Repair Manual

911 Carrera (993)

Volume I:
General
Engine

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Technical data

(Adjusting values and wear limits are included in the respective repair groups)

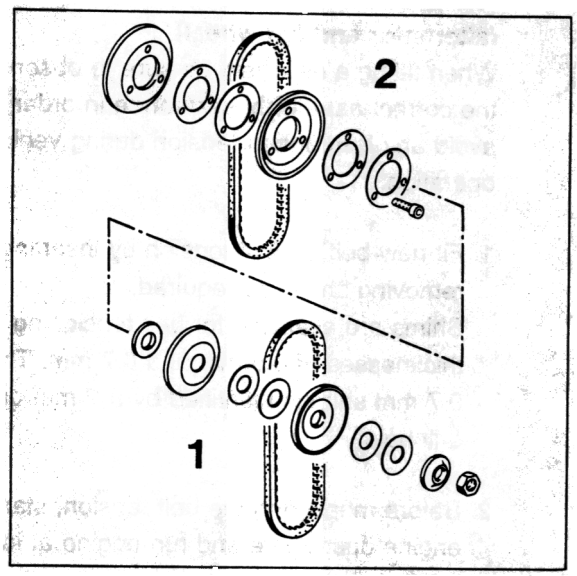
Note: U.S. values are given in brackets

Drive unit

Internal engine designation	Manual transm. Tiptronic	Row M 64 / 05 Row M 64 / 06	USA 07 USA 08
No. of cylinders		6	
Bore	mm/in.	100 (3.94)	
Stroke	mm/in.	76.4 (3.01)	
Displacement (actual)	c.c./cu.in.	3600 (219.7)	
Compression ratio		11.3 : 1	
Max. engine power to 80/1269 EEC Net Power, SAE J 1349 at engine speed	 kW/HP kW(HP) rpm	 200 / 272 200 (270) 6100	
Max. torque to 80/1269 EEC Net Torque, SAE J 1349 at engine speed	 Nm/kpm Nm(lbft) rpm	 330/33.6 330 (243) 5000	
Max. specific power output DIN 70020 SAE J 1349	 kW/l/HP/l kW/l (HP/l)	 55.6 / 75.6 55,6 (75,0)	
Rpm limiter, fuel cutoff at Idle speed Fuel octane rating	 rpm rpm RON/MON	 6700 800 ± 40 98/88	
Engine weight (dry, ready for fitting)			
Manual transmission	kg (lbs)	232 (511)	
Tiptronic	kg (lbs)	224 (494)	

General adjustment notes

Fan wheel and alternator have separate drives.



1863-27

1 = Alternator drive components
2 = Fan wheel drive components

Adjusting the V-belts

1. Use polygon wrench (999 571 052 02) to lock shaft and undo hexagon head nut. Remove shims and pulley half.

2. If belt tension is below specification, remove one shim from between pulley halves and refit in front of front pulley half. Tighten hexagon head nut to 50 ± 5 Nm.

3. Three additional M 6 screws have to be undone for V-belt and fan wheel.

4. Use only V-belts that have been approved by the manufacturer.

Note

Rotate engine only at lower belt pulley or by operating the starter. After completing all operations, check to make sure that hexagon head nut has been tightened sufficiently on alternator shaft.

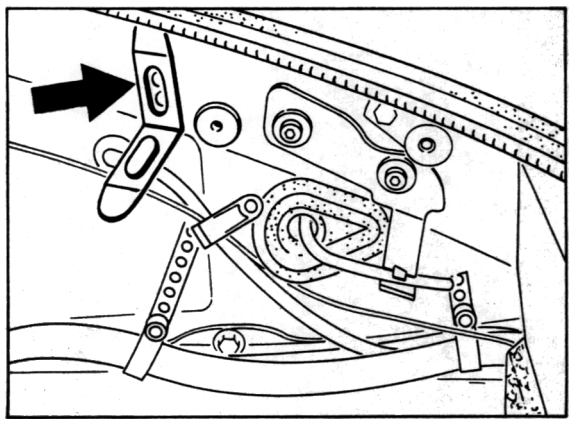
Checking operation of lighting system:

Adjusting headlights

1. Open trunk lid.

2. Remove trunk mat from wheel housing wall.

3. Open cover for headlight adjusting screws.



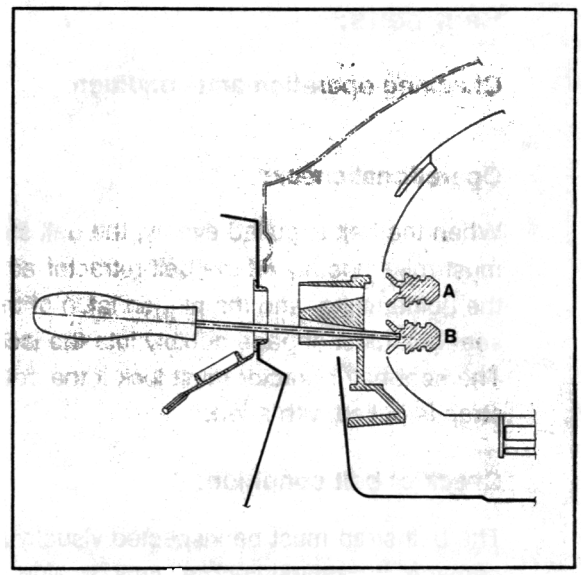
1586-03

4. Clean lens and switch on dipped beam.

5. The vehicle must be placed on a level surface. Using a headlight aiming device, adjust headlights with vehicle in roadworthy condition (full fuel tank, driver's seat occupied or loaded with 75 kgs, tires inflated to correct pressure).

Note

Adjust headlights with control switch set to the 0 position. (headlight beam adjuster).



1585-03

A - Lateral and vertical adjustment
B - Vertical adjustment

Use a standard 5 mm ball socket screwdriver for adjustment.

Changing the brake fluid (hydraulic brake booster)

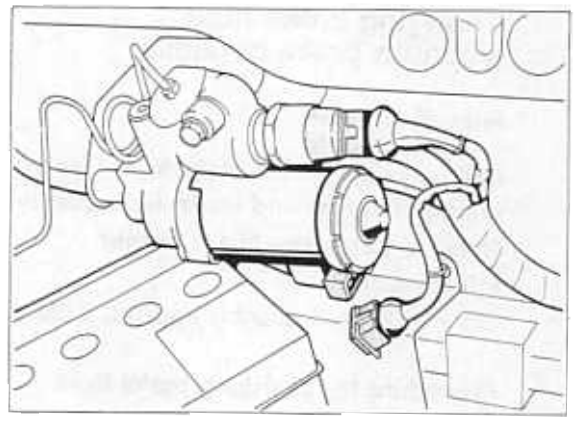
Important notes

Use only new DOT 4 brake fluid. **Observe correct fluid change intervals and fluid grade. Refer to page 03 - 11 for further information**
Total brake fluid quantity for brake fluid change **approx. 1.6 liters.**

Brake fluid change procedure

Important notes

Depressurize booster circuit before changing the brake fluid.
Do not depressurize by actuating the brake pedal but rather at the bleeding valve of the pressure accumulator. This will allow part of the old brake fluid to be drained.
Caution: Start by filling the accumulator completely (with ignition key in position 1, actuate brake pedal until pump starts to run). After the pump has switched off, **pull off electrical connector** and release pressure completely from accumulator vent valve. **Open bleeder valve slowly and keep bleeder hose in place.**
Caution: A pressure of up to 180 bar is present in the system.
Wear goggles and protective gloves!



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To allow the brake fluid to be changed in a rapid and practical manner, a filling and bleeding device should be used.

If the booster circuit has not been depressurized completely, do not actuate the brake pedal while the bleeder device is connected.

Changing the brake fluid: 1st step

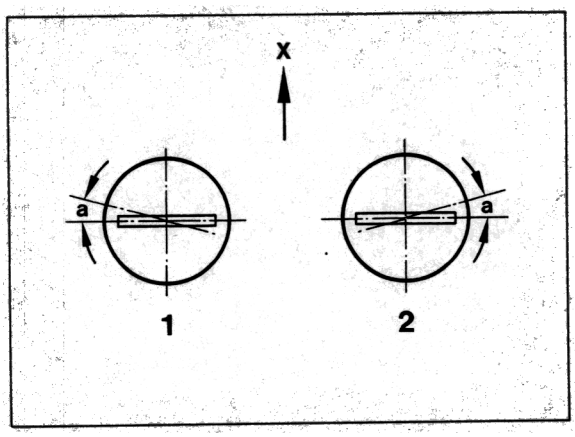
With the booster circuit depressurized, top up with fresh brake fluid to upper edge of reservoir. **Connect bleeder device to reservoir.**
Clamp shut overflow hose/venting hose with a hose clamp. The overflow hose/venting hose has been omitted as from October 1995; see Technical Information, Group 4, No. 16/95
Switch on bleeder device. Bleeding pressure: approx. 1.5 bar.

8. Put the engine compartment rubber seal between body and engine paneling in place correctly before installing the engine/ transmission unit in its final position.

9. Make sure the inner rubber seals of the connectors fit correctly.

10. Fit lid of assembly bores of engine suspension:

    Put the metal lid in place from below. The holding brackets on the lids must face upwards into the engine compartment. As shown in the figure, the holding brackets must be positioned at a right angle to the direction of travel in the "a" area. Only in this area is a tight fit ensured.



2149-10

1 = Lid left
2 = Lid right
a = 5 mm dimension - installation area

Assembly notes

Sealing the crankcase mating sections

Use only **Loctite 574** to seal.

Loctite 574 hardens only when contact with metal is made and air ingress is prevented. After having applied the sealant, bolt up the crankcase sections within approx. 10 minutes since the sealant bead applied directly to the metal surface will otherwise start to cure.

Removing old sealant

In case of repairs, the old sealant coat must not necessarily be removed. It is sufficient to de-grease the surface and apply the new coat of sealant after the solvent has evaporated.

New Loctite will soften the old sealant embedded in the machining marks and will cure after assembly.

Should it be required to remove the old sealant, it isrecommended to use a fine-mesh wire brush or Loctite adhesive remover 80646.

Applying sealant

1. For manual application, it is recommended to use a short-pile paint roller and to pour the sealant into a dish with grooves at its circumference (for squeezing excess sealant off the roller).

2. Apply a uniform coat of Loctite 574 sealant to the left-hand crankcase section using the paint roller. Use a small paint brush to apply sealant to the areas around the bolt holes.

Grind running surfaces for oil seals to 29.670 and 89.580 sizes only if score marks are too deep.
In other cases, repolish if required, Rt = 3.

Oil bores are rounded to R 0.5 after grinding.

Remove sharp edges with R = 0.2...0.5.

Max. permissible radial runout relative to support in-.-.-max. 0.04.

Surface treatment requirements: Gas carbonitrided PN 2063.

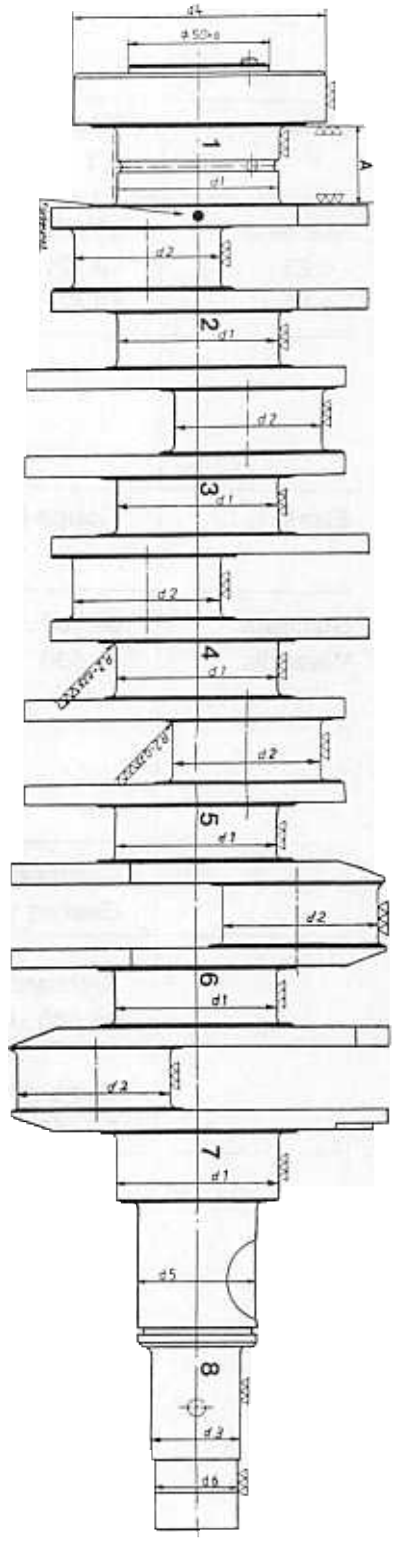
Do not straighten main bearings 3 and 5 after nitriding treatment.

Straightening the other main bearing by levering at the radii is permissible.

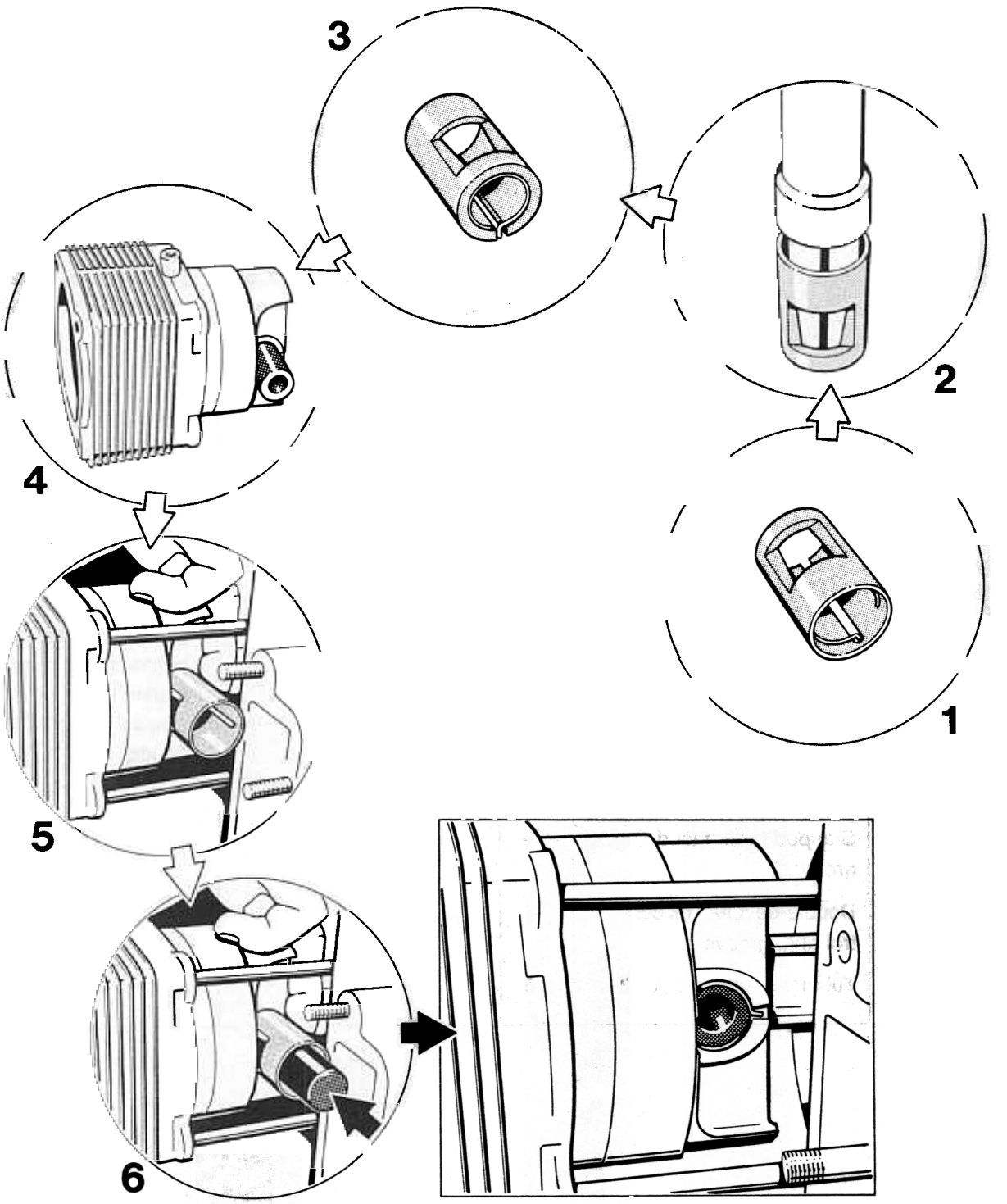
Running surfaces of main and big end bearing journals are polished after nitriding treatment.

Color coding or repair sizes:

1st repair size	blue dot
2nd repair size	green dot



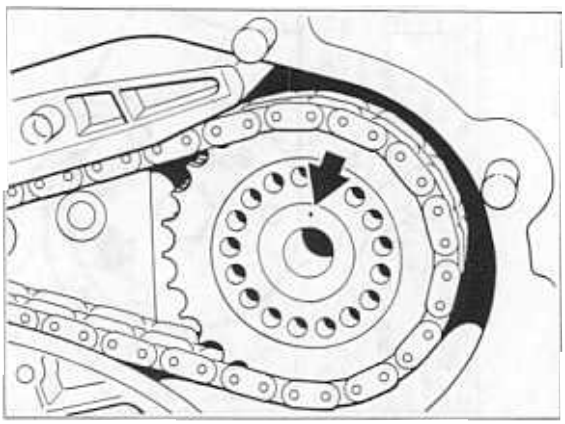
13 10 37 Dismantling and assembling pistons and cylinders



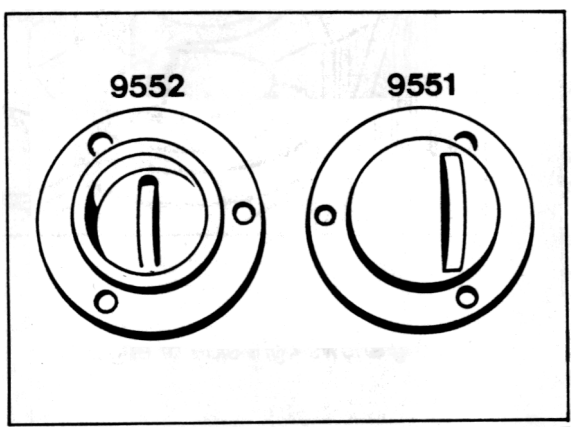
5. Turn both camshafts until punch mark faces up.

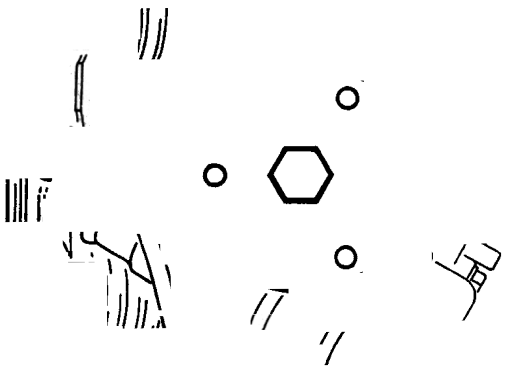
Note

If the mark is missing, rotate camshafts until woodruff key groove points up.



6. The camshafts may be aligned and rotated from the front (flywheel end) using Special Tools (locking devices) 9551 or 9552, respectively.

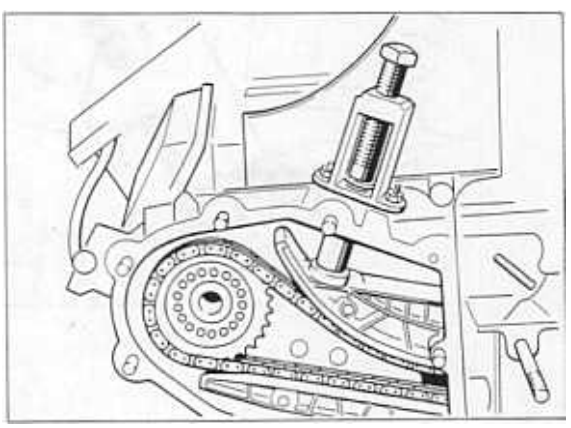




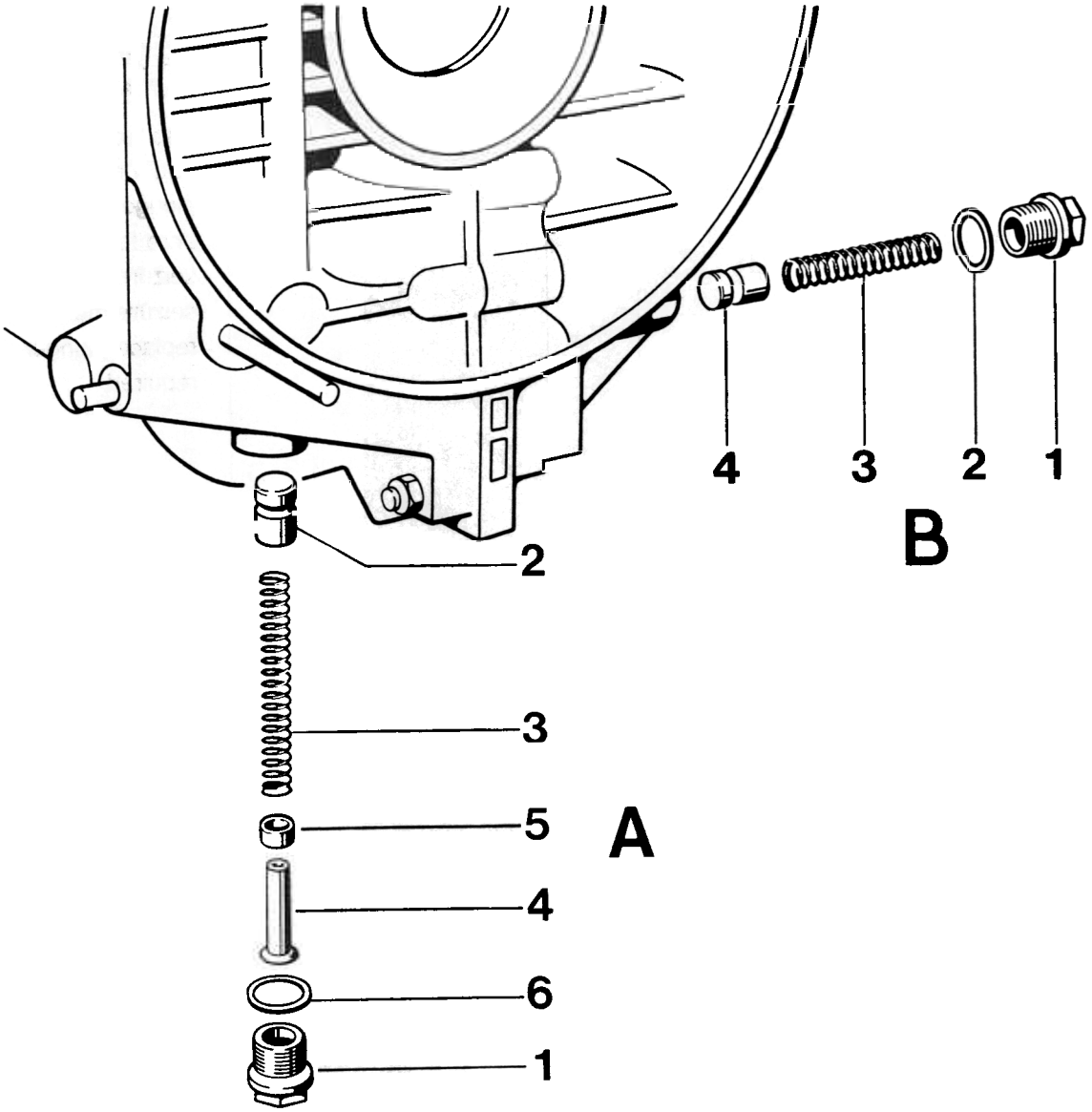
7. When the Z 1 mark on the pulley has been aligned with the seam and when the punch marks or woodruff key groove, respectively, point up, the engine is in the basic firing TDC for cylinder No. 1 and the overlap TDC for cylinder No. 4.

8. Fit auxiliary chain tensioner (Special Tool 9401).

Figure shows left-hand side of auxiliary chain tensioner



17 26 38 Removing and installing pressure regulating valves (Pressure relief valves)



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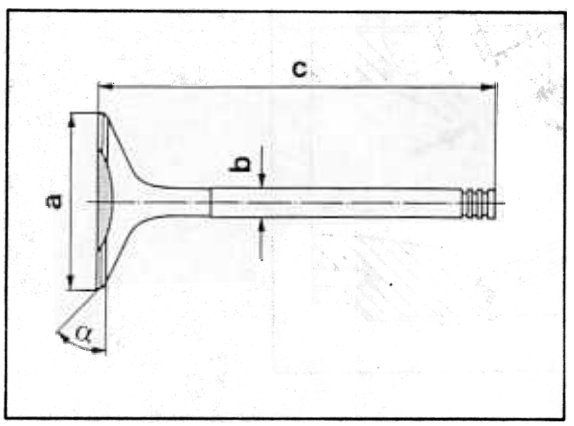
15 62 04 Measuring the valves

Valve dimensions
911 Carrera RS (values in brackets)

Inlet valve

Dimension	Inlet valve (sodium-filled)
a	49 ± 0.1 mm (51,5 ± 0,1 mm)
b	7.970 - 0.012 mm
c	110.1 ± 0.1 mm
α	45°

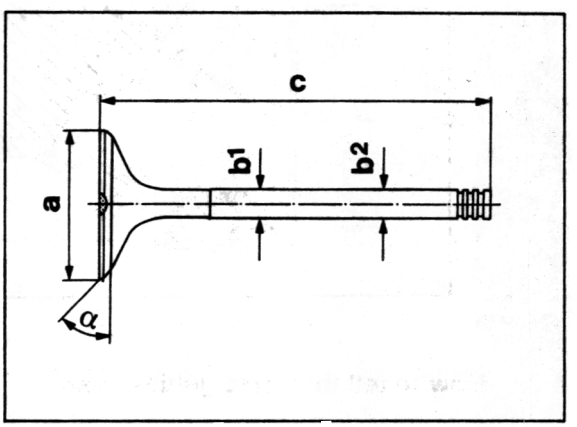


1770 - 15

The intake valves of the 911 Carrera (993) and the 911 Carrera RS are sodium-filled!

Exhaust valve

Dimension	Exhaust valve (b^1 - b^2 = tapered)
a	42.5 ± 0.1 mm (43.5 ± 0,1 mm)
b1	7.950 - 0.012 mm ((7.940 - 0.012 mm)
b^2	7.970 - 0.012 mm (7.960 - 0.012 mm
c	109 ± 0.1 mm
α	45°



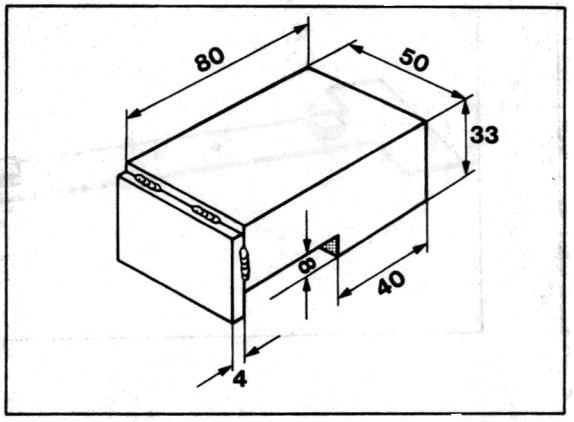
1771 - 15

The exhaust valves of the 911 Carrera RS are sodium-filled!

No.	Designation	Qty.	Note: Removal	Installation
29	Tensioning rail	1		Tensioning rail must engage audibly into groove in retaining stud
30	Lock nut	5		
31	Washer 8.4 x 18 x 3	5		
32	Chain housing (right-hand side)	1		Check O-ring seating area (No. 22) and deburr if required
33	Gasket	1		Must always be replaced. **Coat both sides with Loctite 574**
34	Collar pin	9		Tightening torque **7 Nm** (5 ftlb.), glued into place with **Loctite 270**
35	Stud 6 x 18	2		Bonded in with **Loctite 270**
36	Lock nut	2		Replace if required
37	Washer 6.4 x 14 x 3	2		
38	Flange (bridge)	1		
39	Seal 6 x 25	1		Replace
40	Sleeve	1		
41	Seal 6.7 x 3.53	2		Replace
42	Stud M 6 x 20	1		Bonded in with **Loctite 270**

Auxiliary support for Special Tool 9111/3, attach engine mounting plate

The auxiliary support should be fabricated in the shop



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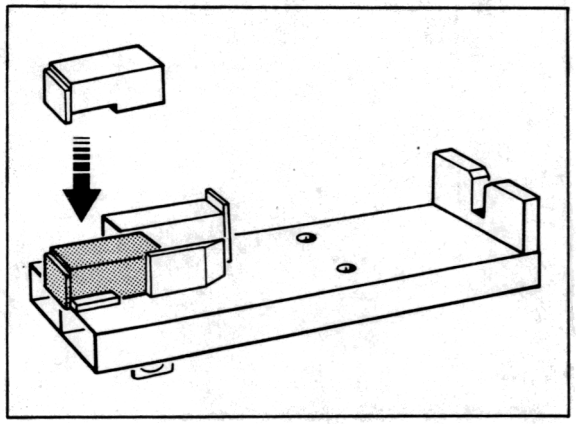


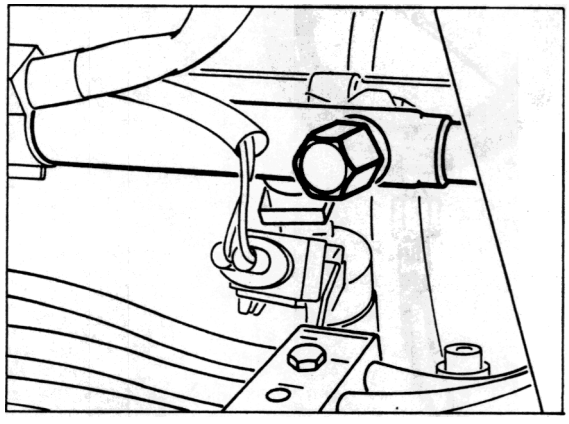
1776-10

20 02 01 Checking fuel pressure

1. Remove heater fan from left-hand rear engine compartment area.

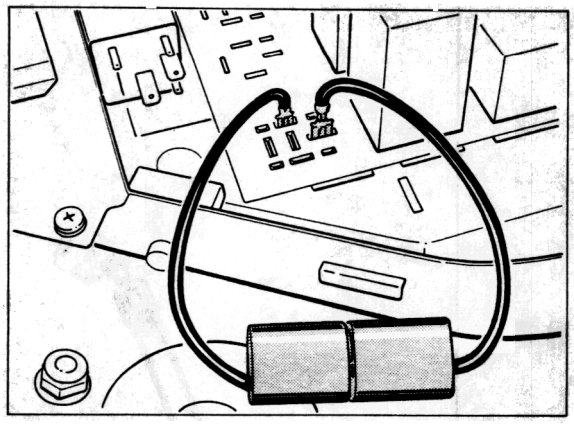
2. Detach cap from fuel collection pipe test connector and take off cap.

3. Connect pressure gauge of pressure measuring device **P 378** or VW 1318 to connecting line **9559** and connect to test connector.



1743-20

4. Pull DME relay (R53) off the Central Electrical System and use a fuse-protected shop-made jump lead to connect pin 30 to pin 87 b (identifications 3 and 7 on Central Electrical System). The fuel pump should now operate.



1728-20

4. Test specifications:

Engine switched off	**3.8 ± 0.2 bar**
Engine idling	**3.3 ± 0.2 bar**

Caution

The plastic cap at the test connector must always be replaced by a new brass cap (Part No. 993.110.218.01).

The seal in the brass cap **cannot** be replaced. The brass cap must therefore be used only **once**.

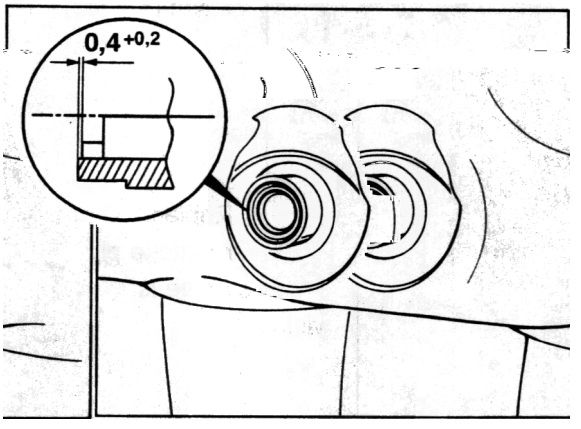
Tighten new brass cap to 2.5 + 0.5 Nm (1.8 + 0.4 ftlb).

Installation instructions

Install shaft seal ring for forked rocker of slide valve.

Installation

The closed side must face the intake pipe, i.e. the open side must be visible.
Ensure that the seal ring is pressed in to the correct depth.

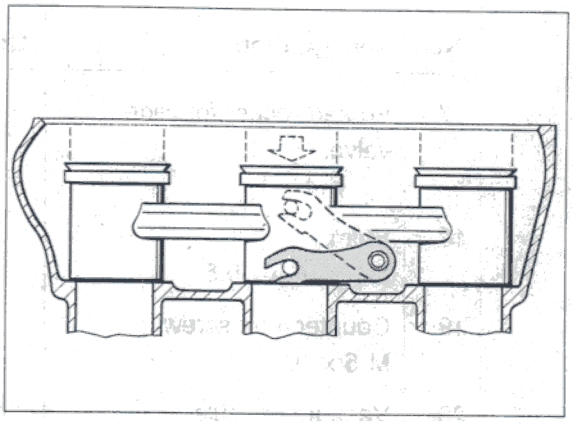


2223-24

Hook forked rocker onto slide valve.

Installation

In order to prevent the slide valve from becoming unhooked, the forked rocker must be installed with the intake pipe upper section turned over. The forked rockers are marked "R" and "L". The intake pipe must not be turned over until the upper section has been bolted to the lower section (installation position).



2224-24

The illustration shows the cutout in the turned over intake pipe upper section for cylinders 1 - 3.

Removing and installing vacuum reservoir

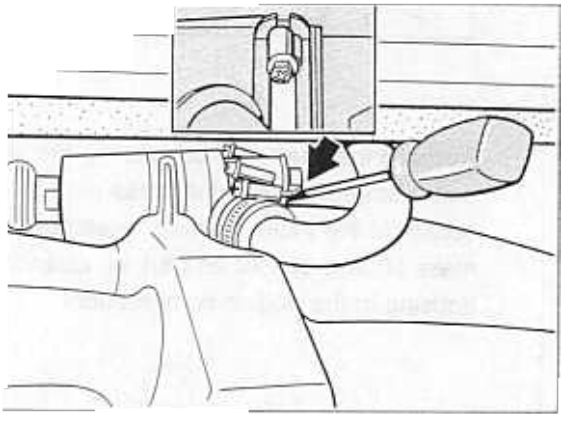
Note

The vacuum reservoir is below the rear left wheel housing, near to the carbon canister.

24 Checking components of injection system for leaks

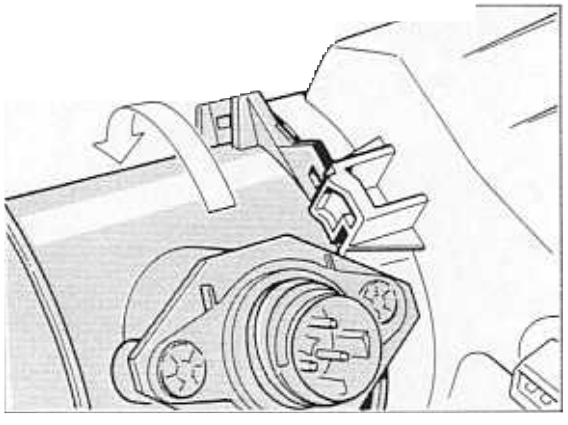
1. Remove air cleaner cap and air cleaner element.

2. Remove hose clamp from mass air flow sensor using cross-head screw driver, e.g. Wiha type, order no. 153-1 (350 mm long).



:354-24

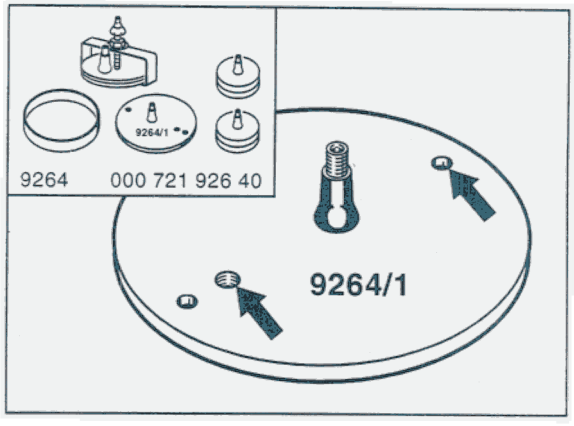
3. Due to the limited space available, the mass air flow sensor and the air filter housing must be separated in the engine compartment. To do so, turn mass air flow sensor in direction of arrow (direction of travel) while locking the air cleaner housing (bayonet lock).

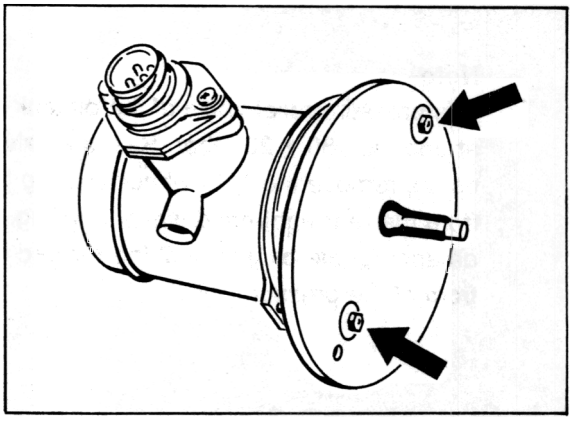


2221-24

4. Lever off snap ring and remove protective grating.

5. Fix sealing plate 9264/1 to hot-film mass air flow sensor using M4x40 screws and washers.





27 60 19 Removing and installing starter (Tiptronic)

Removal

1. Disconnect battery and uncover terminal or battery.

2. Remove engine guard and rear underside panel. Disconnect hot air pipe to left and right of transmission

3. **Slacken** transmission mount bolts **only** (6 bolts) and lower by approx. **10 mm**.

4. Disconnect wire from solenoid terminals 30 and 50. Undo wire clamp of terminal 30 from body and tie-wrap from starter. Undo suction oil pipe from body side member.

5. Using 3/8 inch tools (8 mm INHEX insert), undo hexagon head socket bolts from starter and remove ground strap.

6. Lift starter out of support and rotate starter pinion towards engine oil filter.
   Rotate starter approx 180 deg. along longitudinal axis (solenoid now faces transmission). Carefully take out starter from below.

Installing

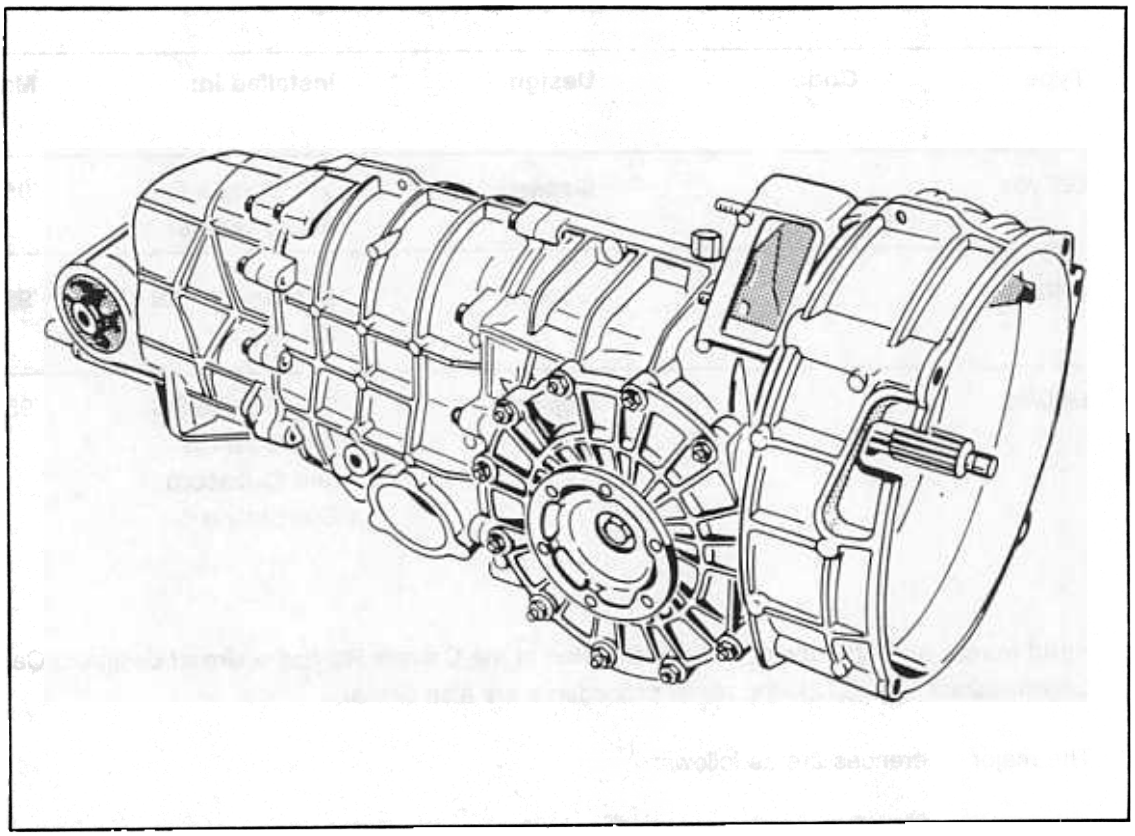
1. Use two tie-wraps to tie wire for alternator terminal 30 to starter housing. Fit protective cover to terminal.

Tightening torques:

Hexagon socket head bolts M 10:	**46 Nm** (30 ftlb.)
Transmission mount to body (six M 10 bolts):	**46 Nm** (34 ftlb.)

3 Technical data

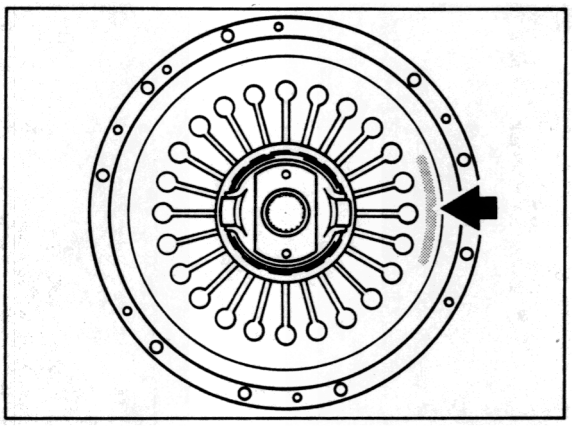
6 speed manual transmission G 50 / 20 / 21 for 911 Carrera (993)



Type	Equipment	installed in:	Model year
G 50/21	6 speed	911 Carrera worldwide except USA, CH, A	'94...'96
G 50/20	6 speed	911 Carrera USA, CH, A	'94...'96
		911 Carrera worldwide	'97

30 52 Identification of clutch pressure plates

To avoid confusion, the pressure plates are color-marked for positive identification.



836-30

Color marking:

968	Green
911 Carrera 2/4	Blue
911 Carrera (993)	No mark
911 Turbo 3.6	Red

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No.	Designation	Qty.	Note: Removal	Installation
1	Hexagon head bolt	2		Tighten to 10 Nm (7 ftlb.)
2	Washer	2		
3	Clamping plate	1		
4	Eccentric bushing	1		Adjust
5	Seal	1		Replace
6	Thrust spring	1		
7	Locking bushing	1		
8	Hexagon head nut	10		Tighten to 23 Nm (17 ftlb.)
9	Washer	10		
10	Front transmission cover	1		
11	Seal	1		Replace
12	Hexagon nut*	1	Lock input shaft with Special Tool 9253 and engage 6th gear	Tighten to 250 Nm (184 ftlb.). Upset flange to lock
13	Hexagon nut*	1	Lock input shaft with Special Tool 9253 and engage 6th gear	Tighten to 140 Nm (103 ftlb.). Upset flange to lock
14	Inner bearing race	1	Pull off across fixed gearwheel No. 15	Heat to approx. 120 °C
15	Fixed gear (reverse)	1		
16	Spacer sleeve	1		
17	Cylindrical roller bearing	1	Pull off across loose gearwheel No. 19	Heat to approx. 120 °C
18	Thrust washer	1		
19	Loose gearwheel (reverse)	1		
20	Synchronizer ring	1	Mark for reinstallation	Check for wear. Fit with the same gearwheel (cogs must face driver dogs)

No.	Designation	Qty.	Note: Removal	Installation
1	Hexagon-head bolt	1		Torque: 35 Nm (26 ftlb.)
2	Bolt with pin	1		Insert in correct position
3	Reverse idler gear	1		Small collar points towards hexagon-head bolt (no. 1)
4	Thrust washer (2.0 mm)	1		
5	Thrust washer (1.5 mm)	1		Do not confuse with washer no. 4
6	Thrust washer (1.5 mm)	1		Do not confuse with washer no. 4
7	Needle-roller assembly	1		
8	Shaft seal	1		Pack the area between dust lip and sealing lip with grease (e.g. Optimol HT2 + 2 EP); press in to stop with mandrel 9254 (p. A)
9	Ball sleeve (long)	1	Press out from the inside, using a suitable mandrel (e.g. 9515)	Press in to stop with Special tool 9254 (p. B)
10	Ball sleeve (short)	1	Pull out with a suitable internal puller (e.g. Schrem 14 - 20) and punch VW 771	Press in to stop with Special tool 9254 (p. A)
11	Retaining ring	1		
12	Cylindrical roller bearing	1	Pull out with suitable internal puller (e.g. Schrem 30 - 40)	Heat cover to approx. 120 °C and press in to stop
13	Retaining ring	1		

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

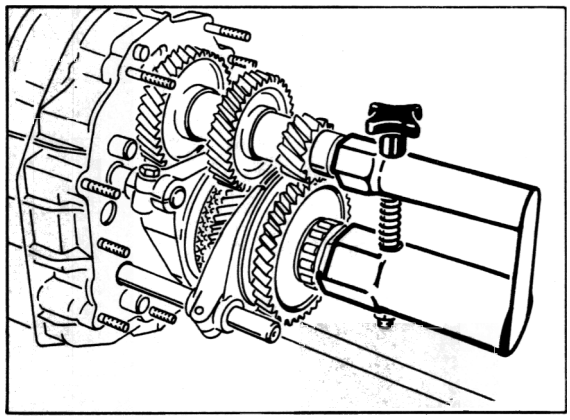
No.	Designation	Qty.	Note: Removal	Installation
10	Needle-roller assembly	1	Mark cage	Install with the same gear-wheel
11	Inner race	1		Heat to approx. 120 °C
12	Guide sleeve	1	Remove complete with shift sleeve	Install complete with shaft sleeve and synchro-mesh components
13	Shift sleeve (3rd and 4th gear)	1	Make sure synchromesh components do not pop out.	Observe installation position, install complete with guide sleeve and synchro-mesh components. Center the centerpunch marks relative to the driver dogs
14	Driver dogs	3		Install in correct position, domed side faces shift sleeve
15	Ball	3		
16	Spring	3		
17	Synchronizing ring	1	Mark for reinstallation	Check for wear, install in correct position with the same gearwheel (lugs face the driver dogs)
18	Loose gearwheel (3rd gear)	1		Replace only in pairs
19	Needle-roller assembly*	1	Mark for reinstallation	Fit with the same gear-wheel
20	Inner race*	1		Heat to approx. 120 °C and press into place
21	Thrust washer (1.85 mm thick)*	1		
22	Fixed gearwheel (2nd gear)*	1	Press off with suitable separating device (e.g. Kukko 17-0)	Replace only in pairs. Flange faces gearwheel of 1st gear
23	Input shaft	1		

* See note on page 35 - 19

No.	Designation	Qty.	Note: Removal	Installation
1	Hexagon head bolt (with ribbed seating surface)	12		Must always be replaced. Threads must be dry and free from grease. Tighten to 200 Nm (148 ftlb.).
2	Ring gear	1		Threaded holes for ring gear bolts must be dry and free from grease. Observe matching number. Readjust if required.
3	Tapered roller bearing inner race	1	Pull off with suitable puller and P 263	Press on with P 264 b
4	Adjusting shim	X	Mark for reinstallation	Redetermine thickness if required
5	Tapered roller bearing inner race	1	Pull off with suitable puller and P 263	Press on with P 264 b
6	Adjusting shim	X	Mark for reinstallation	Redetermine thickness if required
7	Spiral pin	1		Press into correct position
8	Pin	1		
9	Bevel pinion	2		Always replace as a set (with shaft bevel gears)
10	Spacer sleeve	1		
11	Needle roller sleeve (31 individual needle rollers each)	2	Take care not lose any needle rollers	Apply stiff grease to install
12	Shaft bevel gear	2		Always replace as a set (with bevel pinion)
13	Threaded piece	2		
14	Housing	1		

Note

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



1710-39

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

Note

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

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

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

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

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

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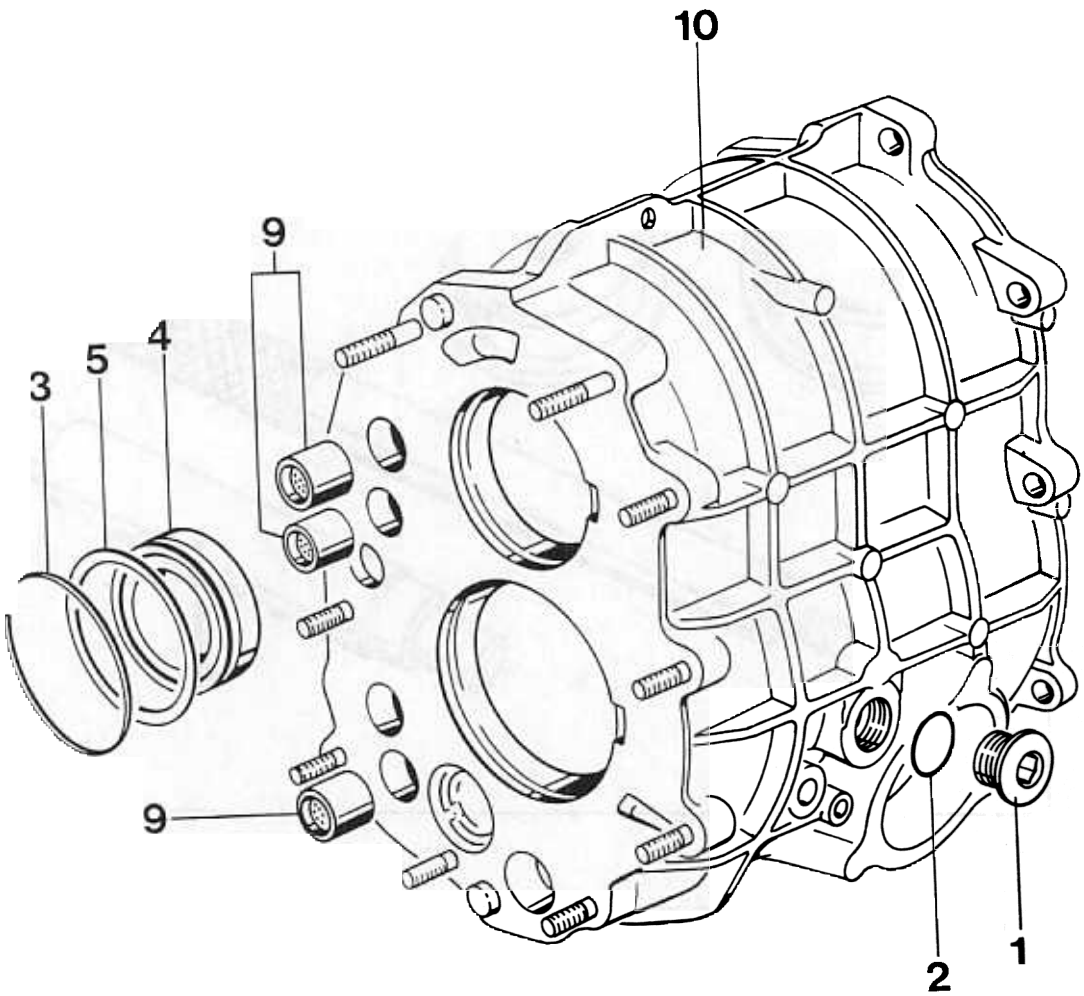
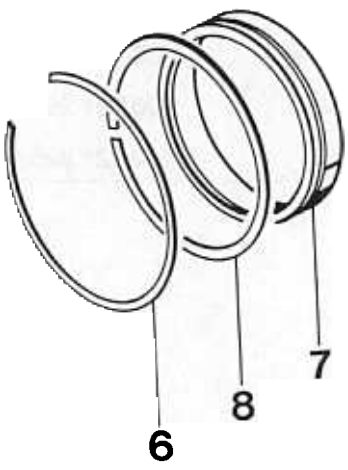
34 52 37 Dismantling and assembling gear housing





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

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

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Adjusting ring gear

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

The ring gear must be adjusted, if the:

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

Note

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

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

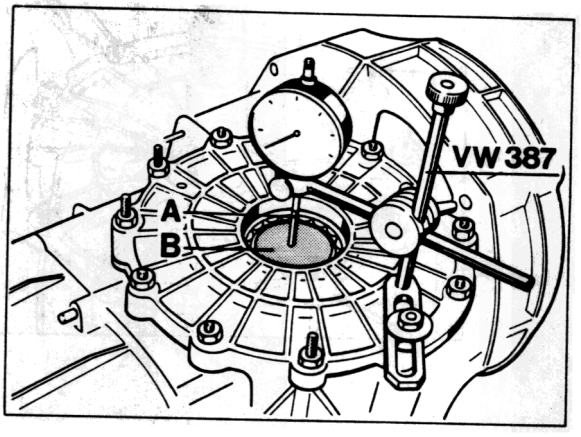
2. Fit one spacer ring (2.5 mm thick) on the ring gear side and on the opposite side of the differential to be used.

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

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

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

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



546-39

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

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

Note

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

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

Preface

Structure

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

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

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

Layout

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

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

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

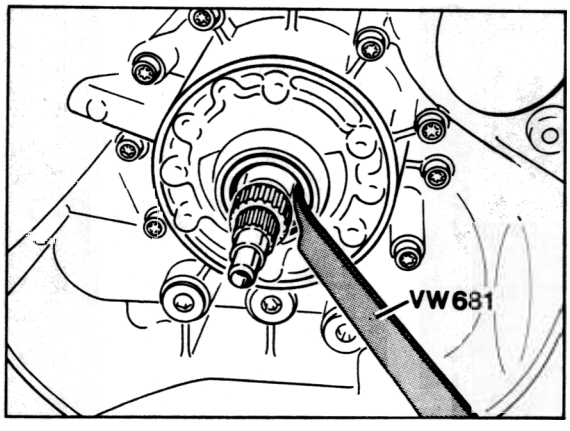
Another new feature is that the contents of the "Service Information Technik" are indicated in the Repair Manual. This brochure concentrates on a description of the design and function of components and of the new features introduced for a particular model year.

32 47 19 Removing and installing torque converter seal ring

Removing

1. Remove transmission and converter.

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



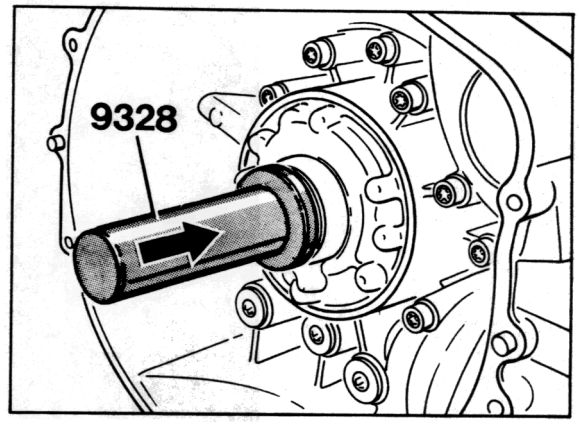
419-38

Installing

Installation takes place in reverse order.

1. Wet sealing lip with ATF.

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



420-38

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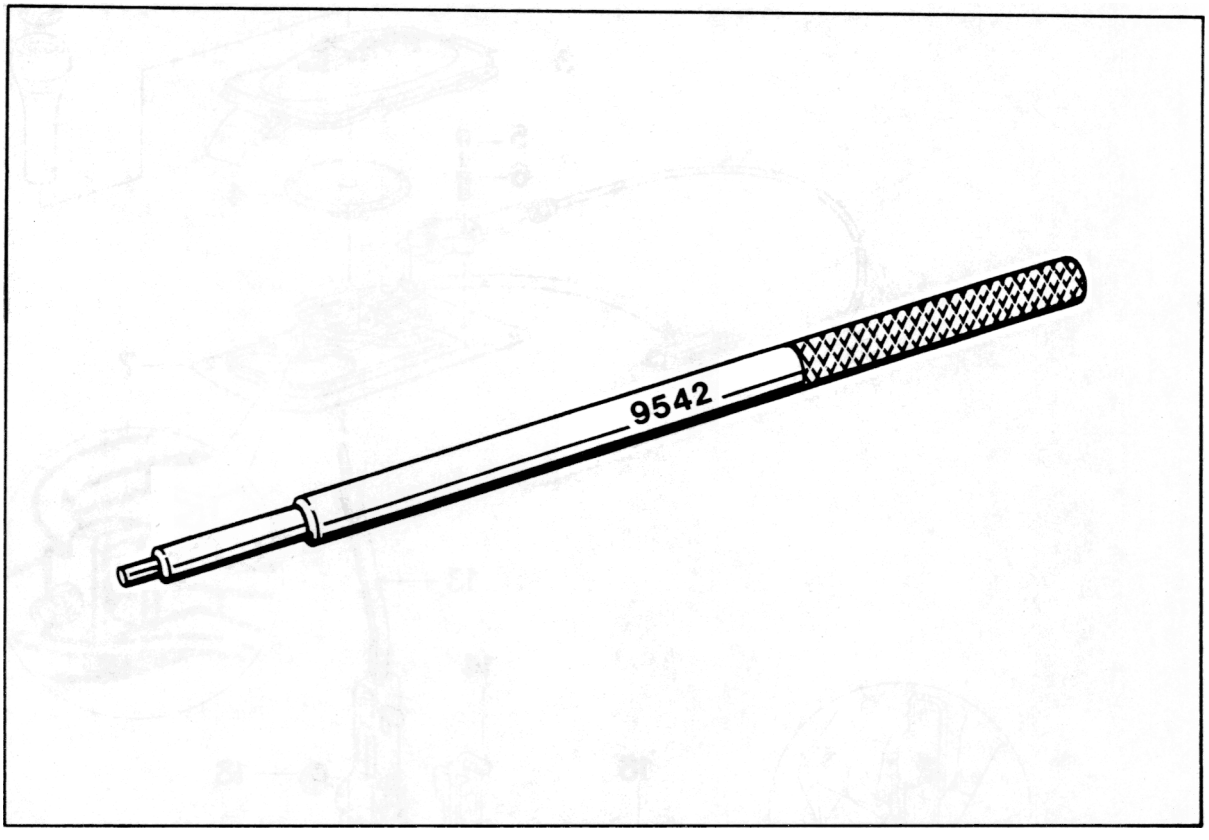
37 10 37 Dismantling and assembling gear selecting system

Tools



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

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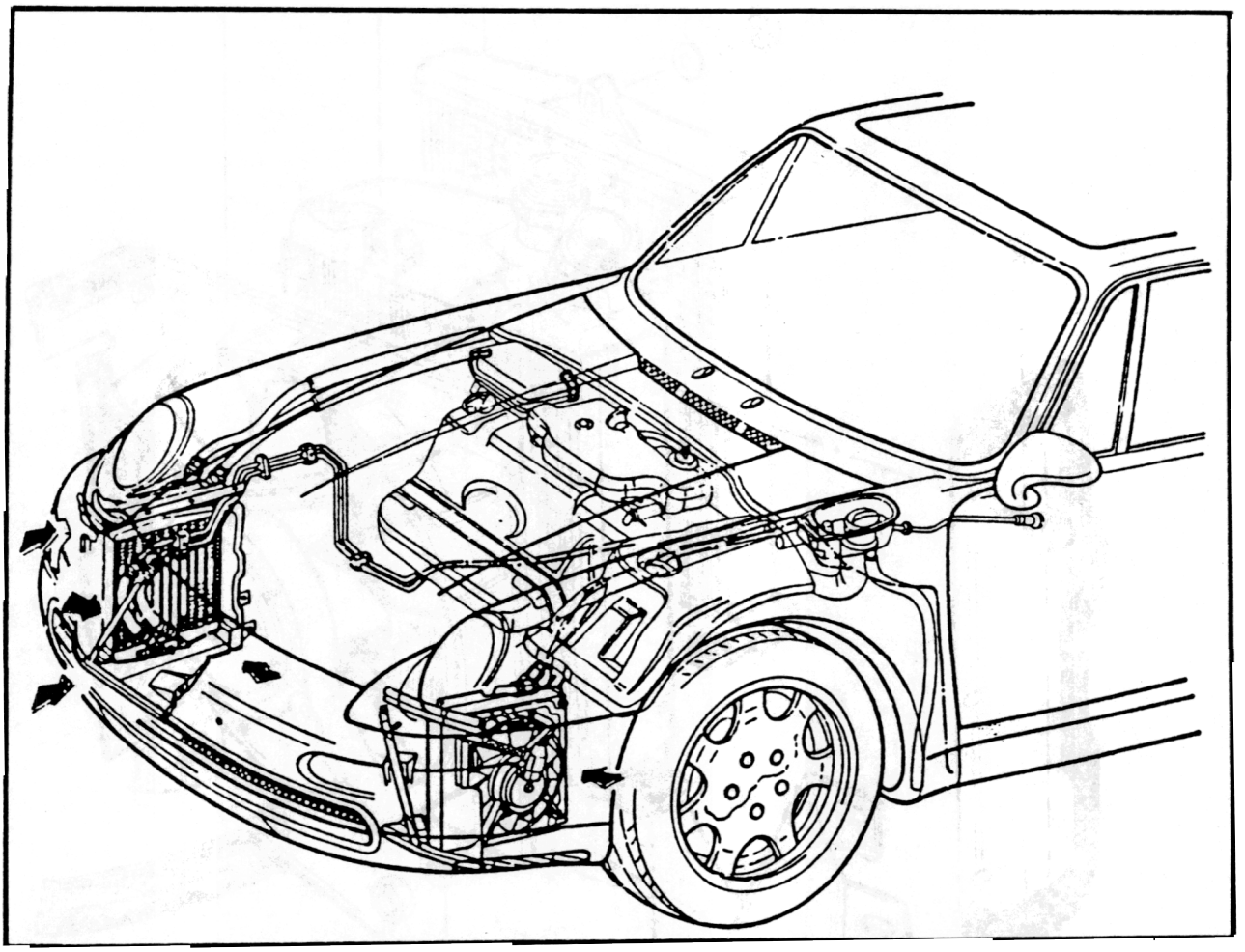
38 60 R moving nd insta ng ATF ooler



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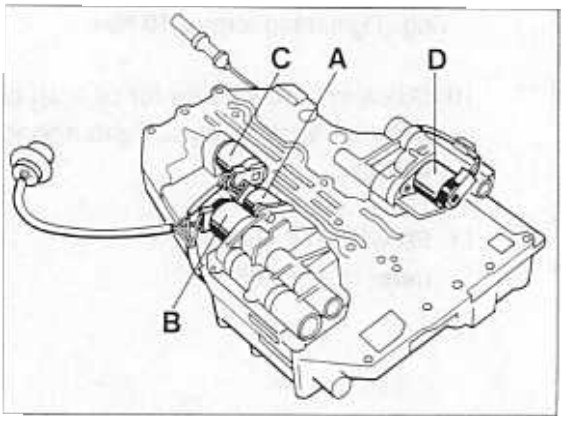
2. Push on push-on sleeves for solenoid valves up to the stop. Pay attention to cable colors.

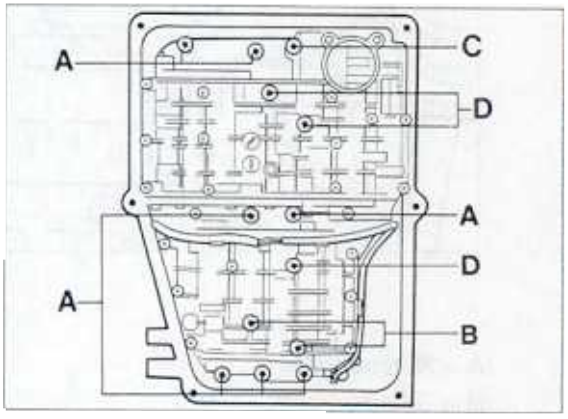


383-38

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

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

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



399-38

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

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

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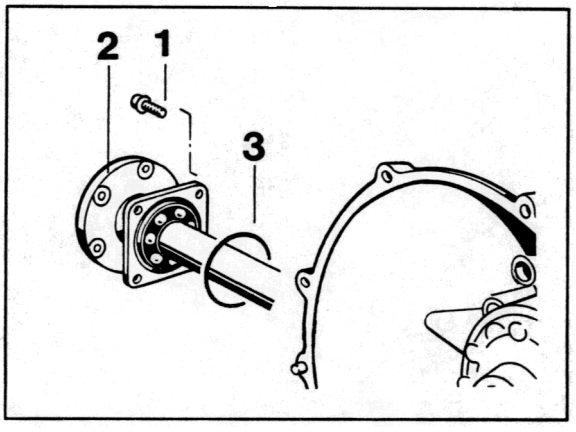
39 25 19 Removing and installing long halfshaft flange

With transmission installed

Removal

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

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



2184-39

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

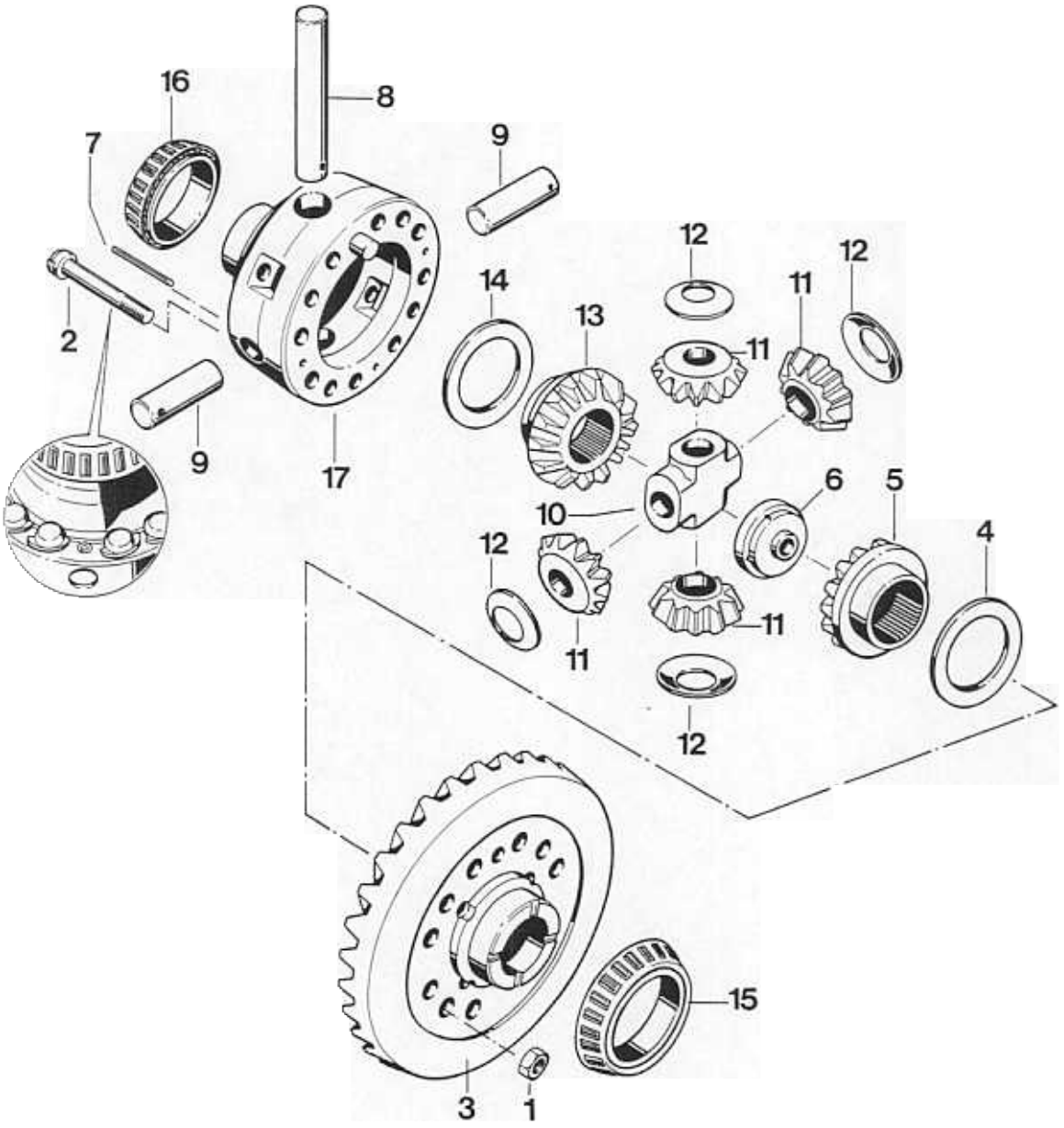
Installation

1. Install the parts in the reverse order of dismantling

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

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

39 09 37 Dismantling and assembling differential



960-39

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

Example

Total shim thickness of adjusting shims

$S_1 + S_2 = 2.85$ mm

Thickness of adjusting shim "S_1"

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

Thickness of adjusting shim "S_2"

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

Note

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

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

Example

Calculated shim thickness

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

Rounded down shim thickness

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

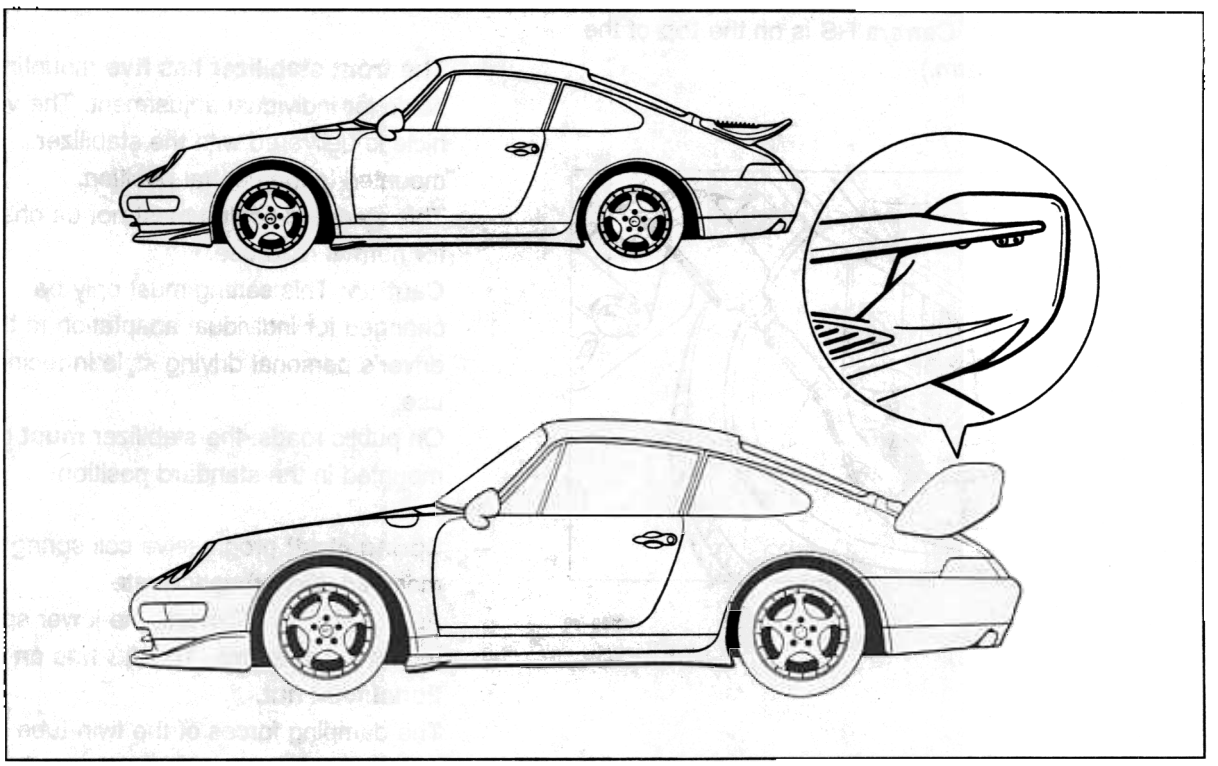
4 Chassis- overview 911 Carrera RS

General

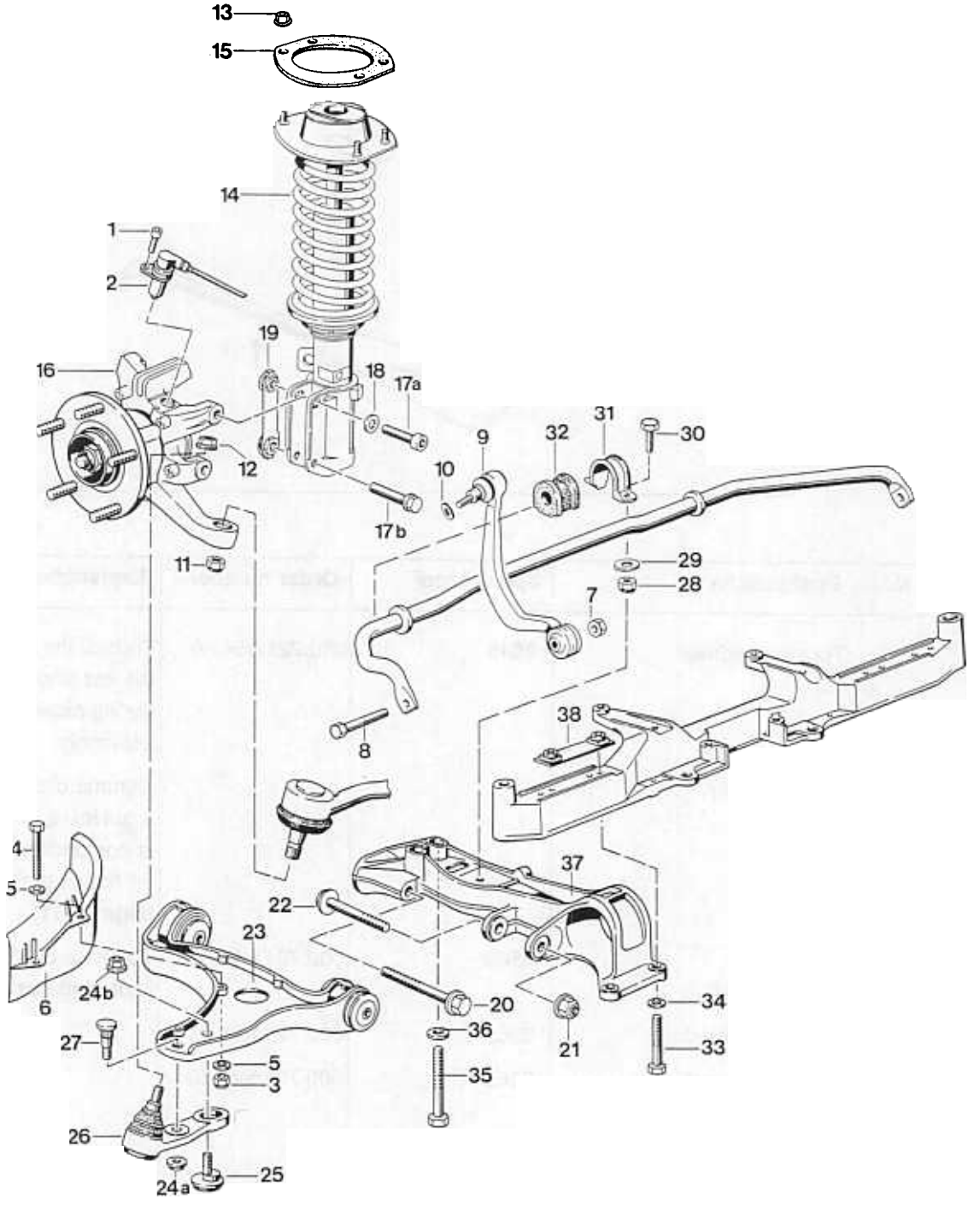
The 911 Carrera RS (993) is produced in a **basic version** (M002) and a **Clubsport version** (M003)

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

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



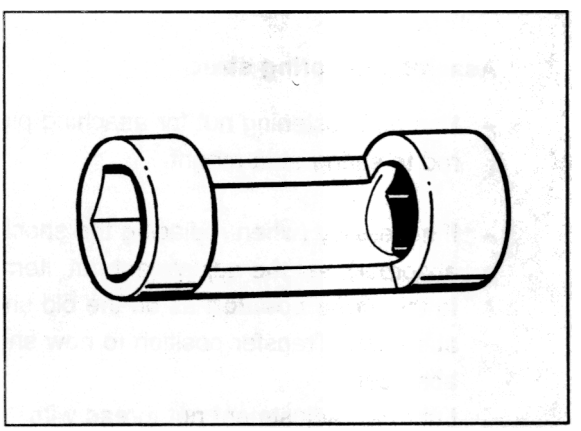
40 05 37 Dismantling and assembling suspension



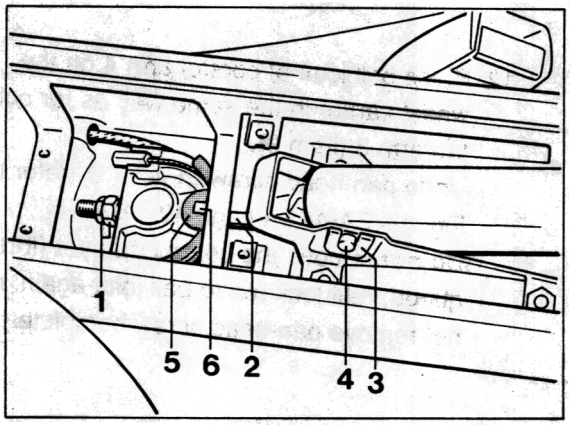
In the case of progressive coil springs **the tighter winding** must point towards the spring strut mount.

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

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



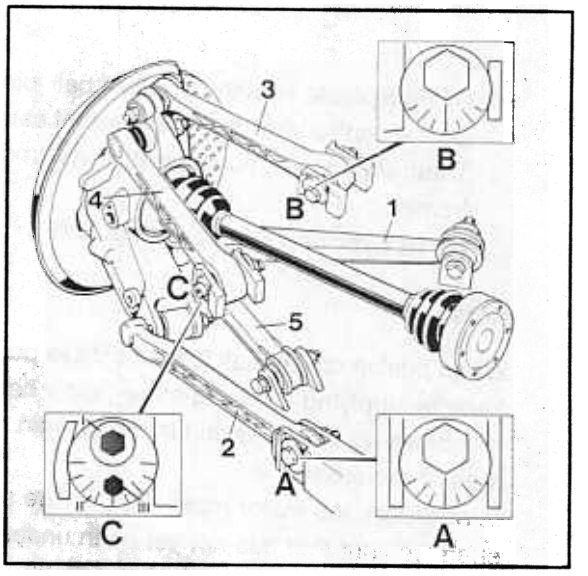
The handbrake cable may remain installed when the wheel bearing, the wheel carrier or the wheel hub is replaced.
In this case, unbolt brake disc and parking brake assembly instead.



1844-42

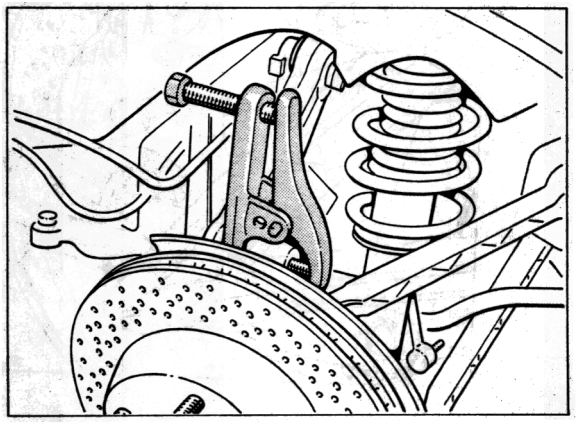
8. **Mark position** of eccentric bolts **A and B** as well as eccentric washer **C II** for reinstallation.
   Then remove eccentric **B.**

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



1445A-44

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



1846-42

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

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Porsche Suspension Alignment

Customer No.:	Repair Order No.:
Customer:	Vehicle Identification No.:
Street:	Registration No.:
Town:	Date of 1st registration:
Phone:	Mileage: km/miles
Measurement made by:	Date / signature

Vehicle: Porsche 911 from model 94 (993) **Version:**

Measuring requirements (Vehicle weight): Curb weight to DIN 70020.

This means: Full fuel tank, spare wheel and tools in vehicle.

Reason for measurement:

Tire make: Size/type: Front Rear

	Front left	Front right	Rear left	Rear right
Tire pressure (cold tires) bar				
Tire/wheel (possibly damaged) Tire - tread depth (mm)				

			Measurement **as received**	Specifications max. difference LH/RI	Measurement **as delivered**
Vehicle height / wheel load	Height/wheel load front (mm / kg)	left / right	/ /	5 mm / 20 kg	/ /
	Height/wheel load rear (mm / kg)	left / right	/ /	5 mm / 20 kg	/ /
Rear axle	Camber	left / right		20'	
	Toe-in	left / right		+0°10'/ +0°05' - 0°05' (not valid for RS)	
		total		+0°20'/ +0°10' - 0°10 (not valid for RS)	
	Kinematic toe-in correction	left	scale units*	Angular diff. **L2 / L5**	scale units*
		right	scale units*	max. 1.5 scale units*	scale units*
	Driving axis angle			+0°00'/ +0°10' - 0°10'	
Front axle	Caster	left / right		+5°20'/ +0°15' - 0°30' 15'	
	Toe difference angle	left / right			
	camber	left / right		10'	
	Toe-in	left / right		+0°03'/ +0°03' - 0°03'	
		total		+ 0°05'/ + 0°05' - 0°05'	

* SKE = scale units. Special tools 9549 and 9550 are needed for measurement. The reading must be taken at the center of the level (bubble).

44 Checking wheel rims

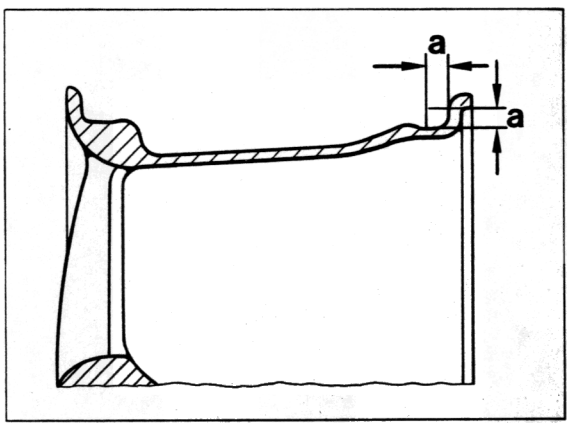
Checking radial and lateral runout

Radial and lateral runout must be measured at the points on the inside of the wheel rim shown on the following drawing (dimension "a").

The **maximum** allowable radial and lateral runout on **light alloy wheels** is **0.7 mm.**

The **maximum** allowable radial and lateral runout on **wheels with tires** is **1.25 mm.** Values lower than 1.0 mm (preferably around 0.5 mm) should be aimed for.
See also page 44-23.

Caution: Welding and straightening work on light alloy wheels is not allowed.

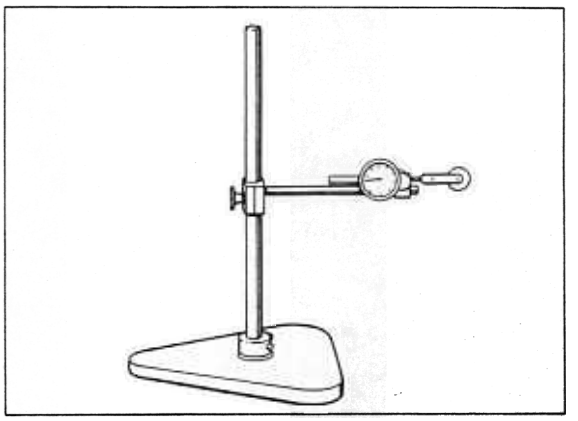


2273-44

Dimension "a" = 8 mm

Note

For measurements on wheels with or without tires, use a tire runout gage, e.g. V.A.G 1435.



2272-44

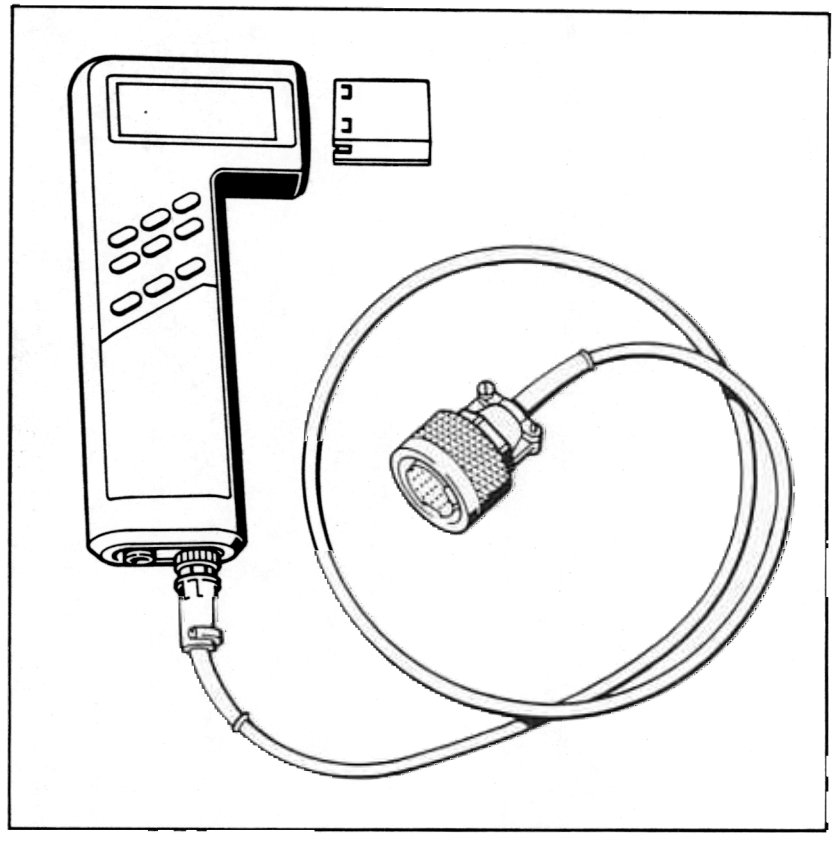
45 ABS 5 test with System Tester 9288

Importaint notes on the ABS 5 and ABS 5 / ABD systems

When carrying out operations on the hydraulic unit, the rpm sensors and the wire assembly, or when replacing units, a **system check (operational check)** with System Tester 9288 must be carried out. This may be required e.g. after accident repairs. This check ensures that confusion of electrical wires and hydraulic lines is avoided and that **correct system operation** is ensured. When replacing certain brake pipes, e.g. at the intermediate section (in the upper left spare wheel well), **a system check must also** be run. Inadvertent bending of the brake pipes may cause the hydraulic connections to be incorrect in spite of the presence of different threads (M12 x 1 and M 10 x 1).

2. If a fault is displayed, (and if no assembly operations have been carried out before) **diagnosis and troubleshooting** are also carried out with System Tester 9288. To run the test, select System ABS 5 or ABS 5 / ABD, respectively, and read out the fault memory. The relevant menus (page 45-9) may then be used to locate the fault.

Tools



855-03

46 36 20 Removing and installing front brake pads

Note

The brake pads are replaced as on the other Porsche models with four-piston fixed calipers. The operations are therefore only described in brief. The following instructions, however, should be observed at all times:

Use correct brake pad quality (refer to spare parts catalog).

Replace damping plates whenever the brake pads are replaced.

The damping plate are provided with an adhesive backing and a protective sheet. **This protective sheet must be removed prior to installation.**

Never apply grease to the brake backplates (backs of brake pads).

Removal

Compress cross spring in the middle and disengage it from its seat. **At the same time, i.e. before compressing the cross spring, press the spring in the holder area towards the brake disc (release spring).** This prevents damage to the holder plate.

Move out warning contact on brake caliper and pull warning contact out of brake pad backing plate.

Note

Replace warning contacts if wire core is exposed or ground through. If grinding marks are limited to the plastic section of the warning contact, the contact may be reused.

Pull out brake pads with brake pad impact puller. **Be sure to observe** the following notes:

Move out brake pads along with damping plates. If this is not possible (depending on the degree of wear of the brake pads), use a spatula to separate the damping plates from the pad backing plate prior to removal of the pads.
In both cases, start by resetting the brake pads as far as possible using a piston retracting tool. If required, draw off some brake fluid from the reservoir prior to this operation.

Installing

If required, use retracting tool to push pistons back into home position.

Clean seating and guide surface of brake pads inside the caliper with white spirits and a cylindrical brush or special brush. **Take care not to damage the dust caps of the brake pistons.**

Important note on new brake pads

Due to the relative high abrasive action of perforated friction discs, the wear pattern of newly fitted brake pads will adapt itself relatively rapidly to the wear pattern of the used brake disc. After introduction of optimized perforation patterns, the service life of perforated Porsche discs as well as of brake pad materials is now **almost equal to the service life of smooth discs.**

47 01 07 Bleeding the brakes (hydraulic brake booster)

Caution: The following description is only applicable to vehicles fitted with a hydraulic brake booster.

Important notes about brake fluid

Use only new brake fluid DOT 4.
Observe brake-fluid quality.

The brake fluid DOT 4 Type 200 used until now (change interval 3 years) is **no longer available** via the Porsche Parts Service.

"Super DOT 4" brake fluid will be delivered instead. The **change interval** for this brake fluid is **2 years.**

Vehicles with brake systems filled with the previous brake fluid **must be filled with SUPER DOT 4 at the next scheduled brake-fluid change.**

The brake fluid is available under the following part number:
Container volume **1** litre = 000.043.203.**66**
Container volume **30** litres = 000.043.203.**67**

Miscibility of the brake fluids:
The brake fluid DOT 4 Type 200 used until now is **miscible** with Super DOT 4. This means that, until the next scheduled brake-fluid change, vehicles with brake systems filled with the previous brake fluid can be topped up with **Super DOT 4.**
Both brake fluids are coloured amber.

Bleeding procedure / subdivision

1. **Bleeding the brake master cylinder circuits**
   (from page 47-12).
   Includes: Partial bleeding (simplified bleeding) of brake booster circuit (provided that **no** booster circuit components have been dismantled).
   If parts of the booster circuit have been dismantled, start by bleeding the booster circuit completely (from page 47-15).

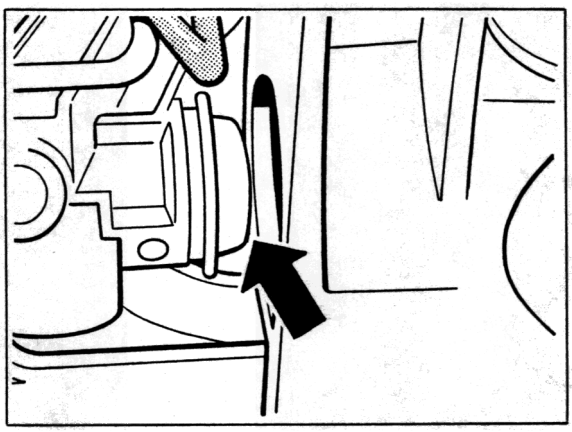
2. **Bleeding the ABD circuit** (ABD = Automatic Brake Differential) in the hydraulic unit if the hydraulic has been replaced or removed (page 47-14).

3. **Bleeding the brake booster circuit**
   if parts of the booster circuit or the system (including the suction side of the pump unit) have been opened (from page 47-15).

Tools

No.	Designation	Special tool	Order number	Explanation
4	Pressure gage	9509	000.721.950.90	For checking leakage and switching point (booster circuit pressure tests) together with measuring line 9509/2 (No. 5) or measuring line 9509/1 (-) on earlier cars without miniature measuring union on pressure reservoir
5	High press. measuring line	9509/2	000.721.950.92	connection to pressure reservoir

9. Retract steering rack on **left-hand** side fully into steering gear housing (arrow), pulling or pushing (as required) on face of steering rack (take care not to damage the steering rack). Extend steering gear in rotary piston area and take out towards bottem.



1092-48

Installation

Install in reverse order. Be sure to **observe** the following points:

Replace steering gear mounting bolts and dowel screw of the steering shaft with new parts after each removal operation.

The threads of the bores and the washers must be clean and fat-free. Remove micro-encapsulation residuals from the threaded bores required to fix the steering gear (use Aceton for cleaning, then blow out bores with compressed air).

Important: Since 1995, 12.9 screws have been used (previously 10.9 screws). The 12.9 screws must be used retroactively. **For replacement, use only 12.9 screws.**

Part numbers of 12.9 screws

Pan-head screw 8 x 60 = 999 218 102 09 (4 on vehicles without cross strut, 2 on vehicles with cross strut)

Pan-head screw 8 x 80 = 999 218 103 09 (2 on vehicles with cross strut)

Note

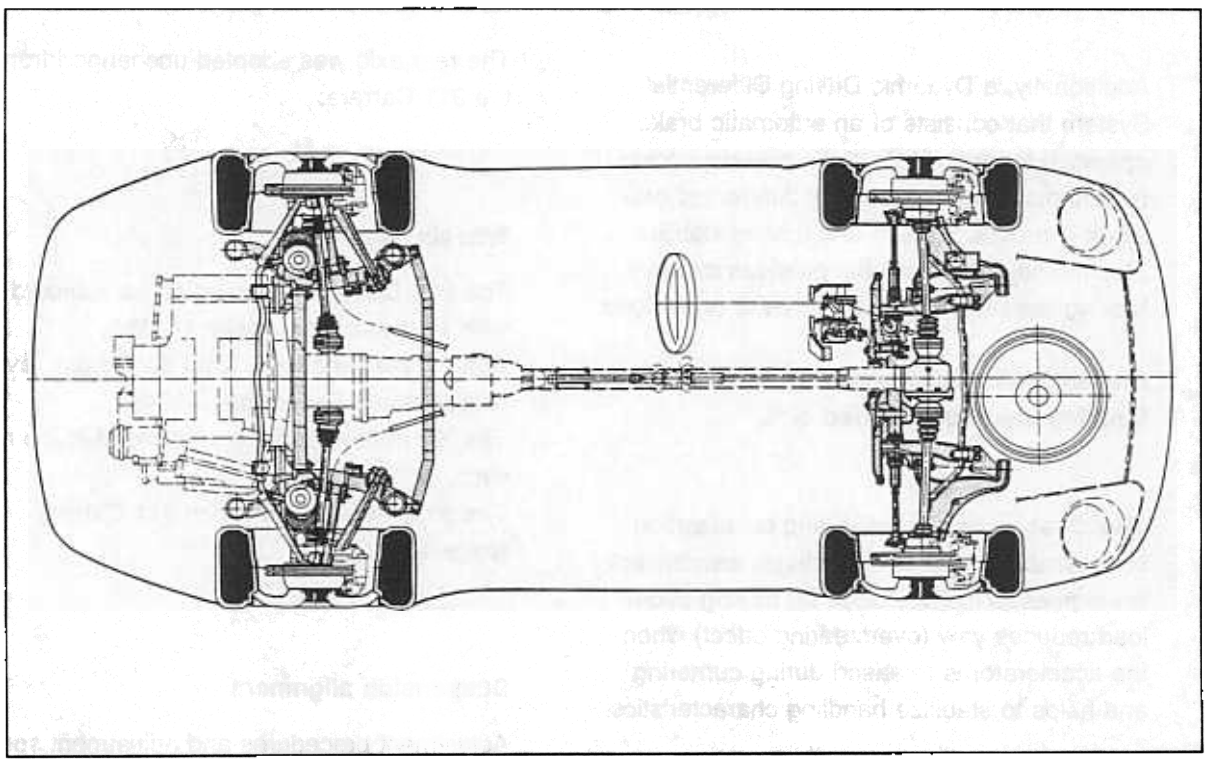
Observe the procedure for tightening the fastening screws for the steering gear strictly (see page 48-12).

Make sure that the steering rack is not damaged (score marks).

With the rack fully extended, coat steering rack with VW steering gear grease AOF 063 000 04.

4 Running gear overview of 911 Carrera 4

Just like the 911 Carrera (rear-wheel drive 993), the 911 Carrera 4 (four wheel drive 993) is offered with a variety of running gear versions (standard running gear / sports-type running gear M 030 for Coupé only / lowered running gear M 033). Components and running gear tuning of the 911 Carrera (993) and 911 Carrera 4 (993) differ only slightly from each other.



Four-wheel drive (General)

The 911 Carrera 4 is fitted with a permanent four-wheel drive system with **variable** power distribution to the front and rear wheels.

Power is distributed to the wheels across a viscous multi-disc clutch to reflect the wheel speed difference of the front and rear wheels. This ensures that the front wheels are given only enough drive torque to ensure optimum propulsion even under adverse road conditions.

Printed in Germany - 19, 1996

General remarks on body parts of stronger sheet steel

Applicable to the 911 Carrera (993) types

Body parts of stronger sheet steel contribute to the strength of the passenger compartment and thus serve to protect the passengers. Furthermore, the fatigue strength is improved in addition to the crash safety.

In terms of crash behaviour, body parts made from stronger sheet steel are distinguished for their high energy absorption. But this also means that higher reshaping force must be applied in straightening work.

Welding work

Body parts of stronger sheet steel can be welded using the MIG welding processes that are customary in workshops. The use of the oxycetylene welding process is not permissible for body parts made from stronger sheet steel.

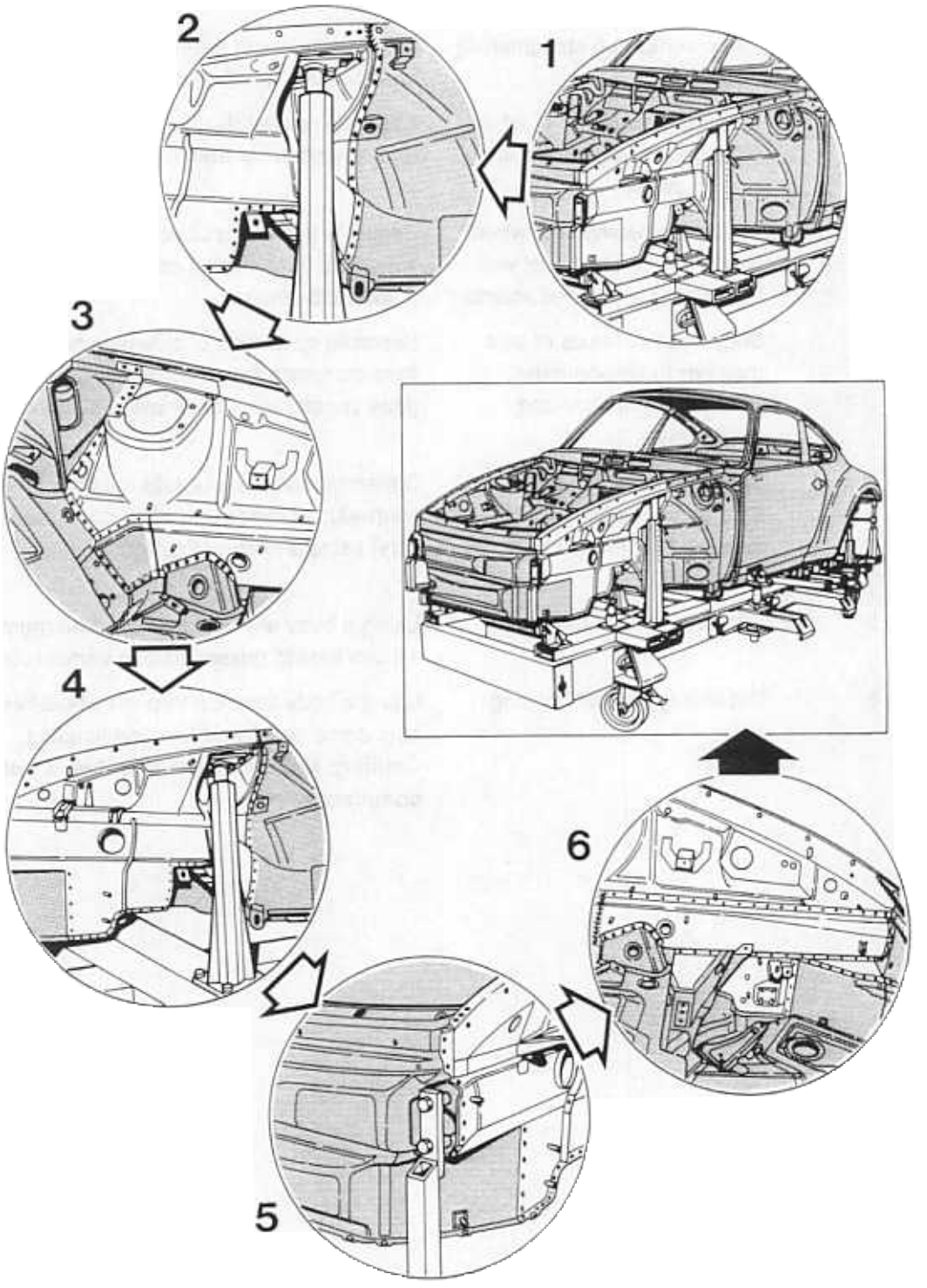
Repair note:

If significant deformation in this type of body panels has occurred, they cannot be brought back into shape by straightening. Body repairs therefore require fitting of new panels and/or sectional repairs.

For these purposes, only "Original Porsche Parts" and/or sections of "Original Porsche Parts" must be used!

Replacing part of wheel housing and side member

Fitting wheel housing and side member into body



Replacing complete front end

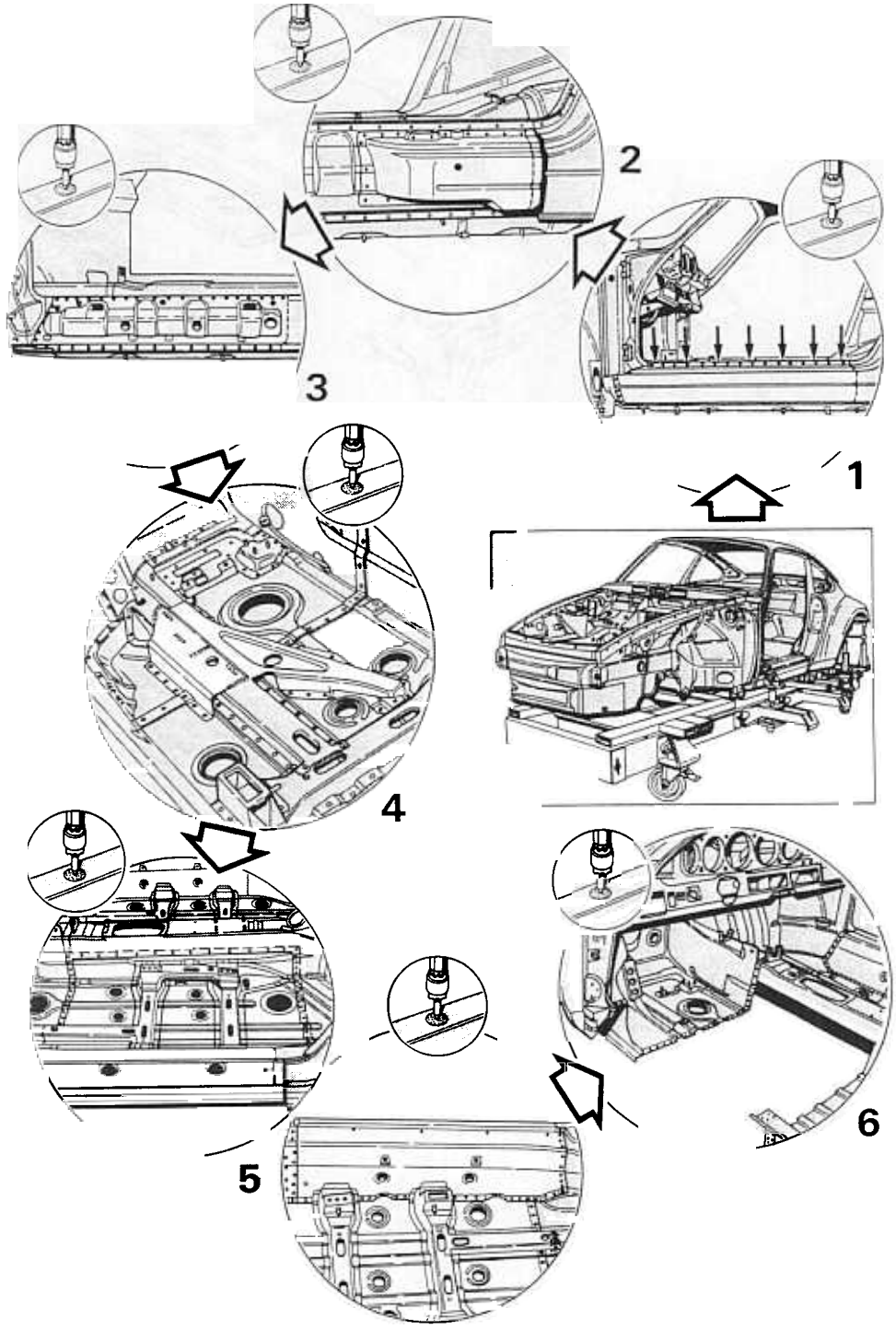
Attaching front end to body

Preparing the bonding cartridge for application of adhesive

No.	Operation	Instructions
4	Open nozzle fitting of cartridge containing component A	Use a screwdriver to pierce the diaphragm of the nozzle fitting of the cartridge containing component A (C1).
5	Open flanged cover of cartridge containing component A	Use the screwdriver handle to pierce the flanged cover at the end of the cartridge containing component A (C1).
6	Screw filling nozzle onto cartridge containing component A	Screw filling nozzle (C10) onto cartridge containing component A (C1).
7	Place cartridge containing component A into bonding gun	Place cartridge containing component A (C1) into bonding gun (A). Remove screw-on cap of mixing cartridge (C3).
8	Press component A into mixing cartridge	Insert filling nozzle (C10) of cartridge containing component A (C1) into mixing cartridge (C3). Use bonding gun (A) to press component A into mixing cartridge (C3).
9	Open nozzle fitting of cartridge containing component B	Use a knife to cut off the tip of the nozzle fitting of the cartridge containing component B (C2).
10	Screw injector nozzle onto cartridge containing component B	Screw injector nozzle (C7) onto cartridge containing component B (C2).
11	Place cartridge containing component B into bonding gun	Place cartridge containing component B (C2) into bonding gun (A).

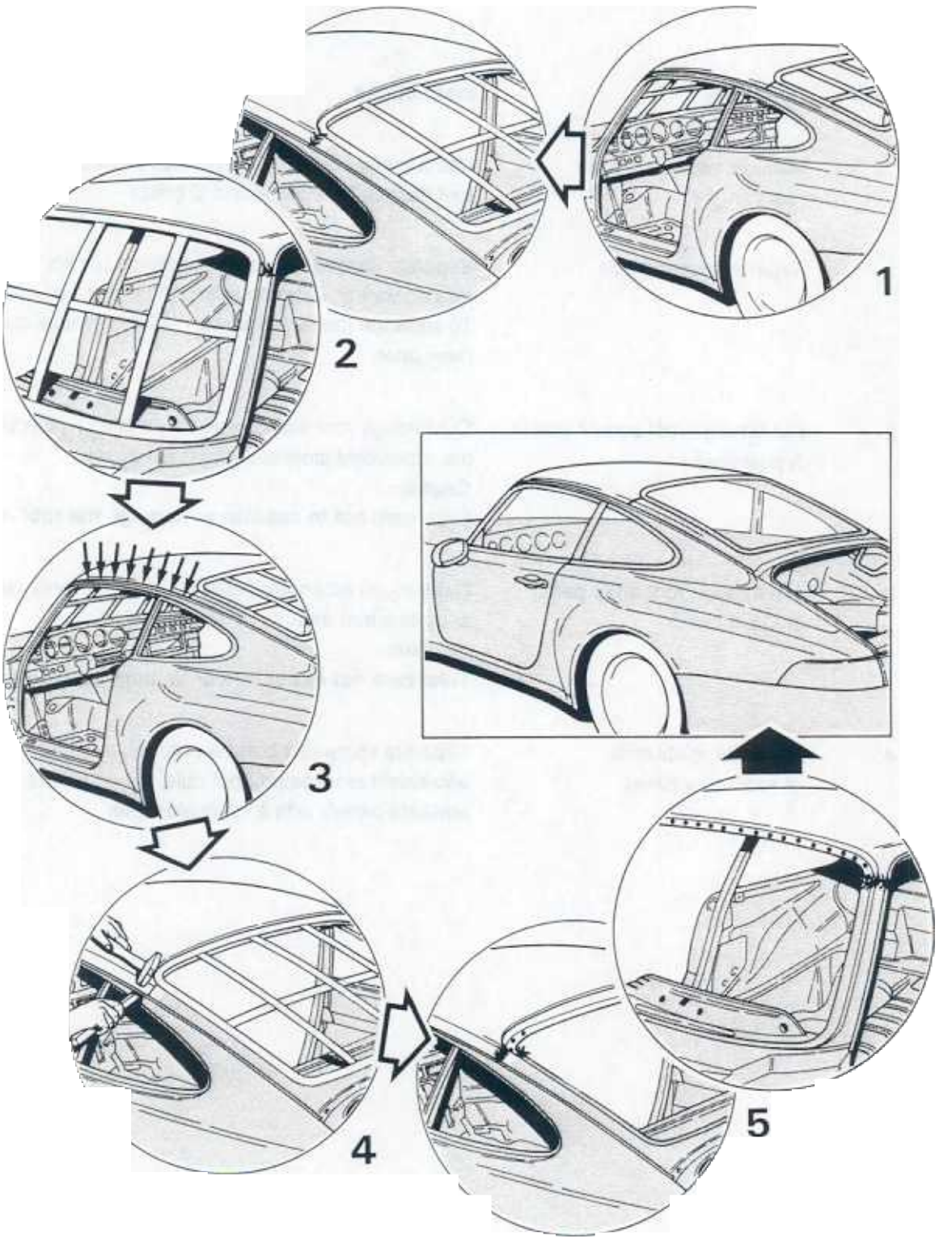
Replacing floorpan

Cutting outer side member, center side member, inner side member and floorpan partially out of body

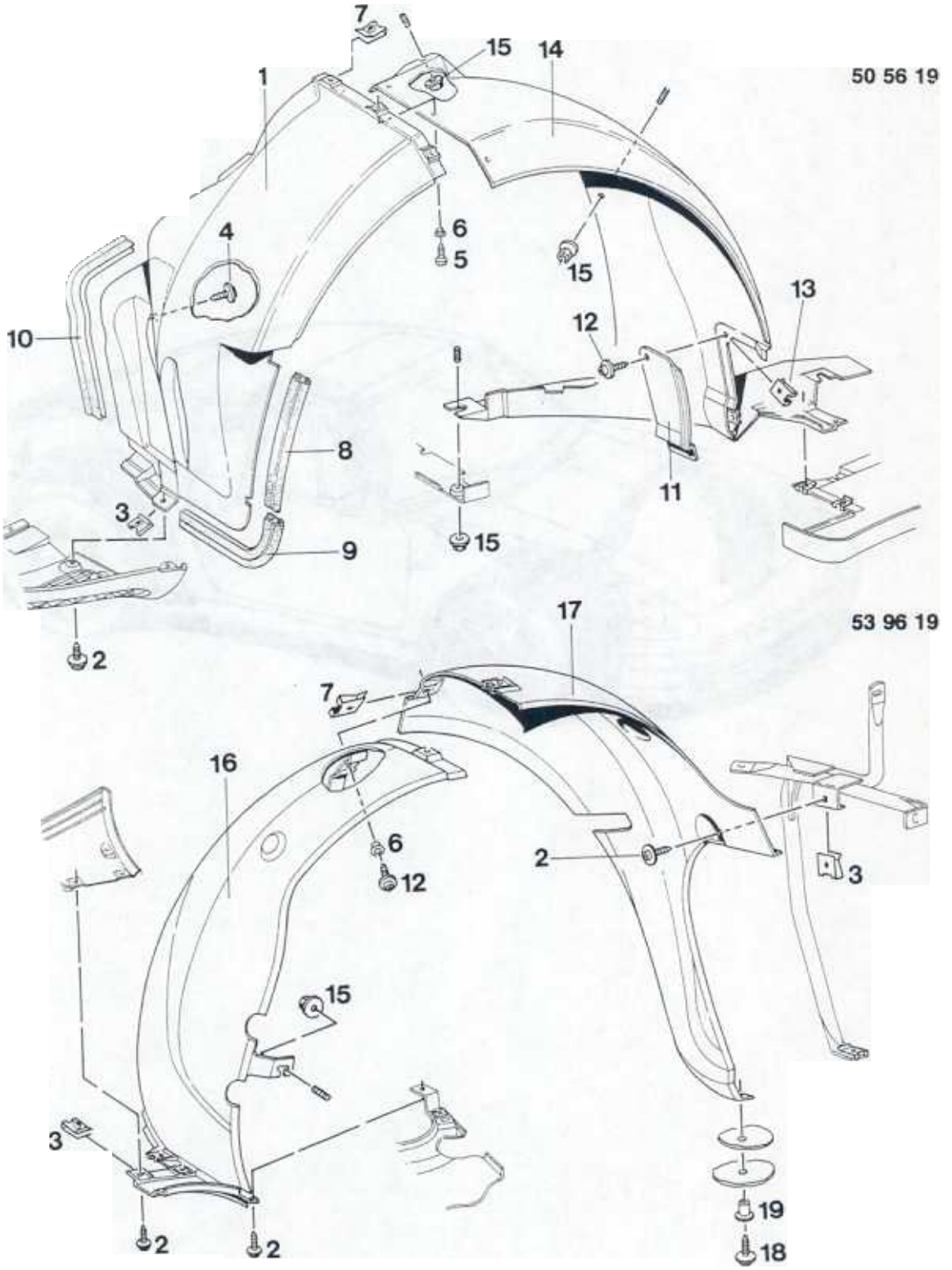


Replacing part of roof panel

Fitting part of roof panel to body



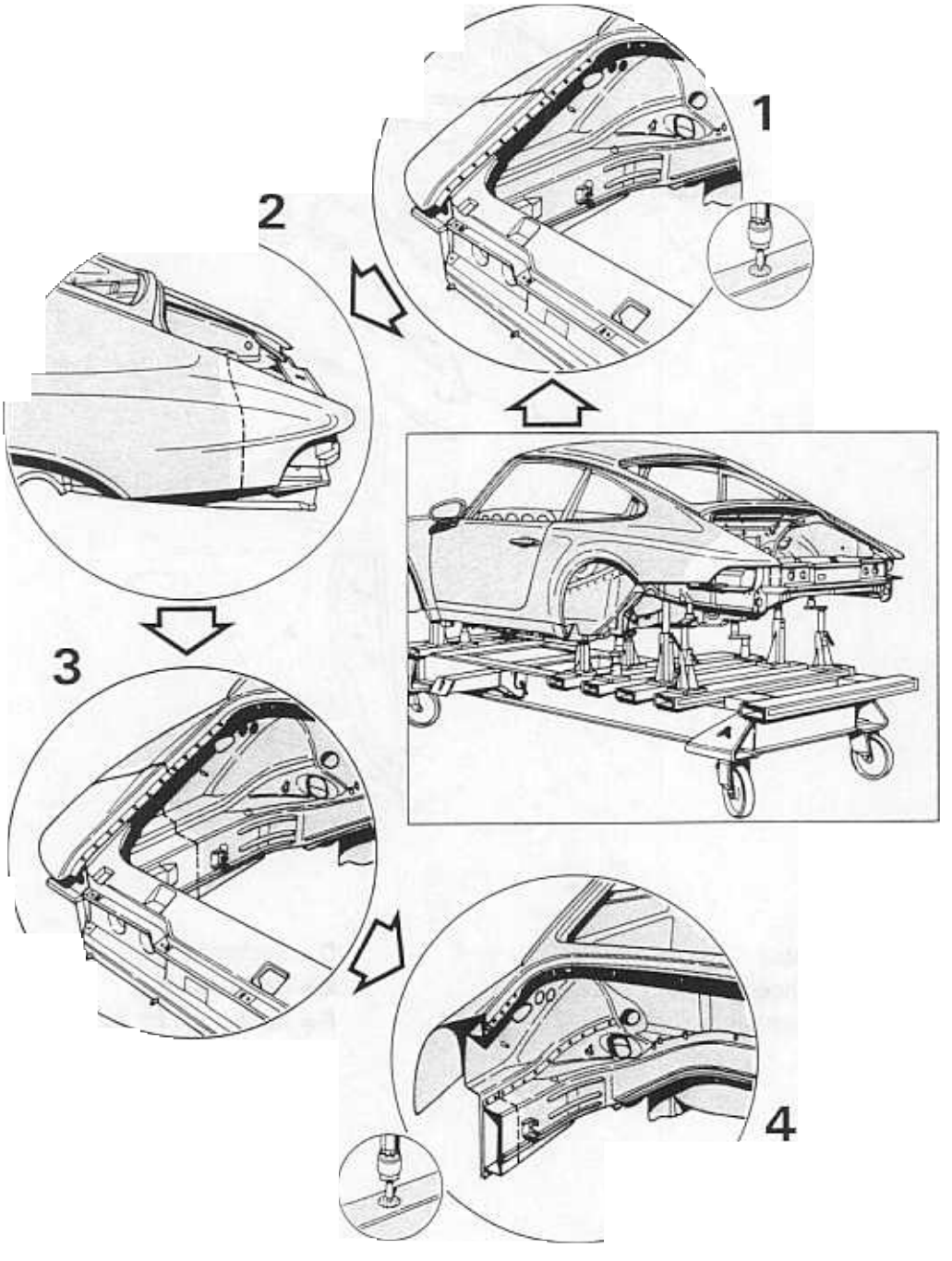
53 69 19 Removing and installing wheel housing liner



Partly renewing rear section of body

Renewing cross-member with engine mount, partly renewing side panels, rear wheel housings and side members

Cutting rear section partly from the body



Inserting rear body section into body at on side

No.	Operation	Instructions
	Clean the weld areas	Clean the body areas to be welded with a hot air blower or rotary brush to remove underseal, paint etc. Remove factory-applied primer with a rotary brush from the weld areas on the replacement parts.
1	Fit side member and rear axle cross member into body and weld in	Fit side member and rear axle cross member into body, secure with clamping tools and tack weld into position. Using the inert gas method, butt weld the replacement side member to the body side member with a full seam. Plug weld the side member to the cross member, engine mount and rear axle cross member. Note: The rear axle cross member may only be fitted together with a side member.
2	Insert special tool P 853	Place special tool P 853 (rear window template) into body cutout for rear window and secure with clamps to the spot weld flange.
3	Fit rear wheel housing into body and prepare for welding in	Trial-fit reinforcements to the side member, secure with clamping tools and tack weld.
4	Trial-fit rear wheel housing to body and prepare for welding in	Trial-fit rear wheel housing to body. Drill out the rear wheel housing ready for plug welding at points not accessible for spot welding.
5	Weld the rear wheel housing into the body (from the outside)	Secure the rear wheel housing with clamping tools and spot weld to the cross member, rear wheel housing reinforcement, side member (where accessible) and roof frame. Using the inert gas method, plug weld the rear wheel housing to the central side member in the areas of the side member and the rear wheel housing reinforcement not accessible for spot welding.

Body paint colors beginning with 1996 Model Year

Standard olors:		Special colors	
Grandprix white	908	Polar silver metallic	92E
Grandprix white	92R*	Polar silver metallic	92M*
Black		Midnight blue metall	37W
Black		Midnight blue metalic	39C*
Guards red	80K	Black metall	746
uards red	84A	Black metall	'44'
Speed yellow	2G	Slate gray metallic	22D
Speed yellow	2H*	Slate gray metallic	23F*
Blue turquoise	3AR	ris blue metallic	39N
Blue turquoise	3AS*	Iris blue metallic	39V*
		Aventurine green metall	39R
		venturine green metallic	39S*
		red metallic	84R
		Arena red metallic	84S*
Water-base paints		Turquoise metallic	25C
		urquoise metallic	25D*

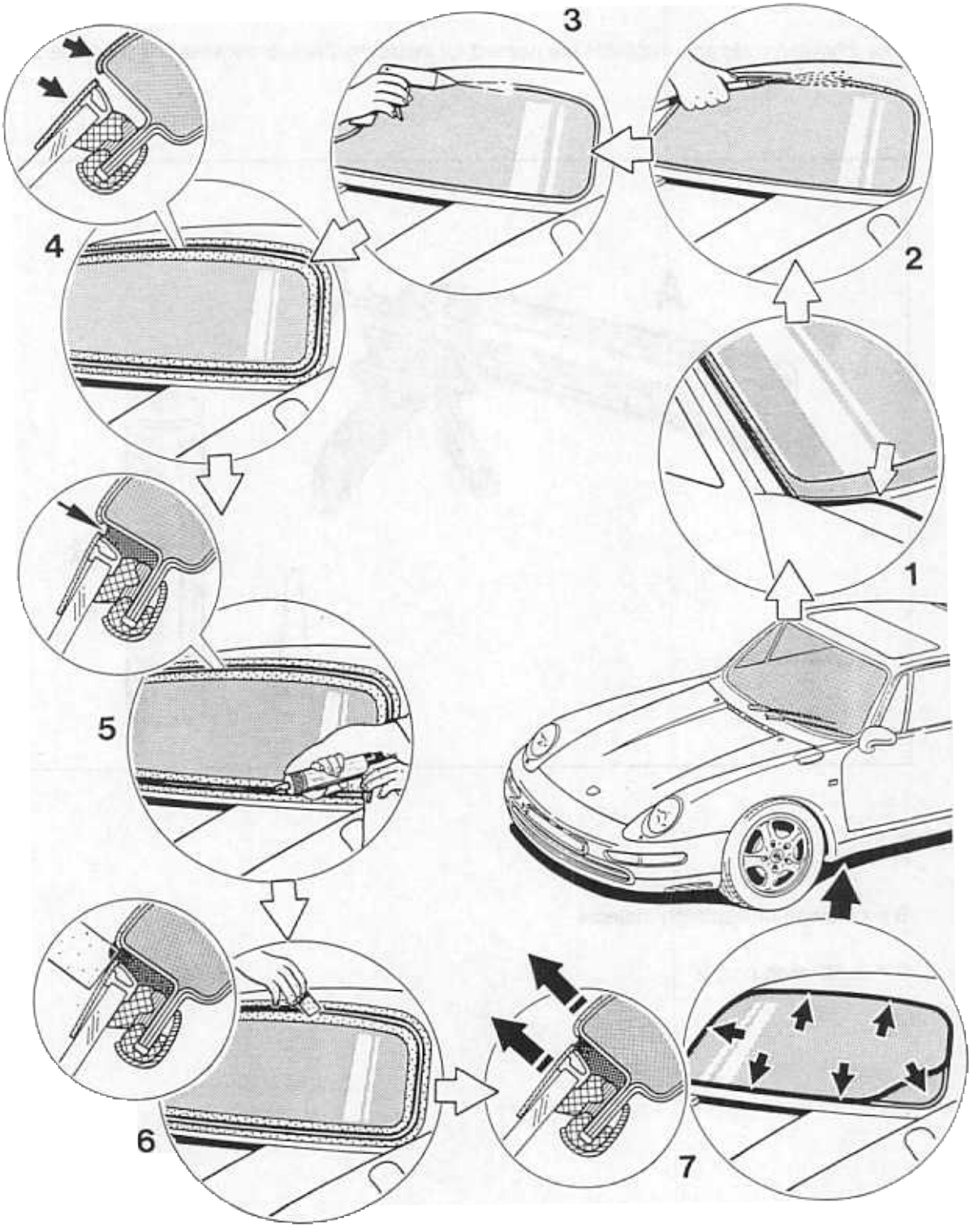
Installing convertible top fabric and roof liner

63 55 19 Removing and installing tail panels

Undo the wheel housing liners partially before removing the tail panels!

No.	Designation	Qty.	Note: Removal	Installation
1	Cover	1	Open plug nut	Close plug nut
2	Plug nut	4		Check, replace if required
3	Lamp assembly	2	Unclip from end cover and undo electrical connection	Reconnect electrical connection and clip into end cover
4	Self-tapping screw	2		
5	Sheetmetal nut	2		
6	End cover	1	Undo threaded stud (13), screw out fillister head screws (7), take end cover off tail panel and disconnect electrical connection	Reconnect electrical connection, insert end cover and adjust with item 11 at bottom and item 7 at top to line up with body contours
7	Fillister head screw	3		
8	Bracket	1		
9	Bracket	2		
10	Adjuster element	3		
11	PT screw	3		
12	Spacer	3		
13	Threaded stud	3	Screw out of adjuster element up to upper edge of end cover	Screw into adjuster element
14	Rubber grommet	6		Check, replace if required

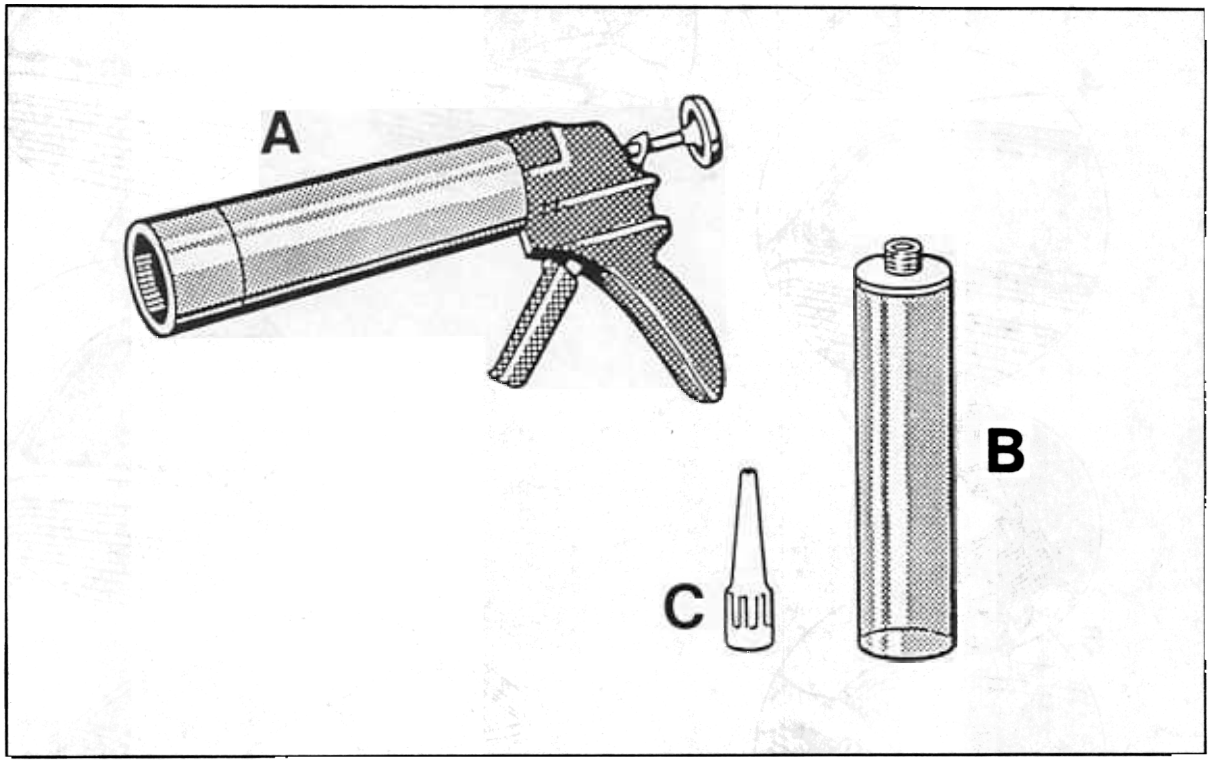
Insulating the gap between windshield and body



64 86 51 Sealing the rear window

Insulating the gap between rear window and body

The following tools and materials are needed for insulating the gap between the rear window and the body.



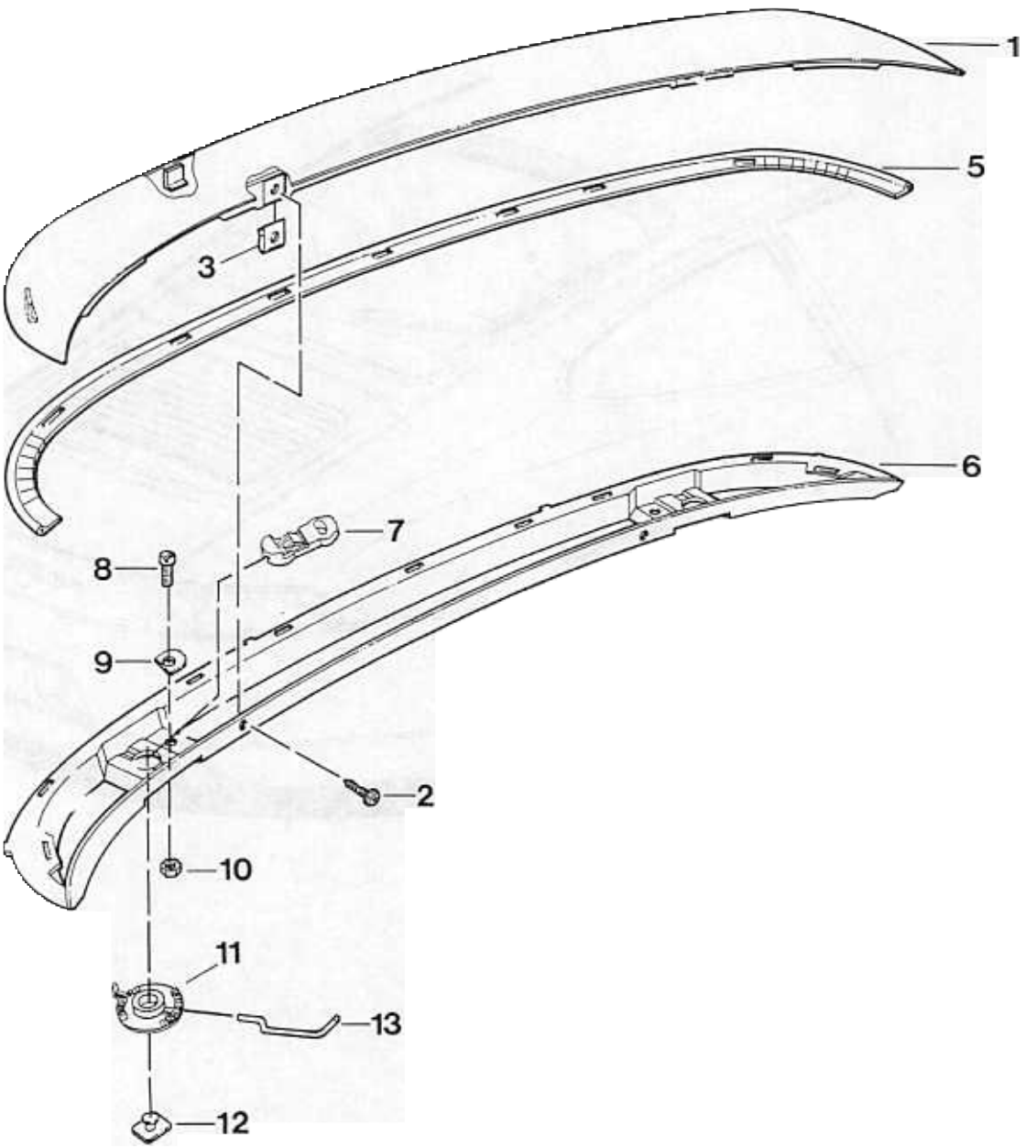
A = bonding gun

B = cartridge of insulation material

C = application nozzle

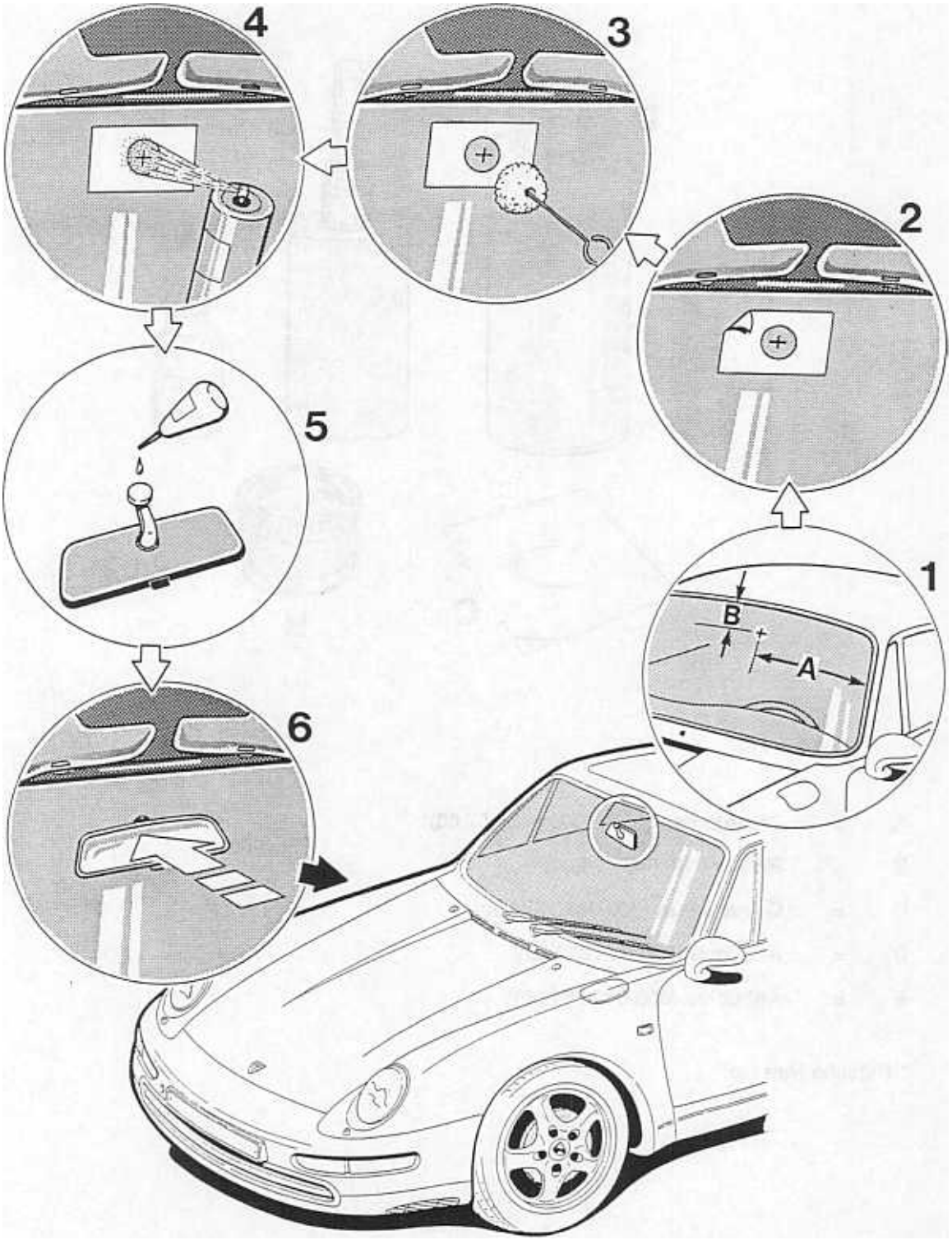
No.	Designation	Qty.	Note: Removal	Installation
53	Toothed sector	1		Fit tab (A) of the toothed sector (53) into the opening (B) of the guide lever (C) on the linkage (49)
54	Torsion spring	1		
55	Rubber stop	2		
56	Right-hand grille, only ***Carrera S***	1		
57	Left-hand grille, only ***Carrera S***	1		
58	Centre grille, only ***Carrera S***	1		
59	Rail, only ***Carrera S***	1		
60	Hexagon-head bolt M5	1		
A	Tab on toothed sector	1		
B	Opening in guide lever	1		
C	Guide lever on linkage	1		

66 38 19 Removing and installing roof cover



68 27 13 Bonding interior rearview mirror into place

Bonding assembled interior rearview mirror to the windshield



68 68 19 Removing and installing passenger airbag unit

1. Disconnect battery and cover terminal or battery.

2. Remove left and right-hand side nozzles.

3. Remove radio and mounting bracket.

4. Remove heater and air conditioning control and mounting bracket.

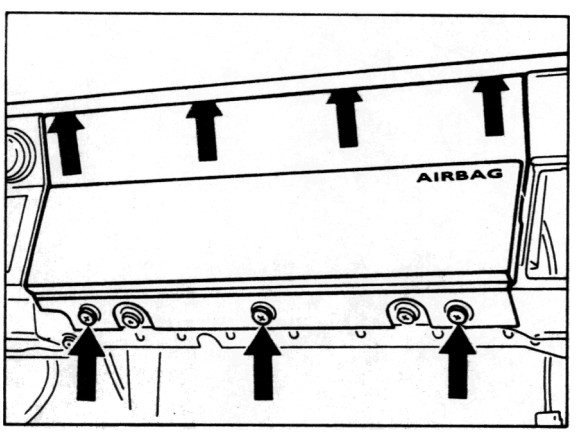
Note

One nut and bolt assembly each for the knee protector mounting is located below the mounting bracket and the side nozzles.

5. Remove ashtray.

6. Remove knee protector. Disconnect plug-in connector of airbag unit.

7. Release lower airbag flap (3 screws). Release upper airbag cap (4 screws). After releasing the 4 screws, press flap forward and pull out from below (the flap engages into a stay).

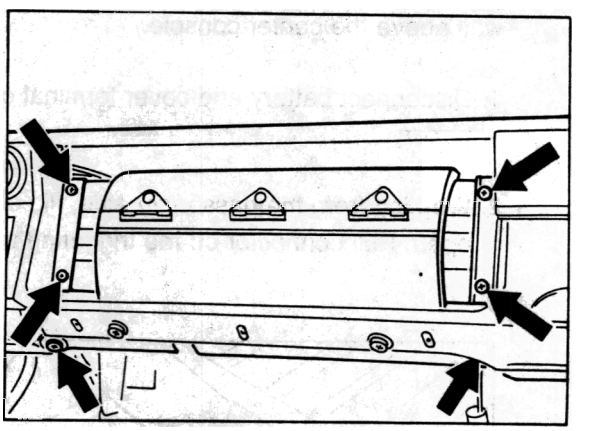


1719-68

Note

The hex socket head bolts are micro-sealed. Use new screws when refitting the assembly. **Tightening torque: 6 Nm** (4 ftlb.)

8. Release airbag unit and pull out from below.



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Removing and installing inside rear view mirror

Removing inside rear view mirror

No.	Operation	Instructions
1	Fix pliers in position	Set pliers to diameter of mirror foot and attach pliers to foot of mirror with projecting plastic parts facing windshield.
2	Loosen mirror	Turn foot of inside rear view mirror 90° using pliers (**special tool 9578**). Remove pliers from foot of mirror.
3	Remove mirror	Unclip foot of inside rear view mirror from retaining plate on windshield. **After removal of the inside rear view mirror from its foot, the small aluminium chip in the locking area must be removed as otherwise it might not be possible to seat the mirror securely when it is fitted. If fitting for the second or third time, check the locking area of the mirror foot for wear and replace the mirror if necessary.**

Installing inside rear view mirror

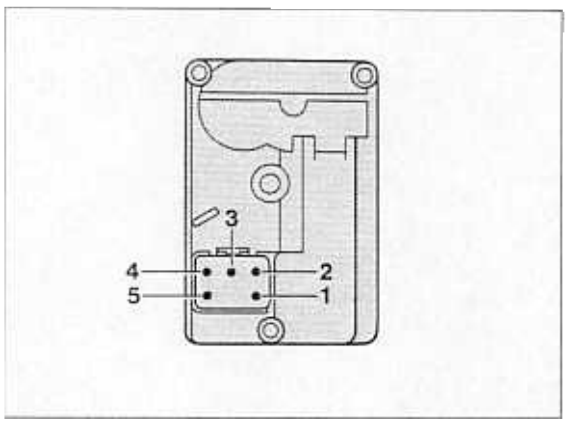
No.	Operation	Instructions
4	Insert mirror	Clip foot of inside rear view mirror, turned 90°, into retaining plate on windshield.
5	Fix mirror in position	Attach pliers **(special tool 9578)** to foot of mirror with projecting plastic parts facing windshield. Turn the foot of the mirror 90° using the pliers. **The mirror must not be turned beyond the locking point.** Remove pliers from foot of mirror.

No.	Operation	Instructions
16	Position seat on seat rail mount at the rear. Screw seat into place at front and rear.	Move the seat up to the stop at the front and alighn the bolt holes correctly at the rear. Position the rear bolts with washers and tighten them. Move the seat to the back and tighten the mounting screws at the front. **Tightening torque at front and rear: 23 Nm (17 ftlb)**

85 16 15 Adjusting the flaps of the heater/ A/C unit

Adjusting the defroster center nozzle flap

1. Set motor to "Defroster closed" end position: Apply a voltage of 12 volts to pin 4 (positive) and pin 5 (negative) using two jumper leads until the motor is positioned in the end position.



256-87

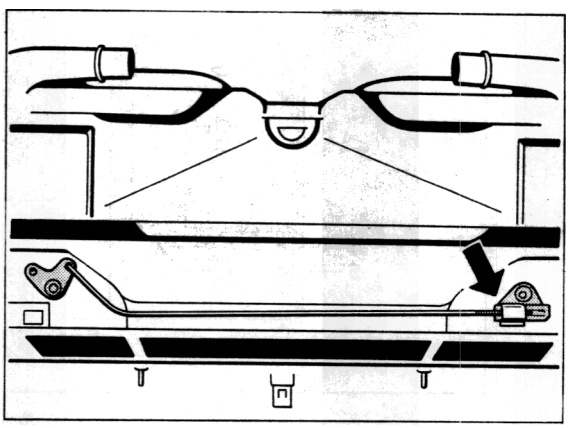
2. Press defroster center nozzle flap into "Defroster nozzle closed" position (upper outlet closed).

3. Assemble motor drive with flap link and lock assembly.

Adjusting the footwell flaps

1. Set motor to "Footwell flaps closed" end position: apply a voltage of 12 volts to pin 4 (negative) and pin 5 (positive) using two jumper leads until the motor is positioned in the end position. The drive lever now points towards the fresh air inlet.

2. Set both footwell flaps to closed position. Engage linkage with lever and locate with clamp.



258-87

87 03 Safety instructions for handling refrigerant R 134 a

The refrigerant R 134a used in this system is specified as a safety refrigerant. This means that this refrigerant is inflammable, non-explosive, non-toxic, non-irritating, odorless and tasteless. The following precautions should nevertheless be observed.

1. Avoid any contact with liquid or gaseous refrigerant. Treat all skin areas affected as in the case of frostbite; rinse with cold water immediately and consult a doctor. Wear goggles to protect your eyes. Consult a doctor immediately if refrigerant gets into your eyes. Wear protective gloves to protect your hands.

2. When repairing the A/C system, drain the system and clean the refrigerant. Even non-chlorine refrigerants must never be released into the atmosphere and must be disposed of correctly.
   Due to the differing chemical composition, different types of refrigerant must never be mixed with each other (not even in small quantities).

3. Never perform welding operations on parts of the closed A/C system or in their immediate vicinity. Heating generates excessive pressure regardless of whether the system is filled with refrigerant or not and may cause system damage or even explosions. R 134 a is completely non-toxic at normal temperatures but will decompose if it gets into contact with flames or if it is exposed to high temperatures.

4. Do not throw refrigerant bottles and do not expose filled bottles to direct sunlight or other heat sources for longer periods of time. The maximum admissible temperature of a filled refrigerant bottle must not exceed 45 °C.

87 53 19 Removing and installing condenser fan

Removal

1. Remove lower front spoiler section on the left side.

2. Pull off electrical connector from fan motor. Unclip headlight wire and vent hose.

3. Pull both headlight washer hoses off the regulator valve. Remove fan bracket from condenser retaining bracket and take out from below.

4. Detach fan from retaining bracket and take off fan.

Note

Check after installation if fan is able to rotate freely.

Tuning remote control units

Note

A maximum of four remote control units may be assigned to a vehicle at the same time. Additional remote control units must **always** be tuned to a vehicle **together** with the two units already assigned to it. Before the code number is entered, the **immobilizer** must be primed but the alarm and central locking systems must not be activated. This status is reached **90 seconds** after the ignition key has been removed or **3 minutes** after the vehicle has been unlocked using the remote control unit if the ignition key is not turned in the lock.

Entry of code number

1. Switch the **ignition** on. The **warning light** in the clock will go on and off again after **15 seconds**.

2. Follow the instructions in points 3 to 6 on page 7.

3. If you have reached the tuning status (point 6 page 7 **warning light is flashing**) the remote control units **must be tuned within one minute.**

4. Press the pushbuttons of the remote control units until the **LEDs** of the alarm system in the doors **flash** (as an acknowledgement). Operate all the remote control units one after the other.

5. If no more remote control units are operated within **1 minute** or the ignition is switched off, tuning is stopped.

911 Carerra RS vehicles

Note

As Carrera RS vehicles are not equipped with a central locking system, both doors must be locked and unlocked using the key.

To deactivate the immobilizer, the remote control unit must be **operated twice** in the following situation.
The immobilizer has self-primed and the ignition has not been switched on.

If the ignition is switched on before operating the remote control unit or the remote control unit is used to activate the immobilizer, the remote control unit must only be operated **once.**

The procedure for tuning remote control units is the same as for the 911 Carrera (993) from model '95.

Printed in Germany - I3, 1995

Retrofitting a CD changer

Remove front compartment carpet, spare tire, protective cover, fuel tank and battery!

No.	Operation	Instructions
1	Insert pop rivet nuts for attachment of the CD changer bracket into side member	Scribe attachment points for CD changer bracket on left-hand front end of side member. Using a 9.5 mm dia. drill bit, drill holes into side member according to scribe marks. Insert M 6 pop rivet nuts into side member and rivet in place using a pop rivet nut gun,
2	Drill 20 mm dia. hole for routing of connecting wire	Scribe hole for routing of CD changer/radio connecting wire on bulkhead and drill to 20 mm dia.
3	Finish assembly of CD changer	Remove transport locks from CD changer. Cover open holes on CD changer using the self-adhesive sheets supplied. Fit interface to CD changer using M 4 x 8 combination screws (4 pc.). Connect interface/CD changer wiring.
4	Insert connecting wire	Route connecting wire across hole in bulkhead, put grommet into place and insert connecting wire into radio. Tie connecting wire to wiring harness along side member.
	Install and connect battery	Enter radio code, correct clock setting and carry out system adaptation.
5	Fit bracket for CD changer	Fit CD changer bracket to side member, using M 6 x 16 combination screws (4 pc.).
6	Fit CD changer	Plug connecting wire into interface (CD changer). Fit CD changer to CD changer bracket, using M 4 x 8 combination screws (5 pc.).
	Check CD changer operation	
7	Fit spare tire, modified front compartment carpet and trim for CD changer	

Printed in Germany - 12, 1995

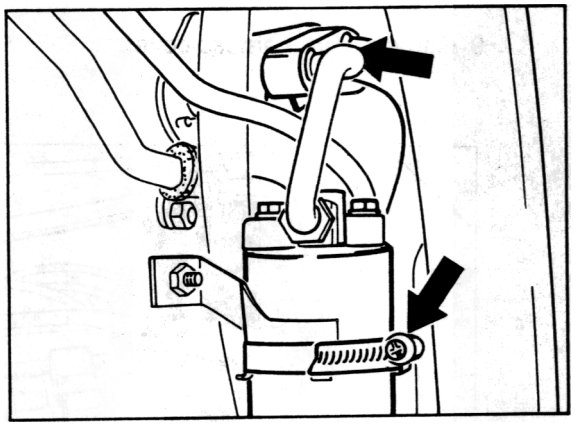
11. Unplug cable connector from final stage of fan.

12. Remove firewall.

13. Disconnect A/C lines from expansion valve. Immediately insert air-tight plugs in ends of all lines and connections. Loosen retaining clip.

14. Remove rear wheel housing liner on front left fender.

15. Disconnect hose clip from fluid reservoir. Undo mounting screw between wheel housing A/C lines and luggage compartment A/C lines. Immediately insert air-tight plugs in ends of all lines.



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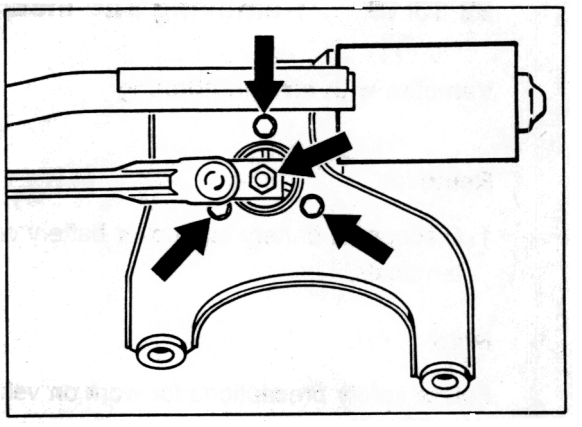
16. Move A/C lines to side from wiper mount.

17. Release mounting nut of linkage, holding a 21 mm open-end wrench against linkage.



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Tightening torque: 22 ± 2 Nm (16 ± 1.5 ftlb.

18. Release mounting screws. Tightening torque: 11 Nm (8 ftlb.).

19. Remove wiper motor through installation opening of tachometer.

Installation

Note

Installation of the wiper motor is much easier if the motor is fixed in position with a stud bolt (sawn-off screw) and a nut. After fixing the motor, fasten it in place with 2 screws. Then unscrew the nut and stud bolt and insert the third screw.

1. Connect battery and switch wiper motor on and off (park position).

2. Install linkage. Cable and linkage must form a straight line.

3. Switch on wiper motor and check wiper positions.

Preface

Structure

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

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

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

Layout

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

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

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

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

97 09 Spare part - passenger compartment wire harness for Model '95

World-wide, 8 wire harnesses are available as spare parts. When using this wire harness, the following modifications must therefore be made:

Left-hand drive vehicles, model '95

1. Insert jumper adapter 964.610.184.00 in relay socket R 34 on the central electrical system (not for Japan and USA/Canada vehicles).
   On Japan and USA/Canada vehicles, the foglight relay remains in position.

2. On Tiptronic vehicles **without immobilizer,** the wire (0.75 mm^2 yellow/black) on the immobilizer relay (R 61), pin 7, must be cut off about 80 mm ahead of the relay socket.
   The lead from relay pin 7 must then be crimped to the lead (4 mm^2, yellow) from pin 3 (double connection).
   See wiring diagram - section N 49 line (0.75 mm^2 yellow) "M 249 not M 530"

3. On manual vehicles **without immobilizer**, jumper adapter 964.610.184.00 must be inserted in relay socket R 61 on the central electrical system.

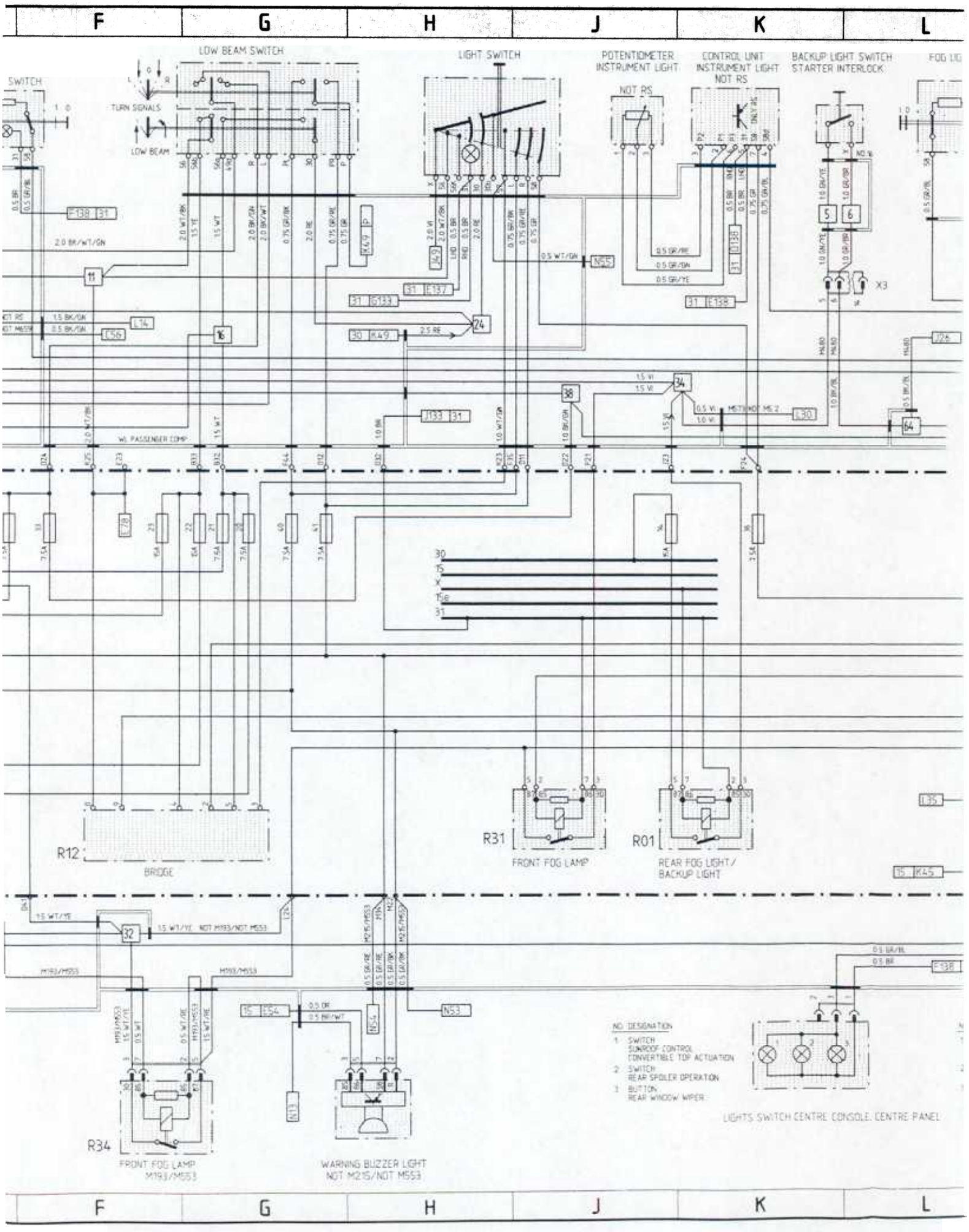
4. On vehicles **with immobilizer**, the lead (0.5 mm^2 orange/black) at connector X 4/2 pin 12 (double connection), must be cut off at the contact, insulated and tied up.

5. On vehicles **without four-wheel drive**, the lead (0.5 mm^2 brown) from connector II (white) on the central informer (Pin 24) must be unclipped and insulated.

6. On vehicles with small fuel tanks (approx. 71 l) the lead (0.5 mm^2 orange/black) from connector II (white) on the central informer (pin 26) must be unclipped and insulated.

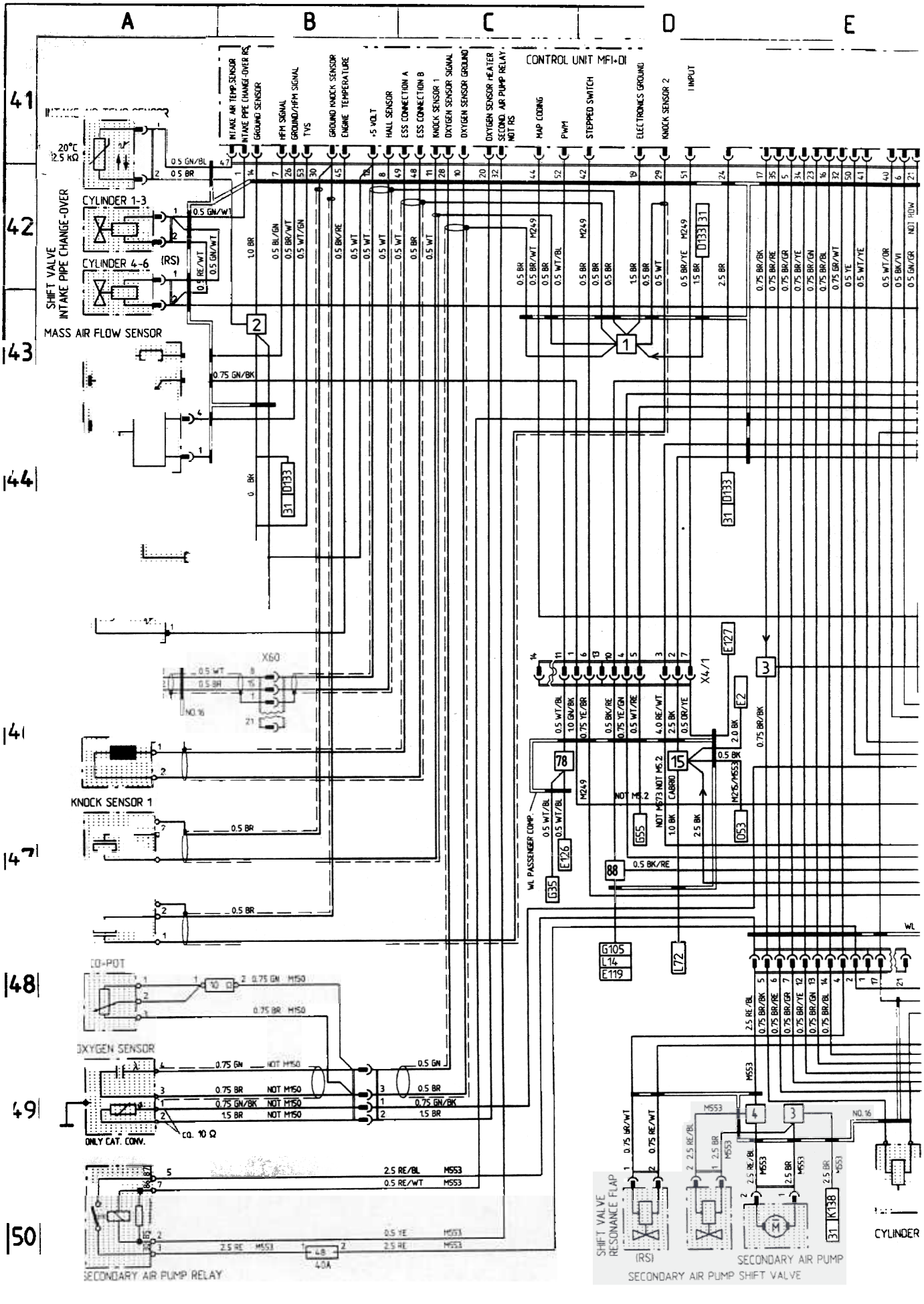
7. On vehicles without **sound package**, radio connector II (loudspeaker lines) must be disconnected from the booster adapter (8-pin connector ahead of radio) and connected to the radio.

8. Instead of the buzzer (443.951.307 B) for the light warning, the gong relay (928.618.102.03) must be installed (already installed on vehicles for USA/Canada and Saudi Arabia).


F
G
H
J
K
L
LOW BEAM SWITCH
LIGHT SWITCH
POTENTIOMETER INSTRUMENT LIGHT
CONTROL UNIT INSTRUMENT LIGHT
NOT RS
BACKUP LIGHT SWITCH STARTER INTERLOCK
TURN SIGNALS
LOW BEAM
R12
BRIDGE
R31
FRONT FOG LAMP
R01
REAR FOG LIGHT / BACKUP LIGHT
R34
FRONT FOG LAMP M193/M553
WARNING BUZZER LIGHT NOT M215/NOT M553
NO. DESIGNATION
1 SWITCH SUNROOF CONTROL CONVERTIBLE TOP ACTUATION
2 SWITCH REAR SPOILER OPERATION
3 BUTTON REAR WINDOW WIPER
LIGHTS SWITCH CENTRE CONSOLE, CENTRE PANEL
BK = BLACK
WT = WHITE
RE = RED
GN = GREEN
YE = YELLOW
GR = GREY
BR = BROWN
BL = BLUE
VI = VIOLET

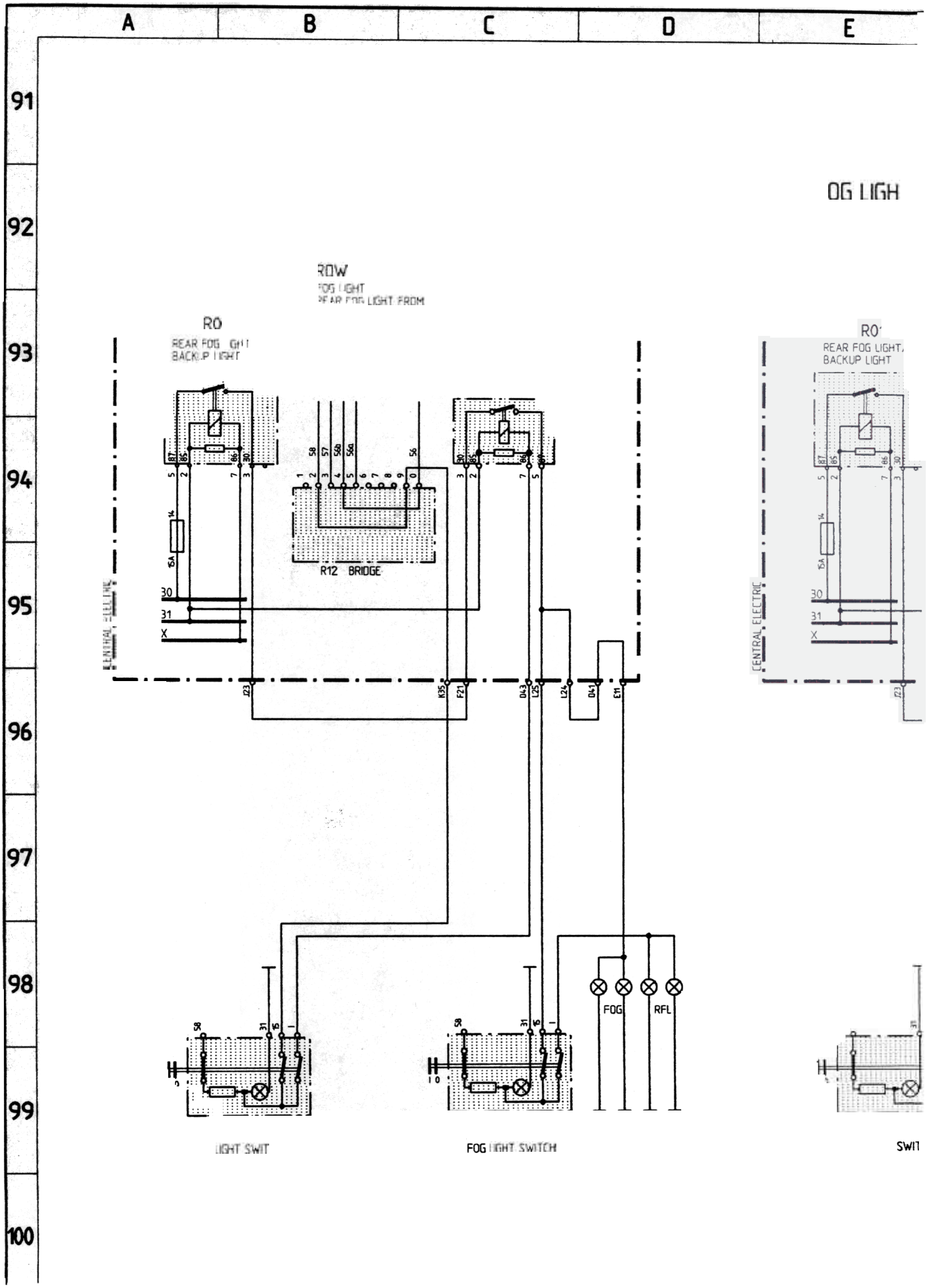
911 Carrera (993) MODEL 95/2 SHEET 5 A

ENGINE ELECTRICS M2.10, FUEL, IGNITION SYSTEM, CRUISE CONTROL



arrera 993 MODEL 95/2 SHEET 10

FOG LIGHT REAR OG LIGHT



F	G	H	J	K	L

DESIGNATION, FUNCTION	POSITION IN VEHICLE LHD	POSITION IN VEHICLE RHD	NOTE	FIELD IN WIRING DIAGRAM
MICRO SWITCH TDC	12cL	12cL	BEHIND SIDE PANEL COVERING	O71
	12cL	12cL	BEHIND SIDE PANEL COVERING	P71
	12aN	12aN	IN ROOF	G73
MOTOR TOP CONTROL RIGHT	15cN	15cN	BEHIND REAR SEAT	N71
MOTOR TOP CONTROL LEFT	15c0	15c0	BEHIND REAR SEAT	N71
MOTOR TOP LOCK RIGHT	9aN	9aN	AT CONVERTIBLE TOP FRAME	K/L79
	9a0	9a0	AT CONVERTIBLE TOP FRAME	J/K79
	16cP	16cP	ON ENGINE	G30
	15cN	15cN	ON ENGINE	A42
OUTSIDE TEMP. SENSOR	2dP	2dP	FRONT LH BUMPER	A60
OXYGEN SENSORS CYL.1-3	16dP	16dP	ON ENGINE	F150
OXYGEN SENSORS CYL.4-6	16dM	16dM	ON ENGINE	D150
OIL PRESSURE SENSOR/SWITCH	14cN	14cN	ON ENGINE	A54
OIL COOLER BLOWER	2dL	2dL	IN WHEEL HOUSING FRONT RIGHT	O21
OIL LEVEL SENSOR	12cK	12cK	IN WHEEL HOUSING REAR RIGHT	E51
OIL TEMPERATURE SENSOR FOR INSTRUMENT	14cN	14cN	ON ENGINE	A53
OIL TEMPERATURE SENSOR FOR OIL COOLER BLOWER	2dL	2dL	IN WHEEL HOUSING FRONT RIGHT	J21
PRESSURE TRANSDUCER, CHARGE AIR PRESSURE	16bM	16bM	ON ENGINE	A56
PRESSURE SWITCH AIR CONDITIONING SYSTEM	6b0	6b0	IN LUGGAGE COMPARTMENT	E30
PRESSURE WARNING SWITCH	1d0	1d0	IN LUGGAGE COMPARTMENT	M/N39
REAR FOG LIGHT CUTOUT RELAY	17dN	17dN	BEHIND REAR PANEL	H108
REAR WINDOW WIPER RELAY	15b0	15b0	ON REAR WINDOW WIPER MOTOR	E71
	16dP	16dP	IN ENGINE COMPARTMENT	J30
	2dQ	2dQ	IN WHEEL HOUSING FRONT LEFT	M21
RESISTOR OIL COOLER BLOWER	2dL	2dL	IN WHEEL HOUSING FRONT RIGHT	
RELAY CONDENSER BLOWER	6cM	6cM	CENTRAL ELECTRIC	L21
RELAY AC COMPRESSOR	16cP	16cP	CARRIER PLATE IN ENGINE COMPARTMENT	L30
RELAY TWO-TONE HORN	6cM	6cM	CENTRAL ELECTRIC	F78
RELAY POWER WINDOW	6cM	6cM	CENTRAL ELECTRIC	K18/19
RELAY BLOWER ENGINE COMPARTMENT	16cP	16cP	CARRIER PLATE IN ENGINE COMPARTMENT	J/K30
RELAY STARTER TIPTRONIC-TRANSMISSION	6cM	6cM	CENTRAL ELECTRIC	N50
RELAY BACKUP LIGHT	7bQ	7bQ	IN LUGGAGE COMPARTMENT LEFT	
RELAY THERMO SWITCH CATALYTIC CONVERTER	6cM	6cM	CENTRAL ELECTRIC	L/M51
RELAY TERM.X	6cM	6cM	CENTRAL ELECTRIC	J/K44
RELAY TERM.15 E	6cM	6cM	CENTRAL ELECTRIC	K/L44
RELAY RFL - BACKUP LIGHT	6cM	6cM	CENTRAL ELECTRIC	J/K7, A-M94
RELAY FRONT FOG LAMP	6cM	6cM	CENTRAL ELECTRIC	J7, C-094
RELAY OIL COOLER BLOWER	6cM	6cM	CENTRAL ELECTRIC	K21
	4cL	4cL	IN LUGGAGE COMPARTMENT RIGHT	M39
	6cM	6cM	CENTRAL ELECTRIC	H75
RELAY DAYTIME RUNNING LIGHT CANADA	6cM	6cM	CENTRAL ELECTRIC	D1
RELAY FOG LIGHT SWITCH OFF USA/JAPAN	6cM	6cM	CENTRAL ELECTRIC	H-P/94, F/G10
SECONDARY AIR PUMP RELAY	17cP	17cP	ON CARRIER ON LH SIDE IN ENGINE COMPARTMENT	A50
STOP LIGHT SWITCH	6dP	6dM	AT THE BRAKE PEDAL BELOW THE FLOOR PANEL	N9
	12d0	12d0	ON GEARBOX	D-F129
SHIFT VALVE RESONANCE FLAP		15bN	ON ENGINE	H41
STARTER	14dN	14dN	BY CLUTCH HOUSING RIGHT	P49/50
SECONDARY AIR PUMP	16cN	16cN	ON ENGINE	D/E50
	15bN	15bN	ON THROTTLE VALVE ASSEMBLY	A44
TIMING VALVE	16cM	16cM	ON ENGINE	L150
TANK VENTING VALVE	16cP	16cP	ON ENGINE	K41
TWO-TONE HORN I	3cL	3cL	IN WHEEL HOUSING FRONT RIGHT	F80
TWO-TONE HORN II	3cL	3cL	IN WHEEL HOUSING FRONT RIGHT	G80
V-BELT CONTROL	17d0	17d0	ON ENGINE REAR MIDDLE	A55
WINDSHIELD WASHING FLUID PUMP	3cQ	3cQ	BY WASHING FLUID RESERVOIR IN WHEEL HOUSING FL	A78
WIPER INTERMITTENT CONTROL RELAY	6cM	6cM	CENTRAL ELECTRIC	F/G75

F	G	H	J	K	L

Survey of contents of Service Information Technik '95

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

One troubleshooting requirement is that the testing person

- is familiar with the location of components, operation and technical relationships among the systems to be tested
- is able to read and analyze Porsche wiring diagrams
- is familiar with functions of circuits and relays
- is able to operate and analyze testers such as oscilloscope, voltmeter, ohmmeter and ammeter

The fault text in the display indicates a fault path, i.e. the fault may be present anywhere along the path, starting from the control unit across all connectors up to the component itself.
Before reading out the fault memory, do not try to locate the fault e.g. by pulling off connectors etc. as this would cause a fault to be stored in the fault memory.

Note for System Tester 9288

If the Tester displays "**...not present**"", this may mean:

- Fault was not present when the test condition existed

  In case of an intermittent fault, the + symbol is also displayed.
  Example: "**...not present +**"
  Remedy: Check path visually

  Test conditions under which the fault was tested do not correspond to the ambient conditions when the fault occurred.
  Remedy: Meet the ambient conditions displayed on the tester

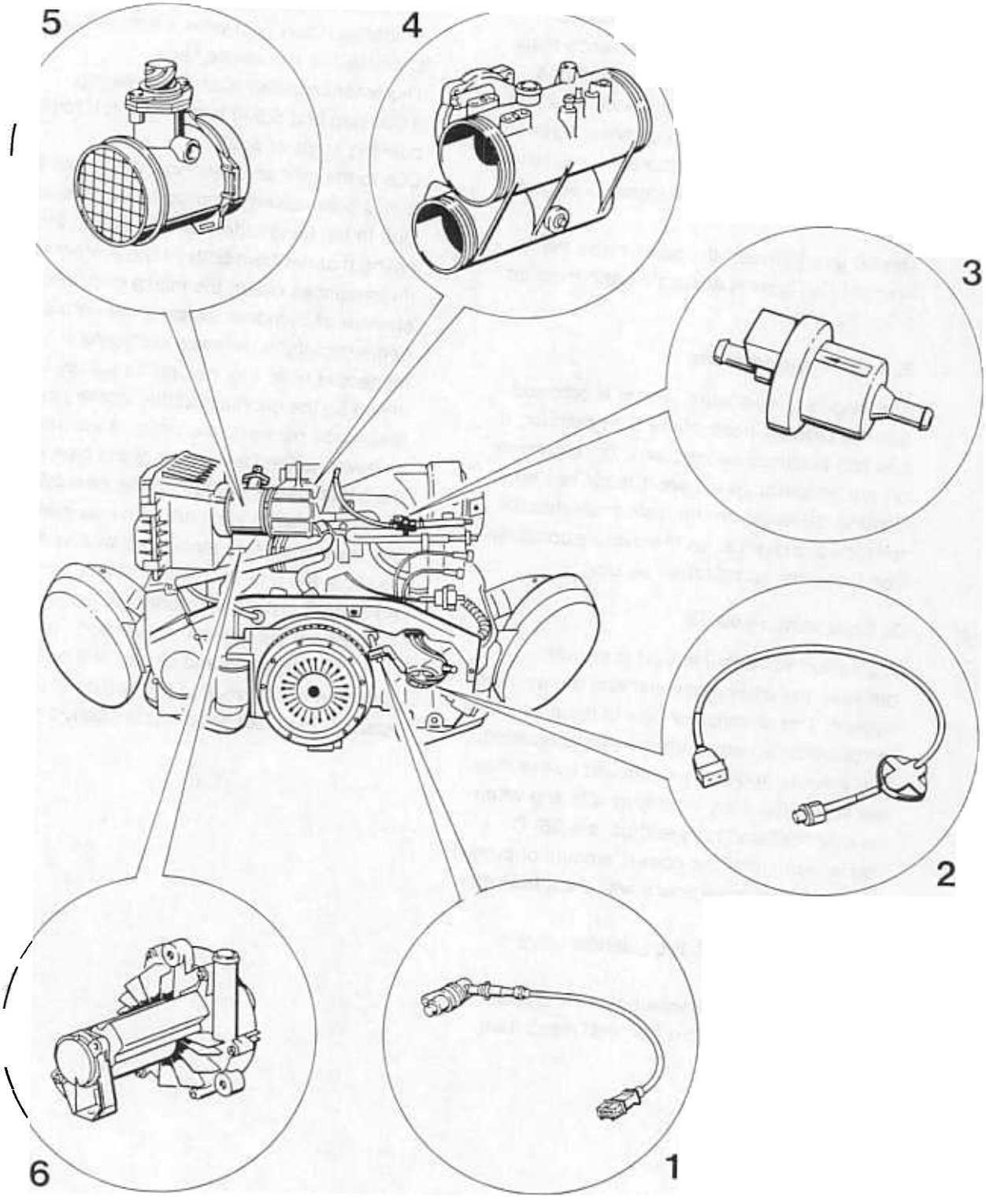
If the tester displays "**Signal unplausible**", this may mean that

- the signal of the monitored component is not within the tolerance range

Explanation of the counter displayed on the Tester display

When the fault occurs for the first time, the counter is always set to 50. If a lower figure is displayed, calculate the difference between the 50 and the number indicated. This value is equal to the combination of – Starting procedure, meeting the test requirements and non-presence of the fault –. When the number 0 is reached, the fault path in the control unit is erased.
If the fault status changes from not present to present at a figure below 50, the counter is reset to 50. If a figure above 50 is displayed, the difference corresponds to the number of intermittent contacts that have ocurred. Even when the values are above 50, the counter counts back to 0 when the above combination is met.

Arrangement of components on the engine



Engine in perfect running condition
Battery charged
Starter motor cranks the engine

Terms in bold letters = Display Fault Memory / Fault Path

Test point	1	2	3	4	5	6	7	8	9	10	11	12	13
Plug, control Unit	24 → 18 24 → 27	45 → 14		49 → 48		7 → 26							
Test equipment	V	Ω	V	≡	≡	V		V	Ω		V≡	V≡	
Fault Code 1		14	15	18	19	21	22	23 24	25	26	27	28	31
Supply voltage													
Engine temperature sensor 2													
Throttle potentiometer													
Rpm signal													
Speed signal <- Speedometer													
Hot Film Mass Air flow sensor													
Oxygen sensor (Signal)													
Oxygen regulation/Oxygen sensor													
Intake Temperature Sensor													
Ignition timing change													
Opening winding of idle stabilizer													
Closing winding of idle stabilizer													
Knock sensor 1													

Engine will not start	x	x		x									
Engine hard to start		x		x		x					x	x	
Erratic idling		x	x			x					x	x	
Poor pick-up		x	x	x		x	x	x	x				x
Misfiring	x			x		x							
High fuel consumption		x	x			x	x	x					x
Poor energie power		x		x		x	x	x	x				x
Engine hesitation	x	x		x		x	x	x					
Poor hot starting											x	x	
Diagnosis not practicable	x												

Fault, Fault Code	Possible Causes, Elimination, Remarks

Test point 15

Control unit faulty
(Knock computer)
Fault code 1_33

Ignition timing is retarded by 6° on the crankshaft for all cylinders from a certain engine load if this fault occurs.

Replace control unit.

Test point 16

Hall signal
Fault code 1_34

The hall sender is connected to the control unit for voltage supply (approx. 5 V) and ground connection.

The signal is fed to the control unit via the 0 line.

In case of error display: Check voltage supply, ground connection and signal line in accordance with the wiring diagram.

Hall sender plug terminals		Control unit plug terminals
	→	19
2	→	8
3	→	12

Test point 17

Idle CO
potentiometer
Fault code 1_36

On vehicles without catalytic converter that show fault code 36, start by testing the control unit coding with System Tester 9288, **Actual values menu item.**

If the coding is O.K., check power supply for CO potentiometer and potentiometer signal in accordance with the wiring diagram.

Test point 18

Control unit faulty

Fault code 1_41

If this fault is detected by the control unit, maximum engine speed is limited to 6,000 rpm 6 minutes after starting the engine. This is done to protect the engine.

General Information

A self-diagnosis feature with fault memory is built into the transmission control unit to allow specific faults within the electronic Tiptronic control to be detected and 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 engine starts.

Caution!

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

If terminal 15 becomes inoperative, the system enters the "emergency mode". The fault warning lamp does not light up in this case.

In "emergency mode" and if diagnosis wires are faulty, the diagnosis program cannot be entered (see page 03 - 3).

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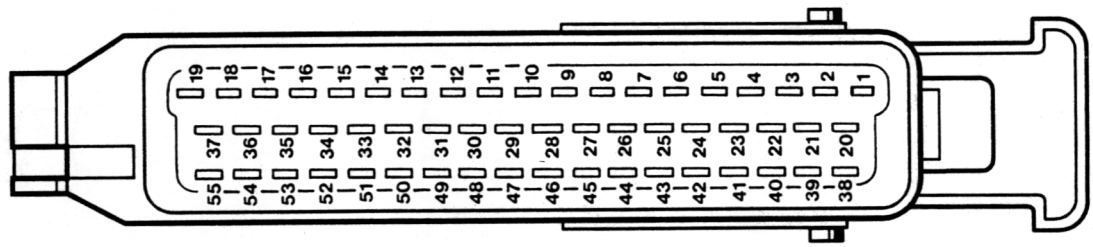
Connector pin assignment (Transmission control unit connector)



1 - Terminal 15 E
2 - Output rpm +
3 - Engine rpm (TN)
4 - Stop light
5 - Solenoid valve 1
6 - Solenoid valve modulating pressure
7 - Electronics - Ground
8 - Input +5 V (reference voltage)
9 - Pin coding 1
10 - Upshift
11 - Throttle signal
12 - Front wheel speed (FR)
13 - Manual program display
14 - Position Y switch
15 - L wire
16 - 1st gear display
17 - Not used
18 - Not used
19 - + for solenoid valves
20 - Shield / output rpm
21 - Load signal (TI)
22 - Not used
23 - Warning lamp
24 - Solenoid valve 2
25 - Reverse light relay
26 - Power ground
27 - Not used
28 - Pin coding 2
29 - Downshift
30 - Kickdown
31 - 2nd gear display
32 - Change of ignition timing
33 - Position Z switch
34 - Not used
35 - Not used
36 - Not used
37 - Not used
38 - Output rpm –
39 - Terminal 30
40 - Transverse acceleration sensor
41 - Redundancy
42 - Lockup clutch solenoid valve
43 - 3rd gear display
44 - Ground (ATF temperature sensor/ transverse acceleration sensor)
45 - Output + 5V
46 - ATF-Temperature sensor
47 - Not used
48 - Input signal (manual program)
49 - Not used
50 - Position X switch
51 - K wire
52 - Not used
53 - Not used
54 - Not used
55 - 4th gear display

Fault, fault code	Possible causes, remedy, notes

- Is cable adjusted correctly?
- Repair instructions: „Adjust position switch"
- Open circuit, short to ground, short to positive?

4) Check position switch without connections
- Pull connector off the switch
- Check switch for continuity acc. to Table 2

Fig. 7

Ohmmeter display

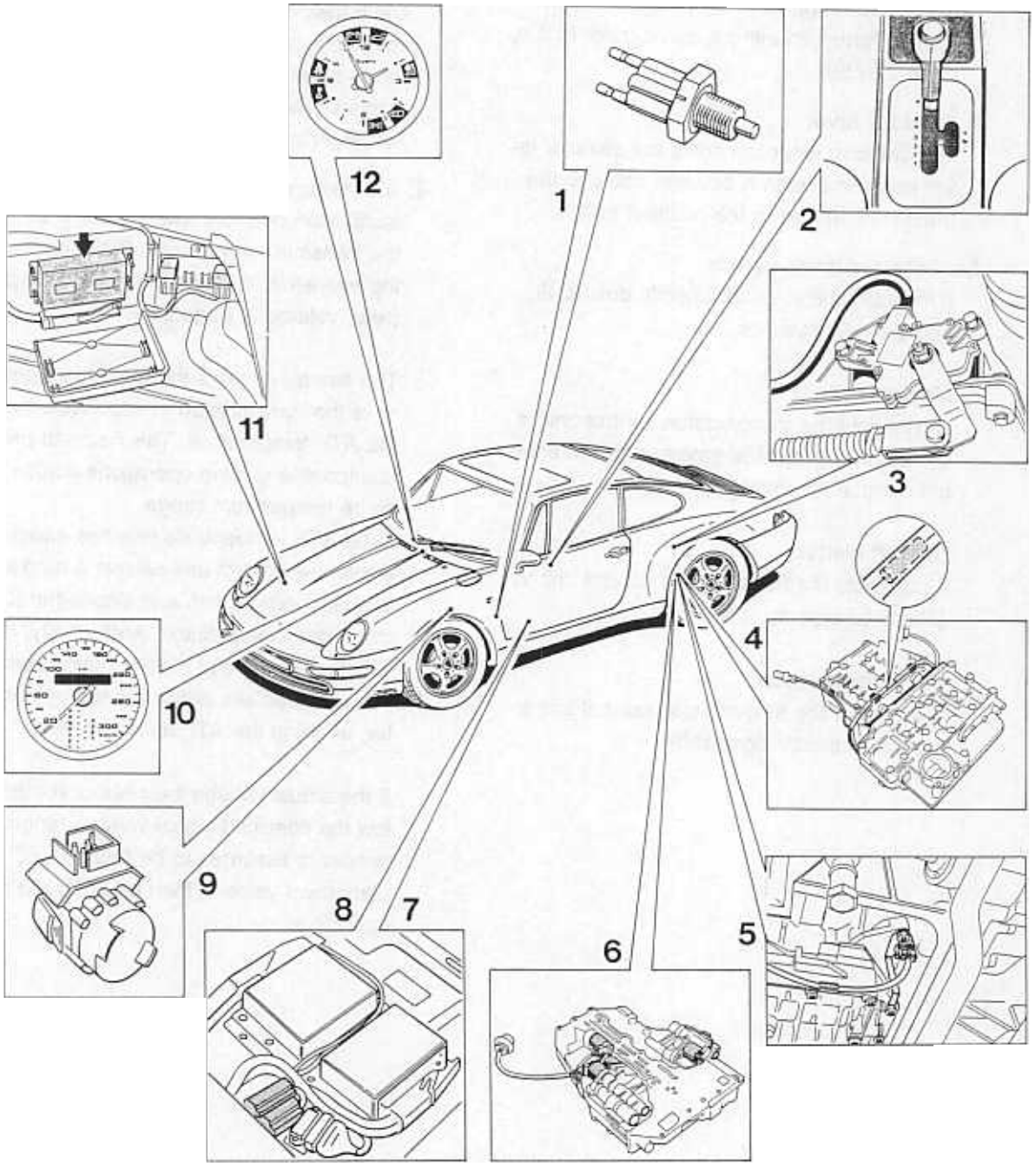
– = No continuity
0 = Continuity

Table 2

Pin	E-B	E-C	E-A	F-G	H-D
P	–	–	0	0	0
R	0	–	0	–	0
N	0	–	–	0	–
D	0	0	–	–	
3	0	0	0		
2	–	0	0		
1	–	0	–		

Faulty? Replace position switch

Component layout



Test point	Fault code	Title	Causes	Page
16	44	Control unit defective (watchdog)	Restricted driving program	37 - 79
17	45	Rpm limiter	Restricted driving program	37 - 79
18	46	Downshift protection	Restricted driving program	37 - 79
19	49	Control unit defective (EEPROM)	No reaction	37 - 79
20	51	Manual program switch	No manual program	37 - 80
21	53	Switch, kickdown	No kickdown	37 - 80
22	55	Speed signal (FR)	No manual program	37 - 80
23	56	Instrument cluster control	No reaction	37 - 81
24	59	Switch, R position	Restricted driving program	37 - 82
25	62	Speed signal (FL)	No manual program	37 - 82
26	63	Shiftlock P/N ground	No reaction	37 - 84
27	71	Gear monitoring 1st gear	No reaction	37 - 84
28	72	Gear monitoring 2nd gear	No reaction	37 - 84
29	73	Gear monitoring 3rd gear	No reaction	37 - 84
30	74	Gear monitoring 4th gear	No reaction	37 - 84

Fault, fault code	Possible causes, remedy, notes
Test point 20 **Manual program switch** Fault code 51	**No manual program available** Detectable faults: Short to ground 1) Check operation with Tester 9288 (Input signals) 2) Pull off connector from transmission control unit Check connection from transmission control unit connector pin 13 to selector lever switch/pin 3 Connection o.k. Replace selector lever switch plate Switch and connection o.k.: Transmission control unit faulty
Test point 21 **Kick-down switch** Fault code 53	**No kickdown shift** Detectable faults: Short to ground 1a) Acoustical switch test b) Check operation with Tester 9288 (Input signals test) 2) Remove and check kickdown switch (Note: Adjust switch after replacement) 3) Pull off connector from transmission control unit. Check connection from transmission control unit connector pin 18 to kickdown switch pin 2. Check o.k.: Transmission control unit faulty
Test point 22 **Speed signal (FR)** Fault code 55	**Upshifting is not prevented, no manual program** Detectable faults: Open circuit/short to ground/short to positive 1) Signal comes from ABS. ABS o.k.? 2) Check signal with Tester 9288, raising the vehicle and rotating right-hand front wheel manually.

4. Speed sensor

The speed sensors (rpm sensors) supply wheel speed information (speed information for each individual wheel) to the control unit. The Speed sensors operate according to the inductive principle and, corresponding to the number of teeth of a pulse wheel, generate sinusoidal alternating voltages, the frequency of which is an indicator of the wheel speed.

Note

The front and rear speed sensors are **different**.
Identification: Part No. on speed sensor wire and position of mounting hole relative to the edge position (see page 45-23).

5. Warning and information lamps

System readiness display (warning lamps).

Fault display (warning lamps).

Control display (ABD information lamp).

Note

No. 7 (Page 45-8) = ABS warning lamp
No. 3 (Page 45-8) = ABD warning lamp
No. 2 (Page 45-8) = ABD information lamp

6. Hydraulic unit

The main components of the hydraulic unit consist essentially of several fast-switching solenoids and a return pump. Regardless of the pressure in the brake master cylinder, the hydraulic unit can modify the fluid pressure to the wheel cylinders (pressure holding or pressure reduction). It is not possible, however, to increase the pressure beyond the pressure applied by the master cylinder.

The ABS 5 hydraulic unit has
3 hydraulic outputs (3-channel system) and 6 solenoid valves (3 inlet and 3 outlet solenoids).

The ABS 5 / ABD hydraulic unit has
4 hydraulic outputs (4-channel system) and 10 solenoid valves (4 inlet solenoids / 4 outlet solenoids as well as 1 switch-over and 1 intake solenoid).
The intake and switch-over solenoids are required to allow the return pump to perform two duties:

I. Return feed to brake master cylinder (pressure release) for ABS control.
II. Supply feed (presure buildup) to right or left rear wheel brake cylinder with **ABD control.**

Fault, fault code	Possible causes, remedy, notes

Test point 8

Speed sensor front right
Signal unplausible
Fault code 22

General procedure as for test point 7 / fault code 21 (Check speed sensor signal with System Tester 9288).

Speed sensor signal: Enter the Actual values menu. Select Speed and then Speed sensor front right.

Test point 9

Speed sensor rear right
Signal unplausible
Fault code 23

General procedure as for test point 7 / fault code 21 (Check speed sensor signal with System Tester 9288).

Speed sensor signal: Enter the Actual values menu. Select speed and then speed sensor rear right.

Test point 10

Speed sensor rear left
Signal unplausible
Fault code 24

General procedure as for test point 7 / fault code 21 (Check speed sensor with System Tester 9288).

Speed sensor signal: Enter Actual values menu. Select speed and then speed sensor rear left.

Test point 11

Speed sensor front left
Open circuit/ short to ground/ short to positive
Fault code 25

Wires / connectors between control unit and speed sensor are not o.k. (open circuit, short to positive or short to ground) or the speed sensor itself is damaged.

- Check speed sensor wire and connector wiring in wheel area for damage (visual check).

  Check speed sensor signal with System Tester 9288 across the Actual values menu (Refer to Test point 7 / fault code 21). If no speed is displayed when the left front wheel rotates, check the wiring path from the control unit connector to the speed sensor (subsequent test step).

  Pull off control unit connector. Measure internal resistance / continuity between PIN 36 and PIN 10 or between PIN 35 and PIN 10, respectively, on the connector (refer to connector pin assignment on page 45-12/13).
  Specification 1600...1800 Ω.
  If the specification is not obtained, check wiring and connectors in wiring path from front left speed sensor.
  If specification (1600...1800 Ω) is not obtained although wires / connectors are in perfect condition, replace the speed sensor.

Check 2 during straight-ahead driving at approx. 2-4 km/h
(Signal quality of individual wheels is compared). Check 2 provdes better conclusions on signal quality than check 1.

Re: Check 1

To check, manually rotate left front wheel steadily at approx. 2 to 3km/h (observe tester display)..
Increase speed slowly and observe speed increase (display) at the same time.

Specifications/Specifications display
Speed increments of approx. 0.06 km/h. Initial display at 1.75 km/h. This means: The subsequent value must exceed the value measured last by 0.06 km/h or must be 0.06 km/h below this value when the wheel is rotated slower.
In some cases, the tester rounds the value down to 0.05 km/h or up to 0.07 km/h.

Example

First measured value	=1.81 km/h
Second value as specified	=1,87 km/h
Third specified value	=1,93 km/h
etc.	

Note

Lock the oposite wheel (to prevent from rotating) when checking the wheels on the rear axle.
On four-wheel drive vehicles, the three other wheels must be locked during this check.

Re: Check 2

Select all 4 wheels on tester display by additionally pressing tester button 1 (function key 1).

Drive smoothly at approx. 2-4 km/h in a straight-ahead direction and have a helper observe the tester display.

Specification: Wheel speeds of all four wheels must not
deviate from each other by **more than 1 km/h**.

Re: Signal of terminal 61

Specified display:
Engine stopped - Signal not present
Engine running - Signal present

Re: Throttle signal:

Precondition: Engine runs. Throttle position is displayed as a percentage. Display changes according to throttle position when the accelerator is depressed.