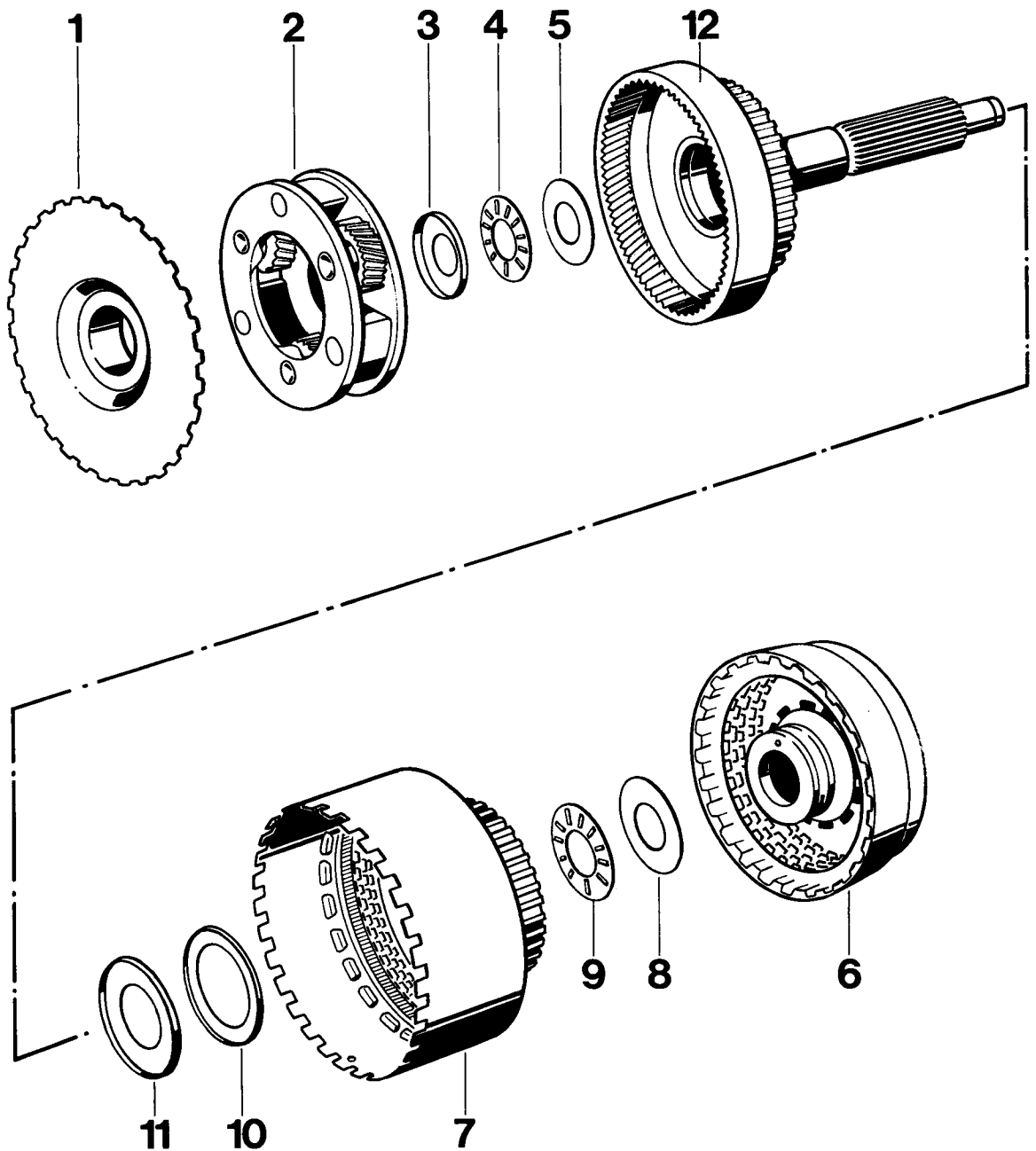
Dismantling and assembling 4th gear tower



911-38

No.	Designation	Special tool	Order number	Explanation
1	Clamp	9334	000.721.933.40	
2	Assembly support	9314	000.721.931.40	

Dismantling and assembling 4th gear tower



No.	Designation	Qty.	Note:	
			Removal	Installation
1	Sun wheel	1		
2	Planetary set	1		Check for correct seating of the rectangular ring. Engage into hollow gear with a slight rotary motion
3	Angled disc	1		Fit in correct position
4	Axial needle roller cage	1		
5	Thrust washer	1		
6	Brake F	1	For dismantling, refer to page 38 - 137	Make sure rectangular rings are located correctly. Rotate them slightly to move them into installation position
7	Clutch E	1	For dismantling, refer to page 38 - 131	Fit with a rotary motion. The specified position is achieved when cylinder E rests against the copper angle disc
8	Thrust washer	1		
9	Axial needle roller cage	1		
10	Copper angle disc	1		Install in correct position
11	Steel angle disc	1		Install in correct position
12	Output shaft with freewheel	1	For dismantling, refer to page 38 - 127	

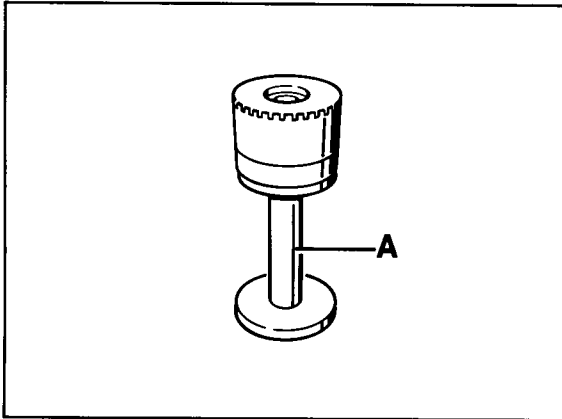
Note

Parts No. 1 to 5 should be fitted only after the 4th gear tower has been installed

Dismantling and assembly notes

Dismantling

1. Take Special Tool **9334** off the output shaft, lift the complete pack by the cylinder and place onto Special Tool **9314**.

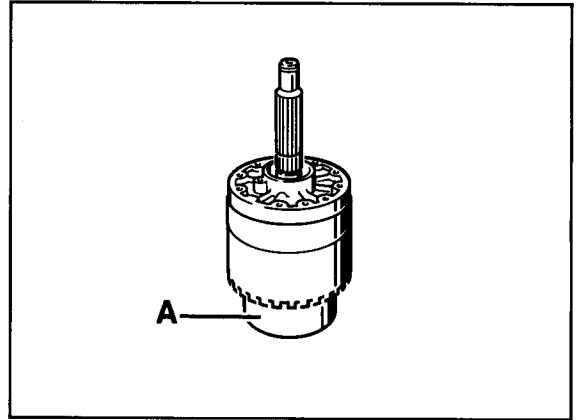


882-38

A - Special Tool **9314**

2. Take off sun wheel and planetary set.

3. Turn over the complete pack on the output shaft and place on a suitable support (e.g. Special Tool **9508/1**).



883-38

A = Special Tool **9508/1**

4. Take off cylinder F and E

Assembly

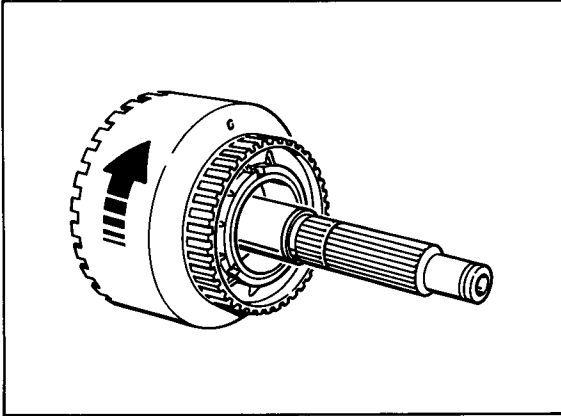
1. Place preassembled output shaft on a suitable support (e.g. **9508/1**).

2. Put steel and copper angle disc in place and fit cylinder E with a rotary motion.

Note

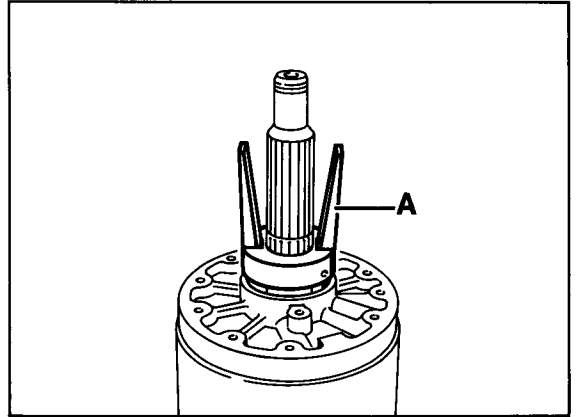
The teeth of the end disc and of the free-wheel outer ring must engage with each in such a manner that cylinder E rests on the copper angle disc.

4. If the freewheel has been fitted correctly, cylinder E must be free to rotate clockwise with the output shaft being held, but it must lock when an attempt is made to rotate it counterclockwise.



880-38

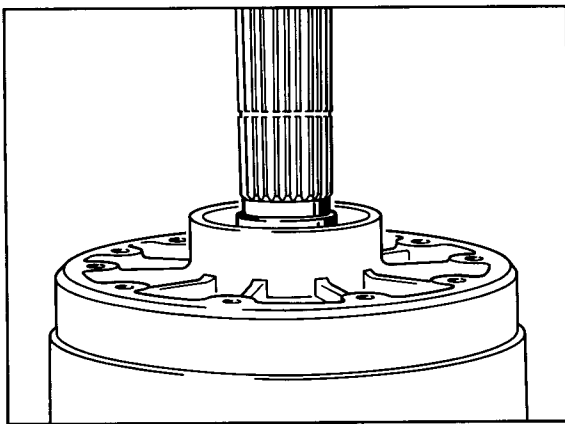
6. To prevent the preassembled pack from separating, allow **Special Tool 9334** to engage into the groove of the round seal.



885-37

A – Special Tool 9334

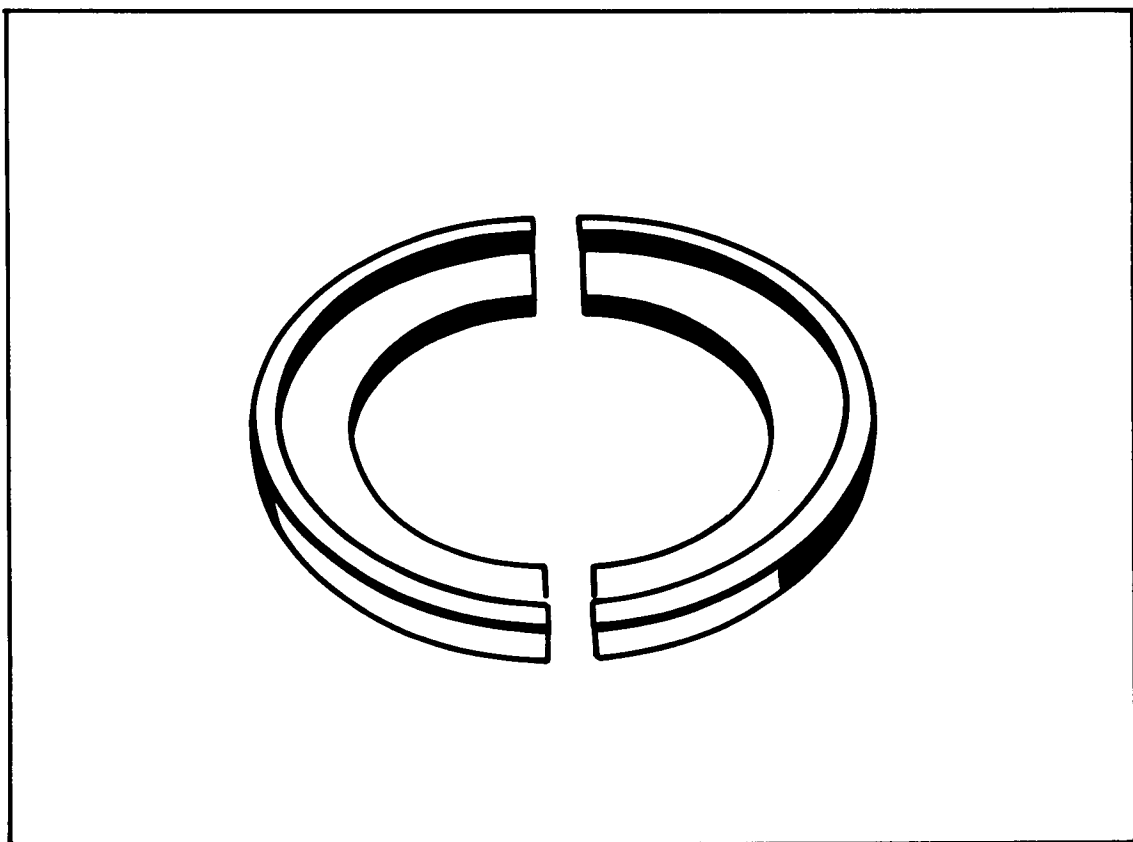
5. Fit axial needle roller cage and thrust washer. Place cylinder F onto cylinder E with a rotary motion until it is in assembly position.



884-38

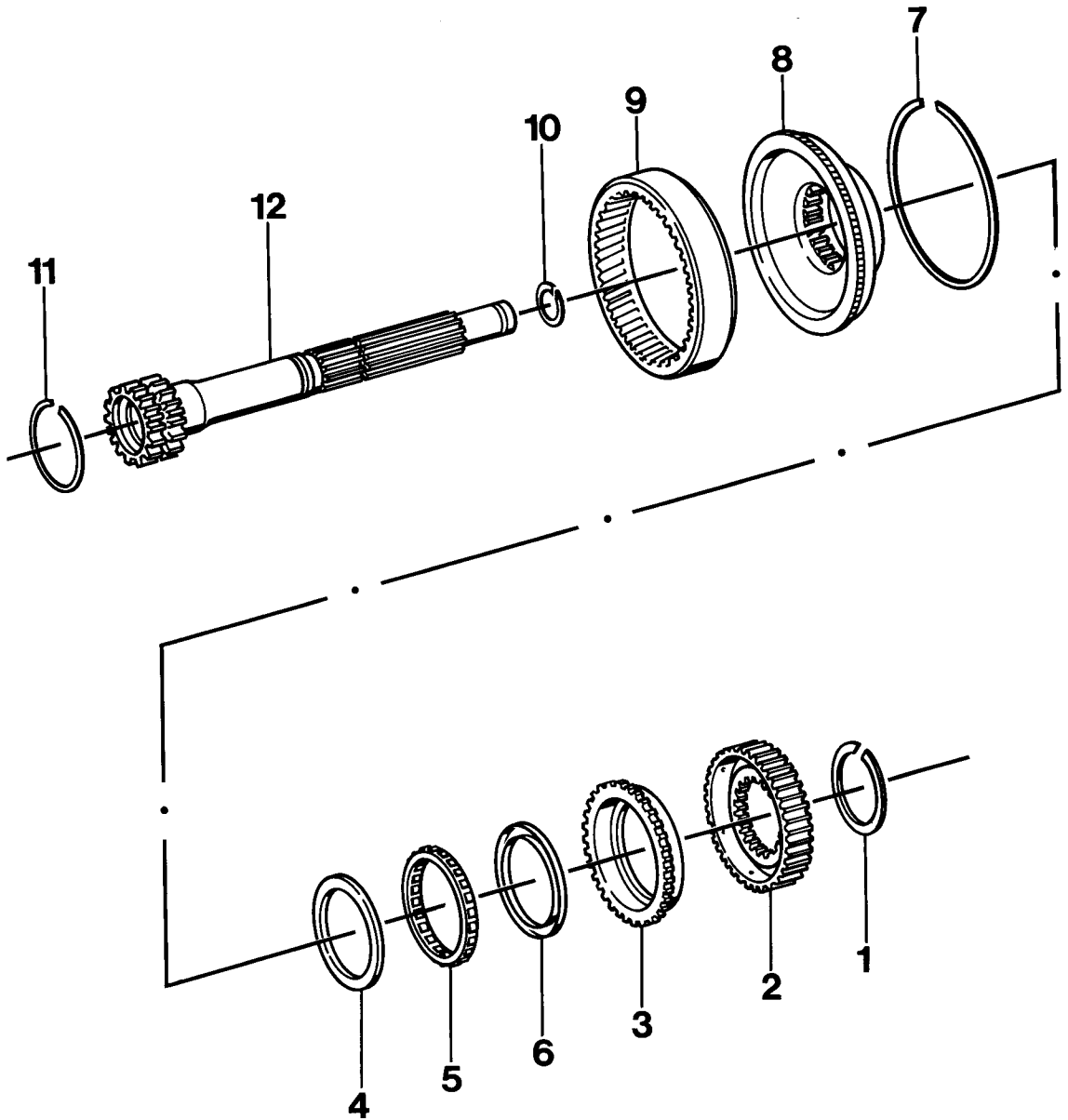
Note

The teeth of end disc and freewheel outer ring engage only over a length of approx. 3 mm.

Dismantling and assembling output shaft and freewheel

No.	Designation	Special tool	Order number	Explanation
	Assembly ring	9336	000.721.933.60	

Dismantling and assembling output shaft and freewheel



902-38

No.	Designation	Qty.	Note:	
			Removal	Installation
1	Snap ring	1	Remove with suitable pliers and screwdriver	Install with suitable pliers (e.g. VW 161a)
2	Disc carrier	1		
3	Freewheel outer ring	1	Rotate to lift off along with freewheel cage	Rotate clockwise to push onto inner ring along with freewheel cage
4	Thrust washer	1		
5	Freewheel cage	1	Mark installation position for reassembly. Press carefully out of outer ring	Use Special Tool 9336 to place into outer ring
6	Thrust washer	1		
7	Snap ring	1		
8	Freewheel inner ring	1		
9	Hollow gear	1		
10	Rectangular ring	1		Replace
11	Snap ring	1		
12	Output shaft	1		

Dismantling and assembly notes

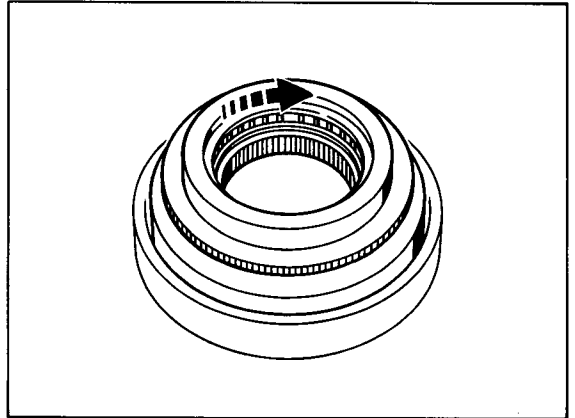
Dismantling

1. Remove snap ring (No. 1) and take off freewheel assembly along with disc carrier and hollow gear.

3. Push freewheel outer ring onto inner ring, following a clockwise rotary motion.

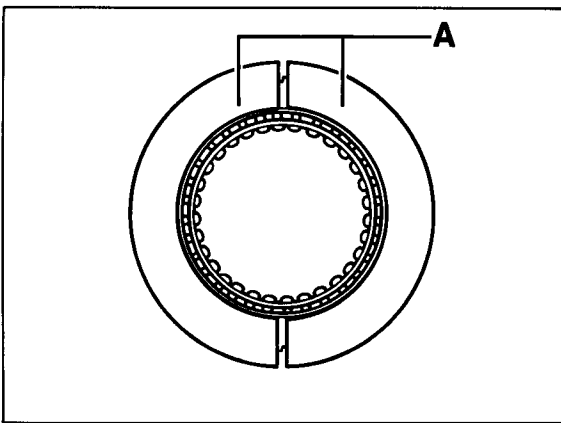
Assembly

1. Place freewheel cage onto outer ring and align.
2. Use Special Tool 9336 to compress freewheel cage and to push it into the outer ring.



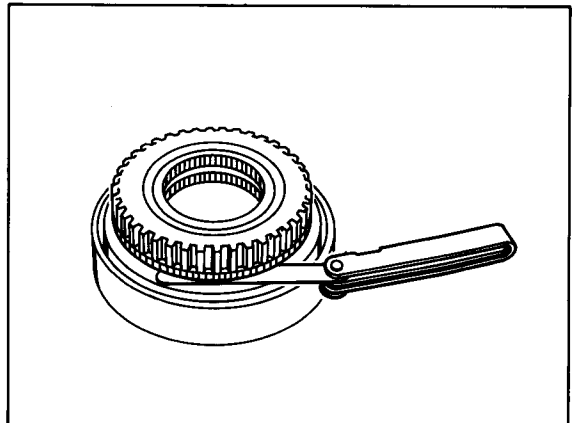
887-38

4. Determine gap between freewheel inner ring and freewheel outer ring. A minimum gap of 0.1 mm must remain.

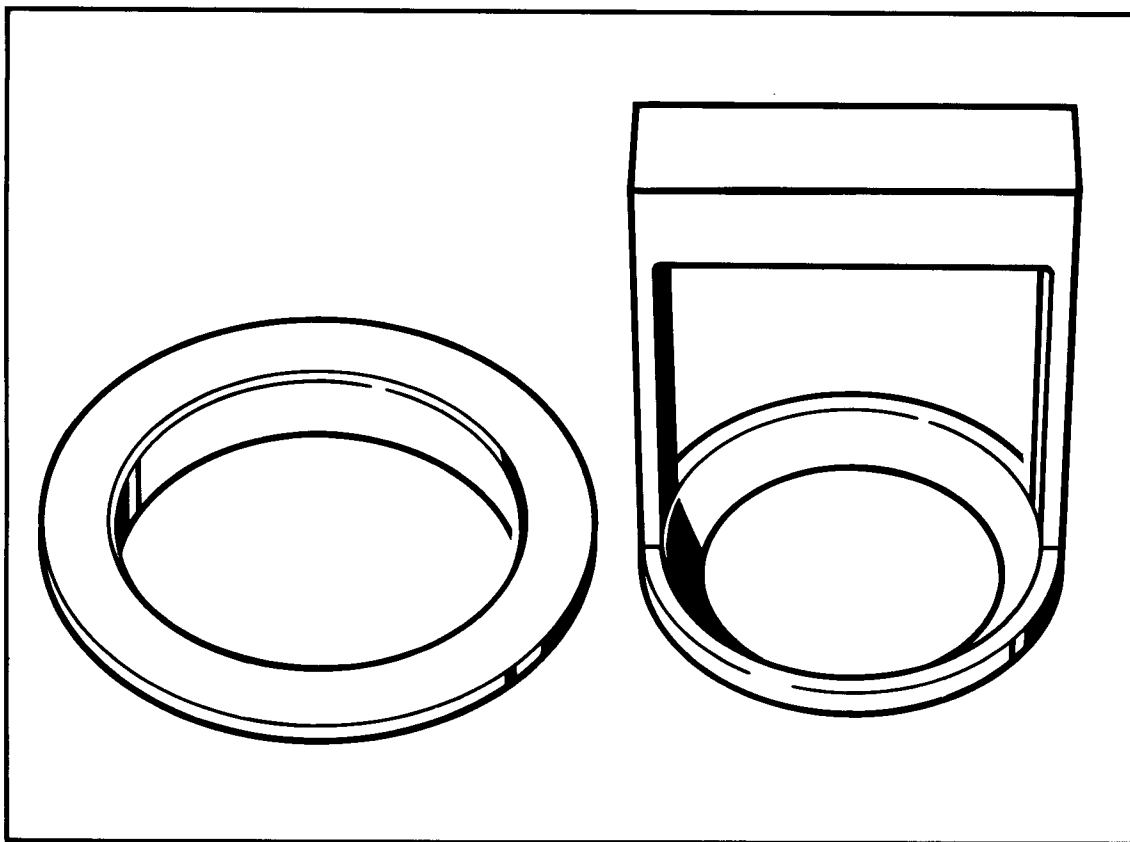


886-38

A - Special Tool 9336

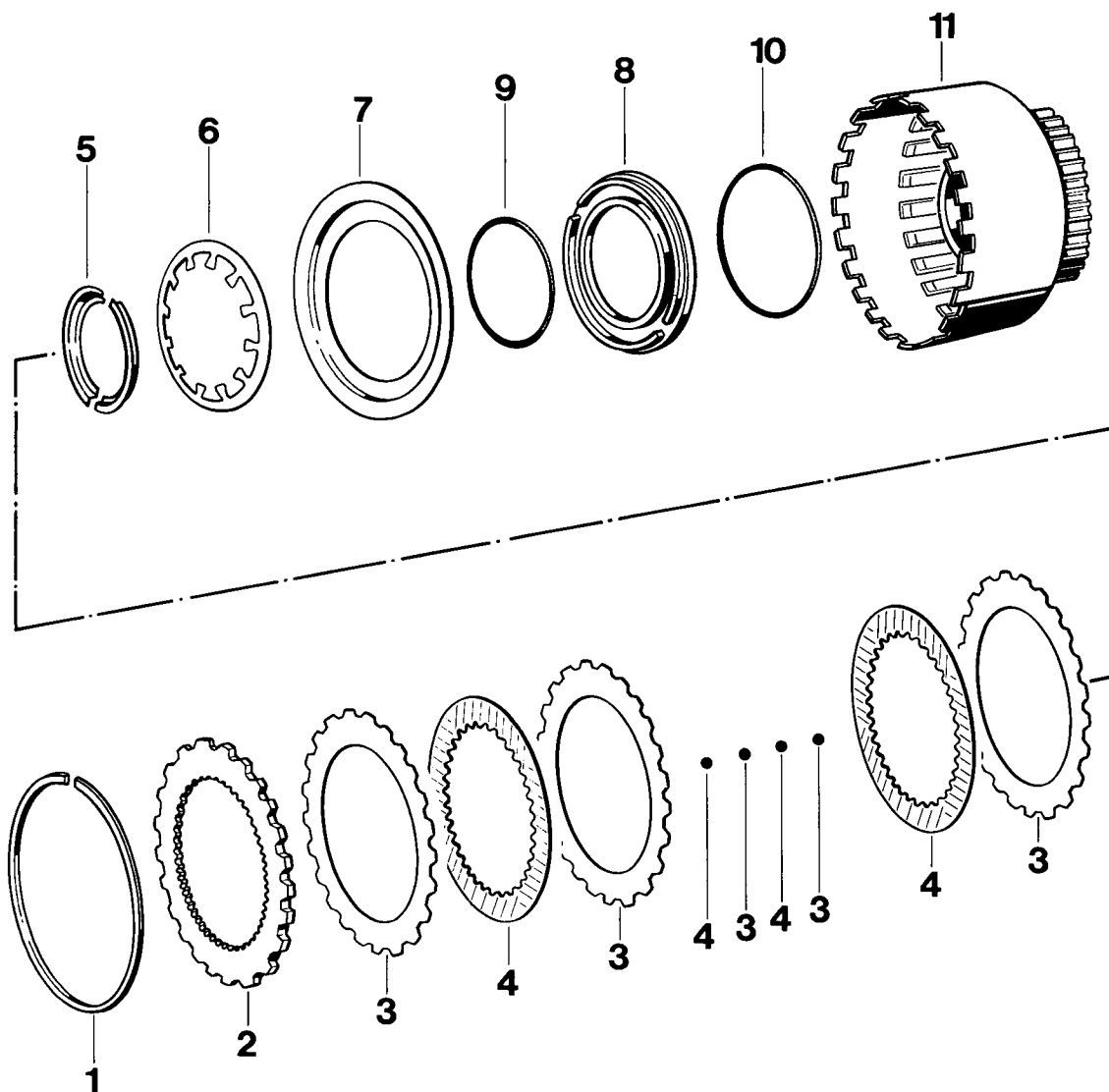


888-38

Dismantling and assembling clutch E

No.	Designation	Special tool	Order number	Explanation
	Assembly tool	9335	000.721.933.50	

Dismantling and assembling clutch E



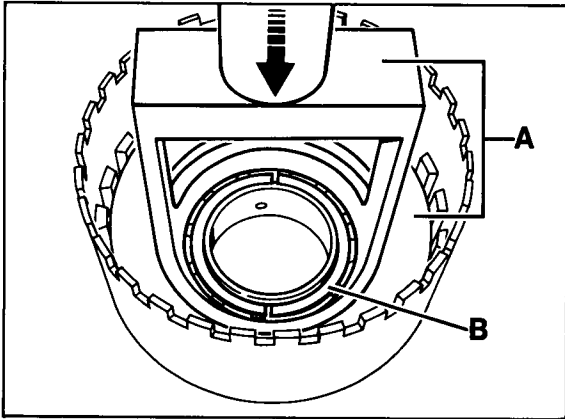
908-38

No.	Designation	Qty.	Note:	
			Removal	Installation
1	Snap ring	1		
2	End disc (with internal teeth)	1		Do not confuse with end disc of brake F
3	Outer disc (1.5 mm thick)	5		Do not confuse with outer discs of brake F
4	Inner disc	4		
5	Retainer ring	1	Remove with Special Tool 9335, using a press	Install with Special Tool 9335, using a press
6	Cup spring	1		Convex side faces retainer ring
7	Thrust cup	1		Place into position with convex side facing down
8	Piston	1	To remove, apply compressed air across oil feed bore	Grease round seals (with Vaseline) and press piston carefully in place, making sure it does not bind
9	Round seal	1		Replace
10	Round seal	1		Replace
11	Cylinder	1		

Dismantling and assembly notes

Dismantling

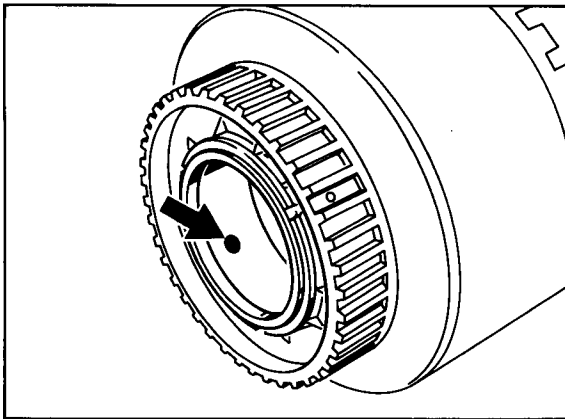
1. Remove retainer ring with Special Tool 9335 and a bar magnet, using a press.



870-38

- A - Special Tool 9335
B - Split retainer ring

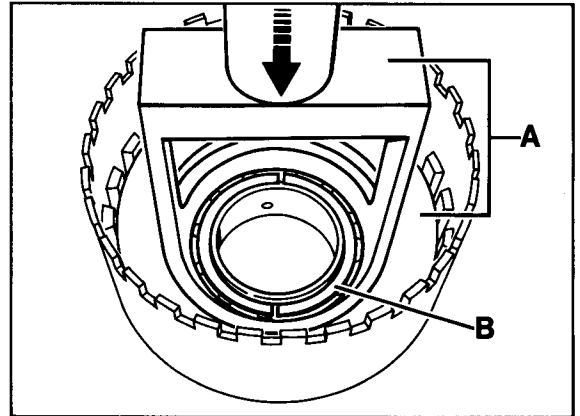
2. Remove piston by applying compressed air across the oil feed bore.
Use a air gun fitted with a sealing sleeve.



871-38

Assembly

1. Fit split retainer ring with Special Tool 9335 and a press, observing the correct position.

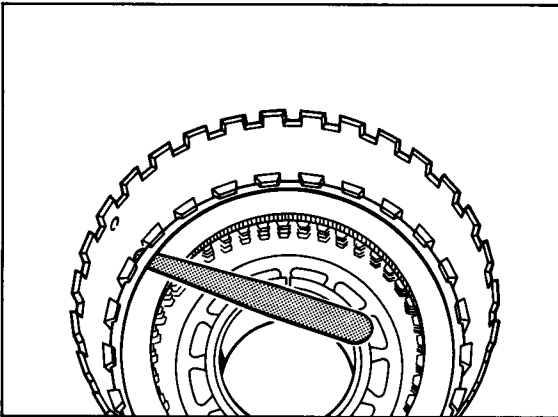


870-38

2. Coat discs with ATF fluid.

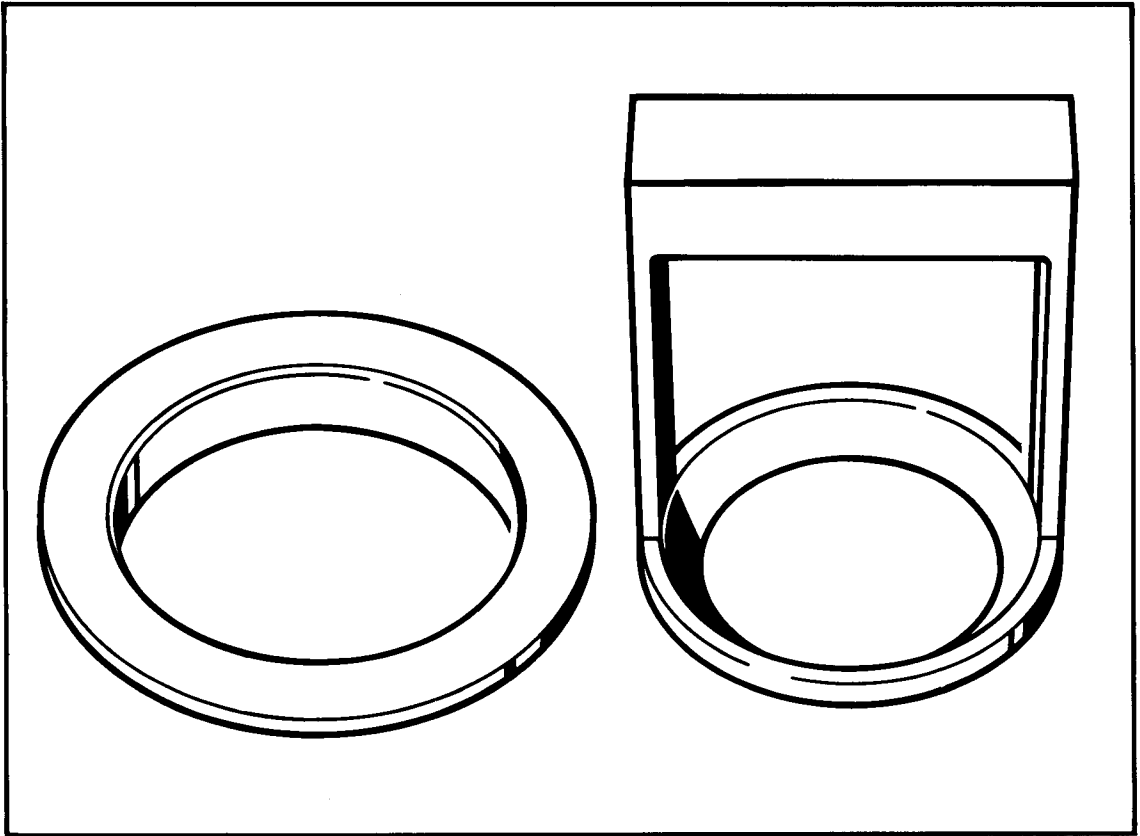
Measure air gap**Standard: 1.16...2.74 mm**

1. Use a screwdriver to press snap ring upwards along its entire circumference and measure air gap with a feeler gauge. If the wear limit has been reached, the entire disc pack must be replaced.



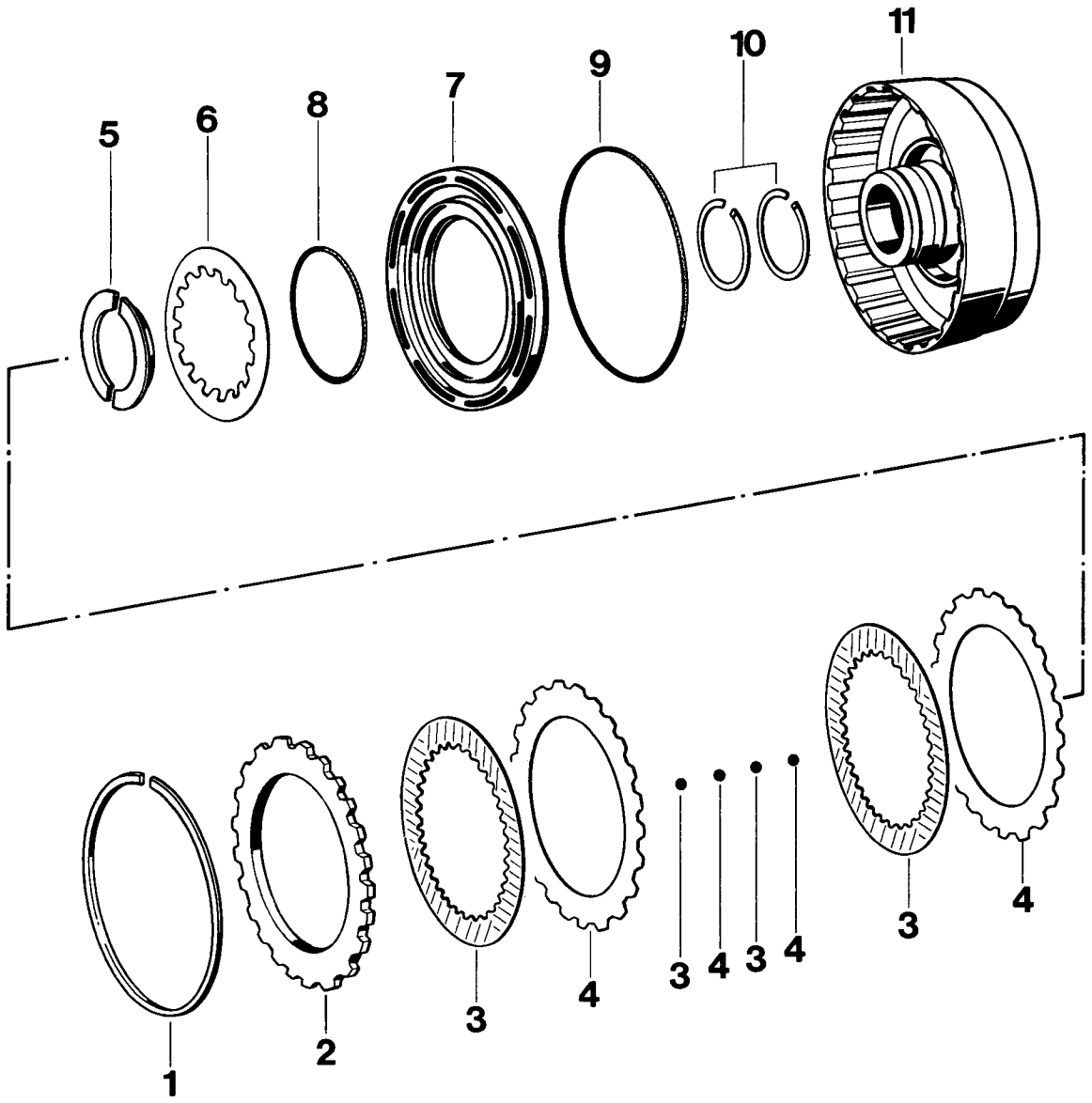
918-38

Dismantling and assembling brake F



No.	Designation	Special tool	Order number	Explanation
	Assembly tool	9335	000.721.933.50	

Dismantling and assembling brake F



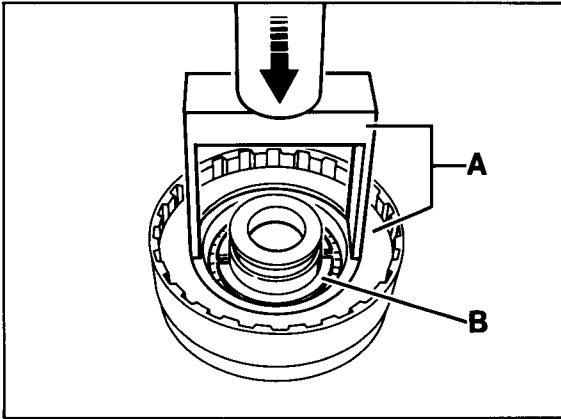
920-38

No.	Designation	Qty.	Note:	
			Removal	Installation
1	Snap ring	1		
2	End disc (without internal teeth)	1		Do not confuse with end disc of clutch E
3	Inner disc	4		
4	Outer disc (2.1 mm thick)	4		Do not confuse with outer disc of clutch E
5	Ring (split)	1	Remove with Special Tool 9335 and a press	Install with Special Tool 9335 and a press, observing correct position. Stepped side faces inside.
6	Cup spring	1		Lugs face inside
7	Piston	1	Press out of cylinder from outside, using a suitable tool	Grease round seals (with vaseline) and press carefully into cylinder, making sure the piston does not bind.
8	Sealing ring	1		Replace To avoid damage, expand ring slightly and fit at once
9	Round seal	1		Replace
10	Rectangular ring	2		Hooked ends must engage into each other
11	Cylinder	1		

Dismantling and assembly notes

Dismantling

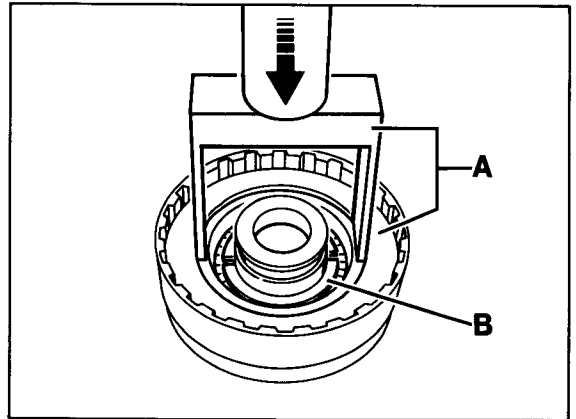
1. Remove split ring with Special Tool 9335 and a bar magnet, using a press.



863-38

Assembly

1. Install split ring with Special Tool 9335 and a press.

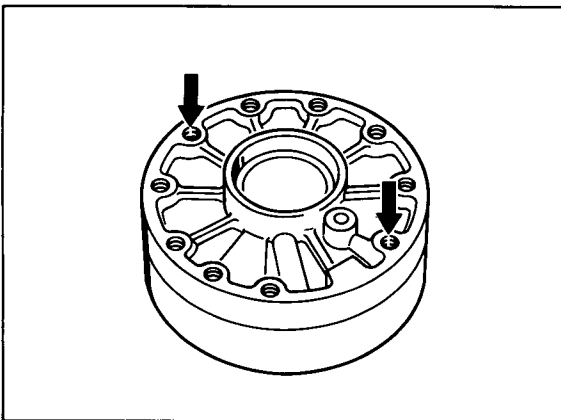


863-38

A - Special Tool 9335

B - Split ring

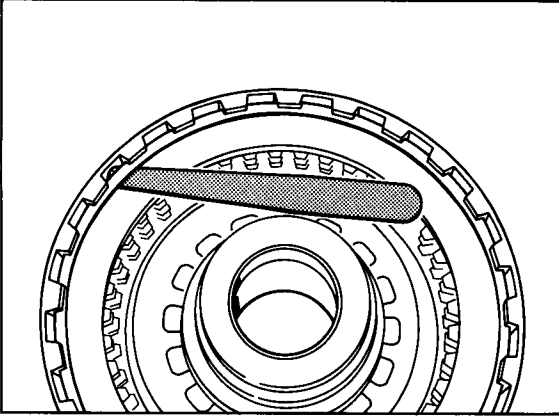
2. Using a suitable tool, press piston out of cylinder from the outside.



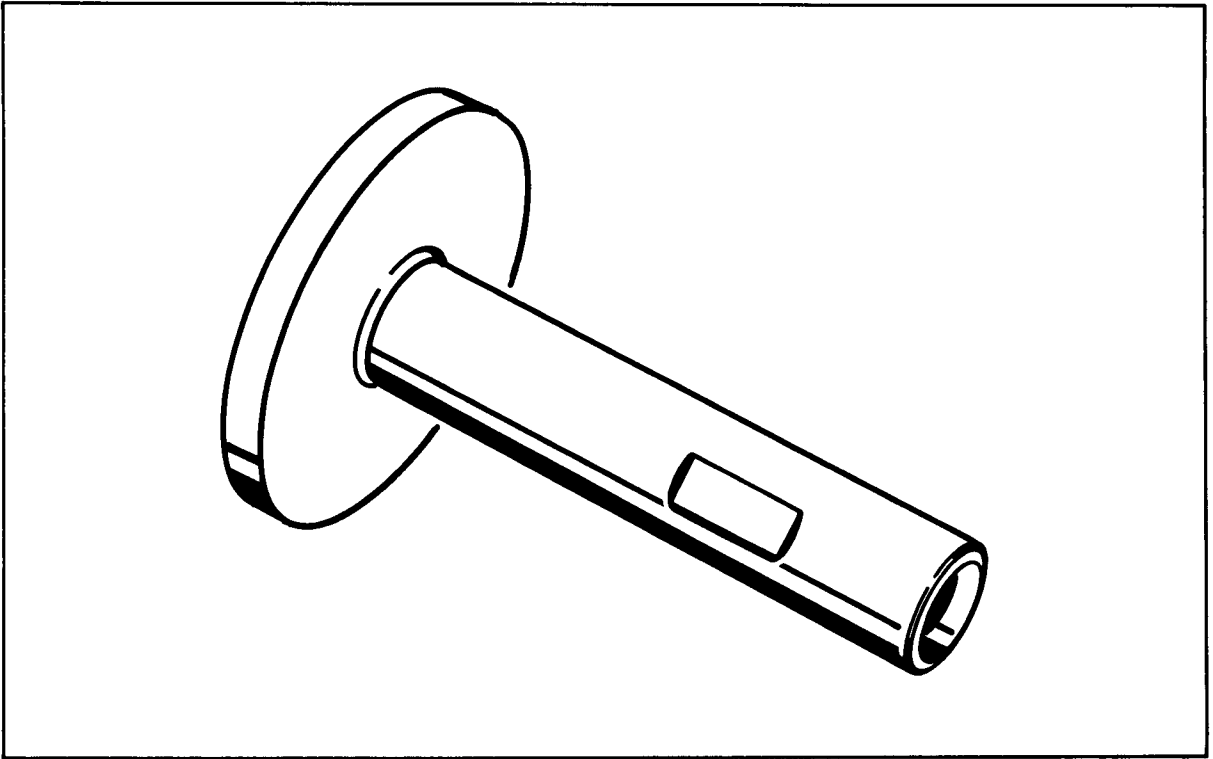
864-38

Measure air gap**Standard: 1.45...2.75 mm**

1. Use a screwdriver to press snap ring upwards along its entire circumference and measure air gap with a feeler gauge. If the wear limit has been reached, the complete disc pack must be replaced.



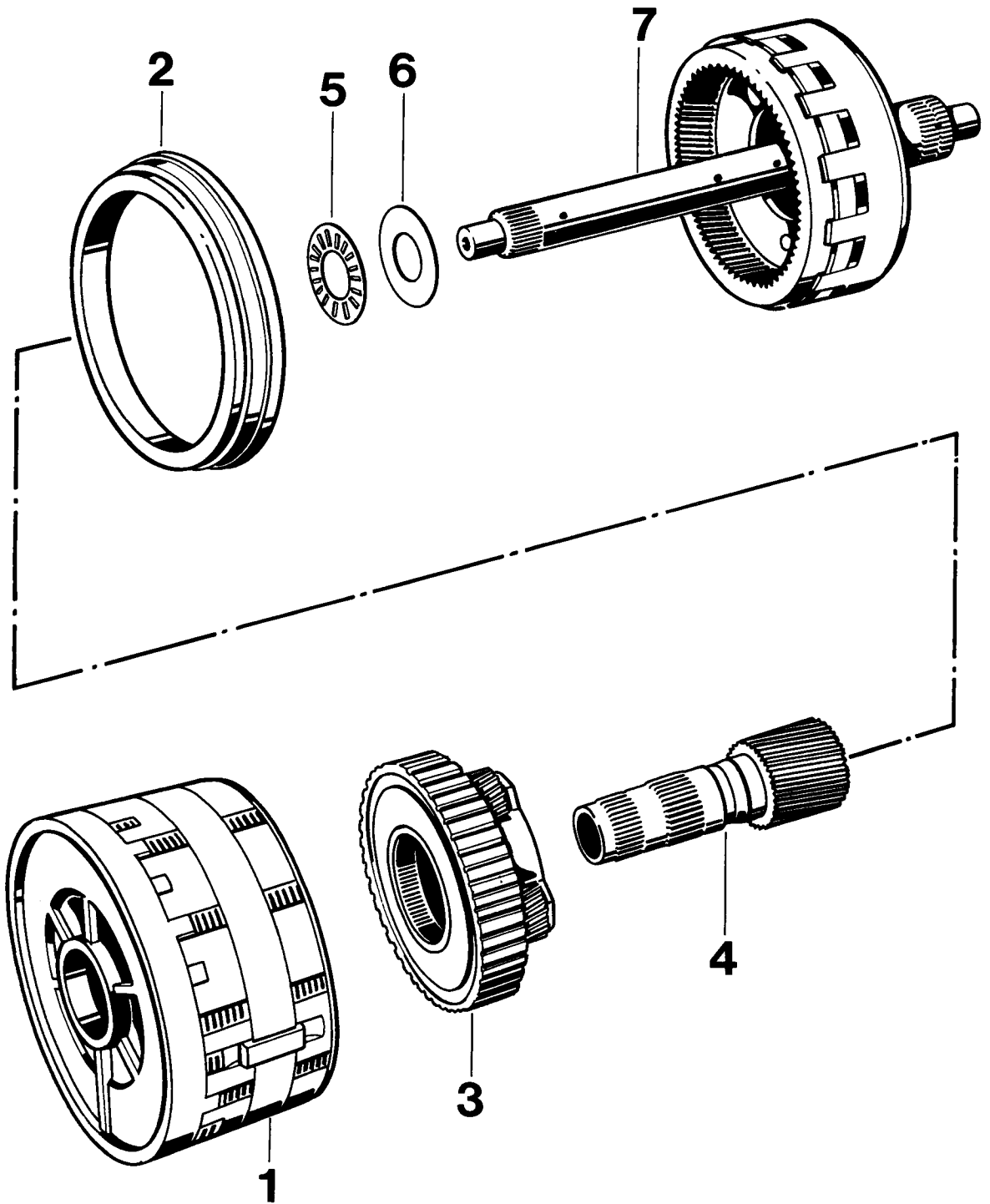
919-38

Dismantling and assembling brake pack CD with spider shaft

898-38

No.	Designation	Special tool	Order number	Explanation
	Assembly support	9314	000.721.931.40	

Dismantling and assembling brake pack CD with spider shaft

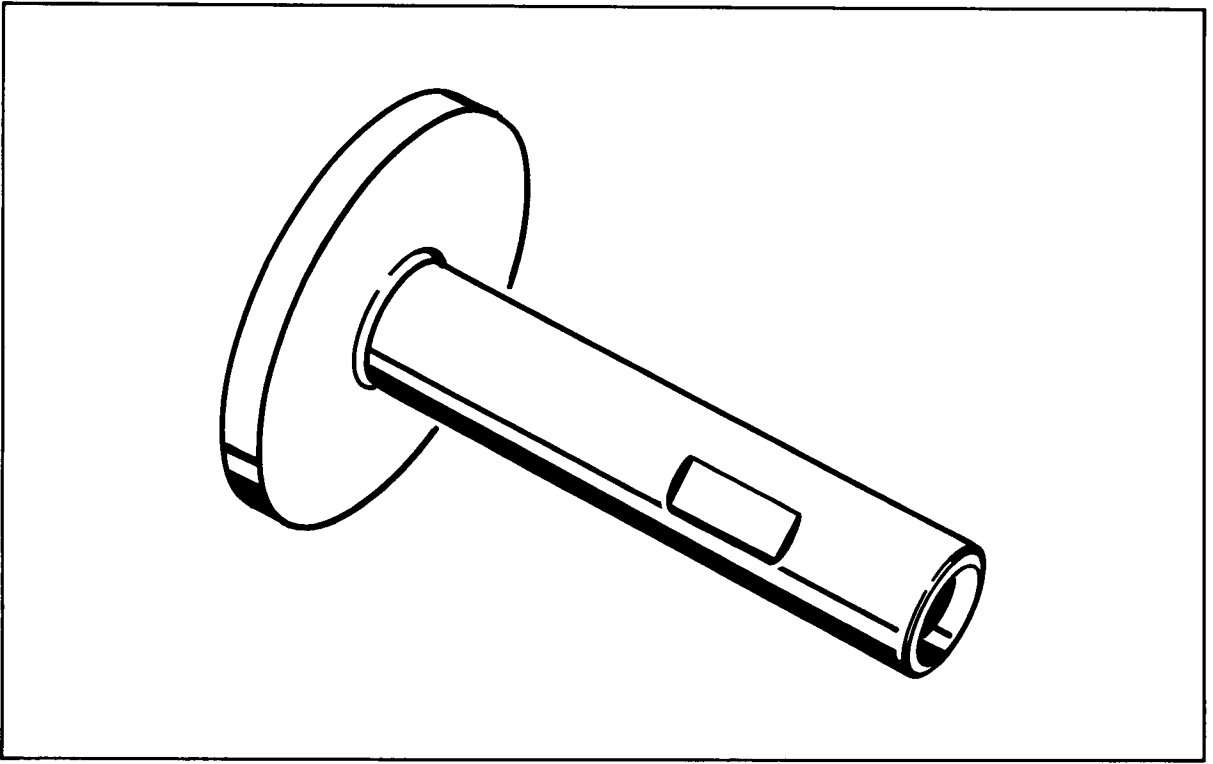


No.	Designation	Qty.	Note:	
			Removal	Installation
1	Cylinder CD	1	Remove with centering plate and support ring. For dismantling, refer to page 38 - 152	
2	Support ring	1		
3	Planetary set	1		Refer to "Dismantling and assembling brake D" (refer to page 38 - 152)
4	Sun shaft	1		Hook ends of rectangular rings into each other
5	Axial needle roller cage	1		
6	Thrust washer	1		
7	Spider shaft (with hollow gear and intermediate shaft)	1	For dismantling, refer to page 38 - 147	

Note

To dismantle, place spider shaft with cylinder CD onto Special Tool **9314**.

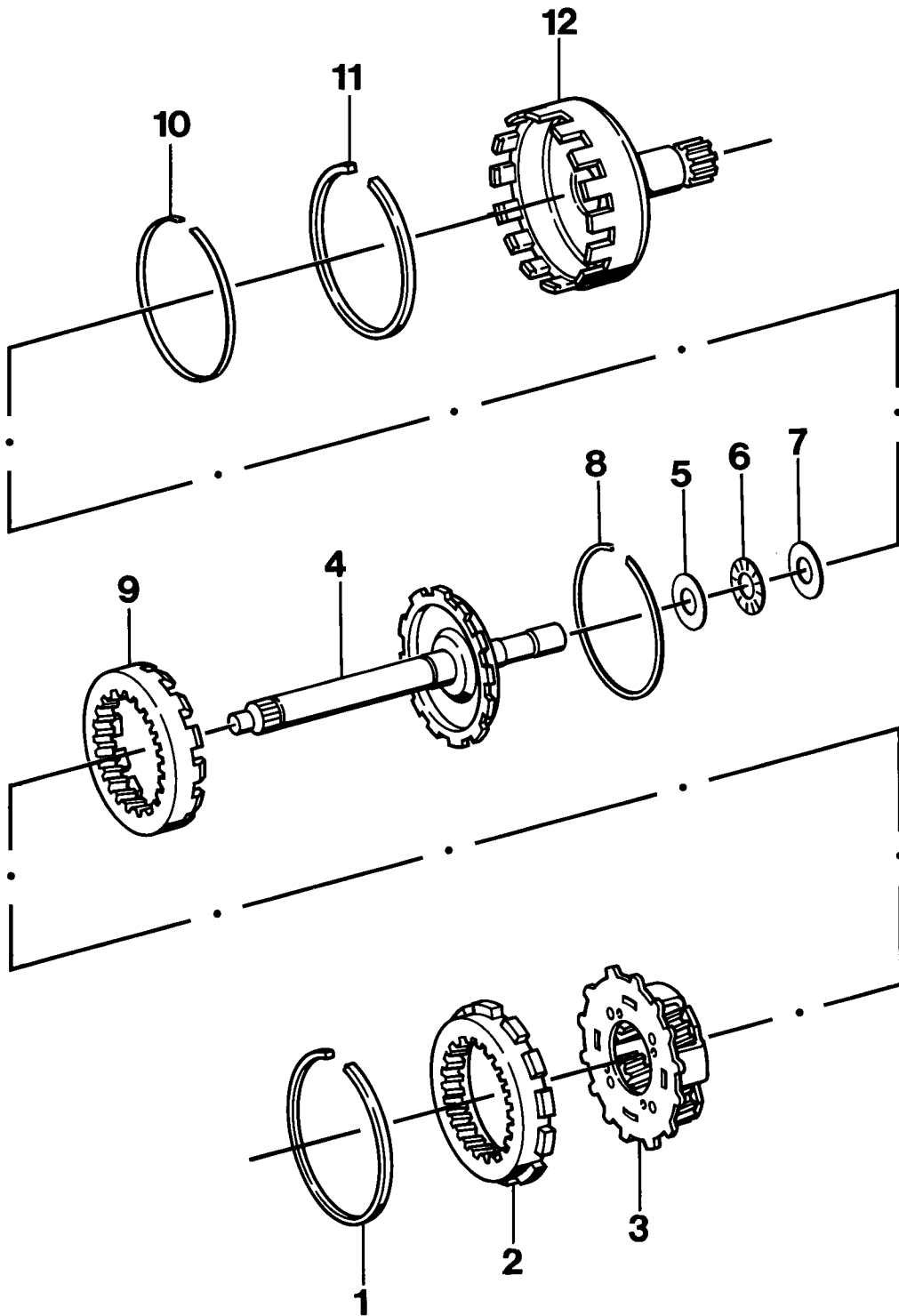
Dismantling and assembling spider shaft



899-38

No.	Designation	Special tool	Order number	Explanation
	Assembly support	9314	000.721.931.40	

Dismantling and assembling spider shaft

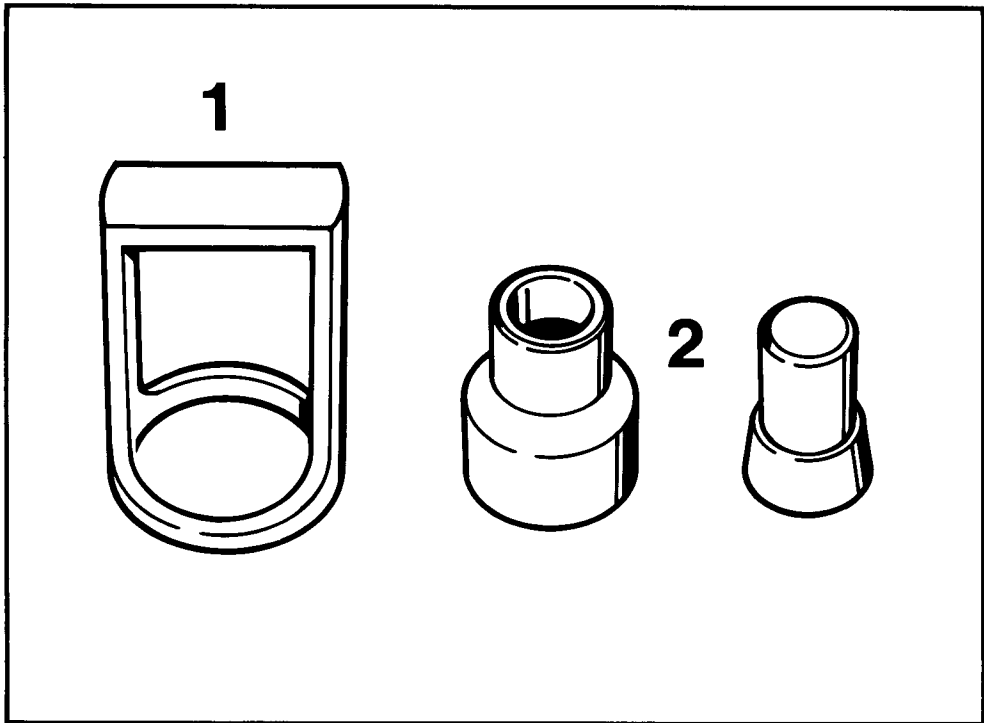


No.	Designation	Qty.	Note:	
			Removal	Installation
1	Snap ring	1		
2	Front hollow gear	1		
3	Planetary set	1		Do not allow to bind, rotate intermediate shaft to place unit in assembly position
4	Intermediate shaft	1		Fit rear hollow gear and place both into spider shaft
5	Thrust washer	1		
6	Axial needle roller cage	1		
7	Thrust washer	1		
8	Snap ring	1		
9	Rear hollow gear	1		
10	Spacer ring	1		
11	Snap ring	1		
12	Spider shaft	1		

Note

To dismantle and assemble the spider shaft, place it onto Special Tool **9314**.

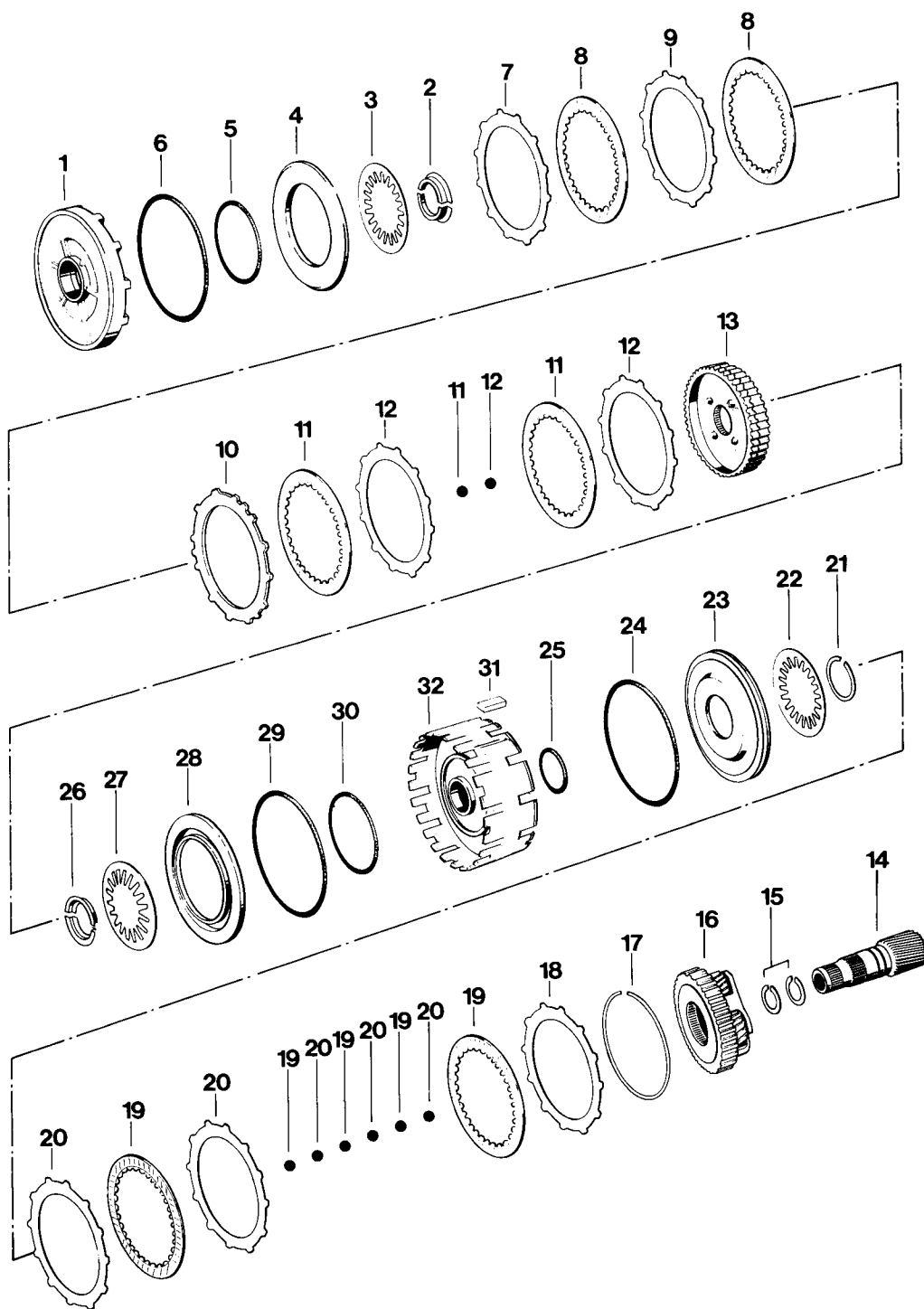
Dismantling and assembling brake C, C' and D



910 - 38

No.	Designation	Special tool	Order number	Explanation
1	Thrust piece	9332	000.721.933.20	
2	Assembly sleeve	9333	000.721.933.30	

Dismantling and assembling brake C, C' and D



916-38

No.	Designation	Qty.	Note:	
			Removal	Installation
1	Centering plate	1		Observe installation position
2	Retainer ring (split)	1	Remove with Special Tool 9332 and a bar magnet, using a press	Install with Special Tool 9332, using a press
3	Cup spring	1		Center in such a way that it is not squeezed by the retainer ring
4	Piston C'	1	To remove, apply compressed air across the oil feed bore	Do not confuse with piston C. Grease seals with vaseline and push them carefully onto the centering plate, making sure the piston does not bind
5	Round seal	1		Replace
6	Round seal	1		Replace
7	Outer disc (1.8 mm thick)	1		Observe installation position
8	Inner disc	2		
9	Outer disc (2.1 mm thick)	1		Observe installation position
10	End disc	1		Observe installation position
11	Inner disc	3		
12	Outer disc	3		Observe installation position
13	Freewheel (2nd gear)	1		Fit into correct position Wider section of teeth faces inside
14	Sun shaft	1		
15	Rectangular ring	2		Ring ends must be hooked into each other
16	Planetary set	1		
17	Snap ring	1		

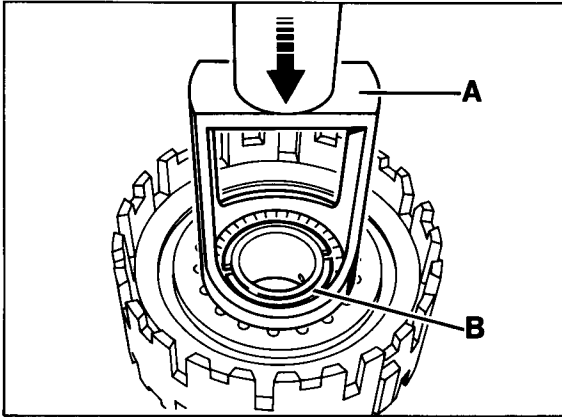
No.	Designation	Qty.	Note:	
			Removal	Installation
18	Adjusting outer disc	1		If required, reestablish correct thickness
19	Inner disc	5		To facilitate assembly, reinstall planetary set first
20	Outer disc	5		
21	Snap ring	1	Using Special Tool 9332 and suitable snap ring pliers, remove with a press	Install with Special Tool 9333 , using a press
22	Cup spring	1		
23	Piston D	1	To remove, apply compressed air across the oil feed bore	Grease seals with vaseline and press them carefully into cylinder, making sure the piston does not bind
24	Round seal	1		Replace
25	Round seal	1		Replace
26	Retainer ring (split)	1	Remove with Special Tool 9332 and a bar magnet, using a press	Install with Special Tool 9332 , using a press
27	Cup spring	1		
28	Piston C	1	To remove, apply compressed air across the oil feed bore	Do not confuse with piston C'. Grease seals with vaseline and press carefully into cylinder, making sure the piston does not bind.
29	Round seal	1		Replace
30	Round seal	1		Replace
31	Woodruff key	1		Place exactly into center of cutout of cylinder CD
32	Cylinder CD	1		

Dismantling and assembly notes

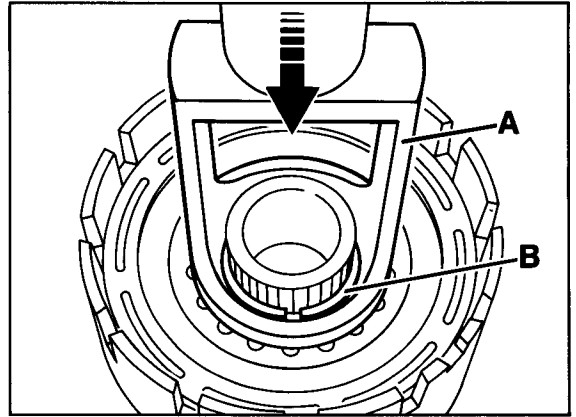
Dismantling

1. Remove retainer ring with Special Tool 9332 and a bar magnet, using a press.

3. Remove snap ring with Special Tool 9332 and suitable pliers, using a press.



874-38



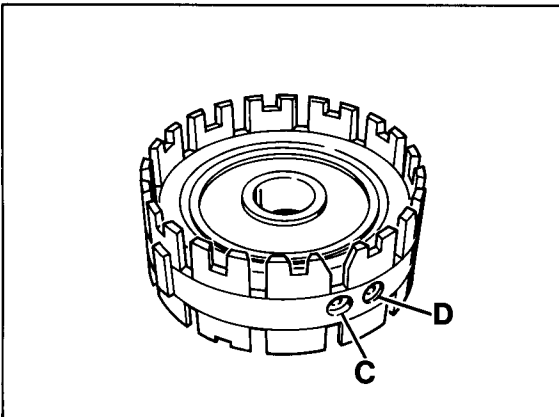
915-38

A - Special Tool 9332
B - Split retainer ring

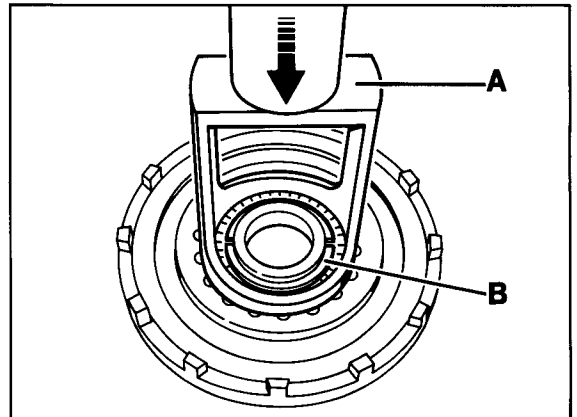
A - Special Tool 9332
B - Snap ring

2. Remove pistons C and D by applying compressed air across the oil feed bores.

3. Remove retainer ring with Special Tool 9332 and a bar magnet, using a press.



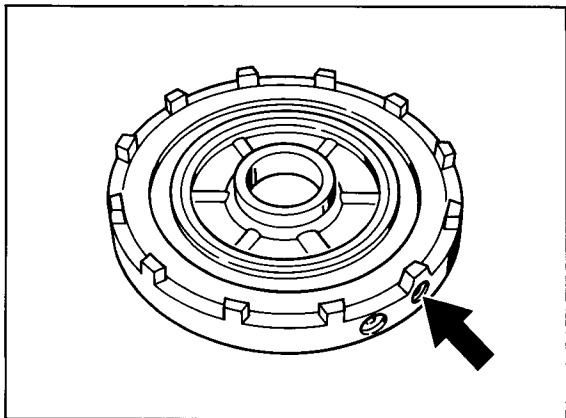
875-38



872-38

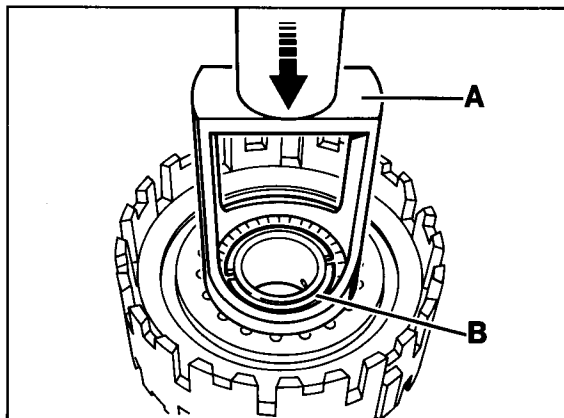
A - Special Tool 9332
B - Split retainer ring

4. Remove piston C' by applying compressed air across the poil feed bore.



873-38

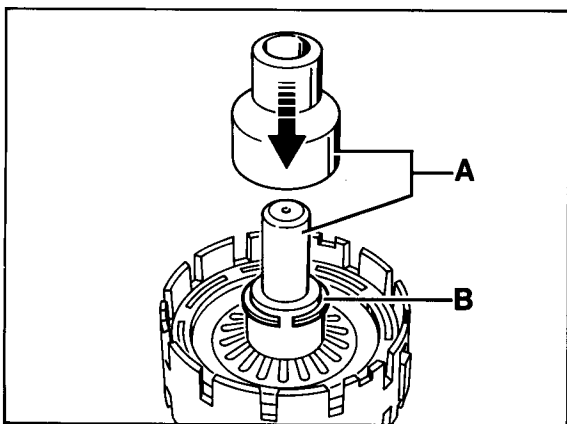
2. Install retainer ring with Special Tool 9332, using a press.



874-38

Assembly

1. Install snap ring with Special Tool 9333, using a press.

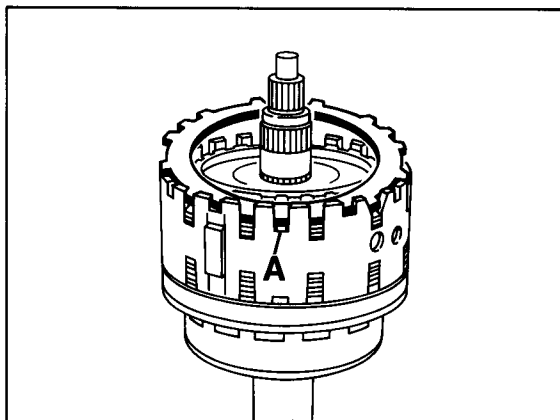


879-38

A - Special Tool 9333

B - Snap ring

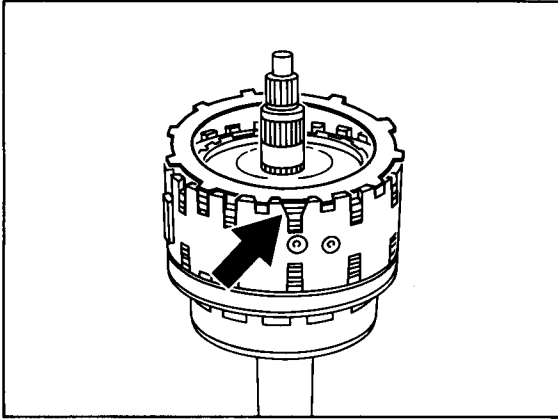
3. Coat discs with ATF fluid.
4. Place end disc (No. 10) into position so that the center tooth of the three adjacent teeth rests on the three notches (with cast lugs) of cylinder CD.



877-38

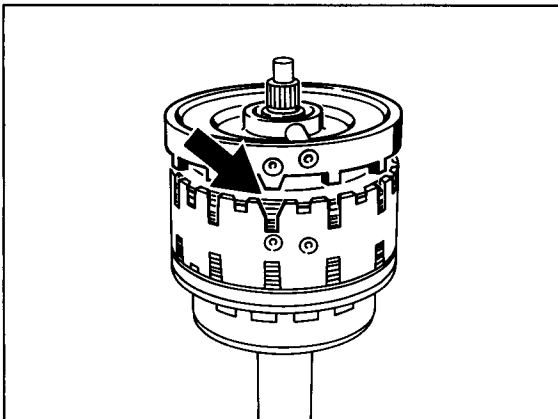
A - Lugs

5. The outer teeth of the outer discs C' must not protrude into the bevelled cutout of the cylinder.



878-38

6. Place centering plate in position so that the bevelled cam fits into the corresponding bevelled cutout of cylinder CD.



876-38

Determining air gap of brakes C', C and D

Brakes C' and C

Brake C'

Specification: 0.55...1.97 mm

Brake C

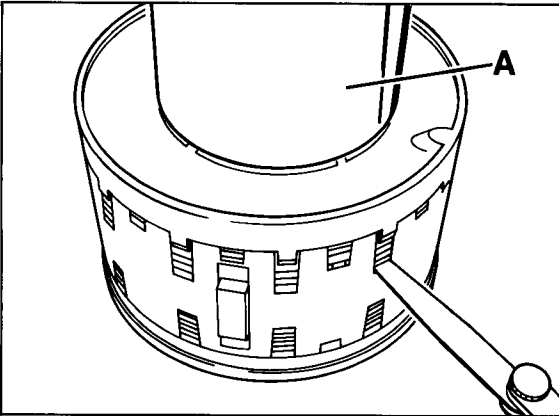
Specification: 0.63...2.40 mm

Determine air gap with a feeler gauge

Note

To avoid false readings, place centering plate under a suitable load (e.g. Special Tool 9508/1).

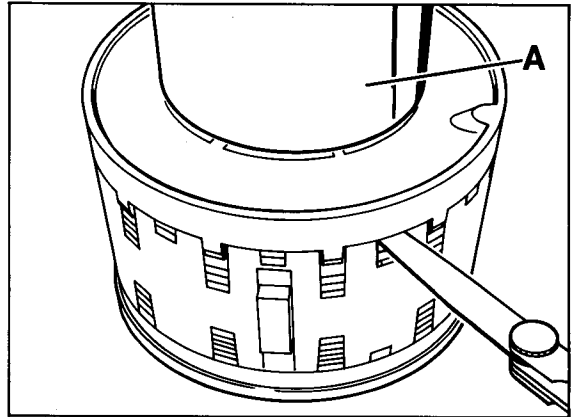
Brake C'



921-38

A - Special Tool 9508/1

Brake C



922-38

A - Special Tool 9508/1

If the wear limit has been reached, all discs must be replaced.

Brake D

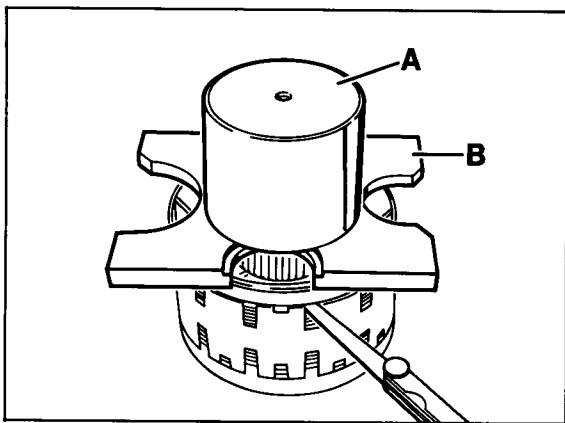
Specification: 1,34...2,39 mm

The air gap may be adjusted using the adjustment outer disc (18) available in a variety of thicknesses.

Determine air gap with a feeler gauge.

Note

To avoid false readings, place support ring under a suitable load (e.g. Special Tool 9508/1).



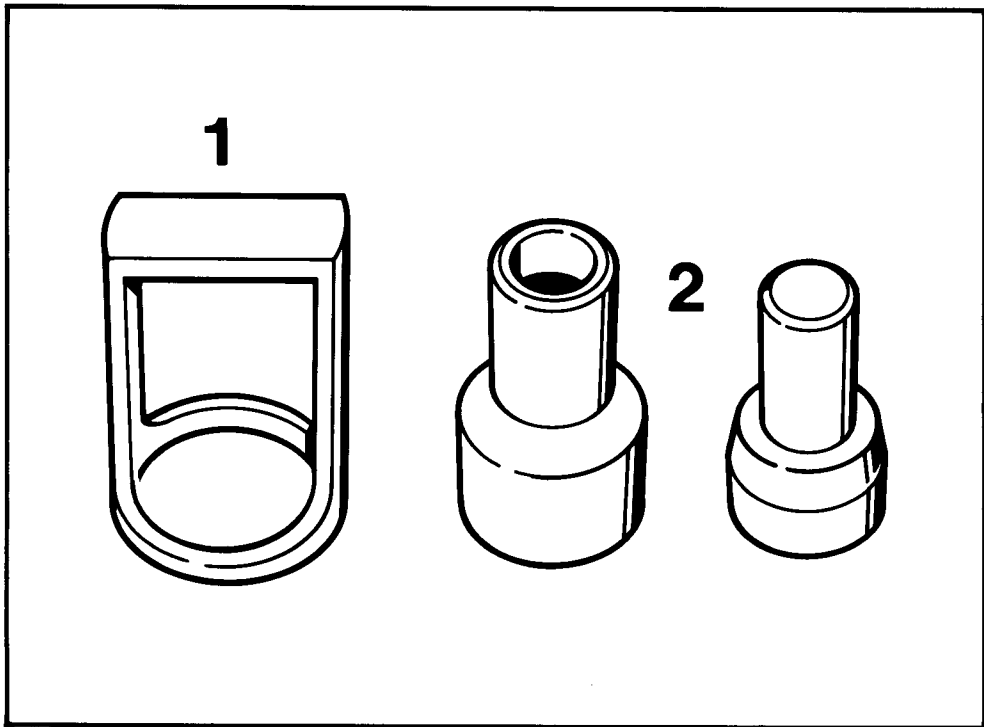
923-38

A - Special Tool 9508/1

B - Special Tool VW 402

If the wear limit has been reached, all discs must be replaced and the air gap must be re-adjusted with the adjustment outer disc (18).

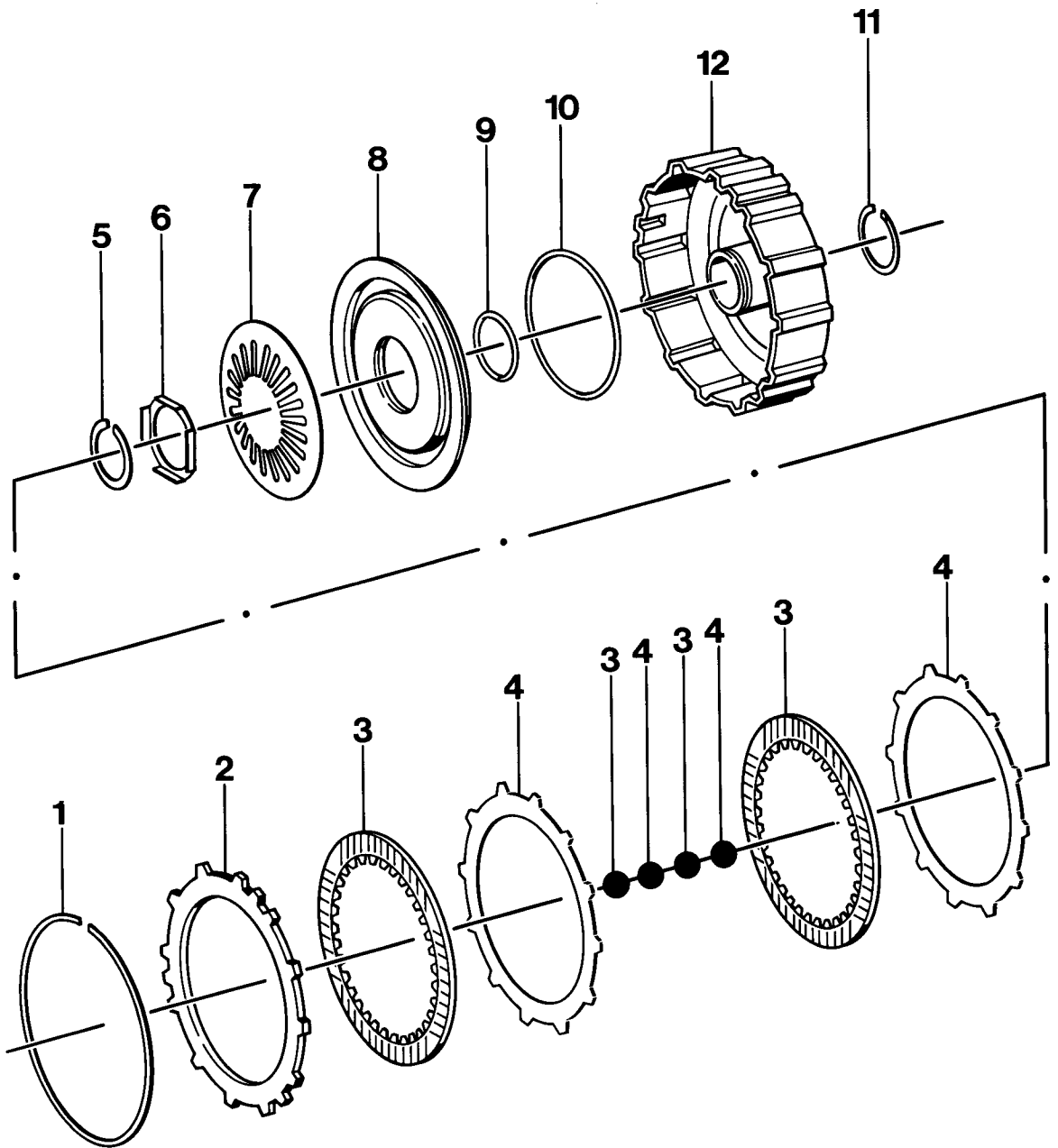
Dismantling and assembling clutch B



909-38

No.	Designation	Special tool	Order number	Explanation
1	Thrust piece	9332	000.721.933.20	
2	Assembly sleeve	9330/1	000.721.933.01	

Dismantling and assembling clutch B



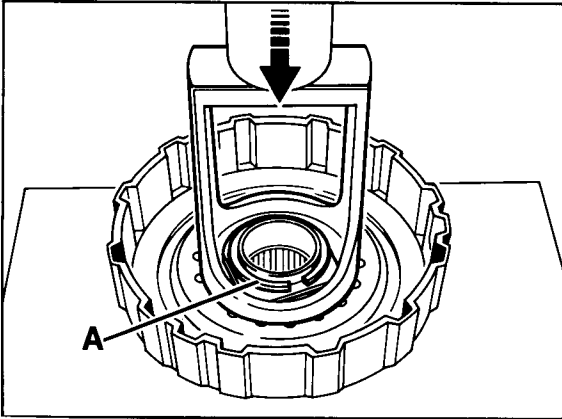
906-38

No.	Designation	Qty.	Note:	
			Removal	Installation
1	Snap ring	1		Redetermine thickness if required
2	End disc	1		
3	Inner disc	4		
4	Outer disc (2.1 mm thick)	4		
5	Snap ring	1	Remove with Special Tool 9332 using a press	Install with Special Tool 9330/1 using a press, checking for correct seating
6	Tab washer	1		
7	Cup spring	1		Place in correct position
8	Piston	1	To loosen, apply compressed air across the oil feed bore and take out by knocking lightly on a wooden support	Grease round seals (use vaseline) and press carefully into cylinder F, making sure the piston does not bind
9	Round seal	1		Replace
10	Round seal	1		Replace
11	Rectangular ring	1		Hook ends into each other
12	Cylinder	1		

Dismantling and assembly notes

Dismantling

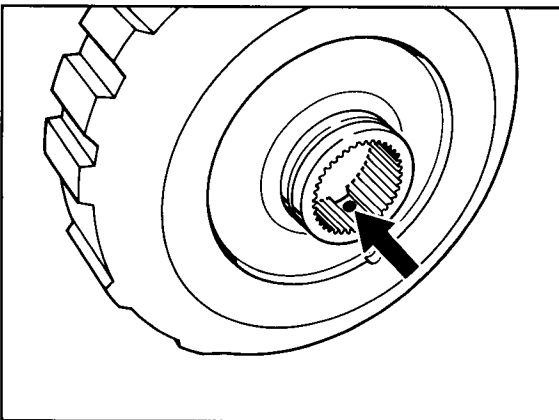
1. Remove snap ring with Special Tool 9332 using a press.



866-38

A = Snap ring

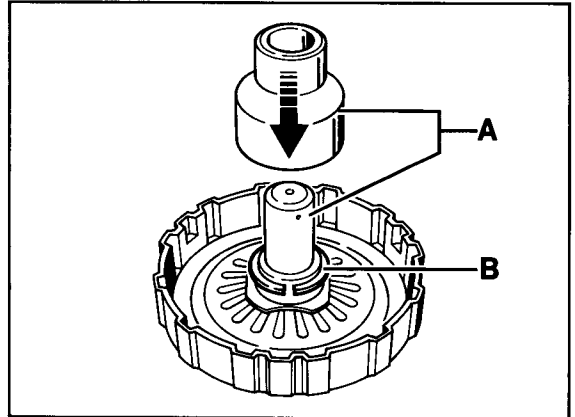
2. To loosen, apply compressed air across the oil feed bore and take out by knocking lightly on a wooden support.



867-38

Assembly

1. Fit snap ring, placing internal section of Special Tool 9330/1 into position and pushing snap ring up to the taper. Then use outer section of Special Tool 9330/1 and a press to push the snap ring into the groove.



865-38

A = Special Tool 9330/1

B = Snap ring

2. Coat discs with ATF fluid.

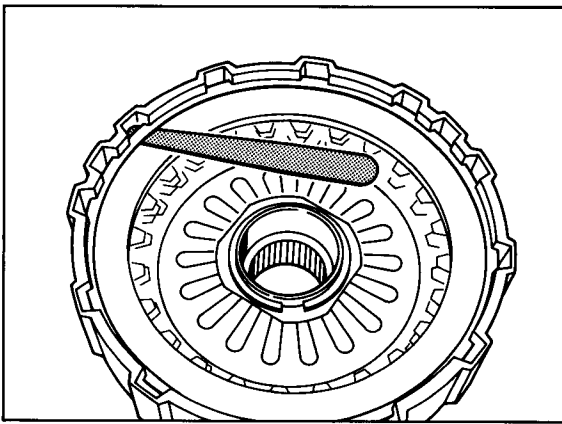
Measuring the air gap

Standard: 1.23...1.57 mm

Note

The air gap can be adjusted with the snap ring (No. 1) that is available in three thicknesses (1.5 - 2.0 - 2.5 mm).

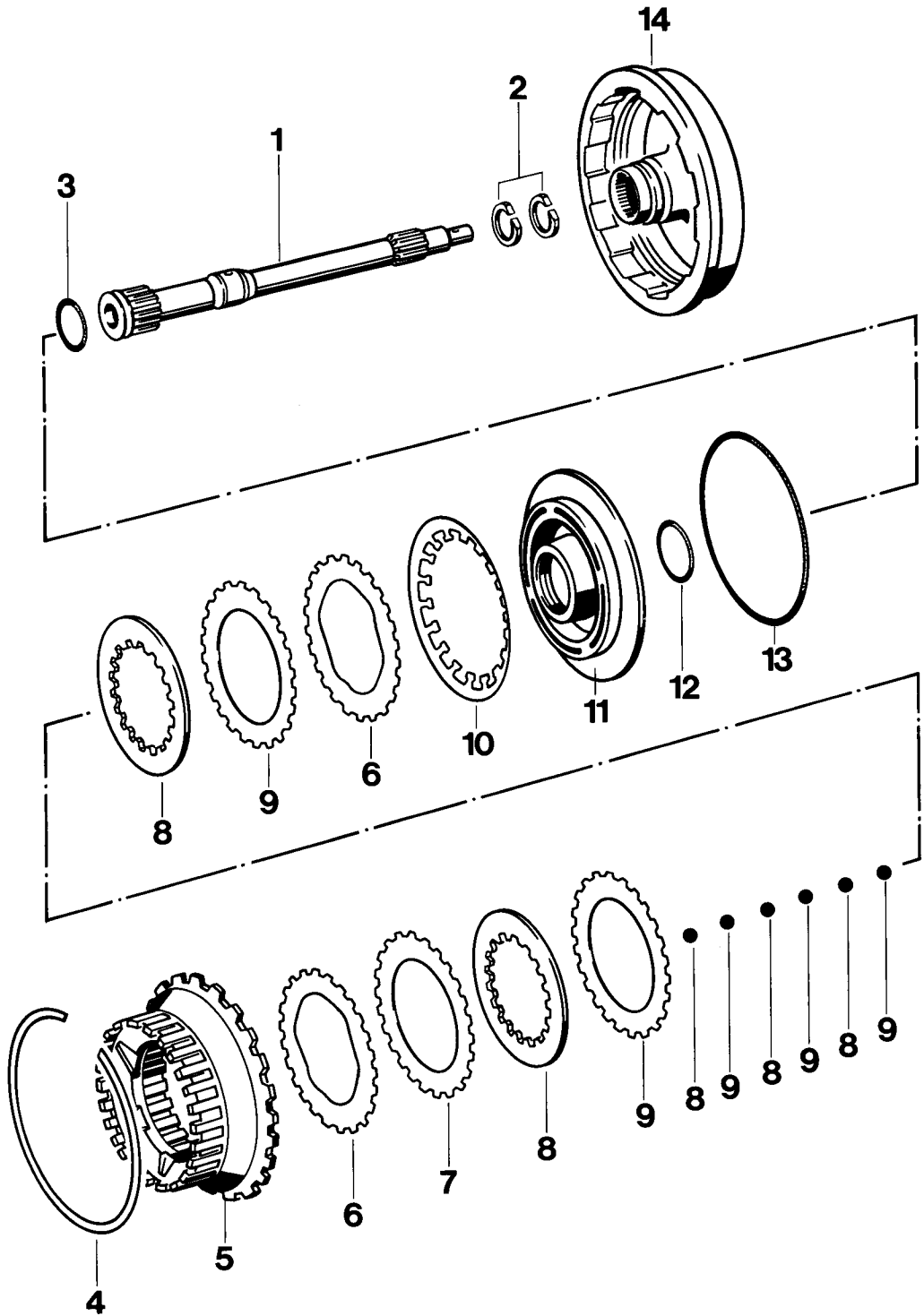
1. Use a screwdriver to press snap ring upwards along its entire circumference and measure air gap with a feeler gauge. If the wear limit has been reached, the entire disc pack must be replaced and the thickness of the snap ring must be redetermined.



917-38

Dismantling and assembling clutch A

Dismantling and assembling clutch A

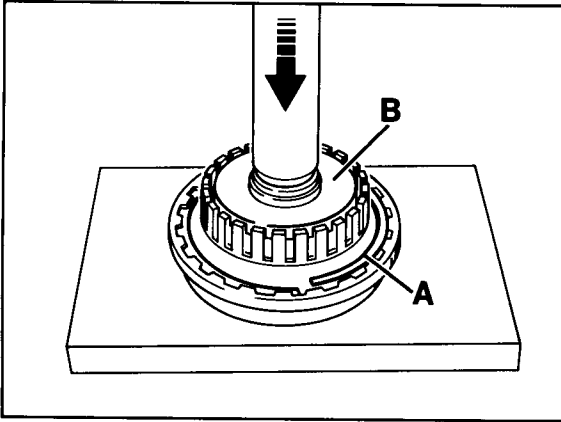


No.	Designation	Qty.	Note:	
			Removal	Installation
1	Drive shaft	1	Separate from cylinder by tapping lightly on a wooden support	
2	Rectangular ring	2		
3	Round seal	1		Replace, coat with vaseline
4	Snap ring	1	Remove with a suitable thrust piece (e.g. plate of 9329), using a press	Install with a suitable thrust piece (e.g. plate of 9329), using a press
5	Disc pack AB	1		
6	Spring disc	2		
7	Adjustment outer disc	1	Record thickness for reassembly	Refit old discs or use new disc of the same thickness
8	Inner disc	5		Wear limit: Thickness below 1.5 mm
9	Outer disc	5		
10	Cup spring	1		Install in correct position
11	Piston	1	To remove, apply compressed air across oil feed bore	Grease sealing rings (use vaseline) and press carefully into cylinder, making sure the piston does not bind.
12	Round seal	1		Replace
13	Round seal	1		Replace
14	Cylinder	1		

Dismantling and assembly notes

Dismantling

1. Press down disc carrier with a suitable thrust piece (e.g. plate of 9329) using a press, and take out snap ring.

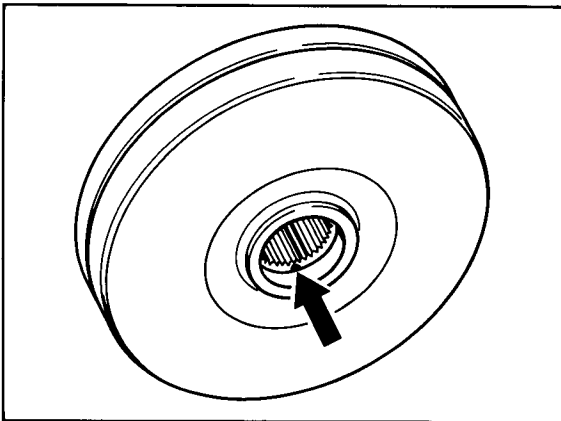


868-38

A - Snap ring

B - Plate of Special Tool 9323

2. To remove piston, apply compressed air across the oil feed bore.



869-38

Assembly

1. If the wear limit of the inner discs has been reached, the entire disc pack must be replaced along with the old adjustment outer disc.
2. Coat discs with ATF fluid.

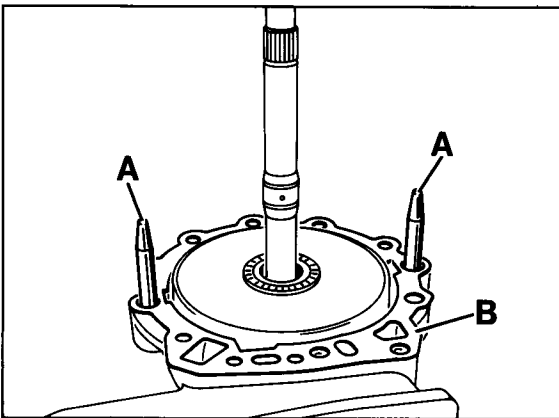
Determining the end clearance

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 37 - 105).

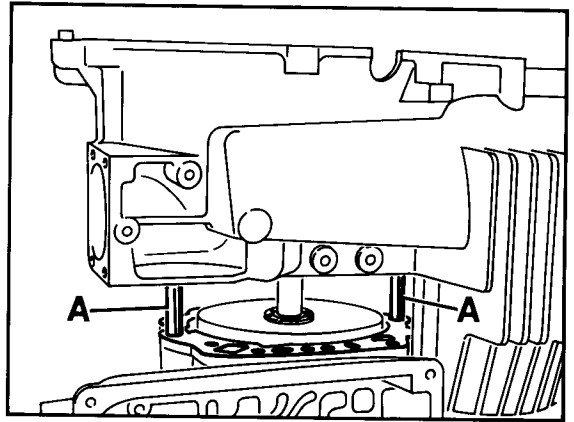
1. Assembly transmission (complete with spur gear drive and front transmission cover).
2. Screw centering pins 9321 into transmission case and apply some grease (vaseline) to stick paper gasket to sealing surface.



964-38

- A - Centering pins 9321
B - Gasket

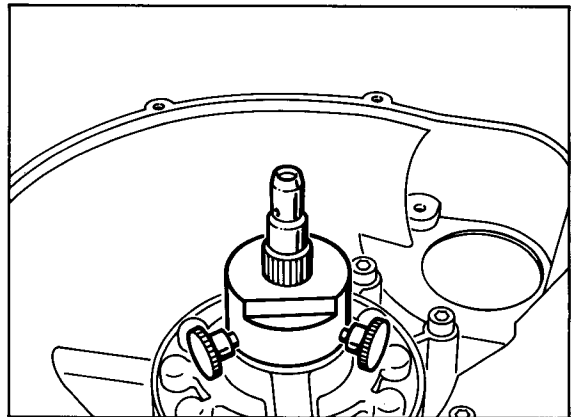
3. Using some grease (use vaseline), stick the removed adjusting washer to the rear transmission case and put housing carefully into position.



961-38

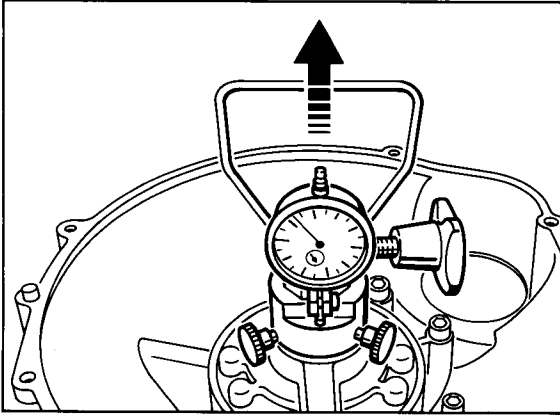
- A - Centering pins 9321

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

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



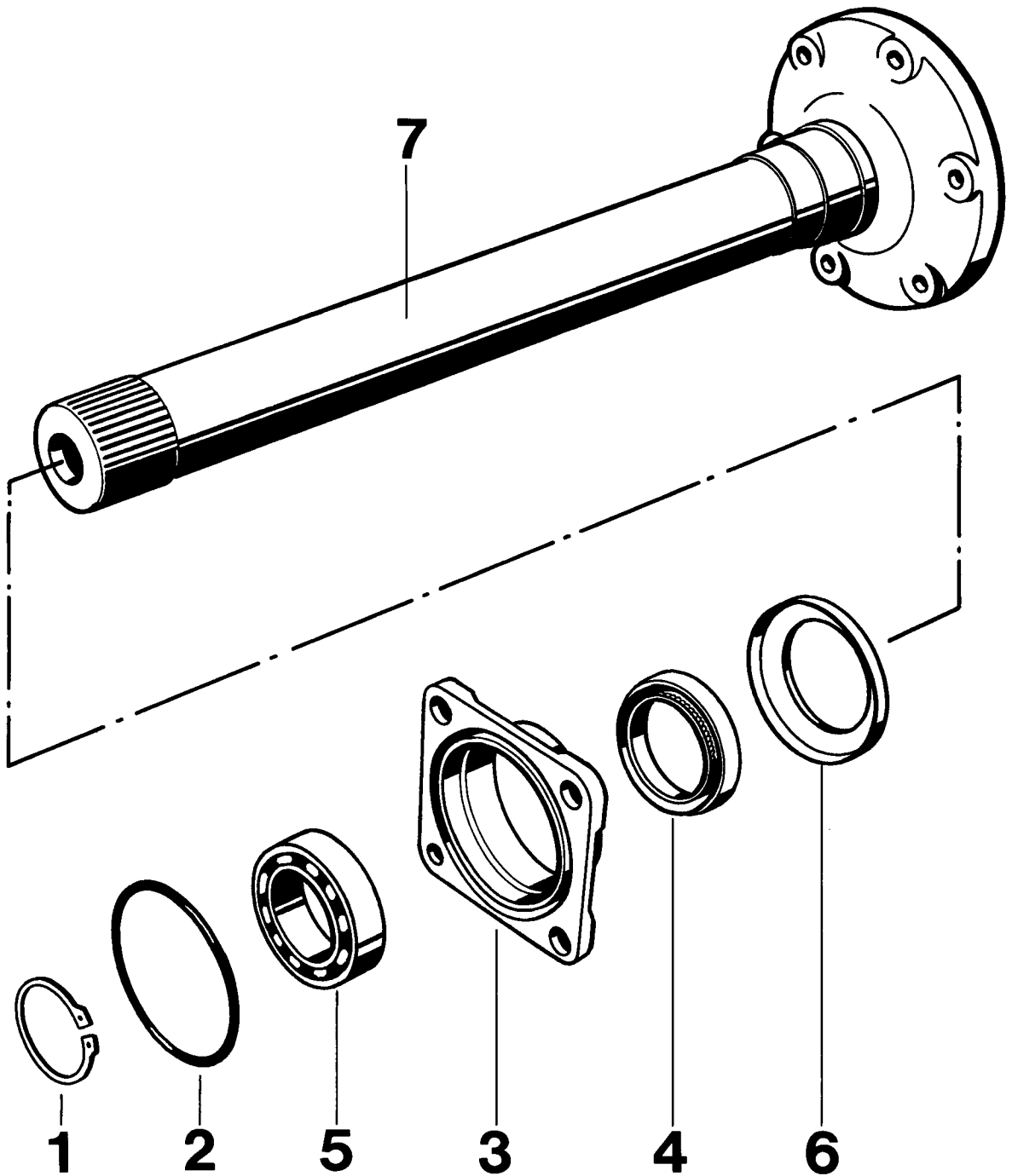
963-38

- Set measuring sleeve to zero with a certain preload.
- Determine end clearance by pulling the handle. Repeat measurement several times.

Note

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

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		

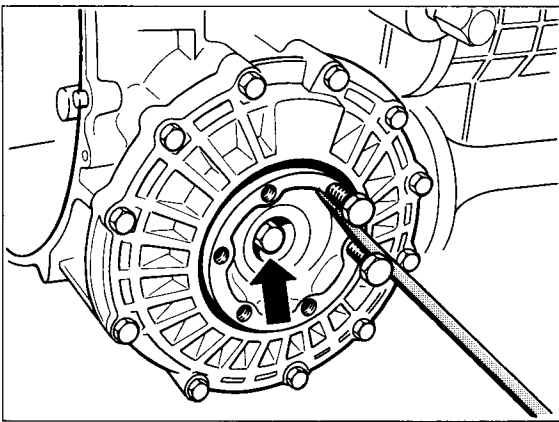
Removing and installing the rotary shaft seal for the short joint flange

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**.

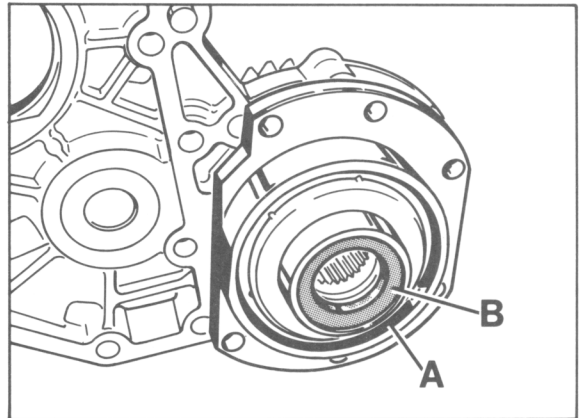
Installing

1. Press in rotary shaft seal flush with suitable pressure piece.
2. Tighten hexagon screw for joint flange with **46 Nm (34 ftlb)**.

Sealing off the driving shaft

1. Drain ATF
2. Remove engine with gearbox (do not unbolt engine from gearbox).
3. Remove intermediate plate (see page 37 - 107).
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).

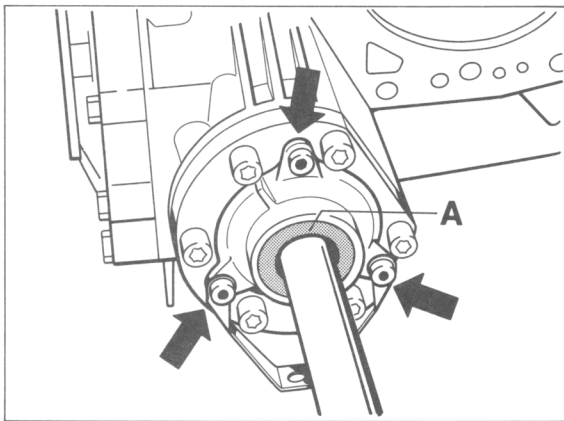
Press-in depth 2.0 ± 0.5 mm.



423-39

A = Snap ring

B = Rotary shaft seal



A = Rotary shaft seal

422-39

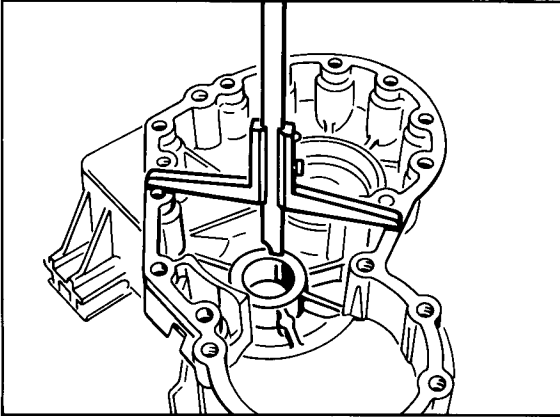
5. Fit bearing cap with new O-ring and tighten fixing screws with **10 Nm**.
6. Remove snap ring for bearing cap at intermediate plate and pull out cap.

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.

Adjusting the preload of the spur gear taper roller bearings

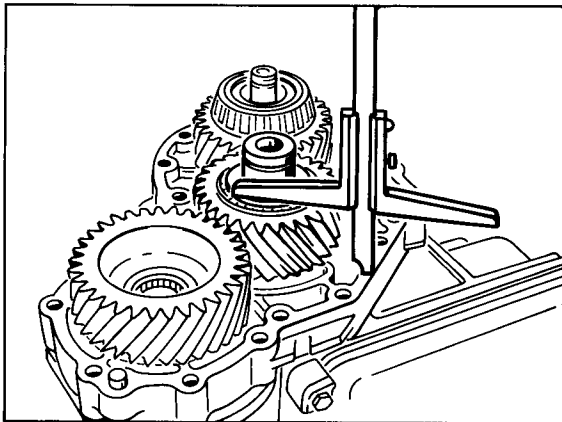
Adjusting spur gear II (intermediate gear)

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

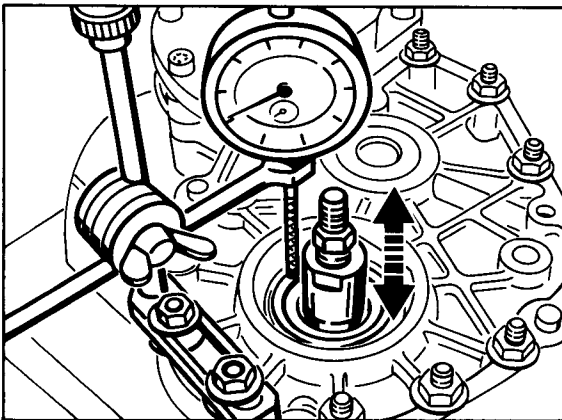
Dimension "a" e.g.	45.90	mm
Dimension "b" e.g.	- 44.65	mm
	<u>1.25</u>	mm
Constant	+ 0.22	mm
Shim thickness	<u>1.47</u>	mm

Note

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

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 not 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.

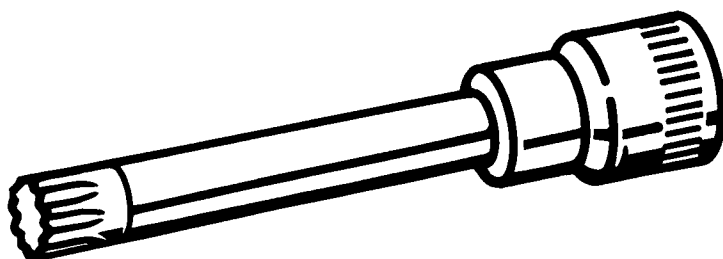
Example

Measured value	1.18 mm
Constant value	+ 0.20 mm
Shim thickness	<u>1.38 mm</u>

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

Note

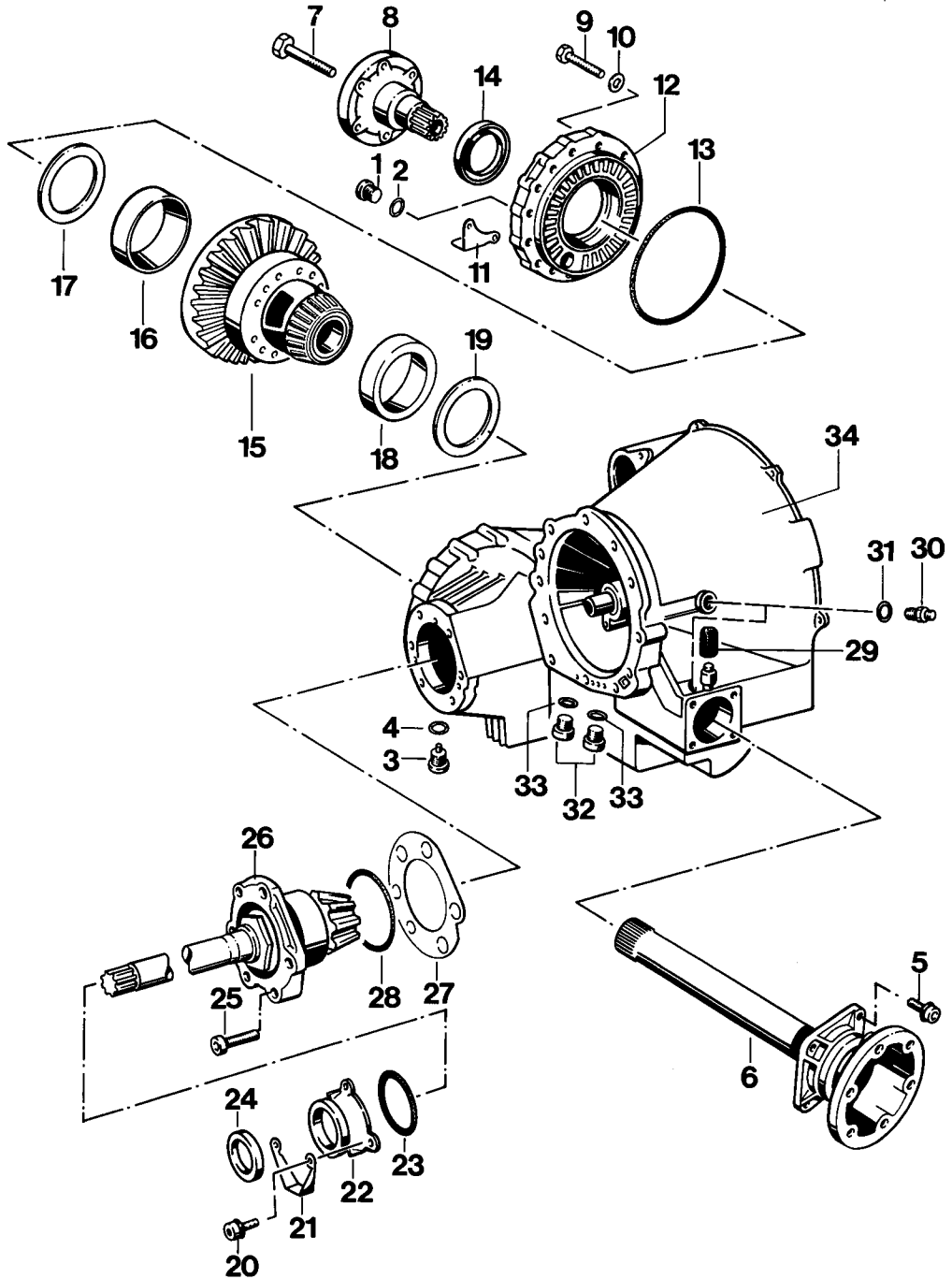
Always round shim thickness up or down to the nearest 0.05 mm figure.

Removing and installing differential and drive pinion

966-39

No.	Designation	Special tool	Order number	Explanation
	Socket	9330	000.721.933.00	

Removing and installing differential and drive pinion

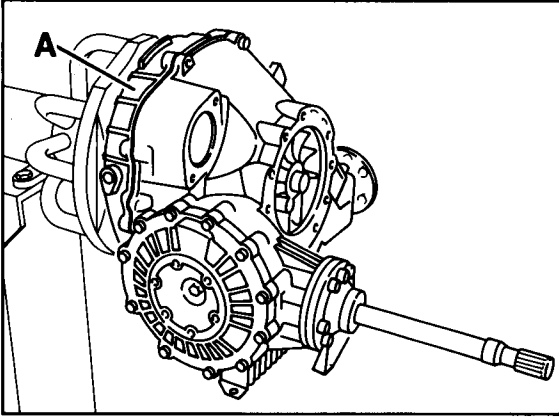


No.	Designation	Qty.	Note:	
			Removal	Installation
1	Plug	1		Tighten to 50 Nm (37 ftlb)
2	Seal	1		Replace
3	Plug with solenoid	1		Tighten to 50 Nm (37 ftlb)
4	Seal	1		Replace
5	Pan head screw	4	Remove with Special Tool 9330	Tighten to 23 Nm (17 ftlb)
6	Halfshaft flange	1		For dismantling, refer to page 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		
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		
17	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)

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	Rear transmission housing	1		

Removal note

Mount rear transmission case with converter housing on assembly support.

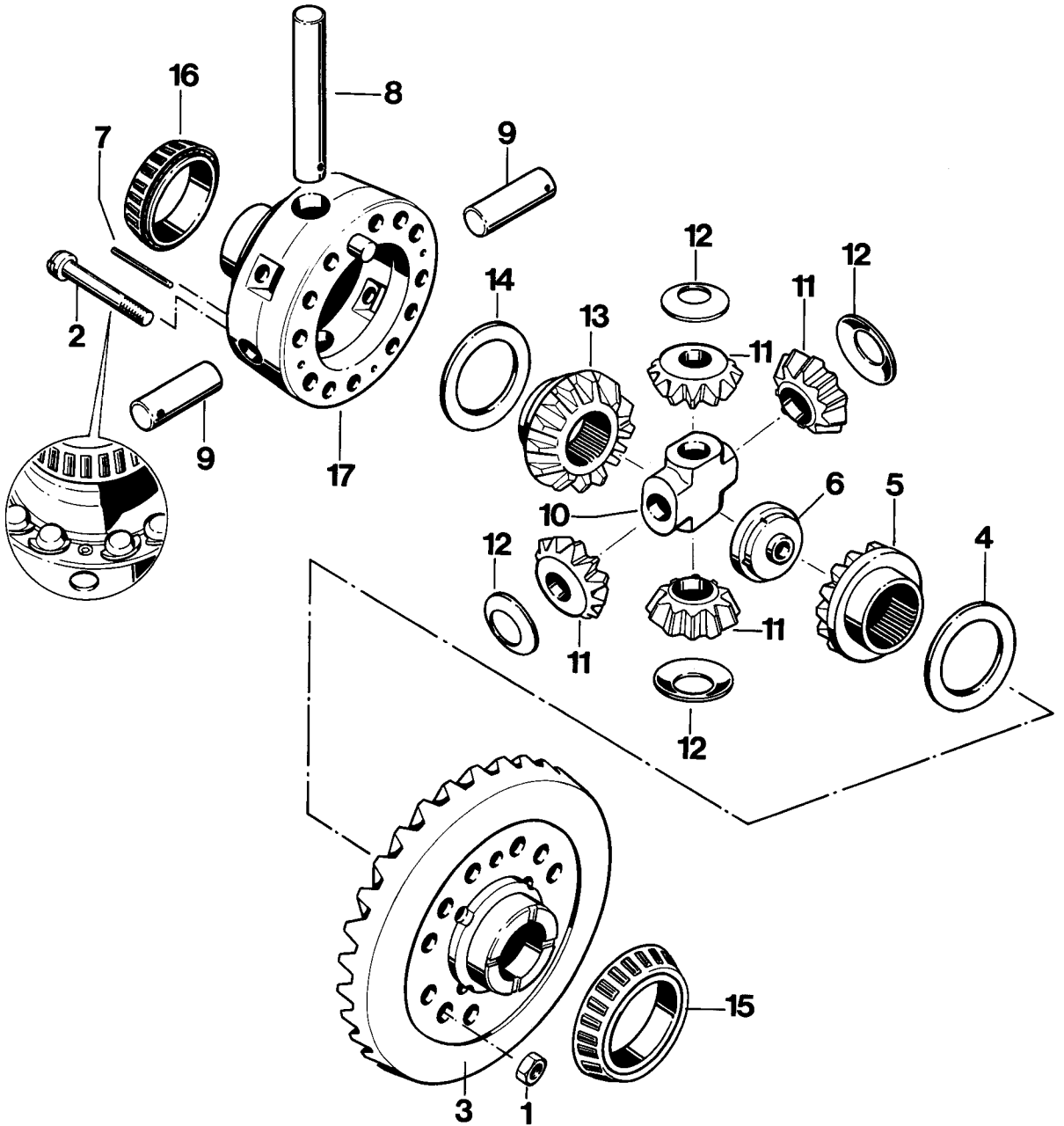


965-39

A - Converter housing (spare part)

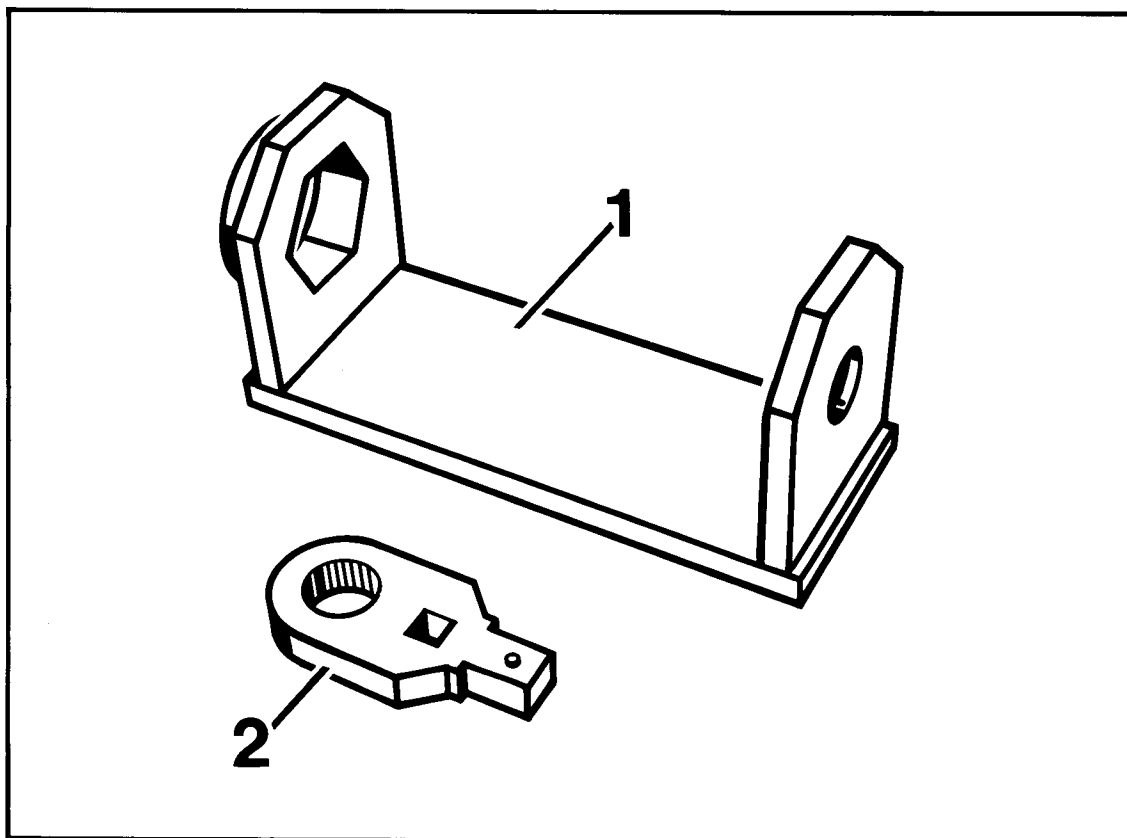
Dismantling and assembling differential

Dismantling and assembling differential



No.	Designation	Qty.	Note:	
			Removal	Installation
1	Hexagon nut	12		Replace. Threads must be dry and free from grease. Secure with Loctite 262, tighten to 85 Nm (63 ftlb)
2	Lock screw	12		Replace. Threads 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 off 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

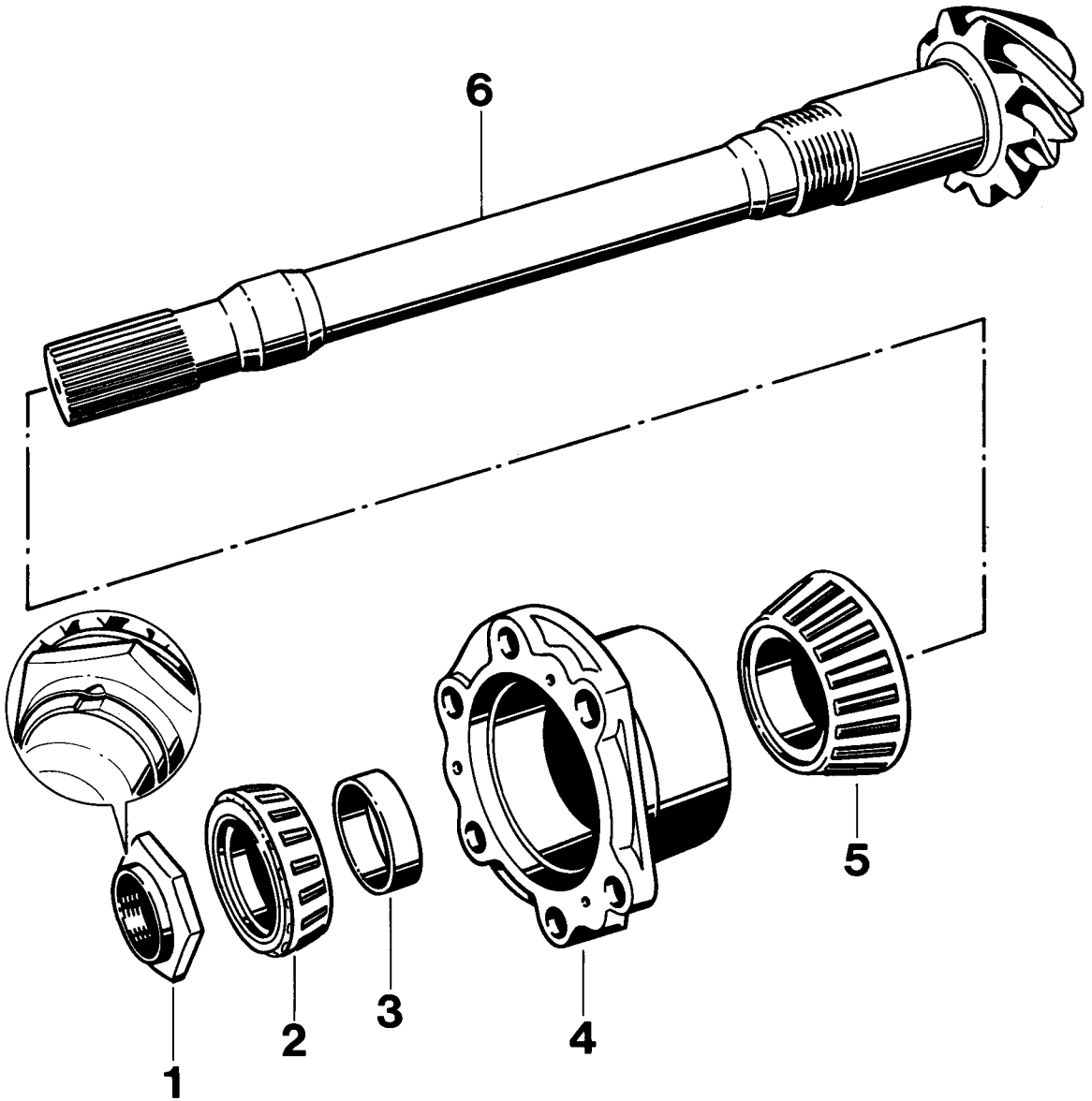
Dismantling and assembling drive pinion



967-39

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

Dismantling and assembling drive pinion

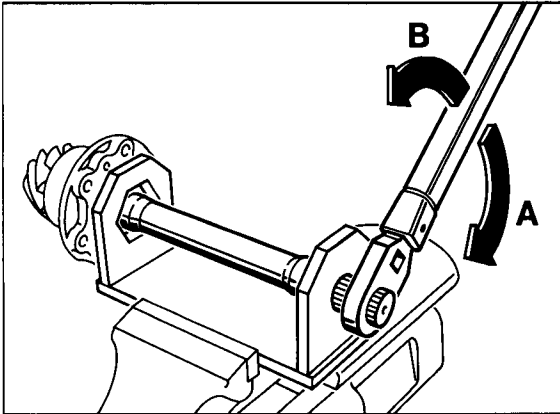


No.	Designation	Qty.	Note:	
			Removal	Installation
1	Lock nut	1	Undo with Special Tool 9337 and 9282	Tighten to 250 Nm (184 ftlb) and secure by upsetting the flange in two places
2	Taper roller bearing inner race	1	Press off with bearing flange	Heat to approx. 120° C and press on
3	Adjusting ring	X		
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

Dismantling note

Dismantling

Undo lock nut with Special Tools 9337 and 9282.



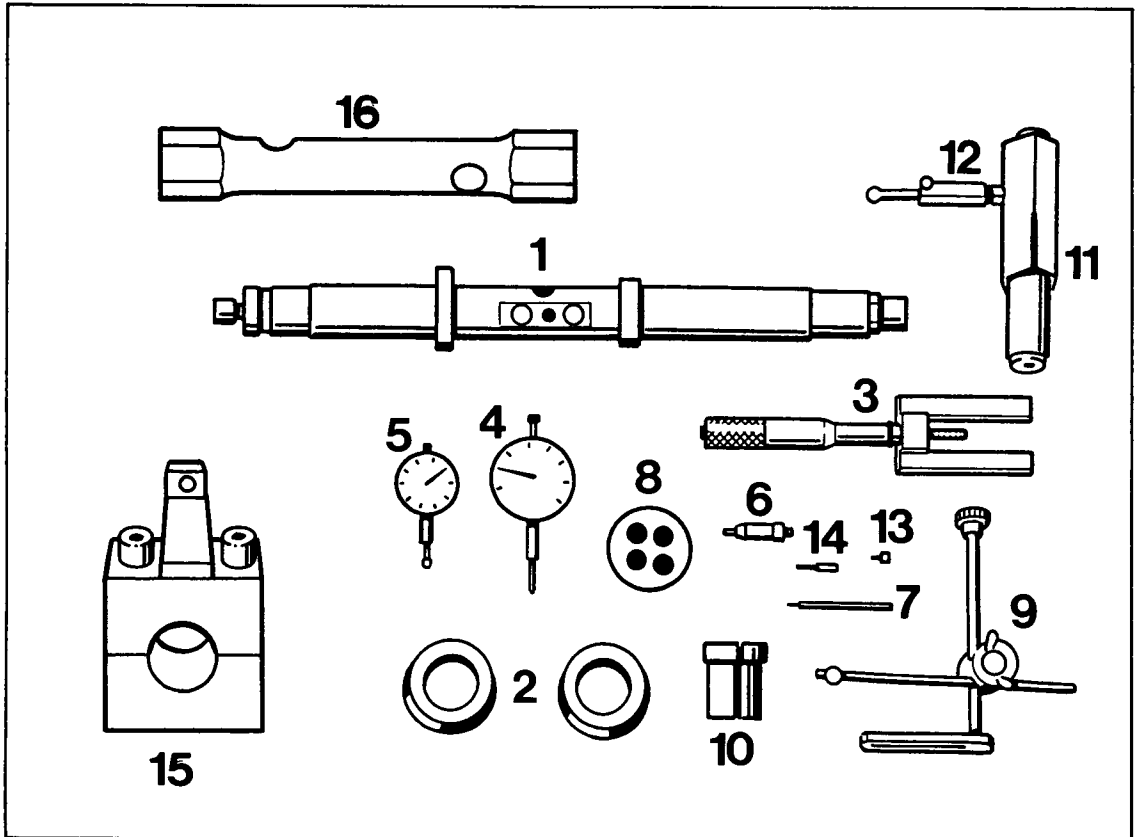
968-39

A - Undoing

B - Tightening

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	000.721.934.10	
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)

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:

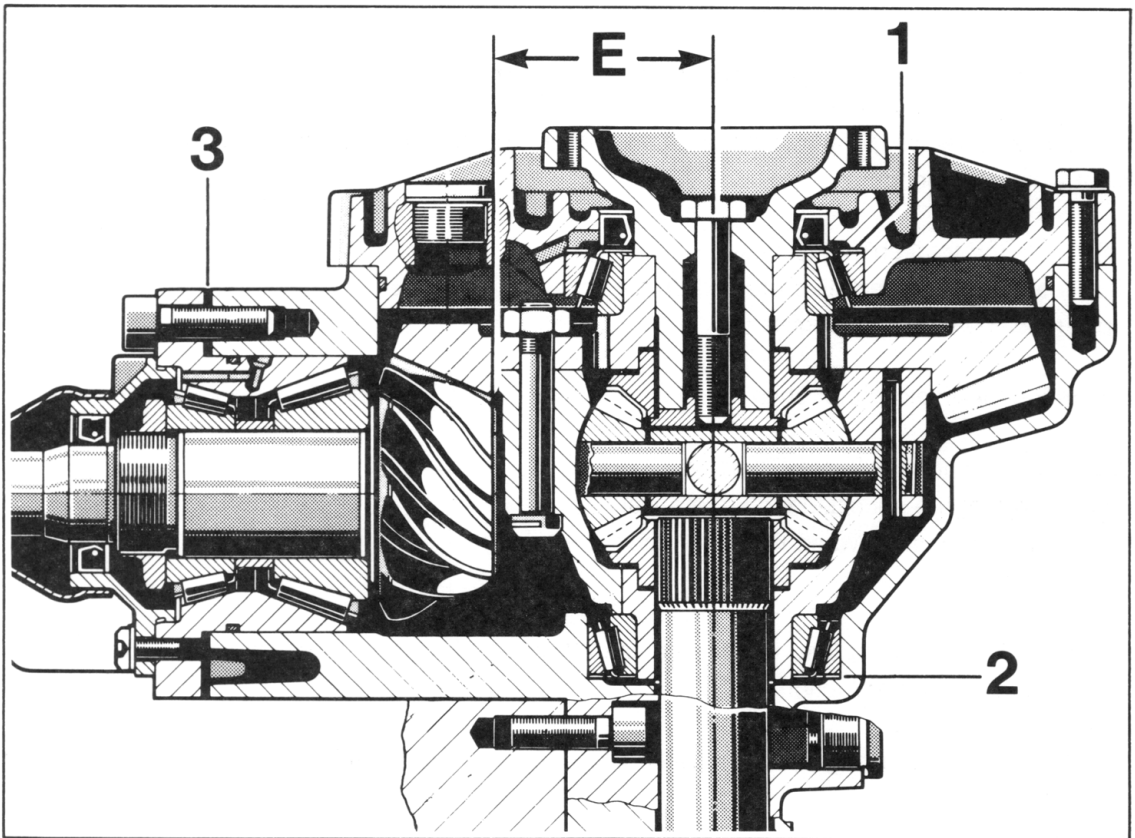
1. Determine the total shim thickness "Stot" (S_1 plus S_2) for the specified preload on the taper roller bearings/differential.
2. Determine the thickness of shim " S_3 ".
3. Split the total shim thickness "Stot" into S_1 and S_2 so that the specified circumferential backlash is present between ring 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:	Ring gear ($S_1 + S_2$)	Drive pinion (S_3)
Replaced component		
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	



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

945-39

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

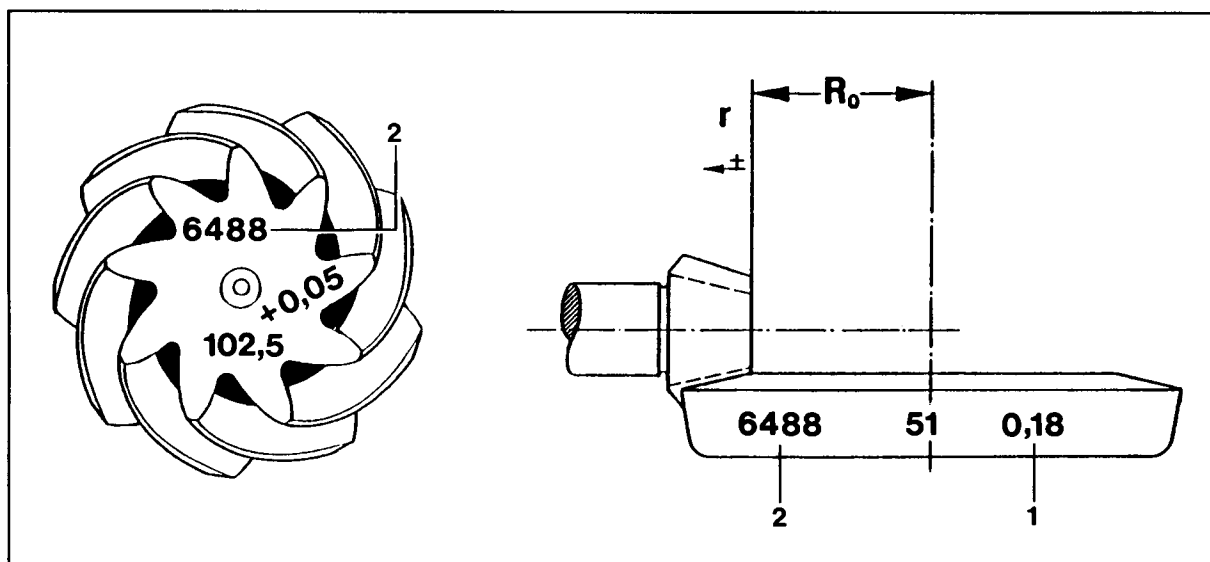
Adjusting drive set

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".

During initial production, drive sets that feature only the values for production setting were used. When replacing components on those drive sets that affect the drive pinion position directly (transmission housing and bearing assembly for drive pinion), a measurement of **actual values** is required (refer to page 39 - 131).

Production version "A"

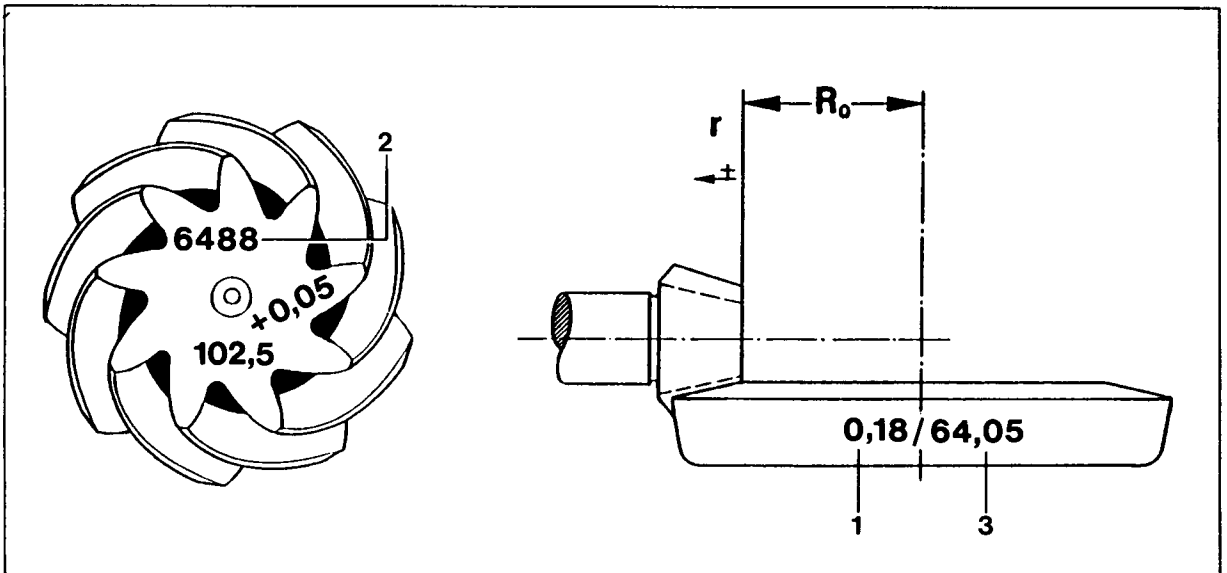


994-39

- 1 - Backlash (e.g. 0.18 mm)
- 2 - Matching number

All other characters are used for adjustment in production.

Version "B" for service



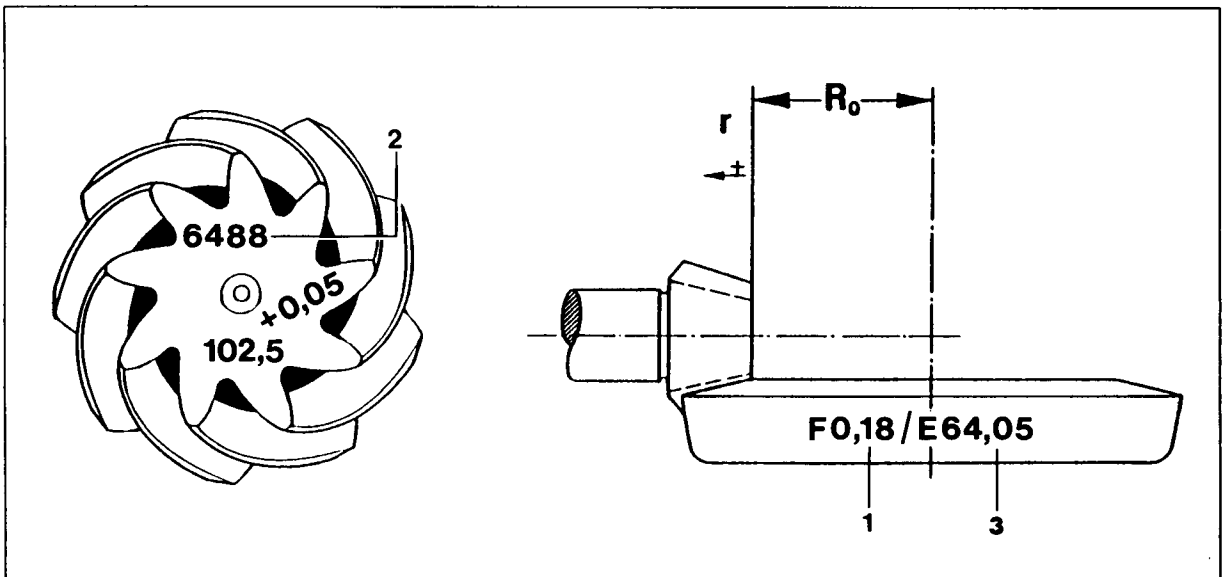
996-39

1 - Backlash "F" (e.g. 0.18 mm)

2 - Matching number

3 - Setting dimension "E" (e.g. 64.05 mm)

Version "C" for service



996-39

Ro - Design dimension (64.00 mm)

r - Deviation r

1 - Backlash "F" (e.g. 0.18 mm)

2 - Matching number

3 - Setting dimension "E" (Ro + r)

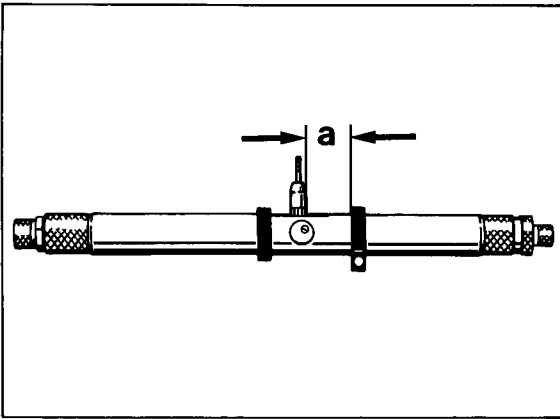
The service versions also feature the production dimensions of version "A". However, they are offset by 180°.

Adjusting drive pinion

Note

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

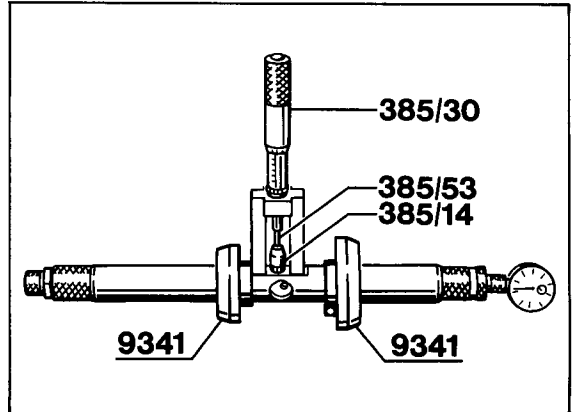
1. Install drive pinion without shims "S₃" and tighten all pan head screws of bearing assembly to 50 Nm (37 ftlb).
2. Rotate adjustable stop ring along with spindle towards measuring plunger as far as it will go and set second setting ring to dimension "a".



969-39

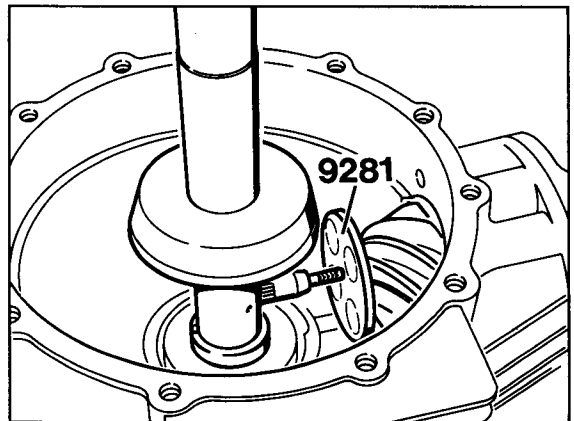
a = 30 mm

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.



971-39

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 "S₃" 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.

Determining installation position of drive pinion

Measuring actual values

Note

Initial production vehicles used drive sets that did not have the "E" and "F" marks for service adjustment.

When replacing components that affect the drive pinion position directly on those transmissions, the actual values must be measured.

1. Remove differential.
2. Assemble measuring mandrel VW 385/1 and set to design dimension
"Ro" = 64.00 mm.
(Refer to page 39 - 129).
3. Install measuring mandrel and measure difference (deviation "r") to "Ro".
4. Design dimension "Ro" plus deviation "r" equals the actual or setting dimension "E".
5. After the parts have been replaced, adjust the drive pinion, taking the actual value determined into account.

Adjusting ring gear

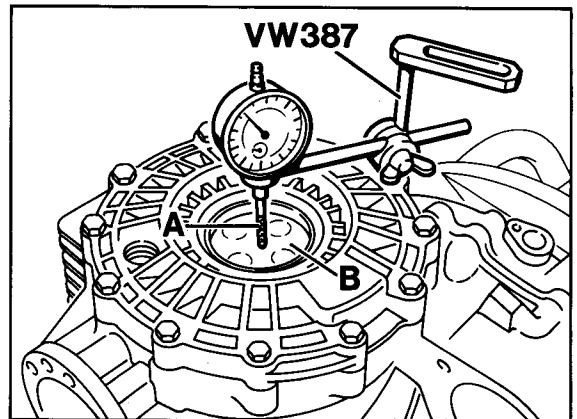
Determining total shim thickness "Stot." ($S_1 + S_2$)

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 "S₁" (in transmission side cover).
2. Adjusting shim "S₂" 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 and 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 "S₂" and determine thickness using a micrometer.
10. Calculate "Stot".
"Stot." = Thickness of adjusting shim "S₂"
+ 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"	<u>2.85 mm</u>

11. Spread calculated shim thickness "Stot" as follows.

To start with the backlash adjustment, the thickness of adjusting shim "S₁" is reduced by 0.40 mm while the thickness of adjusting shim "S₂" is increased by 0.40 mm.

Example

Total shim thickness of adjusting shims

$$S_1 + S_2 = 2.85 \text{ mm}$$

Thickness of adjusting shim "S₁"

$$\begin{array}{rcl} 2.85 \text{ mm} & = & 1.425 \text{ mm} \\ \hline 2 & & - 0.40 \text{ mm} \\ & & \hline & & 1.025 \text{ mm} \end{array}$$

Thickness of adjusting shim "S₂"

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

Note

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

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

Example

Calculated shim thickness

$$S_1 + S_2 = 1.025 + 1.825 = 2.85 \text{ mm}$$

Rounded down shim thickness

$$S_1 + S_2 = 1.00 + 1.85 = 2.85 \text{ mm}$$

Adjusting circumferential backlash

Note

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

1. Mount gear set using the shims "S₃" 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).

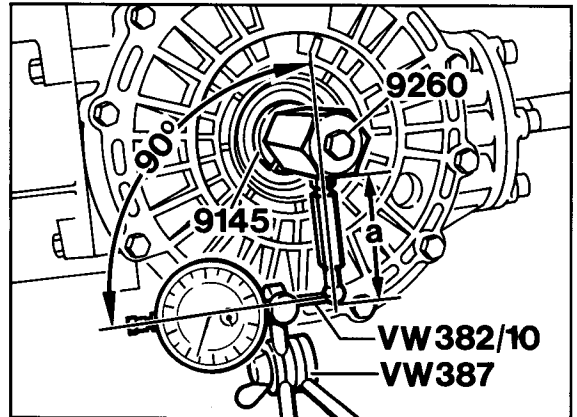
2. Fit the adjusting shims (S₁ + S₂) determined into the transmission case and the transmission side cover, respectively.
3. Fit differential and transmission side cover and tighten all hexagon head bolts of the cover to 23 Nm (17 ftlb).

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.



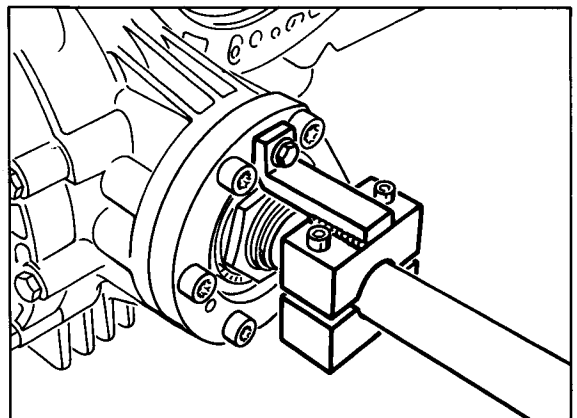
972-39

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.

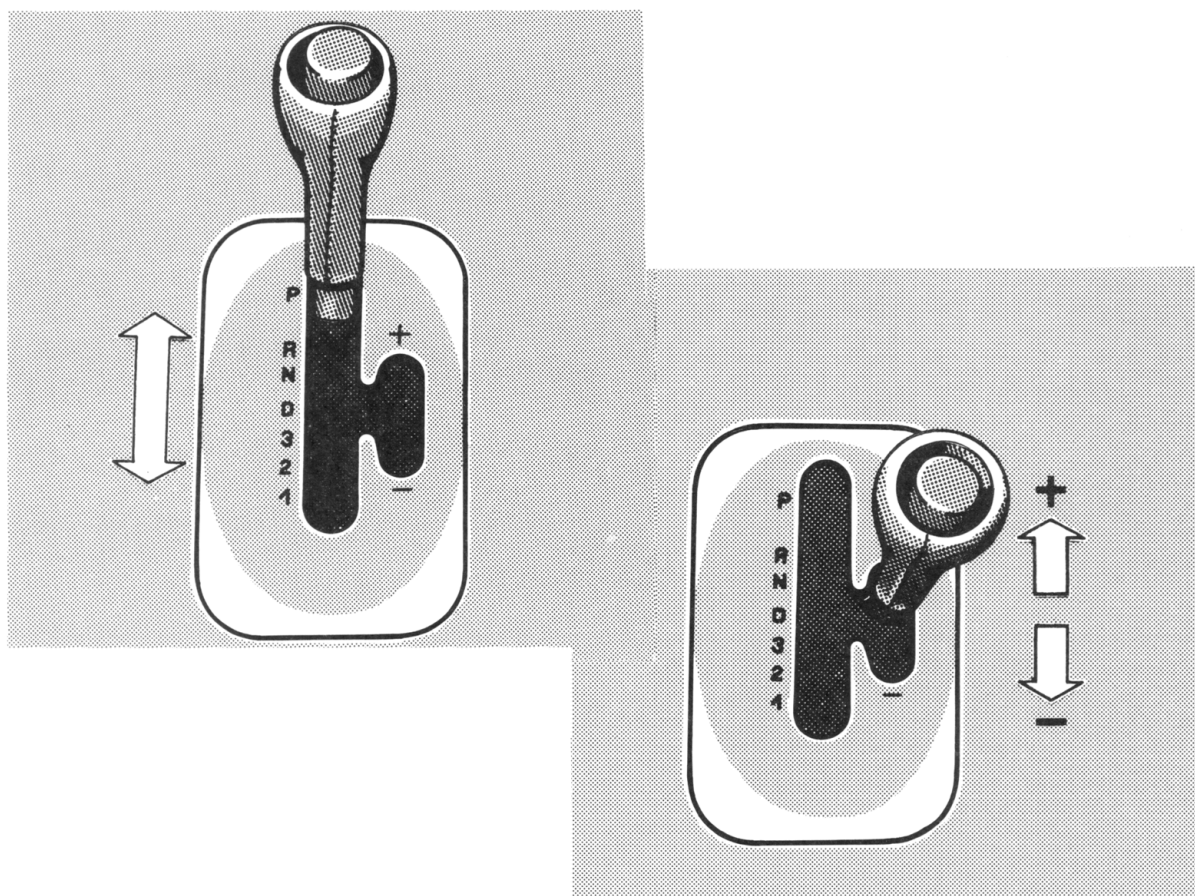
10. If the required backlash cannot be obtained, replace spacers (S1 + S2) again. The total shim thickness (S tot.) must not be altered, however.

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.

Tiptronic Diagnosis / Troubleshooting

911 Carrera 2

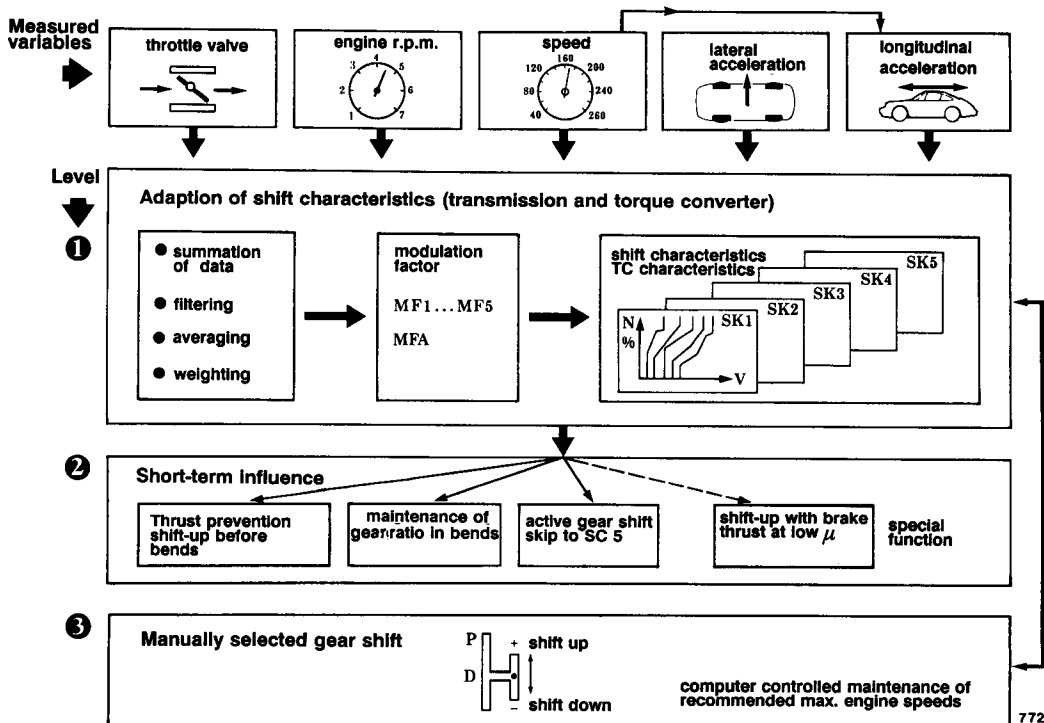


Fault overview / Contents

Testpoint	Fault code	Item	Results of fault	Page
		General		102
		Connector layout		110
0		Diagnosis connector		111
1	11	Voltage control unit (Term. 15)	Emergency operation, no display	112
2	12	Supply voltage (Term. 30)	No diagnosis	113
3	13	Supply voltage, drive links	Emergency operation	113
4	14	Supply voltage, sensor, 5 V	Emergency operation	114
5	21	Rpm signal (engine)	Emergency operation	115
6	22	Load signal	Emergency operation	116
7	23	Throttle potentiometer	Emergency operation	117
8	24	Change of ignition timing	Emergency operation	118
9	31	Soleonid valve 1	Emergency operation	119
10	32	Solenoid valve 2	Emergency operation	119
11	33	Solenoid valve (torque conv. clutch)	Emergency operation	120
12	34	Pressure regulator	Emergency operation	120
13	35	Selector lever switch	Emergency operation	121
14	36	Speed sensor (transmission)	Emergency operation	123
15	37	Transmission temperature sensor	Replacement value 60° C	124
16	38	Selector lever switch (for starting)	Emergency operation	125
17	42	Control unit faulty	Emergency operation	125
18	43	Control unit faulty	Emergency operation	125
19	44	Control unit faulty	Emergency operation	126
20	45	Downshift fault	Emergency operation	126
21	46	Rev. limiter	Emergency operation	126
22	51	Manual program switch	No manual program	126
23	52	Tip-switch up/down shifting	No manual program	126
24	53	Kickdown switch	No kickdown	127
25	54	Transverse acceleration sensor	No upshift prevention	127
26	55	Speed signal 1 (ABS)	No upshift prevention no manual program	128
27	56	Combi-instrument input	No diagnosis	128
28	57	Oil cooler blower (not used at pres.)	Fault memory	129
29	59	Switch R-position (as of N prog.)	Emergency operation	129
30	60	Reverse light relay (as of N prog.)	no diagnosis	130

Functional Overview

This is how the information is processed in the Tiptronic control unit



The Tiptronic control unit is located below the left-hand seat and is built into a housing that is slightly smaller than the DME control unit located in the same place.

The following parameters are constantly supplied to the Tiptronic control unit:

Parameter

- Throttle position
- Throttle actuation speed
- Engine speed
- Driving speed
- Vehicle transverse acceleration
- Vehicle axial acceleration/deceleration

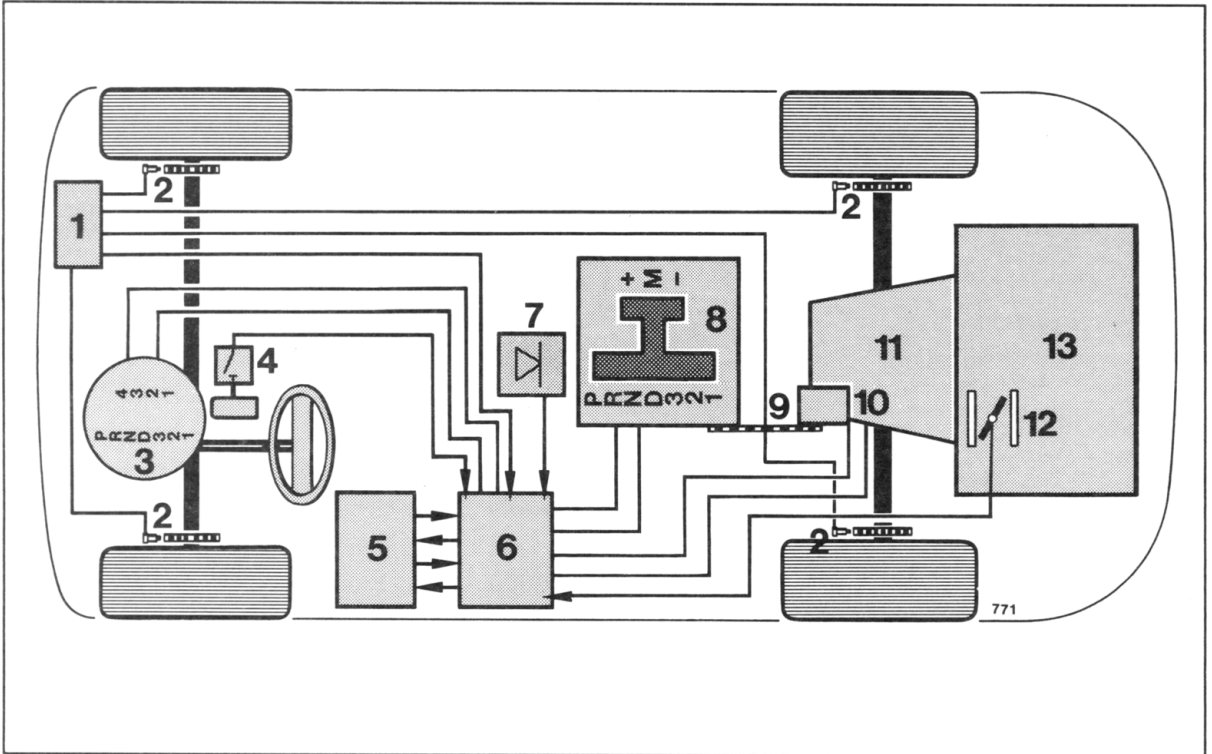
Type of measurement

- Potentiometer resistance
- Time for change of resistance at potentiometer
- Frequency measurement (from DME)
- No. of pulses at pole wheel of transmission shaft
- Signal from transverse acceleration sensor on center console
- Change of no. of pulses within clock time

The above values are determined several times per second and are processed in the control unit.

By comparing those measurements with the stored programs, factors are generated that cause the transmission to enter or to shift into one of the five shift curves.

The automatic shift strategy of the Porsche Tiptronic



- | | |
|-------------------------------------|--|
| 1 ABS control unit | 8 Selector lever system with two gates |
| 2 ABS sensors at wheels | 9 Cable |
| 3 Speedometer | 10 Position switch |
| 4 Kickdown switch | 11 Automatic transmission |
| 5 DME control unit | 12 Throttle with potentiometer |
| 6 Electronic Tiptronic control unit | 13 911 Carrera 2 engine |
| 7 Transverse acceleration sensor | |

The electronic Tiptronic control unit (6) is the information and command center of the entire system. A large quantity of **information inputs** that are compared with the stored **driving or gearshift programs** is used to generate **commands** that **cause the transmission to execute or not to execute** gearshifts.

Major Data at a Glance:

Automatic four-speed sports transmission with integral hypoid final drive, with manual and automatic shift features.

No. of gears: 4 forward gears, 1 reverse

	WW → '91	RoW 92 →	US 92 →
Porsche model designation:	A 50.01	A 50.02	A 50.03
Ratios			
1st gear	i = 2.479	..	..
2nd gear	i = 1.479	..	..
3rd gear	i = 1.000	..	..
4th gear	i = 0.728	..	..
Spur gear drive 30 : 33	i = 1.100	..	..
Final drive	i = 3.667	3.667	3.556
Hypoid offset 15 mm			

Stall speed 2,300 rpm – 400 rpm

Control unit: 8-bit microprocessor with external 32 KB EPROM memory

Transmission unit overall weight: 98 kg

Extra weight: 911 Carrera 2 vehicle with Tiptronic: 34 kg

Filling capacities:

Automatic section: Initial filling approx. 9.1 l, ATF Dexron II D

This quantity is reduced accordingly when ATF fluid is changed

Final drive: 0.9 l transmission oil GL5 (MIL L 2105B)
either multigrade SAE 75 W 90
or single grade SAE 90

Start of diagnosis

To assess a Tiptronic transmission for which complaints have been received, the information about the fault and the fault occurrence should be as complete as possible.

To avoid extra damage during test drives or faulty diagnosis results, the following items must be checked and corrected (if required) prior to the test drive:

1. Read out fault memory with System Tester 9288 and correct fault.
Battery, connectors, ground points O.K.
2. External damage, leaks at transmission (ATF leaks) or final drive (hypoid oil loss), disconnected cables.
3. ATF level in transmission correct, fluid is **neither dirty nor does it leave a burning smell**. If ATF is dirty or if it leaves a burning smell, it is recommended to replace the Tiptronic transmission if complete removal of the dirt residues cannot be ensured. In addition, the coolant lines and the cooler must be flushed.
4. Engine operation, full opening of throttle when accelerator is in full-throttle position

Notes:

If a system fault occurs, the Tiptronic system shifts into a reduced driving program. The warning lamp comes on and the automatic system shifts to 4th gear, irrespective of the selector lever position.

If the vehicle is started again in the "P" or "N" selector lever position after it has been stopped, only 3rd gear is activated in the "D", 3, 2 or 1 selector lever positions.

Caution: The reverse gear interlock monitor is inoperative.

Do not shift into "R" while the vehicle is in motion.

The test drive

The test drive should be used to check if the customer complaint situations actually occur when the vehicle is driven. It is actually preferable to have the customer drive the car and to check for any potential faults, malfunctions or even for incorrect operation by the driver.

Check all functions of the transmission during the test drive:

- All shifts, including in kickdown position in the automatic gate, as well as shifts in the manual gate
- Various driving speeds
- Driving in reverse (uphill if possible)
- Stall speed

A safe diagnosis is only possible if you are familiar with the design and operation of the Tiptronic transmission. Read the Functional Description brochure carefully: Porsche Tiptronic WKD 496 620.

Make your diagnosis using the "Troubleshooting the Tiptronic transmission" section and determine the type of repair required.

This diagnosis plan is based on the fault memory contents. If no fault is stored although a malfunction is present, the troubleshooting plan for the mechanical/hydraulic section should be used.

Troubleshooting requires that the person performing the tests

- is familiar with the location of components, operation and technical relationships of the systems being tested (refer to Model Information)
- is able to read and evaluate Porsche wiring diagrams
- knows the functions of circuits and relays
- is capable of using testers such as oscilloscope, voltmeter, ohmmeter and ammeter, as well as of evaluating the test results.

Important:

The fault text displayed (fault list in case of flashing code) does **not** necessarily indicate a defect in this component, but may also refer to a fault in the corresponding control unit and the wiring (paths) between the component and the control unit.

Before reading out the fault memory, do not try to locate faults by disconnecting plugs etc. while the engine is running as this may be stored as a fault in the fault memory.

Note for System Tester 9288

If the tester display shows

Fault not present, this may indicate:

- Fault did not exist at the time of testing (e.g. in the case of loose connections)
Remedy: Visual inspection of path
- The conditions under which the fault is tested do not correspond to the conditions under which the fault occurred.
Remedy: Conform with the conditions displayed on the tester

Signal unplausible:

The signal of the monitored component is not within the tolerance range of the value preset in the control unit.

Diagnosable Tiptronic control unit

A self-diagnosis feature with fault memory is built into the Tiptronic control unit to allow certain faults within the electronic control system of the Tiptronic to be detected and to be stored.

To prevent detected and stored faults from being erased when the ignition is switched off, a permanent positive voltage is present at the control unit. Detected faults remain stored in the fault memory for at least 50 starts of the engine.

Caution:

If the connector is pulled off the Tiptronic control unit or if the battery is disconnected, the fault memory is erased.

Tester connections

To run the diagnosis, the vehicles are fitted with a 19-pin connector in the passenger footwell.

This connector allows System Tester 9288 or the Flashing Code Tester 9268 (via adapter cable 9268/2) to be connected. Operation of the testers is described in the tester instruction manuals.

Note

The relevant test point is complemented by the corresponding fault flasher code of Tester 9268. As of tester module level 4.0, the following items can be checked or read out with System Tester 9288:

Input signals with „Input signals“ menu	Actual values with „Actual values“ menu	Actuators (Drive links) with „Drive links“ menu
Kickdown	Rpm	Solenoid valve 1
Downshift	Speed 1	Solenoid valve 2
Upshift	Speed 2	Torque converter clutch
Manual program	Injection time	Gear indicator 1 - 4
Selector lever	Throttle	Reverse relay (G 01)
	Temperature	Ignition timing change
	Transverse acceleration	
	Selector lever switch	
	Gear	
	Voltage supply	
	Version coding	

General

Auxiliary tools

Use of the following auxiliary tools is recommended when checking the Electronic Transmission Control (EGS - **E**lektronische **G**etriebe **S**teuerung):

- Diagnosis Tester 9288 with connection cable
- Voltage and resistance meter for internal resistance > 10 M Ω
- Oscilloscope
- Jump lead with matching spade connectors

General information

- Do not run resistance measurements on live wiring
- If poor terminal connections are found,
 - check wiring for damage
 - check connector terminals for tight fit, tight wire connections, deformation and corrosion
 - Before replacing the transmission or the electronic control unit, always check the wiring harness and system components with the System Tester. Otherwise new new control unit or transmission may be destroyed again.

Abbreviations:

TE = Transmission electronics= – System components

ECU = Electronic transmission control unit

HCU = Hydraulic transmission control unit

Signals that can be checked with the oscilloscope

- Speed signal (from ABS)
- Speed signal (from transmission)
- Rpm signal (n-Mot) (from DME)
- ti signal (load of DME)

Definitions

System voltage

The system voltage reflects the current charging state of the battery. When the battery is discharged, the voltage is approx. 11 V; when the engine is running it is approx. 14.5 V

Needle pulse

Needle pulses are pulses of extremely short duration that appear as a vertical line on the oscilloscope (tr signal)



Unit functions

Installed units must operate correctly within a voltage range of 9.5 to 16.8 Volts.

Faults that cannot be detected by self-diagnosis

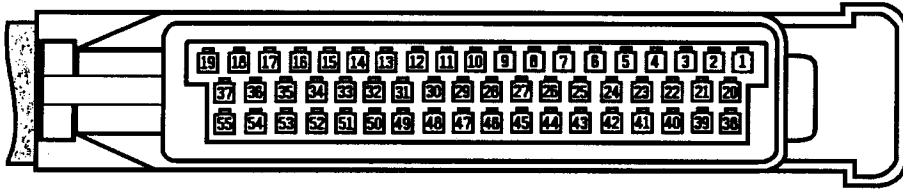
The ECU cannot detect and store all potential faults.

If a fault is found and if no fault has been stored, the tester may be used to run a system check to indicate any faults that may be present.

Some of these faults are stated below.

- No diagnosis possible, Test point 0
No diagnosis is possible if the diagnostic leads are faulty.
- Terminal 15, Test point 1
If terminal 15 is inoperative, the system enters the (mechanical-hydraulic) emergency mode. The fault lamp does not come on.
- Terminal 30, Test point 2
If terminal 30 is inoperative, all faults that may have been stored are erased after the ignition is switched off.
- DME rpm signal is missing. Test point 2: Actual values, connector to DME.
- Tiptronic is in emergency mode, warning lamp comes on. No Tiptronic diagnosis possible.
If all above items are o.k.: Replace ECU
- Transmission oil level o.k.?
- Start interlock feature
It must only be possible to start the engine in the P and N selector lever positions. Check selector lever switch to ignition switch cable.
- Several faults
If several faults occur, this may be due to a missing ground lead (e.g. the common ground lead of the sensors at ECU pin 44), ground of body engine/transmission.
- Gear selected
If the gear selection feature is faulty, the position switch should be checked (Test point 13).

Connector layout for diagnosis



Figs. 1 and 2 Tiptronic or DME control unit

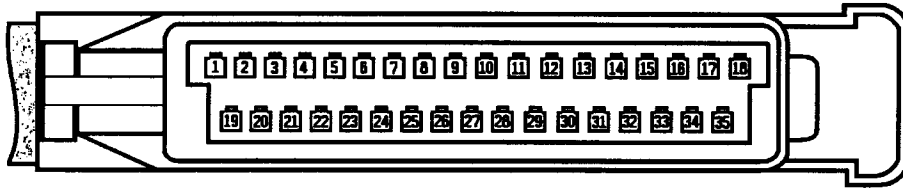


Fig. 3 ABS control unit

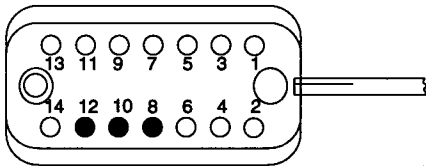


Fig. 4 T 16

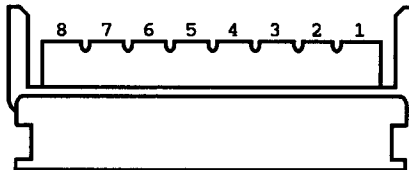


Fig. 8 Selector lever connector

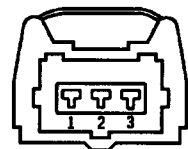


Fig. 11 Transversal acceleration sensor

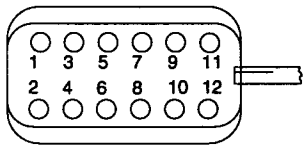


Fig. 5 T41

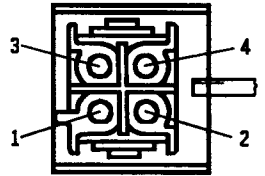


Fig. 12 Kickdown switch

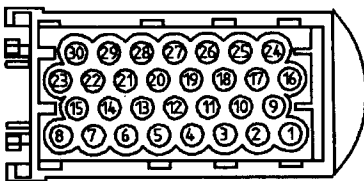


Fig. 6 T 40

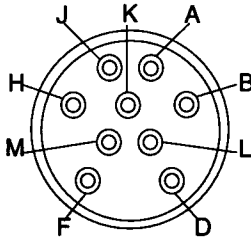


Fig. 9 Transmission connector

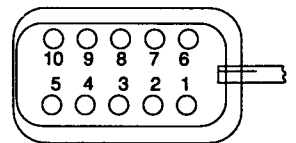


Fig. 13 T 13

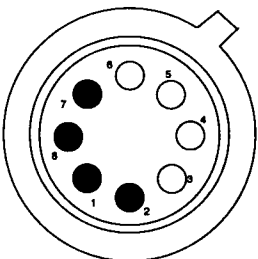


Fig. 7 Position switch

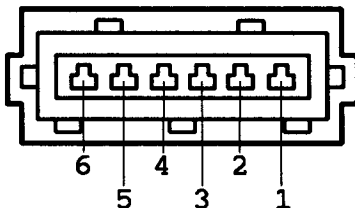


Fig. 10 Throttle potentiometer

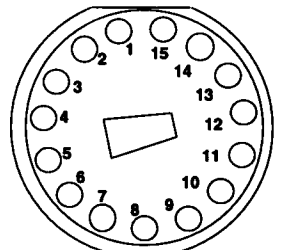


Fig. 14 Speedometer

Fault, Fault code**Possible Causes, Elimination, Remarks****Test point 0****K and L wire**

The diagnostic connection between the ECU control unit and the tester is made across the K and L wires.

If it is not possible to run a diagnosis on all systems, the following checks should be made:

1) Continuity check (refer to wiring diagram)

- L wire: Pin 7 (diagnosis socket) to Pin 13 (ECU connector)
- K wire: Pin 8 (diagnosis socket) to Pin 51 (ECU connector)

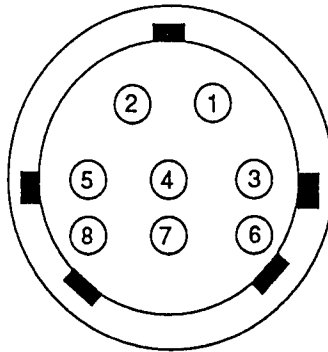
2) Short to ground check (refer to wiring diagram)

- L wire: The voltage at pin 7 (diagnosis socket) should be $> 8\text{ V}$ when the ignition is switched on.
- K wire: The voltage at pin 8 (diagnosis socket) should be $> 8\text{ V}$ when the ignition is switched on.

Possible cause:

- Short to ground or open circuit on the wiring or connectors.
- A defective control unit connected to those wires. (May be any diagnosable control unit, must not necessarily be the ECU control unit.)

To determine the faulty control unit, pull off the control unit connectors one after another until a voltage of $> 8\text{ V}$ is present.



Bushing 3 = L wire

Bushing 4 = Ground

Bushing 5 = Terminal 15

Bushing 7 = K wire

See also page 03 - 43.

Fault, Fault code	Possible Causes, Elimination, Remarks
Test point 1 Voltage control unit (Fault code 11 Signal unplausible)	Emergency operation, no display. Possible faults: Open circuit, short to positive, short to ground, loose connection, voltage outside of valid range 1) Tiptronic warning lamp does not light when the ignition is switched on Check fuse (Central Electrical System) Measure voltage at fuse – No voltage, check wiring to DME relay or operation of DME relay, respectively Measure voltage at ECU connector pin 1 No voltage: Check wiring according to wiring diagram 2) Voltage outside of valid range Fault code 11 Signal unplausible – Low voltage? $U < 11 \text{ V}$ Check battery, generator, regulator! – O.k.? Check for contact resistance at junctions, deformations and corrosion of contacts – Excessive voltage? Check power supply of vehicle (generator, regulator) $U > 14.5 \text{ V}$ with engine running

Fig. 1

Fault, Fault code	Possible Causes, Elimination, Remarks
Test point 2 Permanent positive (system voltage)	<p>No diagnosis possible.</p> <p>Possible faults: Open circuit, short to ground, loose connection</p> <p>Note:</p> <ul style="list-style-type: none"> - No fault storage (Faults are lost when ignition is switched off) - Open circuit/short to ground: Check fuse (Central Electrical System) - Fuse faulty: Pull off connector at ECU Check pin 39 for short to ground - Short to ground? Check wiring according to wiring diagram - No short to ground: ECU faulty Fuse o.k.: Check voltage according to wiring diagram <p>Fig. 1</p>
Test point 3 Voltage of drive links Fault code 13	<p>Tiptronic warning lamp comes on, transmission is in emergency mode.</p> <p>Possible faults: Transmission relay in control unit cannot be pick up or drop out</p> <p>Pull off transmission connector. Measure voltage at pin M. (System voltage)</p> <p>1) No voltage: Pull off ECU connector. Check wiring from ECU pin 19 to transmission connector pin M</p> <p>Wiring o.k.: ECU faulty</p> <p>2) Voltage cannot be switched off: Fault lamp does not come on when fault occurs (e.g. connector pulled off at throttle potentiometer)</p> <p>Pull off ECU connector</p> <p>No voltage at pin M: ECU faulty</p> <p>Voltage at pin M: Short to positive within wiring (transmission → ECU)</p> <p>Figs. 1, 9</p>

Fault, Fault code	Possible Causes, Elimination, Remarks
Test point 4 Voltage of sensors Fault code 14	<p>Tiptronic warning lamp comes on, transmission in emergency mode.</p> <p>Possible faults: Open circuit, short to ground, short to positive Pull connector off ECU. Ignition „off“</p> <p>Transverse acceleration sensor</p> <p>Open up junction T 41. Check wiring from ECU pin 45 to transverse acceleration sensor pin 3 for continuity. Check transverse acceleration sensor pin 3 to pin 7 ECU (ground) and pin 1 ECU (15) for short to ground / short to positive.</p> <p>Throttle potentiometer</p> <p>Open up junction T 40.</p> <p>Check wiring from ECU pin 45 to throttle potentiometer pin 1 for continuity and measure short to ground / short to positive at pin 7 ECU (ground) and pin 1 ECU (terminal 15).</p> <p>Check return line of sensor supply voltage from T 41 pin 3 to ECU pin 27 (M prog.) or pin 8 (as of N prog.).</p> <p>Wiring connections o.k.? ESG faulty</p> <p>Sensor supply voltage $5\text{ V} \pm 0.5\text{ V}$</p> <p>Figs. 1, 5, 6, 10, 11</p>

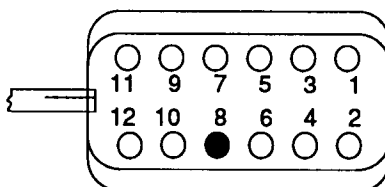
Fault, Fault code	Possible Causes, Elimination, Remarks
Test point 5 Rpm signal from DME Fault code 21	<p>Tiptronic warning lamp comes on, transmission is in emergency mode.</p> <p>Possible faults: Open circuit/short to ground, short to positive, loose connection</p> <p>1) Signal check</p> <p>Check signal with Tester 9288. (Engine operation)</p> <p>Check signal with oscilloscope at ECU connector pin 3. If signal is o.k.: ECU faulty</p> <p>Signal shape of tr signal (refer to page 108)</p> <p>2) Open circuit, short to ground, short to positive</p> <p>Check wiring according to wiring diagram.</p> <p>ECU connector pin 3 to DME connector pin 3 (ground at ECU connector pin 7, positive at ECU connector pin 1)</p> <p>Wiring connections o.k.: DME control unit faulty</p> <p>Note:</p> <p>If pin 3 of the DME control unit is shorted to ground, the DME relay cannot drop out and the fuel pump will run on even when the engine is switched off. This is also the case if a short to ground is found in the wirings to the ECU.</p>

Fault, Fault code	Possible Causes, Elimination, Remarks
Test point 6 Load signal from DME Fault code 22	Tiptronic warning lamp comes on, transmission is in emergency mode. Possible faults: Open circuit, short to ground, short to positive, loose connection 1) Signal check – Check signal with Tester 9288 (injection time) with the engine running – Check signal at ECU connector pin 21 using an oscilloscope. If signal is o.k.: ECU faulty Signal shape of ti signal (refer to page 108) 2) Open circuit, short to ground, short to positive Check wiring. ECU connector pin 21 to DME connector pin 3 (ground at ECU connector pin 7, positive at ECU connector pin 1) Connections o.k.: Check connection from T 16 to rev counter Connections o.k.: DME control unit faulty Figs. 1, 4

Fault, Fault code	Possible Causes, Elimination, Remarks
Test point 7 Throttle potentiometer Fault code 23	<p>Tiptronic warning lamp comes on, transmission is in emergency mode.</p> <p>Detectable faults: Open circuit/short to ground, short to positive</p> <ol style="list-style-type: none"> 1) Check throttle potentiometer with Tester 9288 (Actual values 100 % – 5 %) 2) Pull connector off ECU. Measure resistance between pin 44 and pin 8 (M prog.) or pin 27 (as of N prog.). <ul style="list-style-type: none"> – Measurement between approx. 0.5 and approx. 4 kΩ with throttle position between idle and full load. – Measurement o.k.: Check ground at ECU connector pin 7 – Check wiring of potentiometer pin 5 to ECU pin 44 O.k.: ECU faulty 3) Repeat resistance measurement at potentiometer (between pin 2 and pin 3). <ul style="list-style-type: none"> – Incorrect measurements: Potentiometer faulty 4) Check wiring (Throttle potentiometer pin 4 to ECU pin 8 (M prog.) or pin 27 (as of N prog.)) <ul style="list-style-type: none"> – Insert ECU connector. – Check ground at throttle potentiometer connector pin 2. – No ground: Check wiring (Throttle potentiometer pin 5 to ECU pin 44) <p>Figs. 1, 10</p>

Fault, Fault code	Possible Causes, Elimination, Remarks
Test point 8 Change of Ignition timing Fault code 24	<p>Tiptronic warning lamp comes on, transmission is in emergency mode.</p> <p>Possible faults: Open circuit, short to ground, short to positive</p> <ol style="list-style-type: none"> 1) Check operation with Tester 9288 (drive link test) <ul style="list-style-type: none"> – Idle speed drops during test. – Check coding plug at DME 2) Check voltage drop <ul style="list-style-type: none"> – Remove cover from plugged-in connector T41. – Switch on ignition – Measure voltage at pin 8. Nominal value approx. 5 volts – Trigger signal with Tester. Voltage must drop. – Operation o.k.: Check wiring to DME control unit (T 41 pin 8 to DME control unit pin 51). – Wiring o.k.: DME control unit faulty – Operation not o.k.: Check wiring to ECU (T 41 pin 8 to ECU pin 32). – Wiring o.k.: ECU faulty <p>Note: Check engine-to-body ground strap</p>

Figs. 1, 2, 5



Fault, Fault code	Possible Causes, Elimination, Remarks
Test point 9 Solenoid valve 1 Fault code 31	<p>Tiptronic warning lamp comes on, transmission is in emergency mode.</p> <p>Possible faults: Open circuit, short to ground, short to positive</p> <ol style="list-style-type: none"> 1) Check operation with Tester 9288 (drive link test) <ul style="list-style-type: none"> – Acoustical test Triggering cycle of valves is audible as a clicking noise near the transmission. 2) Pull connector off ECU. <ol style="list-style-type: none"> a) Measure resistance between pin 5 and pin 19. Nominal value 34 Ohms, tolerance 10 % b) Check that pins 5 and 19 are free from shorts to ground. <ul style="list-style-type: none"> – Check o.k.: ECU faulty 3) Also pull off connector at transmission. <ul style="list-style-type: none"> – Check wiring (ECU connector pin 5 to transmission connector pin H and ECU connector pin 19 to transmission connector pin M). – Wiring o.k.: Transmission faulty, refer to mechanical section <p>Figs. 1, 9</p> <p>Note: If a „sporadic solenoid fault“ occurs, check connections for pushed-back PINS.</p>
Test point 10 Solenoid valve 2 Fault code 32	<p>Tiptronic warning lamp comes on, transmission is in emergency mode.</p> <p>Possible faults: Open circuit, short to ground, short to positive</p> <ol style="list-style-type: none"> 1) Check operation with Tester 9288 (drive link test) <ul style="list-style-type: none"> – Acoustical check Triggering cycle of valves is audible as a clicking noise near the transmission. 2) Pull connector off ECU <ol style="list-style-type: none"> a) Measure resistance between pin 24 and pin 19. Nominal value 34 Ohms, tolerance 10 % b) Check that pins 24 and 19 are free from shorts to ground. <ul style="list-style-type: none"> – Check o.k.: ECU faulty 3) Also disconnect connector from transmission. <ul style="list-style-type: none"> – Check wiring (ECU connector pin 24 to transmission connector pin K and ECU connector pin 19 to transmission connector pin M). – Wiring o.k.: Transmission fault, refer to mechanical section <p>Figs. 1, 9</p>

Fault, Fault code	Possible Causes, Elimination, Remarks
Test point 11 Solenoid valve torque conv. clutch Fault code 33	<p>Tiptronic warning lamp comes on, transmission is in emergency mode.</p> <p>Possible faults: Open circuit, short to ground, short to positive</p> <ol style="list-style-type: none"> 1) Check operation with Tester 9288 (drive link test) <ul style="list-style-type: none"> - Acoustical check Triggering cycle of valves is audible as a clicking noise near the transmission. 2) Pull connector off ECU. <ol style="list-style-type: none"> a) Measure resistance between pin 42 and pin 19. Nominal value 34 Ohms, tolerance 10 %. b) Check that pins 42 and 19 are free from shorts to ground. <ul style="list-style-type: none"> - Check o.k.: ECU faulty 3) Also pull off connector at transmission. <ul style="list-style-type: none"> - Check wiring (ECU connector pin 42 to transmission connector pin L and ECU connector pin 19 to transmission connector pin M). - Wiring o.k.: Transmission fault, refer to mechanical section <p>Figs. 1, 9</p>
Test point 12 Pressure regulator Fault code 34	<p>Tiptronic warning lamp comes on, transmission is in emergency mode.</p> <p>Possible faults: Open circuit, short to ground, short to positive</p> <ol style="list-style-type: none"> 1) Pull connector off ECU <ol style="list-style-type: none"> a) Measure resistance between pin 6 and pin 19. Nominal value 6 Ohms \pm 2 Ohms b) Check pins 6 und 19 for freedom from shorts to ground. <ul style="list-style-type: none"> - Check o.k.: ECU faulty 2) Also pull off connector at transmission. <ul style="list-style-type: none"> - Check wiring (ECU connector pin 6 to transmission connector pin B and ECU connector pin 19 to transmission connector pin M). - Wiring o.k.: Transmission fault, refer to mechanical section <p>Figs. 1, 9</p>

Fault, Fault code	Possible Causes, Elimination, Remarks
<p>Test point 13</p> <p>Selector lever switch/transmission</p> <p>Fault code 35</p>	<p>Tiptronic warning lamp comes on, transmission is in emergency mode.</p> <p>Possible faults: Open circuit, short to ground, short to positive</p> <p>1) Check operation with Tester 9288</p> <p>Adjustment of Tester 9288: Menu: „Input signals“ = Selector lever/manual program</p> <p>Shift through selector lever positions P, R, N, D, 3, 2, 1 one after another.</p> <p>Compare: Selector lever position Position indicator in speedometer Position indicator on Tester 9288</p> <p>Caution:</p> <p>Due to its design, the display on Tester 9288 appears with a certain delay - shift through positions sufficiently slowly.</p> <p>No match: Check wiring according to wiring diagram, check position switch with/without wiring</p> <p>2) Disconnect ECU control unit connector, with the ignition turned off</p> <p>– Open up junction T 40</p> <p>Figs. 1, 6</p> <p>– Check ECU connector pin 26 for ground, using an ohmmeter</p> <p>– If no ground is present, refer to wiring diagram distributing point 1 and GP V</p>

Fault, Fault code

Possible Causes, Elimination, Remarks

3) Measure position switch according to table 1

Ohmmeter display – = no continuity
 0 = continuity

Table 1

	Pin 14	Pin 33	Pin 50	(N prog.) Pin 41 → to ground
P	–	–	0	0
R	0	–	0	0
N	0	–	–	--/0
D	0	0	–	–
3	0	0	0	–
2	–	0	0	–
1	–	0	–	–

- Measurements o.k. Control unit faulty
- Measurements present but wrong sequence?
- Check connection cable from selector lever switch to position switch
- Connection cable adjusted correctly?
- Repair instruction: "Adjust position switch"
- Open circuit, short to ground, short to positive?

4) Check position switch without connections

- Disconnect connector from position switch
- Check switch for continuity (Table 2)

Fig. 7

Ohmmeter display – = no continuity
 0 = continuity

Table 2

	Pin 4-1	4-2	4-3	5-6	7-8
P	–	–	0	0	0
R	0	–	0	–	0
N	0	–	–	0	--/0
D	0	0	–	–	–
3	0	0	0	–	–
2	–	0	0	–	–
1	–	0	–	–	–

- Fault? Replace position switch
- No fault: Check wirings from position switch to T 40, T 41

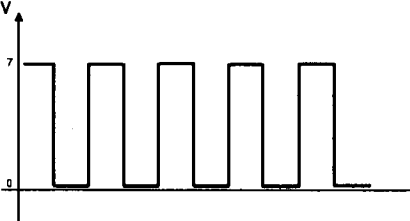
Fault, Fault code	Possible Causes, Elimination, Remarks
<p>Test point 14</p> <p>Speed sensor (transmission)</p> <p>The sensor transmits the transmission speed. ECU compares it to the wheel speed.</p> <p>Fault code 36</p>	<p>Tiptronic warning lamp comes on, transmission is in emergency mode.</p> <p>Possible faults: Open circuit, short to ground, short to positive, loose connection</p> <p>Note:</p> <p>Check with Tester 9288 (actual values). Store fault as of engine speed = 2800 rpm</p> <ol style="list-style-type: none"> 1) Pull connector off ECU <ol style="list-style-type: none"> a) Measure resistance between pin 2 and pin 38. Nominal value approx. 350 Ohms b) Check that pin 2 und pin 38 are free from shorts to ground. <ul style="list-style-type: none"> – Check o.k.: ECU faulty 2) Also pull off connector from transmission. <p>Check for continuity at ECU connector pin 2 to pin A Pin 38 to pin F</p> <p>Short to ground pin 2 und pin 38 to pin 7 (ground) Pin 2 und pin 38 to pin 20 (screening) Short to positive pin 2 und pin 38 to pin 1 (positive)</p> <p>Note:</p> <p>If it is to be assumed that intermittent faults linked to the output speed occur, the screening connection at pin 20 should be checked after opening the connector housing.</p> <p>Wiring o.k.: Check sensor and wiring in transmission</p> <p>Possible transmission faults: Oil strainer clogged, air intake if oil starvation occurs etc., power transmission interrupted.</p> <p>Figs. 1, 9</p>

Fault, Fault code	Possible Causes, Elimination, Remarks						
Test point 15 Transmission temperature sensor Fault code 37	<p>If a fault occurs, a replacement value = 60° C is assumed.</p> <p>Possible faults: Open circuit, short to ground, short to positive, corrupted signal</p> <p>Note:</p> <p>Existing faults are stored only when the engine is running.</p> <p>1) Check temperature with Tester 9288 (actual values)</p> <p>2) Pull connector off ECU</p> <p>Check resistance between pin 46 and pin 44</p> <p>Nominal value</p> <table><tr><td>approx.</td><td>1.00 kΩ/20° C</td></tr><tr><td></td><td>1.15 kΩ/40° C</td></tr><tr><td></td><td>1.30 kΩ/60° C</td></tr></table> <p>Check wiring.</p> <p>Check o.k.: ECU faulty</p> <p>Figs. 1, 9</p> <p>Note:</p> <p>If the display</p> <p>„Temperature sensor short to positive“</p> <p>and/or</p> <p>„Transv. acceleration sensor short to positive“</p> <p>appears, this may be due to a faulty control unit.</p> <p>1. Remove short circuit 2. Replace control unit.</p>	approx.	1.00 kΩ/20° C		1.15 kΩ/40° C		1.30 kΩ/60° C
approx.	1.00 kΩ/20° C						
	1.15 kΩ/40° C						
	1.30 kΩ/60° C						

Fault, Fault code	Possible Causes, Elimination, Remarks
<p>Test point 16</p> <p>Selector lever switch/transmission</p> <p>Fault code 38</p>	<p>Tiptronic warning lamp comes on, transmission is in emergency mode.</p> <p>Specification: Engine may be started in P or N positions only</p> <p>Actual status: Engine may also be started in other selector lever positions except P and N</p> <p>Possible faults: Open circuit, short to ground, short to positive</p> <p>Start possible, except P and N</p> <ol style="list-style-type: none"> 1) Check adjustment of bowden cable to position switch. <ul style="list-style-type: none"> – If required, run electrical test as described under Test point 14, item 4 – No start possible? 2) Pull off start relay R 61 in Central Electrical System <ul style="list-style-type: none"> – Ground must be present at relay base terminal 85 when the selector lever is set to P or N. – Ground present: Check start relay or ignition lock and related wiring – No ground: Check position switch and wiring to start relay 3) Check position switch as described under Test point 14, item 4 <ul style="list-style-type: none"> – Position switch o.k. <p>Check continuity:</p> <ol style="list-style-type: none"> a) Position switch pin 6 to Central Electrical System (start relay). b) Junction 40 pin 10 to DME connector pin 42 <ul style="list-style-type: none"> – Wiring o.k. Transmission-based starting requirements are met. <p>Figs. 2, 5, 6, 7</p>
<p>Test point 17</p> <p>Control unit faulty</p> <p>Fault code 42</p>	<p>Tiptronic warning lamp comes on, transmission is in emergency mode.</p> <p>Replace control unit</p>
<p>Test point 18</p> <p>Control unit faulty</p> <p>Fault code 43</p>	<p>Tiptronic warning lamp comes on, transmission is in emergency mode.</p> <p>Replace control unit</p>

Fault, Fault code	Possible Causes, Elimination, Remarks
Test point 19 Control unit faulty Fault code 44	Tiptronic warning lamp comes on, transmission is in emergency mode. Replace control unit
Test point 20 - 21 Downshift fault/ rev. limiter Fault code 45, 46	Tiptronic warning lamp comes on, transmission is in emergency mode. Possible faults: Corrupted rpm signal, from output or engine or output/engine rpm relationship Faulty transmission (clutch slips) 1) Check drive rpm sensor, Test point 14 2) Check transmission
Test point 22 Manual program switch Fault code 51	No manual program possible. Detectable faults: Short to ground 1) Check operation with Tester 9288 (Input signals) 2) Pull connector off ECU. Check ground at pin 26. Check connection from ECU/pin 48 to selector lever switch/pin 3 Connection o.k. Exchange selector lever switch unit Switch and connection o.k.: ECU faulty Figs. 1, 6, 8
Test point 23 Tip-switch up/down shifting Fault code 52	No manual program possible. Detectable faults: Short to ground 1) Check operation with Tester 9288 (Input signals) 2) Pull connector off ECU Check ground at pin 26 Check connection from ECU/pin 10 to selector lever switch/pin 2 (upshift) or connection from ECU/pin 29 to selector lever switch/pin 1 (downshift). Connection o.k. Replace selector lever switch unit Switch and connection o.k., ECU faulty Figs. 1, 8

Fault, Fault code	Possible Causes, Elimination, Remarks
Test point 24 Kick-down switch Fault code 53	<p>No kickdown shift.</p> <p>Detectable faults: Short to ground</p> <ol style="list-style-type: none"> 1a) Acoustical check of switch <ol style="list-style-type: none"> b) Check operation with Tester 9288 (Input signals - Test) 2) Remove and check kick-down switch (Note: Adjust switch after replacement) 3) Pull connector off ECU. <p>Check connection of ECU pin 30 to kick-down switch pin 2.</p> <p>Check o.k.: ECU faulty</p> <p>Figs. 1, 12</p>
Test point 25 Transverse acceleration sensor Fault code 54	<p>Upshifting in curves is not prevented.</p> <p>Detectable faults: Open circuit/short to ground, short to positive</p> <ol style="list-style-type: none"> 1) Check sensor with Tester 9288 (actual values) (Nominal value around 0 g with vehicle on level surface. Sensor can be checked by raising the vehicle on one side). 2) Remove connector from sensor. <p>Check sensor supply (5 V) to pin 3 and ground at pin 1.</p> <ol style="list-style-type: none"> 3) Check wiring according to wiring diagram <p>Check continuity from pin 45/ECU to pin 3/sensor</p> <p>Pin 40/ECU to pin 2/sensor</p> <p>Pin 44/ECU to pin 1/sensor</p> <p>Short to ground at pin 2 und pin 3/sensor to pin 7/ECU (ground)</p> <p>Short to positive: Pins 1, 2 and 3/sensor to pin 1/ECU (positive)</p> <p>Check ground connection of pin 44/ECU</p> <p>Wiring o.k.: Replace sensor</p> <p>Fault persists: ECU faulty</p> <p>Figs. 1, 11</p>

Fault, Fault code	Possible Causes, Elimination, Remarks
Test point 26 Speed signal 1 of ABS Fault code 55	<p>Upshifting is not prevented, no manual program</p> <p>Detectable faults: Open circuit/short to ground/short to positive</p> <ol style="list-style-type: none"> 1) Signal comes from ABS. ABS o. k.? 2) Check signal with Tester 9288, raising the vehicle and rotating right-hand front wheel manually. 3) Check wiring according to wiring diagram. <p>Check for continuity: Pin 12/ECU to ABS-SG/pin 23</p> <p>Short to ground: Pin 12 to pin 7/ECU (ground)</p> <p>Short to positive: Pin 12 to pin 1/ECU (positive)</p> <ol style="list-style-type: none"> 4) Check signal with oscilloscope (ECU connector pin 12) (Ignition on) <p>Speed signal</p> <p>Signal present: ECU faulty</p> <p>No signal: ABS faulty</p> <p>Figs. 1, 3</p> 
Test point 27 Combi-Instrument Input (Display as of M-program) Fault code 56	<p>No diagnosis possible.</p> <p>Detectable faults: Open circuit/short to ground, short to positive</p> <ol style="list-style-type: none"> 1) Turn manual program on and off Check display on instrument 2) Pull off ECU connector. Connect pin 13 to ground. Display o.k.: ECU faulty 3) Check wiring of ECU pin 13 to speedo pin 9. <p>Wiring o.k. Speedometer faulty</p> <p>Figs. 1, 14</p>

Fault, Fault code	Possible Causes, Elimination, Remarks
Test point 28 Oil cooler blower relay Fault code 57	Detectable faults: Short to positive 1) Turn cooler blower on and off using Tester 9288. (Drive links) Acoustical check 2) Check fuse No. 2 (Central Electrical System) 3) Disconnect oil cooler relay R 04. Shunt terminals 87 and 30 on relay base. Blower runs: Relay faulty Blower does not run: Check blower 4) Check connection of ECU/pin 49 to relay base/terminal 85. (Observe connection to A/C control unit). Wiring o.k.: ECU faulty Fig. 1
Test point 29 Switch R-position Fault code 59	Tiptronic warning lamp comes on, transmission is in emergency mode. Possible faults: Open circuit, short to ground, signal implausible 1) Ground must be present at pin 41 when the selector lever is set to the P and R positions. (N is possible due to overlaps) – No ground: Check wiring from ECU connector pin 41 to position switch connector pin 8. – Wiring o.k. Check position switch as described under Test point 14, item 4. Figs. 1, 7

Fault, Fault code	Possible Causes, Elimination, Remarks
Test point 30 Reverse light relay Fault code 60	<p>No diagnosis possible.</p> <p>Detectable faults: Open circuit/short to ground, short to positive</p> <ol style="list-style-type: none">1) Trigger reverse light relay with Tester 9288 (Drive links). The relay and the reverse lights must come on and go off in two-second intervals. (Acoustical check. Relay is located on the left-hand side behind the instruments).2) Disconnect fog light relay R 31 (Central Electrical System). (Note: Both R 31 and RFL relay are supplied via Si 14 and R 01.)<ul style="list-style-type: none">- Check voltage at terminal 30 of relay base.- No voltage: Check fuse 14 and relay R 01 (Central Electrical System).3) Pull connector off ECU. Short-circuit pin 25 to ground (pin 7). Does reverse light relay pick up? ECU faulty4) Pull off reverse light relay. Check voltage at terminal 30 of relay base. Check connection of ECU/pin 25 to relay base/terminal 85. Wiring o.k.: Relay faulty <p>Fig. 1</p>

Troubleshooting the Tiptronic transmission (mechanical/hydraulic section)

Introduction

The below troubleshooting chart for the mechanical/hydraulic section of the Tiptronic is designed as a guideline for repair operations.

The faults have been arranged in the way they are usually indicated by the customers. Deviations of the descriptions are possible and should be completed accordingly by the service personnel.

If complaints about leaks are received it is recommended to determine the location of the leak as closely as possible before any sealing operations are started. Crack testing agents such as

Spot - Check or Met-L-Check

are suitable for this purpose. These products are marketed as spray cans and allow positive identification of the leak after a short test drive.

Troubleshooting procedure: Proceed in the sequence of the selector lever positions, starting with

1. Position P	Page D 38 - 103
2. Position R	Page D 38 - 103
3. Position N	Page D 38 - 105
4. Position D	Page D 38 - 105
5. Position 3, 3rd gear	Page D 38 - 108
6. Position 2	Page D 38 - 108
7. Position 1	Page D 38 - 108
8. Torque conv. clutch	Page D 38 - 108
9. General	Page D 38 - 109
10. Leaks	Page D 38 - 110
11. Noises	Page D 38 - 111

Clutches, brakes and freewheels applied in the individual gears

Selector lever position	Gear	Clutches				Brakes				Freewheels		
		A	B	E	C'	C	D	F	1st gear	2nd gear	3rd gear	
D	1.	X		X						X		X
D	2.	X		X	X	X					X	X
D	3.	X	X	X		X						X
D	4.	X	X			X		X				
3	1.	X		X						X		X
3	2.	X		X	X	X					X	X
3	3.	X	X	X		X						X
2	1.	X		X						X		X
2	2.	X		X	X	X					X	X
*1	1.	X		X				X		(X)		X
R	R		X	X				X				

* engine brake effective in overrun mode

This overview allows the components affected to be located if mechanical damage has occurred.

Troubleshooting mechanical/hydraulic section

(Causes indicated in italics are located in the HCU)

Fault	Possible cause	Remedy
1. Position P		
1.1 Parking position does not engage	<ul style="list-style-type: none"> Shift cable between shift lever and transmission adjusted incorrectly Excessive friction in parking lock mechanism 	<ul style="list-style-type: none"> Correct adjustment Replace parking lock components (linkage rod, pawl) or make them operative again
1.2 Parking position does not remain engaged (jumps out of gear)	<ul style="list-style-type: none"> Shift cable between shift lever and transmission adjusted incorrectly 	<ul style="list-style-type: none"> Correct adjustment
1.3 Engine cannot be started	<ul style="list-style-type: none"> Position switch adjusted incorrectly Position switch faulty 	<ul style="list-style-type: none"> Correct adjustment Replace position switch Refer to diagnosis item 16
2. R Position		
2.1 No reverse gear	<ul style="list-style-type: none"> Shift cable between shift lever and transmission adjusted incorrectly <i>Reverse lock remains operative</i> Oil strainer clogged Clutch B destroyed. No third gear is therefore available Brake D destroyed. No engine brake effect is therefore available in position 1, 1st gear Clutch E destroyed. Hence no engine brake effect in 2nd and 3rd gear as well as in position 1, 1st gear 	<ul style="list-style-type: none"> Correct adjustment <i>Replace HCU</i> Refer to item 11.2 Replace transmission* Replace transmission* Replace transmission*

* Repair possible if ATF fluid does not contain excessive dirt; otherwise replace transmission.

Fault	Possible cause	Remedy
2.2 Poor power transmission	<ul style="list-style-type: none"> • <i>Pressure in clutch B or E or brake D is too low</i> 	<ul style="list-style-type: none"> • <i>Replace HCU</i>
2.3 Slipping or judder when moving off	<ul style="list-style-type: none"> • Clutch B or E or brake D damaged 	<ul style="list-style-type: none"> • Repair or replace transmission*
2.4 Hard, bumpy engagement of P-R or N-R or clearly noticeable double shock during P-R or N-R shifts	<ul style="list-style-type: none"> • Idle speed too high • <i>Damper B faulty. In this case, 2-3 shift operations will also be impaired</i> • <i>Modulating pressure excessively high</i> • Rectangular rings on cylinder F/hub E side leaky 	<ul style="list-style-type: none"> • Adjust engine • <i>Replace HCU</i> • Check TE • Refer to diagnosis item 13 • <i>Replace HCU</i> • Replace transmission
2.5 Reverse light does not light (electrical system o.k.)	<ul style="list-style-type: none"> • Position switch adjusted incorrectly • Position switch faulty 	<ul style="list-style-type: none"> • Correct adjustment • Replace position switch • Refer to diagnosis item 14
2.6 No reverse and no forward gear	<ul style="list-style-type: none"> • <i>Main pressure valve stuck</i> • <i>Main pressure valve spring broken</i> 	<ul style="list-style-type: none"> • <i>Replace HCU</i>
2.7 Vibrations in reverse gear	<ul style="list-style-type: none"> • Torque converter out of balance 	<ul style="list-style-type: none"> • Replace torque converter

* Repair possible if ATF fluid does not contain excessive dirt; otherwise replace transmission.

Fault	Possible cause	Remedy
3. N Position		
3.1 Engine cannot be started	<ul style="list-style-type: none"> • Position switch adjusted incorrectly • Position switch faulty 	<ul style="list-style-type: none"> • Correct adjustment • Replace position switch • Refer to diagnosis item 17
3.2 Vehicle moves off or creeps	<ul style="list-style-type: none"> • Shift cable between shift lever and transmission adjusted incorrectly • Clutch A faulty (welded up) • Second rectangular ring on turbine shaft faulty 	<ul style="list-style-type: none"> • Correct adjustment • Replace transmission* • Seal
4. D Position		
4.1 No power flow	<ul style="list-style-type: none"> • Shift cable between shift lever and transmission adjusted incorrectly • Oil strainer clogged • <i>Main pressure valve stuck</i> • <i>Main pressure valve spring broken</i> • Clutch A faulty • 1st gear freewheel slipping 	<ul style="list-style-type: none"> • Correct adjustment • Refer to item 11.2 • <i>Replace HCU</i> • <i>Replace HCU</i> • Replace transmission* • Replace transmission*
4.2 Poor power transmission	<ul style="list-style-type: none"> • <i>Pressure in clutch A too low</i> 	<ul style="list-style-type: none"> • <i>Replace HCU</i>

* Repair possible if ATF fluid does not contain excessive dirt; otherwise replace transmission.

Fault	Possible cause	Remedy
4.4 Slipping or judder when moving off	<ul style="list-style-type: none"> Clutch A damaged 	<ul style="list-style-type: none"> Repair or replace transmission*
4.5 Hard, jerky engagement of N-D	<ul style="list-style-type: none"> Idle speed excessively high <i>Damper A defective</i> Clutch A damaged 	<ul style="list-style-type: none"> Adjust engine <i>Replace HCU</i> Repair or replace transmission*
4.6 Knocking noise in N position	<ul style="list-style-type: none"> Torque converter out of balance 	<ul style="list-style-type: none"> Fit torque converter offset by 180° with regard to driver plate
4.7 No shift 1-2/2-1	<ul style="list-style-type: none"> <i>Shift valve 1-2 stuck</i> <i>Pressure reducer valve 1 stuck</i> Brakes C' and C damaged 	<ul style="list-style-type: none"> <i>Replace HCU</i> Repair or replace transmission*
4.8 No shift 2-3/3-2	<ul style="list-style-type: none"> <i>Shift valve 2-3 stuck</i> Clutch B damaged 	<ul style="list-style-type: none"> <i>Replace HCU</i> Repair or replace transmission*
4.9 No shift 3-4/4-3	<ul style="list-style-type: none"> <i>Shift valve 3-4 stuck</i> Brake F damaged 	<ul style="list-style-type: none"> <i>Replace HCU</i> Repair or replace transmission*
4.10 Vehicle moves off in 2nd gear	<ul style="list-style-type: none"> <i>Shift valve 1-2 stuck</i> 	<ul style="list-style-type: none"> <i>Replace HCU</i>
Vehicle moves off in 3rd gear	<ul style="list-style-type: none"> <i>Shift valve 1-2 and 2-3 stuck</i> 	<ul style="list-style-type: none"> <i>Replace HCU</i>
Vehicle shifts from 1st into 3rd	<ul style="list-style-type: none"> <i>Shift valve 2-3 stuck</i> 	<ul style="list-style-type: none"> <i>Replace HCU</i>

* Repair possible if ATF fluid does not contain excessive dirt; otherwise replace transmission.

Fault	Possible cause	Remedy
4.11 Shift rpm		
Zero-load shift not o.k.	<ul style="list-style-type: none"> • Throttle potentiometer adjustment 	<ul style="list-style-type: none"> • Refer to diagnosis item 7
Shift point not o.k.	<ul style="list-style-type: none"> • Throttle potentiometer adjustment 	<ul style="list-style-type: none"> • Refer to diagnosis item 7
No kickdown shift	<ul style="list-style-type: none"> • Kickdown switch faulty 	<ul style="list-style-type: none"> • Check switch, replace if required
4.12 Shift progressions		
Zero-load shifts excessively hard	<ul style="list-style-type: none"> • <i>Modulating pressure excessively high</i> • <i>Damper faulty</i> • <i>Friction discs damaged</i> 	<ul style="list-style-type: none"> • <i>Replace HCU</i> • <i>Replace HCU</i> • <i>Replace transmission*</i>
4.13 Shifts too lengthy 1-2/2-3/3-4		
Full-load and kickdown shifts too lengthy	<ul style="list-style-type: none"> • <i>Damper faulty</i> • <i>Modulating valve binding</i> • <i>Pressure reducer valves 1 and 2 binding</i> 	<ul style="list-style-type: none"> • <i>Replace HCU</i> • <i>Replace HCU</i> • <i>Replace transmission*</i>
4.14 Upshifts 1-2/2-3/3-4 too hard		
Full-load and kickdown shifts too hard	<ul style="list-style-type: none"> • <i>Modulating pressure too low</i> • <i>Damper damaged</i> • <i>Friction discs damaged</i> 	<ul style="list-style-type: none"> • <i>Replace HCU</i> • <i>Replace HCU</i>
4.15 Downshift 4-3 too hard		
Full-load and kickdown shifts too hard	<ul style="list-style-type: none"> • <i>Modulating pressure not o.k.</i> • <i>Damper damaged</i> 	<ul style="list-style-type: none"> • <i>Replace HCU</i> • <i>Replace HCU</i>
4.15 Downshift 4-3 too hard	<ul style="list-style-type: none"> • <i>Draining baffle F clogged</i> 	<ul style="list-style-type: none"> • <i>Replace HCU</i>

* Repair possible if ATF fluid does not contain excessive dirt; otherwise replace transmission.

Fault	Possible cause	Remedy
5. Position 3, 3rd gear		
5.1 No engine braking effect 4-3	<ul style="list-style-type: none"> • <i>Damper E faulty</i> • Clutch E damaged 	<ul style="list-style-type: none"> • <i>Replace HCU</i> • Replace transmission*
6. Position 2		
6.1 Manual downshift 3-2 not o.k.	<ul style="list-style-type: none"> • <i>Shift valve 2-3 stuck</i> • <i>Damper C' faulty</i> 	• <i>Replace HCU</i>
6.2 No engine braking effect	<ul style="list-style-type: none"> • Brake C' or clutch E damaged 	• Replace transmission*
7. Position 1		
7.1 Manual downshift 2-1 not o.k.	<ul style="list-style-type: none"> • <i>Shift valve 1-2 stuck</i> • <i>Damper D faulty</i> • <i>Modulating valve binding</i> 	• <i>Replace HCU</i>
7.2 No engine braking effect	<ul style="list-style-type: none"> • Brake D or clutch E damaged 	• Replace transmission*
8. Torque converter clutch		
8.1 Shift progressions too harsh	<ul style="list-style-type: none"> • <i>Torque converter clutch damper faulty</i> • Torque converter not o.k. 	<ul style="list-style-type: none"> • <i>Replace HCU</i> • Replace torque converter
8.2 No converter clutch shift	<ul style="list-style-type: none"> • <i>Shift slide for torque converter stuck</i> • Torque converter faulty 	<ul style="list-style-type: none"> • <i>Replace HCU</i> • Replace torque converter

* Repair possible if ATF fluid does not contain excessive dirt; otherwise replace transmission.

Fault	Possible cause	Remedy
8.3 Torque converter clutch always closed (engine stalls in driving position)		<ul style="list-style-type: none"> • <i>Replace HCU</i>
8.4 Power flow during or after starting	<ul style="list-style-type: none"> • Torque converter clutch faulty 	<ul style="list-style-type: none"> • Replace torque converter
9. General		
9.1 Noises are audible after longer driving periods and power flow is interrupted subsequently	<ul style="list-style-type: none"> • Oil strainer of HCU clogged 	<ul style="list-style-type: none"> • If no burnt clutch lining is present in the oil pan, only the oil strainer requires replacing. Replace transmission in all other cases.
9.2 No forward or rear power flow, heavy noises	<ul style="list-style-type: none"> • Driver plate between torque converter and engine torn off • Pump driver torn 	<ul style="list-style-type: none"> • Replace driver plate or torque converter, respectively • Replace transmission*
9.3 Engine is stalled when braking heavily to standstill	<ul style="list-style-type: none"> • <i>Torque converter valve faulty</i> • Torque converter quick-opening feature (only standardized as of M-program) 	<ul style="list-style-type: none"> • <i>Replace HCU</i> • Install M program ECU
9.4 Power flow is interrupted during heavy braking and subsequent acceleration	<ul style="list-style-type: none"> • Transmission with old type of oil strainer (prior to transmission No. 1850) 	<ul style="list-style-type: none"> • Fit oil strainer with pickup tube (standard as of transmission No. 1850)

* Repair possible if ATF fluid does not contain excessive dirt; otherwise replace transmission.

Fault	Possible cause	Remedy
10. Leaks		
10.1 Oil drips from torque converter bell housing	<ul style="list-style-type: none"> • Seal in pump housing damaged • Pump housing leaky • Torque converter leaks at weld joint 	<ul style="list-style-type: none"> • Replace oil seal • Replace pump assy. • Replace torque converter
10.2 Leaks between transmission housing and oil sump	<ul style="list-style-type: none"> • Oil sump mounting bolts not tightened to specified torque • Oil sump gasket damaged 	<ul style="list-style-type: none"> • Retighten bolts • Replace gasket
10.3 Leaks between intermed. plate and transmission housing (particularly in pump pressure hole area)	<ul style="list-style-type: none"> • Torque converter bell housing mounting bolts have worked loose 	<ul style="list-style-type: none"> • Retighten bolts
10.4 Oil loss at transmission connector	<ul style="list-style-type: none"> • O-ring damaged 	<ul style="list-style-type: none"> • Replace O-ring
10.5 Oil loss on output end	<ul style="list-style-type: none"> • Shaft seal on output side damaged 	<ul style="list-style-type: none"> • Replace oil seal
10.6 Oil loss across or at breather	<ul style="list-style-type: none"> • Oil level too high • Incorrect oil (excessive foaming) • Breather cover missing • O-ring at breather damaged • Lock washer preload insufficient 	<ul style="list-style-type: none"> • Correct oil level • Change oil, remove transmission if required and drain complete with torque converter • Refit cap or replace breather as required • Replace O-ring • Replace lock washer
10.7 Oil loss at cooler line	<ul style="list-style-type: none"> • Bolt connection has worked loose • Cooler pipe damaged • Cooler leaky 	<ul style="list-style-type: none"> • Retighten bolts • Replace cooler pipe • Replace cooler

Fault	Possible cause	Remedy
10.8 Oil loss at intermediate plate	<ul style="list-style-type: none"> • Plug at intermediate plate is leaking 	<ul style="list-style-type: none"> • Retighten plug • Replace seals
10.9 Leaks between transmission housings	<ul style="list-style-type: none"> • Mounting bolts have worked loose • Gasket damaged 	<ul style="list-style-type: none"> • Retighten bolts • Replace gasket
10.10 Oil loss at rear axle breather	<ul style="list-style-type: none"> • Oil level excessively high • Oil buildup in housing area of long joint flange 	<ul style="list-style-type: none"> • Correct oil level
11. Noises		
11.1 High-pitched noise in all shift positions, particularly while oil is cold. Oil pump intake noise	<ul style="list-style-type: none"> • Oil level too low • <i>HCU leaky</i> • Pump bushing has seized 	<ul style="list-style-type: none"> • Correct oil level • <i>Replace HCU</i> • Replace pump
11.2 High-pitched, chirping noise varying with rpm in all shift positions, particularly when engine is hot, may appear after longer driving periods, sometimes in conjunction with interruption of power flow	<ul style="list-style-type: none"> • Oil strainer clogged 	<ul style="list-style-type: none"> • Replace oil strainer if no friction lining residues are found in the oil sump. Replace the complete transmission assy. in all other cases.
11.3 Heavy noise when torque converter clutch is closed	<ul style="list-style-type: none"> • Torsion damper faulty 	<ul style="list-style-type: none"> • Replace torque converter
11.4 Noises in reverse	<ul style="list-style-type: none"> • Pump bushing has seized 	<ul style="list-style-type: none"> • Replace pump

