Cruise Control - Citroen XM 2.5 TD

Cruise Control is fitted as standard on 2.5 TD Exclusive models. None of my 3 VSX 2.5 TD's were factory fitted but all have been successfully retro fitted just by adding the control and engagement switches. The wiring was found to be insitu complete with plugs to fit both the switches. After installation, on next turn on of the ignition the ECU recognised the presence of the cruise controls. Learning how to use cruise was the biggest problem in all of this and took a few days. Broadly the dash switch enables and disables cruise capability. The steering column lever sets cruise into action and selects speed. Cruise can be disabled by flicking the column lever or using the brake. See drivers manual for full details.
Components needed:

Engagement switch – Part No 96 132 778 ZL – cost £25.87plus vat
Control switch – Part No 6552 HK – cost £15.32 plus vat (in Sept 2004)

Fitting:

First check that the cruise control wiring and plugs are present in the car.

1. Prize out the blank switch above the climate controls on the dash and check that a yellow plug with 4 wires is present. This will take the control switch. See figs 1 and 2 below:

Figure 1

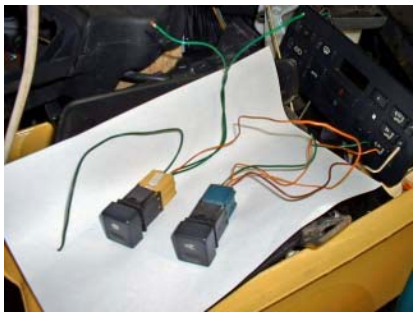

Figure 2

2. Take off the lower plastic shroud on the steering column and by the ignition switch you should see a brown plug and connector. Immediately above this should be found a grey plug with 5 wires fitted to a brown blank socket. This grey plug and blank socket will be held in place with a cable tie. The engagement switch will come with come with a wired brown socket to fit to the grey plug. See figs 3 and 4.

Figure 3

Figure 4

The engagement switch fits to the lower half of the steering column shroud. You will find 3 plastic pillar mouldings to take the 3 mounting screws on the inside of the shroud. See fig 5.

Figure 5

A hole will need to be drilled in the side of the shroud to let the engagement lever fit through with sufficient space for it to operate. The hole that I needed to drill can be seen in fig 5 just above the three switch mounting pillars. I used a 22mm hole saw and this is about the same size as the purpose made hole in the shroud of an exclusive model. The centre of the hole was 15mm to the side of the vertical crease between the two angles at the side of the shroud and 28mm from the base of the shroud. Figs 6 and 7 show the shroud before and after drilling the hole. Note that the shroud is shown upside down in these photos.

Figure 6

Figure 7

Reassemble the shroud and then test the new controls.

JRM 10/07/05 file CC002XMTD1

Citroen XM 2.5TD – ECU Models and Related Emissions Standards

Engine	Emissions Std	ECU Type	Bosch Part no	Citroen Part No	Citroen Part No		Bar Code	Any other relevant info
DK5ATE/L	L17, L18	Bosch MSA 11 3.6	0 281 001 212	1929 E5 / 1929 X9	96 157 661 / 96 237 486	from model year 07/1994, for manufacturers emission standard EURO 1993 - CEE 19.05	EAN No: 31 65 142 02 608 4	
DK5ATE/Y	Y19	Bosch MSA 11 3.6	0 281 001 213	1929 E6 / 1929 Y0	96 186 320 / 96 237 487	from model year 07/1994, for manufacturers emissions standard U.S. 87	EAN No: 31 65 142 18 037 3	
DK5ATE/Z	Z	`						
DK5ATE/L 3	L3.16	Bosch MSA 11 7.6	0 281 001 336	1929 P9	96 195 596 / 96 211 621	built from 07/1994 until 09/1996 year until Organisation number 7233	EAN No: 31 65 142 66 693 8	
DK5ATE/D	L3.17	Bosch MSA 11 7.6	0 281 001 589	1929 6P	96 286 071	from model year 10/1996, EURO emission standards for manufacturers in Euro1996, CEE(EEC) 95, L3, from Organisation number 7234	EAN No: 31 65 143 06 235 7	

Emission Standards	
K	1504
L	EEC93 (CEE93)
Y	US87
Z	US83
L3	EEC96(CEE96)/Euro96
L3.16	Euro96
L3.17	
L4	EEC2000(Euro2000)

ECU Type variations for CITROEN XM

Serial Programming	Chip No.	ECU No.	Eprom	Chksum
EPROM	2287358818	281001212	27C256	F700
EPROM	2287358818	281001336	27C256	FD00
EPROM	2237355488	281001336	87C257	5
EPROM	228735XXXX	281001213	27C256	2F00
EPROM	223735xxxx	281001213	87C257	800
EPROM	1037355913	281001589	27C256	2
EPROM	1037355914	281001589	87C257	D800

Tier	Date	CO	THC	NMHC	NO_x	$HC+NO_x$	PM	P***
Euro 1†	July 1992	2.72 (3.16)	-	-	-	0.97 (1.13)	0.14 (0.18)	–
Euro 2	January 1996	1.0	-	-	-	0.7	0.08	–
Euro 3	January 2000	0.64	-	-	0.50	0.56	0.05	–
Euro 4	January 2005	0.50	-	-	0.25	0.30	0.025	–
Euro 5	September 2009	0.500	-	-	0.180	0.230	0.005	–
Euro 6 (future)	September 2014	0.500	-	-	0.080	0.170	0.005	–

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Citroen 2.5TD Turbo repair
Does your 2.5TD lack that sparkle in terms of pulling power whether overtaking or pulling a heavy load? Whilst there are many permutations of faults which can lead to this condition a very important one is the wastegate on the turbo.

On a 2.5TD the wastegate on the turbo is purely mechanically controlled. There is no electric, electronic or any other wizardry connected to the turbo. The turbo spins due to the volume of exhaust gases leaving the engine being pushed through the exhaust turbine which drives the compressor via a common shaft. The compressor draws in fresh air through the air filter and raises its pressure to approximately 1 Bar(gauge) or 14.5 psi in old money. The discharge pressure from the turbo is experienced by all of the downstream components including the piping, intercooler, inlet manifold and most importantly the wastegate actuator. A small (approx 5mm diameter) plastic hose is connected to the piping just downstream of the turbo outlet. The plastic hose is connected to the wastegate actuator. The actuator consists of a set of bellows mounted inside a tube. The bellows act against a spring and the spring maintains the bellows in a compressed state when at rest. On the end of the bellows there is a circular plate with a rod fixed to the centre. The rod passes out of the tube and is fitted with an eyelet at the extreme end. In between the actuator and the eyelet is a threaded section which is used to lengthen or shorten the rod. This adjustment in length affects the pressure at which the wastegate opens. The eyelet is then fitted over a pin on the end of a short crank. The other end of the crank is welded to the pivot point of the wastegate valve itself. As the crank rotates from its rest position the wastegate valve opens. The wastegate valve allows the exhaust gases leaving the engine to bypass the turbine into the car exhaust thereby failing to impart energy to the incoming fresh air stream via the compressor. This is the condition required of the wastegate valve when the turbo pressure is not required (eg during deceleration).

When the outlet pressure from the turbo rises, the sensed pressure travels along the plastic hose and inflates the bellows in the actuator. When the pressure in the bellows overcomes the spring pressure acting in the opposite direction then the rod begins to be pushed out of the actuator by the bellows. The greater the rise in pressure the further the rod is pushed out of the actuator. The more the rod is pushed the more the crank is rotated about its pivot. The greater the rotation of the crank the further the wastegate is opened and the more the exhaust gas is bypassed around the turbine. This causes the turbine to slow down and in turn the compressor produces less pressure. Equilibrium is reached at a pressure determined by the adjusted length of the rod and the strength of the spring in the actuator. (in technical terms the rod length sets the ‘zero’ and the spring ‘k’ value determines the ‘span’. The distance over which the actuator travels or the pressure changes is called the ‘proportional band’). When the pressure from the turbo reduces the reverse of the above sequence takes place.

The photographs below were taken after removing the turbo from the car. To do this the front portion of the exhaust must be removed along with the off-side drive shaft. The 4 bolts holding the turbo to the exhaust manifold are difficult to get to but possible. To slacken them the first time I had to use an oxy-acetylene torch on the nuts to slacken them. The nuts are M8’s but not the usual 13mm across the flats. The outside of the nuts are splined with approx 12 points. I found that a 12 point 10mm ring spanner fitted the nuts and removed them without much problem.

The plastic piping which carries fresh air from the filter to the inlet to the turbo must be removed to allow the turbo to be removed through the space between the rear of the engine and the front crossmember. One end is held onto the turbo inlet by two 10mm bolts which are accessible through the wheel arch. The other end is fixed to a joint in the piping behind the engine with a jubilee clip. The jubilee clip is accessible from below the car.
The plastic piping on the discharge of the turbo is secured with another two 10mm bolts. Again these are accessible through the wheel arch.
The two oil hoses are easily removed but a temporary plug is required on the sump connection to prevent the contents of the sump ending up on the garage floor.

There follows a sequence of annotated photographs of the turbo to illustrate the above description of operation.

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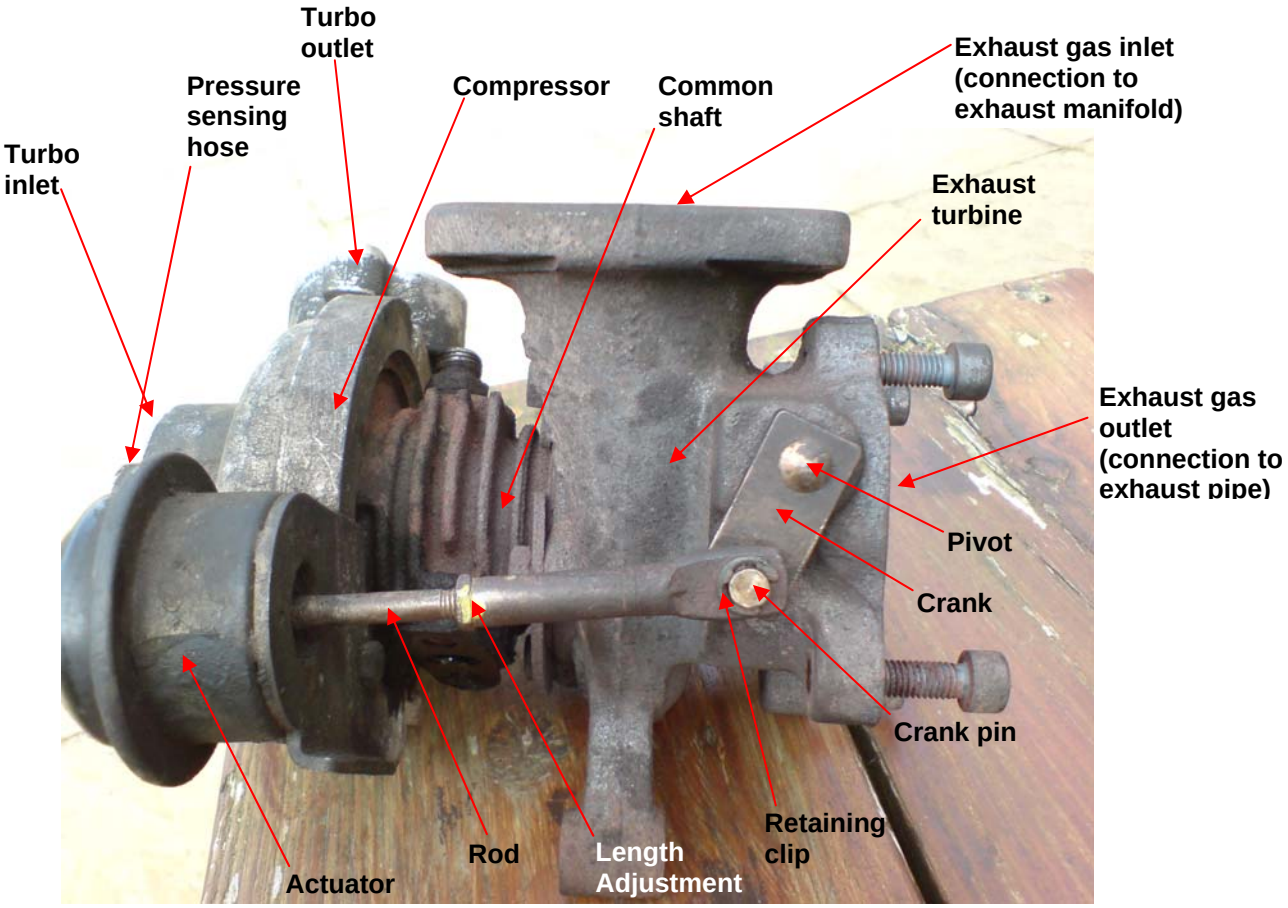

Photo1 – Complete assembled turbo

The photo below shows the eyelet at the end of the actuator rod disconnected from the crank pin after having removed the retaining clip.

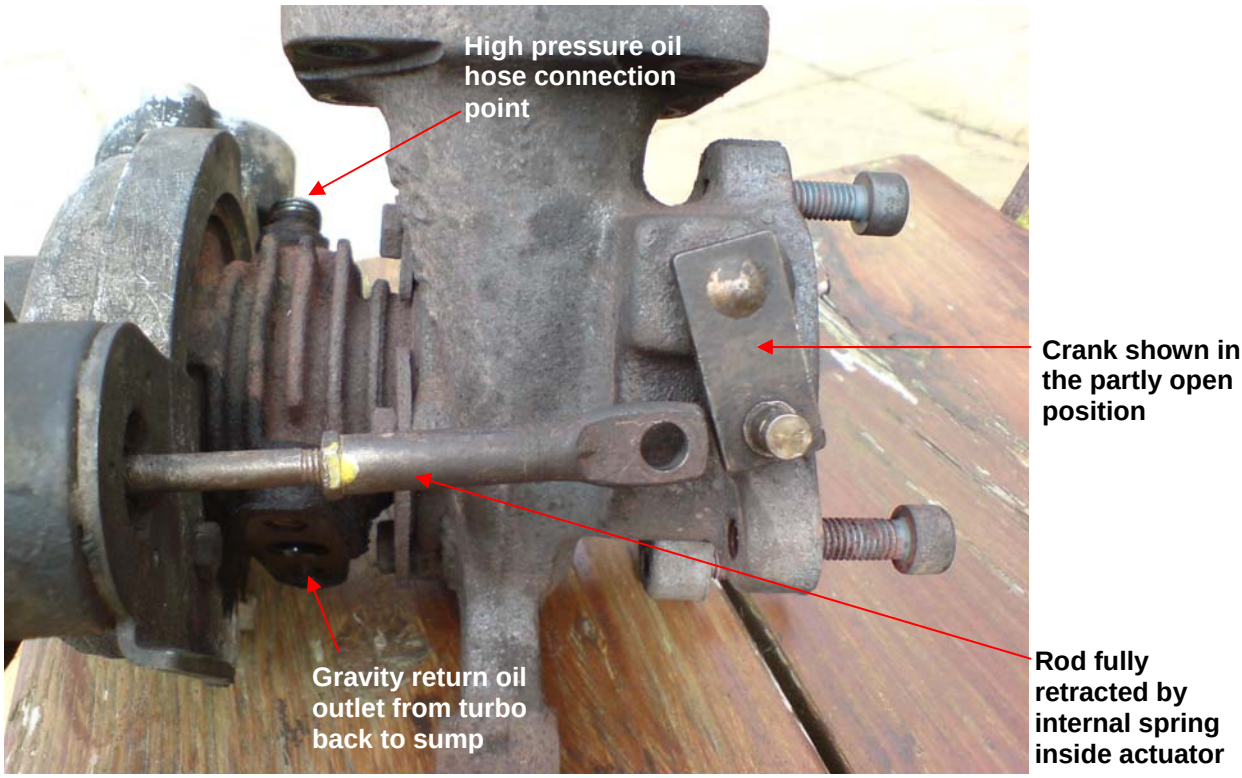

Photo2 – Crank arm disassembled

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The following photo shows the wastegate valve in the fully closed position (maximum pressure/boost)

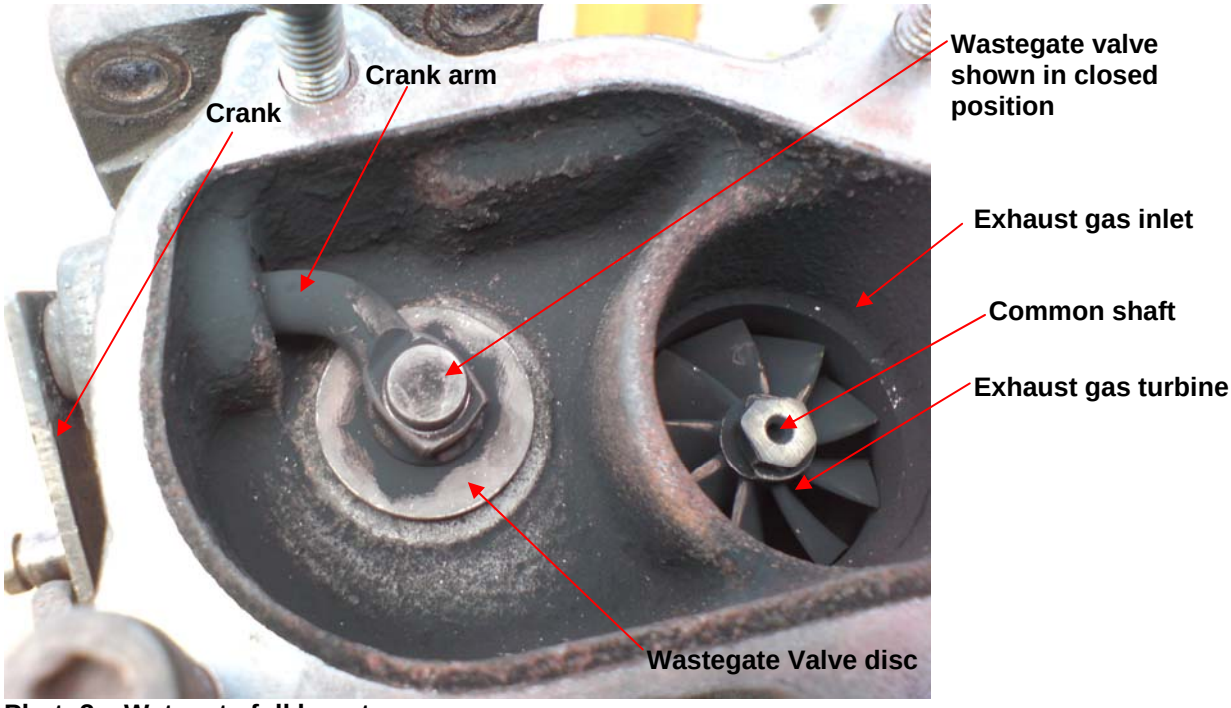

Photo3 – Wategate full boost

The following photo shows the wastegate valve in the partly open position (medium pressure/boost)

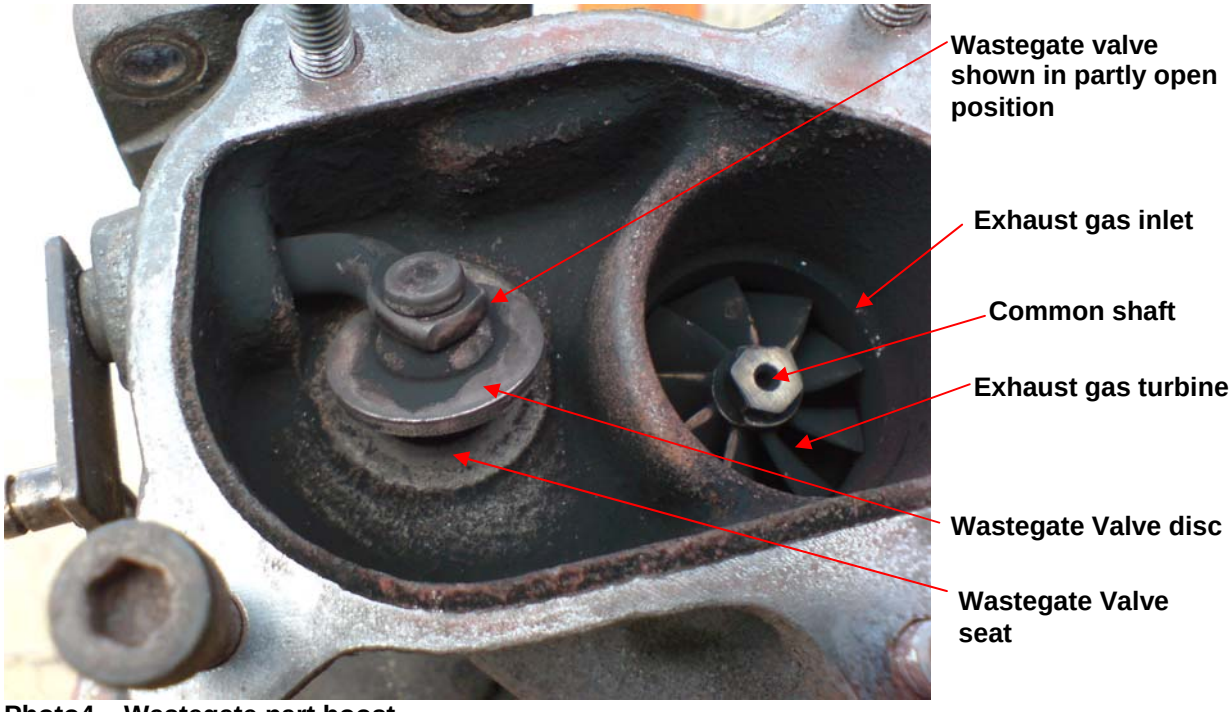

Photo4 – Wastegate part boost

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The following photo shows the wastegate valve in the fully open position (zero pressure/boost). In practise it never gets this far open.

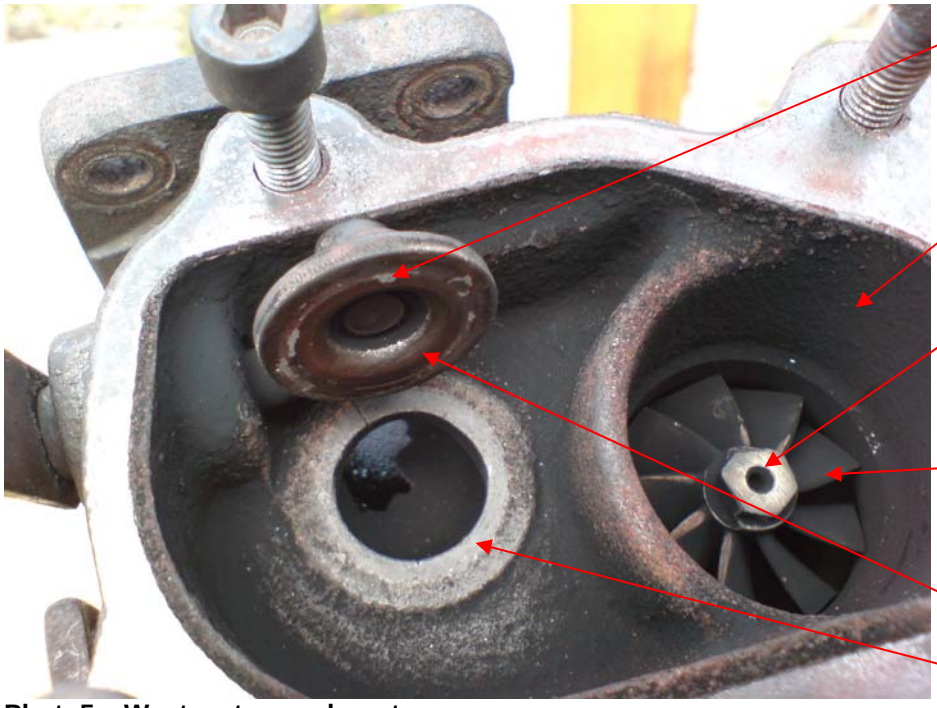

Photo5 – Wastegate zero boost

The following photo shows my suggested adjustment. With the actuator rod in its fully retracted position and the wastegate valve firmly closed adjust the length of the rod so that the crank pin is **not** fully lined up with the hole in the eyelet as shown below:

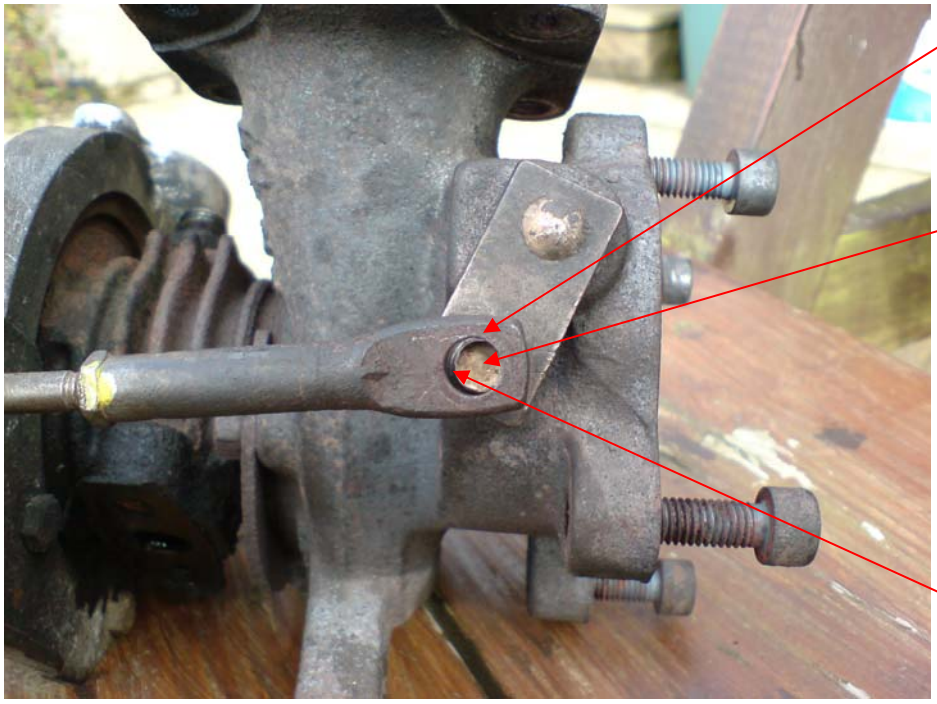

Photo6 – Rod adjustment

Once the rod length has been adjusted as above you should be able to pull on the rod until it the eyelet slips over the end of the crank pin. The residual tension in the rod keeps the wastegate valve fully closed when maximum boost is needed.

 ©2007 Norrie

The following photograph shows the centre of the fresh air inlet at the compressor end of the turbo

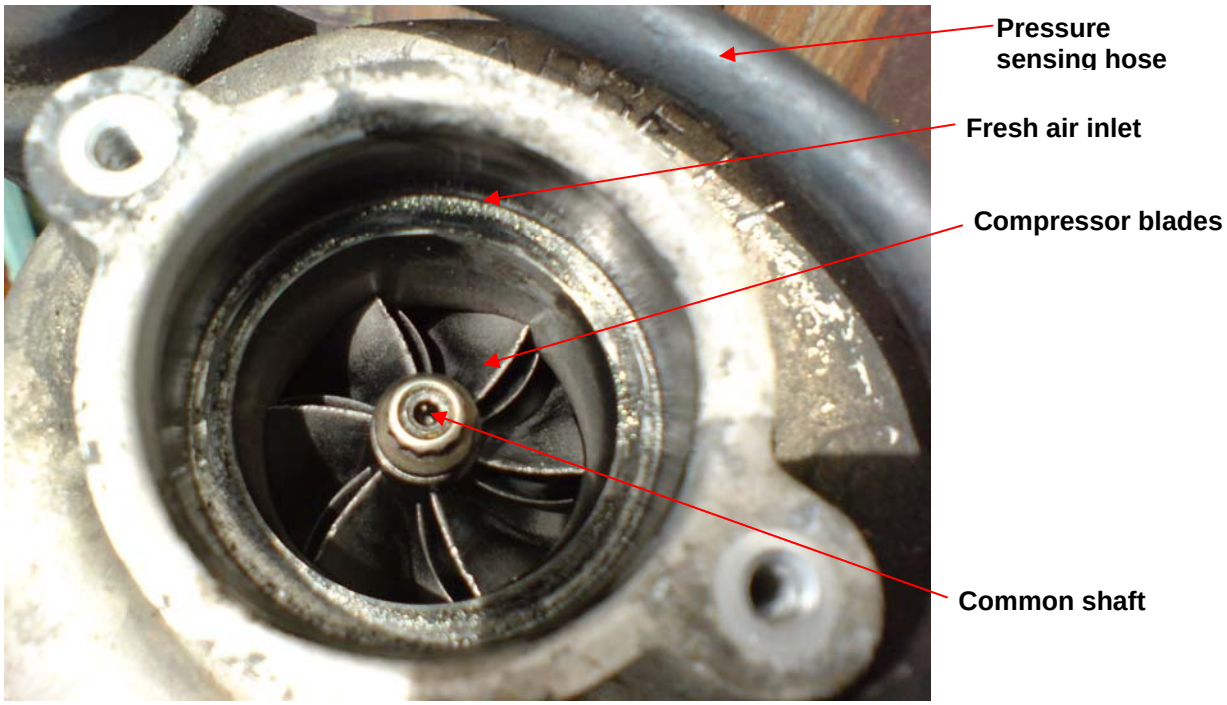

Photo7 – Compressor inlet

The most common problem associated with the turbo on a 2.5TD is that the eyelet on the end of the actuator rod seizes on the crank pin.

If it seizes in the position where the wastegate valve is fully closed then the turbo will produce over maximum boost at all times. This will cause the inlet manifold pressure to rise to 2 Bar (gauge). With a boost pressure of 2 bar you will feel the awesome power of the 2.5TD but unfortunately your engine won't last that long before it self destructs. Curiously there is a kind of self-protection mechanism in that the MAP sensor reads the manifold pressure and if it detects that its too high the ECU momentarily cuts the fuel to the engine to slow it down. The power returns after a second or so once the pressure has reduced. The engine then accelerates again until the pressure increases where the cycle repeats itself. This happens approximately every 8 seconds. However, this mechanism doesn't work at lower pressures even if they are too high.

If it seizes in the position where the wastegate is partly open then the turbo will never produce maximum boost and the engine will have lacklustre performance. Indeed if its stuck too far open the engine will perform as if it has no turbo at all.

It is important not only to check that the eyelet can pivot freely on the crank pin but also that the crank returns to the position where the wastegate valve is fully closed. This can only be accurately determined by separating the eyelet from the crank pin. Having separated them, push on the crank until you can feel that the valve is fully closed. Check the position of the crank pin through the eyelet hole. It should match photograph 6. If not, adjust the rod length until it does.

To prevent further seizing in the future I initially greased the crank pin and reassembled. However, the grease burned off very quickly and the pin seized again. The next time I drilled the eyelet out to 7.0mm diameter so that there was approx 0.5mm clearance between the eyelet and the crank pin. Since doing this I've had no further problems.

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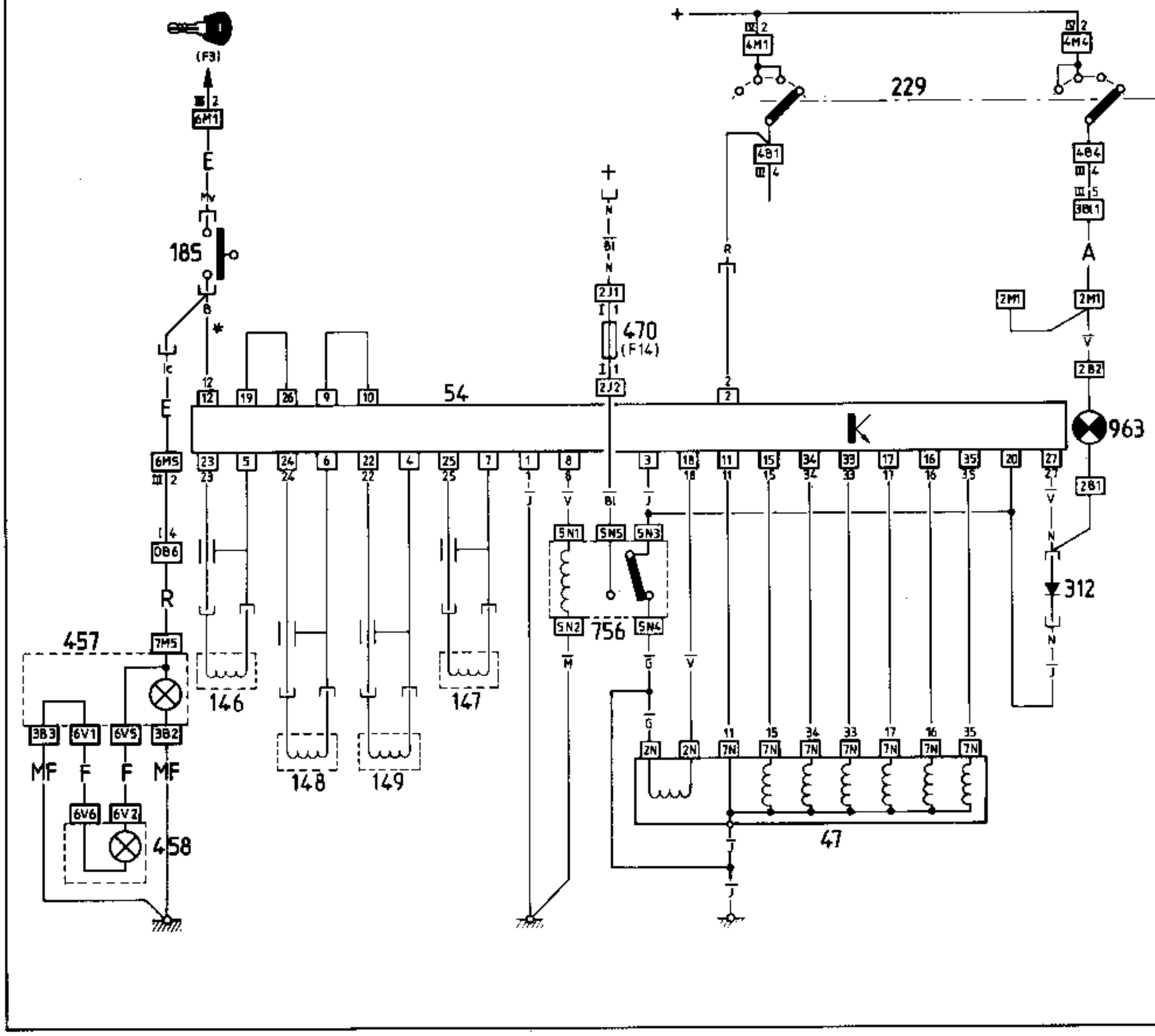
(F3)
6M1
185
E
Mv
B
*
Ic
12
12
19
26
9
10
54
6MS
23
5
24
6
22
4
25
7
1
8
3
18
11
15
34
33
17
16
35
20
27
OB6
R
7MS
457
458
146
147
148
149
3B3
6V1
6VS
3B2
MF
F
F
MF
6V6
6V2
5N1
5N5
5N3
5N2
5N4
756
M
G
V
2J1
I 1
470
(F14)
2J2
2
2
R
229
+
2M4
4B1
4
4B4
4
5
3B1
A
2M1
2M1
V
2B2
963
2B1
312
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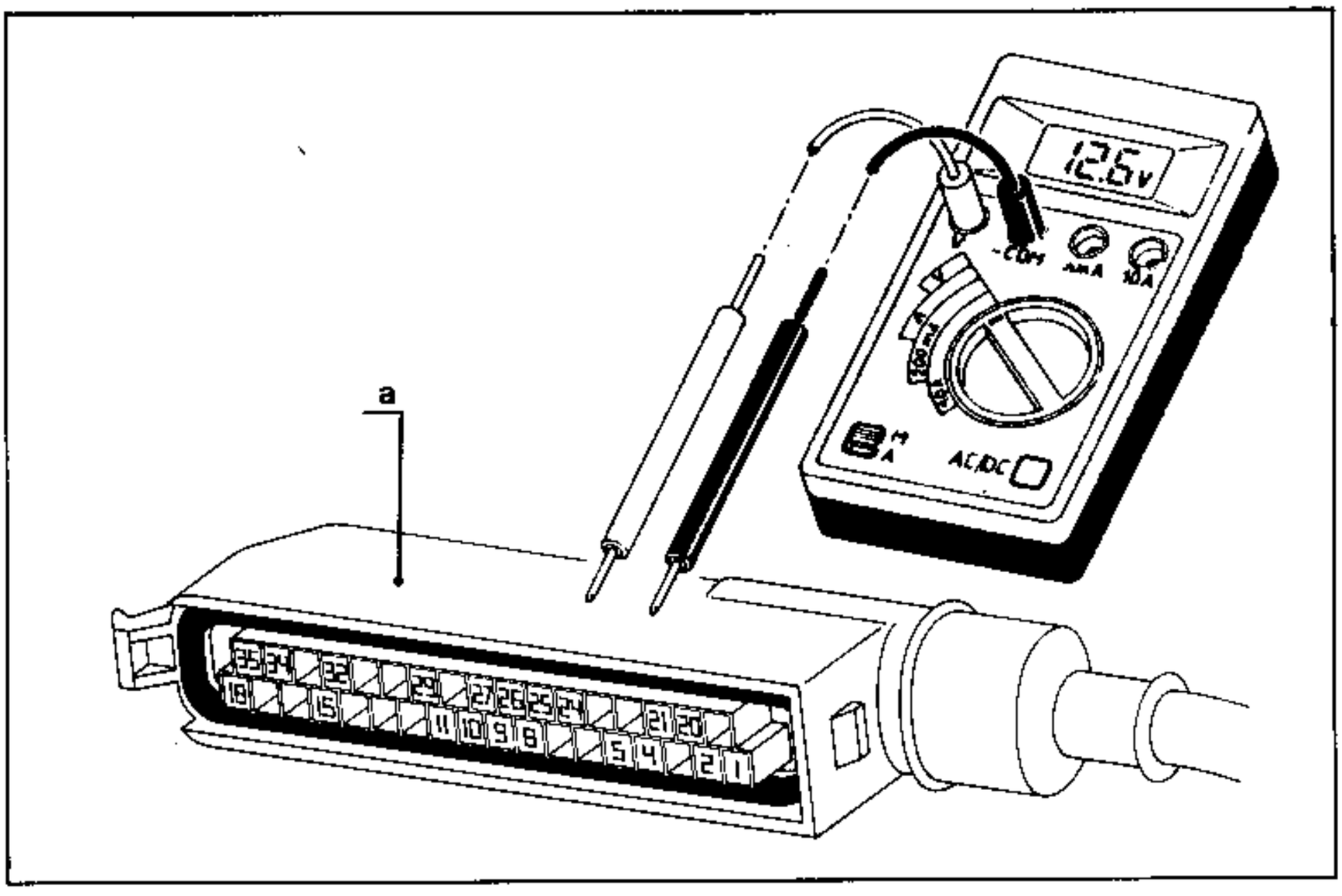
47

BX. 45-25e


12.6v
AC/DC
a
25 24 22 21 27 26 23 20
18 15 13 10 9 8 5 4 2 1

PARTS LIST

47 : A.B.S. hydraulic control block
54 : A.B.S. electronic control unit
146 : Front LH wheel sensor
147 : Front RH wheel sensor
148 : Rear LH wheel sensor
149 : Rear RH wheel sensor
185 : Stoplamp switch
229 : Antitheft/ignition switch
312 : Anti-blocage system diode
457 : LH stoplamp
458 : RH stoplamp
470 : Fuse
756 : A.B.S. electrovalve relay
963 : A.B.S. warning lamp.

WARNESS IDENTIFICATION

A : Front
E : Screen wiper
F : Connection for rear lamps
MF : Rear lamp earth
R : Rear
(No identification) : Anti-blocage system.

* : Connection to stoplamp 1/9/87 →

NOTE : For the parts and connectors location, see the wiring diagram of (12) Op. XB19E.510.00C.

A.B.S. SYSTEM AUTO-CHECKING DEVICE :

The anti-locking braking system has a self check device built into the electronic control unit.

- AIM :
  - Check of the internal circuits of the ECU
  - Check of the A.B.S. units.

  Remark : the road wheel sensor signals will be checked with the engine running.

- PRINCIPLE OF OPERATION :

– The A.B.S. warning lamp (963) circuit is completed, being connected to earth by connection **27** of the electron control unit (54). The lamp **is on.**
– Connection **2** of the ECU is electrically supplied.
– Connection **8** supplies the control relay (**756**) via the ECU.
– Connections **8** and **20** of the ECU are supplied by the control relay (**756**) power circuit.
– If no fault is found, the ECU will cut off the earth circuit at connection **27** : **the warning lamp will go out.**
– **The system is ready to operate**.

A.B.S. FAULT FINDING :

When a fault is detected :

– Connection **8** of the ECU is no longer supplied electrically.
– Control relay (**756**) does not operate.
– **The warning lamp circuit is completed to earth via the relay.**
– **The A.B.S. is out of operation**.

DIAGNOSTIC AND ELECTRICAL CHECKS

NORMAL CYCLE	FAULT DETECTED	POINTS TO CHECK	Chapter
ANTITHEFT/IGNITION SWITCH IN « **HOME** » POSITION ↓ **E** ANTITHEFT/IGNITION SWITCH IN THE « **ACCESSORY** » POSITION ↓ **E** ANTITHEFT/IGNITION SWITCH IN THE « **IGNITION ON** » POSITION ↓ **A** SELF CHECK	→ **A** →	– Electrical supply to the ECU	**1** (page 5)
		– Wheel sensor resistances	**2** (page 5)
		– Resistance of controlling electrovalves (inlet and exhaust)	**4** (page 6)
		– Resistance of the main electrovalve	**5** (page 6)
		– Earth screening of the wheel sensor leads	**6** (page 6)
↓ **E** ANTITHEFT/IGNITION SWITCH IN THE « **STARTER** » POSITION ↓ **A** ANTITHEFT/IGNITION SWITCH IN THE « **IGNITION/ON, ENGINE RUNNING** » POSITION ↓ **A** SELF CHECK ↓ **E** **VEHICLE MOVING**	→ **A** →	Current output from the wheel sensors	**3** (page 5)
↓ **E**			

A = ABS warning lamp stays on

E = warning lamp does not light

CHECKING THE A.B.S. ELECTRONIC UNITS AND ELECTRICAL CIRCUITS :

The ECU connector checks are carried out with the ECU disconnected.
So as not to deteriorate the sockets of the harness connector, it is advised to remove the protection cover **« a »** and to take readings on the wire entry as shown on drawing, page 2.
With the protector cover removed, the multipin connector has the sockets numbered **1** to **35**.

IMPORTANT : Always switch off the electrical supply to the ECU before disconnecting it.

CHAPTER 1 – Electrical supply to the ECU :

CHECKING EQUIPMENT VOLMETER or OHM-METER	CORRECT VALUE	IF READING IS INCORRECT
• Switch the ignition on (accessory or ignition position) – Voltmeter between connections **1** and **2**.	above **12 V**	Check the electrical circuit for continuity.
• Switch the ignition off : – Ohm-meter between connections **1** and **3**	less than **1Ω**	Check : – control relay **(756)** – the continuity of the circuit
– Ohm-meter between connections **1** and **20**	less than **1Ω**	Check, for continuity, the electrical circuit
– Ohm-meter between connections **1** and **8**	between **50** and **100Ω**	Check : – control relay **(756)** – the continuity of the circuit
• Link up connections **2** and **8** then switch the ignition on : – Volt-meter between connections **1** and **3**.	above **12 V**	Check : – control relay **(756)** – the continuity of the circuit

CHAPTER 2 – Wheel sensor resistances :

CHECKING EQUIPMENTS : OHM-METER	CORRECT VALUE	IF READING IS INCORRECT
R.H. rear sensor (149) : Ohm-meter between connections **4** and **22**. **L.H. rear sensor (148) :** Ohm-meter between connections **6** and **24**. **R.H. front sensor (147) :** Ohm-meter between connections **7** and **25**. **L.H. front sensor (146) :** Ohm-meter between connections **5** and **23**.	between **800** and **1400Ω**	Connect an ohm-meter on the connections of the corresponding sensor. – if the reading is correct, check the circuit for continuity between the sensor and the ECU plug. – if the reading is incorrect, change the sensor.

CHAPTER 3 – Current output from the sensors :

CHECKING EQUIPMENT : VOLTMETER « AC » (or « ≈ ») range	CORRECT VALUE	IF READING IS INCORRECT
The check is carried out by rotating the road wheel of the sensor concerned at approximately 1 turn per second : **R.H. rear sensor (149) :** Voltmeter between connections **4** and **22**. **L.H. rear sensor (148) :** Voltmeter between connections **6** and **24**.	between **100** and **570mV**	Check : – the reading of the sensor, – the air gap (not adjustable) – the rotor wheel (fitting and condition of the teeth)
R.H. front sensor (147) : Voltmeter between connections **7** and **25**. **L.H. front sensor (146) :** Voltmeter between connections **5** and **23**.	between **100** and **350mV**	

CHAPTER 4 – Resistance of the controlling electrovalves (located inside the hydraulic control block) :

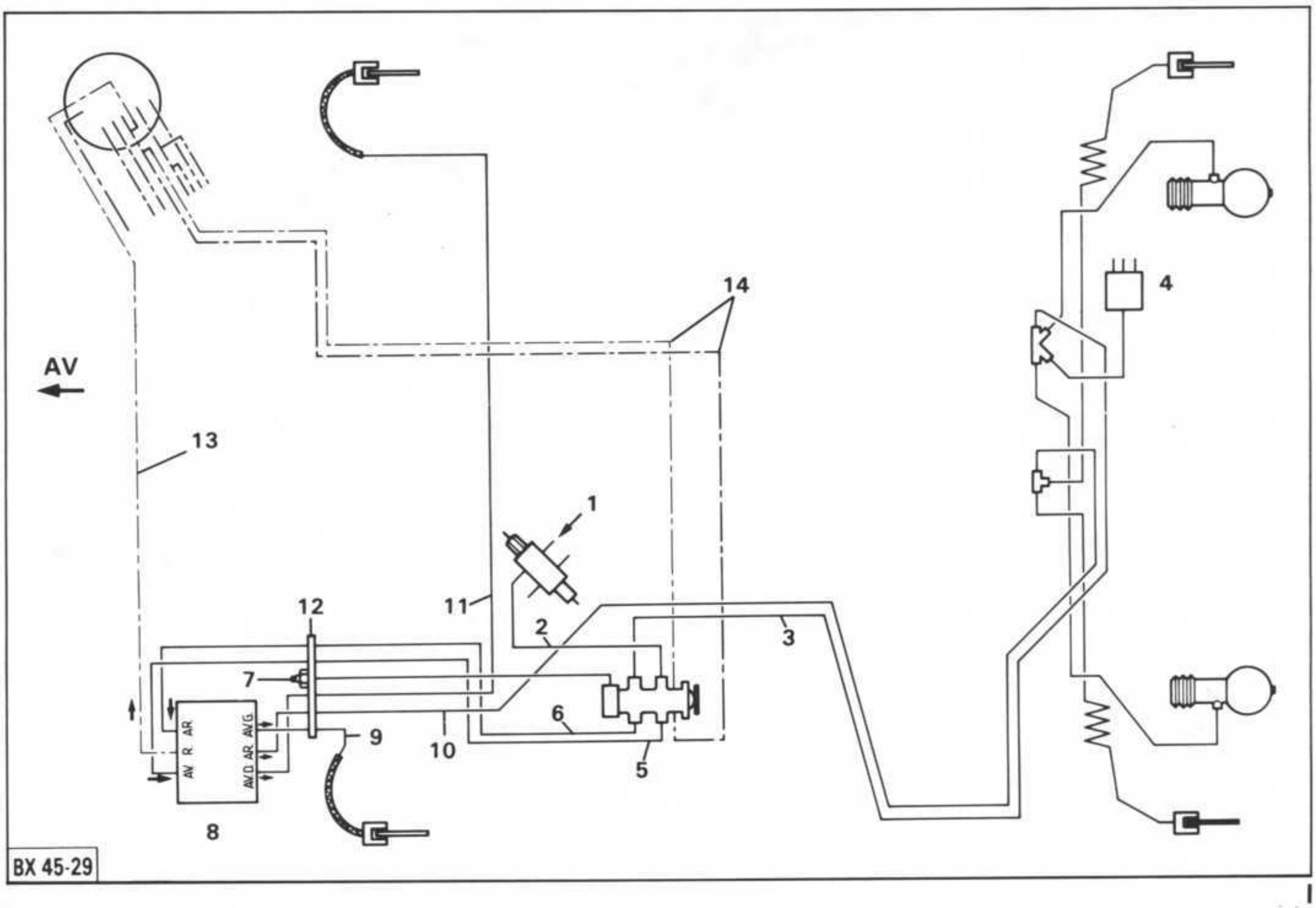
CHECKING EQUIPMENT : OHM-METER	CORRECT VALUE	IF READING IS INCORRECT
Ohm-meter between connections **11** and **1**	less than **1 Ω**	Check : – on the 7-way connector of the hydraulic control block, if lead **11** is to earth. – for continuity, the circuit on lead **11** between the ECU and the hydraulic control block.
R.H. front electrovalve (inlet) : ohm-meter between connections **11** and **15** **R.H. front electrovalve (exhaust) :** ohm-meter between connections **11** and **34** **L.H. front electrovalve (inlet) :** ohm-meter between connections **11** and **35** **L.H. front electrovalve (exhaust) :** ohm-meter between connections **11** and **16** **Rear electrovalve (inlet) :** ohm-meter between connections **11** and **17** **Rear electrovalve (exhaust) :** ohm-meter between connections **11** and **33**	between **3** and **7 Ω**	Check : – on the 7-way connector of the hydraulic control block, the resistance of the electrovalves : ohm-meter between leads : – 11 and 15 – 11 and 34 – 11 and 35 – 11 and 16 – 11 and 17 – 11 and 33 – If one of the readings is incorrect, change the hydraulic block. – If all the readings are correct, check the continuity of the electrical circuit between the 7-way connector of the hydraulic control bloc and the ECU plug.

CHAPTER 5 – Resistance of the main electrovalve (attached to the hydraulic control block)

CHECKING EQUIPMENT : OHM-METER	CORRECT VALUE	IF READING IS INCORRECT
Ohm-meter between connections **11** and **18**	between **2** and **5 Ω**	Connect an ohm-meter on the 2-way connector of the hydraulic control block (not disconnected) : – if the reading is correct, check the continuity of the circuit between the electrovalve connector and the ECU plug, – if the reading is incorrect, change the hydraulic block.

CHAPTER 6 – Screening of the sensor leads :

CHECKING EQUIPMENT : OHM-METER	CORRECT VALUE	IF READING IS INCORRECT
R.H. rear sensor (149) : ohm-meter between connections **4** and **1** **L.H. rear sensor (148) :** ohm-meter between connections **6** and **1** **R.H. front sensor (147) :** ohm-meter between connections **7** and **1** **L.H. front sensor (146) :** ohm-meter between connections **5** and **1**	∞	Check the insulation of the electrical circuit screening against the earth of the vehicle.



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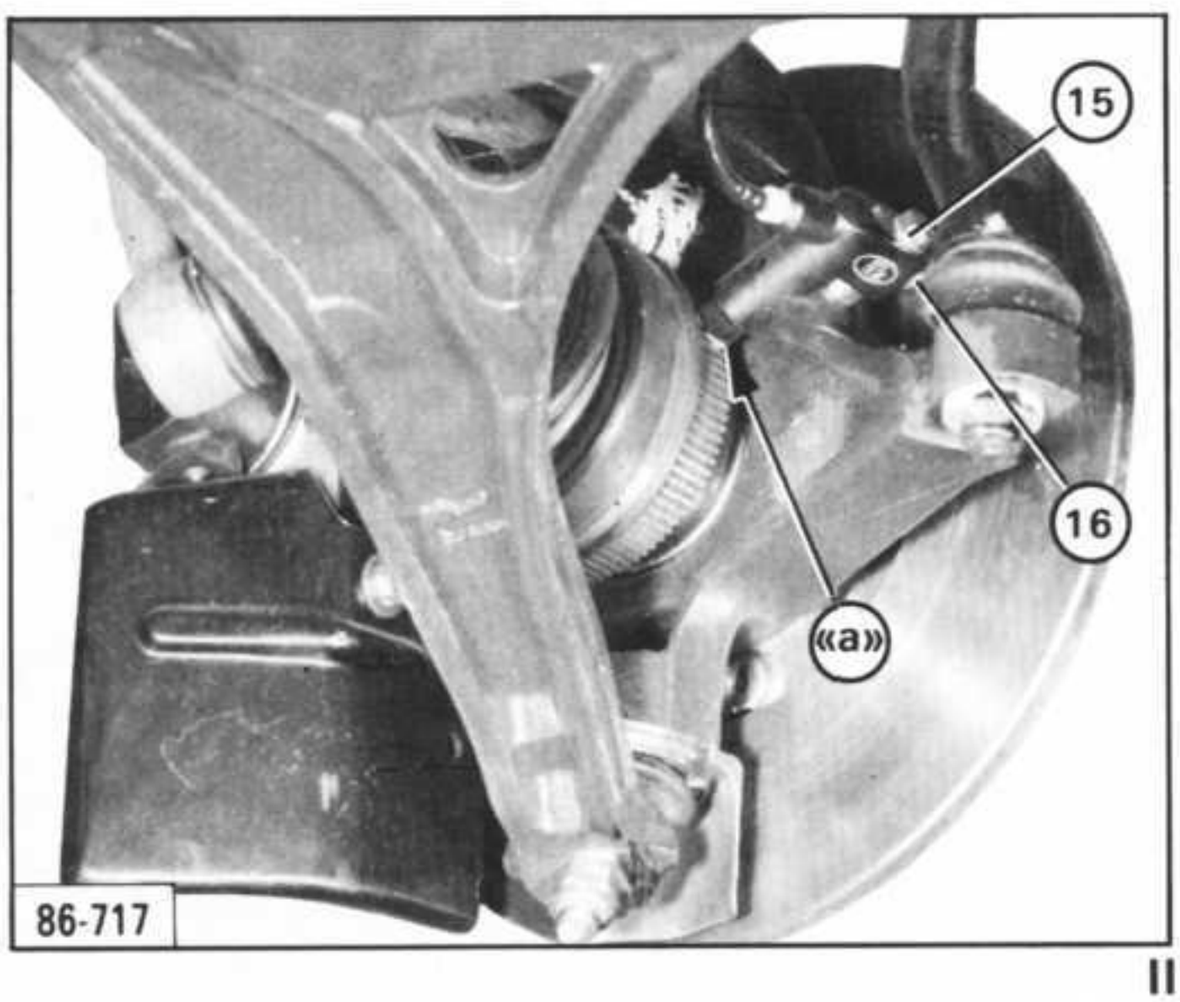
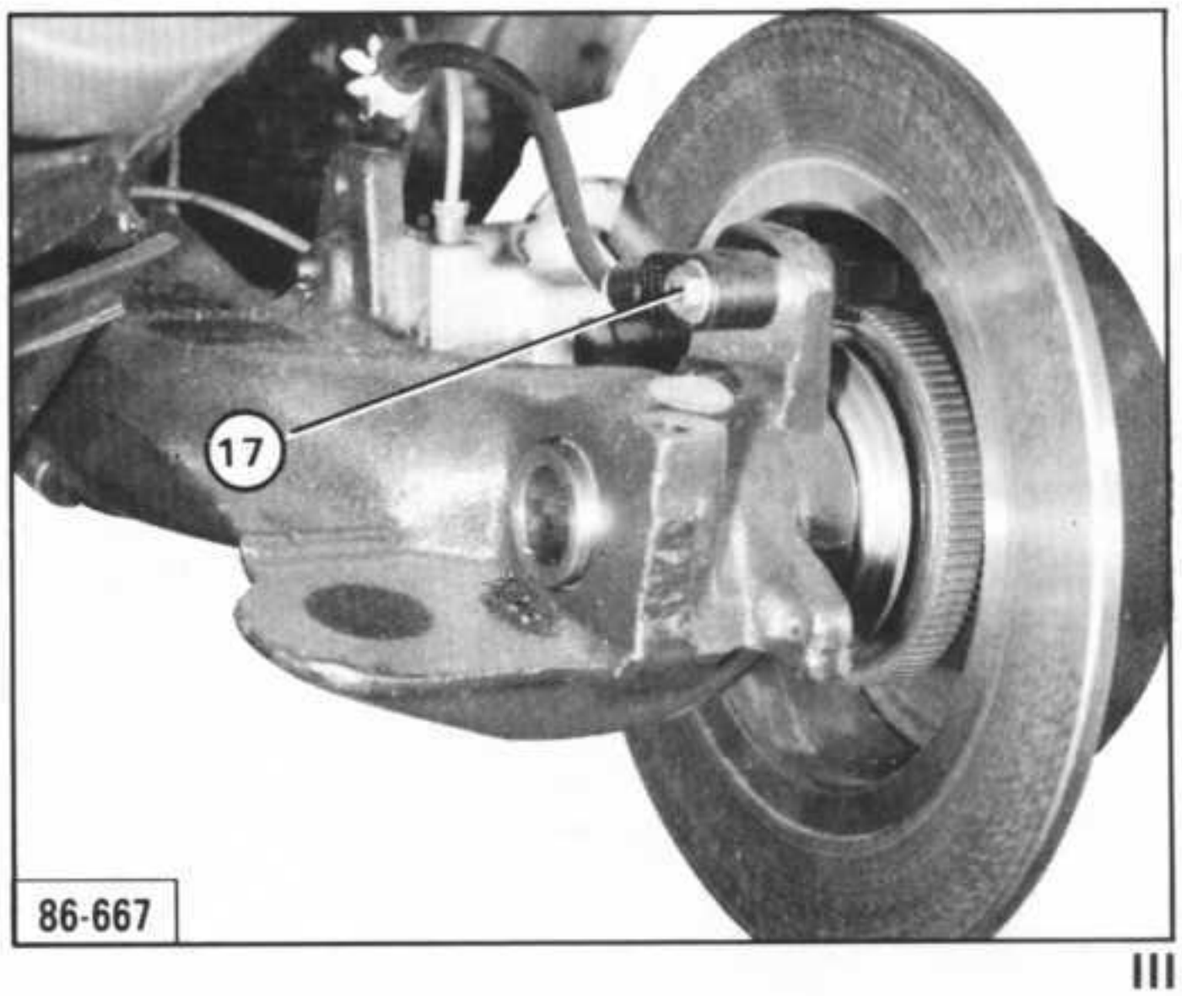
I



86-717

II



86-667

III

ANTI-LOCKING BRAKING SYSTEM

Hydraulic circuit, Fig. I

1 : Source of pressure.
2 : High pressure supply to the brake control valve (front brakes).
3 : Rear suspension pressure ; feed to control valve (rear brakes).
4 : Rear suspension height corrector.
5 : Front braking pressure to hydraulic control block.
6 : Rear braking pressure to hydraulic control block.
7 : Compensator bleed screw.
8 : A.B.S. hydraulic control block.
9 : Front LH wheel braking pressure.
10 : Rear wheels braking pressure.
11 : Front RH wheel braking pressure.
12 : Brake tube carrier on bulkhead.
13 : Hydraulic block return to reservoir.
14 : Brake control valve return to reservoir.
Note : Front brake hoses have a blue identification mark ; hose connection is M. 9 x 125 instead of M. 8 x 125.

Road wheel sensors

Front wheel sensors, **Fig. II.**

Air gap : 0.30 m to 1 mm (not adjustable)
Fitting a new sensor :
– slacken screw (16),
– offer up the sensor with its adjusting paper shim « a »,
– tighten screw (15) previously coated with LOCTITE FRENETANCH compound, to 1 mdaN,
– push the sensor until its paper shim is into contact with the toothed wheel,
– tighten screw (16) until it shears.

Rear wheel sensors, **Fig. III.**

Air gap : 0,50 to 1,10 mm (not adjustable)
Screw (17) tightening : 1 mdaN (previously coated with LOCTITE FRENETANCH)

Hydraulic block (8), Fig. I (identification : purple disc 09/87 →)

Situated on the front LH wheel arch.
It is composed of 6 electro-valves (2 per braking circuit : LH front, RH front and rear).
The hydraulic pipe connections are marked as shown on the drawing of **Fig. I.**

Electronic control unit (identification : purple disc 09/87 →)

Located under the front LH seat.

REPAIR : On the vehicles produced until 09/87, the electronic control unit or the hydraulic block with the purple identification replaces the former ones.
It is compulsory to fit a part with a purple identification to the vehicles manufactured since 09/87 or having components with purple ident. marks.

CHECKING the A.B.S. : *See Op* (11) *XB 453-Oa.*

Air Conditioning Evaporator Condensate Drain

If your XM has Air Conditioning and the carpet gets wet in the front footwells, it may be the condensate drain from the evaporator section. As the evaporator cools the air condensation forms on the fins and dribbles down into the collection tray at the bottom. A plastic tube connects on to the outlet pipe as shown and leads the water away out of the car. It is possible for the tube to become disconnected from the spigot.

You can see the whole heater unit viewed from the offside (RH Drive) here:

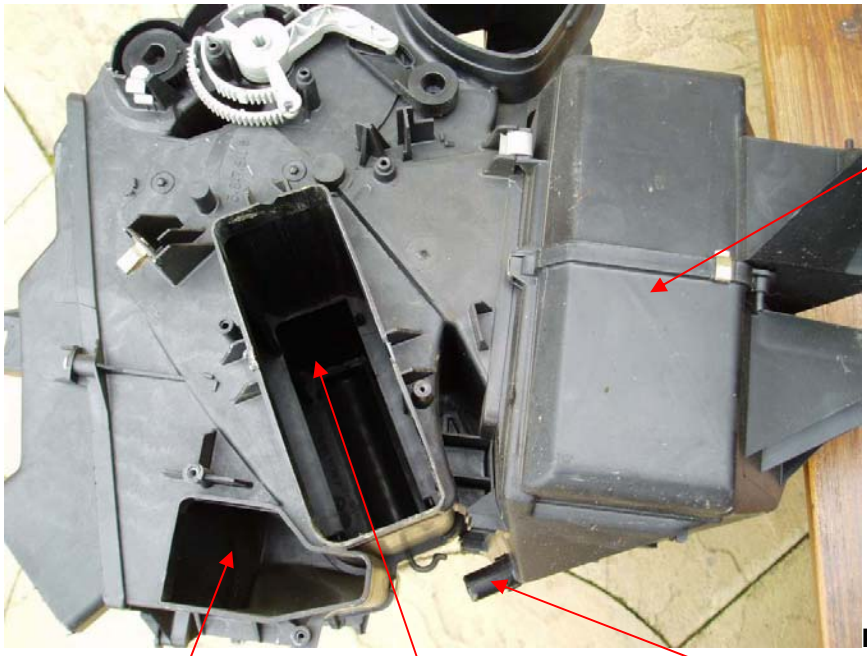


Photo1

 ©2005 Norrie

XM heater flap servo

Problems with the servo motor unit that moves the heater flap seems to be quite common on (older) XM's.

The heater flap servo is located on the left side of the central heater box high-up under (in) the dash. In order to be able to remove the servo from the car, the panel under the steering has to be removed first (see Fig. 1). One also has to remove the carpet covered panel in the footwell that cover the left side of the central console.

Fig. 1 : Panel under the steering wheel and carpet covered panel removed.

When the panels have been removed the flap motor servo unit is visible under the dash. Unfortuneatly the front screw that mounts the servo to the heater box can not be accessed because the of large white connector (See Fig. 2 and 3). The rear screw is not visible at all, here a very short screwdriver is needed because of the limited space.

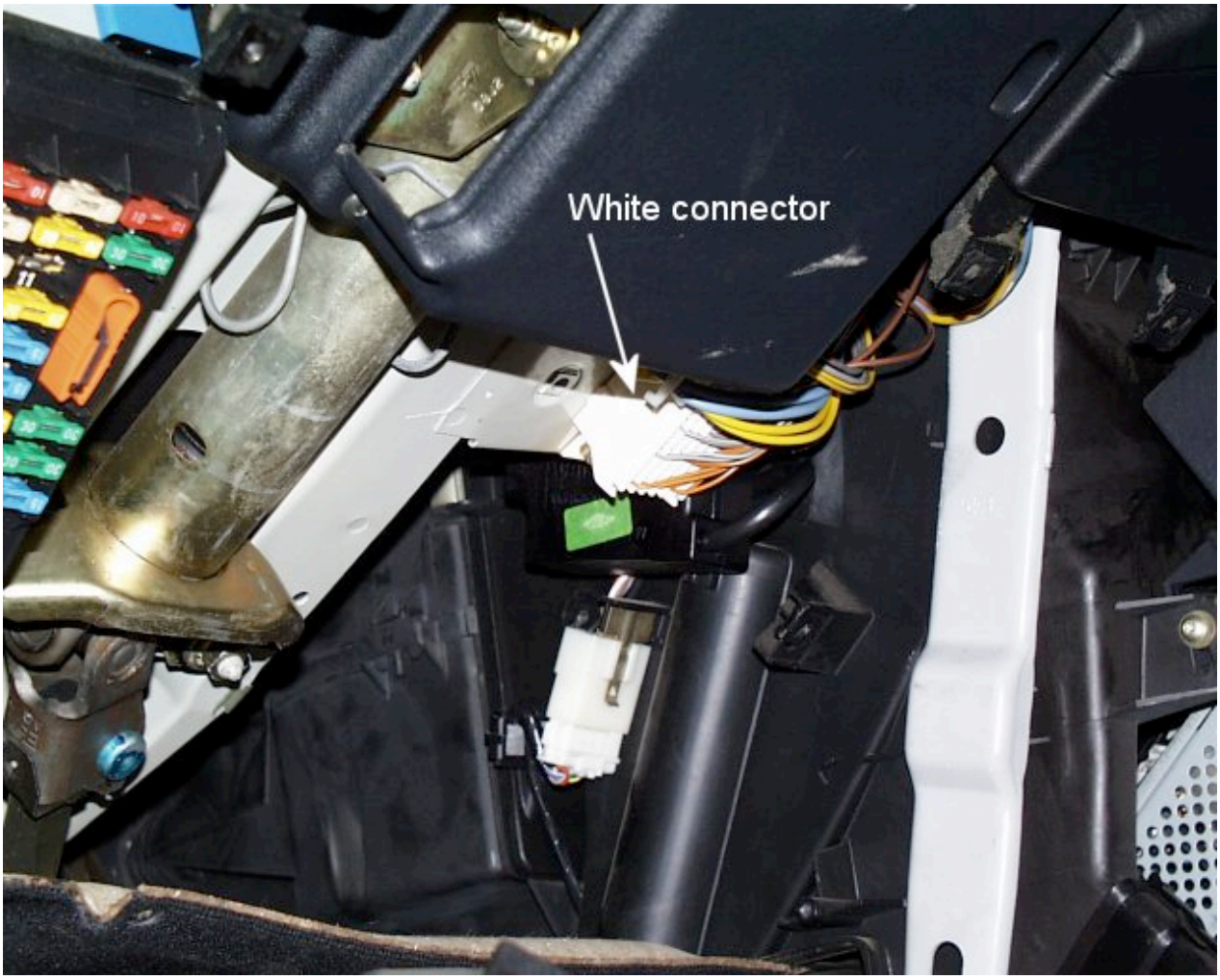


Fig. 2 : The heater flap servo is now visible, it's small black plastic box with the green sticker.

The white connector has to be removed in order to be able to access the front screw. The connector is bolted to the frame with two bolts, removing is easy.

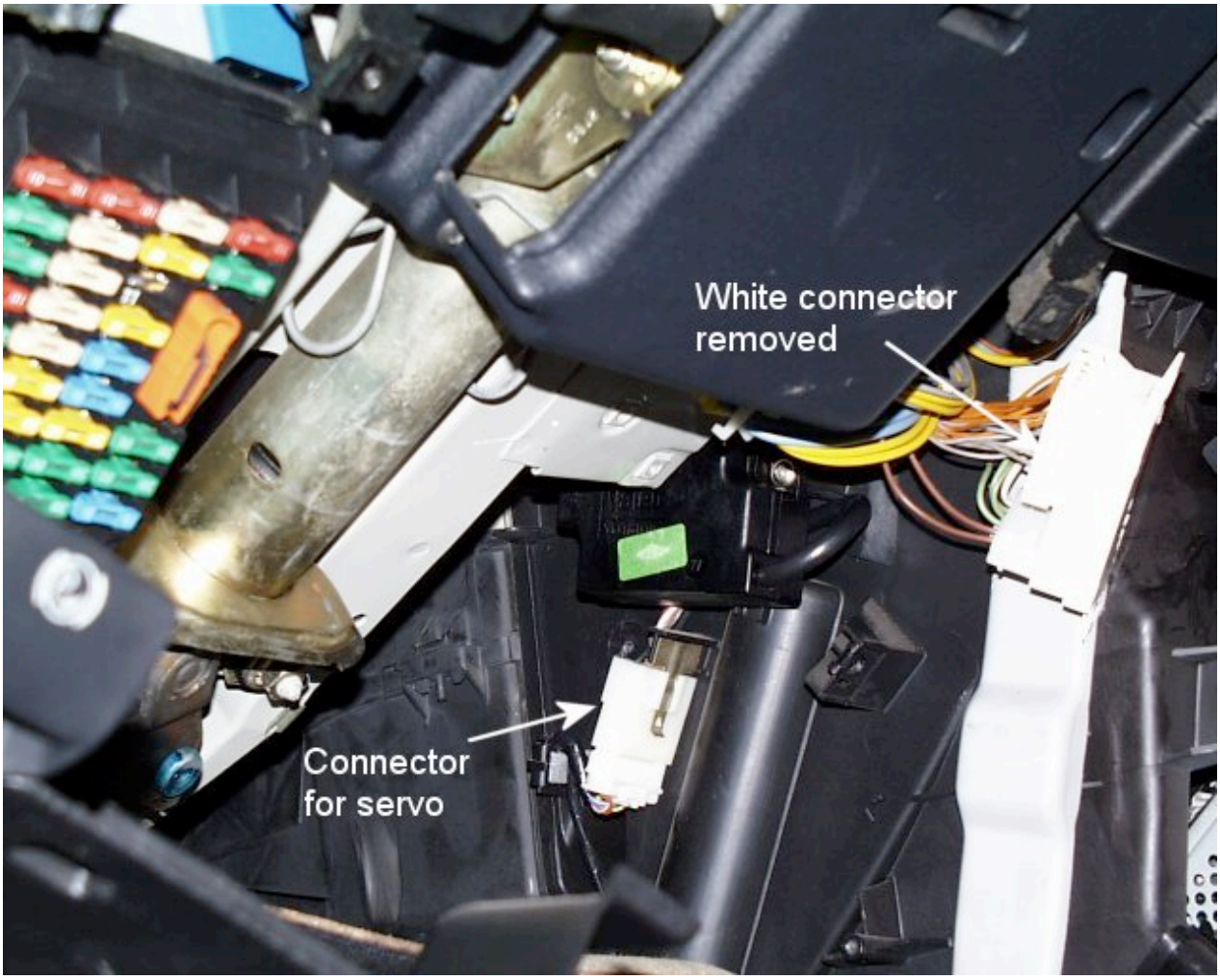


Fig. 3 : After removing the white eletrical connector unit the rear mounting screw is accessable.

After the heater flap servo has been removed (Fig. 4) one can see the two mounitng points and the heater flap axis with the small lever-arm (which is probably there for the cars with manual heater control).

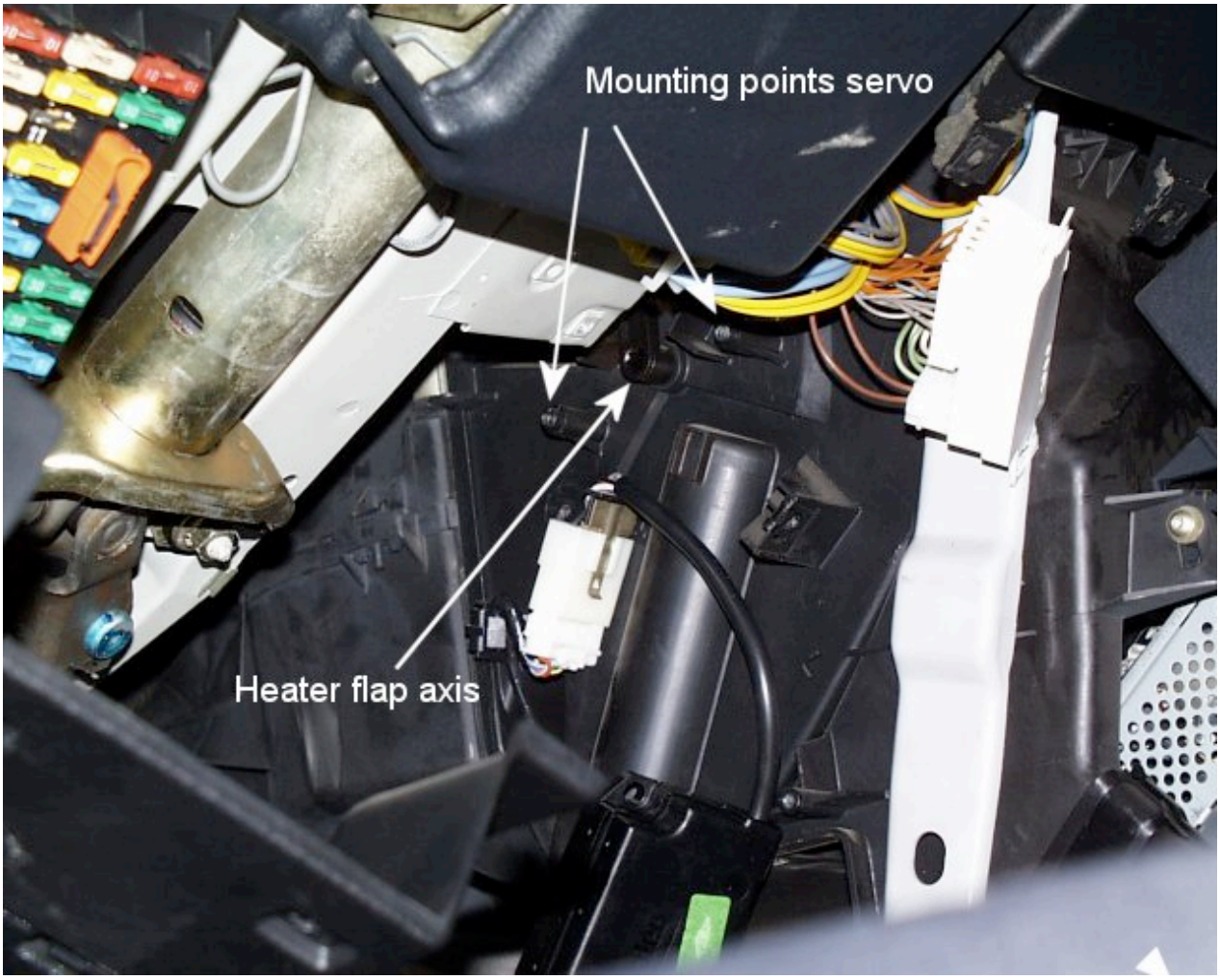


Fig. 4 : The servo is now removed, it's hanging from its electric cable.

The servo axis is flattened at one side (see Fig. 5), the hole in the heater flap axis has the same shape. Both axis will fit together at one position only, so make sure that the servo axis is in the same position after reassembling.

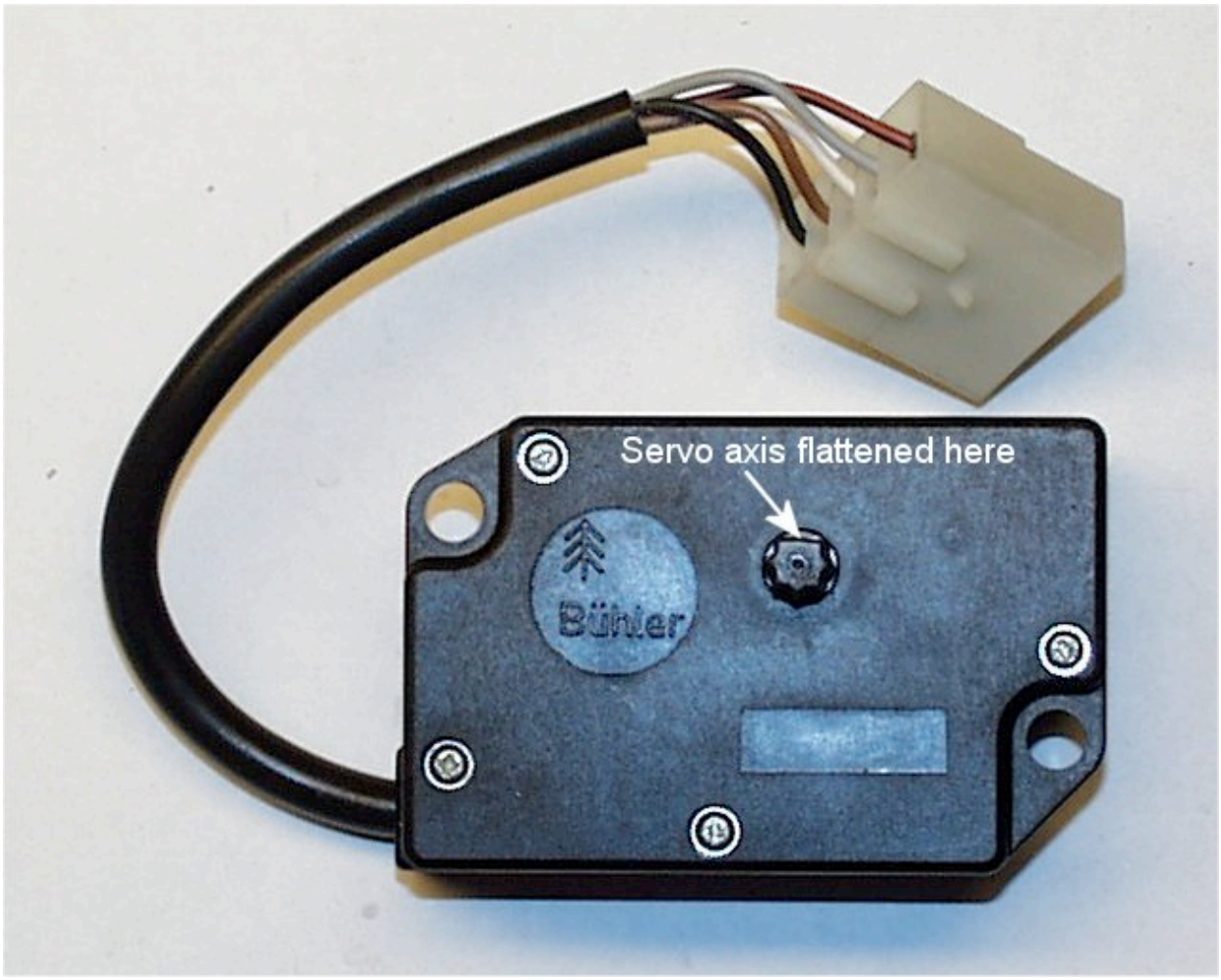


Fig. 5 : The complete heater flap servo.

The servo is easily opened by unscrewing the four screws (see Fig. 6). Take care while pulling apart the two halfs of the servo box in order not to tear the rather fragile seal (see Fig. 7). Please note the arrows on the big gear wheel (that drives the flap) and the smaller gear wheel (that drives the servo potentiometer) at the right. On both gear wheels there is an arrow, they have to be aligned when the servo is reassembled.

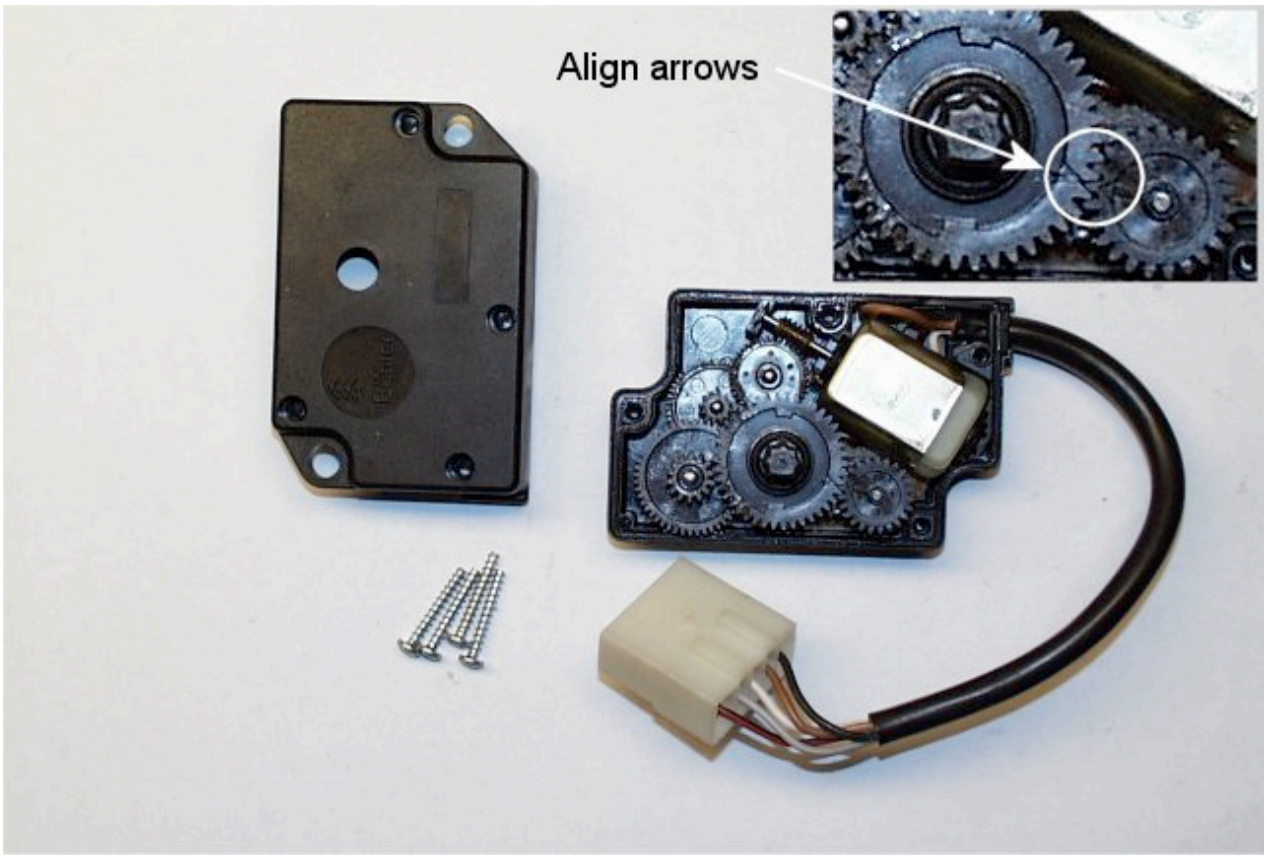


Fig. 6 : The heater flap servo box opened.

The two gear wheels mentioned above are easily removed (just pull them upwards).

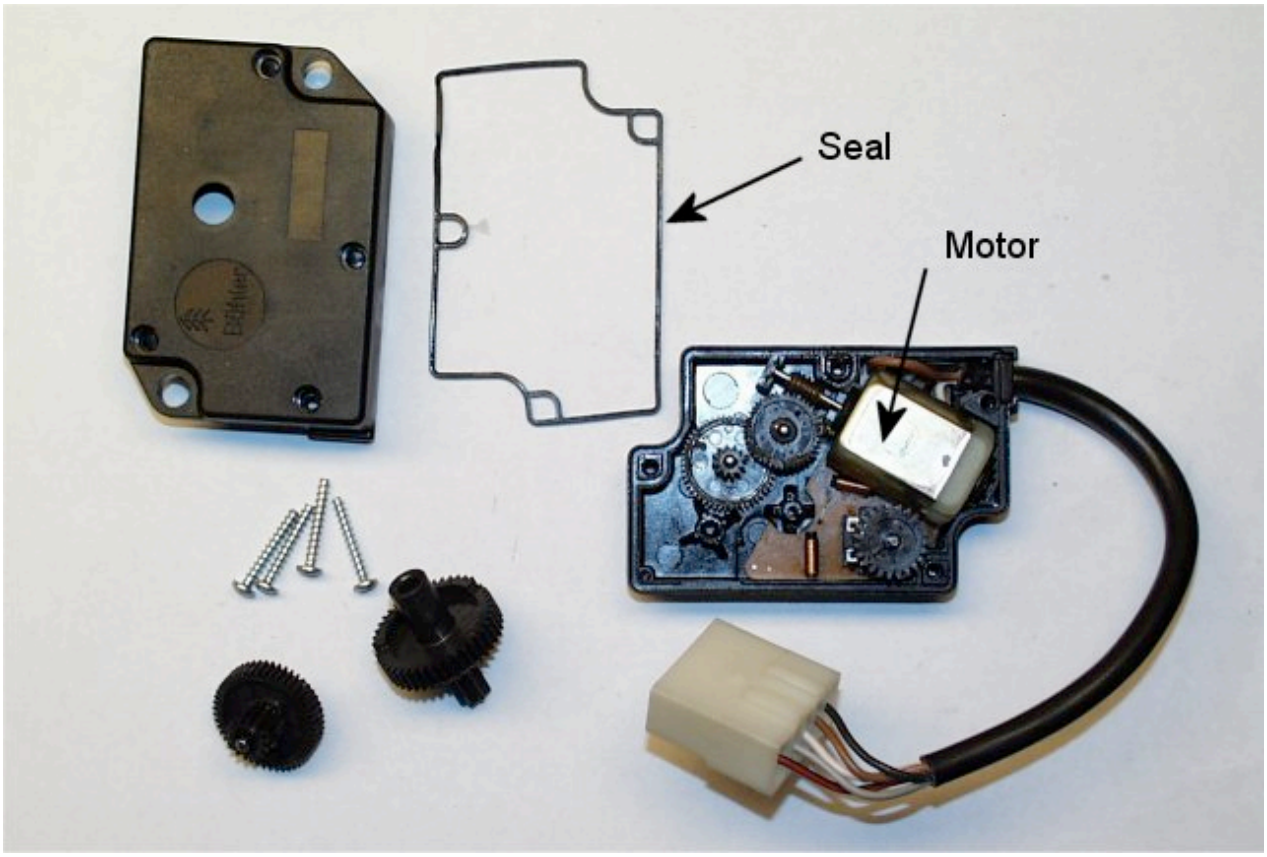


Fig. 7 : The heater flap servo partly dissasembled.

Now the little motor can be removed together which the circuit board (PCB). The motor is is soldered onto the PCB.

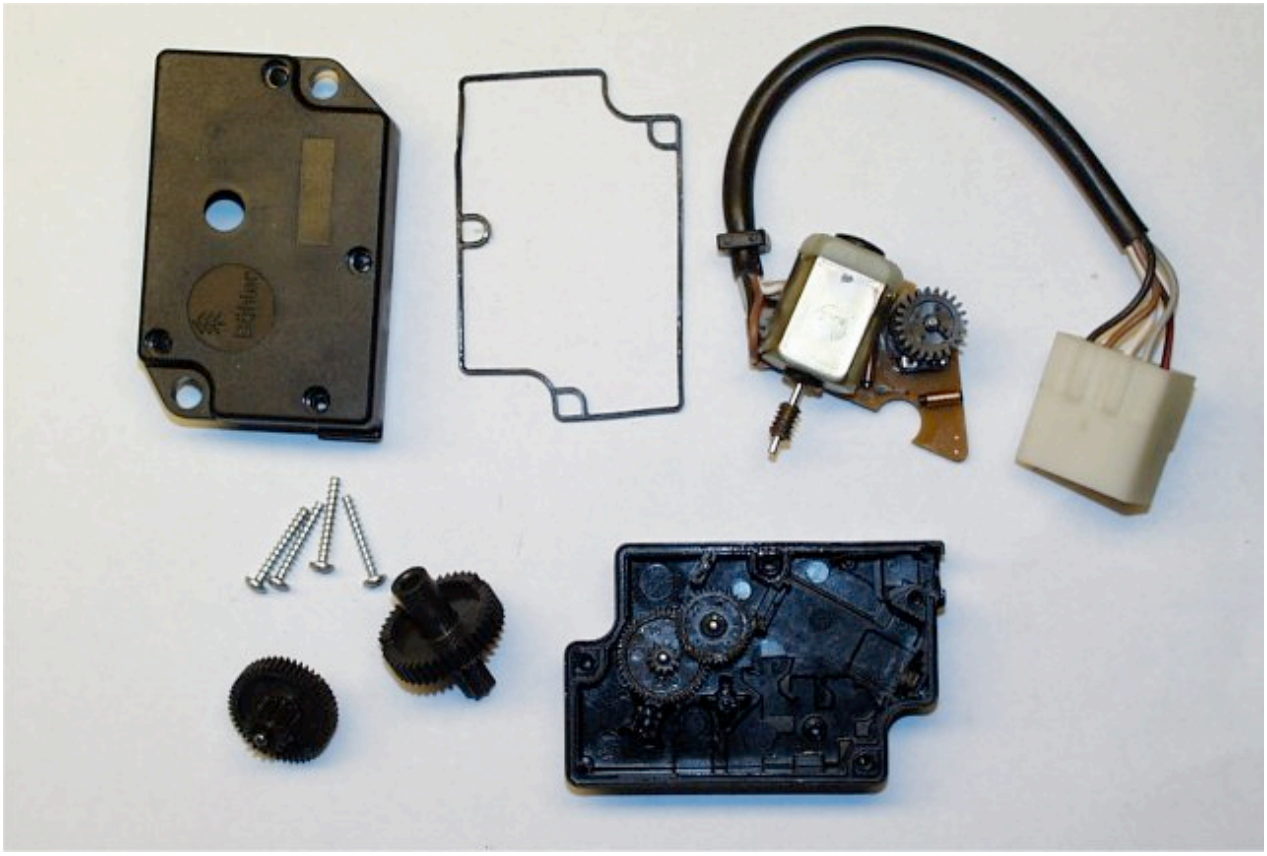


Fig. 8 : The heater flap servo almost completely dissasembled.

The motor can be tested by applying 7 Volt DC to the brown and the black wire in the plug. Of course you can also do this when the servo is still assembled.

In case the motor doesn't run correctly anymore you might try the following as suggested by Frank Verschuren on the XM-L mail list :

Typically what happens is that the brushes in the motor short circuit a little, so the current through the motor is to big for the IC output in the climate control ecu to handle. I took me some time to figure out, because in my case the motor would still run on a normal 9V battery (and then it runs for some time until the motor stops at the wrong place causing the brushes to short-circuit again.) If above sounds familiar than read on below.

It's not that difficult to solve if you are careful and handy. You can open up the unit and solder the motor out. Don't overheath it with the soldering iron btw, I did that the first time and the plastic where the brushes are in melted a little.

If you have the motor apart you can carefully scrape the brushes of the motor somewhat into shape. You must scrape some of the graphite(?) off, so the brush is more square rather than rounded around the contacts of the rotor (which is causing the short-circuit).

Assemble the rotor in the motor outside and dry-run it first with a 9V battery. If it works you can reassemble it back in the flap control housing. When assembling look at the marking on two of the gear-wheels they should face each-other getting the potentiometer in line with the flap position.

You don't have to reset anything when all is back in place, just cycle the ignition off and back on, it should be cleared.

It worked for me. The first I repaired got the problem back after a year and I repeated the procedure. Within the current XM, I had the same problem and it hasn't reappeared yet. (1.5 years ago now).

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The URL of this page is : http://www.citroen-ds-id.com/xm/XM_Heater_Flap_Servo.html

Alternator Belt Tensioner on a Citroen XM 2.5TD

The tensioner consists of a bearing trapped between two mating flanges which are riveted together to form the flat pulley on which the belt runs. The angled bracket extends from the centre part of the bearing up to the adjustment bolt.

Photo1

After having drilled out the rivets the two halves of the pulley split apart.

Photo2

Rivet Holes

Location of bearing

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This leaves the outer race and the ball bearings still assembled onto the centre shaft.

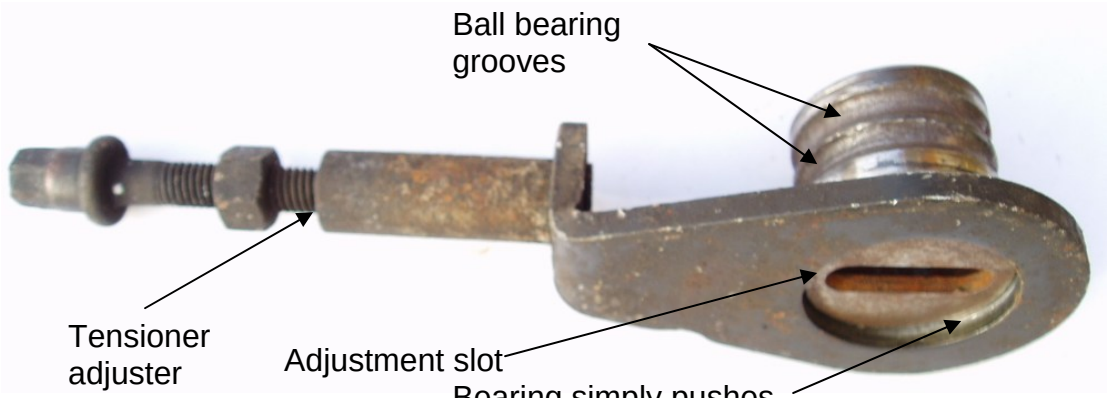

Photo3

Presumably, when the bearing is assembled in the factory, the balls are entered one at a time with the inner and outer races at an angle to each other. The balls being closer together take up less room and therefore allow the races to move away from the parallel position to allow entry of all the balls. Once the correct number of balls is entered into the groove the cage can be fitted. The cage spaces out the balls evenly. There's now no slack space which forces the two races to become parallel. Lastly the oil seals are fitted to keep the lubricant inside the bearing.

Inner and Outer races

You can see that the outer race is a more normal race for a double row ball bearing. The inner race however is a shaft with the two grooves for the balls machined into the surface. Both races will be heat treated for hardness.

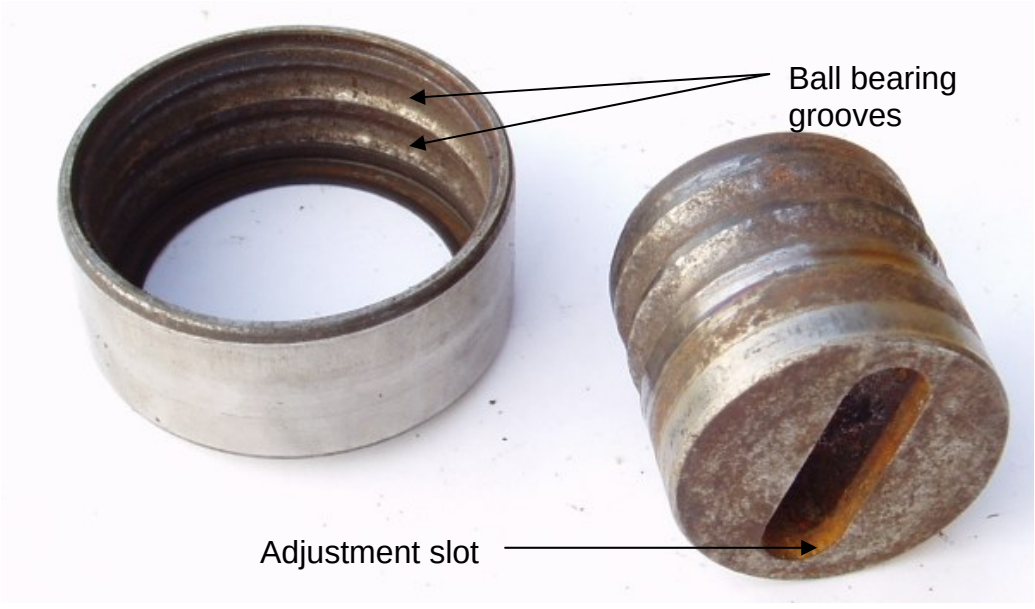

Photo4

 ©2005 Norrie

As you can see the lubrication was lost and the bearing overheated. The cage which keeps the balls in position was either worn away or melted or a combination of both. Once the cage is gone the balls all move to one end and the inner and outer races are no longer parallel. This starts a catalogue of faults due to the misalignment.

Repair/Replacement

The original manufacturer of the bearing/tensioner assembly is INA. They can be found here:

http://www.ina.co.uk/

The original INA part number is BSRS F-121722. However you can't just buy the bearing part of the tensioner. You have to buy the whole thing. If you find out differently please inform me here:

http://club-xm.com

One INA agent in the UK is BRT Bearings. They can be found here:

http://www.brt-bearings.com/1024x768/index.html

BRT's part number for the INA tensioner is PBT8522. I paid 24.29GBP in April 2005 for the part. I ordered the part and received it the following day.

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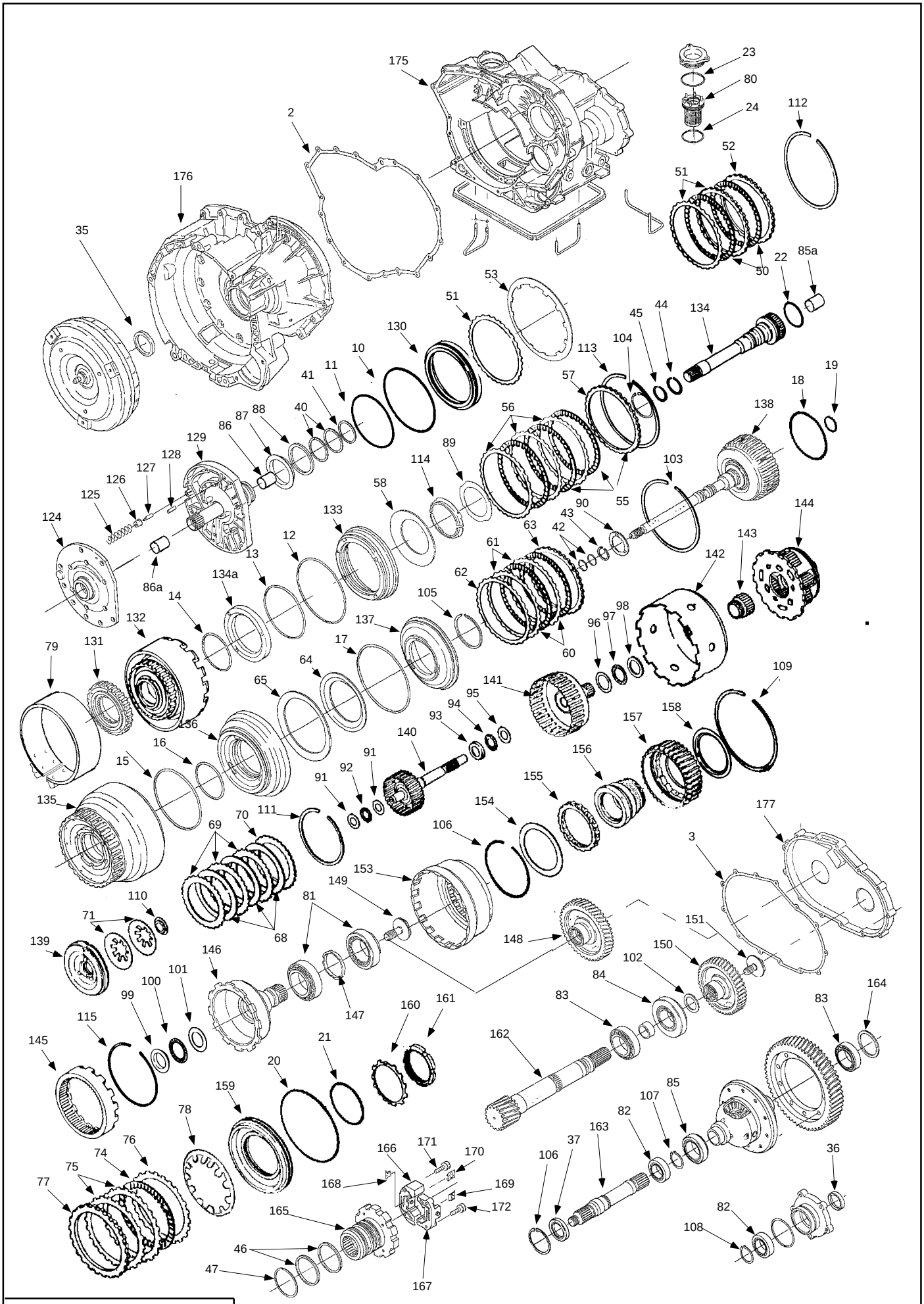

ZF4HP18 **Iss 22**

Illus	Description	Part No.
	KITS	
	Overhaul - SAAB	183 02 01
	Overhaul - Citroen/Peugeot	183 02 02
	Overhaul - Alfa Romeo & Lancia	183 02 03
	Overhaul - Audi 100 without final drive	183 02 04
	Overhaul Final Drive only Audi 100 2WD	183 02 05
	Overhaul Final Drive only Audi 100 4WD	183 02 06
	Gasket & seal	183 03 01
	Gasket & seal - Alfa Romeo & Lancia	183 03 03
	Shaft sealing rings	183 06 01
	Full friction kit	183 07 01
	GASKETS	
1	Pan	183 25 01
2	Converter housing SAAB, Alfa	183 25 02
2	Converter housing Citroen, Peugeot	183 25 07
2	Converter housing Lancia	183 25 08
3	Cover	183 25 03
NI	Valve body plate gasket	180 25 05
NI	Valve body small	183 25 05
NI	Valve body large	183 25 06
NI	Valve body - Audi	183 25 09
	RUBBER COMPONENTS	
10	"C" clutch outer "O" ring	137 16 07
11	"C" clutch inner "O" ring	183 16 02
12	"B" clutch outer "O" ring	137 16 07
13	"B" clutch inner "O" ring	180 16 06
14	"B" clutch intermediate ring "O" ring	183 16 03
15	"A" clutch outer "O" ring	180 16 12
16	"A"clutch inner "O" ring	183 16 05
17	"A" clutch dam "O" ring	178 16 10
18	"E" clutch outer "O" ring	137 16 08
19	"E" clutch inner "O" ring	180 16 10
20	"D" clutch outer "O" ring	137 16 07
21	"D" clutch inner "O" ring	137 16 06
22	Turbine shaft "O" ring	180 16 04
NI	Servo cover "O" ring (2)	180 16 14
NI	Servo piston "O" ring	183 16 13
NI	Band pin "O" ring	183 16 14
23	Filter cap "O" ring	183 16 06
24	Filter "O" ring	183 16 15
NI	Valve body pipe "O" ring (2)	183 16 07
NI	Dipstick "O" ring (1/2)	183 16 08
NI	Cable "O" ring	183 16 09
NI	Speedo sleeve "O" ring	183 16 10
NI	Bearing cover "O" ring - SAAB only	183 16 12
NI	Bearing cover "O" ring - excluding SAAB	183 16 16
NI	Plug "O" ring (2)	180 16 02
NI	Input (Diff) "O" ring	183 16 11
NI	Breather seal	183 20 01
NI	Speedo pinion shaft seal	183 20 02
NI	Converter housing washer	183 20 03
NI	Parking lock cam washer	183 20 04
NI	Parking lock support washer	183 20 05
NI	Band adjuster screw seal	183 20 06
NI	Small cooler seal	183 20 07
NI	Large cooler seal	183 20 08
	METAL CLAD SEALS	
35	Pump	183 15 01
36	Differential LH SAAB (small)	183 15 02
37	Differential RH SAAB (large)	183 15 03
36	Differential LH Alfa Romeo & Lancia	183 15 04
37	Differential RH Alfa Romeo & Lancia	183 15 05
36	Differential LH Peugeot & Citroen	183 15 06
37	Differential RH Peugeot & Citroen	180 15 02
NI	Selector shaft	113 15 02
	SHAFT SEALING RINGS	
40	Stator body 58mm dia x 2.50 (2)	183 26 01

Illus	Description	Part No
41	Stator body 52mm dia x 2.50 (1)	178 26 03
42	Input shaft teflon 22mm dia x 1.90 (2)	183 26 03
43	Input shaft early (thin) 26mm dia x 2.00 (1)	180 26 06
43	Input shaft late (thick) 26mm dia x 2.50 (1)	183 26 07
44	Turbine shaft - early (thin) 32mm dia x 2.00 (1)	183 26 04
44	Turbine shaft - late (thick) 32mm dia x 2.50 (1)	183 26 08
45	Turbine shaft 31mm dia x 2.00 (1)	183 26 05
46	Governor - rubber 56mm dia x 2.50 (2)	180 26 09
47	Governor - steel 56mm dia x 2.50 (2)	183 26 06
	CLUTCH PLATES	
50	"C" clutch friction 143mm x 1.6 x 48T (3)	137 11 03
51	"C" clutch steel (3)	137 12 03
52	"C" clutch pressure	183 13 01
53	"C" clutch diaphram spring	183 24 01
55	"B" clutch friction 147mm x 2.0 x 30T (2/3)	183 11 02
56	"B" clutch steel (2/3)	183 12 02
57	"B" clutch pressure	183 13 02
58	"B" clutch diaphram spring	183 24 04
60	"A" clutch friction 147mm x 1.6 x 30T (4/5)	183 11 03
61	"A" clutch steel (4/5)	183 12 02
62	"A" clutch steel (wavy)	183 12 04
63	"A" clutch pressure	183 13 02
64	"A" clutch small dished spring	183 24 05
65	"A" clutch large dished spring	183 24 06
68	"E" clutch friction 108mm x 1.6 x 36T (4/5)	183 11 04
69	"E" clutch steel (4/5)	183 12 03
70	"E" clutch pressure (4 plate)	183 13 03
70	"E" clutch pressure (5 plate)	183 13 04
71	"E" clutch diaphram spring (2)	180 24 05
74	"D" clutch friction 147mm x 1.6 x 30T Std (5/6)	183 11 03
74	"D" clutch friction 147mm x 1.6 x 30T OEM (5/6)	183 11 05
75	"D" clutch steel (5/6)	183 12 02
76	"D" clutch steel (wavy)	183 12 04
77	"D" clutch pressure	183 13 02
78	"D" clutch diaphram spring	183 24 02
	BRAKE BAND	
79	Band - all except Audi 100	183 14 01
79	Band - Audi 100	183 14 02
	FILTER	
80	Pick up	183 27 01
80	Pick up - Audi	183 27 02
	BUSHES & BEARINGS	
	Bush kit (pump, stator x 2,turb shaft, 3/4 drum)	193 09 01
81a	Pump	183 21 07
81	Output shaft (2)	180 21 01
82	Differential input shaft	183 21 03
82	Drive shaft	183 21 03
83	Differential (crownwheel side)	183 21 02
83	Side shaft	183 21 02
84	Side shaft	183 21 01
85	Differential cage	183 21 04
85a	Turbine shaft	180 21 06
85a	Turbine shaft (undersize)	180 21 10
86	Stator support rear (see "TOOLS" for fitting)	183 21 05
86a	Stator support front	183 21 06
NI	Reverse drum	183 21 08
NI	Bearing rear OWC - Audi	183 46 03
NI	Pinion roller bearing - Audi	183 46 01
NI	Idle gear roller bearing - Audi	183 46 02
	THRUST WASHERS	
87	"C" clutch stepped thrust	183 22 07
88	"C" clutch selective 3.60mm	183 22 08
88	"C" clutch selective 3.40mm	183 22 09
88	"C" clutch selective 3.20mm	183 22 10
88	"C" clutch selective 3.00mm	183 22 11
88	"C" clutch selective 2.80mm	183 22 12
88	"C" clutch selective 2.60mm	183 22 13
88	"C" clutch selective 2.40mm	183 22 14
88	"C" clutch selective 2.20mm	183 22 15
88	"C" clutch selective 2.00mm	183 22 16

Illus	Description	Part No.
88	"C" clutch selective 1.80mm	183 22 17
88	"C" clutch selective 1.60mm	183 22 18
88	"C" clutch selective 1.40mm	183 22 19
88	"C" clutch selective 1.20mm	183 22 20
88	"C" clutch selective 1.00mm	183 22 21
89	"B" clutch to shell	183 22 06
90	Input shaft & "E" clutch housing	180 22 44
91	"E" clutch hub to "E" clutch housing plate (2)	180 22 45
92	"E" clutch hub to "E" clutch housing needle	180 23 06
93	Inter shaft to sungear cupped bearing retainer	183 22 04
94	Inter shaft to sungear needle	183 23 03
95	Inter shaft to sungear thrust plate	183 22 05
96	Sungear to shell plate	183 22 01
97	Sungear to shell needle	183 23 01
98	Sungear to shell thrust plate	183 22 02
99	Output shaft top hat race	183 22 03
100	Output shaft needle	183 23 02
101	Output shaft flat race	178 22 18
102	Pinion shaft selective 1.95mm	183 22 22
102	Pinion shaft selective 1.90mm	183 22 23
102	Pinion shaft selective 1.85mm	180 22 58
102	Pinion shaft selective 1.80mm	180 22 57
102	Pinion shaft selective 1.75mm	180 22 03
102	Pinion shaft selective 1.70mm	180 22 04
102	Pinion shaft selective 1.65mm	180 22 05
102	Pinion shaft selective 1.60mm	180 22 06
102	Pinion shaft selective 1.55mm	180 22 07
102	Pinion shaft selective 1.50mm	180 22 08
102	Pinion shaft selective 1.45mm	180 22 09
102	Pinion shaft selective 1.40mm	180 22 10
102	Pinion shaft selective 1.35mm	180 22 11
102	Pinion shaft selective 1.30mm	180 22 12
102	Pinion shaft selective 1.25mm	180 22 13
102	Pinion shaft selective 1.20mm	180 22 14
102	Pinion shaft selective 1.15mm	180 22 15
102	Pinion shaft selective 1.10mm	180 22 16
102	Pinion shaft selective 1.05mm	180 22 17
102	Pinion shaft selective 1.00mm	180 22 18
	CIRCLIPS	
103	"A" clutch retainer selective 2.80mm	183 32 01
103	"A" clutch retainer selective 2.60mm	157 32 07
103	"A" clutch retainer selective 2.40mm	183 32 03
103	"A" clutch retainer selective 2.20mm	183 32 04
103	"A" clutch retainer selective 2.00mm	183 32 05
103	"A" clutch retainer selective 1.80mm	183 32 06
103	"A" clutch retainer selective 1.60mm	183 32 07
103	"A" clutch retainer selective 1.40mm	183 32 08
103	"A" clutch retainer selective 1.20mm	183 32 09
103	"A" clutch retainer selective 1.00mm	183 32 10
104	Turbine shaft	183 32 19
105	"A" clutch piston	183 32 20
106	Differential input shaft large	183 32 21
107	Differential input shaft small	183 32 22
108	Drive shaft	183 32 23
108a	Rear one way clutch	183 32 24
109	"D" clutch retainer 2.20mm	183 32 04
109	"D" clutch retainer 2.60mm	157 32 07
109	"D" clutch retainer 3.00mm	157 32 06
109	"D" clutch retainer 3.50mm	157 32 05
109	"D" clutch retainer 4.00mm	157 32 04
110	"E"clutch spring retainer (pair)	180 29 19
111	"E"clutch retainer	183 32 11
112	"C" clutch retainer 0.90mm	183 32 12
112	"C" clutch retainer 1.10mm	183 32 13
112	"C" clutch retainer 1.30mm	183 32 14
112	"C" clutch retainer 1.50mm	137 32 01
112	"C" clutch retainer 1.70mm	183 32 16
112	"C" clutch retainer 1.90mm	183 32 15
113	"B" clutch retainer 1.60mm	183 32 07

Illus	Description	Part No
114	"B" clutch spring retainer (pair)	183 29 16
NI	Servo cover	183 32 17
115	Gearset ring gear	183 32 18
	HARD PARTS	
124	Pump assembly	183 38 01
124	Pump assembly for 092, 094, 097, 104 to 110,	183 38 03
	118, 122 to 127, 132, 133, 150, 151, 152, 155, 156	183 38 03
	159 to 164	183 38 03
NI	Pump screws (long outer) (8)	180 37 08
NI	Pump screws (short inner) (6)	183 37 02
125	Relief valve spring	180 24 16
126	Relief valve cap	180 29 54
127	Relief valve	180 29 53
128	Dowel pump to stator	180 29 14
129	Stator support	183 39 01
130	"C" clutch piston	183 45 09
131	Intermediate ring and one way clutch	183 44 01
132	"B" clutch cylinder	183 29 07
133	"B" clutch piston (3 plate clutch)	183 45 10
133	"B" clutch piston (2 plate clutch)	183 45 11
134a	"B" clutch intermediate ring	183 29 17
134	Turbine shaft	183 38 02
135	"A" clutch cylinder	183 29 01
135	"A" clutch cylinder (Audi only)	183 29 34
136	"A" clutch piston (5 plate clutch)	183 45 01
137	Oil throw ring	183 45 03
138	Input shaft "E" clutch housing	183 29 08
139	"E" clutch piston (5 plate clutch)	183 45 07
139	"E" clutch piston (4 plate clutch)	183 45 08
140	Inter shaft "E" clutch hub	183 29 09
141	Sungear shaft "A" clutch hub	183 29 02
142	Driving shell	183 29 06
143	Planetary sungear	183 65 01
144	Planetary assembly	183 66 01
144	Planetary assembly Cit/Peu 092 to 095, 097,	
	104 to 108, 118, 122 to 127, 132 & 133	183 66 03
145	Planetary ring gear	183 66 02
146	Output shaft	183 57 01
147	Spur gear shim selective 6.59 mm	183 36 01
147	Spur gear shim selective 6.56 mm	183 36 02
147	Spur gear shim selective 6.53 mm	183 36 03
147	Spur gear shim selective 6.50 mm	183 36 04
147	Spur gear shim selective 6.47 mm	183 36 05
147	Spur gear shim selective 6.44 mm	183 36 06
147	Spur gear shim selective 6.41 mm	183 36 07
147	Spur gear shim selective 6.38 mm	183 36 08
147	Spur gear shim selective 6.35 mm	183 36 09
147	Spur gear shim selective 6.32 mm	183 36 10
147	Spur gear shim selective 6.29 mm	183 36 11
147	Spur gear shim selective 6.26 mm	183 36 12
147	Spur gear shim selective 6.23 mm	183 36 13
147	Spur gear shim selective 6.20 mm	183 36 14
147	Spur gear shim selective 6.17 mm	183 36 15
147	Spur gear shim selective 6.14 mm	183 36 16
147	Spur gear shim selective 6.11 mm	183 36 17
147	Spur gear shim selective 6.08 mm	183 36 18
147	Spur gear shim selective 6.05 mm	183 36 19
147	Spur gear shim selective 6.02 mm	183 36 20
147	Spur gear shim selective 5.99 mm	183 36 21
147	Spur gear shim selective 5.96 mm	183 36 22
147	Spur gear shim selective 5.93 mm	183 36 23
147	Spur gear shim selective 5.90 mm	183 36 24
147	Spur gear shim selective 5.87 mm	183 36 25
148	Spur gear (output shaft) 023 - 031 - 048 - 058	183 29 10
148	Spur gear (output shaft) 024 - 032 - 049 - 059	183 29 11
149	Spur gear bolt - early (Allen key hex socket)	180 37 15
149	Spur gear bolt - SAAB 068,116,139,142,145,168,184,	
	186,& 219	180 37 04
150	Spur gear (pinion shaft) 023 - 031 - 048 - 058	183 29 12
150	Spur gear (pinion shaft) 024 - 032 - 049 - 059	183 29 13

Illus	Description	Part No.
151	Spur gear bolt (hex for spanner)	180 37 15
152	Spur gear bolt shim	180 36 01
153	Output shaft shell	183 29 18
154	Rear OWC stop ring	183 29 19
155	OWC rear	183 44 02
155	& 157. OWC & house. Citroen 092, 093, 097, 104, 106, 108, 118, 123, 125, 127, 132	183 44 03
156	Rear OWC hub	183 29 20
156	Rear OWC hub - Audi	183 44 05
157	Rear OWC housing (Dir clutch hub)	183 29 21
157	Rear OWC housing (Dir clutch hub) - Audi	183 44 04
158	"D" clutch stop ring	183 29 27
159	"D" clutch piston 024	183 45 04
159	"D" clutch piston 023	183 45 05
159	"D" clutch piston 031 - 032 - 048 - 049 - 058 - 059	183 45 06
160	Retaining ring	180 34 01
161	Slotted nut "D" clutch	183 37 01
162	Pinion shaft	183 29 14
NI	Pinion gear - Audi	183 66 04
NI	Idler gear - Audi	183 66 05
NI	Helical gear - Audi	183 66 06
NI	Outer adapter housing - Audi	183 54 01
163	Differential planet shaft	183 29 24
164	Diff shim selective (excluding Audi) 0.15mm	183 36 26
164	Diff shim selective (excluding Audi) 0.20mm	183 36 27
164	Diff shim selective (excluding Audi) 0.25mm	183 36 28
164	Diff shim selective (excluding Audi) 0.30mm	183 36 29
164	Diff shim selective (excluding Audi) 0.35mm	183 36 30
164	Diff shim selective (excluding Audi) 0.40mm	183 36 31
164	Diff shim selective (excluding Audi) 0.70mm	183 36 32
164	Diff shim selective (excluding Audi) 1.00mm	183 36 33
164	Diff shim selective (excluding Audi) 1.20mm	183 36 34
164	Diff shim selective (excluding Audi) 1.50mm	183 36 35
NI	Pinion gear shim (Audi only) 0.25mm	183 36 58
NI	Pinion gear shim (Audi only) 0.35mm	183 36 59
NI	Pinion gear shim (Audi only) 0.35mm	183 36 77
NI	Pinion gear shim (Audi only) 0.40mm	183 36 78
NI	Pinion gear shim (Audi only) 0.45mm	183 36 79
NI	Pinion gear shim (Audi only) 0.50mm	183 36 36
NI	Pinion gear shim (Audi only) 0.55mm	183 36 37
NI	Pinion gear shim (Audi only) 0.60mm	183 36 38
NI	Pinion gear shim (Audi only) 0.65mm	183 36 39
NI	Pinion gear shim (Audi only) 0.70mm	183 36 40
NI	Pinion gear shim (Audi only) 0.75mm	183 36 41
NI	Pinion gear shim (Audi only) 0.80mm	183 36 42
NI	Pinion gear shim (Audi only) 0.85mm	183 36 43
NI	Pinion gear shim (Audi only) 0.90mm	183 36 44
NI	Pinion gear shim (Audi only) 0.95mm	183 36 45
NI	Pinion gear shim (Audi only) 1.00mm	183 36 46
NI	Pinion gear shim (Audi only) 1.05mm	183 36 47
NI	Pinion gear shim (Audi only) 1.10mm	183 36 48
NI	Pinion gear shim (Audi only) 1.15mm	183 36 49
NI	Pinion gear shim (Audi only) 1.20mm	183 36 50
NI	Pinion gear shim (Audi only) 1.25mm	183 36 51
NI	Pinion gear shim (Audi only) 1.30mm	183 36 52
NI	Pinion gear shim (Audi only) 1.35mm	183 36 53
NI	Pinion gear shim (Audi only) 1.40mm	183 36 54
NI	Pinion gear shim (Audi only) 1.45mm	183 36 55
NI	Pinion gear shim (Audi only) 1.50mm	183 36 56
NI	Pinion gear shim (Audi only) 1.55mm	183 36 57
NI	Band adjusting shim (Audi only) 3.00mm	183 36 60
NI	Band adjusting shim (Audi only) 3.25mm	183 36 60
NI	Band adjusting shim (Audi only) 3.50mm	183 36 62
NI	Band adjusting shim (Audi only) 3.75mm	183 36 63
NI	Band adjusting shim (Audi only) 4.00mm	183 36 64
NI	Band adjusting shim (Audi only) 4.25mm	183 36 65
NI	Band adjusting shim (Audi only) 4.50mm	183 36 66
NI	Band adjusting shim (Audi only) 4.75mm	183 36 67
NI	Band adjusting shim (Audi only) 5.00mm	183 36 68
NI	Band adjusting shim (Audi only) 5.25mm	183 36 69
NI	Band adjusting shim (Audi only) 5.50mm	183 36 70
NI	Band adjusting shim (Audi only) 5.75mm	183 36 71
NI	Band adjusting shim (Audi only) 6.00mm	183 36 72

Illus	Description	Part No
NI	Band adjusting shim (Audi only) 6.25mm	183 36 73
NI	Band adjusting shim (Audi only) 6.50mm	183 36 74
NI	Speedo drive worm	183 60 01
NI	Speedo drive worm - 139	183 60 04
NI	Speedo drive pinion 023, 024, 031	183 60 02
NI	Speedo drive pinion 032, 048, 049	183 60 02
NI	Speedo drive pinion 058, 059	183 60 03
165	Governor flanges 023, 024, 031, 032	183 59 01
165	Governor flanges 048, 049, 058, 059	183 59 02
166	Governor housing 024, 032 (1)	183 59 03
166	Governor housing 048, 058 (1)	183 59 05
166	Governor housing 023, 031 (1)	183 59 04
166	Governor housing 049, 059 (1)	183 59 06
166	Governor housing Peugeot 107 (1)	183 59 16
166	Governor housing Citroen 132 (1)	183 59 19
167	Governor housing 024, 032 (1)	183 59 09
167	Governor housing 048, 058 (1)	183 59 10
167	Governor housing 023, 031 (1)	183 59 07
167	Governor housing 049, 059 (1)	183 59 08
167	Governor housing Citroen 132 (1)	183 59 20
168	Governor stop plate	183 59 11
169	Governor fixing plate	183 59 13
170	Governor plate	183 59 12
171	Governor screws 023, 024, 031, 032 (4)	180 37 07
171	Governor screws 048, 049, 058, 059 (2)	180 37 07
172	Governor screws 048, 049, 058, 059 (3)	183 37 03
175	Maincase Saab 024	183 53 01
175	Maincase Saab 023	183 53 02
175	Maincase Saab 032 - 049 - 059	183 53 03
175	Maincase Saab 031 - 048 - 058	183 53 04
NI	Boost tube (in case) 132, 133 Cit/Peug	183 63 01
176	Converter housing	183 29 22
177	End cover	183 29 23
NI	V/B "A" clutch damper spring for Alfa Romeo 042, 046, 047, 062, 063, 064, 074, 089	183 62 04
	043, 060, 098	183 62 05
	061	183 62 06
NI	V/B "A" clutch damper spring for SAAB 048, 049, 058, 059, 065	183 24 10
	067, 088, 115, 119, 134, 135	183 62 02
	068, 116, 142	183 62 03
	023, 024, 031, 032	180 62 09
NI	V/B "A" clutch damper spring for Citroen/Peugeot 093, 095, 104, 105, 123, 124,	183 62 02
	092, 094, 097, 106, 107, 108, 109, 110, 118, 122	183 62 03
	125, 126, 127, 132, 133, 159, 160	183 62 03
	150, 151, 152, 155, 156, 161, 162, 163, 164	180 62 08
	Valve body ball (large) (2)	180 62 13
	Valve body ball (small) (2)	180 62 14
	Valve body orifice valve 0.70 mm dia	178 62 03
	Valve body orifice valve 0.80 mm dia	178 62 04
	Valve body orifice valve 0.90 mm dia	178 62 14
	Valve body orifice valve 1.00 mm dia	178 62 06
	Valve body orifice valve 1.20 mm dia	178 62 02
	Valve body orifice valve 1.30 mm dia	178 62 15
	Valve body orifice valve 1.50 mm dia	178 62 05
	Valve body orifice valve 1.70 mm dia	178 62 01
	Oversize pressure regulator valve kit	183 62 07
NI	Stone guard	183 29 15
NI	Park lock cam	183 29 03
NI	Park pawl 023, 024, 031, 037,	183 29 04
NI	Park pawl 048, 049, 058, 059	183 29 05

TOOLS

Rear stator bush insert mandrel		180 33 04
Rear stator bush insert collets	(pair)	180 33 01
Regulator tool kit		183 33 11

CITROËN TECHNICAL TRAINING

ZF 4HP20 AUTOMATIC TRANSMISSION

CITROËN UK LTD
221 BATH ROAD
SLOUGH SL1 4BA

DEALER PERSONNEL
DEVELOPMENT AND
TRAINING

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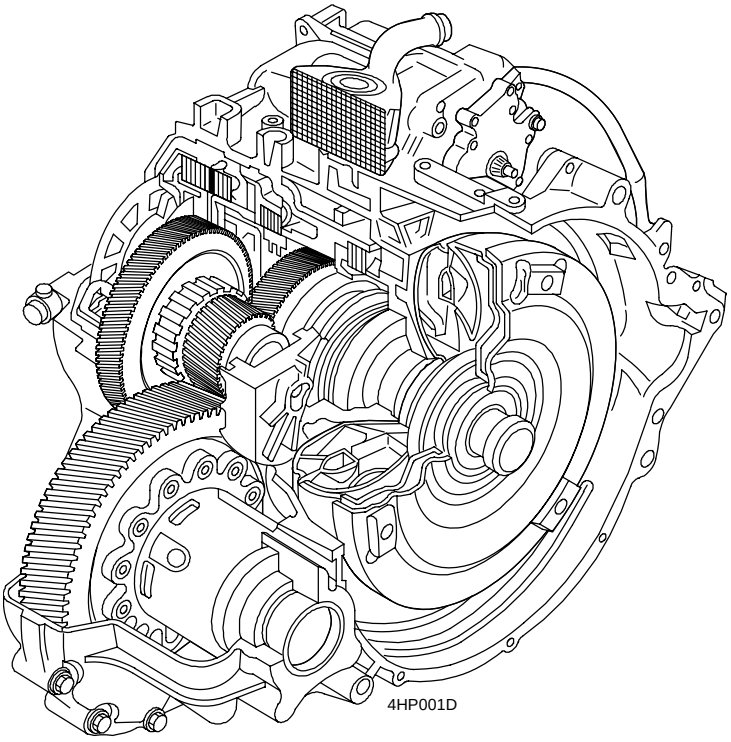
PRESENTATION - GENERAL

I - INTRODUCTION



- Totally electronically managed transverse automatic transmission.
- Four forward gears and one reverse gear.
- Auto-adaptive ECU used for managing the converter, gear changes and specific programs.
- The maximum torque capacity is 330 mN.
- Sealed transmission with reduced maintenance.
- This transmission is aimed at the powerful engines fitted to the top of the range CITROËN vehicles: mono volume, H and M2 segments.

Note: This document only deals with the ES9 J4 L3 engine.

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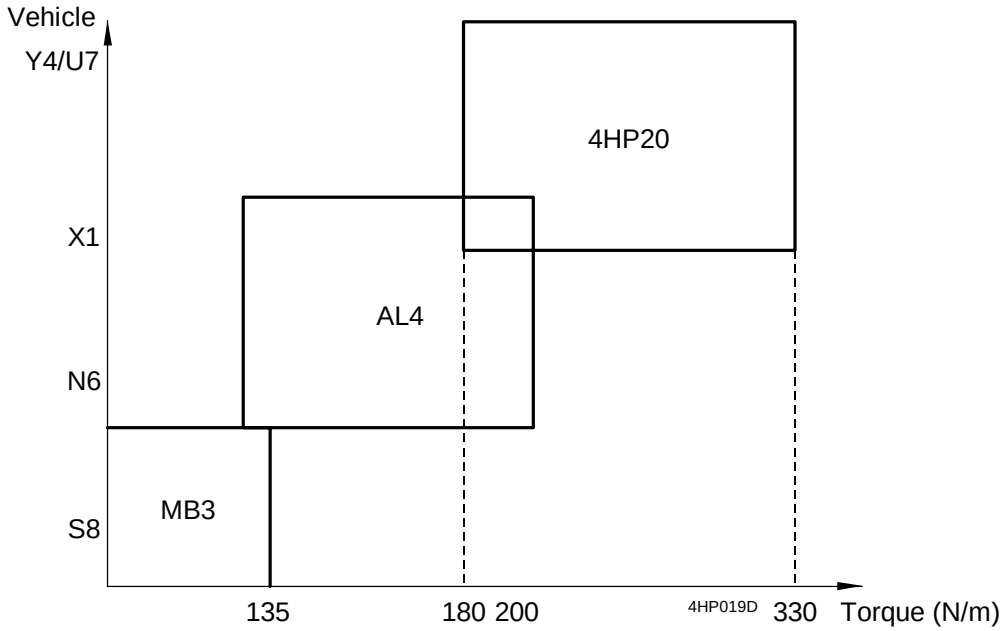

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II - PRESENTATION

Transmission architecture

- Hydraulic torque converter with lock-up device.
- Primary shaft.
- Two "Simpson 2" type epicyclic gear trains.
- Multidisc clutches / brakes (no belt brakes).
- Step down torque in central position.
- Differential with sealed outputs.

Control

This is provided by:

- the hydraulic unit,
- the ECU,
- the control cable.

Points of note

- Lock-up of 2nd, 3rd and 4th gears with controlled slip.
- Electronic management of all regulation and gear changing functions.
- Multiple programs: auto-adaptive (DSP) - Sport-Snow.
- Gears and programs displayed on dashboard.
- Possibility of manually selecting one of the first three gears: 1 - 2 - 3.
- Cannot change up a gear when in no load position (foot off accelerator).
- ECU with auto-adaptive "Flash EPROM".
- Downgraded mode operation in the event of a fault.
- Closed loop operation.
- Autodiagnostic and downgraded mode.
- SHIFT LOCK* and KEY LOCK** functions

* Shift lock: impossible to leave position P without having pressed brake beforehand.

** KEY LOCK: impossible to remove key from ignition if the selector lever is not in P. On CITROËN vehicles, the KEY LOCK device has not been chosen and may be replaced by a buzzer (same as the lights on reminder buzzer).

This will appear on the restyled CITROËN XANTIA.

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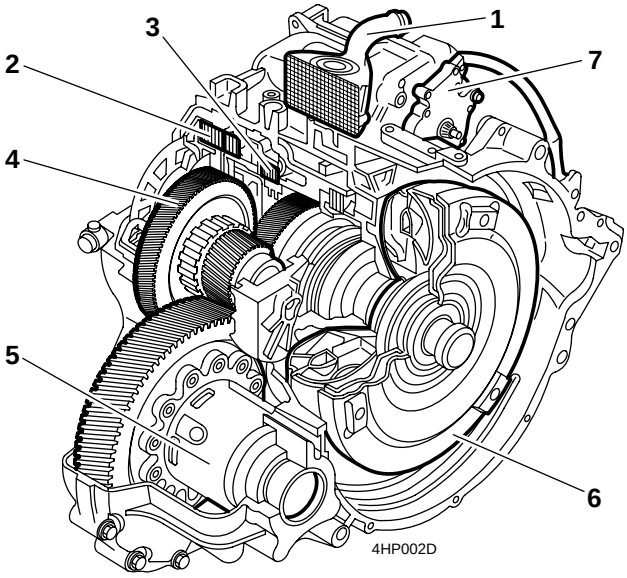
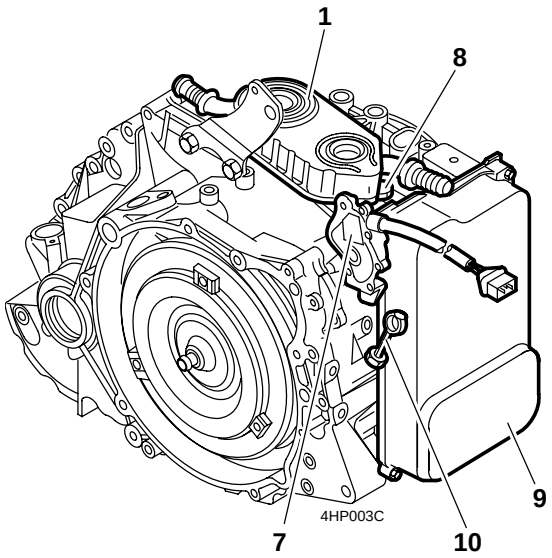
III - DESCRIPTION



1 - Heat exchanger
2 - Clutch
3 - Brake
4 - Step-down torque
5 - Differential
6 - Torque converter
7 - Multifunction switch



8 - Breather
9 - Hydraulic unit cover
10 - Oil dipstick

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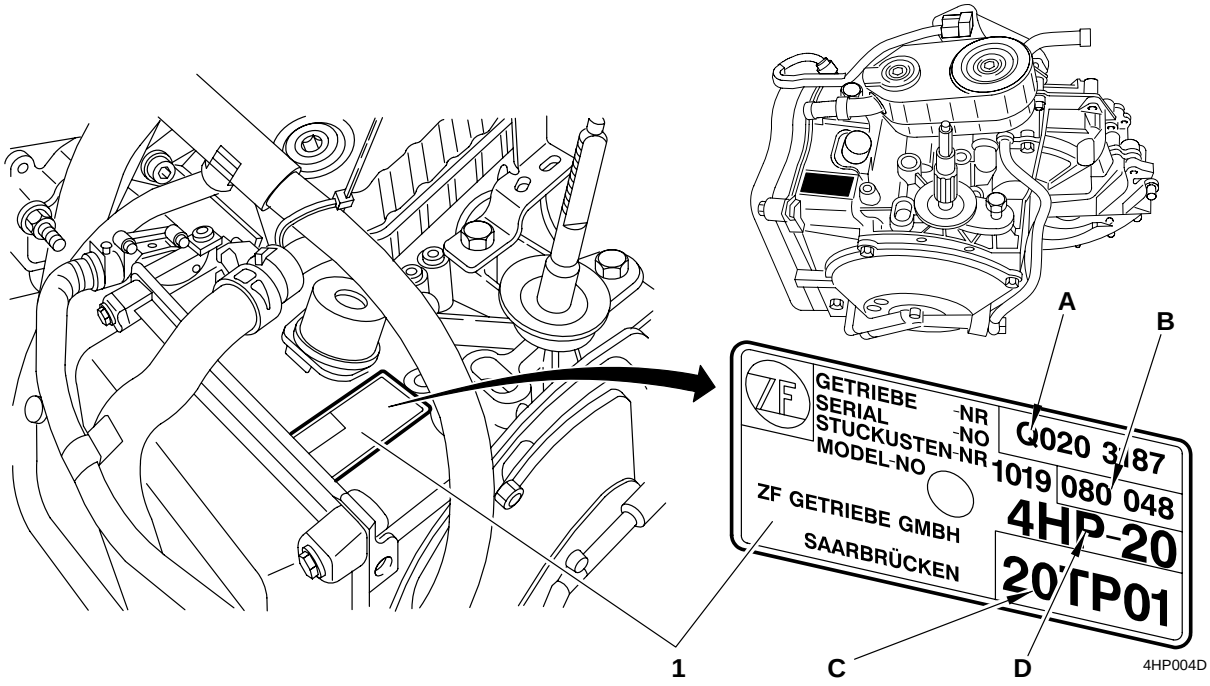
IV - IDENTIFICATION OF THE COMPONENTS OF THE AUTOMATIC TRANSMISSION

A - AUTOMATIC TRANSMISSION



1 - Identification plate

The transmission is identified by means of a plate riveted to the housing:

A - Serial number.

B - Parts list number (last 3 figures taken into account).

C - Component reference.

D - Automatic transmission type.

ZF PARTS LIST NUMBER (B)	COMPONENT REFERENCE (C)	HYDRAULIC UNIT NUMBER (D)
1019000010	20HZ07	1019198306

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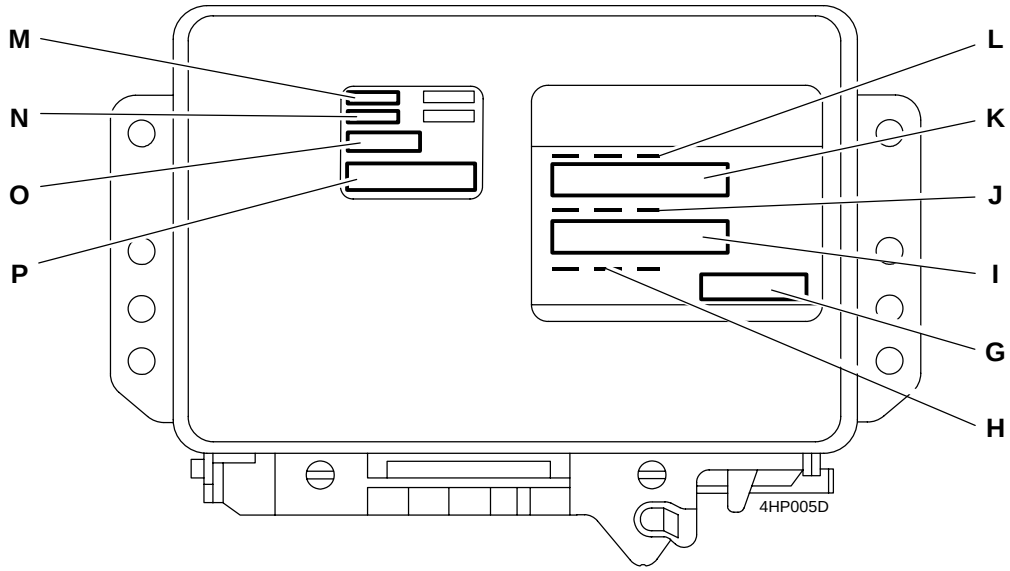
B - ECU



G - Reference.

H - Customer number.

I - Customer number bar code.

J - ZF parts list number.

K - ZF number bar code (software identification).

L - Order number.

M - Hardware version.

N - Program data version (software version).

O - Date of manufacture.

P - Serial number.

Identification (with an ELIT type diagnostic device)

- The ECU identification is found in the Identification menu.

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V - SPECIFICATIONS - MAINTENANCE

A - INTERVALS - CAPACITIES

	XANTIA
Engine	ES9J4L3
Transmission capacity	7.7 - 8.3 litres
Draining capacity	between 2.7 and 3 litres
Exclusive oil	ESSO LT 71141
Draining interval	lubricated for life
Top-up interval	60 000 km
Transmission lubrication	pressurised
Final drive lubrication	oil splash
Weight	88 kg with oil and electronics
Torque capacity	330 mN at 3500 rpm

B - GEARS

	XANTIA	XM
Engine	ES9J4L3	ES9J4L3
Tyres - circumference	205/60R15MXV3 A	205/65R15 index V
1st	2.718 - 11.35 km/h*	2.718 - 11.65 km/h*
2nd	1.481 - 21 km/h*	1.481 - 21.4 km/h*
3rd	1 - 31 km/h*	1 - 31.66 km/h*
4th	0.720 - 43 km/h*	0.720 - 44 km/h*
Reverse	2.568 - 12 km/h*	2.568 - 12.33 km/h*
Step-down torque	61x66	59x68
Cylindrical torque	20x69	20x69
Tachometric torque	20x16	20x16

* Speeds in km/h are given at 1000 rpm.

Internal gear change safety thresholds:

LEVER POSITION	SAFETY THRESHOLD
D $\rightarrow$ R	10 km/h
D $\rightarrow$ 3	165 km/h
3 $\rightarrow$ 2	110 km/h
2 $\rightarrow$ 1	60 km/h

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VI - TIGHTENING TORQUES

TRANSMISSION COMPONENT	DESCRIPTION	N° BOLTS	HEX HEAD	BOLT DIMENSIONS	TIGHTENING TORQUE(S)
Auto trans housing	Exchanger output connector tube mounting to auto. trans	1	Hex head - 13 mm spanner	M8	23 Nm
Side cover	Cover mountings	5	Hex head - 13 mm spanner	M8 L = 28	23 Nm
Side cover	Banjo connect. Transmission input	1	Hex head - 19 mm spanner	M14 x 1.5	25 Nm
Converter housing	External mountings on auto trans + strap bracket (2 bolts)	18	Hex head - 13 mm spanner	M8 L = 40	23 Nm
Converter housing	auto trans mountings behind converter	5	Hex head - 13 mm spanner	M8 L = 50	23 Nm
Converter housing	Drain plug	1	6 point socket bolt, 8 spanner	M16 x 1.5	45 Nm
Exchanger	Mounting(s) on auto trans (socket bolts)	2	6 point socket bolt, 6 spanner	M12 x 1.5	35 Nm
Position switch	Switch mountings on support plate	2	Hex head - 10 mm spanner	M6 L = 16	10 Nm
Selector control	Selector mounting on shaft	1	Hex nut (13)	M8	21 Nm
Selector control	Sleeve stop lug mounting on converter housing	2	Hex head - 13 mm spanner	M8	15 Nm
Hydraulic unit cover	Bridge mountings on auto trans housing	4	-	M6 L = 37	6 Nm
Hydraulic unit cover	Angle mountings on auto trans housing	2	Hex head - 10 mm spanner	M6 L = 20	6 Nm
Hydraulic unit	Mounting(s) on auto trans housing	7	TORX	M6 L = 55	8 Nm
Engine speed sensor	Mounting on hydraulic unit (output speed)	1	TORX	M6 L = 20	10 Nm
Engine speed sensor	Mounting(s) on auto trans housing (input speed)	1	TORX	M6 L = 35	8 Nm
Speedo sensor	Mounting(s) on auto trans housing	1	Hex head - 11 mm spanner	M7 X1 L = 16	8 Nm

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ASSEMBLY	N° BOLTS	BOLT HEAD	BOLT DIMENSIONS	TIGHTENING TORQUE(S)
Drive plate converter	3	Hex head - 16 mm spanner	M8 x 1.25 L = 14	65 Nm (± 20%)
Engine block converter housing	4	Hex head - 17 mm spanner	M10 x 1.5 L = 75	65 Nm (± 20%)
Engine block converter housing	2	6 point socket bolt - 8 spanner (thread on AT side)	M10 x 1.5 L = 80	65 Nm (± 20%)
Crankshaft/carrier - ring	8	Hex head - 17 mm spanner	M9 x 1 L = 18	90 Nm (± 10%)
Closure plate	3	Hex head - 10 mm spanner	M6 x 1 L = 16	17.6 Nm (± 10%)
Auto trans. suspension	1	Stud(s)	M14 x 1.5 L = 29	50 Nm (± 10%)
Auto trans. suspension	1	Hex head - 13 mm spanner	M12 x 1.5 L = 35	60 Nm

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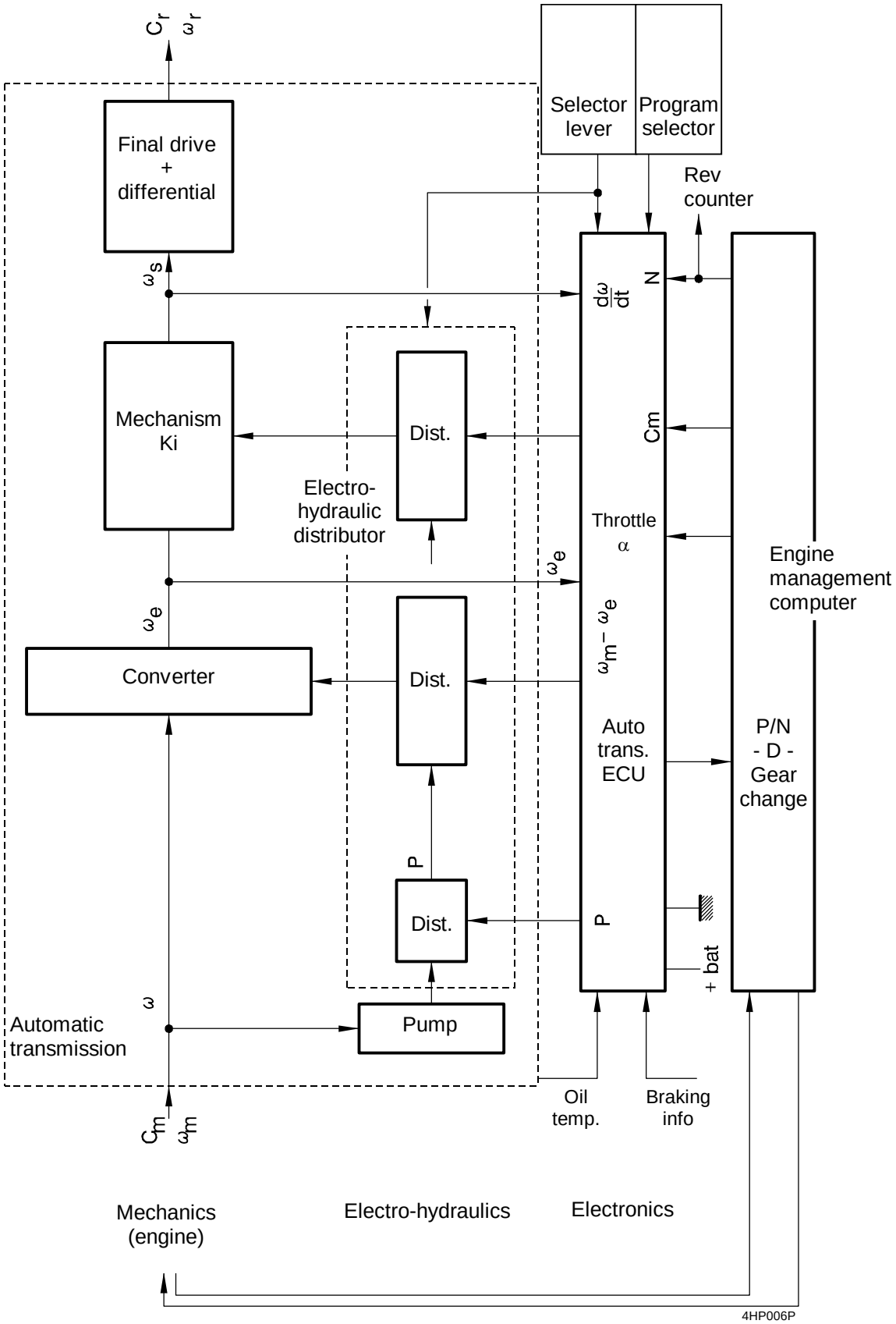
VII - LAYOUT OF THE 4HP20 AUTOMATIC TRANSMISSION



ZF 4HP20 AUTOMATIC TRANSMISSION

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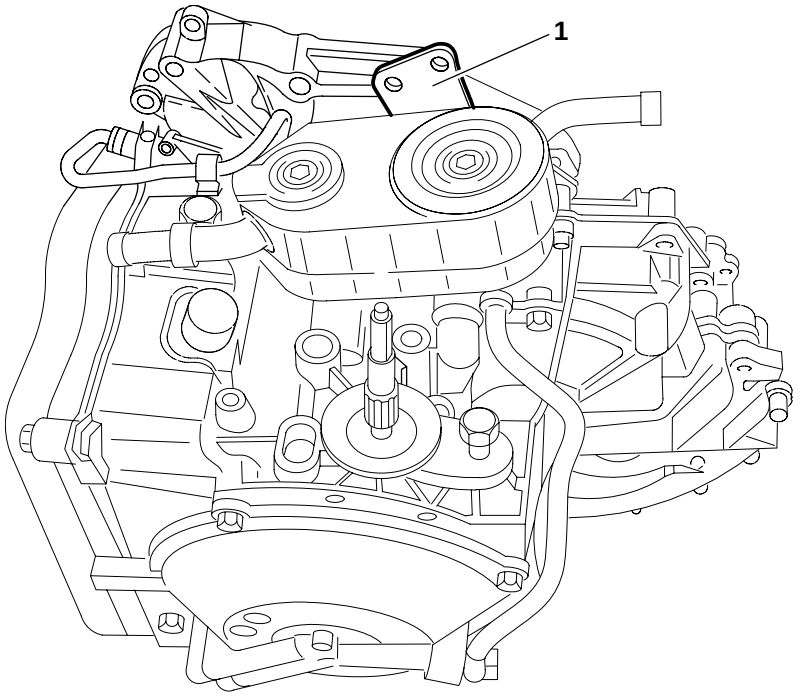
VIII - MISCELLANEOUS NOTES

A - TOWING

The transmission is lubricated when the engine is running since the engine drives the transmission oil pump; therefore, when towing, the drive wheels must be raised off the ground. The vehicle can however be towed with the drive wheels on the ground under exceptional circumstances as long as the following conditions are complied with:

- travel a distance of no more than 100 km,
- drive at less than 70 km/h,
- put lever in position N,
- the vehicle must be horizontal or else be inclined by a maximum of 5° if the rear wheels have to be raised.

B - LIFTING



The 4HP20 transmission is fitted with a sling bracket (1) for easy lifting.

Never place the transmission on the floor unprotected.

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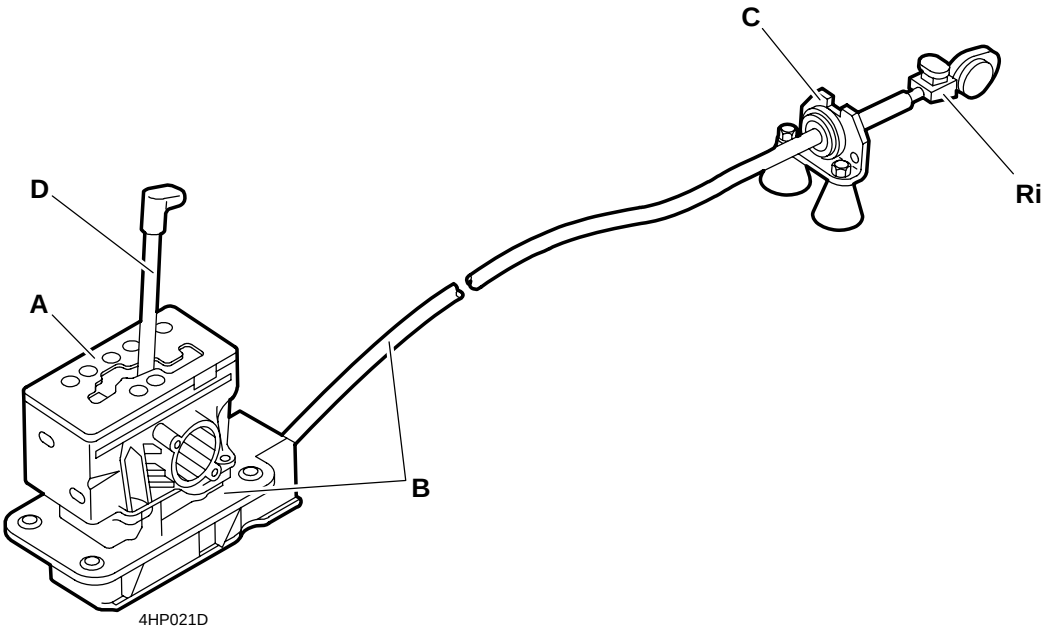
SELECTOR CONTROL

XANTIA

I - SELECTOR LEVER



A - Upper part

B - Lower part

C - Sleeve stop

D - Control lever

Ri - Initial adjustment

The selector lever, located on the central console, has 7 positions using an offset grid.

The lever has a mechanical safety device which locks by means of a radial action on the lever.

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Different positions:

- P - park: the transmission is mechanically locked, the starter motor may be operated.
- R - reverse: corresponds to reverse gear with illumination of reversing lights.
- N - neutral: corresponds to the neutral position; the starter motor may be operated.
- D - drive: the 4 gears are changed automatically; 1-2, 2-3, 3-4, 4-3, 3-2, 2-1
- 3-3rd hold: the first 3 gears can be used
- 2-2nd hold: the first 2 gears can be used
- 1-1st hold: only first gear can be used

Except in "snow" program

The 3rd, 2nd and 1st hold positions are totally controlled by the ECU.

Mechanical safety

The lever has to be moved radially in the following cases:

- from position P to position R,
- from position R to position P,
- from position N to position R,
- from position D to position N,
- from position 3 to position 2,
- from position 2 to position 1.

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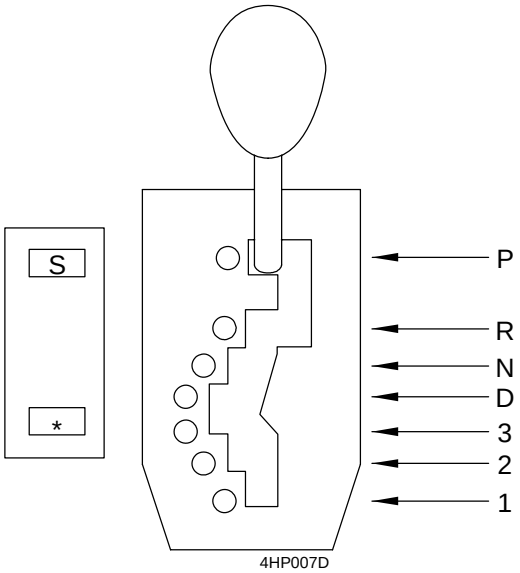
II - PROGRAM SELECTOR

Gears change automatically depending on the vehicle speed and engine load, in accordance with different gear changing strategies. The gear changing strategies are chosen by the ECU as a function of one of three programs offered to the driver.

The driver selects a program by pressing a "double push" switch located on the central console.



The following three programs exist:

- Auto-adaptive or "normal" (no action on switch):

  This is the basic program; the ECU adjusts the operation of the automatic transmission to the style of driving, to the road and to the vehicle load; it promotes economical fuel consumption.

- "Sport" (press S switch):

  This program promotes sporty driving to the detriment of consumption. Gears are still changed automatically.

- "Snow" (press * switch):

  This program is suited to driving on ground with low adherence. In drive, it is characterised by the removal of the first two forward gears and by less frequent change downs.

  Furthermore, in the 1st, 2nd and 3rd hold positions, the transmission will change to the gear shown by the lever (3rd in position 3, 2nd in position 2 and 1st in position 1).

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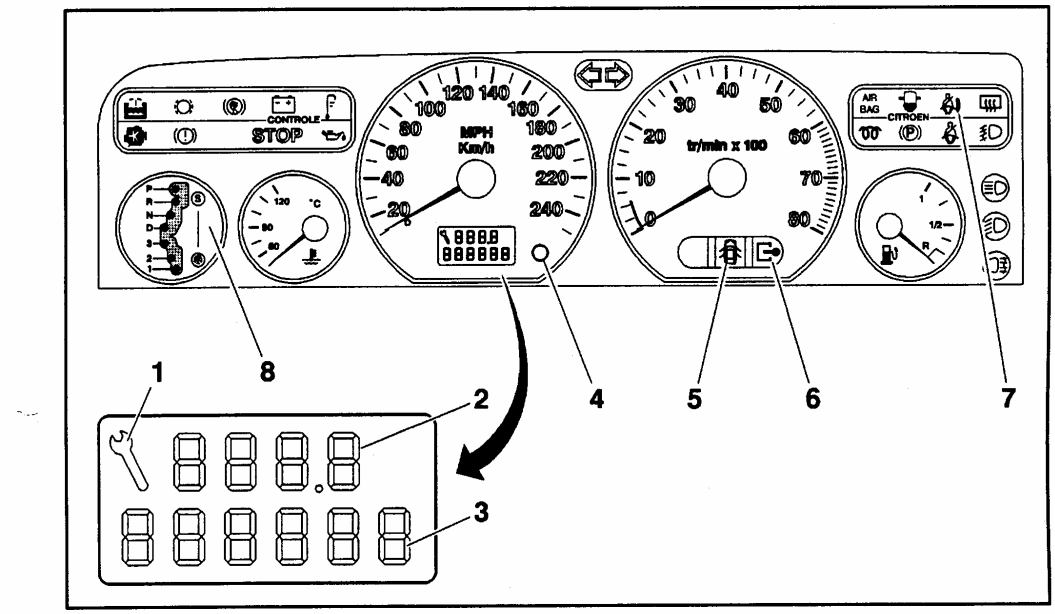
III - DISPLAY ON CONTROL PANEL

This function only appears on the restyled CITROËN XANTIA.



1 - maintenance symbol

2 - tripometers (I and II)

3 - dual function:

- maintenance indicator counter
- mileometer

4 - button for resetting maintenance indicator or selecting and resetting tripometers

5 - door open warning light

6 - transponder warning light

7 - lateral airbag warning light

8 - automatic transmission selector position display.

The LED display on the control panels informs the driver:

- of the position of the selector lever,
- of the program used,
- that the transmission is in emergency mode.

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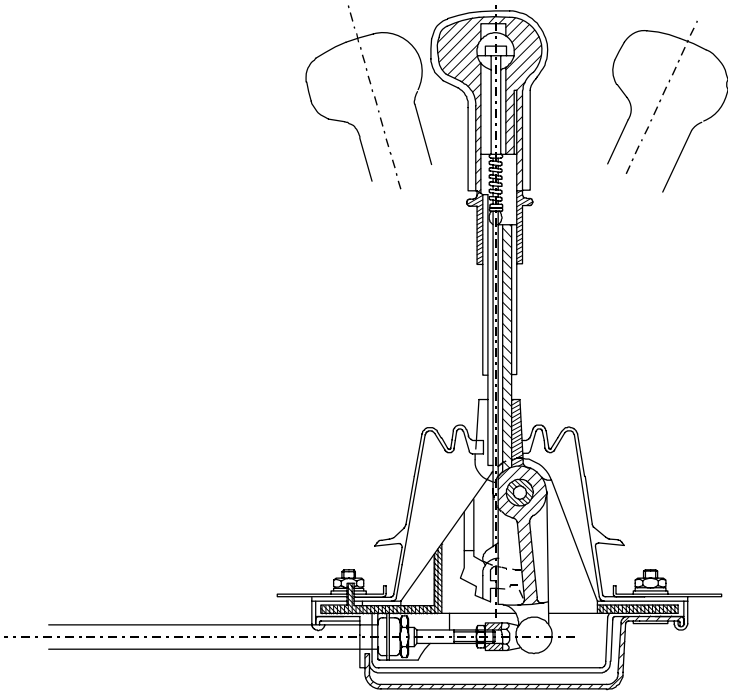
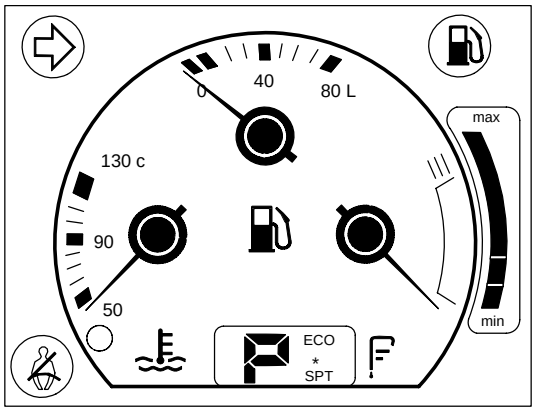
XM

The selector lever and control as well as the gear selection display on the control panel are unchanged.
However, the following have been added:

- a indicator showing the program selected on the control panel,
- a program selector switch.



4HP023D



4HP024C

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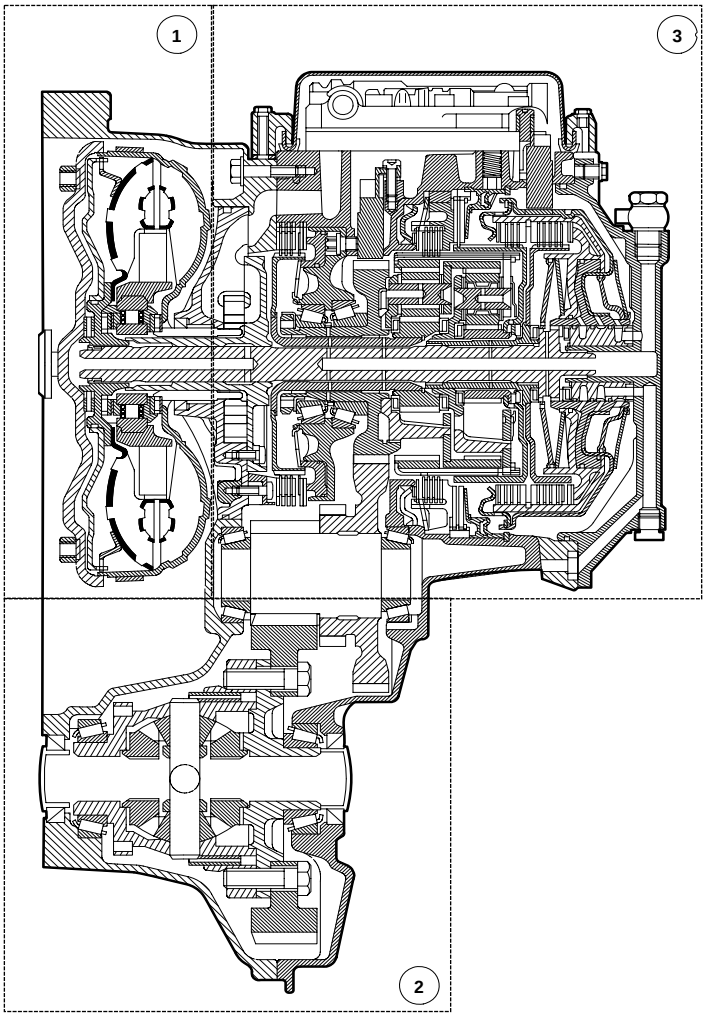
LUBRICATION

I - LUBRICATION CIRCUIT



The same oil is used to lubricate the 3 parts of the transmission:

- 1 - Converter (pressurised lubrication),
- 2 - Final drive (oil splash lubrication),
- 3 - Mechanism (pressurised lubrication),

The oil is cooled by a heat exchanger linked to the engine's cooling circuit.

The transmission is lubricated for life and the level should be checked every 60 000 km.

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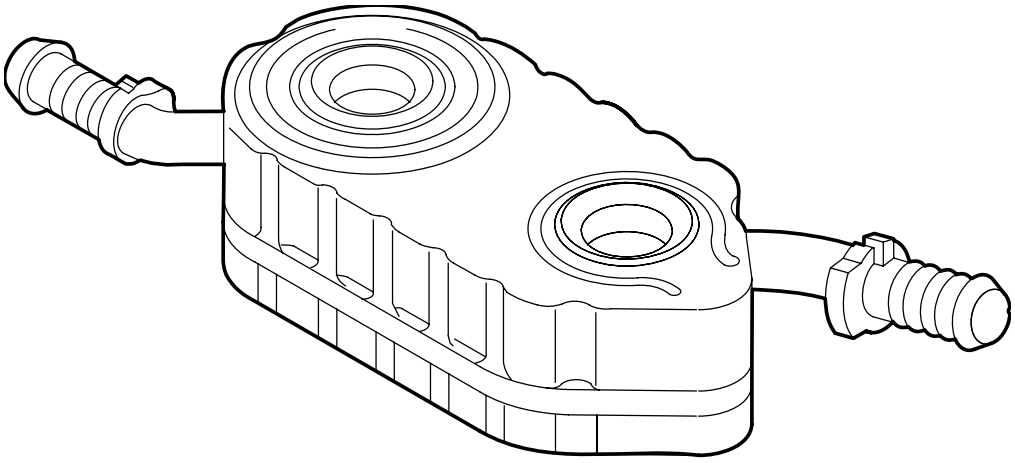
II - OIL GRADE

Exclusively: ESSO LT 71 141

III - PERIPHERAL COMPONENTS

A - WATER/OIL HEAT EXCHANGER



4HP026D

This is an 8 plate cooler connected to the engine's cooling circuit allowing the transmission temperature to be regulated.

Transmission operating temperature: approximately 100°C.

Note: Ensure it is mounted the correct way round: point of the exchanger towards the front of the vehicle.

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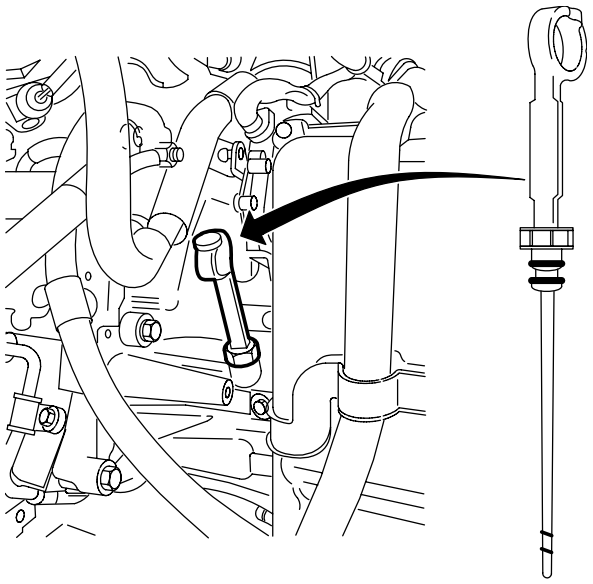
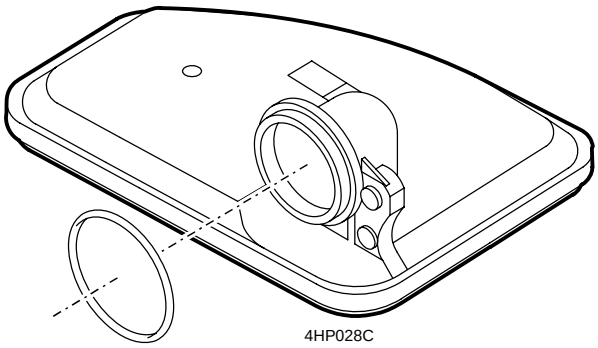
B - DIPSTICK



4HP027C

The dipstick is used to check the oil level in the transmission.

C - FILTER



4HP028C

The filter is used to filter impurities contained in the oil before it is drawn in by the pump.

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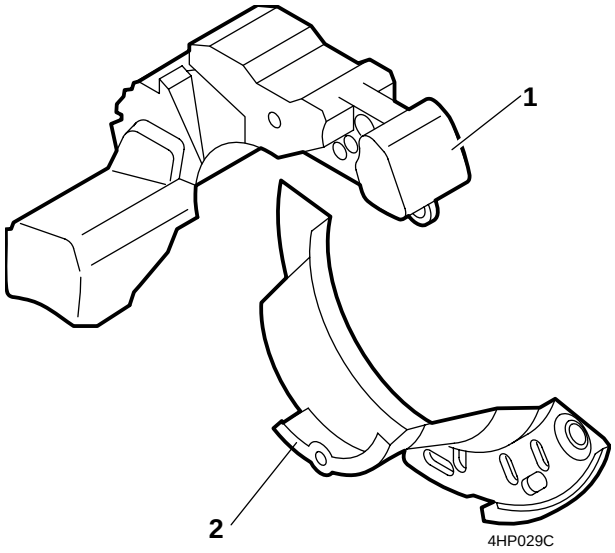
D - SUMP

1 - Description



1 - Sump

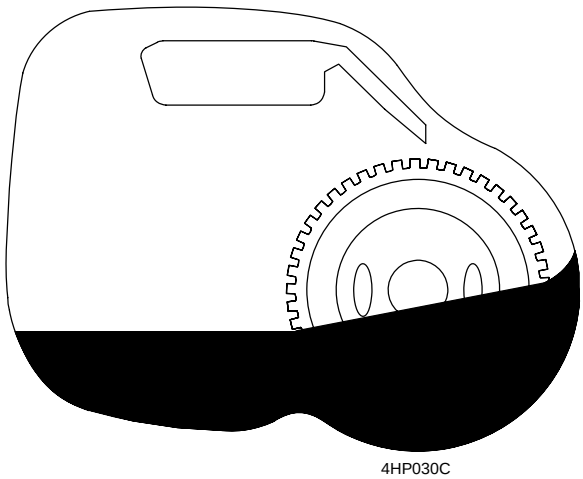
2 - Protective plate

The sump is used to maintain a constant oil level regardless of the temperature of the transmission.

It is located in the upper part of the transmission and has calibrated leaks.

2 - Operating principle

a - Cold transmission



The oil, which is too viscous, cannot be projected into the sump which therefore remains empty.

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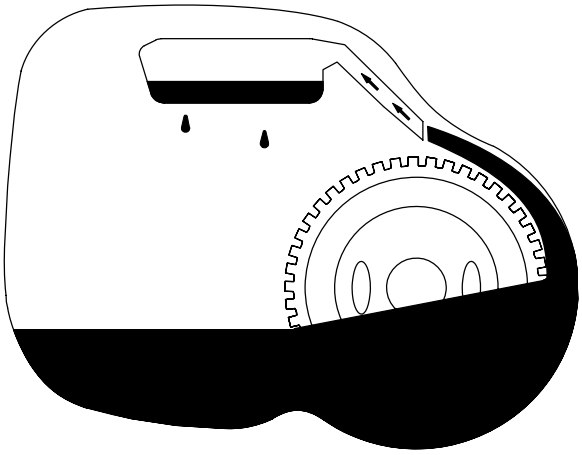
b - Warm transmission



4HP031C

The oil is fluid enough to be projected through the differential ring which acts as an oil pump.

The sump therefore fills up but empties progressively through the two calibrated leaks, thus reducing the active quantity of oil in the transmission.

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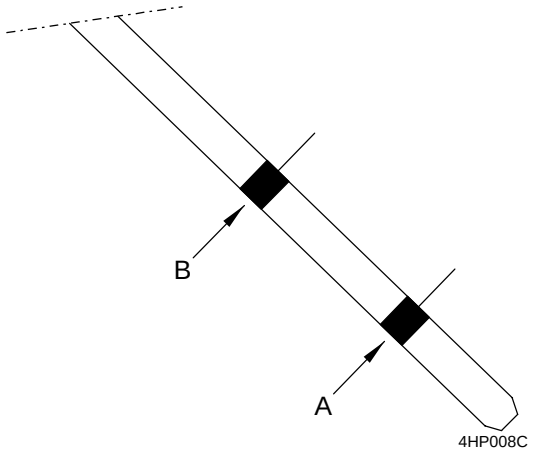
IV - CHECKING THE OIL LEVEL

Check the oil level every 60000 km.
Prior conditions:

- engine warm (transmission temperature: approximately 80° C),
- foot on brake, change through all the gears,
- vehicle on horizontal ground,
- selector lever in position P/N,
- engine idling, check the oil level.



The oil level on the dipstick should between the min (A) and max (B) marks.
Difference between min and max on the dipstick: 0.5 litre (s).

Important:	The oil level should not under any circumstances be above the max mark (B).

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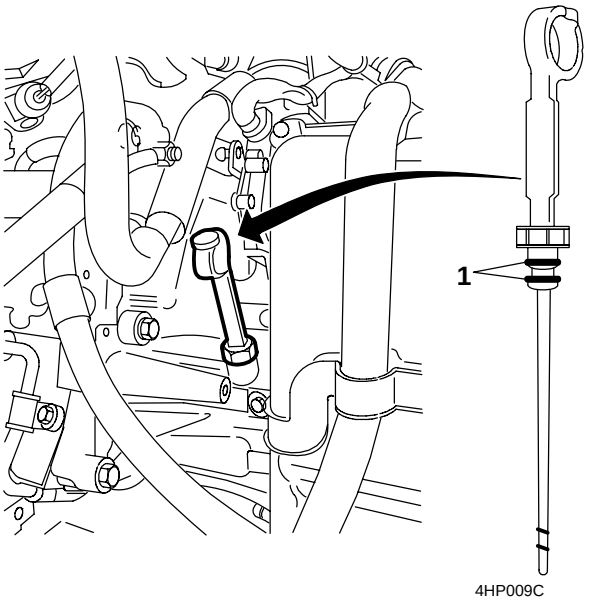
Too much oil may cause the following consequences:

- abnormal heating of the oil
- oil leaks

Not enough oil may damage the transmission.

Warning:	As dirt may collect around the dipstick, blow using compressed air before removing it.



If a leak develops around the dipstick, replace the 2 O-rings (1).

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V - DRAINING - REFILLING THE TRANSMISSION

A - DRAINING DURING SERVICING

Prerequisites:

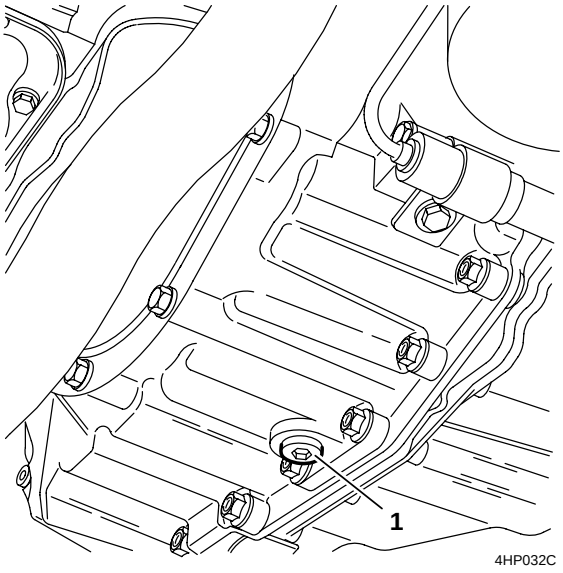
- transmission to be drained when warm to remove the impurities in suspension in the oil.

Draining is only partial since the converter cannot be totally drained.

Total capacity of the transmission:

- minimum: 7.7 litres,
- maximum: 8.3 litres.

When draining, approximately 3 litres are removed.



Drain plug (1).

B - FILLING

Oil is filled through the filler plug.

Use a funnel with a very fine strainer (mesh 0.15 mm).

Amount of oil to be added after draining (approximately) 3 litres.

Complete the operation by checking the dipstick with the engine running (idling).

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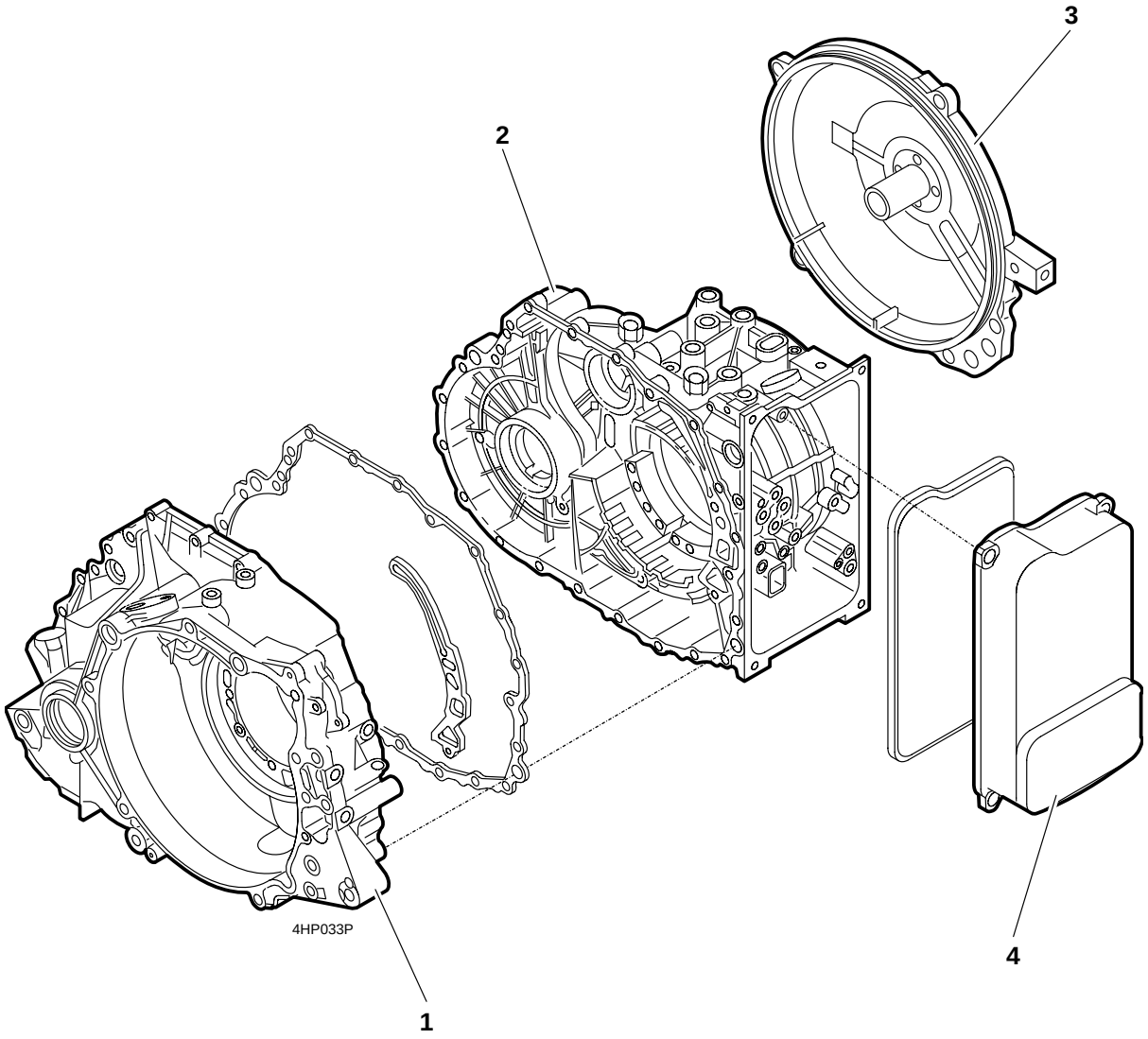
THE HOUSINGS



1 - Converter housing
2 - Transmission housing
3 - Rear housing
4 - Hydraulic unit cover

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ZF 4HP20 AUTOMATIC TRANSMISSION

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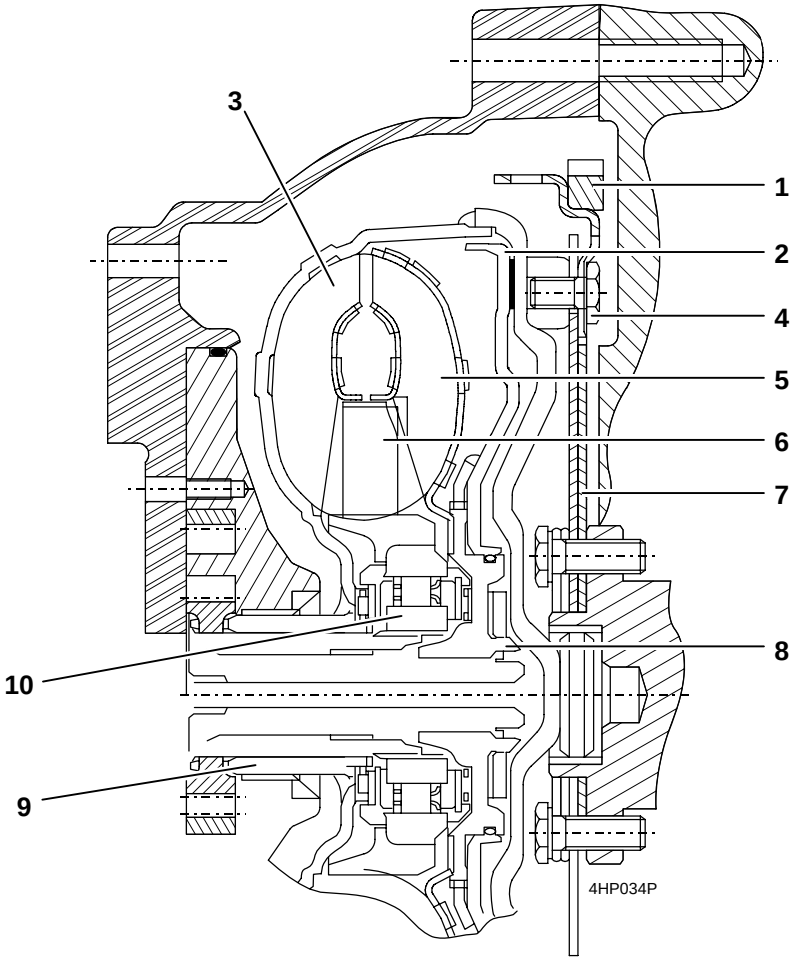
THE TORQUE CONVERTER

The 4HP20 automatic transmission is fitted with a standard torque converter to which is combined a lock-up device with controlled slip (controlled lock-up).

I - DESCRIPTION



1 - Starter motor ring
2 - Lock - up piston
3 - Pump or impeller
4 - Assembly bolt
5 - Turbine
6 - Stator
7 - Flange
8 - Turbine shaft
9 - Pump shaft
10 - Stator free wheel

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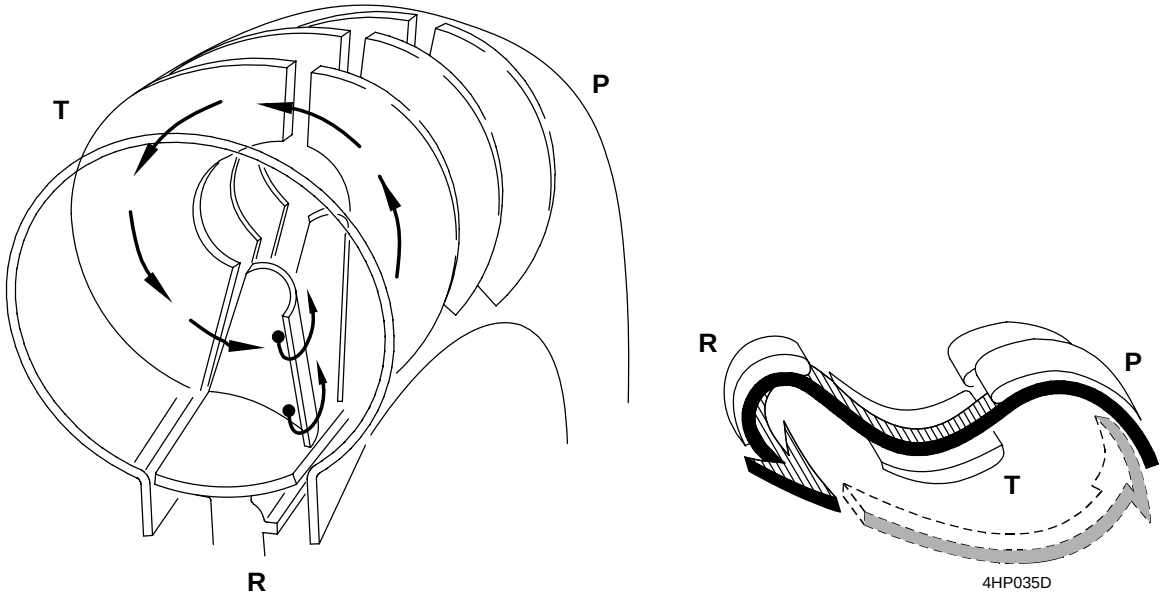
The body of the converter consists of two half-shells which are welded together. It is connected to the engine's crankshaft by a drive flange (7). It is supplied with oil. As the connection between the engine and transmission is not rigid, the converter allows the vehicle to move off progressively and prevents the engine from stalling when the vehicle is stationary.

- The pump or impeller (3) is connected to the engine.
- The turbine (5) is connected to the transmission by the turbine shaft (8).
- The stator (6) fitted on a free wheel (10) is located between the pump and the turbine.
- The lock - up (2) is a clutch which rigidly and directly connects the pump shaft to the turbine shaft.

Note: The converter of the 4HP20 automatic transmission has an oval cross section thus giving a more compact transmission without affecting the hydraulics.



P - Impeller
T - Turbine
R - Stator

II - SPECIFICATIONS

Diameter: 254 mm - Type: X18

Converter phase (when starting):

The engine torque is multiplied by 1.96

Setting torque: 170 mN at 2000 rpm (turbine locked)

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III - LOCK-UP DEVICE

A - PRESENTATION

The lock-up device is electronically controlled and can have three different states:

- Open state → normal operation of the converter with slip (there may be a difference of 100 - 200 rpm between N pump and N turbine at stabilised speed).
- Closed state → "Lock - up"; all the engine torque is transmitted.

Advantages:

- availability of engine brake,
- reduction in fuel consumption,
- cooling of automatic transmission oil,
- cooling of the lock-up track.

Disadvantages:

No filtering (acyclic/hesitation)

- Controlled state → slip is obtained such that N pump - N turbine = 50 rpm in most cases.

Advantages:

- filtering of engine acyclisms (oscillations),
- filtering of hesitation during variations in engine load, without losing the first three advantages given above (closed state).

The lock-up system is in the form of a clutch located between the converter cover and the turbine.

The converter can either be locked up or not by inverting the direction of oil circulation.

The various states are managed by the ECU using a network of strategy curves specific to each program and each gear in question (2nd, 3rd or 4th), depending on how much the throttle is open and the transmission output speed.

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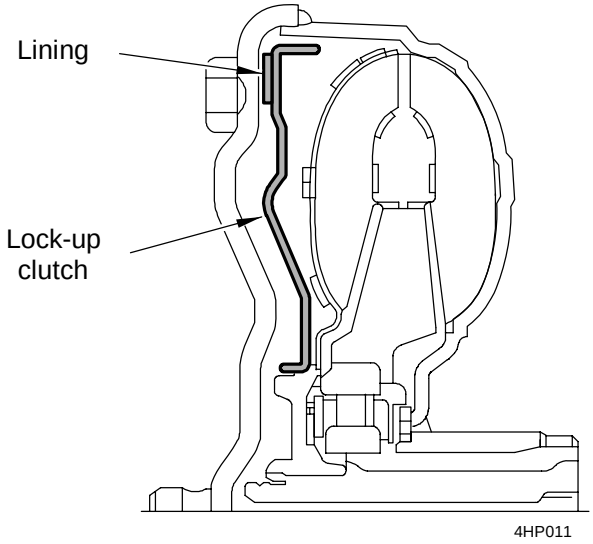
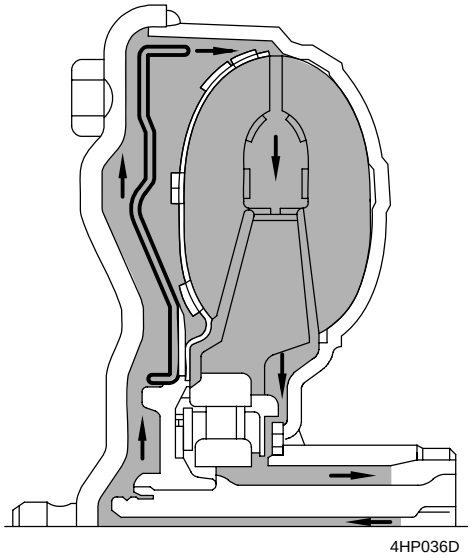


Note: It is essential that the original bolts which mount the converter onto the drive plate are used otherwise the friction track of the lock-up may be damaged.

B - OPERATING PRINCIPLE

→ **Open state:**



The direction of oil circulation allows the converter to operate normally. The oil pressure is the same in all places.

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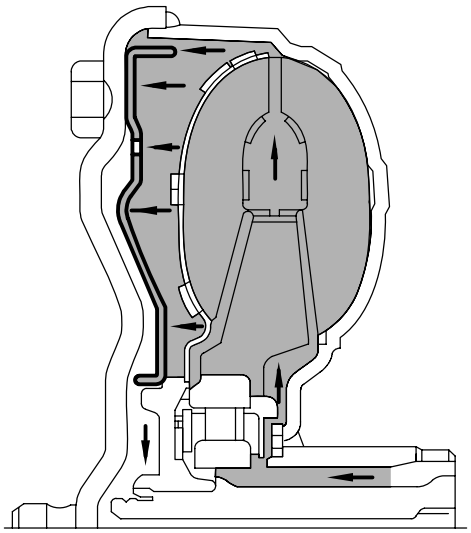
→ Closed state:



The direction of oil circulation is inverted and at the same time, the space behind the clutch is bled. The oil presses the lock-up clutch (integral with the turbine) against the body of the converter (integral with the pump). There is no longer any slip between the pump and the turbine.

The pressure acting on the lock-up clutch on the turbine side is then 5 - 8 bar. On the lining side, there is a residual pressure of 0.2 bar.

Note: A pilot hole located on the lock-up clutch allows the residual oil to circulate in the converter so as to renew the oil between the converter housing and lock-up.

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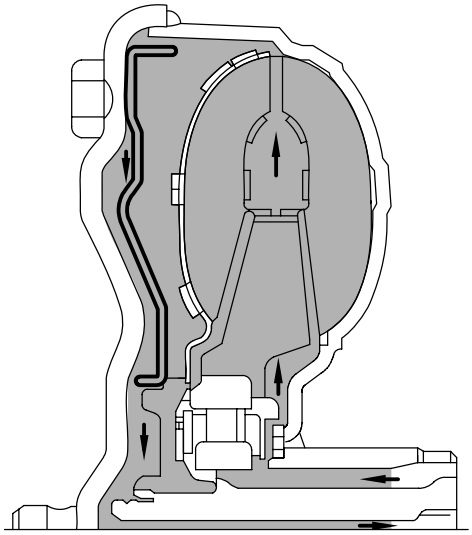
→ Controlled state (or controlled slip):



4HP038D

The reduction in oil flow, when circulating in the converter, is used to maintain a slight slip between the pump and the turbine. This slip is wholly controlled by the ECU.

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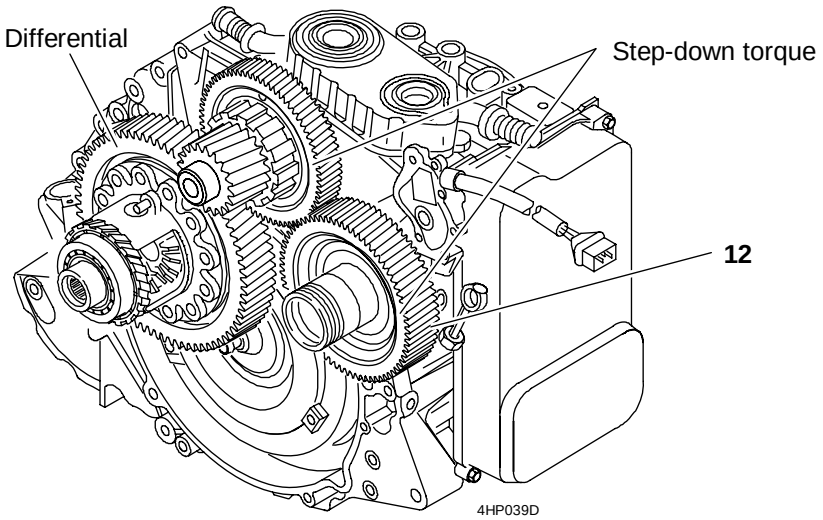
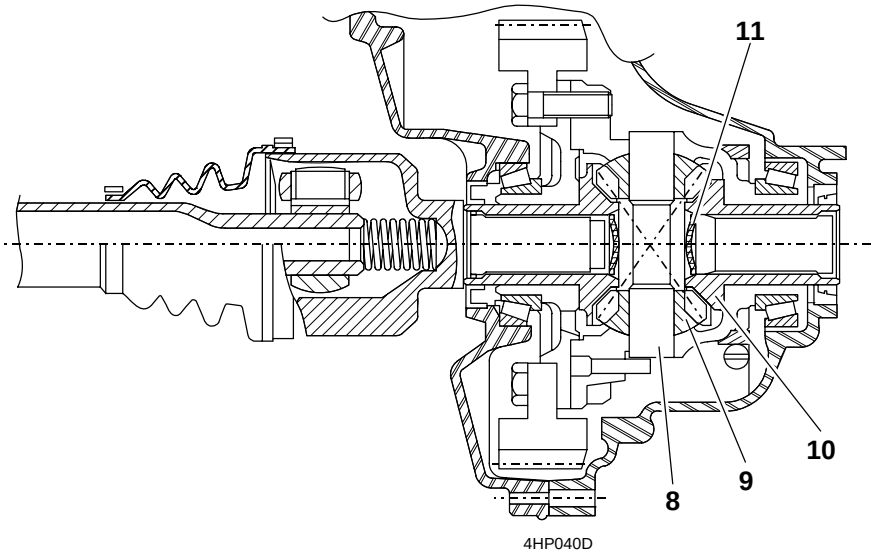
THE FINAL DRIVE

I - DESCRIPTION



4HP039D



4HP040D

8 - Planet wheel shaft
9 - Planet wheels
10 - Sunwheels
11 - Seals
12 - Step-down gear input pinion

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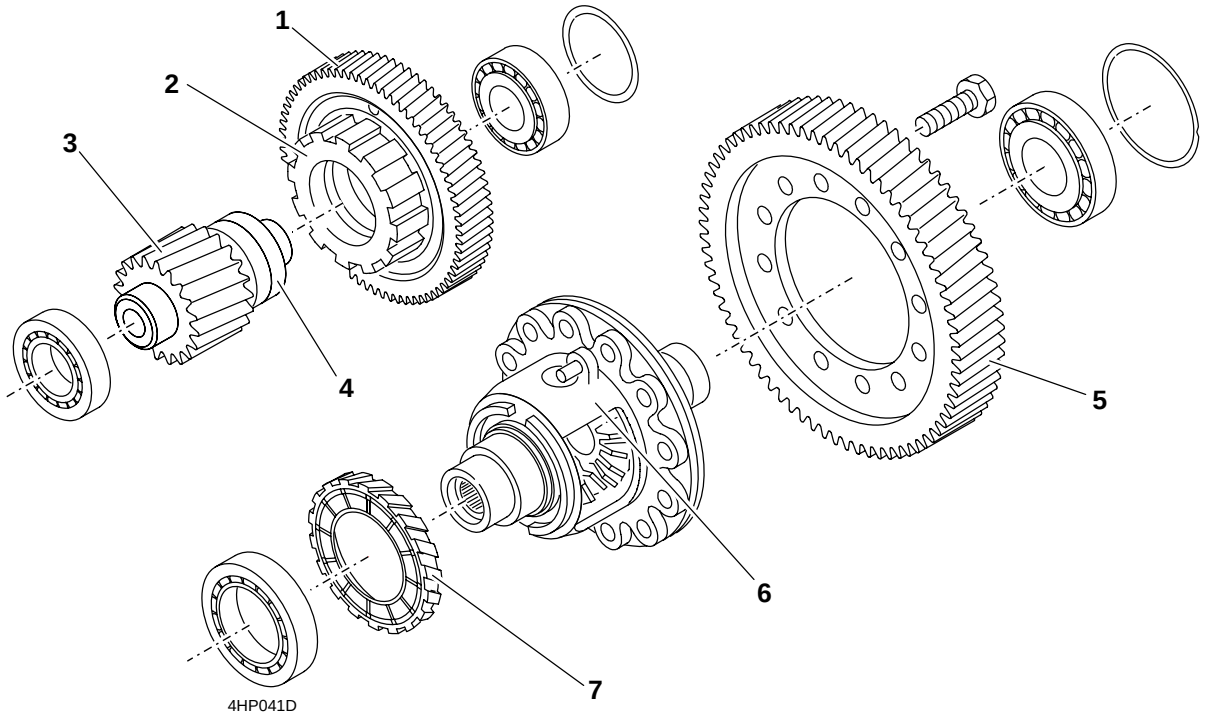

1 - Step-down gear output pinion
2 - Park wheel
3 - Drive pinion
4 - Secondary shaft
5 - Crown wheel
6 - Differential unit
7 - Speedo drive gear

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II - FUNCTION

To transmit the movement supplied by the planet wheel carrier of gear train N° 1 to the drive wheels.

Movement is transmitted as follows:

- The movement leaves the planet wheel carrier n° 1 and is received by the input gear (12) of the step-down gear,
- This transmits the movement to a secondary shaft (4) through the output gear (1) of the step-down gear,
- The secondary shaft transmits the movement to the crown wheel (5) of the differential through its drive pinion (3).

Final drive composition:

Step-down gear: This transmits the output torque from the epicyclic gear train to the return shaft (secondary line) and increases the movement (61 x 66 ratio). It is positioned in the middle of the transmission so as to reduce gearing noises. Its secondary shaft is guided by two tapered bearings with adjusting shims.

Final drive gear: This provides the link between the secondary return shaft and the differential. In addition, it increases movement (20 x 69 ratio).

Differential: This is of standard design and has two planet wheels. It transmits the transmission movement to the wheels.
The differential unit is guided by two X layout tapered bearings with adjustments on the mechanism housing side.
The sunwheels are used to seal the transmission on their outer diameter and provide a seal inside by means of a plug.

Assembly of the driveshafts

Right hand driveshaft → mounted on a bearing

Left hand driveshaft → locked by a spring

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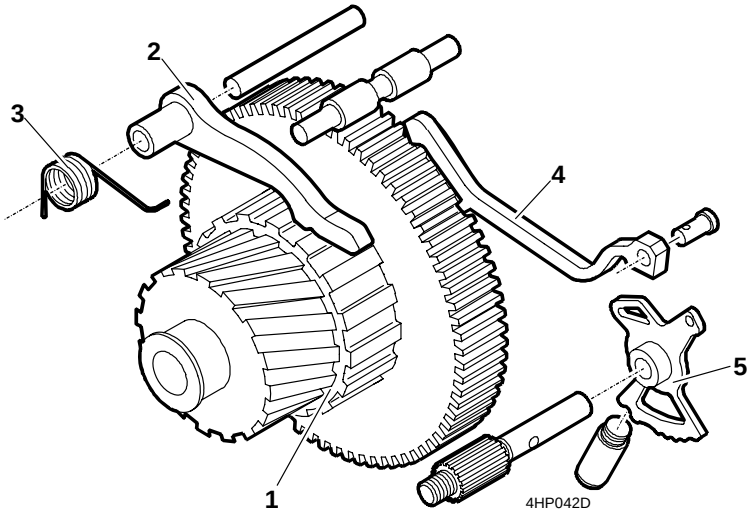
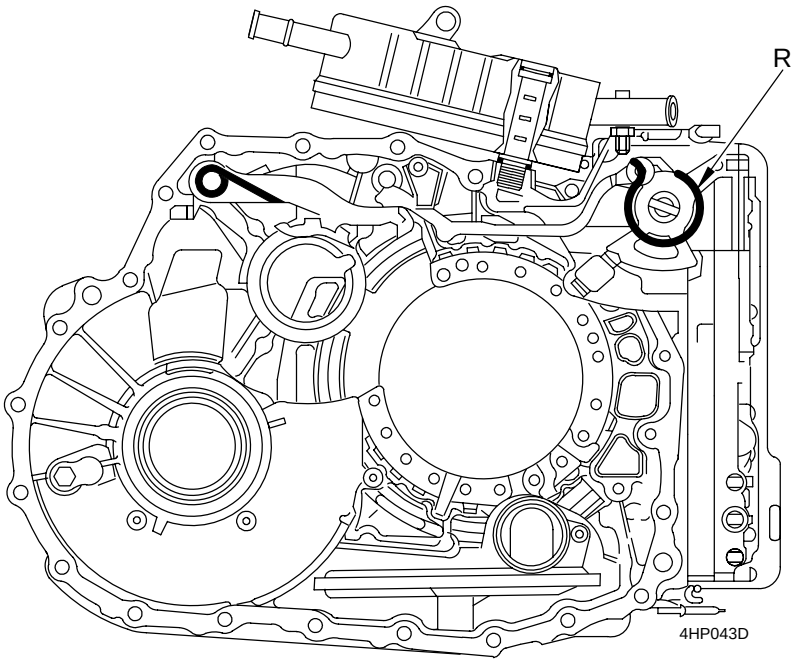
III - PARK LOCK SYSTEM



1 - Castellated gear or park wheel
2 - Park plunger
3 - Spring
4 - Lever
5 - Segment

This is a mechanical system which locks the transmission output when the selector lever is in position P by acting on the castellated gear (1) fitted on the secondary shaft:
When the selector lever is moved to position P, a lever (4) is operated by means of the segment (5); the plunger (2) tilts and then engages into the castellation of the park wheel.
The spring (3) keeps the plunger away from the wheel when the lever is not in position P.
The shape of the teeth of the park wheel and a spiral spring R prevent the plunger from accidentally being engaged when driving (above 4 km/h).



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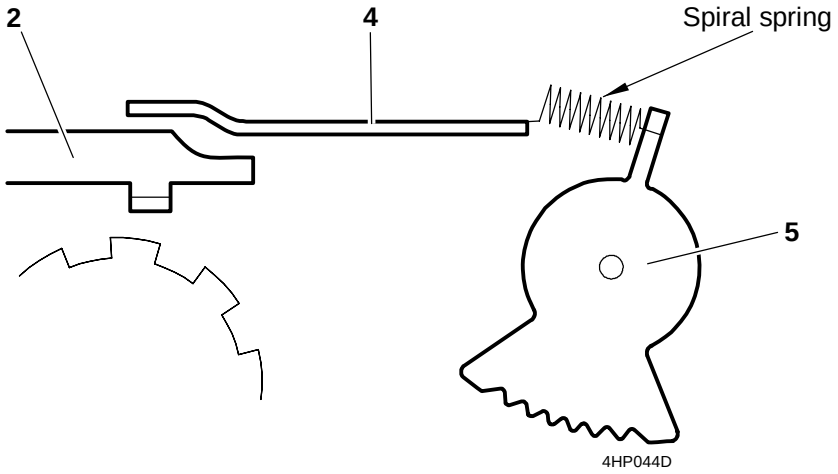
Note:



The role of the spiral spring (shown as a normal spring on the diagram above) is essential. In effect, if the segment (5) tries to engage the park plunger (2) by pushing on the lever (4) on the one side and if on the other the park plunger (2), since it cannot engage, resists the action of the lever (4), the lever risks being broken. The role of the spiral spring, by compressing, is therefore to absorb the force transmitted by the segment (5) to the lever (4) when the park plunger (2) cannot be engaged. When the plunger (2) can finally be engaged into the park wheel, the spiral spring extends so that the lever (4) can operate the plunger (2).

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THE MECHANISM

I - INTRODUCTION

The transmission mechanism has two roles:

- it provides 4 forward gears and 1 reverse gear,
- it automatically changes the forward gears.

The first function is provided by two epicyclic gear trains which receive the movement from the turbine shaft, perform the demultiplications and transmit the movement to the step-down gear.
Automatic changes are performed by hydraulic, electric and electronic components.

Note: The mechanism of the 4HP20 automatic transmission does not have a free wheel since gear changes are performed in a very precise manner and under the best possible conditions due to the hydraulic unit and the ECU strategies.

Reminder of free wheels: in previous automatic transmissions, free wheels allowed gears to be changed without any interruption in the traction force.
Removing the free wheels has the following advantages:

- compact and lighter transmission,
- less mechanical coupling components,
- better efficiency by reducing friction losses,
- lower torque peaks on the components and the moving items.

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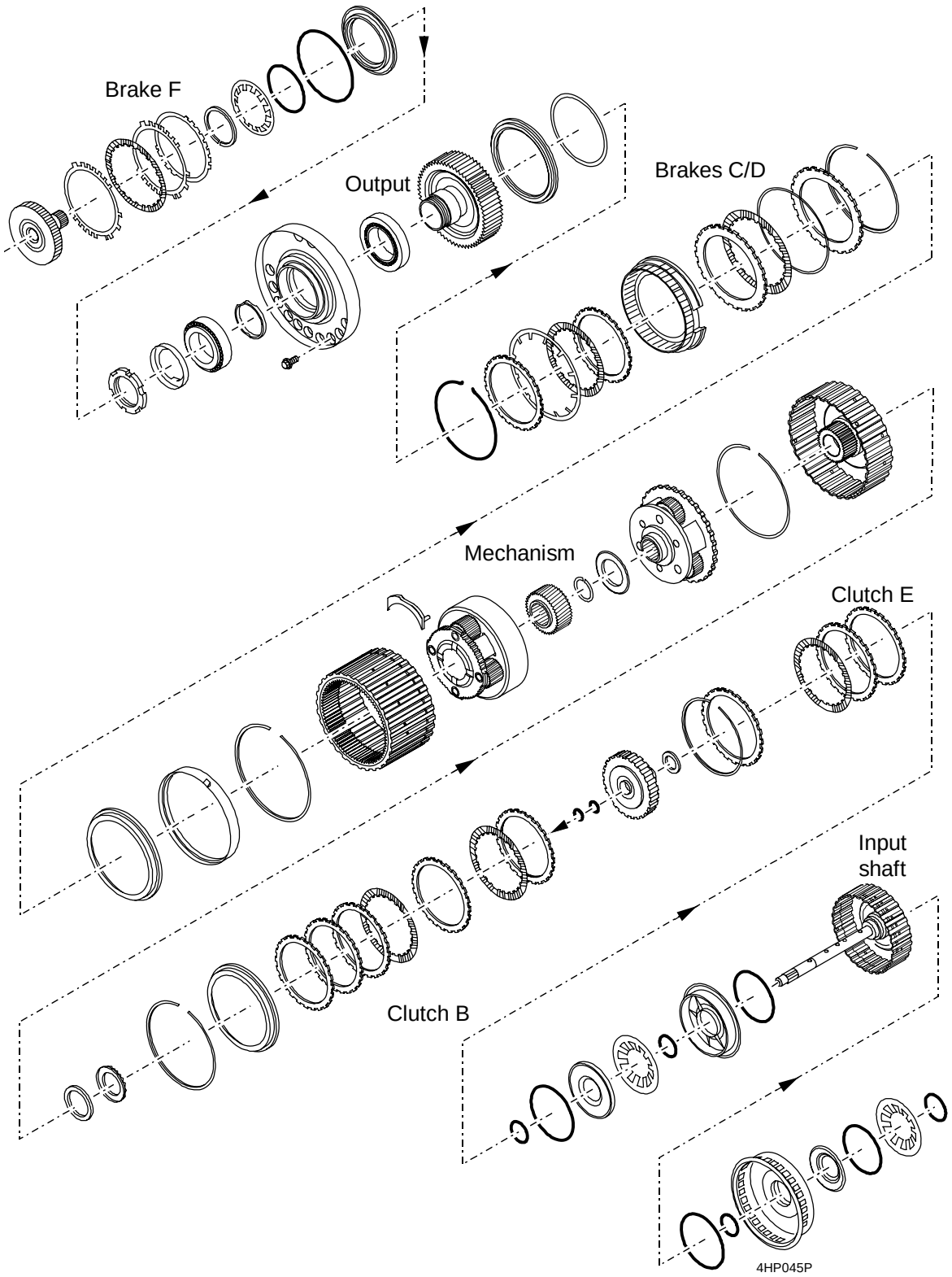

ZF 4HP20 AUTOMATIC TRANSMISSION

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II - THE EPICYCLIC GEAR TRAIN

A - PRESENTATION

To provide four forward gears and one reverse gear, the 4HP20 transmission consists of a SIMPSON type epicyclic gear train. This consists of two simple epicyclic gear trains which are connected together.

There are:

- two sunwheels P1 and P2,
- two sets of planet wheels S1 and S2,
- two planet wheel carriers PS1 and PS2,
- two rings C1 and C2.

The two gear trains are connected in the following way:

- the planet wheel carrier PS1 and the ring C2 are joined together,
- the planet wheel carrier PS2 and the ring C1 are joined together.

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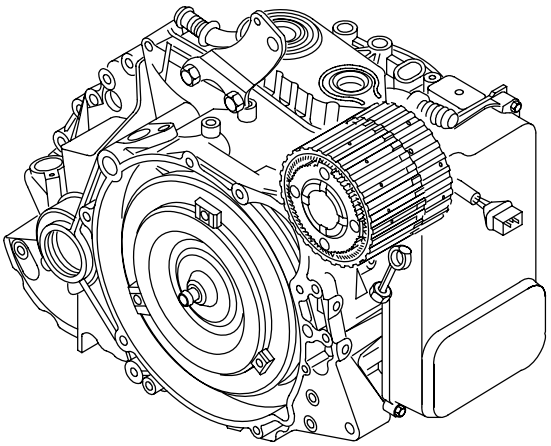
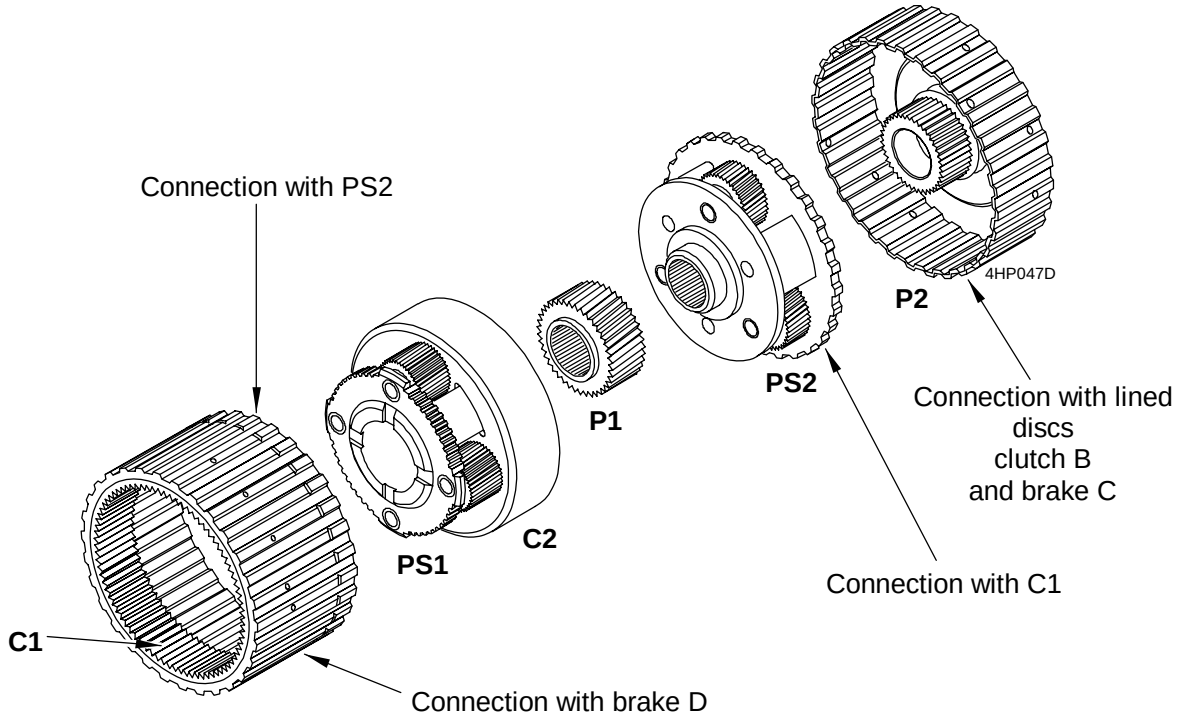


4HP046C



Specifications of gear train:

Sunwheel **P1**	39 teeth
Sunwheel **P2**	37 teeth
Planet wheel **S1**	21 teeth
Planet wheel **S2**	29 teeth
Ring **C1**	81 teeth
Ring **C2**	95 teeth

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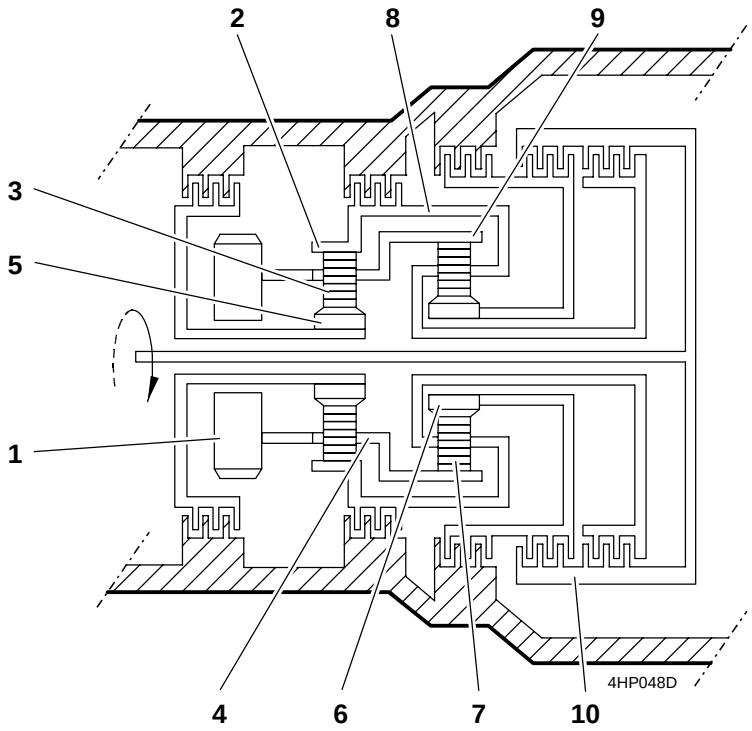
B - DESCRIPTION



1 - Step-down gear output gear
2 - Ring C1 of gear train n°1
3 - Planet wheel S1 of gear train n°1
4 - Planet wheel carrier PS1 of gear train n°1
5 - Sunwheel P1 of gear train n°1
6 - Sunwheel P2 of gear train n°2
7 - Planet wheel S2 of gear train n°2
8 - Planet wheel carrier PS2 of gear train n°2
9 - Ring C2 of gear train n°2
10 - Movement input housing

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III - BRAKES AND CLUTCHES

To obtain the various gear ratios:

- PS2 - C1 must be a driving, free or reaction component
- P2 must be a driving, free or reaction component
- P1 must be a free or reaction component

In practice, the various shafts are locked or driven by "oil pressure multiplate" type receivers which are either operated or not by the hydraulic control components.
These receivers are divided into two families:

- Clutches B and E which are used to couple the driving element to the turbine shaft of the converter.
- Brakes F, D, and C which are used to lock the reaction element by coupling it to the housing.

C1 - PS2 can be: - driven by E
- locked by D

P2 can be: - driven by B
- locked by C

P1 can be locked by F
The clutches and brakes use the same technology and have:

- A succession of smooth steel discs and lined discs
  - the lined discs are connected to the receiver through a disc carrier plate,
  - the smooth discs are coupled to: - the housing $\rightarrow$ brakes
    - the input housing $\rightarrow$ clutches

Contact of the discs between each other provides a driving action (clutch) or locking action (brake).
The number of these discs depends on the engine torque to be transmitted.

- A piston is moved by the oil pressure and returned by a diaphragm spring. The piston comes into contact with all the smooth and lined discs of the clutch or the brake.

Seals are used to seal the unit.

The clutches or brakes are supplied with oil through channels located in the shafts or in the transmission housing.

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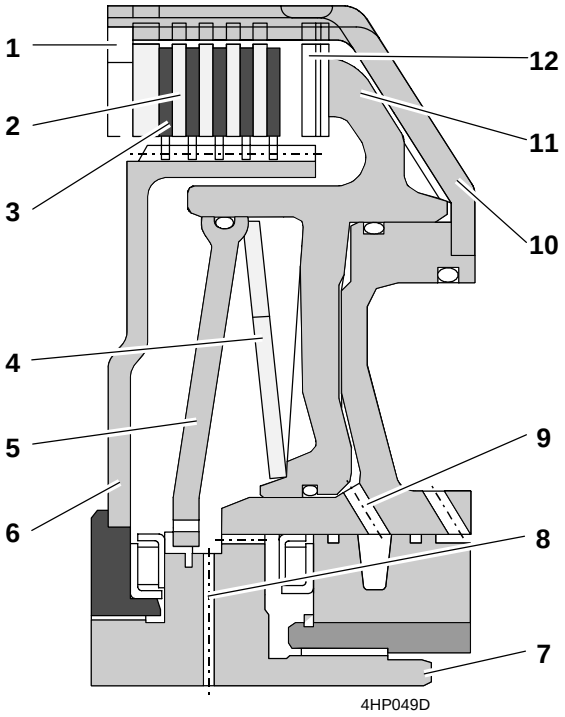
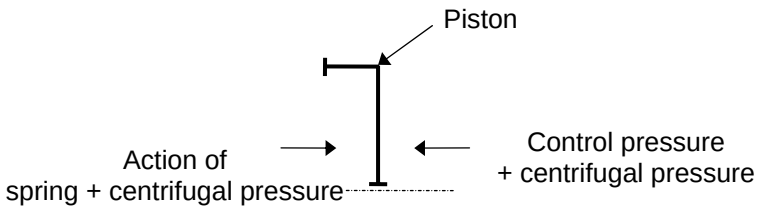
Example: Description of a clutch



1 - Spring ring
2 - Steel disc
3 - Lined disc
4 - Spring - washer
5 - Stop washer
6 - Disc carrier plate
7 - Input shaft
8 - Oil supply for dynamic pressure balance
9 - Clutch oil supply
10 - Cylinder
11 - Piston
12 - Spring - disc

Feature: Dynamic pressure balance.
Clutches B and E are balanced in dynamic pressure since this pressure is the same on either side of the piston.
Process: The gap between the stop washer and the piston is filled with non pressurised oil. A dynamic pressure which depends on the engine speed is then step up. The gap between the piston and the cylinder is filled with pressurised oil by the control valve. A dynamic pressure is also set up but the static pressure controlling the clutch also exists at the same time. When the static pressure falls, the piston returns to its initial position under the action of the spring-washer.
The advantages of the dynamic pressure balance are the following:

- Certain opening of the clutch in all engine speed ranges.
- Greatly improved gear changing quality.



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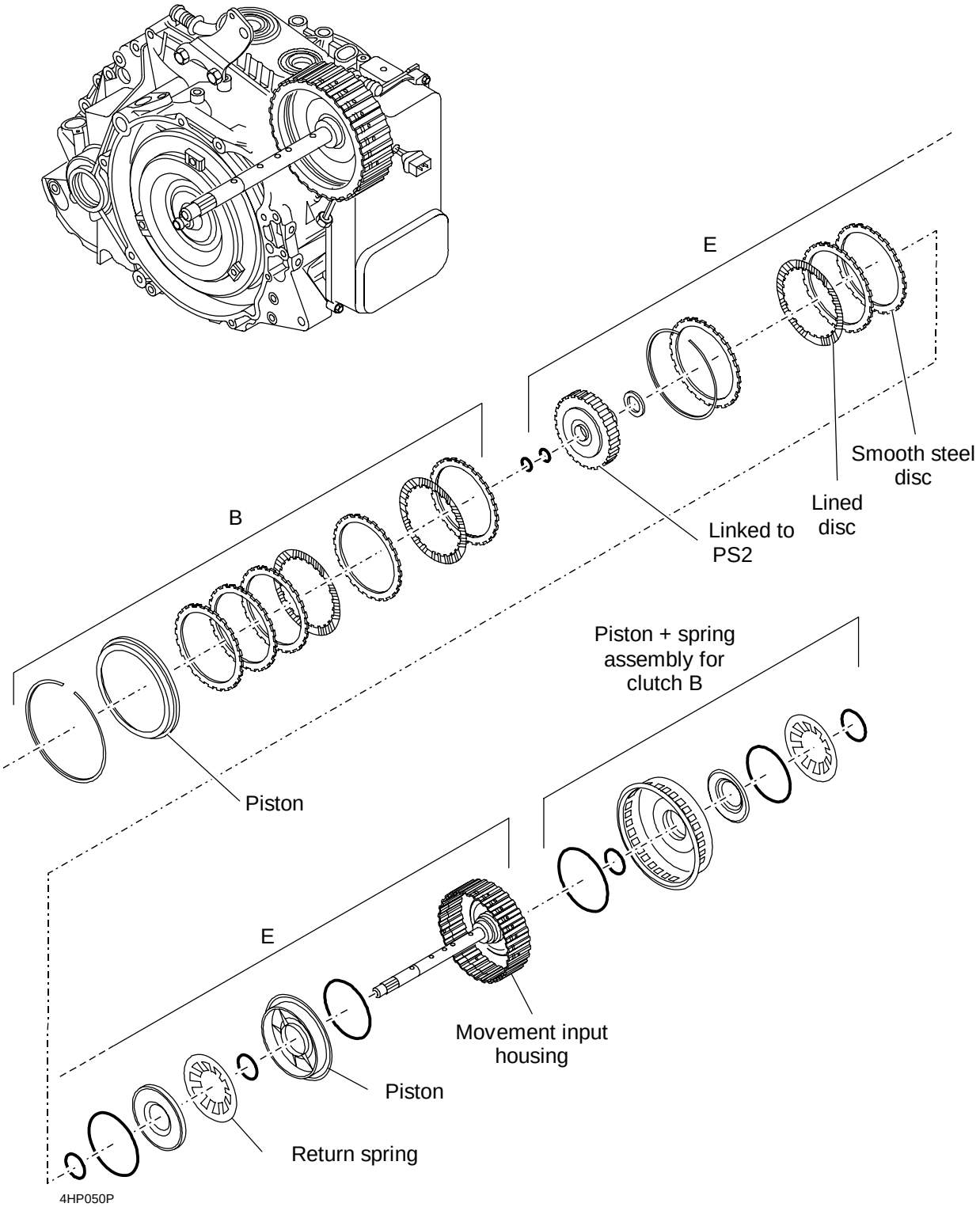
Clutches B and E



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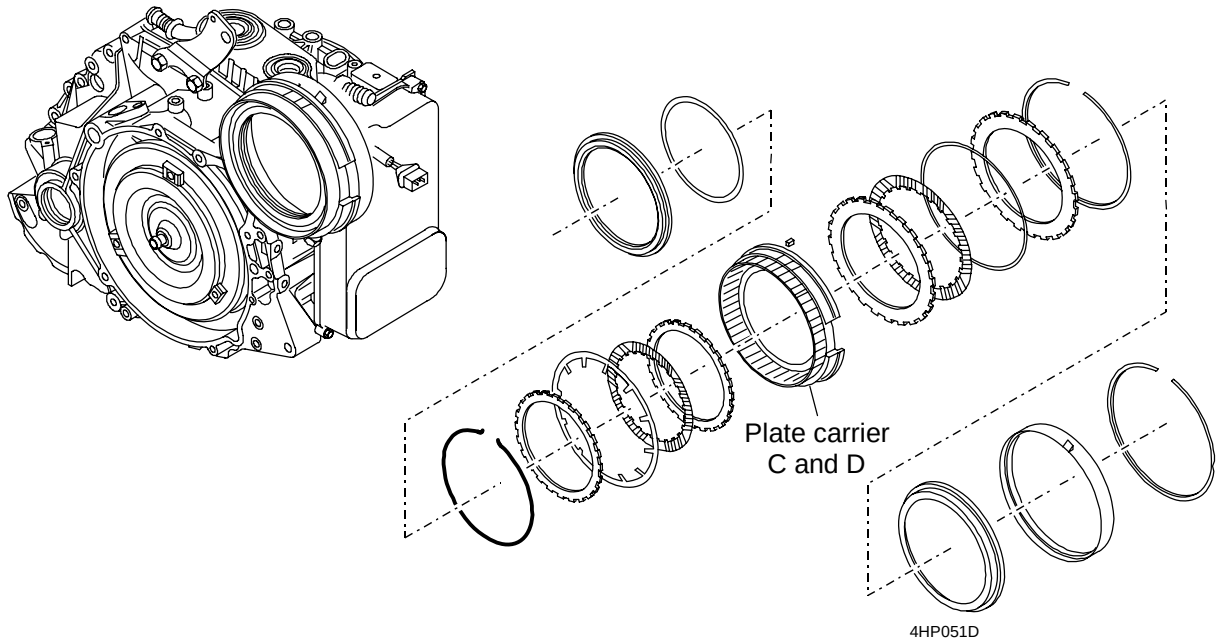
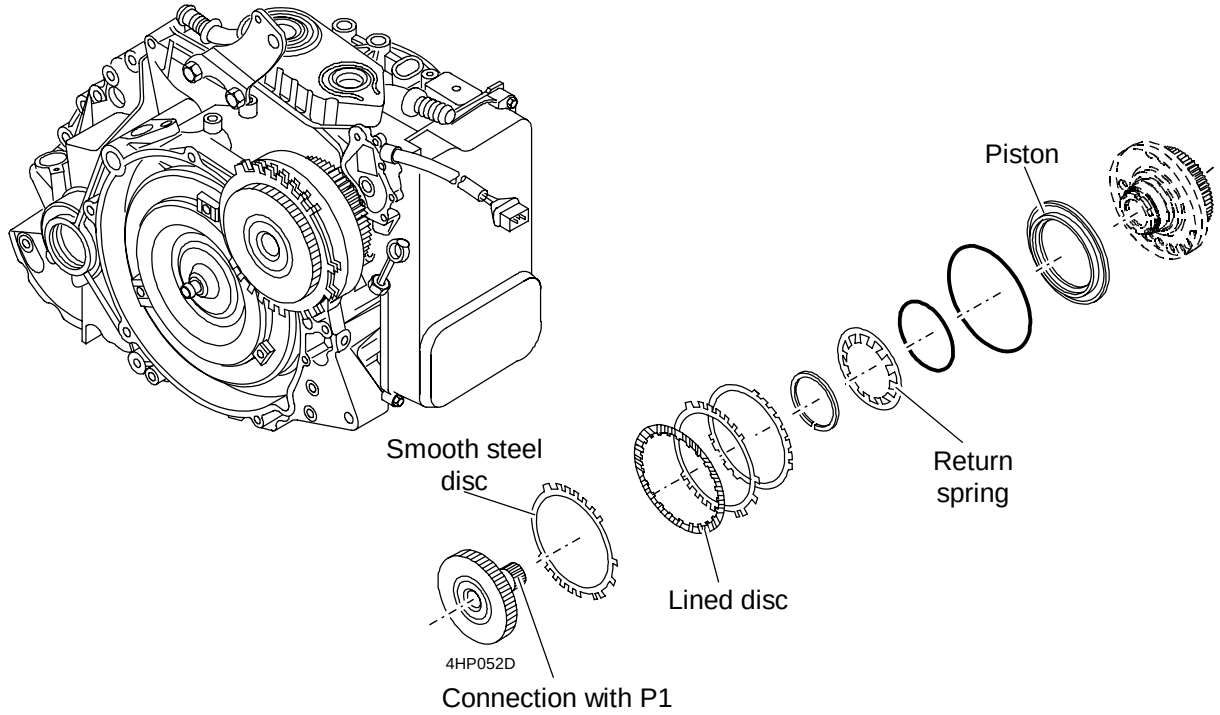
Brakes C and D



Brake F



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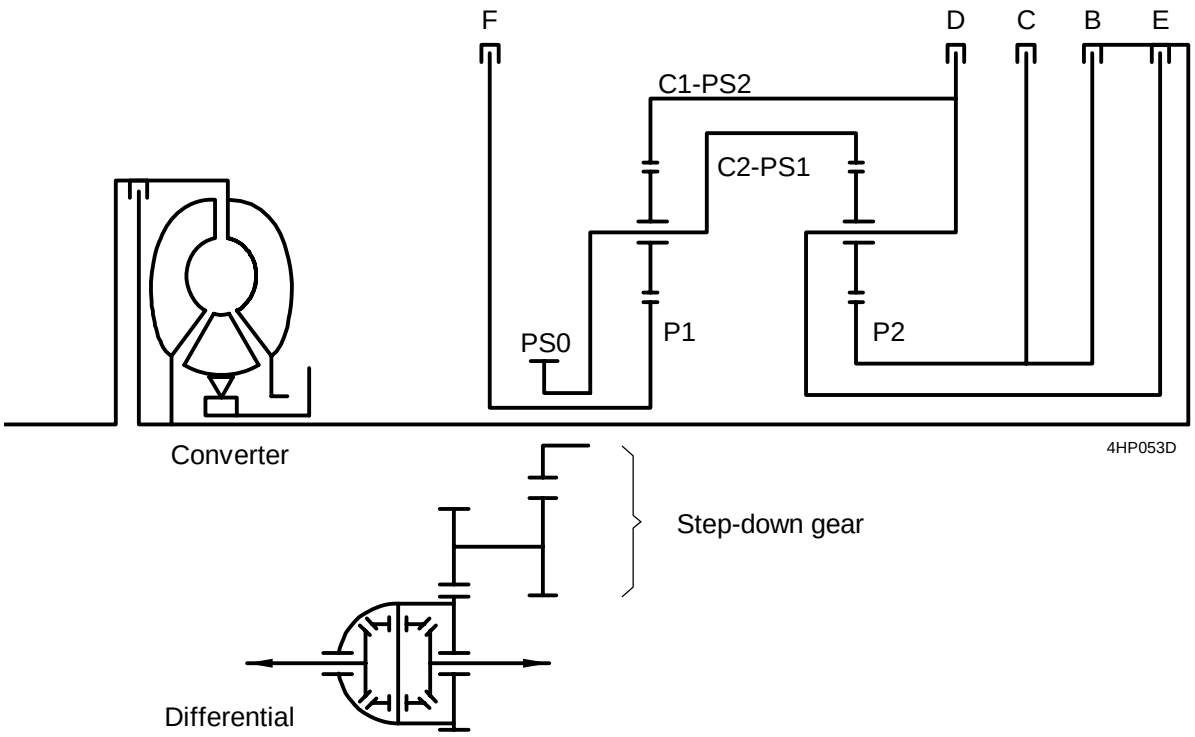
IV - OBTAINING THE GEARS

A - OPERATING DIAGRAM OF THE AUTOMATIC TRANSMISSION



PSO: Transmission output gear

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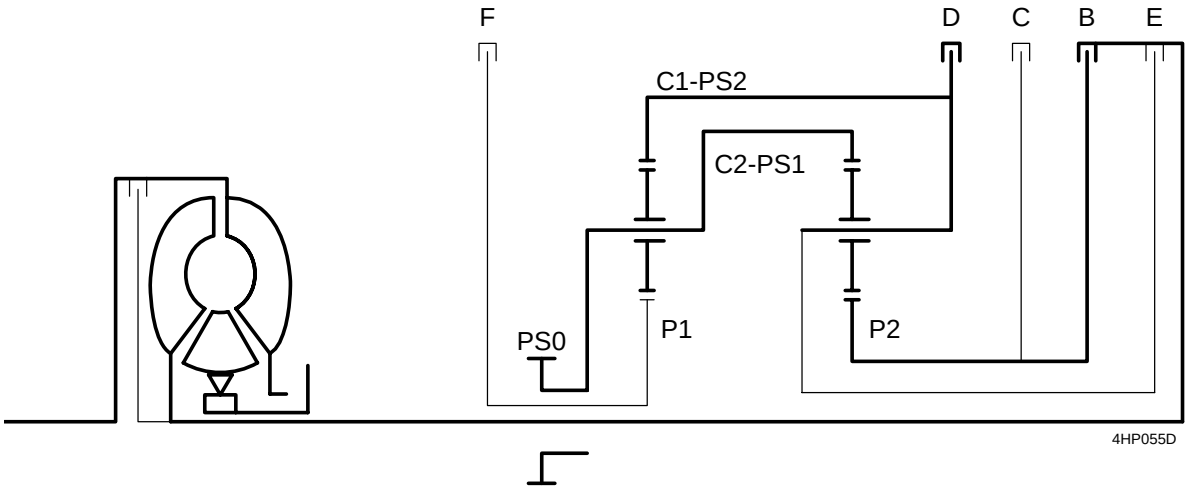
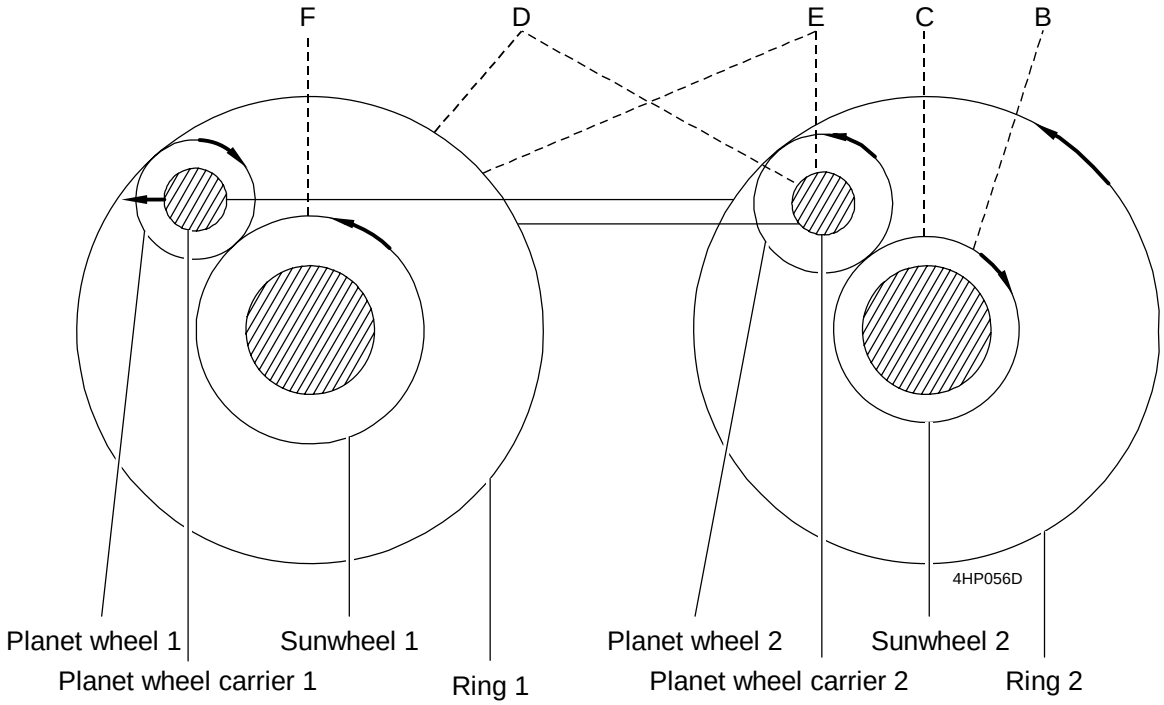
B - REVERSE GEAR





- Drive element P2
- Reaction element PS2 -C1
- P2 → S2
- S2 → C2 - PS1. The planet wheels S1 rotate inside C1
- PS1 → PS0
- PS0/PS1 -C2 turns in the opposite direction to P2
- Demultiplication ratio: - 2.568

Note: The lock-up is systematically open.

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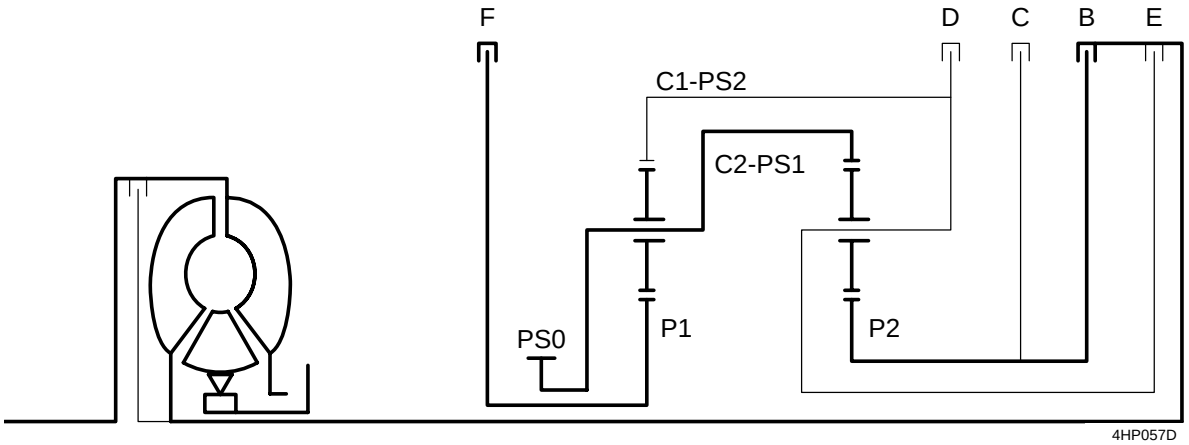
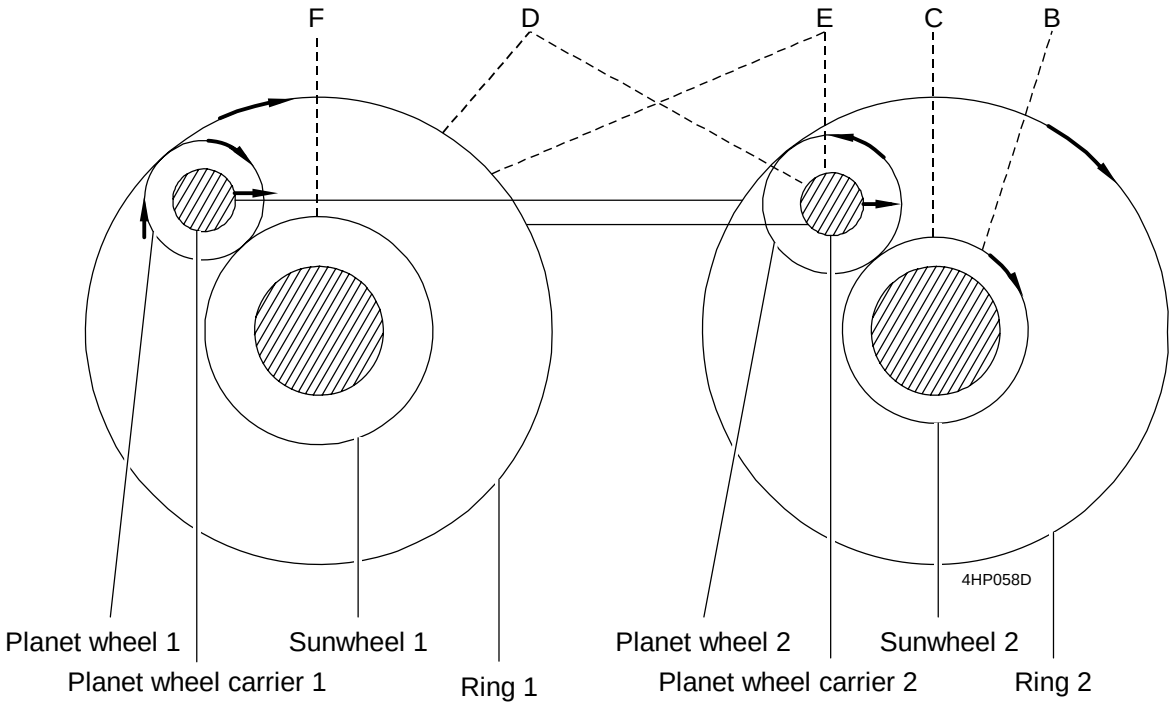
C - 1ST GEAR





- Drive element P2
- Reaction element P1
- P2 → S2
- S2 → C2 - PS1
- PS1 wants to drive the planet wheels S1
- The teeth of the planet wheels S1 butt up against the teeth of locked P1; the planet wheels S1 therefore rotate around P1
- PS1 → PS0
- PS0/PS1 -C2 turns in the same direction as P2
- Demultiplication ratio: 2.718

Note: The lock-up is systematically open

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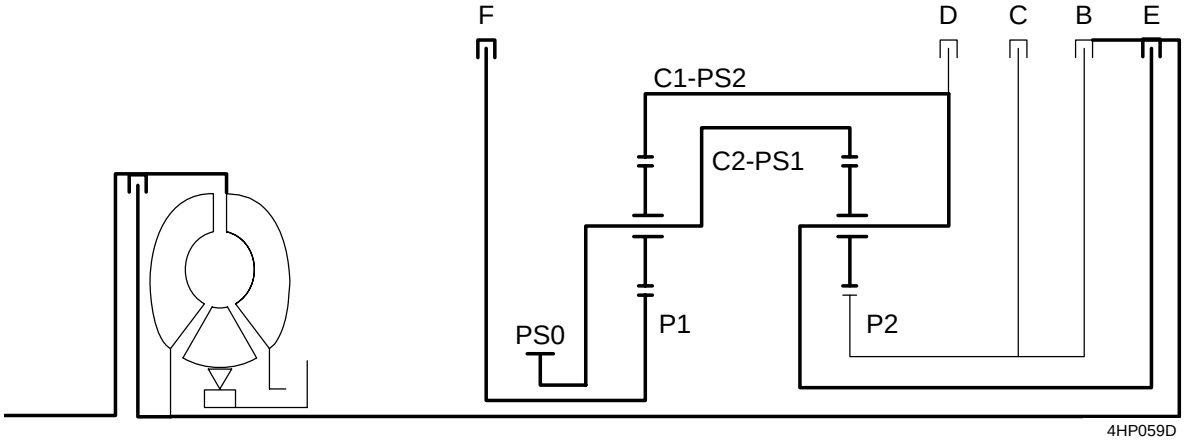
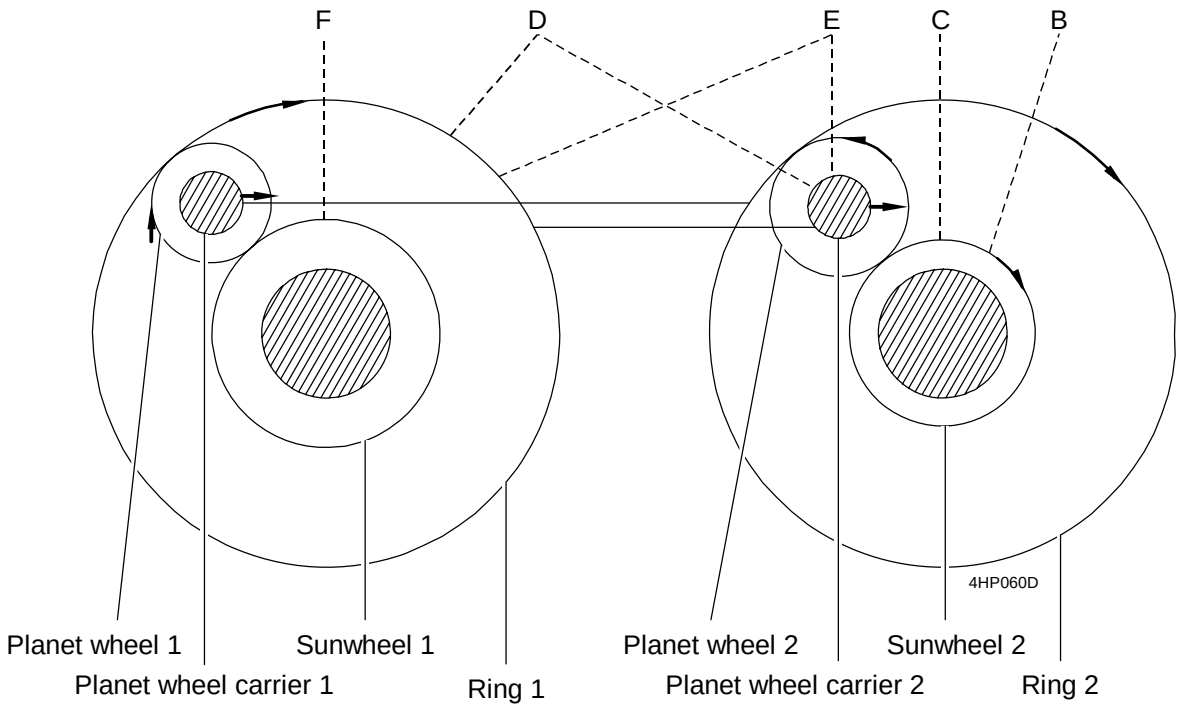
D - 2ND GEAR





- Drive element C1 - PS2
- Reaction element P1
- PS2 - C1 → S1
- The teeth of the planet wheels S1 butt up against the teeth of locked P1; the planet wheels S1 therefore rotate around P1
- S1 → PS1
- PS1 → PS0
- PS0/PS1 - C2 turns in the same direction as PS2
- Demultiplication ratio: 1.481

Note: The lock-up can either be open, controlled or closed.

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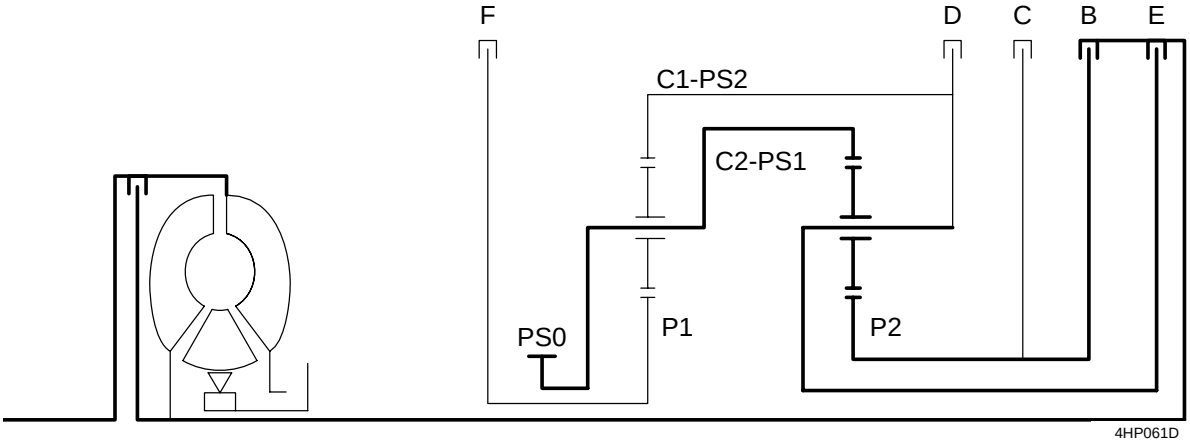
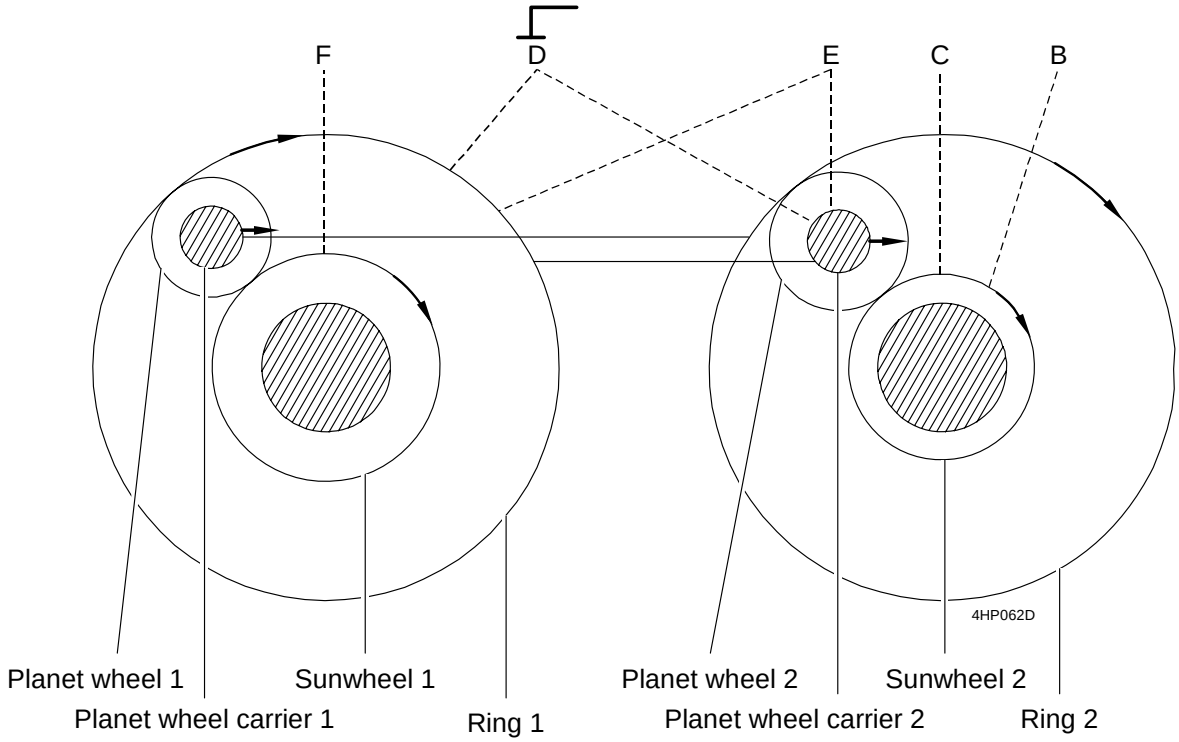
E - 3RD GEAR





- Drive elements PS2 - C1 and P2
- The planet wheels S2 are driven by PS2 and P2; they therefore cannot rotate about themselves.
- S2 → C2 - PS1. PS1 and PS2 turn together.
- PS1 → PS0
- PS0/PS1 turns in the same direction and PS2. This is therefore direct drive.
- Demultiplication ratio: 1

Note: The lock-up can either be open, controlled or closed.

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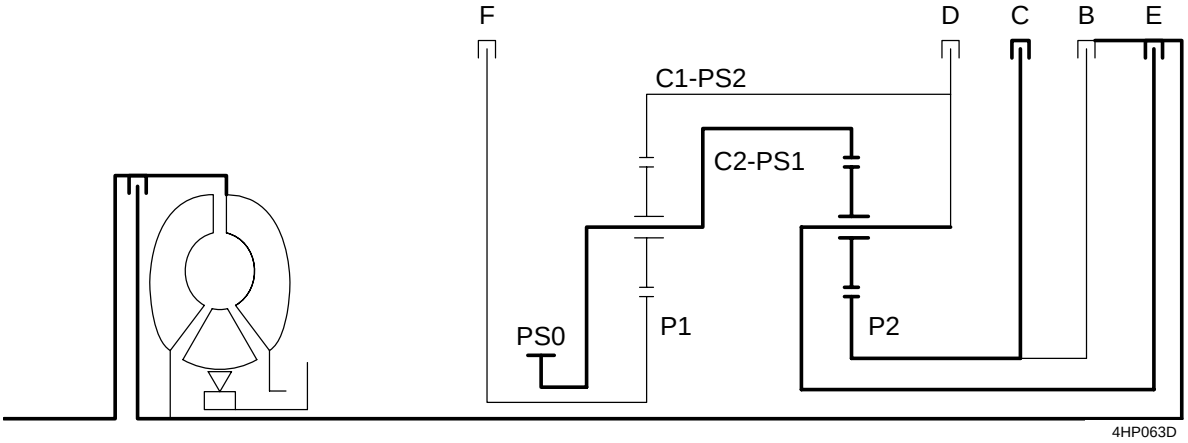
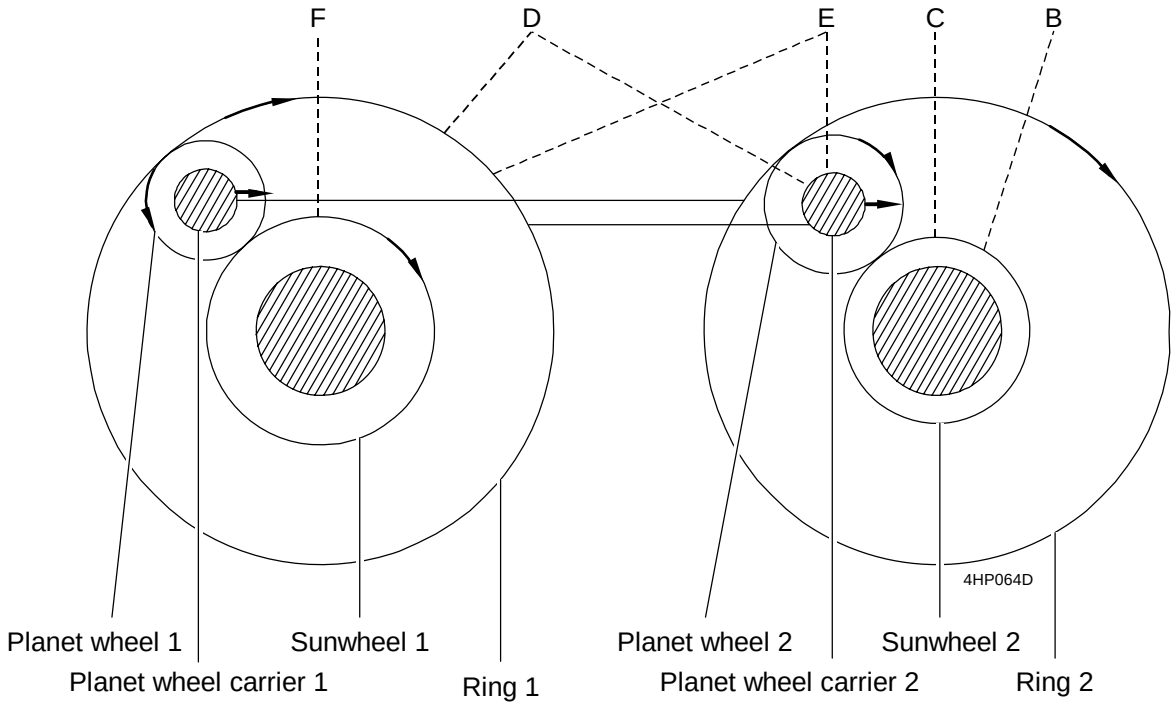
F - 4TH GEAR





- Drive element PS2 - C1
- Reaction element P2
- PS2 wants to drive the planet wheels S2
- The teeth of the planet wheels S2 butt up against the teeth of locked P2; the planet wheels S2 therefore rotate around P2
- S2 $\rightarrow$ C2 - PS1
- PS1 $\rightarrow$ PS0
- PS0/PS1 -C2 turns in the same direction as PS2
- Demultiplication ratio: 0.720

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G - DEMONSTRATION

1st GEAR

For gear train 2

$$\frac{\omega C2 - \omega PS2}{\omega P2 - \omega PS2} = -\frac{37}{95}$$

For gear train 1

$$\frac{\omega C1 - \omega C2}{\cancel{\omega P1} - \omega C2} = -\frac{39}{81} \quad (\omega C2 = \omega PS1)$$

$$\Rightarrow \omega C1 - \omega C2 = \frac{39}{81}\ \omega C2$$

$$\Rightarrow \omega C1 = \frac{120}{81}\ \omega C2 \Rightarrow \omega C2 = \frac{81}{120}\ \omega C1$$

$$\frac{\frac{81}{120}\omega C1 - \omega PS2}{\omega P2 - \omega PS2} = -\frac{37}{95}$$

$$\Rightarrow \frac{81}{120}\ \omega C1 - \omega PS2 = -\frac{37}{95}\ \omega P2 + \frac{37}{95}\ \omega PS2$$

$$\Rightarrow \frac{81}{120}\ \omega C1 = -\frac{37}{95}\ \omega P2 + \frac{132}{95}\ \omega PS2$$

$$\Rightarrow \omega C1 = -\frac{37 \times 120}{95 \times 81}\ \omega P2 + \frac{132 \times 120}{95 \times 81}\ \omega PS2 \text{ however } \omega PS2 = \omega C1$$

$$\Rightarrow \omega C1 - \frac{15840}{7695}\ \omega C1 = -\frac{4440}{7695}\ \omega P2$$

$$\Rightarrow -\frac{8145}{7695}\ \omega C1 = -\frac{4440}{7695}\ \omega P2$$

$$\Rightarrow \omega C1 = \frac{4440 \times 7695}{7695 \times 8145}\ \omega P2$$

$$\Rightarrow \boxed{\omega C1 = \frac{4440}{8145}\ \omega P2}$$

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Therefore, for gear train 1:

$$\frac{\omega C1 - \omega PS1}{\cancel{\omega P1} - \omega PS1} = -\frac{39}{81}$$

$$\Rightarrow \omega C1 - \omega PS1 = \frac{39}{81}\ \omega PS1$$

$$\Rightarrow \omega C1 = \frac{120}{81}\ \omega PS1$$

$$\Rightarrow \underset{\omega C1}{\underset{||}{\frac{4440}{8145}}}\ \omega P2 = \frac{120}{81}\ \omega PS1$$

$$\Rightarrow \omega P2 = \frac{120 \times 8145}{81 \times 4440}\ \omega PS1$$

$$\Rightarrow \omega P2 = \frac{977400}{359640}\ \omega PS1$$

$$\hookrightarrow \approx 2.718$$

2nd GEAR

$$\frac{\omega C1 - \omega PS1}{\cancel{\omega P1} - \omega PS1} = -\frac{39}{81}$$

$$\Rightarrow \omega C1 - \omega PS1 = \frac{39}{81}\ \omega PS1$$

$$\Rightarrow \omega C1 = \frac{120}{81}\ \omega PS1$$

$$\hookrightarrow = 1.481$$

3rd GEAR

$$\frac{\omega C2 - \omega PS2}{\omega P2 - \omega PS2} = -\frac{37}{95}$$

$$\Rightarrow \omega C2 - \omega PS2 = \frac{37}{95}\ \omega PS2 - \frac{37}{95}\ \omega P2$$

$$\Rightarrow \omega C2 = \frac{132}{95}\ \omega PS2 - \frac{37}{95}\ \omega P2 \text{ however, } \omega P2 = \omega PS2$$

$$\Rightarrow \omega C2 = \frac{132}{95}\ \omega PS2 - \frac{37}{95}\ \omega PS2$$

$$\Rightarrow \omega C2 = \frac{95}{95}\ \omega PS2 \Rightarrow \omega C2 = \omega PS2 = 1 \Rightarrow \text{Direct drive}$$

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4th GEAR

$$\frac{\omega C2 - \omega PS2}{\cancel{\omega P2} - \omega PS2} = -\frac{37}{95}$$

$$\Rightarrow \omega C2 - \omega PS2 = \frac{37}{95}\ \omega PS2$$

$$\Rightarrow \omega C2 = \frac{132}{95}\ \omega PS2$$

$$\Rightarrow \omega PS2 = \frac{95}{132}\ \omega C2$$

$$\hookrightarrow \approx 0.720$$

Reverse gear

$$\frac{\omega C2 - \cancel{\omega PS2}}{\omega P2 - \cancel{\omega PS2}} = -\frac{37}{95}$$

$$\Rightarrow \omega C2 = -\frac{37}{95}\ \omega P2$$

$$\Rightarrow \omega P2 = -\frac{95}{37}\ \omega P2$$

$$\hookrightarrow \approx 2.568$$

H - SUMMARY

Table of operated components

GEAR	DRIVE ELEMENT	REACTION ELEMENT	RATIOS
1	**P2**	**P1**	2.718
2	**C1-PS2**	**P1**	1.481
3	**P2** and **C1-PS2**	none	1
4	**C1-PS2**	**P2**	0.720
Reverse	**P2**	**C1-PS2**	2.568

The assembly **C2-PS1** forms the output element.

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Table of operated clutches and brakes:

		CLUTCHES		BRAKES		
GEAR		**B**	**E**	**C**	**D**	**F**
P		**X**				
R		**X**			**X**	
N		**X***				
D	1st	**X**				**X**
	2nd		**X**			**X**
	3rd	**X**	**X**			
	4th		**X**	**X**		
3	1st	**X**				**X**
	2nd		**X**			**X**
	3rd	**X**	**X**			
2	1st	**X**				**X**
	2nd		**X**			**X**
1	1st	**X**				**X**

* Except in Snow program

Note: In 1st automatic, there is an engine brake.

Note: The architecture of the epicyclic gear train means that a 5th gear can be obtained by adding a clutch.

Note: In P and N*, clutch B is supplied in order to anticipate the next gear being engaged (R or 1).

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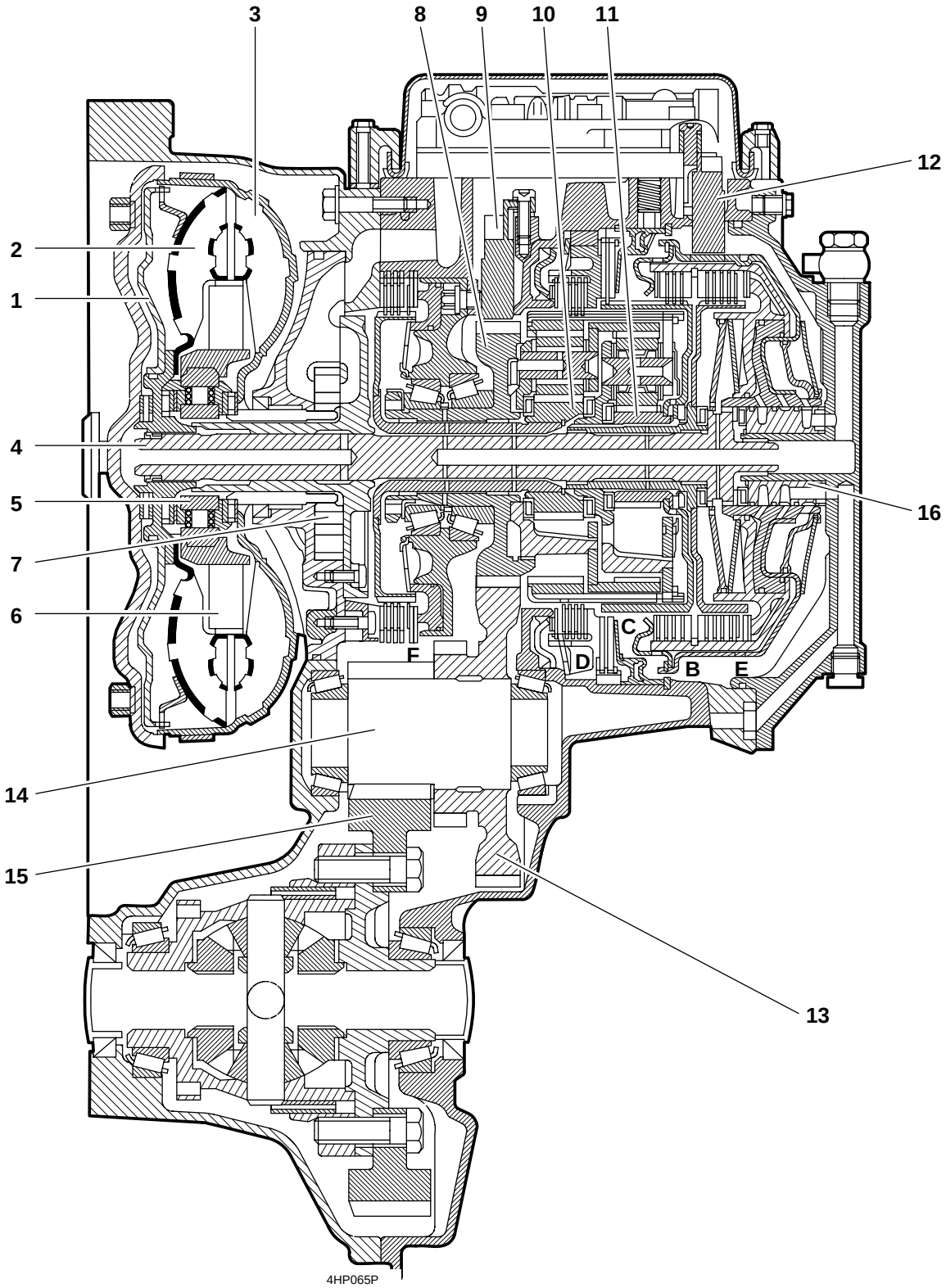
V - COMPLETE OVERVIEW OF THE AUTOMATIC TRANSMISSION



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A - PARTS LIST

1 - Lock-up piston
2 - Turbine
3 - Pump
4 - Movement input shaft
5 - Free wheel
6 - Stator
7 - Oil pump
8 - Step-down gear output gear
9 - Transmission output speed sensor
10 - Epicyclic gear train n°1
11 - Epicyclic gear train n°2
12 - Transmission input or turbine speed sensor
13 - Step-down gear intermediate gear
14 - Drive pinion
15 - Differential ring
16 - Clutch supply ring

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ZF 4HP20 AUTOMATIC TRANSMISSION

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THE HYDRAULIC CIRCUIT

I - FUNCTIONS

The essential elements of the hydraulic circuit are:

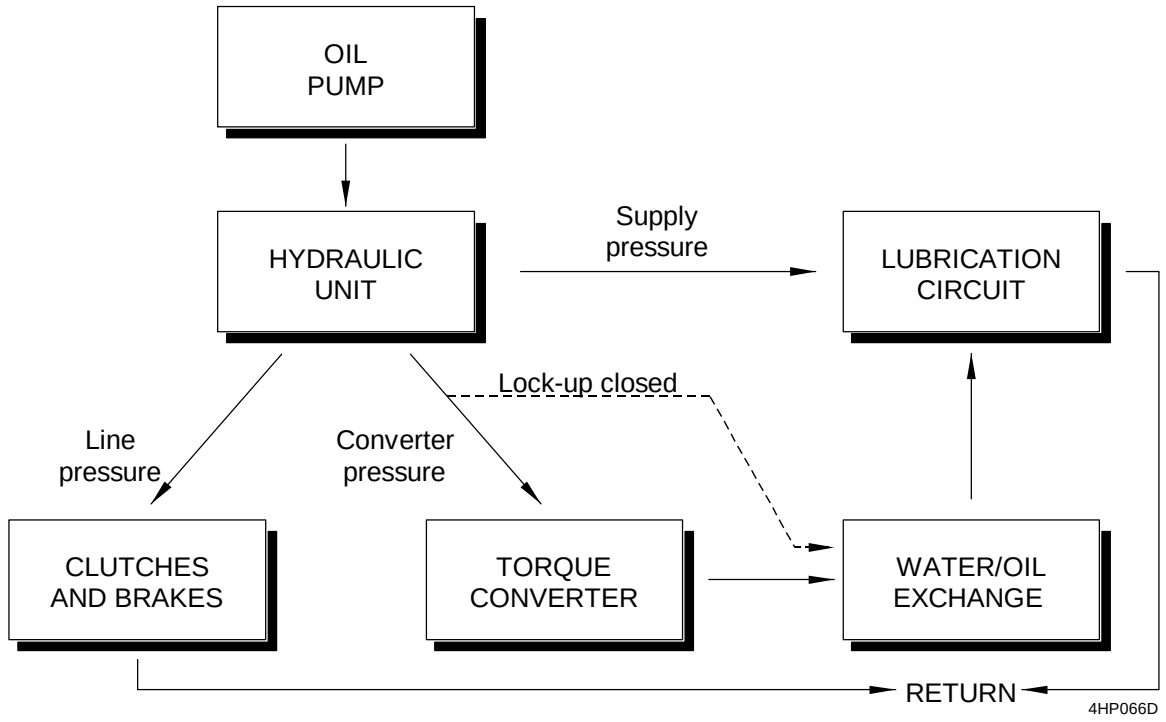
- the oil pump,
- the hydraulic distributor (or unit).

The role of these elements is to:

- supply the clutches and the brakes,
- supply and control the converter,
- supply the transmission lubrication circuit,
- cool the transmission by circulating oil through a heat exchanger.

There are therefore three types of pressure in the hydraulic circuit:

- the supply pressure for the lubrication circuit,
- the converter pressure for supplying and controlling it,
- the line pressure, in other words, the pressure set up on the pistons of the operated brakes and clutches.



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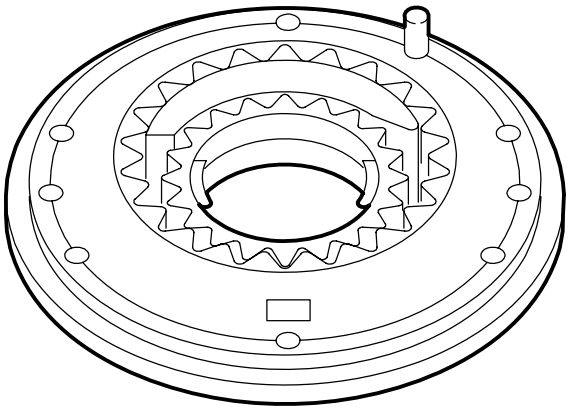
II - OIL PUMP

Crescent shaped internal gear oil pump, driven by the converter impeller and therefore operates as soon as the engine is running.
Its flow is proportional to the speed of rotation. The oil is drawn into the lower part of the mechanism housing through a strainer. This is designed not to be replaced throughout the vehicle's life.
The pressure generated by the oil pump has to be limited by regulating slide valves.
A SPIE seal is used to seal the primary shaft. A paper seal is used to seal the housing.



4HP068C

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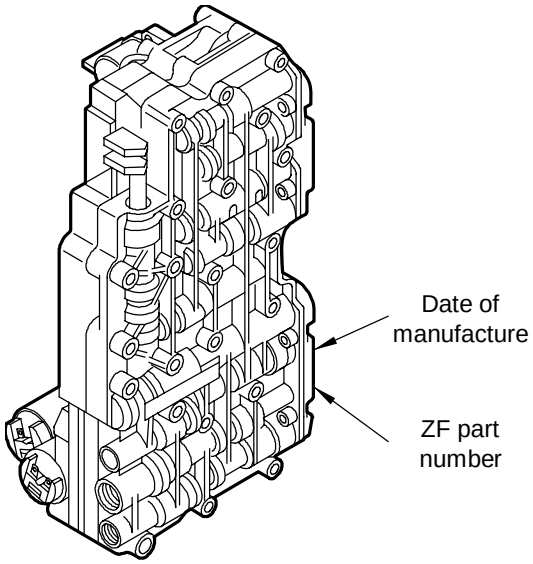
III - THE HYDRAULIC UNIT

A - ROLE



The hydraulic unit performs the following functions:

- regulates the control line pressure of the brakes and clutches,
- controls the brakes and clutches in order to obtain the various gears by using electrovalves and slide valves,
- provides a reduced emergency function (purely hydraulic) of the transmission in the event of problems,
- controls the converter lock-up clutch,
- generates the lubrication pressure for the transmission.

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B - COMPOSITION

The hydraulic unit consists of:

- a selector slide valve (WS),
- a main pressure valve (SYS.DR - V),
- a pressure reducing valve (DR.RED - V),
- a safety valve (SIV),
- a gear control valve (SV),
- a converter pressure valve (WD -V),
- a converter control valve (WD - SV),
- a converter clutch valve (WK -V),
- a lubrication valve (SCHM - V),
- five clutch valves KV - B/C/D/E/F,
- five holding valves HV - B/C/D/E/F,
- four dampers,
- four proportional electrovalves or regulators (EDS3/4/5/6),
- two all or nothing electrovalves (MV 1/2).

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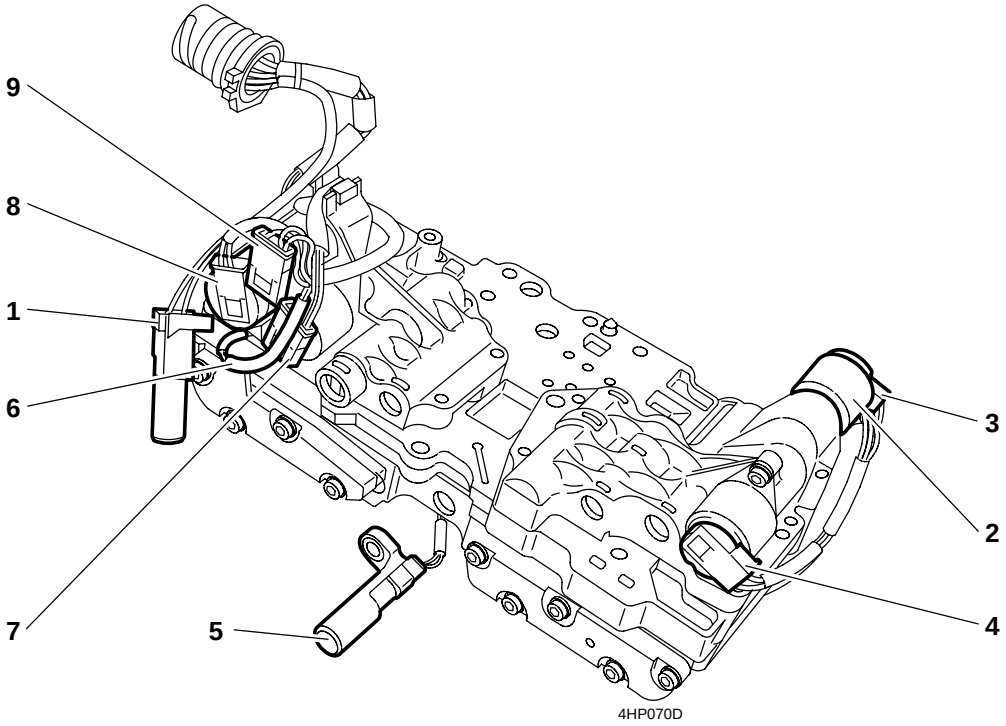
C - DESCRIPTION

1 - External appearance



1 - Automatic transmission output speed sensor connector

2 - Regulator number 6 (EDS6)

3 - Electrovalve MV1

4 - Regulator number 4 (EDS4)

5 - Automatic transmission input speed sensor

6 - Oil temperature probe

7 - Regulator number 3 (EDS3)

8 - Electrovalve MV2

9 - Regulator number 5 (EDS5)

Note: - Regulators 3, 5 and 6 are the same; regulator 4 operates in the opposite manner with respect to the three others.

- The 2 electrovalves are the same.

- The black rings identify the regulators; the green rings identify the electrovalves.

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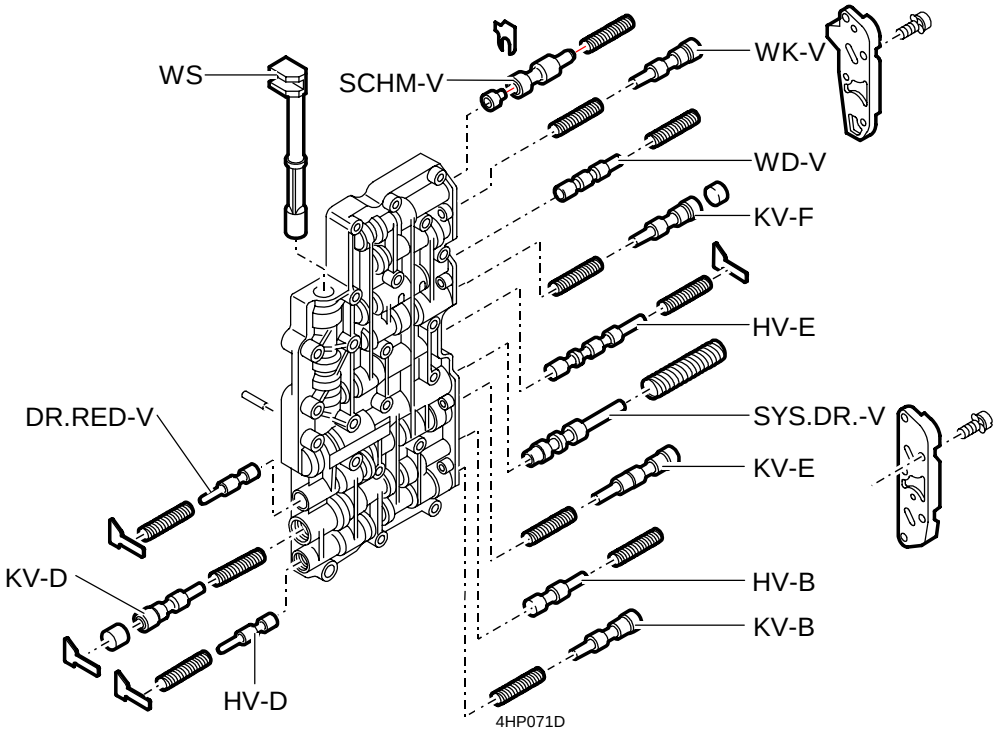
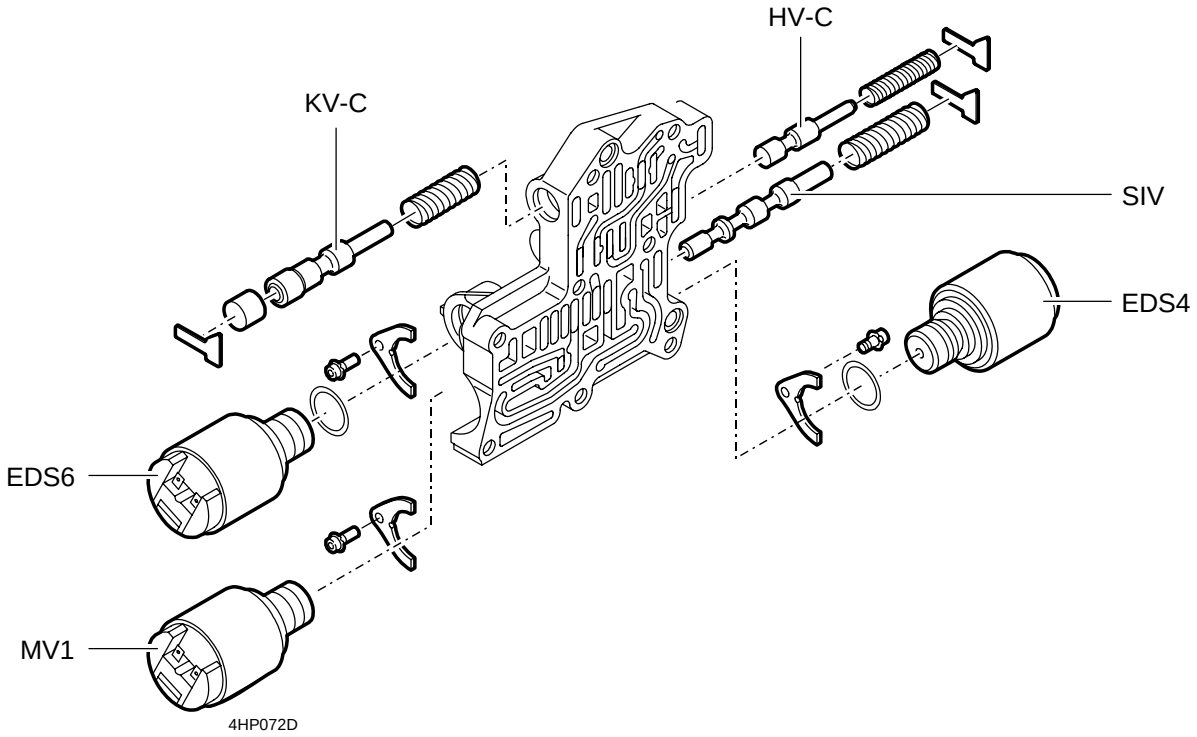
2 - Internal components



In the upper part of the hydraulic unit there is the selector valve WS and the various slide valves along with their springs.



Housing along with its electrovalve MV1 and its pressure regulators EDS4 - EDS6.

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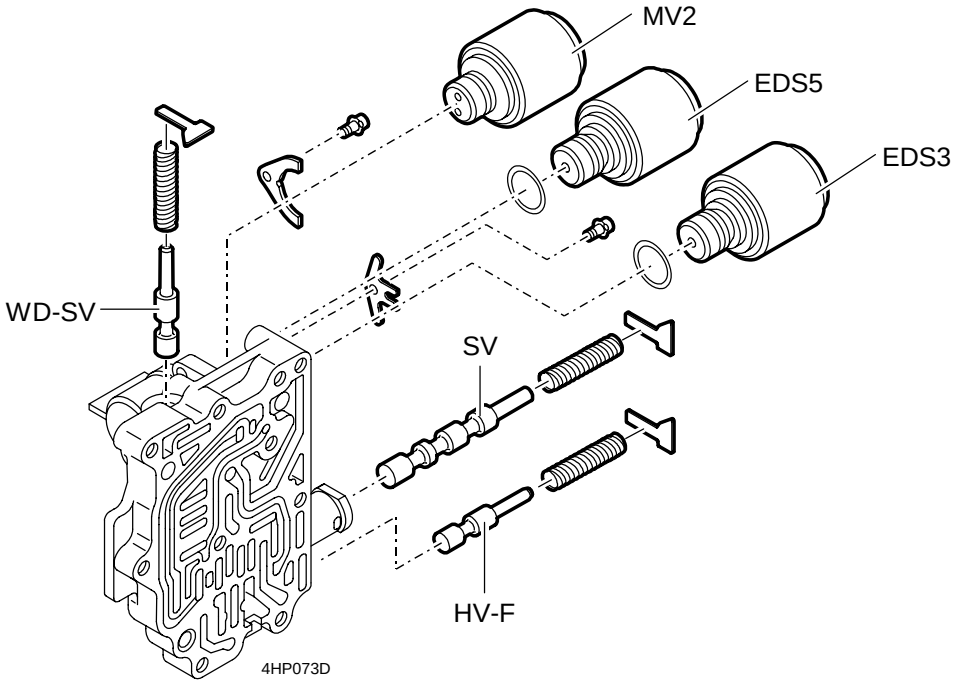
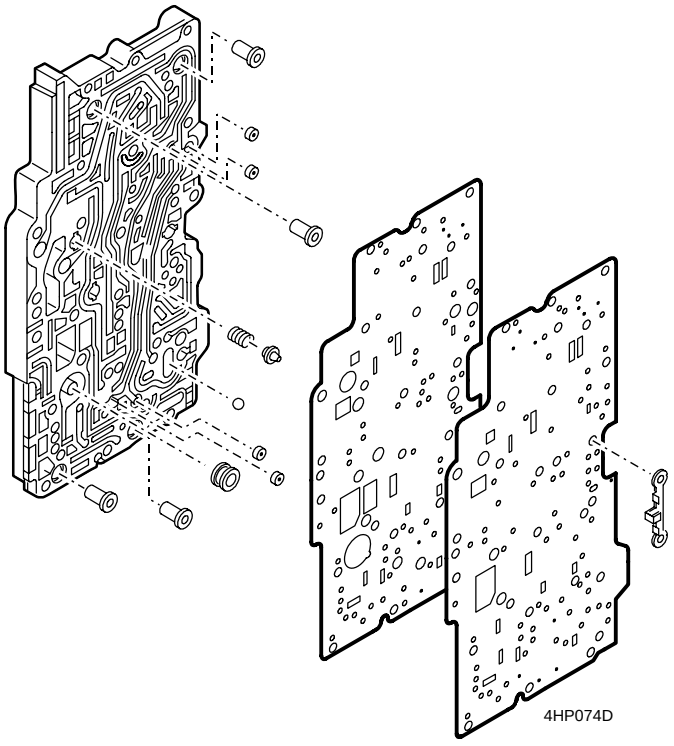


Housing along with its electrovalve MV2 and its pressure regulators EDS5 - EDS3.



Rear valve housing along with its dampers and its adjusters.

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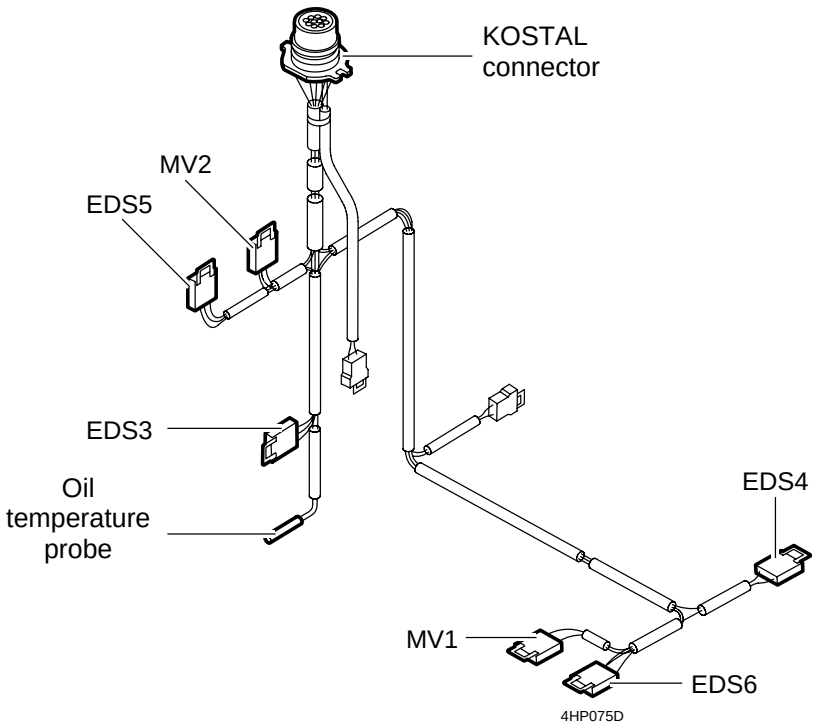
3 - Harness



Electrical harness of the hydraulic unit consisting of various connectors for the electrovalves, pressure regulators, input and output speed sensors as well as the oil temperature probe.

It is connected to the ECU harness by means of a KOSTAL type connector.

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D - FUNCTION OF THE VARIOUS ELEMENTS

1 - Selector slide valve WS

This "informs" the hydraulic unit of the position of the selector lever. It only affects the hydraulics in the followings positions:
- P
- R
- N
- D

Everything occurs electrically for positions 1, 2 and 3.

2 - Main pressure valve SYS.DR - V

This determines the maximum level of the main operating pressure. When not changing gear, the main pressure may have two maximum levels depending on the turbine torque. The main pressure valve firstly supplies (before the maximum value is reached) the clutches and the brakes. Then, the oil for cooling and lubrication reaches the converter.

3 - Pressure reduction valve DR.RED - V

This reduces the main pressure designed to supply the all or nothing electrovalves and the pressure regulators. This allows small electrovalves to be used. Furthermore, the EDS require a constant supply pressure.

4 - Clutch slide valves KV

These provide the necessary oil flow for the clutch from a multiplate element (brake or clutch). They also allow the pressure corresponding to the gear ratio to be transmitted.

Case of slide valve KV -E

Its role is the same as the other slide valves KV but it differs in the following way. When the clutch pressure has been set up, the pressure limiting function is added to a maximum authorised valve (11 bar). This pressure, which is lower than the upper maximum allowable value of the main pressure, allows a smaller clutch to be used.

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5 - Holding slide valves HV

These check that, for a fixed value of pressure in the proportional electrovalve EDS, the corresponding clutch valves allow gears to be changed and that the clutch pressure then increases up to the maximum value of main pressure.

Case of holding slide valve HV - E

These checks that, for a certain value of pressure defined by the proportional electrovalve EDS, the clutch valve E switches the pressure to the maximum allowable value.

Furthermore, the regulation range of the brake F is reduced in 2nd gear. The clutch valve C is supplied by the operating pressure.

6 - Gear control valve SV

Using this, the proportional electrovalve EDS 3 is used when changing from 1st to 2nd gear or for the converter lock-up clutch.

7 - Safety valve SIV

If an electrical fault occurs when driving, the brake C is engaged or else held by the safety valve if it was already engaged. Therefore, 4th gear is obtained in conjunction with the clutch E;

When restarting and in ECU emergency mode, the clutch B is pressurised by the safety valve. 3rd gear is therefore obtained in conjunction with the clutch E.

The safety valve has a holding function which is removed when restarting and is once again made active by the ECU.

8 - Converter pressure valve WD - V

This supplies the lubrication circuit with oil when the converter lock-up clutch is open. When the clutch is closed, it allows the oil to be drained from the gap between the clutch and the converter housing.

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9 - Converter clutch valve WK - V

This is the valve which follows the proportional electrovalve EDS3 when the electrovalve MV2 is no longer energised.

The converter clutch valve is required to provide the flow necessary for the converter clutch. Furthermore, the pressure demultiplication which is required occurs through the converter clutch valve.

10 - Converter pressure control valve WD -SV

This is used to invert the direction of circulation of the oil supplying the converter, depending on whether the lock-up clutch is closed or not.

11 - Lubrication valve SCHM - V

This checks that, when the pump flow is low, the converter is supplied with cooled oil first. Furthermore, it provides, through a by-pass channel, the quantity of oil necessary for cooling and lubricating the transmission.

12 - All or nothing electrovalves MV1 - MV2

These are supplied with 12 volts and are controlled by being earthed by the ECU. These electrovalves are of 3/2 type, in other words, they have three connections but only two positions: open or closed.

At rest (not energised), they are closed $\rightarrow$ the main pressure is blocked. The operating channel is connected to the oil sump return. When energised (earthed), the coil creates a magnetic field. The valve is then attracted, its return spring compresses $\rightarrow$ the return channel is then blocked whilst the operating channel is connected to the main pressure.

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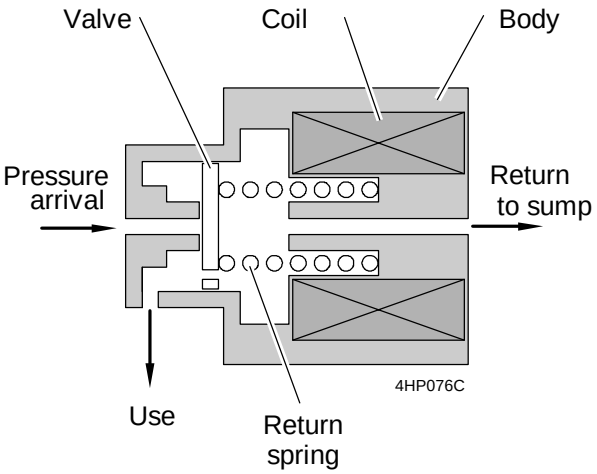
During normal operation, MV1 is always energised and is so as soon as the ECU is powered up.

Diagram



- MV1 is used to obtain the two main pressure levels:
  - energised → low pressure level (7 bar),
  - not energised → high pressure level (16 bar).
- MV2 is used to lock clutch E in 2nd, 3rd and 4th gears as well as in 3rd hydraulic in emergency mode.

13 - Proportional electrovalves or pressure regulators EDS3-4-5-6

a - Introduction

These are supplied with 12 Volts and are controlled by being earthed by the ECU. Their role is to fill or empty a brake or a clutch when changing gear and to keep the receivers closed during a stable gear.

For good driving pleasure and uninterrupted torque transmission when changing gear, the pressure must rise or fall gradually. The main pressure must therefore be modulated and to do this, the proportional electrovalve must cause a variable leak to the sump return.

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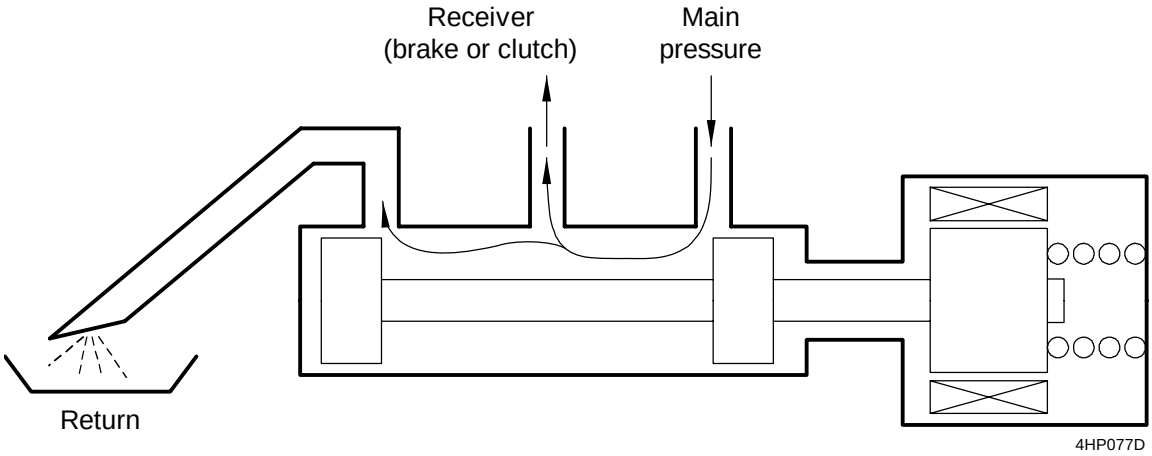
b - Operation



The electrovalves EDS mainly consist of a slide valve linked to an electromagnetic core which is held at rest by a return spring. The EDS are energised by the ECU with a variable cyclic opening ratio (COR). A slide valve opening position and therefore a certain leak and consequently a certain pressure acting on the receiver piston of a brake or a clutch correspond to a set COR.

EDS3 -EDS5 - EDS6:

100% energised → operating pressure = main pressure

Not energised (at rest) → operating pressure = atmospheric pressure

EDS4: Its operation is inverted, in other words when at rest (not energised), operating pressure = main pressure.

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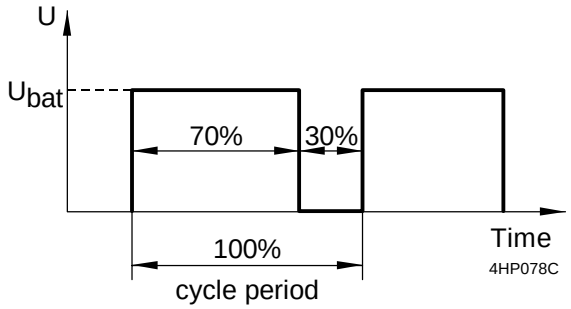
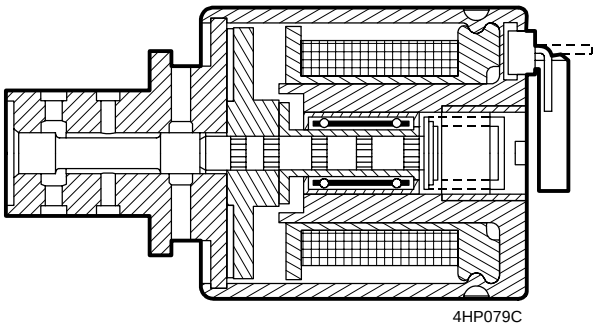
Principle of the COR

The ECU alternately causes the electrovalve coil to be energised then non energised. Over one cycle (period), the energised coil attracts the magnetic core in the direction of pressure increase, if EDS 3, 5 and 6 are used as an example. When the coil is not energised, the core is driven in the direction of pressure reduction under the action of the return spring. The position obtained, and therefore the pressure, depends on the cyclic opening ratio, in other words, the ratio between the percentage of time for which the coil is energised and the percentage of time for which it is not.



Note: In order to permanently check the proportional electrovalves, the ECU permanently supplies them. The current therefore varies from 159 mA to 768 mA; for EDS3, 5 and 6, 159 mA corresponds to the idle position and 768 mA to the fully open position.

Cross section of EDS3, or 5 or 6



c - Functions of the EDS

- EDS3 → neutral position and 1st, then lock-up control
- EDS4 → Reverse, 4th
- EDS5 → 1st and 2nd
- EDS6 → N/1st and 3rd

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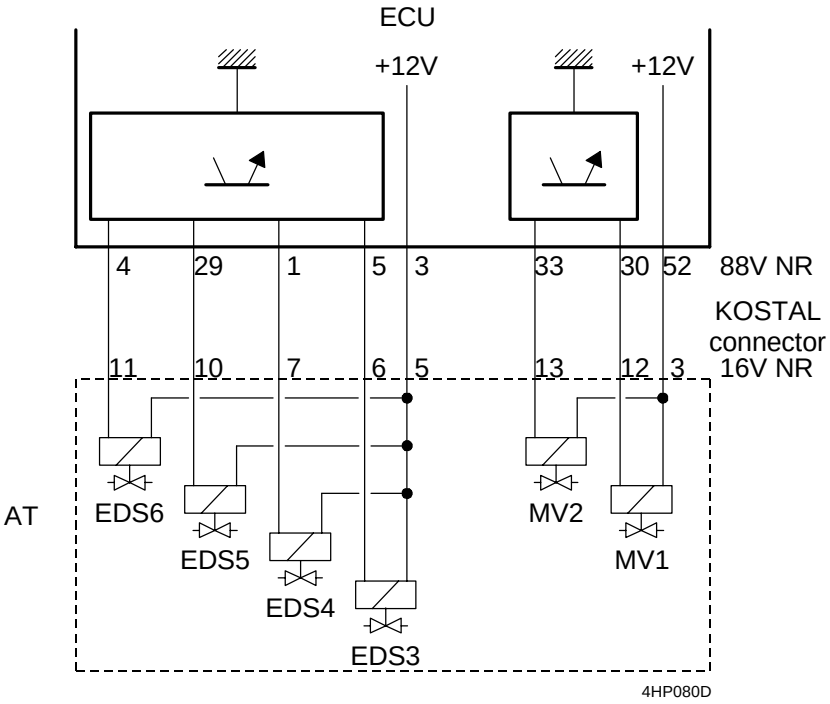
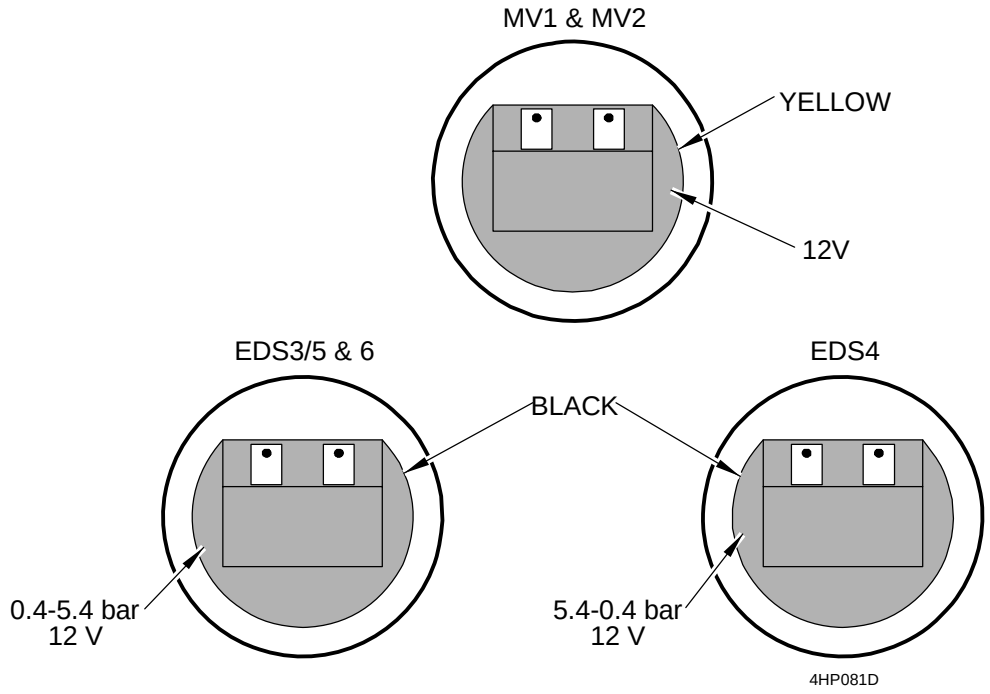
d - Actuator connections



Note: The feed wires of the electrovalves are doubled up for safety (violet wires).

e - Actuator identification



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E - SUMMARY OF OPERATED ELEMENTS

	Clutches		**Brakes**			**Electrovalves - Pressure regulators**						**Lock-up**
gear	**B**	**E**	**C**	**D**	**F**	**MV1**	**MV2**	**EDS3**	**EDS4**	**EDS5**	**EDS6**	
P	X	-	-	-	-	X	X	-	X	-	X	/
R	X	-	-	X	-	X -	X	-	-	-	-	/
N	X (1)	-	-	-	-	X	X	-	X	-	X (1)	/
D 1st	X	-	-	-	X	X -	X	-	X	X	X	/
D 2nd	-	X	-	-	X	X -	-	- X	X	X	-	X
D 3rd	X	X	-	-	-	X -	-	- X	X	-	X	X
D 4th	-	X	X	-	-	X -	-	- X	-	-	-	X
3 1st	X	-	-	-	X	X -	X	-	X	X	X	/
3 2nd	-	X	-	-	X	X -	-	X	X	X	-	X
3 3rd	X	X	-	-	-	X -	-	- X	X	-	X	X
2 1st	X	-	-	-	X	X -	X	-	X	X	X	/
2 2nd	-	X	-	-	X	X -	-	X	X	X	-	X
1 1st	X	-	-	-	X	X -	X	-	X	X	X	/
3rd emer-gency	X	X	-	-	-	-	-	-	-	-	-	/
R emer-gency	X	-	-	X	-	-	-	-	-	-	-	/

(1) except in snow program

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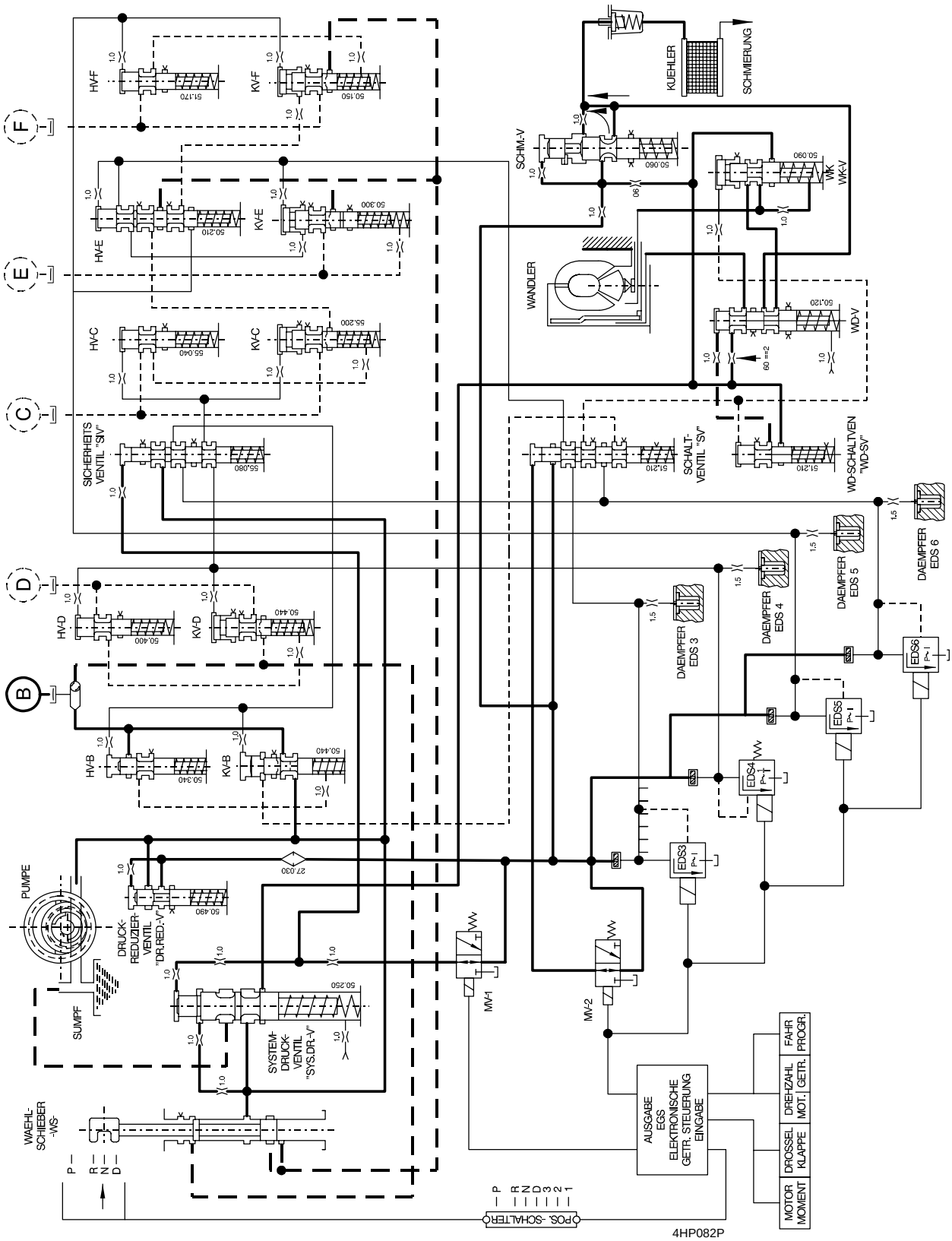
F - LAYOUT OF THE HYDRAULIC UNIT



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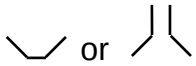
G - OPERATION

Key

: Oil pump

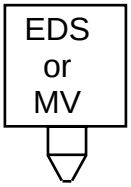


: Oil return to sump

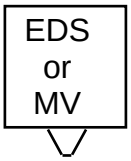
: Empty pipe

: Main pipe used for the gear

: Pipe full of oil but not used for changing gear



: Electrovalve closed



: Electrovalve open

Warning: Only the elements involved in the subject being dealt with (gear changes, lock-up control, etc…) are shown with the aim of simplifying the highly complicated hydraulic circuit!

1 - Gear changes

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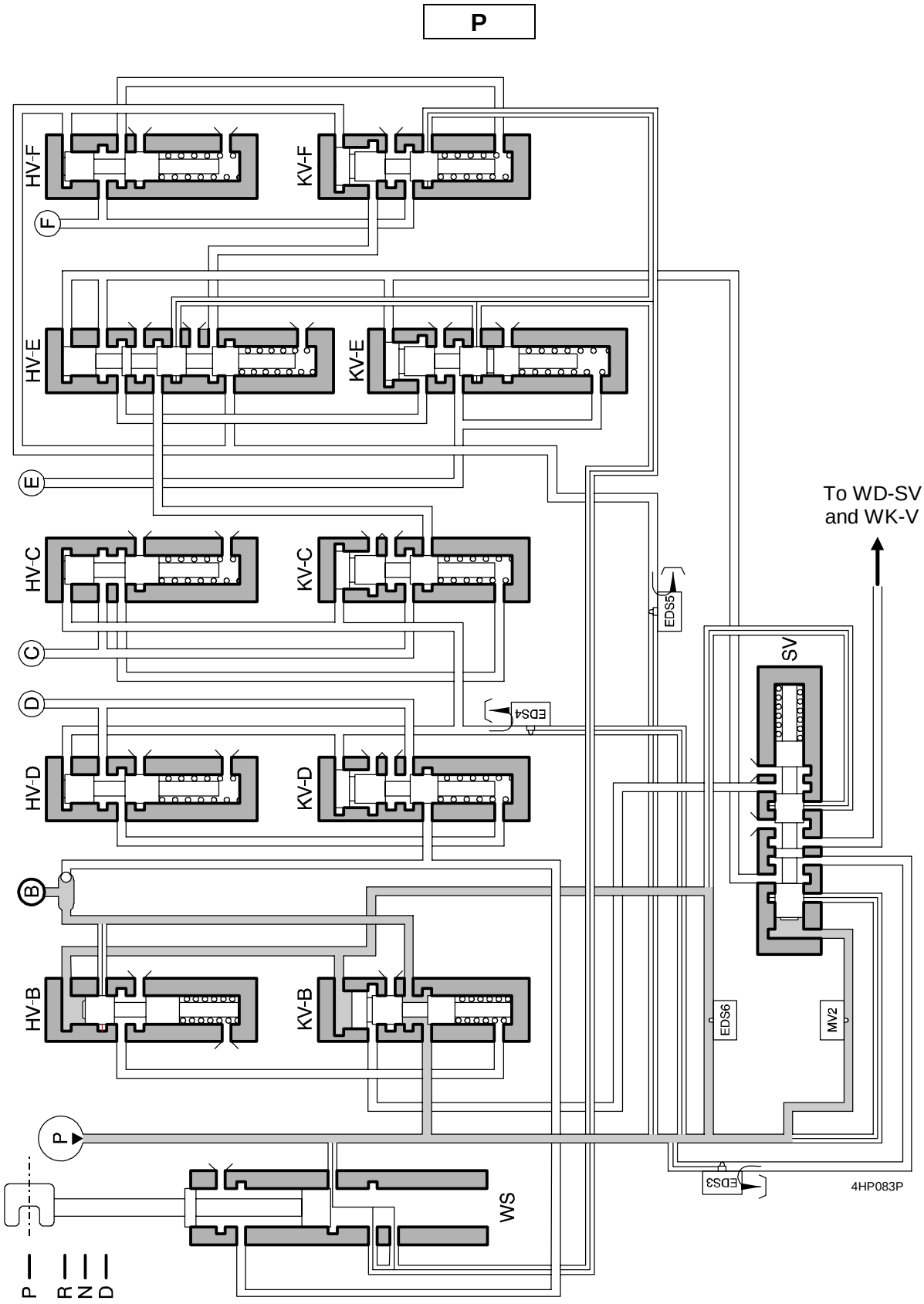

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a - Parking position

- B must be engaged in order to anticipate 1st or reverse gear
- Elements controlled: MV2, EDS4, EDS6 ⇒ The slide valve of HV-B lowers → the slide valve of KV-B lowers in turn ⇒ B is supplied

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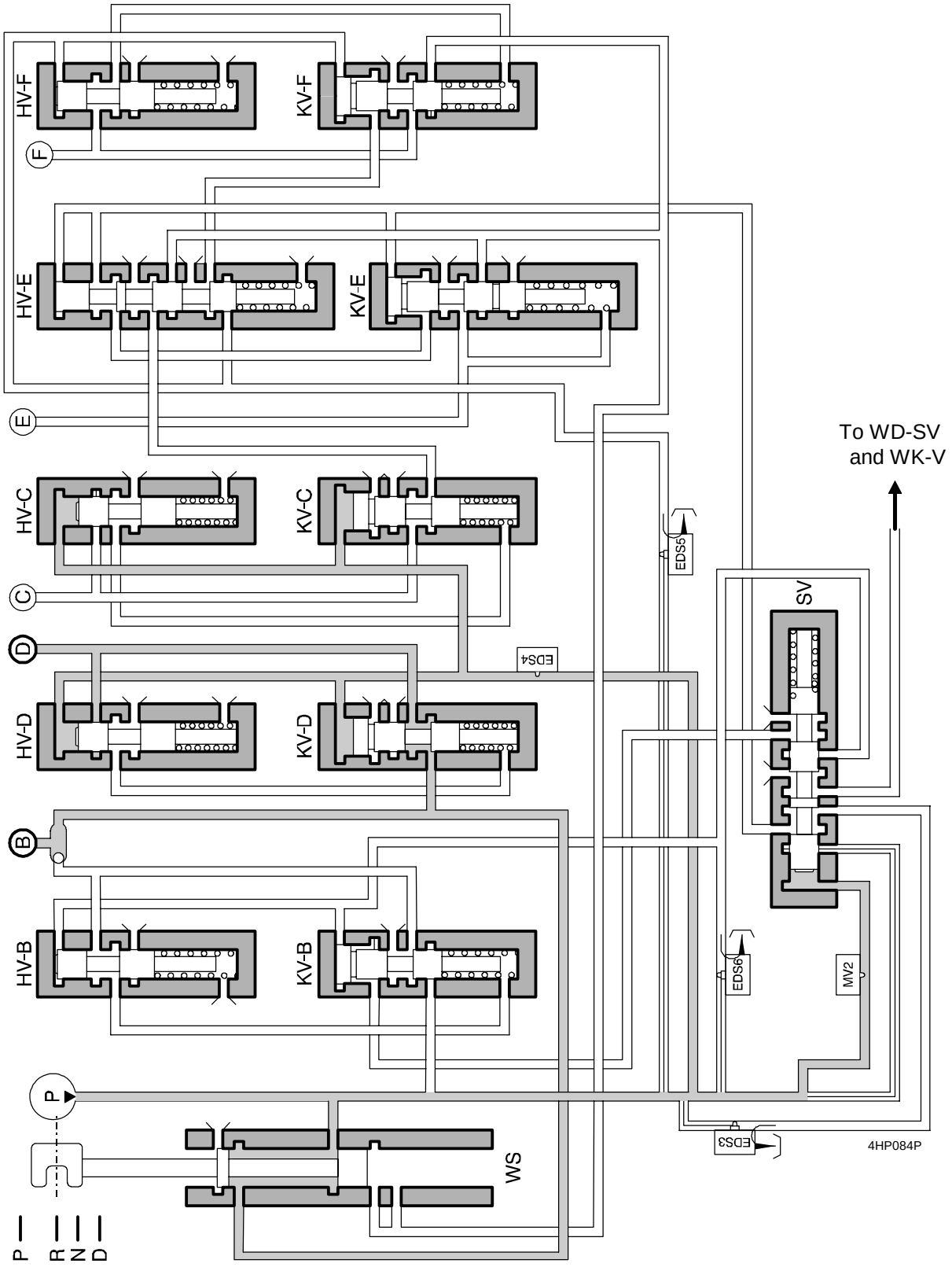
Reverse gear



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b - Reverse gear

- Clutch B and brake D must be engaged.
- Elements controlled: MV2 → no effect.
- As the manual valve is in position R ⇒ clutch B is supplied directly.
- As the proportional valve EDS4 is at rest, and therefore open ⇒ the slide valve HV-D lowers → the slide valve KV-D then lowers in turn → brake D is supplied.

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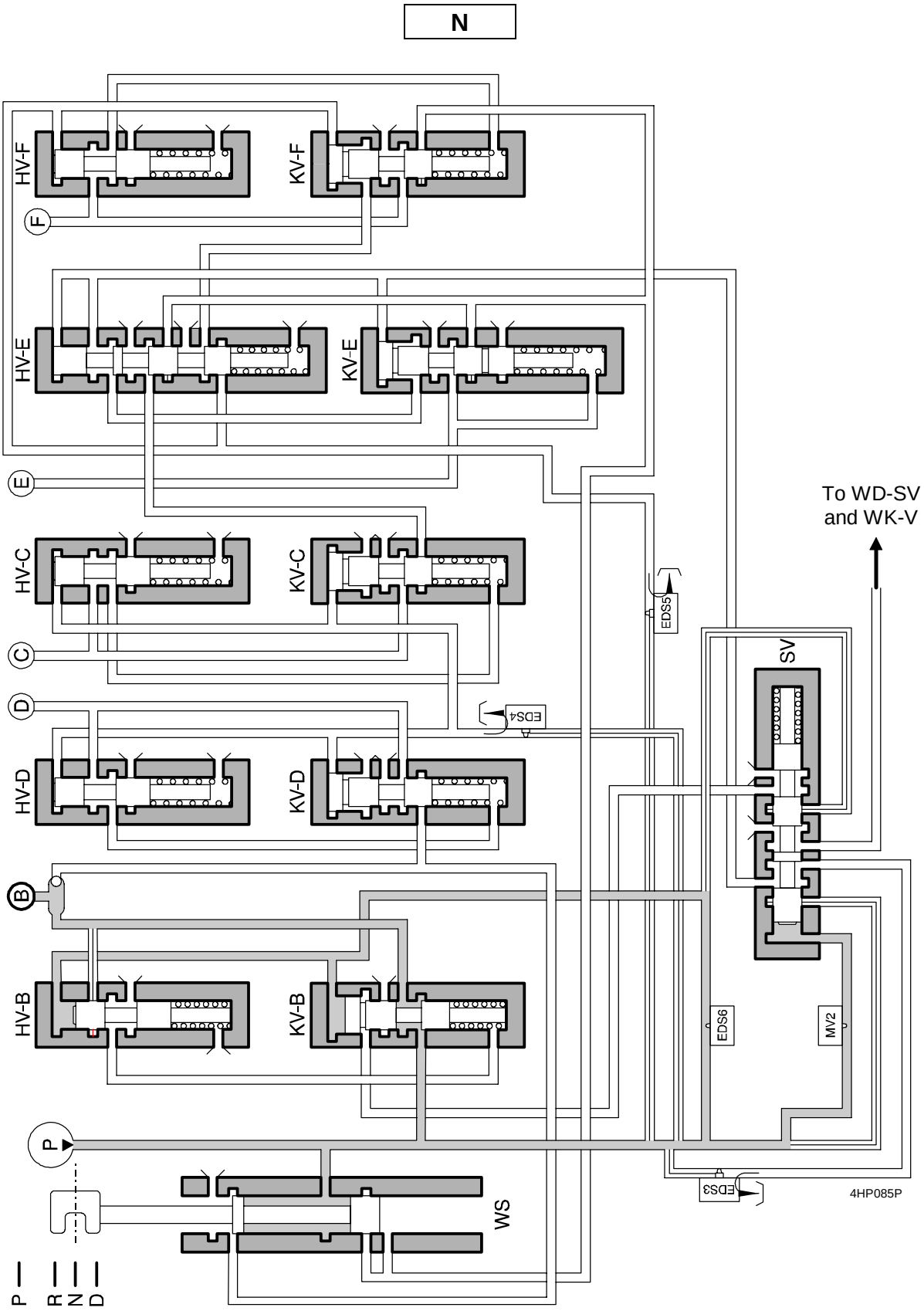

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c - Neutral

Same as parking position.

Elements MV2, EDS4, EDS6 are controlled ⇒ Slide valve HV-B lowers which allows KV-B to lower in turn ⇒ clutch B is supplied.

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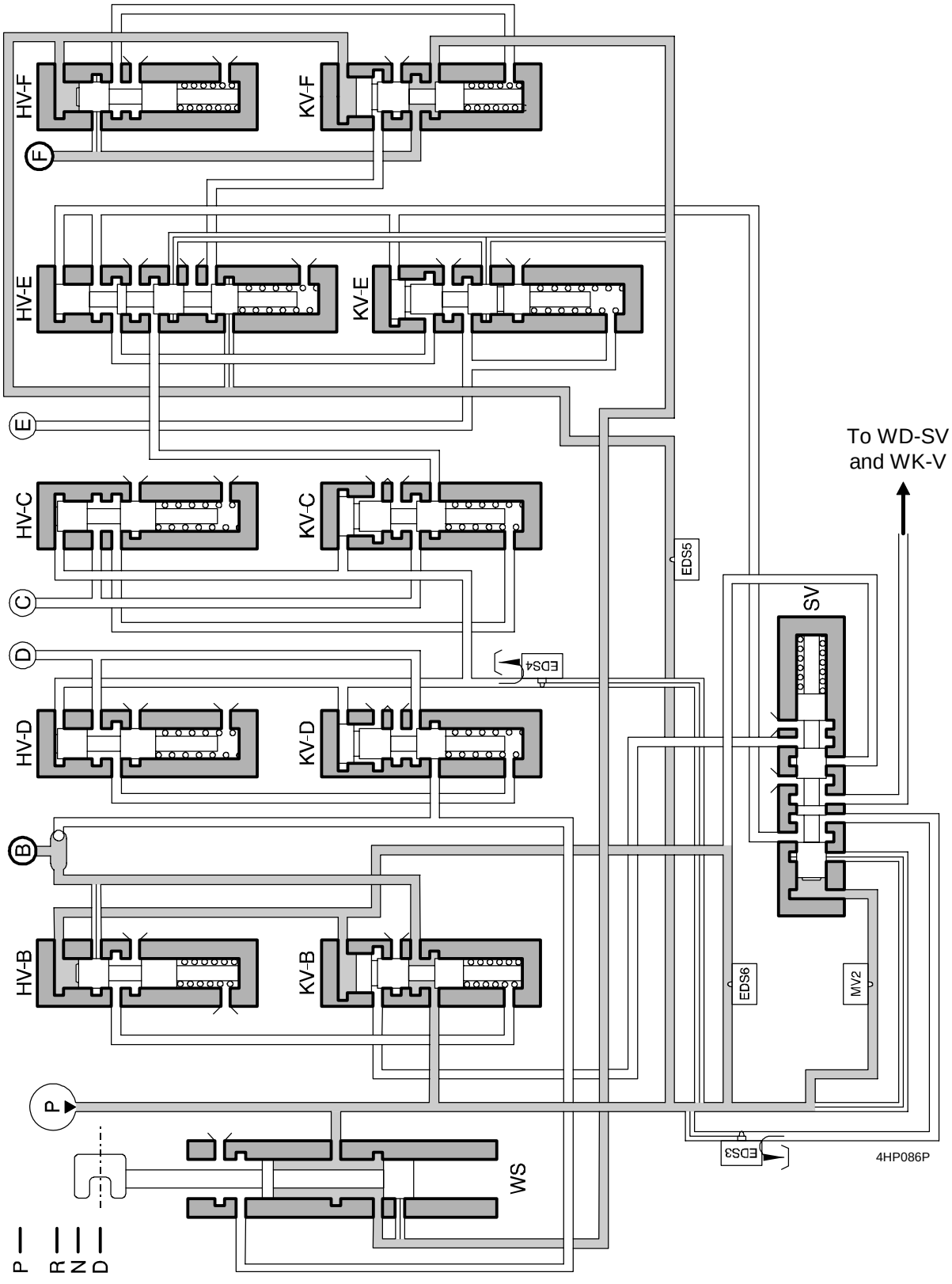
D - 1st



ZF 4HP20 AUTOMATIC TRANSMISSION

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d - Position D - 1st gear

- Clutch B and brake F must be engaged.
- Elements controlled:
  - MV2
  - EDS4
  - EDS5
  - EDS6

  – Through EDS6 $\rightarrow$ slide valve HV-B lowers allowing slide valve KV-B to lower in turn $\Rightarrow$ B is supplied.

  – Through EDS5 $\rightarrow$ slide valve HV-F lowers, allowing slide valve KV-F to lower in turn $\Rightarrow$ F is supplied.

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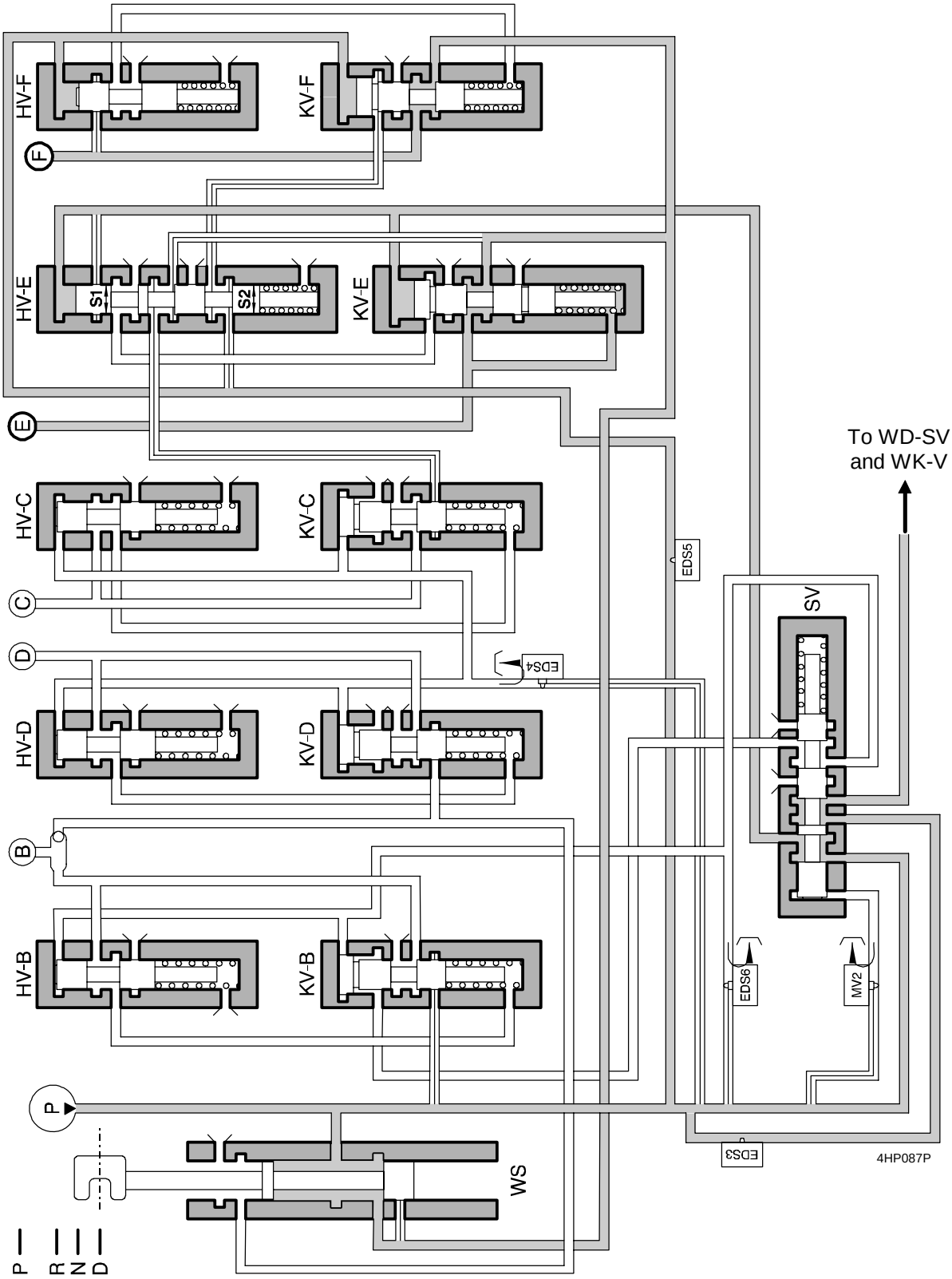
D - 2nd



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e - Position D - 2nd gear

- Clutch E and brake F must be engaged.
- Elements controlled:
  - EDS3
  - EDS4
  - EDS5
- As MV2 is at rest, slide valve SV returns to the idle position $\Rightarrow$ through EDS3, slide valve HV-E lowers $\rightarrow$ slide valve KV-E lowers so as to allow E to be supplied; but this same pressure supplying E comes under slide valve KV-E. When the force created by this pressure combined with the action of the return spring (P x S2 + FR) is greater than the force (P x S1) acting on the top of the slide valve, this slide valve rises $\Rightarrow$ the clutch E is therefore operated with a pressure which is slightly lower than the maximum main pressure.
- Through EDS5 $\rightarrow$ slide valve HV-F lowers, which allows slide valve KV-F to lower in turn $\rightarrow$ F is supplied.

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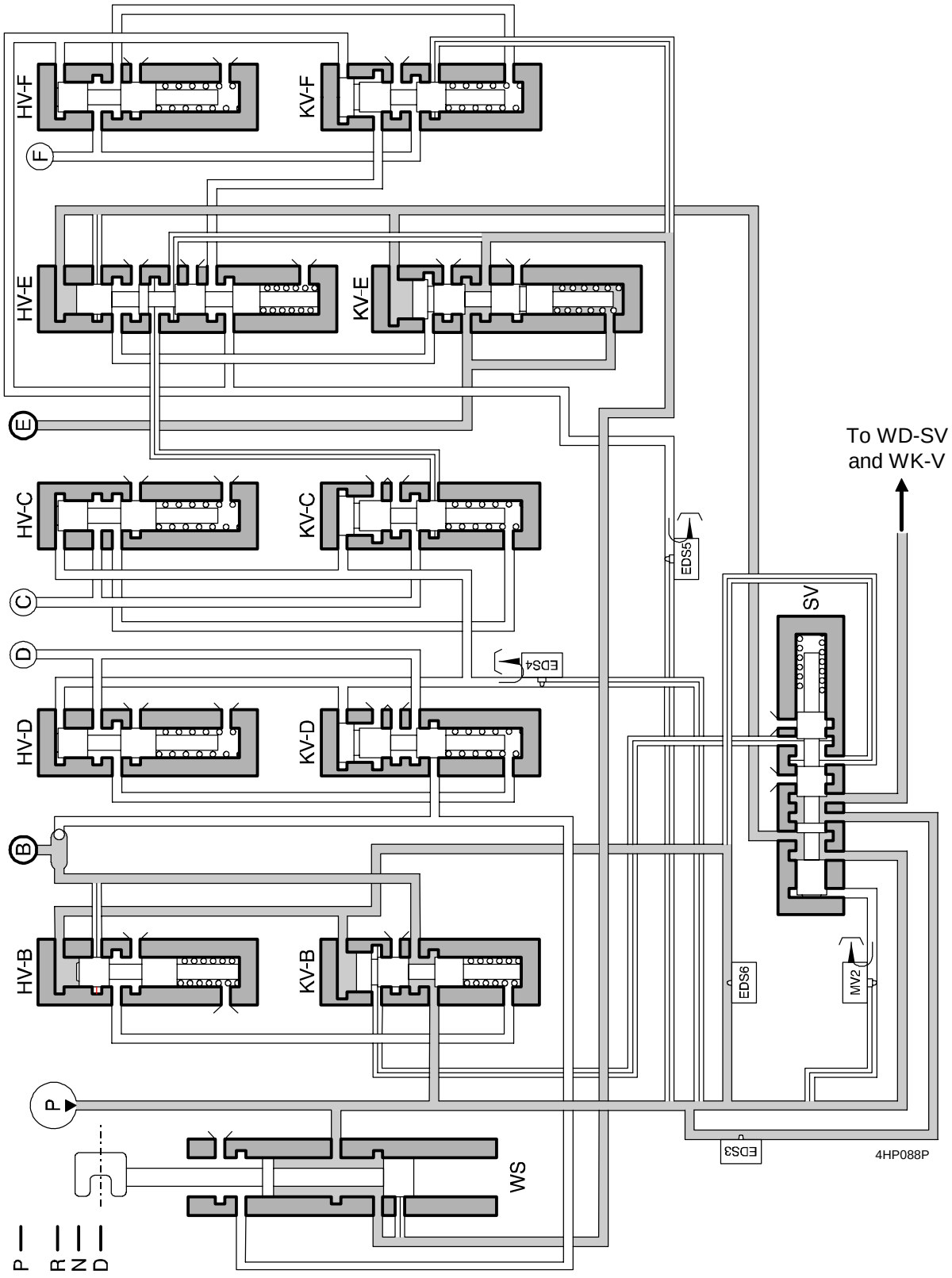
D - 3rd



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f - Position Drive - 3rd gear

- Clutch E and clutch B must be engaged.
- Elements controlled:
  - EDS3
  - EDS4
  - EDS6

  - E is supplied in the same way as in 2nd gear through slide valves HV-E and KV-E by controlling EDS3 and the idle position of slide valve SV (MV2 at rest).
  - Through EDS6 $\rightarrow$ slide valve HV-B lowers, allowing slide valve KV-B to lower in turn $\Rightarrow$ B is supplied.

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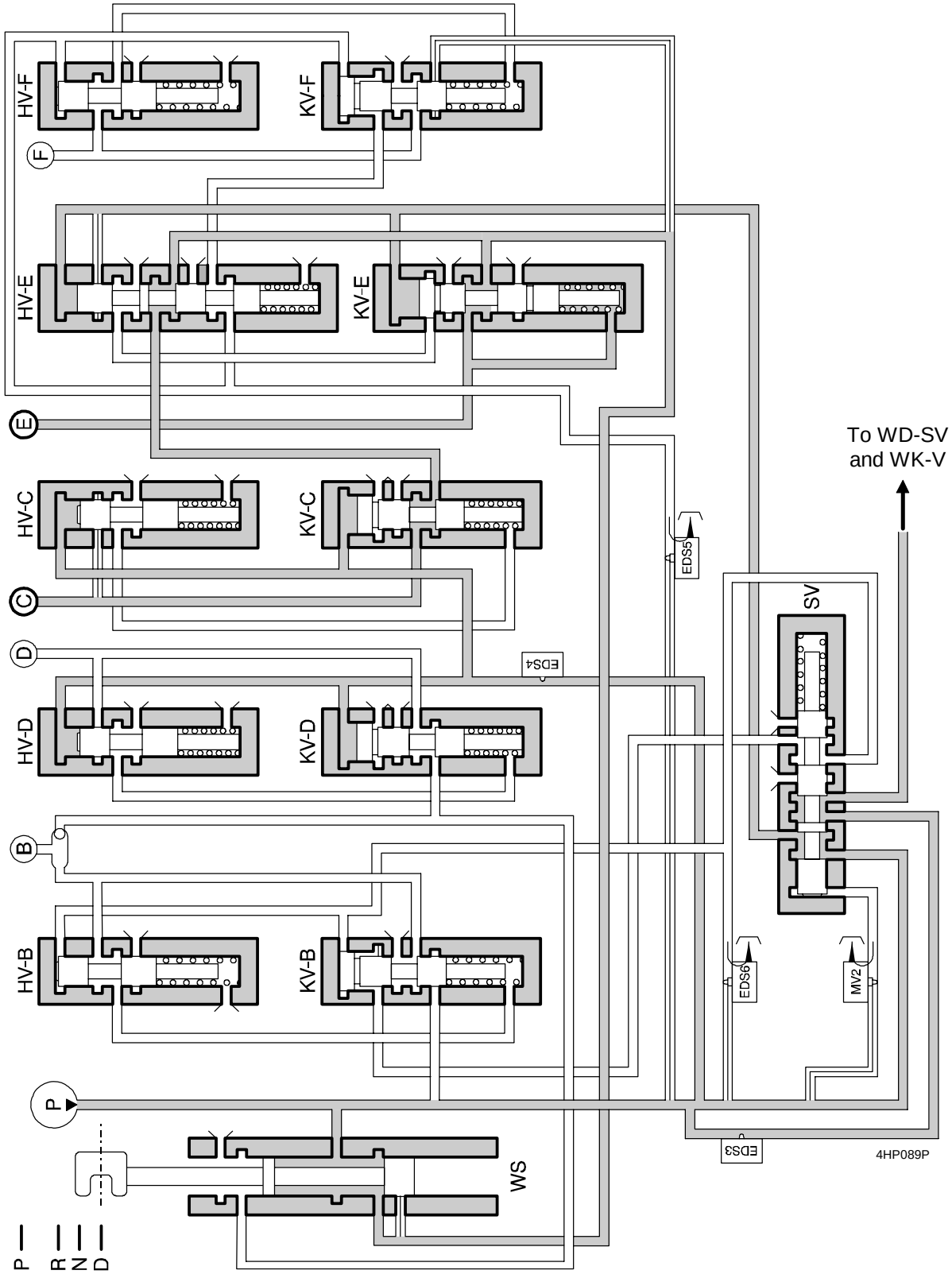
D - 4th



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g - Position Drive - 4th gear

- Clutch E and brake C must be engaged.
- Elements controlled: - EDS3
- Supply to E: same as 2nd and 3rd.
- When EDS4 is at rest and therefore open → slide valve HV-D lowers which allows slide valve KV-D to lower in turn → slide valve HV-C then lowers thus allowing slide valve KV-C to lower → C is then supplied through HV-E.

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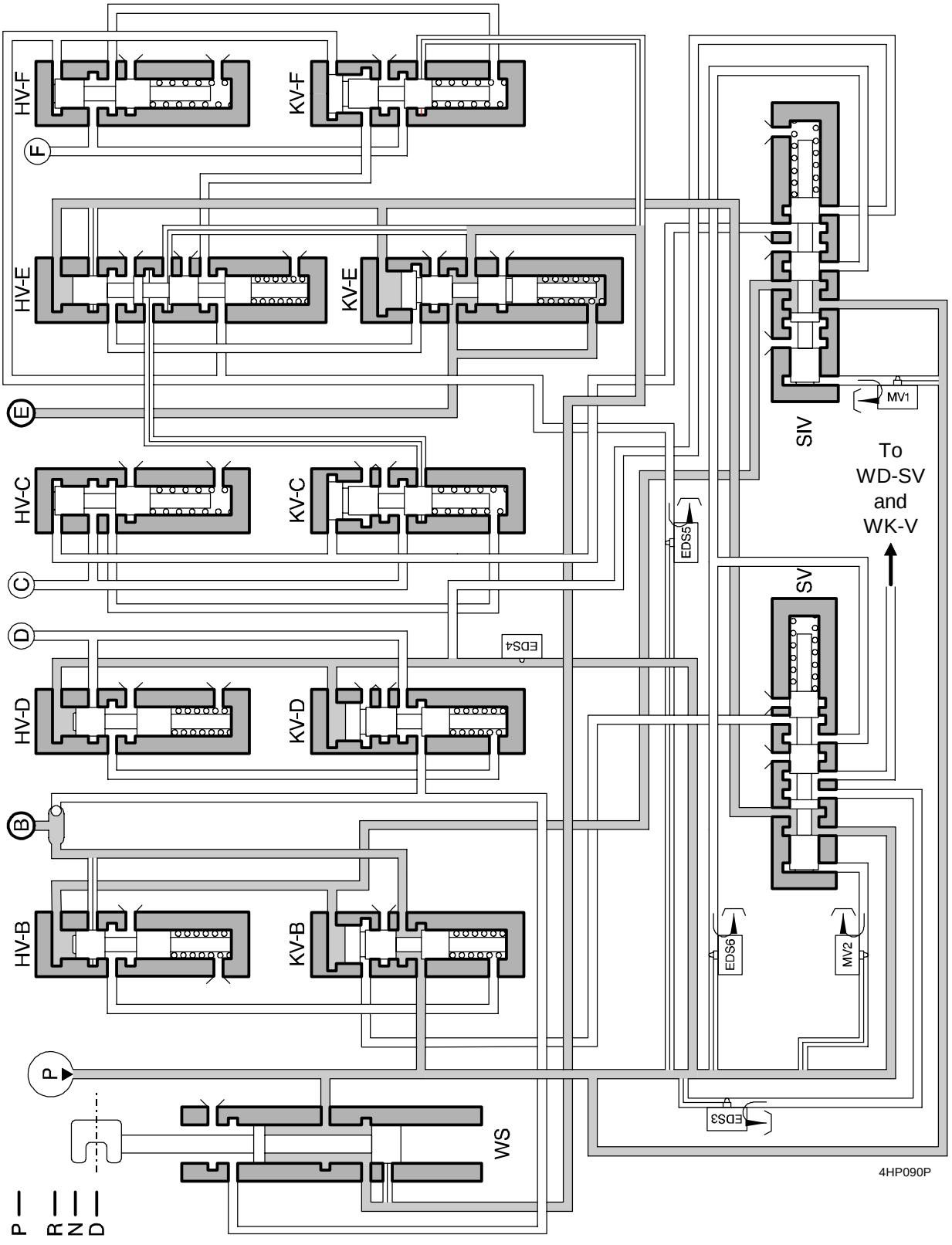
3rd emergency



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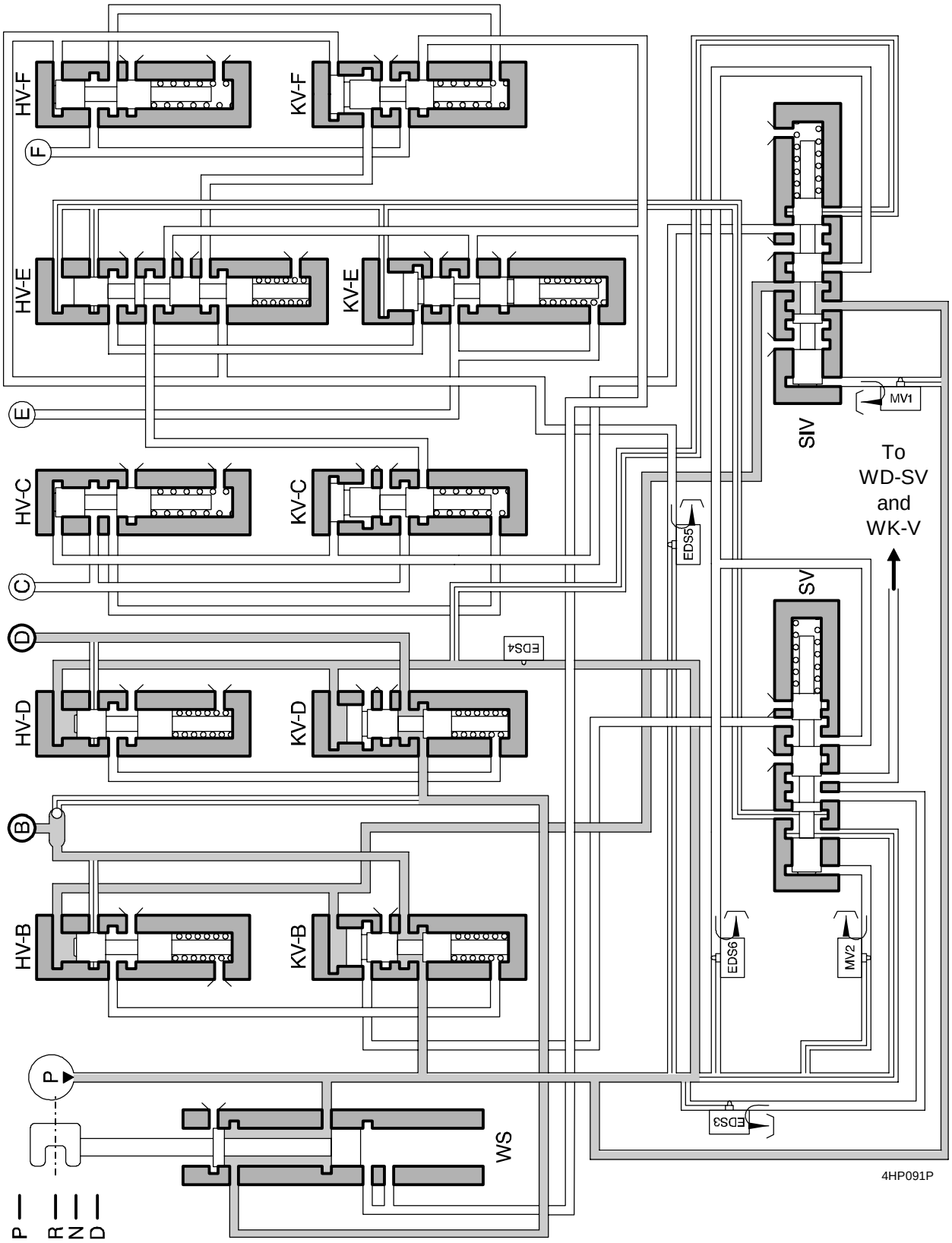
Reverse emergency



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h - Position D - 3rd emergency/Reverse emergency

If the ECU is unable to operate the hydraulic unit, the driver only has the use of two gears; 3rd and reverse.

A way must be found hydraulically of supplying the brakes and clutches corresponding to the desired gear just like during normal operation.

To do this, an additional slide valve SIV has been incorporated into the hydraulic unit. This has been positioned between:

- HV-D/KV-D and HV-C/KV-C
- HV-B/KV-B and EDS6/SV

In the event of a fault, all electrovalves are at rest, including MV1, the role of which is to select the maximum value of the main pressure.

- MV1 is at rest $\Rightarrow$ slide valve SIV is at rest $\rightarrow$ slide valve HV-B lowers, allowing slide valve KV-B to lower in turn $\rightarrow$ B is supplied.
- For third gear, as the manual valve is in position D, slide valve HV-E is directly moved downwards $\rightarrow$ KV-E is then moved in turn in order to supply E.
- For reverse gear, D is supplied directly by the manual valve which is in the reverse gear position $\rightarrow$ same as normal operation.

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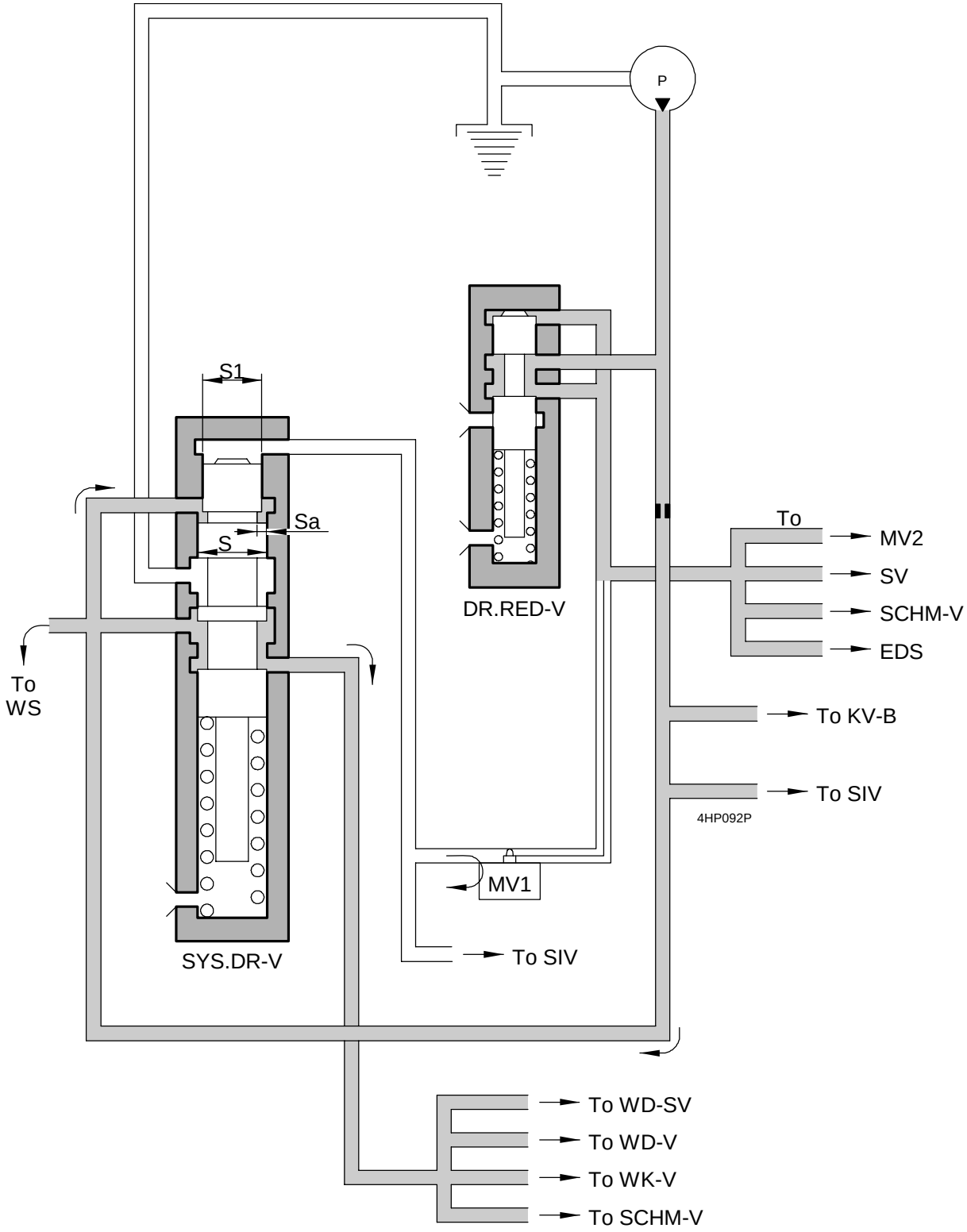
16 bar position



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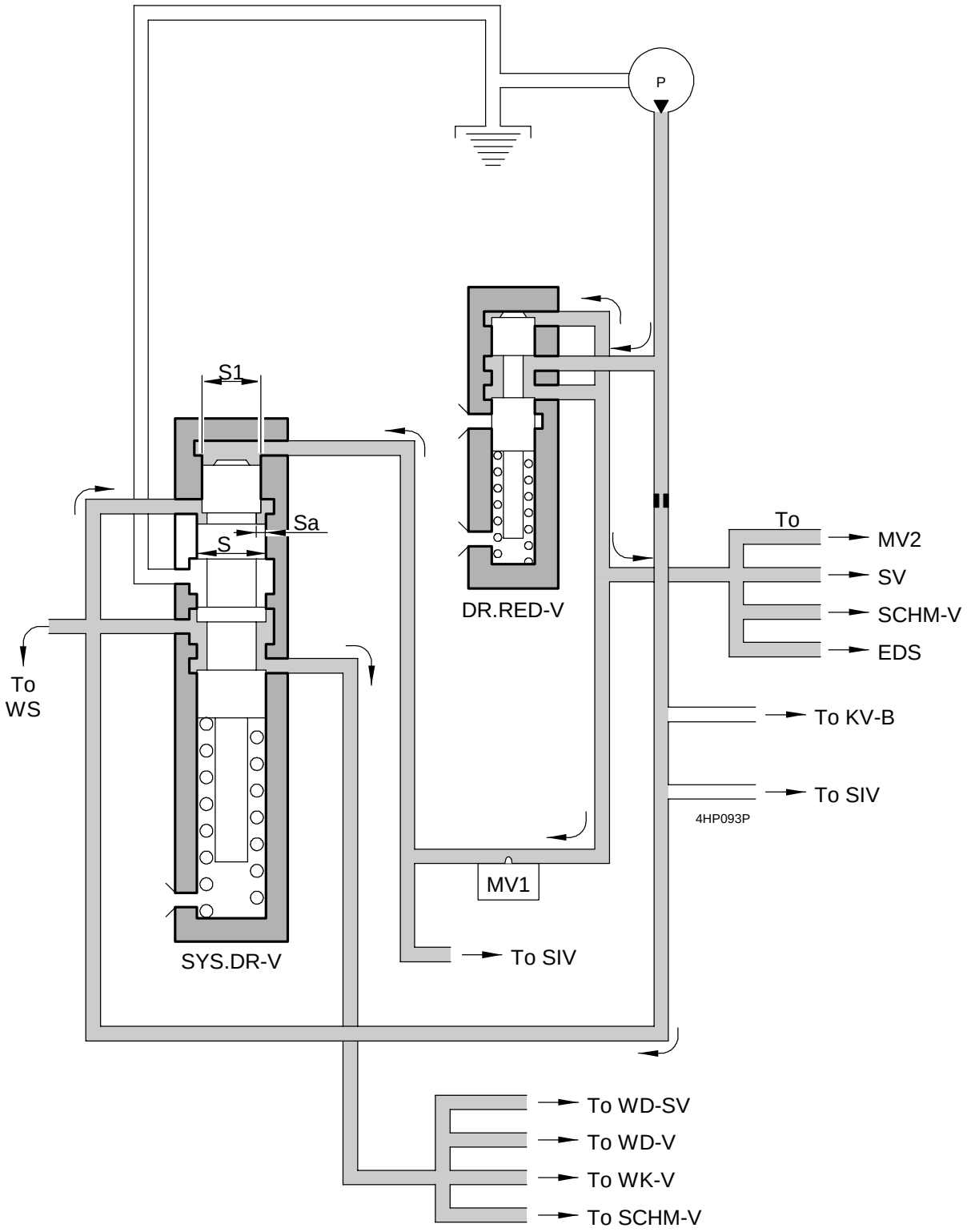
7 bar position



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2 - Controlling the main line pressure

Valve "SYS.DR - V" regulates the main pressure. When this, multiplied by the surface area of the slide valve on which it is being applied, becomes greater than the rating of the spring FR, the slide valve lowers fully in order to uncover the return to sump channel.

a - 16 bar position

The oil provided by the pump applies a force to the annular area Sa of slide valve SYS.DR-V. When P x Sa = FR, the slide valve lowers in order to adopt the equilibrium position such that: Pmain = 16 bar; at this point, the converter and the lubrication circuit are supplied.

b - 7 bar position

The ECU supplies the all or nothing electrovalve MV1 $\rightarrow$ MV1 opens. The oil from the pump is now applied to slide valve SYS.DR-V on an area S = Sa + S1. Slide valve equilibrium is therefore found when FR = P x (Sa + S1); as the application area is greater, the main pressure is proportionally lower: Pmain = 7 bar.

c - Role of DR.RED-V

The control pressure of the receivers can take two maximum valves: 7 or 16 bar. However, for this oil to be applied to the receivers, valves HV and KV are used. These are operated by pressure regulating electrovalves EDS. This operating pressure is regulated to a maximum value of 5 bar.

When the oil reaches a pressure greater than 5 bar, slide valve DR - RED - V moves downwards in order to uncover the return to sump channel.

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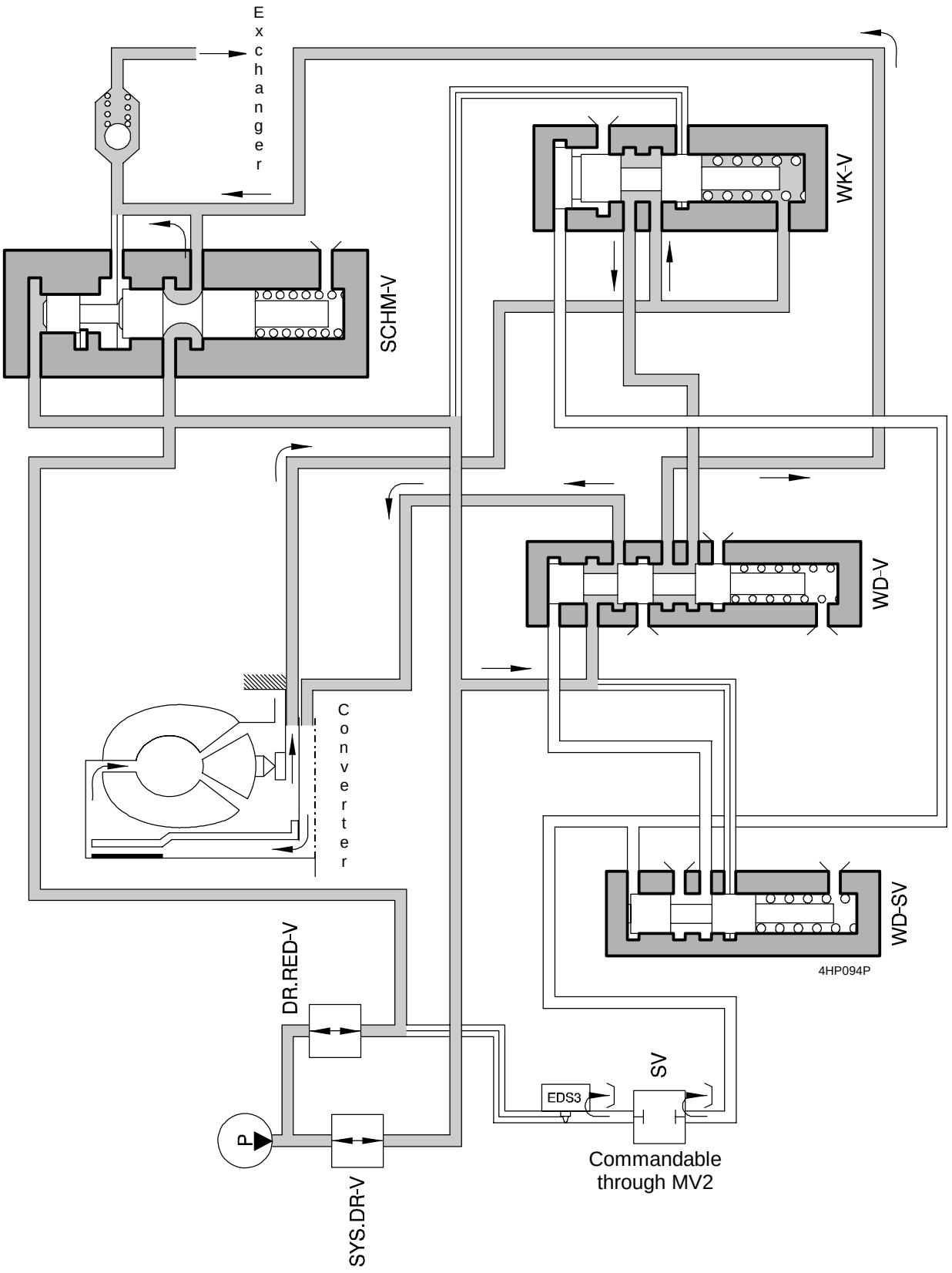
Lock-up open



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3 - Controlling the lock-up

a - "Open" position

- In positions P, N, 1st and reverse, the lock-up is systematically open.
- MV2 is operated and therefore open which allows slide valve SV to be controlled → slide valve WD-SV is at rest. Slide valve WD-D is therefore also at rest.
- WD-V directs the pressurised oil to the converter on the lock-up side; the oil therefore separates the lock-up disc from the impeller housing → it is open. The oil returning from the converter via WK-V and WD-V is then directed to the water/oil exchanger in order to be cooled.

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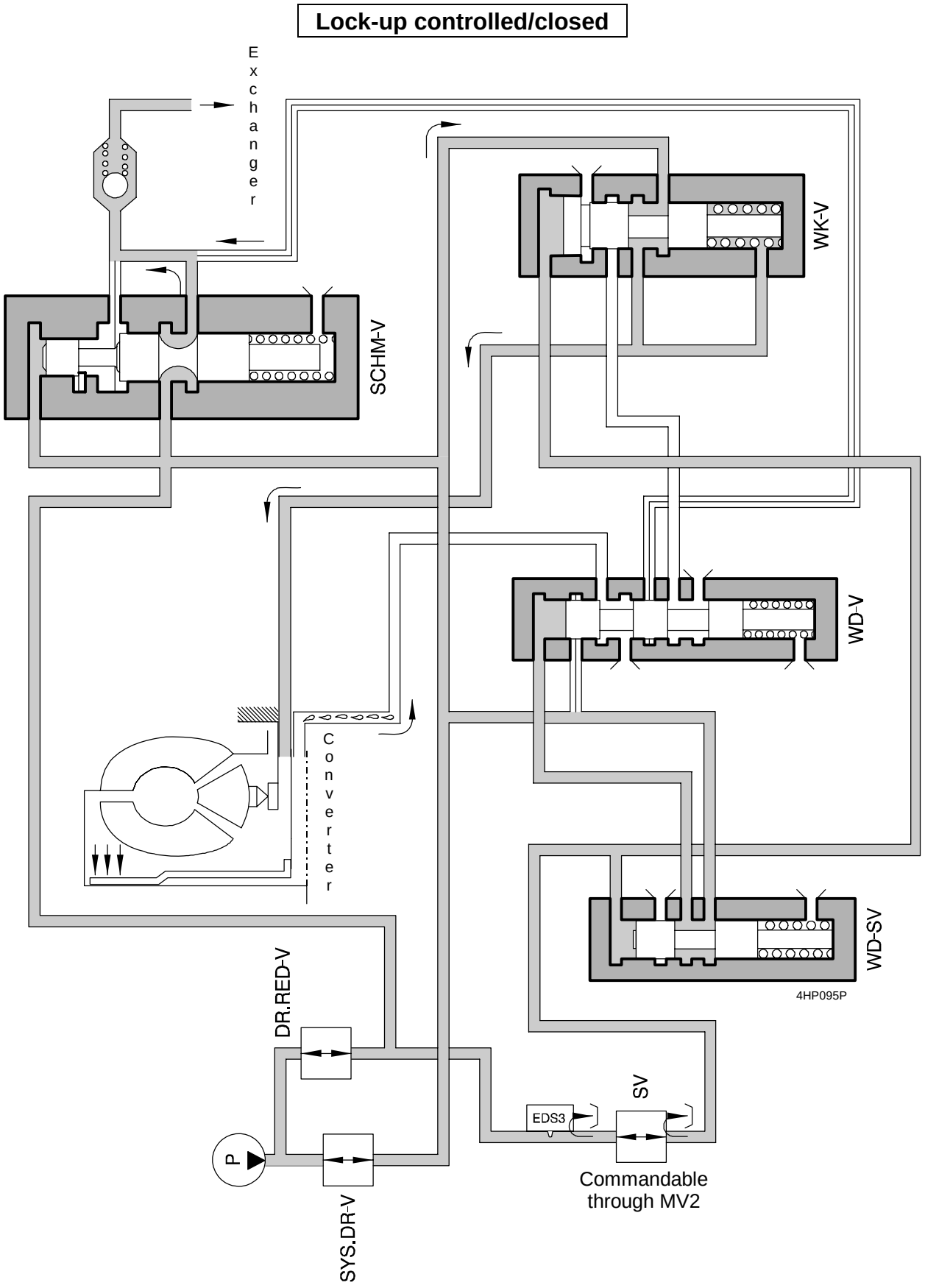

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b - Controlled - closed position

In 2nd, 3rd and 4th gears, MV2 is not controlled → slide valve SV returns to the idle position.

In this case, if the lock-up is to be controlled, all that is required is to order the proportional electrovalve EDS to open.

⇒ Slide valve WD-SV lowers, in order to cause the direction of oil circulation to invert in the converter; in effect:

→ the lowering of slide valve WD-SV causes slide valve WD-V to lower ⇒ the rear of the lock-up disc is connected to the housing, in order to drain this chamber and thus allow a compulsory calibrated return of the oil from the converter.

→ furthermore, the pressurised oil from EDS3 causes slide valve WK-V to lower ⇒ the pressurised oil from SYS.DR-V is then directed towards the converter on the shaft side of the stator; the oil fills the converter and exerts a force on the lock-up disc; this then comes into contact with the impeller housing.

WK-V is hydraulically a regulator, in other words, when the desired pressure in the converter is reached, the slide valve closes again, in other words for $P_{converter} \times S_2 + F_{spring} > P_{EDS3} \times S_1$.

In effect, if the lock-up slip is to be regulated (in other words controlled), it must be possible to control the pressure acting on the lock-up disc perfectly.

The principle therefore consists of modulating, through EDS3, the value of the pressure acting on the top of slide valve WK-V, in other words P_{EDS3}.

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ZF 4HP20 AUTOMATIC TRANSMISSION

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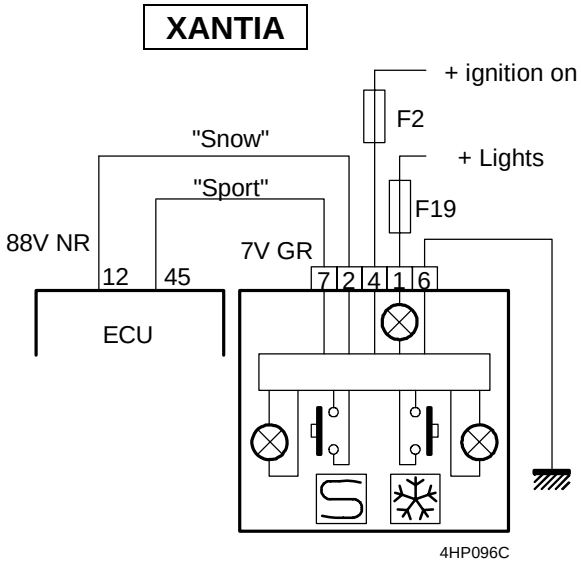
SENSORS AND INFORMATION

I - PROGRAM SELECTOR

This is a double "push" switch located on the central console.



When the switch is pressed, the electronic stage connects an ECU terminal (12 or 45 depending on user's selection) to negative and supplies the corresponding operating light. A second press on the switch cancels the previous selection.
If the switch has never been moved to one of the two proposed programs, the ECU responds to the normal auto-adaptive program.
Therefore, an odd number of presses leads to a specific program being selected and an even number of presses leads to the specific program being cancelled.
Furthermore, the switch has an illumination light supplied by the + lights so that it can be located at night.

Note: After pressing the switch, the earthing is maintained by the electronic stage until a second pulse appears.

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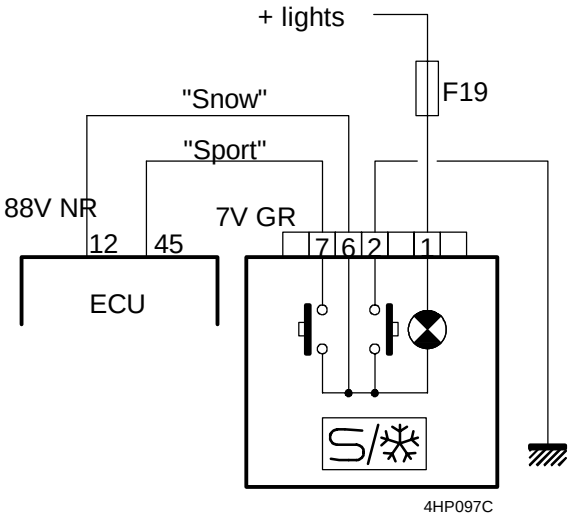
XM - restyled XANTIA



This switch is fitted to vehicles having a selected program indicator on the instrument panel; this means that the electronic stage is no longer required in the switch. The operation remains unchanged:
Pressing the switch connects an ECU terminal (12 or 45 depending on user's selection) to earth. A second press cancels the previous selection.

Note: The earthing operations caused by the switch only last for the length of the press.

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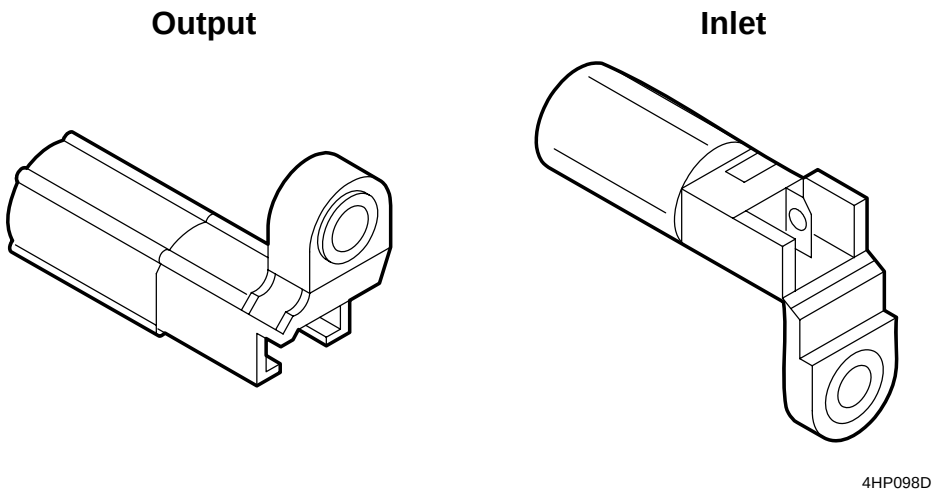
II - AUTOMATIC TRANSMISSION INPUT AND OUTPUT SPEED SENSORS

A - ROLE

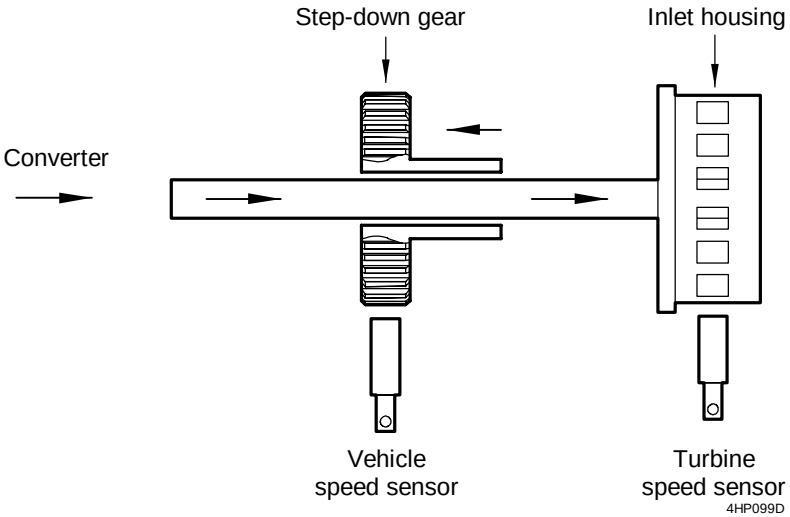


These two sensors provide the ECU with:

- the transmission input speed, by measuring the speed of rotation of the converter turbine,
- the transmission output speed, by measuring the speed of rotation of the mechanism output shaft from the step-down gear,

The input speed sensor is mounted on the hydraulic unit, opposite the movement inlet housing.

The output speed sensor is mounted in the mechanism housing, opposite the mechanism output gear of the step-down gear.



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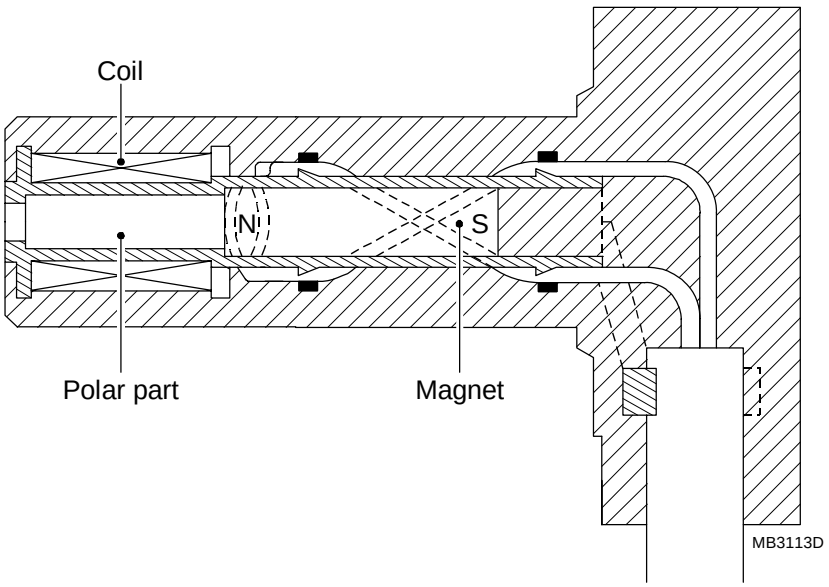
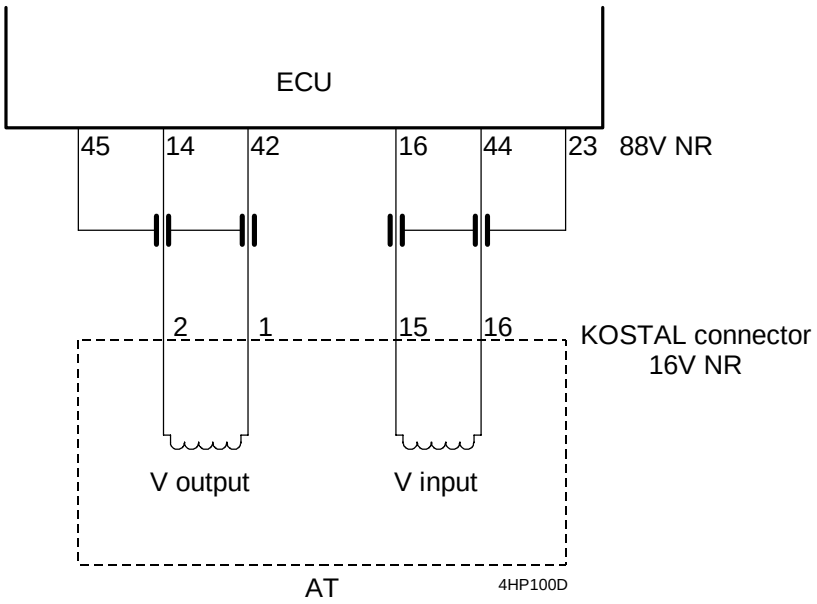
B - DESCRIPTION



They consist of:

- a permanent magnet,
- a coil,

and a polar part.



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C - OPERATION

1 - Turbine speed sensor

The movement inlet housing is connected to the converter turbine by means of the input shaft; it therefore rotates at the same speed as the turbine.

This housing has slots all around its periphery at regular intervals. The material between two slots is similar to a tooth.

When one of these "tooth" sections of the inlet housing passes under the sensor, a variation in flux in the coil is created which then sets up an induced electromotive force.

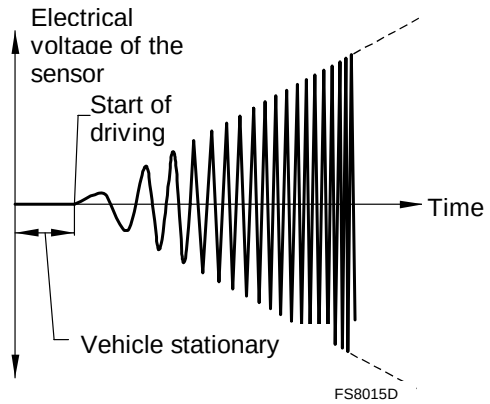
The frequency and amplitude of the sinusoidal signal generated in this way are proportional to the speed of rotation of the inlet housing, and therefore the converter turbine.

2 - Vehicle speed sensor

The input gear of the step-down gear is the mechanism output pinion since it is connected to the planet wheel carrier PS1. Its speed of rotation is therefore proportional to the speed of the vehicle.

Using the same principle as for measuring the input speed, every time one of the gear teeth passes under the sensor, an alternating signal is produced, the frequency and amplitude of which are proportional to the speed of rotation of the mechanism output gear.

Example for the output speed sensor



Note: - The input speed sensor cannot be adjusted.

- The output speed sensor can be adjusted using a shim; in effect, the input gear of the step-down gear has a variable number of teeth depending on the vehicle in question. As its diameter is therefore variable, the sensor must be adjusted to ensure the correct air gap.

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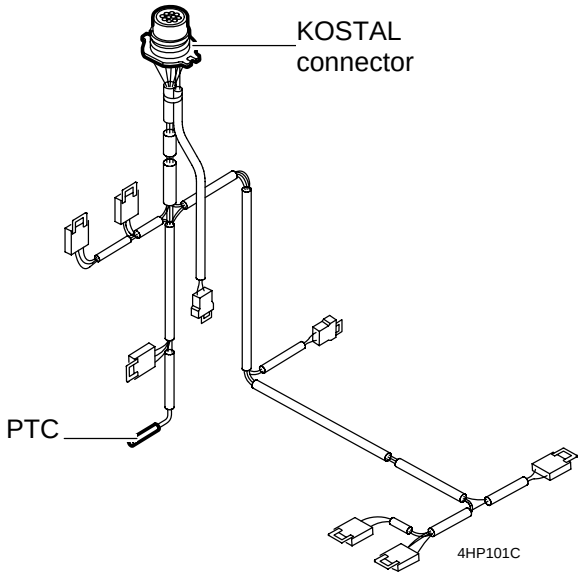
III - OIL TEMPERATURE PROBE

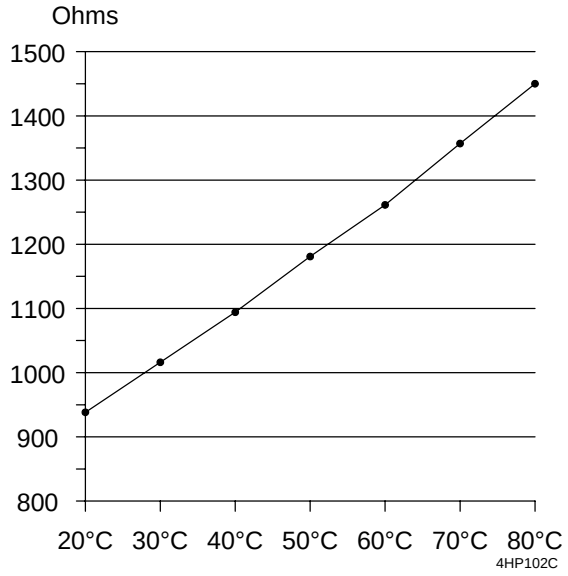
A - ROLE

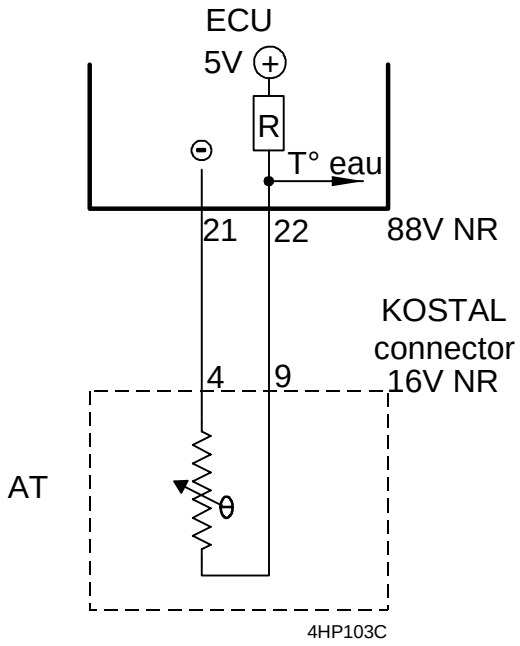
This informs the ECU of the temperature of the transmission oil. It allows it to adopt gear changing strategies and a lock-up control mode preventing the oil from overheating and consequently from damaging the transmission. It also has an effect on the control pressure calculation used within the scope of the management of gear changes.

B - OPERATION

The value of resistance increases as the temperature rises. This is a PTC type thermistor (positive temperature coefficient resistor). It is located in the hydraulic unit.







The probe circuit is supplied with five volts direct current. Between tracks 22 and 21, the ECU measures the voltage at the probe terminals which varies as a function of the probe's resistance.

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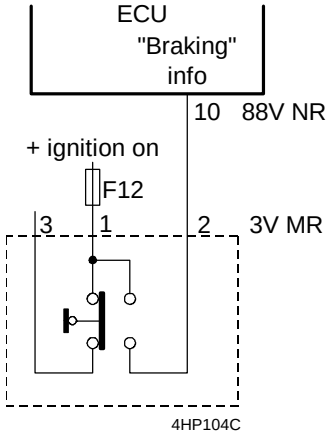
IV - BRAKING INFORMATION

This is supplied to the ECU through the stop switch which is operated by the brake pedal.

This logical information (0 or 1) is used for special strategies:

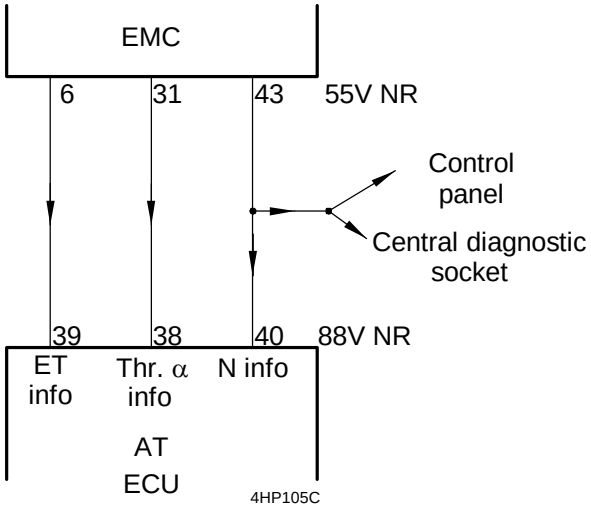
- to force a change down when the brake pedal is used,
- to perform the shift-lock function.



V - LOGICAL INFORMATION SUPPLIED BY THE EMC

The engine management ECU provides the automatic transmission ECU with three items of information in the form of logical signals:

- throttle position (as a percentage)
  - 0% → no load
  - 100% → full load
- engine torque (in Nm),
- engine speed (in rpm).



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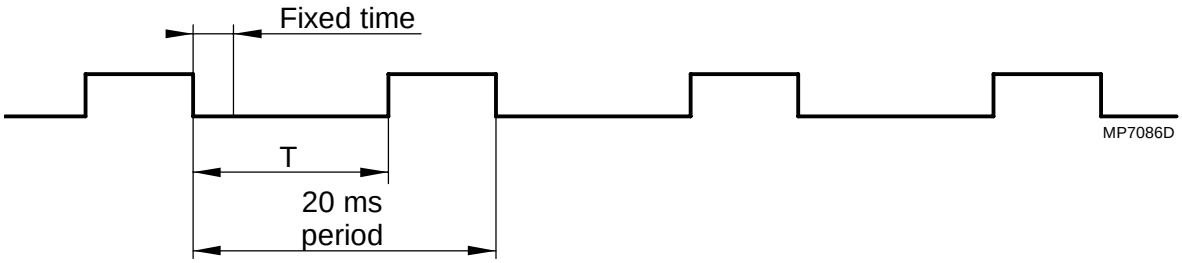
A - THROTTLE POTENTIOMETER SIGNAL FOR AUTOMATIC TRANSMISSION

The MP7.0 ECU provides the automatic transmission ECU with throttle position information, in the form of a 0/1 logical signal, the COR of which represents the instantaneous throttle α.



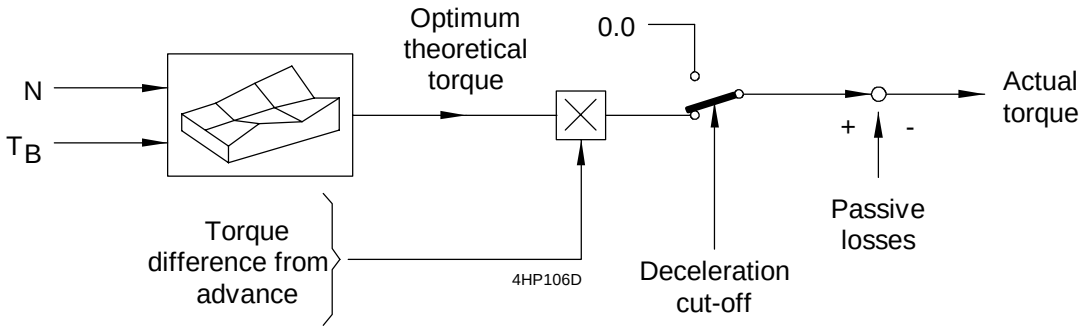
The period, which is constant, is set at 20 ms. It is the time T during which the signal is 0 which represents the throttle position.

T = t0 + t1:
- t0 calibrated time giving the automatic transmission ECU time to react,
- t1 time which is a direct function of α/idle.

B - ENGINE TORQUE SIGNAL FOR AUTOMATIC TRANSMISSION

1 - Calculating the engine torque

a - General method



Torque difference from advance from the shape

$$0,\ xx = \frac{100 - \text{decline in torque from advance in \%}}{100}$$

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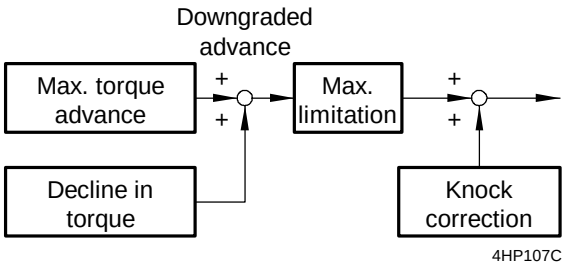
b - Reminder of simplified advance calculation



c - Calculating the decline in torque due to the advance

Value in % of decline = [Stationary torque correction + catalytic converter priming correction] limited in variation +

[corrections "depending on driving pleasure"] + [decline due to knock].

Decline due to knock = from cartographic map the inputs of which are:

- engine speed,
- sum of advance retards from all cylinders linked to knock correction and preventative correction +:

[Max. allowable advance - Downgraded advance] x 6 cylinders]

provided calculated "downgraded advance" > calculated "max allowable advance"

d - Calculating passive losses

The sum of the losses due to friction and the losses due to the absorption of power by an engaged air conditioning compressor are added.

- Losses due to friction

  These are evaluated using an engine speed/time cartographic map; a table f (coolant T°) is used to add a correction representing the effect of engine temperature on friction.

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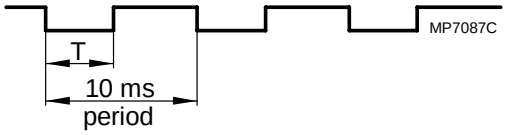
- Torque absorbed by air conditioning compressor

  The fixed value of torque absorbed by the compressor is used to which is added the torque absorbed due to the engaging. This comes from an engine speed/air temperature cartographic map (variable displacement pump) or from a table f (N) only (fixed displacement compressor), and is then filtered so that it decreases down to zero as a function of a calibrated time constant.

Note: It can be seen that logically, the torque reduction requested by the automatic transmission is not taken into account.

2 - Engine torque signal



The period, which is constant, is set at 10 ms.

The time T represents the engine torque.

If N < 500 rpm → T is a function of coolant temperature.

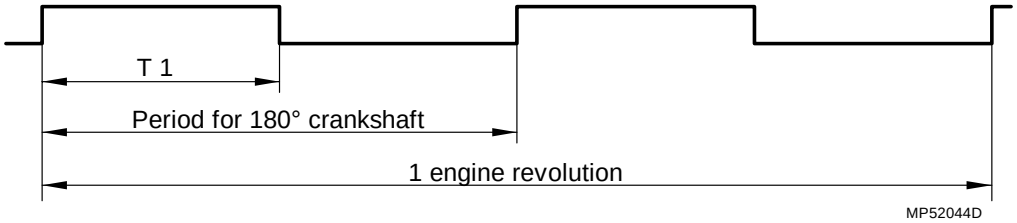
If N > 500 rpm → T = calibrated time to + time t1 f(calculated engine torque).

Note: The engine torque is updated every 20 ms.

C - REV COUNTER SIGNAL GENERATED BY THE MP7.0 EMC

The MP7.0 ECU measures the frequency at which the tooth signals pass under the engine speed/position sensor and from this deduces the engine speed.

Engine speed signal



$$T1 \text{ (in ms)} = \frac{\text{Period}}{2} = \frac{1}{4} \text{x} \frac{60 \text{x} 1000}{N} \text{ms}$$

When stationary: the signal is at state 1.

Engine running: The signal switches every 15 teeth (90° crankshaft).

The lower level is less than 1.5 V.

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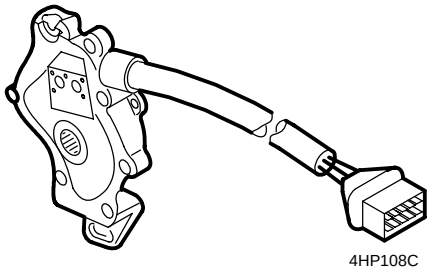
VI - SELECTOR LEVER POSITION INFORMATION

This information is supplied to the ECU by the multifunction switch located on the transmission. It is fitted on the selector shaft which operates the manual valve of the hydraulic unit.



4HP108C

It is used for:

- managing imposed gears,
- displaying the lever position on the control panel,
- preventing the engine from being started in a position other than P and N,
- illuminating the reversing lights in position R.

Note: The multifunction switch cannot be adjusted.

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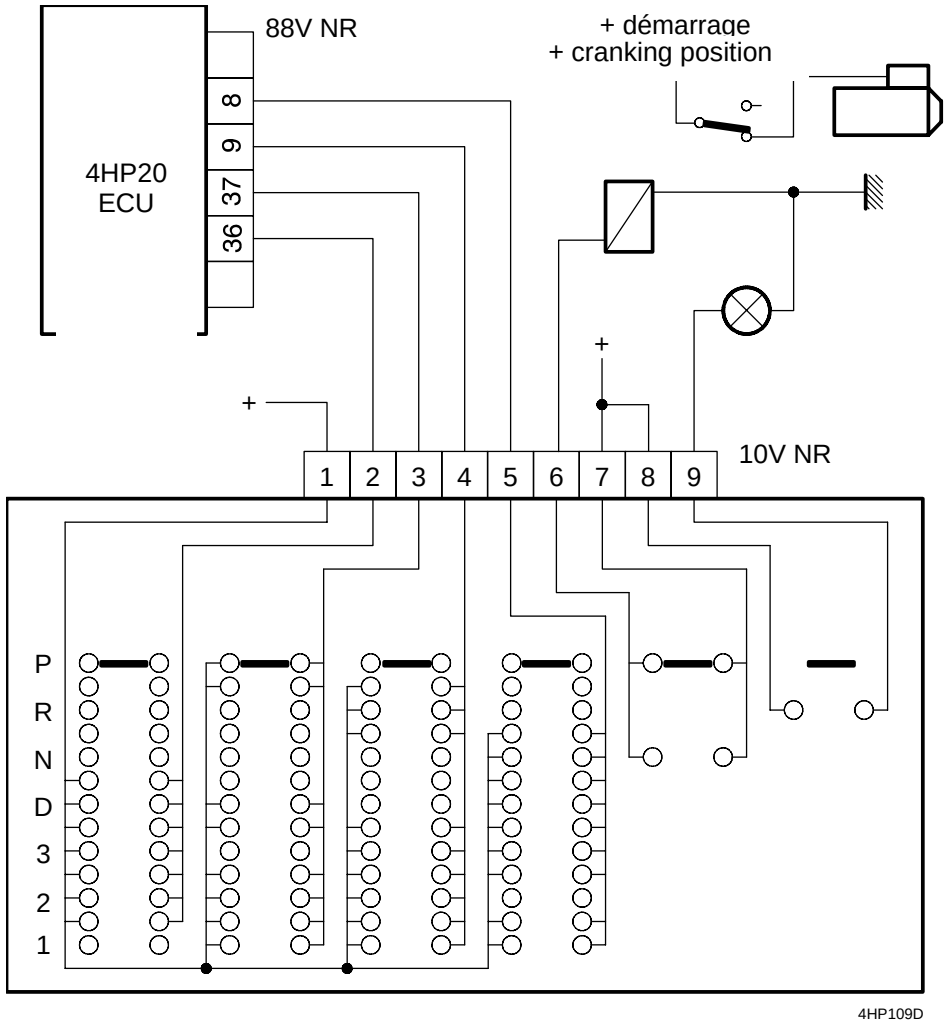
Operating principle:

- Position P:



In this position, the multifunction switch allows the engine to be started via terminal 6 by operating the starting safety relay.

It informs the automatic transmission ECU of its position via terminal 3 for the display on the control panel.

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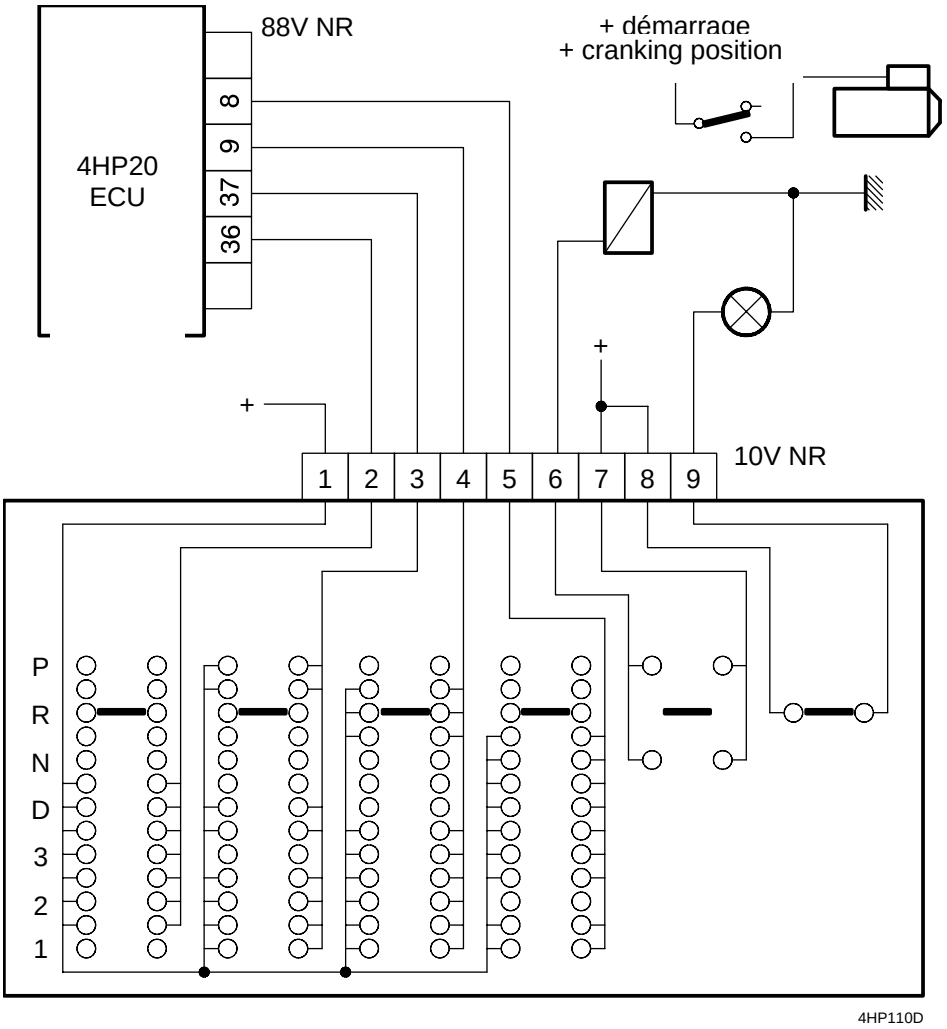
- Position R:



In this position, the multifunction switch causes the reversing lights to be illuminated via terminal 9.

It informs the automatic transmission ECU of its position via terminal 4 for the display on the control panel.

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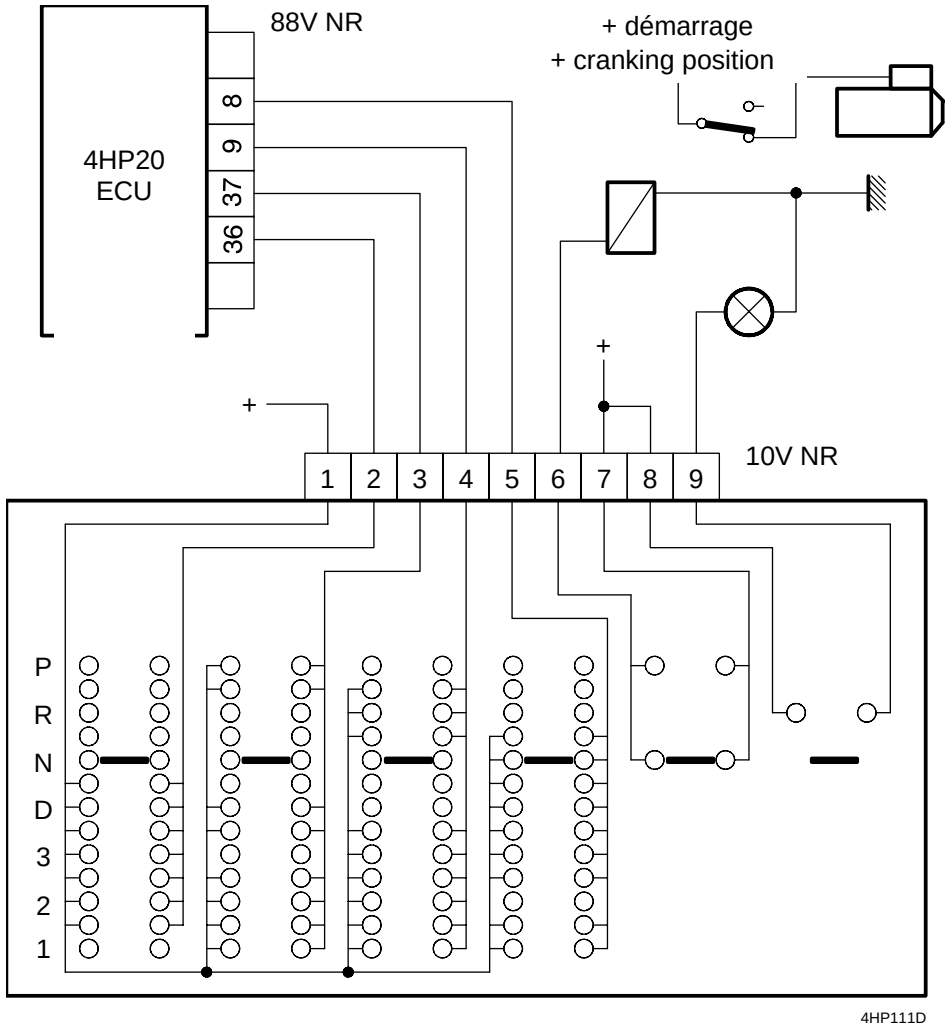
- Position N:



In this position, the multifunction switch allows the engine to be started via terminal 6 by operating the starting safety relay.

It informs the automatic transmission ECU of its position via terminal 5 for the display on the control panel.

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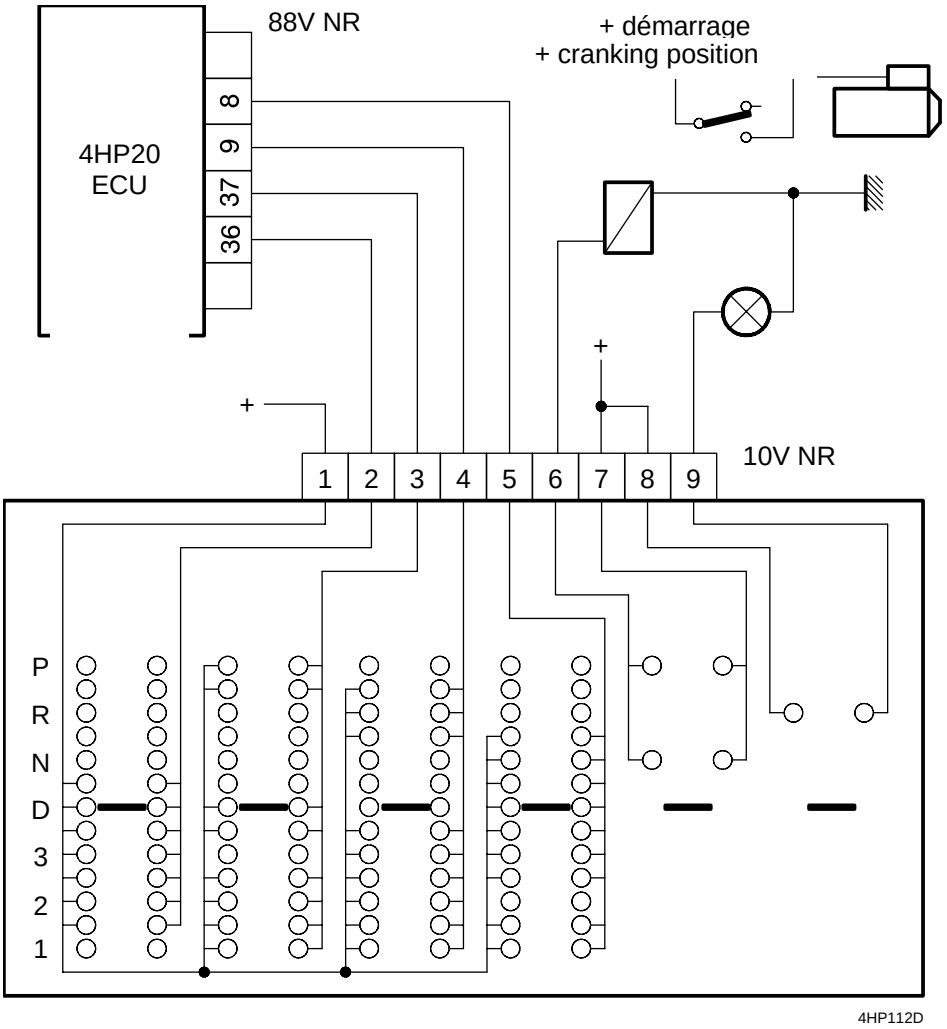
- Position D:



The multifunction switch informs the automatic transmission ECU of its position via terminals 2, 3 and 5 for the display on the control panel.

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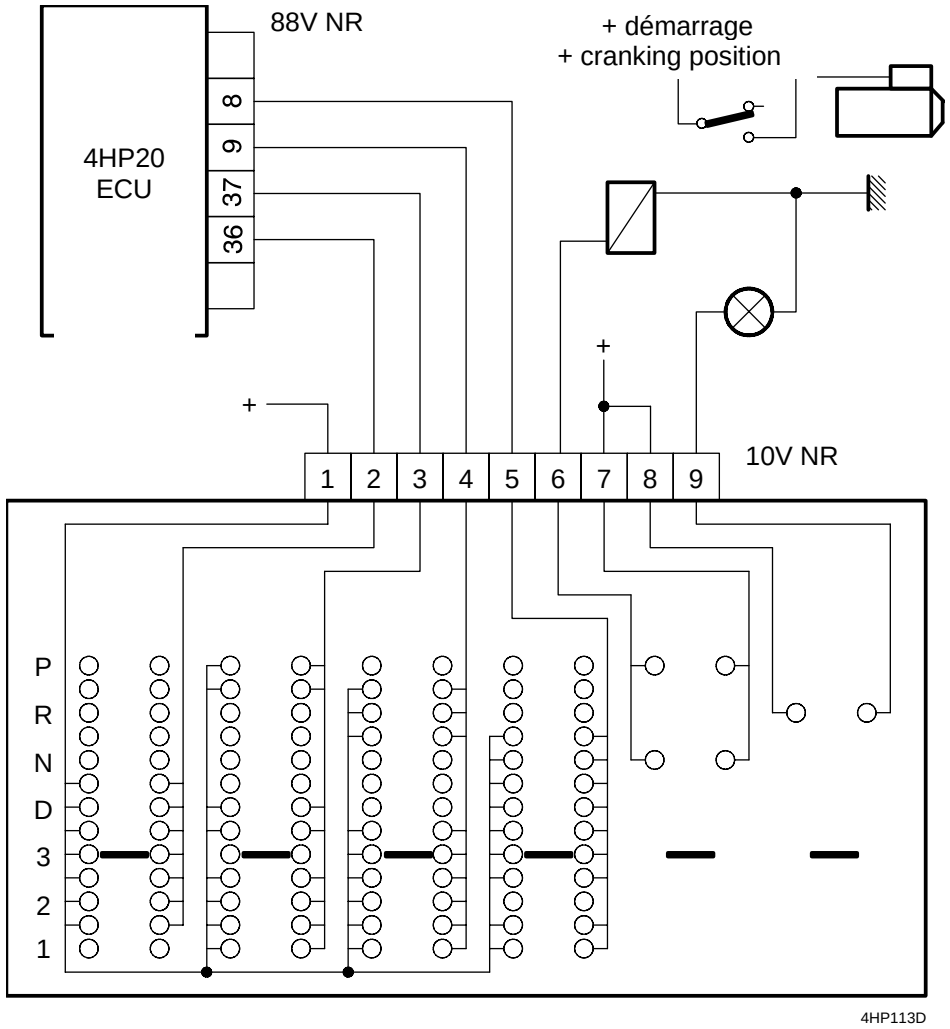
- Position 3:



The multifunction switch informs the automatic transmission ECU of its position via terminals 2, 4 and 5 for the display on the control panel.

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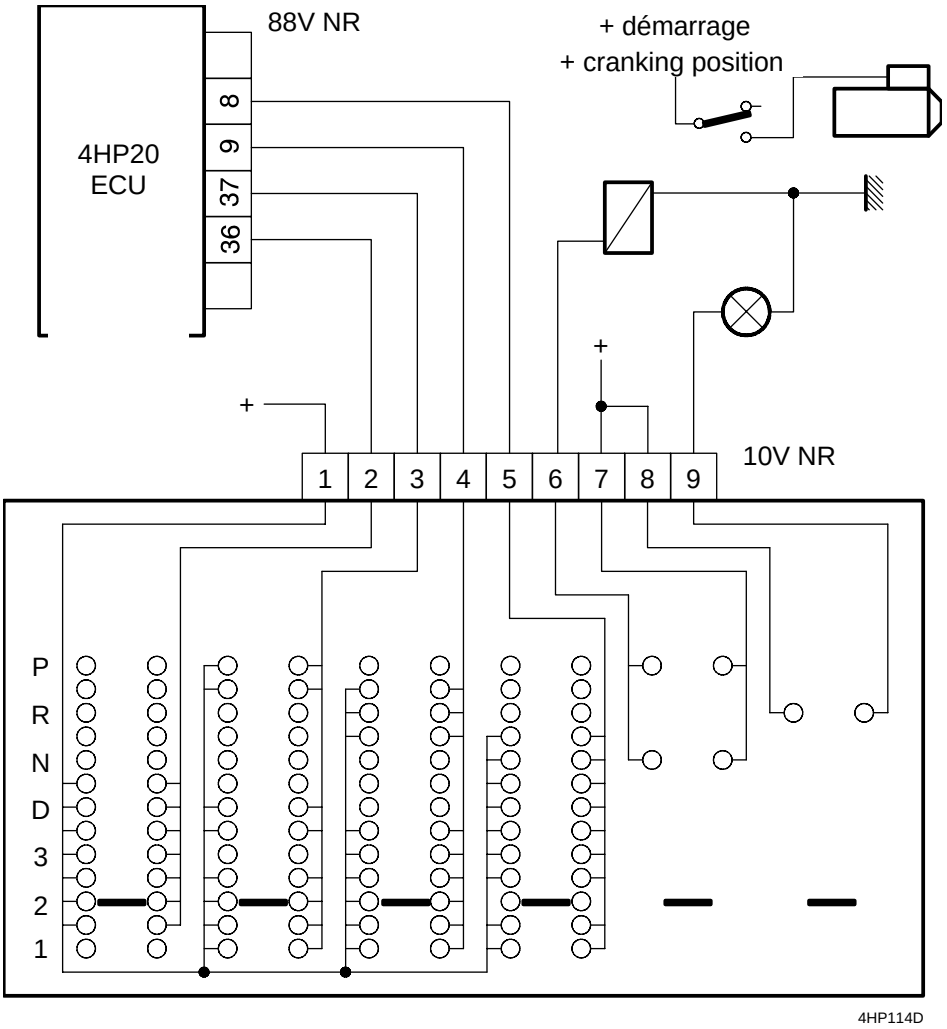
- Position 2:



The multifunction switch informs the automatic transmission ECU of its position via terminals 2, 3 and 4 for the display on the control panel.

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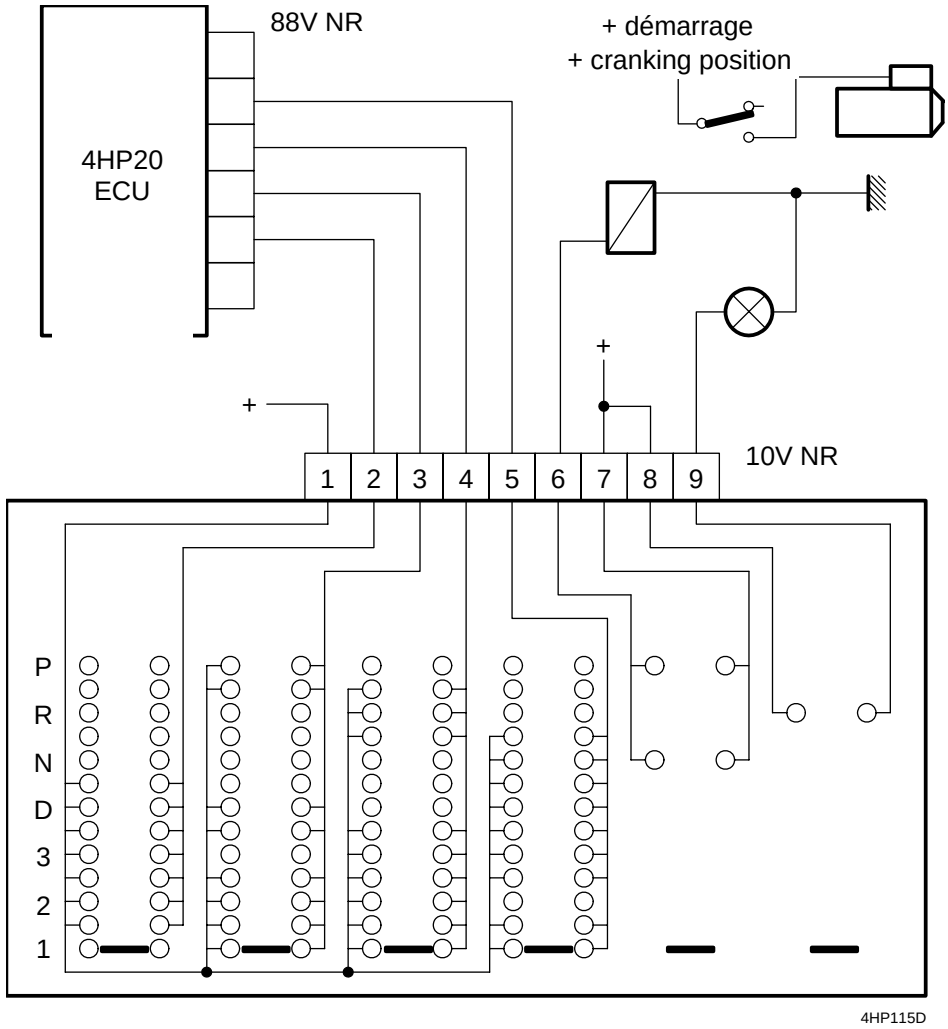
- Position 1:



The multifunction switch informs the automatic transmission ECU of its position via terminals 3, 4 and 5 for the display on the control panel.

Note: The multifunction switch contains intermediate tracks allowing the warning light on the control panel to flash in the intermediate lever positions (especially between position P and D).

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INFORMATION REQUIRED FOR OPERATION

INFORMATION		FUNCTION													
TYPE	SOURCE	Line pressure control	Gear changing decision	Gear changing management	Operating mode	Converter lock/slip	Autoadaptiveness	Torque reduction	Engine anti-stall	Idle speed regulation	Catalytic converter reheating	Engine protection	Safety of people	Transmission protection	Control panel display
Selector lever position	Multifunction switch PRND321		*				*	*		*	*		*	*	*
+/-	Switches		*												*
Set of strategies selected	ECO switch (NORMAL) SPORT SNOW		*		*	*	*								*
Throttle position	Engine ECU or potentiometer		*	*			*	*							
Kickdown request	Throttle position		*				*								
Braking	Stop switch		*		*		*		*				*		
Engine speed	Engine ECU	*			*	*	*	*	*			*		*	
Transmission input speed	Inductive sensor	*		*		*	*	*	*						
Transmission output speed	Inductive sensor		*			*	*					*	*	*	
Engine torque	Engine ECU or injector signal	*		*	*		*	*						*	
Transmission oil temperature	Thermistor	*	*	*	*	*	*	*			*			*	*

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ZF 4HP20 AUTOMATIC TRANSMISSION

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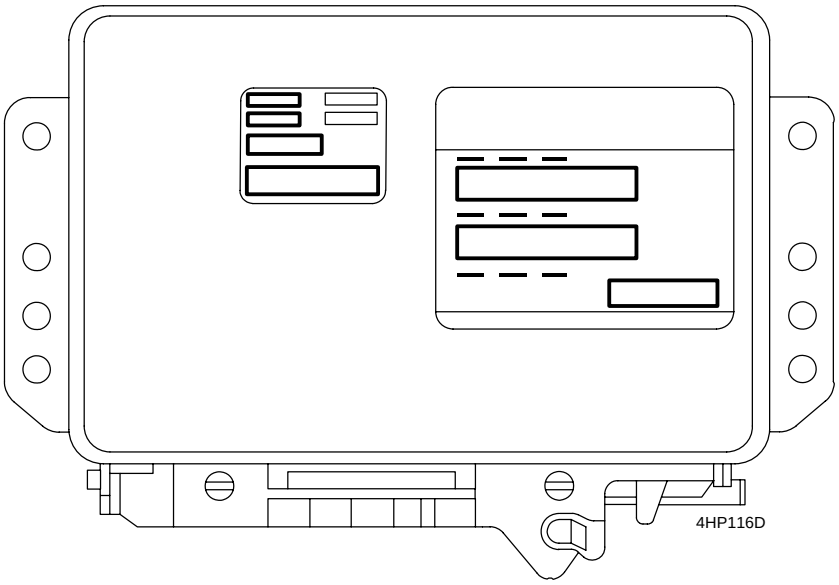
THE ECU

On the CITROËN XANTIA, the ECU is located in the engine compartment under the battery. The ECU inputs and outputs are performed by means of an 88 track connector.



The automatic transmission ECU using "FLASH EPROM" technology.

This new technology means that the ECU can be updated without it having to be removed in the event of a software upgrade (in order to solve a driving pleasure problem for example).

In effect, instead of replacing the ECU or the Eprom, the operation consists of "downloading" the ECU program into its memory from a suitable after-sales tool via the diagnostic socket.

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I - ECU FUNCTIONS

The ECU performs the following functions.

A - GEAR CHANGING LAWS

The ECU has 10 gear changing laws which are used to adjust the transmission operation to the driver's driving style, to the chosen program and to internal and external conditions.

The following laws are therefore obtained:

- 6 laws: for auto-adaptivity,
- 1 law: for the snow program,
- 1 law: for depollution when cold (reheating),
- 2 laws: for temperature protection of the automatic transmission

B - PROGRAMS

The ECU manages 3 programs: auto-adaptive, sport and snow (upon driver's request).

C - AUTO-ADAPTIVITY

The ECU has an auto-adaptive program which it modifies in real time throughout the vehicle's life, adapting itself to its internal and external environment.

The ECU works in a closed loop permanently checking that its commands have been carried out whilst adapting itself to them.

The ECU therefore adapts itself to:

- the driver by memorising his driving style (sporty driving, economic driving...),
- the vehicle (empty, laden, towing, kickdown...),

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- external conditions (going up or down a hill, low adherence, town..),
- the transmission (changing up or down gears, towing, kickdown temperature, oil degradation, mechanical wear of parts...),
- the engine (engine torque, speed, temperature...).

D - GEAR CHANGE UP PREVENTION DUE TO SUDDEN REMOVAL OF FOOT FROM ACCELERATOR

This function prevents the transmission from changing up to a higher gear when the foot is suddenly removed from the accelerator pedal; this allows the engine brake to be maintained whilst decelerating.

E - TORQUE REDUCTION

This function is used to increase driving pleasure by reducing the engine torque when changing gear.

This action consists of momentarily reducing the timing advance in accordance with a pre-programmed table.

F - IDLE SPEED COMPENSATION

This function is used to attenuate the dragging effect of the transmission when it is being driven through the engine management computer (idle reference speed).

G - CHANGE DOWN

The ECU is totally responsible for changing down the gears as a function of engine load, vehicle speed and driving conditions.

In particular, the ECU authorises a double change down (from 4th to 2nd and 3rd to 1st) and may force a single change down to increase engine braking (braking, going down hill...).

H - MANAGEMENT OF IMPOSED GEARS

The ECU is totally responsible for changing imposed gears in terms of operating and safety (changing limits).

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I - KICKDOWN (K.D)

The kickdown function is given by the automatic transmission ECU following a switch to the full load position (load greater than 95%) and as a function of engine speed.

Warning: thick carpets may reduce accelerator pedal travel.

J - CONVERTER OPERATION

This function is used to optimise the operation of the converter by locking it to save fuel, by controlling it to filter out engine acyclisms or so as to permanently work out the engine torque increase value.

K - ADAPTATION OF THE GEAR CHANGING PRESSURE

The ECU alters the gear changing pressure (pressure on clutches and on brakes) as a function of various parameters (engine torque, gear changing times, internal clearance and wear...).

L - CONTROL PANEL DISPLAY

The ECU informs the driver of the position of the selector lever and the choice of program using the liquid crystal display on the control panel (on CITROËN XM and remodelled XANTIA).

The ECU may also warn the driver of a transmission problem by flashing the sport and snow display.

M - SAFETY - DIAGNOSTICS

The ECU permanently checks its supplies and that its sensors and actuators are working correctly. The ECU also has downgraded modes which ensure the safety of the mechanical components when a problem occurs in one or several of the system's components.

N - UPGRADES

The ECU can be updated by downloading.

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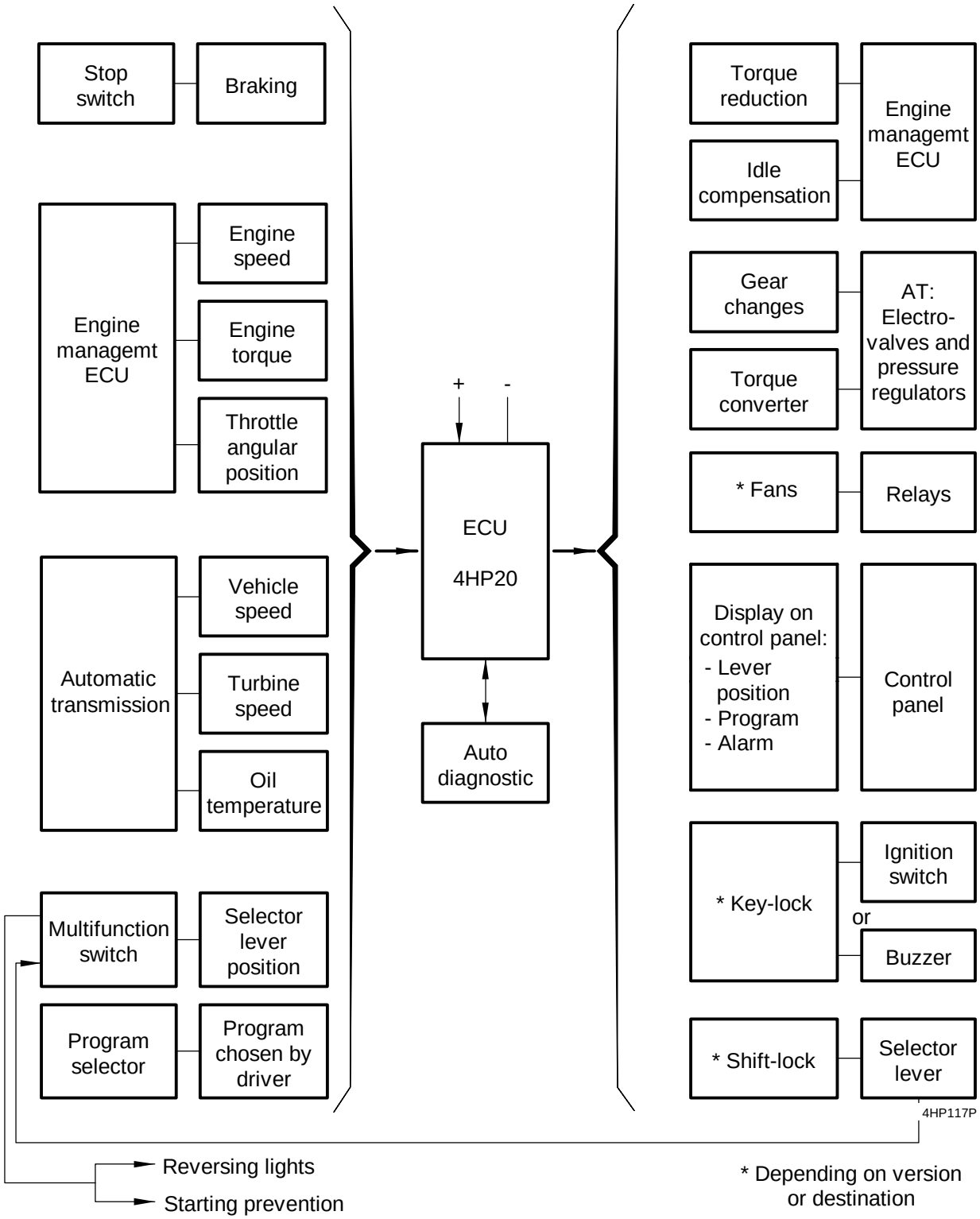
II - INPUTS/OUTPUTS



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III - CONNECTIONS

1 - Control through negative of proportional electrovalve EDS4
3 - +12V supply for proportional electrovalves
4 - Control through negative of proportional electrovalve EDS6
5 - Control through negative of proportional electrovalve EDS3
6 - Power earth
8 - Selector lever position + information (multifunction switch)
9 - Selector lever position + information (multifunction switch)
10 - "Foot on brake pedal" + information (brake switch)
12 - "Snow" program selection - information (program button)
14 - Transmission output speed - information (transmission output speed sensor)
15 - Transmission output speed sensor screening
16 - turbine speed + information (turbine speed or transmission input speed sensor)
20 - - output signal for fan operation request
21 - Analogue earth for transmission oil temperature sensor
22 - Transmission oil temperature + information
23 - Turbine speed sensor screening
25 - Output for display (depending on vehicle)
28 - Earth for electrovalves
29 - Control through negative of proportional electrovalve EDS5
30 - Control through negative of all or nothing electrovalve MV1
31 - + 12V ignition on supply
32 - Control through negative of "Shift-lock" relay
33 - Control through negative of fixed electrovalve MV2
34 - Power earth
36 - Selector lever position + information (multifunction switch)
37 - Selector lever position + information (multifunction switch)
38 - Throttle α information from EMC
39 - Load information (engine torque) from EMC
40 - Rev counter information
42 - Transmission output speed + information (transmission output speed sensor)
44 - Turbine speed - information (transmission input speed sensor)
45 - "Sport" program selection - information (program button)
47 - L diagnostic line (not used)
49 - Key-lock control (depending on country)
50 - K diagnostic line
51 - Automatic transmission position / torque reduction request (to EMC)
52 - + 12V supply for fixed electrovalves MV1 and MV2
54 - + 12V ignition on supply
55 - Permanent battery + for saving autodiagnostic memory

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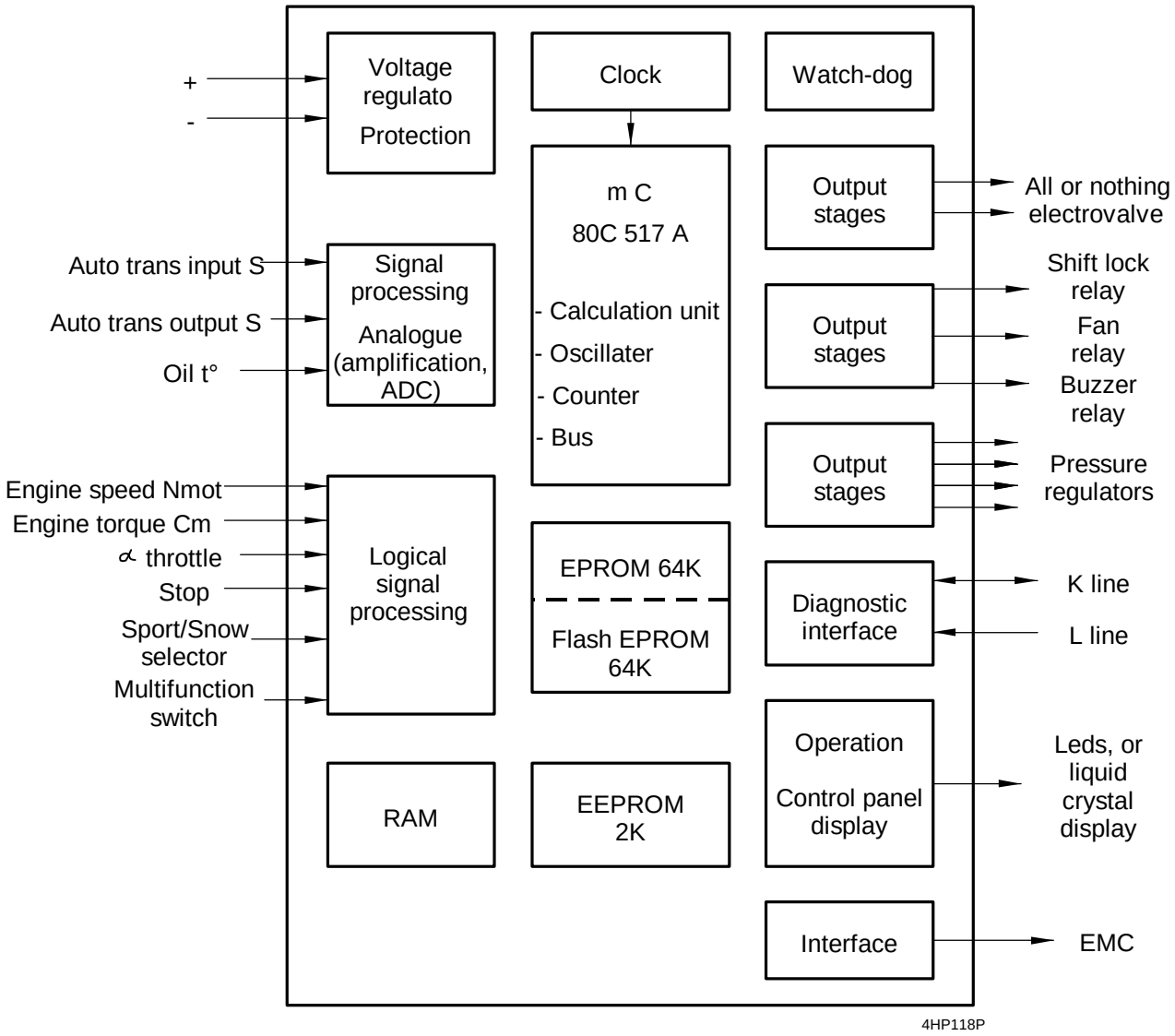
IV - ECU ARCHITECTURE



RAM: Memory for intermediate calculations and for storing data learnt.

EEPROM: This contains: - all learnt data (autoadaptives)

- faults

EPROM: This contains the operating program, the strategies, the laws (characteristic curves), fault detection parameters.

Note: All data learnt whilst driving for the autoadaptation is stored in the RAM then transferred to the EEPROM when the ignition is switched off during a power latch phase (≈20 seconds). When the ignition is switched on, it returns to the RAM.

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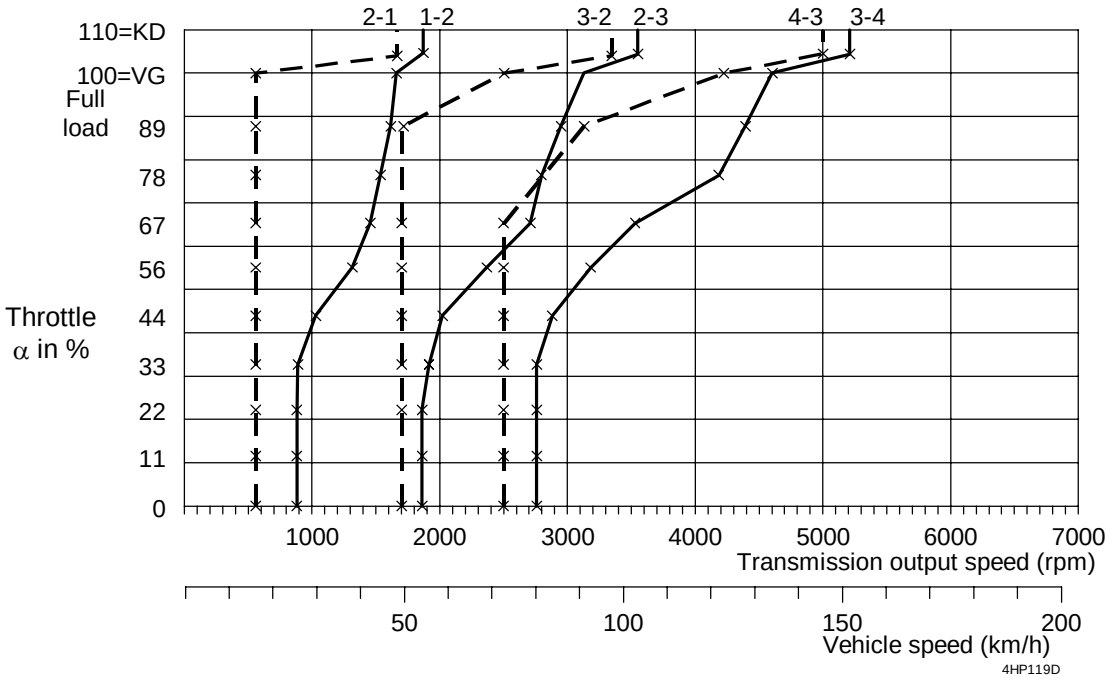
THE STRATEGIES

I - GEAR CHANGING LAWS

The vehicle's operating point is defined by two parameters: "throttle position" (driver's wishes) and "vehicle speed".
During automatic operation, the decision to change from one gear to another is taken from a set of curves f (throttle α; $S_{transmission\ output}$) which form the "gear changing laws".

Example of gear changing laws



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A - NOTES

- A set of gear changing laws - we will see later on that there are several of these - offers all available forward gears if the driver has selected position "D". It defines the changing points and the gears to be changed.

- Two main criteria are used when defining a set of gear changing laws:
  - selection of the gear in which the most economical fuel consumption is achieved with respect to the resistance to forward movement (gear changing points are fairly low),
  - selection of the gear allowing maximum power possible to be accessed.

A set of laws is generally designed in accordance with one of these two criteria although a compromise is always sought.

Furthermore, it is desirable for the maximum possible instantaneous vehicle power to be available at any moment; thus, it should be possible to push the respective gear up to the maximum authorised engine speed before the transmission changes to another gear.

- Gear changing curves are different when changing up and when changing down. In effect, if a gear were to be changed at the same speed when changing up and changing down, a slight variation in throttle position would cause repeated gear changes which is called the "pumping effect".

- The intervals between gear changes are defined so that the next gear is changed to without any significant modification in traction force.

- The set of curves allows the transmission to change down two gears in one step.

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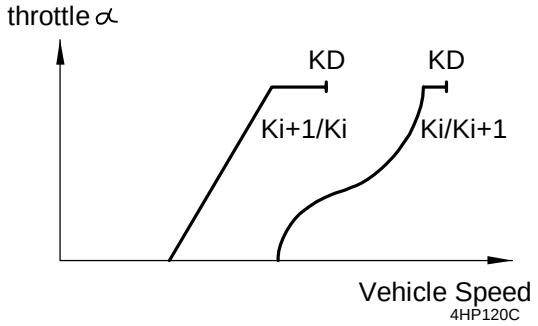
B - INTERPRETING THE CURVES

1/2, 2/3 and 3/4 laws: the corresponding gear changes occur when the operating point curve crosses from the left (increasing vehicle speed) and if the vehicle is not already in second gear for the 1/2 law, in third gear for the 2/3 law or in fourth gear for the 3/4 law.

4/3, 3/2 and 2/1 laws: the corresponding gear changes occur when the operating point curve crosses them from the right (decreasing vehicle speed) and if the vehicle is not already in third gear for the 4/3 law, in second gear for the 3/2 law or in first gear for the 2/1 law.

C - KICK-DOWN FUNCTION



Under certain vehicle speed conditions, this function allows the upper gear changing limit to be reduced or for a lower gear to be changed to earlier.

To do this, the ECU has to receive the "kick down" load information.

When this information is present, the ECU offsets the gear changing limits, in other words the gear changing laws are replaced by six vehicle speed reference values called "kick down points".

In our application, the "kick down" points correspond in theory to maximum gear changing law points. In reality, the "kick down" information is effective for a throttle opening of more than 95% of the electrical travel of the potentiometer.

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II - HOLD COMMAND

Automatic operation is maintained but the range of authorised gears may be limited by the selector lever.

For a selected range, it is not possible to change to a higher gear outside the range. However, changes to lower gears occur automatically as soon as a changing limit is crossed.

All gear changing management functions remain active.

Operating range 1:

Function identification: selector lever in position 1, program E or S. Range: 1st gear.

Changes to higher gears are locked and change downs to this range (4-3, 3-2, 2-1) occur as soon as the lower engine speed limit has been crossed.

Operating range 2:

Function identification: selector lever in position 2, program E or S. Range: 1st or 2nd gear.

Changes to higher gears are locked and change downs to this range (4-3, 3-2) occur as soon as the lower engine speed limit has been crossed.

Changes from 1st gear to 2nd gear and change downs from 2nd gear to 1st gear correspond to the characteristic curves of the gear changes in normal mode, depending on the position of the program switch.

Operating range 3:

Function identification: selector lever in position 3, program E or S. Range: 1st, 2nd and 3rd gear

Changes from 3rd gear to 4th gear are locked, change downs from 4th gear to 3rd gear occur as soon as the corresponding lower engine speed limit has been crossed.

Changes from 1st gear to 2nd gear and from 2nd gear to 3rd gear as well as change downs from 3rd gear to 2nd gear and from 2nd gear to 1st gear correspond to the characteristic curves of the gear changes in normal mode, depending on the position of the program switch.

Case of reverse gear

Selector lever in position R, reverse gear will not be engaged until the vehicle speed is below a certain limit.

Changing limit (order of size)

The ECU prevents the following gears from being selected above certain speeds:

- reverse gear - 10 km/h,
- 3rd hold - 165 km/h,
- 2nd hold - 110 km/h,
- 1st hold - 60 km/h.

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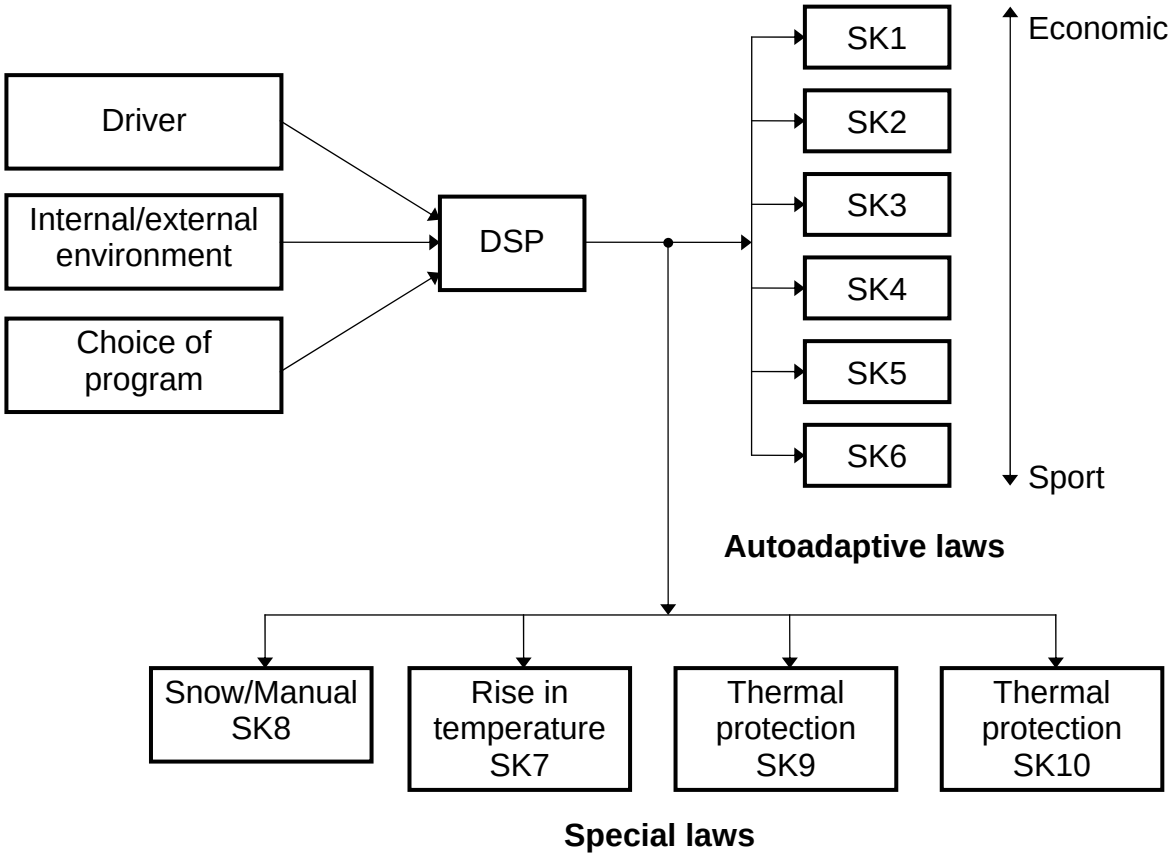
III - PROGRAMS AND VARIOUS LAWS



DSP = Dynamisches schalt programm (autoadaptive gear changing program)
SK = Schalt kenn linie (characteristic gear changing curve)
The ECU has ten sets of gear changing laws and chooses the most suitable one depending on:

- the driver → his driving style,
- internal and external conditions,
- the program selected by the driver.

A switch allows the driver to select the following programs:

- automatic or economic or normal,
- sport,
- snow (and manual)

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- **Normal program:**

  The ECU has 6 sets of gear changing laws, from the most economic to the most sporty. The ECU chooses the set of laws which, at a given moment, are most suited to the driver's driving style and to the surrounding conditions (road profile for example).

  The ECU systematically applies the normal program every time the ignition is switched on.

  Furthermore, the normal program starts:

  – when warm → on the set of laws memorised when the engine was switched off,

  – when cold → on set of laws SK2.

- **Sport program**

  The ECU only uses the most "sporty" sets of laws (SK5, SK6), and the criteria for changing to the immediately less "sporty" set of laws are less severe.

- **Snow program**

  – Selector lever in position D → The ECU adopts a specific set of laws and the engine is systematically started in 3rd gear as 1st and 2nd gear are prohibited. Also there is:

    . no kickdown nor double change down,

    . forced change down when going downhill,

    . forced change down when brake pedal operated.

  Both these functions are specially adjusted in this instance (snow program).

  – Selector lever in manual positions → only the gear corresponding to the position of the selector lever is possible;

    . position 3 → 3rd only ⎫
    . position 2 → 2nd only ⎬ This is the manual mode offered by the "snow" program
    . position 1 → 1st only ⎭

  Naturally, the engine overspeed safety (changing limits) cuts in when the lever is moved to an imposed position (3, 2 or 1).

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- Special sets of laws:
  - Temperature rise laws: this cartographic map is designed to help the engine warm up and therefore to make the catalytic converter heat up quicker. For this, gear changing points are reduced.

    It is applied in the following conditions:

    For 130 seconds after the engine has been started (rev counter information) when the transmission temperature is less than 30°C.

    . Transmission temperature protection laws:

    The ECU has two cartographic maps which result in an increase in engine speed:

    - cartographic map N°1 if transmission temp. > 120°C,
    - cartographic map N°2 if transmission temp. > 118°C and town type driving.

Note: Temperature protection also effects the operation of the lock-up (reduction and even removal of slip)

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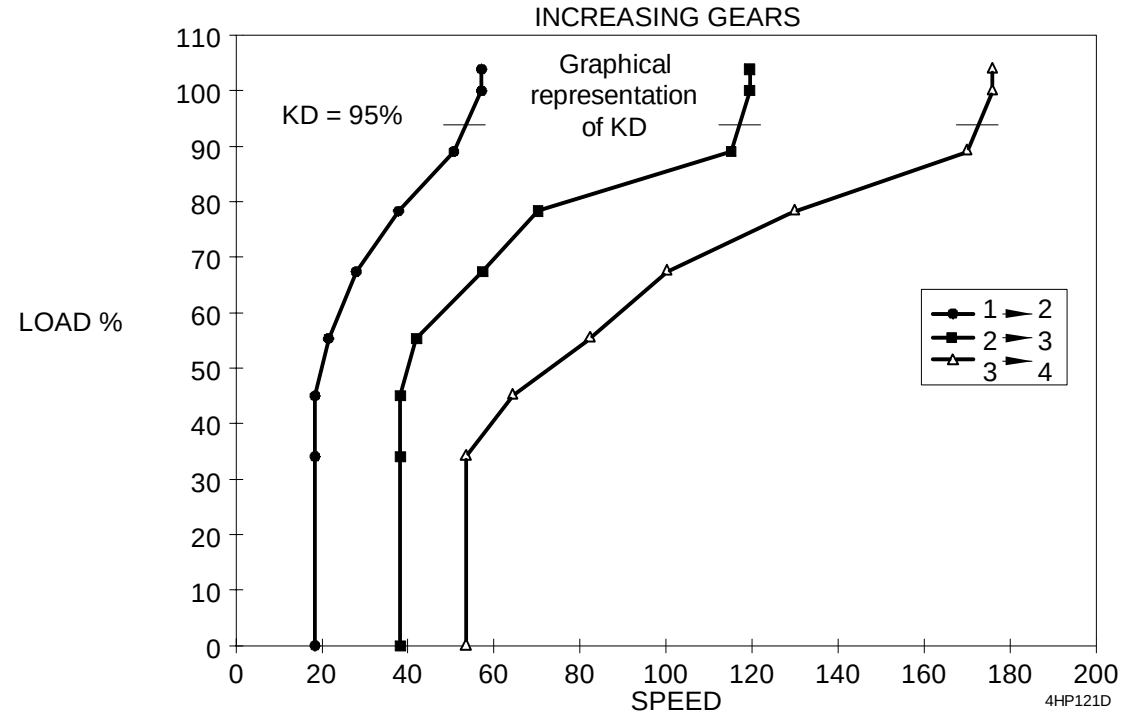
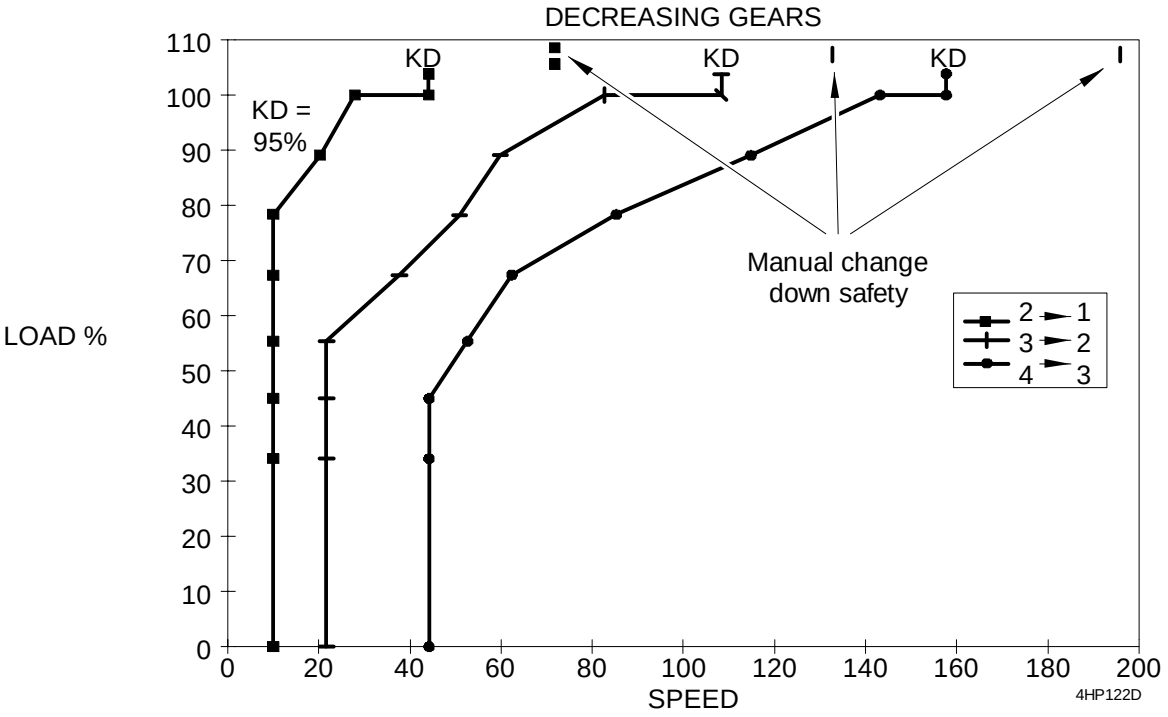
Examples of changing laws

SK2 laws





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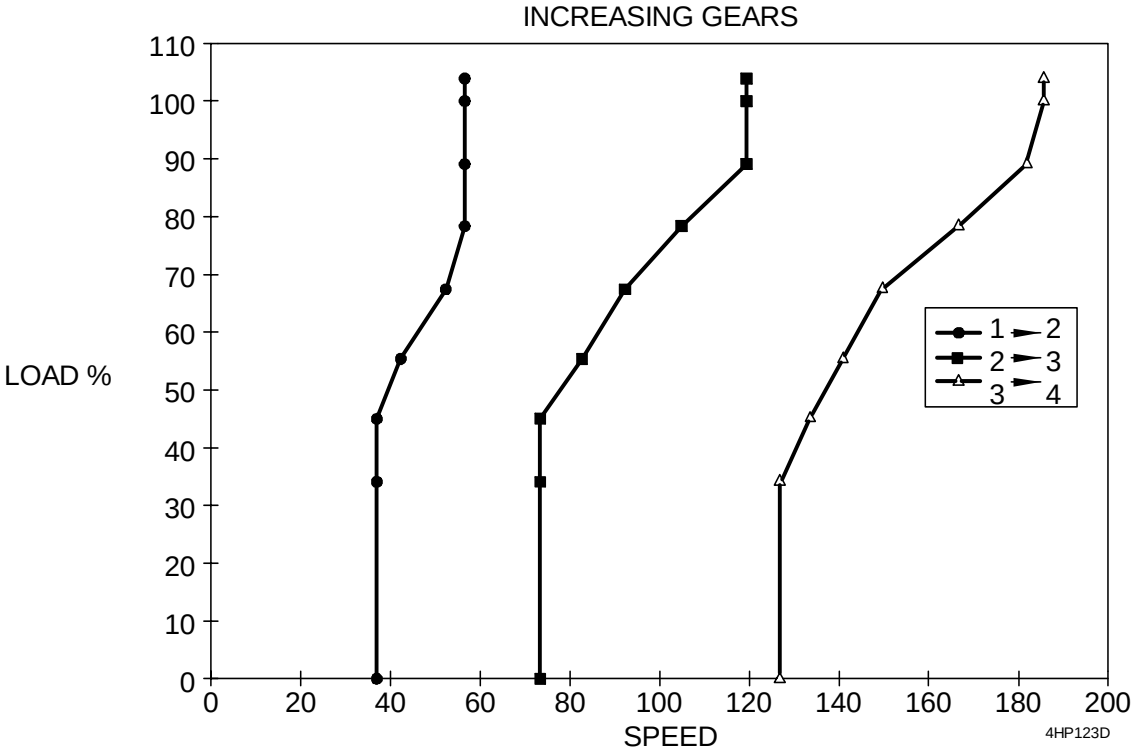
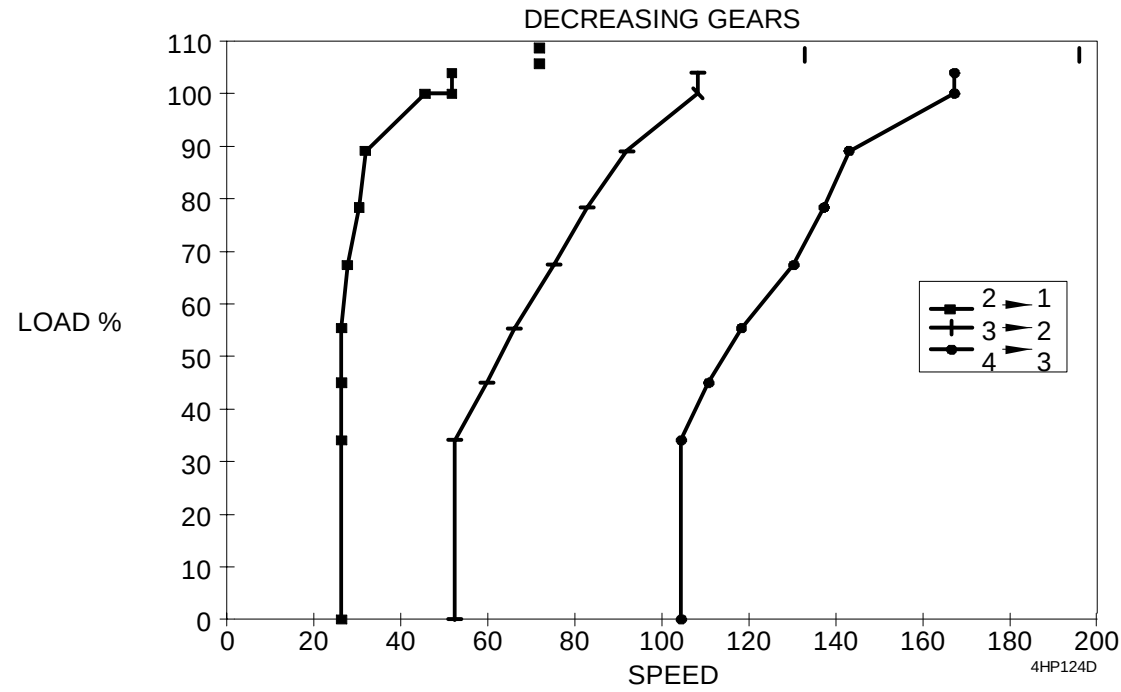
SK5 laws





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IV - DSP FUNCTION (AUTOADAPTIVE CHANGING LAWS)

A - INTRODUCTION

This function allows the ECU to alter the gear changing points automatically as a function of:

- the driver's wishes,
- the driver's style of driving (sporty or fuel economy),
- the vehicle load conditions (recognition of the increase in resistance to movement),
- the road profile (flat, mountain).

The last three parameters are represented by a modulation factor calculated as a function of all the variables the ECU has. The ECU can then choose the most suitable set of gear changing laws from the six it has in its memory. The gear changing points therefore change in real time.

1 - Adaptivity to load (increase gear)

The ECU can recognise an increase in the resistance to movement with respect to the vehicle's normal behaviour on flat road. Gears are therefore changed up slightly later in order to maintain sufficient torque at the wheel. Consequently, the frequency at which the gears are changed is reduced.

2 - Adaptivity to driver

The ECU can recognise the driver's actions so as to work out his style of driving and the traffic conditions (traffic jams for example).

The variables used are the following:

- accelerator position (throttle opening),
- speed at which accelerator is acted upon ($\frac{\Delta \alpha}{\Delta t} \rightarrow$ derivative)
- variation in the transmission output speed.

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3 - Specific case: going downhill and braking

The ECU can anticipate changing down a gear in the following case:

- positive acceleration of the vehicle in the no load position and,
- action on the brake pedal.

It therefore anticipates changing down a gear after the brake pedal has been acted up for:

- 2 seconds on horizontal ground,
- 1 second when going downhill,
- 0.5 seconds in the "snow" program.

4 - Other functions

- Prevention from changing up a gear (locking of 2nd or 3rd gears) after the foot has suddenly been removed from the accelerator.
- Forced gear change down for prolonged braking (case of going downhill).

B - ADAPTIVE FUNCTION

1 - Parameters used

- Position of gas throttle $\rightarrow \alpha$/idle speed in x%.

The automatic transmission ECU receives the instantaneous position of the throttle α from the EMC, which corresponds to volts.

When the ignition is switched on, the ECU reads the position of the throttle α at idle speed. Then, it works out a throttle opening angle with respect to α (idle speed) where α/idle speed = α (instantaneous) - α (idle speed).

- Engine speed Nmot in rpm.
- Transmission output speed $\rightarrow$ Ns in rpm.
- Engine torque $\rightarrow$ Cm in mN.
- Transmission temperature $\rightarrow$ TAT in °C.
- "Braking" information $\rightarrow$ IBRAKE (0 or 1).
- "Pulling" or "deceleration" condition (0 or 1):

  The vehicle is said to be decelerating (i.e. when the vehicle is driving the engine) if α/idle speed < limit f (Nmot)

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The following parameters come from the previous ones:

- travelling speed → Vveh in km/h

  This value is calculated from the gear ratios, the step down and differential torque as well as the circumference of the wheel.

- Acceleration → A+ or A- in m/s² where $|A| = \frac{\Delta Ns}{\Delta t}$

- Output torque → Cs in mN.

  This value is calculated from the gear ratios, the engine torque Cm and the converter torque, since the ECU has the characteristic curve of the torque of this converter in its memory.

- Filtered throttle angle → α/filt.idle1; α/filt.idle2

- Throttle gradient → α/idle speed - GR = $\frac{\Delta \alpha / \text{idle speed}}{\Delta t}$

2 - Description of the function

The ECU permanently calculates a "sportivity index" SP where $0 \leq SP \leq 1$ which allows it to opt for one of the six sets of gear changing laws which it has where:

SP = 0 → not sporty at all

SP = 1 → maximum sportivity

a - Principle

Four sportivity indices SP1, SP2, SP3 and SP4 are calculated simultaneously and in parallel where $0 \leq SPx \leq 1$, which are deemed to represent the driving style from various points of view.

The sportivity index SP which allows the most suitable set of laws to be chosen is equal to: MAX [SP1, SP2, SP3, SP4].

Five programmed values define six ranges of SP between 0 and 1, since there are six sets of laws; the ECU opts for a set of laws lx as a function of the range in which the calculated SP falls.

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b - Processing parameters

α/idle speed is filtered $\Rightarrow$ α/filt.idle1 and α/idle.filt2

α/instantaneous filt.idle = α/previous filt.idle + K (α/instantaneous idle - α/previous filt. idle)

α/idle is received every 20 ms

$K \leq 1$ is the filtering coefficient where:

- K1 is used to obtain α/filt.idle1
- K2 is used to obtain α/filt.idle2
- α/filt.idle2 is more filtered than α/filt.idle1 $\Rightarrow$ K2 < K1

Cs is also filtered using the same principle.

The acceleration A is calculated once a second and the average over its last three values is taken.

c - Working out sportivity indices Spx

- SP1 = f (α/filt.idle1, A+) $\rightarrow$ cartographic map of 10 x 6 control points. SP1 takes into account the relationship between the positive acceleration of the vehicle and the driver's wishes:
  - α/filt.idle1 is the input value,
  - A+ is the parameter.
- SP2 = f (Ns, α/filt.idle2) $\rightarrow$ cartographic map of 6 x 4 control points. SP2 is used to locate the operating point, to prevent unnecessary gear changes and to vary the set of gear changing laws when travelling downhill for a prolonged period:
  - Ns is the input value,
  - α/filt.idle2 is the parameter.
- SP3 = f (Ns, A) $\rightarrow$ cartographic map of 6 x 11 control points. SP3 takes into account the relationship between the acceleration and the travelling speed:
  - Ns is the input value,
  - A is the parameter.

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- SP4 = f (Cs, Ns) $\rightarrow$ cartographic map of 9 x 9 control points:
  - the filtered value Cs is used as an input value,
  - the travelling speed is used as a parameter (vehicle speed Vveh) which is calculated directly from Ns $\Rightarrow$ SP4 is used to take the vehicle's load state into account.

    SP4 is only calculated in the following cases:

    - if - 0.810g $\leq$ A $\leq$ 0.0506 g

      and

    - if the oil temperature limit is moving. In effect, if the transmission temperature is less than + 50°C when starting the engine, SP4 is not included when working out the final SP and this condition lasts for a period of x seconds.

      This avoids falsifying the calculations since Cs depends on Cm where Cm was calculated from the basic injection time TB which is very high when starting. In reality, the timer is set to zero.

d - Working out the set of gear changing laws Skx

Reminder: SP = Max [SP1, SP2, SP3, SP4]; it is recalculated once a second then filtered:

SPinstantaneous filtered = SPprevious filtered + K [SPinstantaneous - SPprevious filtered] where K = filtering coefficient; its calibrated value varies depending on the direction in which SP is changing.

SPfiltered is the input value which is used to determine the set of laws lx applied at the moment in question.

SKx = f (SPfiltered); x = 1 to 6

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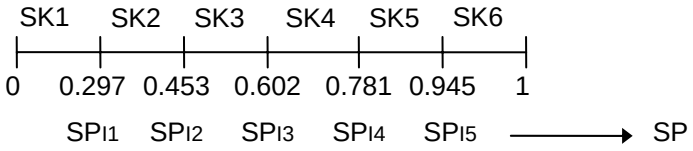
Each of the 6 gear changing laws SK1 ------ SK6 corresponds to an SP interval defined by 5 calibrated intermediate values SPI_1 -----SPI_5:



$0 \leq SPfiltered < SPI_1 \Rightarrow SK1$

$SPI_1 \leq SPfiltered < SPI_2 \Rightarrow SK2$

$SPI_2 \leq SPfiltered < SPI_3 \Rightarrow SK3$

$SPI_3 \leq SPfiltered < SPI_4 \Rightarrow SK4$

$SPI_4 \leq SPfiltered < SPI_5 \Rightarrow SK5$

$SPI_5 \leq SPfiltered \leq 1 \Rightarrow SK6$

The set of gear changing laws is updated every second.

SP is no longer updated when the travelling speed Vveh is less than 17 km/h. The current set of laws is maintained and the most recently calculated SP is stored in the EEPROM. This storage process is performed every 10 minutes.

Entering the DSP function after the starting phase

- If transmission temperature $\geq 50°C \rightarrow$ the last sportivity index SP stored in the EEPROM is used when the ECU is switched off $\rightarrow$ the first set of laws are therefore used again.
- If transmission temperature $< 50°C \rightarrow$ the set of laws SK2 are used until a temperature of 50°C is reached, with the aim of containing pollutant emissions.

e - Safety function

Aim

As the sportivity index SP is calculated permanently, the set of gear changing laws can be changed at any moment, including at stabilised engine speed (constant travelling speed, no α/idle speed activity). If this change in the set of laws is performed immediately, a gear change may occur. In some cases, this gear change must be prevented for safety and comfort reasons.

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Take an example:

A driver takes the motorway. Imagine that he drives down the slip road "nervously" and quickly returns to SK4. If he then finds himself behind a lorry without being able to overtake immediately, the transmission will change down a gear, changing into 3rd gear $\rightarrow$ the Vveh and α/idle speed information decrease; due to the filtering and the average calculated, these parameters decrease progressively although in the mean time the vehicle has stabilised itself. Their variation will possibly at the start still be included in the range corresponding to SK4 then will switch to the range corresponding to SK3, probably leading to 4th gear being selected $\rightarrow$ uncomfortable, safety compromised.

Description of the function

The function consists of replacing the set of gear changing laws used at a given moment with the set of laws which has just been calculated only if a defined "throttle activity" is detected, or else when a gear change (changing up, changing down, gear selection) has started.

"Throttle activity" definition:

Where: SP applied and SP theoretical

↳ SP calculated which should normally be taken into account

Whilst SPtheoretical = SPapplied, the position of the throttle α/idle speed is constantly copied into the memory $\rightarrow$ α/copied idle speed.

As soon as SPtheoretical differs from SPapplied, and therefore when a change in gear changing laws is requested, α/copied idle speed is blocked. The change to the requested set of laws is only applied when one of the following conditions is fulfilled:

- SPtheoretical > SPapplied and α/idle speed $\geq$ α/copied idle speed + 5.098% (increase in gear changing program, change down anticipated).
- SPtheoretical < SPapplied and α/idle speed < α/copied idle speed - 5.098% (decrease in gear changing program, change up anticipated).
- SPtheoretical > SPapplied and α/idle speed > 90.2%.
- SPtheoretical < SPapplied and α/idle speed < 10.2%.
- A gear change has started (changing up/down, gear selection).

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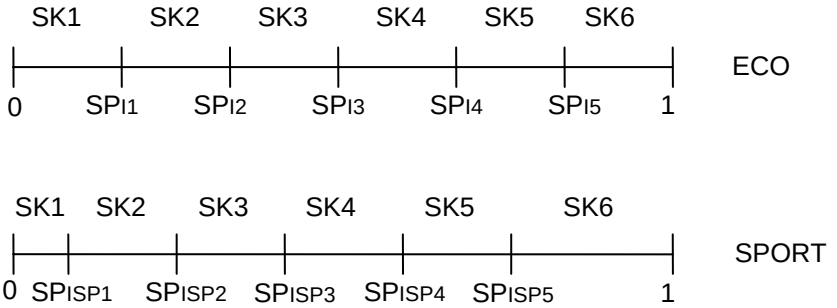
f - Case of "sport" program

The "sport" button is engaged; in this case, operation is still autoadaptive and the sportivity index is calculated normally. In theory, the solution is to use specific intermediate values of SP_I (SP_{ISP}) such that, for an SP calculated in the same way as for the ECO program, a higher set of gear changing laws is used (more sporty) - the sets of laws are the same as in ECO.



In our application, we have kept the same SP_I, but the minimum set of gear changing laws is imposed; this is SK5.

The driver therefore changes to SK6 when the calculated SP is between 0.945 (SP_{I5}) and 1, like for the ECO program.

g - Substitution program E-PROG

If the autoadaptive gear changing program (DSP) cannot be applied (one or several parameters not available for example), the ECU uses a specific emergency mode set of laws SK11.

h - Short duration function SESP

For information purposes - this is not active in our application.

Objective

If a great deal of power is required, a "more sporty" set of gear changing laws may be required for a short duration.

Description

This function is active when, for Ns > calibrated limit, $\frac{\Delta \alpha / \text{idle speed}}{\Delta t}$ > limit (calibrated positive value). In this case, the set of gear changing laws which is immediately higher is implemented. The gear corresponding to this new set of laws is then engaged.

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This function is quit either when a gear is changed up or when α/idle speed < calibrated limit. The set of gear changing laws determined by the calculation is then switched to, and the gear corresponding to this set of laws is engaged.

The calculation algorithm continues to work in the background whilst the SESP function is active.

C - SPECIFIC FUNCTIONS

1 - Recognition of vehicle going downhill

The vehicle is going downhill, if:

$$\left.\begin{array}{l} \alpha/\text{filt.idle2} < 9.804\% \\ \text{and } 33 \text{ km/h} < Ns < 109 \text{ km/h} \end{array}\right\} \Rightarrow \text{Downhill flag} = 1$$

2 - Gear change up prevention (HSV)

a - Aim

This function is used to prevent gears being changed up when not required when the accelerator pedal is released quickly.

It is active regardless of which set of gear changing laws is being used.

b - Description

The function is active if in "CHANGE DOWN "

and 0 > α/idle speed - GR > 133%/s.

When the function is active, no upward gear changes resulting from the instantaneous gear change law are authorised. However, gear changes down are allowed and the DSP adaptive calculation continues in the background. This function is deactivated when one of the following conditions is fulfilled:

* [vehicle pulling] and [α/idle speed > limit f (Nmot) = 8 to 80%] and [timer = 0.5 seconds elapsed]; the timer is started as soon as "vehicle pulling" and α/idle speed > limit.

* Vveh < 20 km/h

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* Vveh > limit f (gear engaged, downhill flag status, snow flag status)

  ↓ 0 or 1 ↓ 0 or 1

* Vveh > Vveho + Δ Veh where:

  Vveho = Vveh at the point where the 0.5 s timer is triggered

  Δ Vveh = f (gear ratio, downhill flag status, snow flag status) = 9.6 km/h in our application

When the function is deactivated, the gear is determined by the active set of laws → gear changes up are authorised.

3 - Forced gear changes down when braking (ZRS)

a - Aim

This function is used to anticipate gear changes down, so as to provide the engine brake and therefore save the brakes over a long downhill (slope). It may be active regardless of the set of gear changing laws used.

b - Description

The function is active if, for a duration the value of which depends on the status of the downhill flag, the brake pedal is applied (brake flag = 1) and the vehicle is "changing down".

When the function is active, independently to the active set of gear changing laws, a gear is changed down as soon as the safety conditions are satisfied (engaging safety limits) and when:

Vveh < limit f (gear engaged) = 30 km/h - 155 km/h
and, - 0.4 g < γ < 0. A gear will be changed down more easily when

$\gamma = \frac{\Delta Vveh}{\Delta t}$

travelling downhill.

For as long as the above conditions are fulfilled, all upward gear changes - based on the active set of laws - are forbidden.

Case of several gear changes down

After a forced gear change down, if the conditions are once again fulfilled, a second gear change down may be performed if a specific bit f (set of gear changing laws used, downhill flag) = 1.

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The function is stopped if one of the following conditions is fulfilled:

* Brake flag = 0

  and, α/idle speed > limit (calibrated value)

  and timer f ($Flag_{snow}$, $Flag_{downhill}$) has elapsed; this timer is triggered when $Flag_{brake}$ = 0 and α/idle speed > limit.

* Vveh < limit f (set of gear changing laws, $Flag_{snow}$)

* Vveh > limit f (gear engaged, $Flag_{downhill}$, $Flag_{snow}$)

* Vveh > Vveho + Δ Vveh f (gear engaged, $Flag_{downhill}$, $Flag_{snow}$)

  Vveho = Vveh at the instant when the timer described above is triggered.

When the function is stopped, the gear is once again worked out by the active set of gear changing laws.

Case where "gear change up prevention" is already active:

If the conditions of the ZRS function are fulfilled, a forced gear change down may be performed if the specific bit f (set of gear changing laws used, downhill flag) = 1.

4 - Temperature protection functions SKTEMP

These functions are available in the DSP (SK1 to SK6), sport and snow (SK8) programs.

a - Specific gear changing laws in the event of high temperature.

Aim

Two independent and specific sets of gear changing laws are used to encourage high engine speeds in order to ensure a sufficient flow through the radiators, or to limit converter slip if the allowable oil temperature in the transmission is exceeded.

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Description

* If $T°_{AT} > 120°C \rightarrow$ Set of laws SK9 activated

* If $T°_{AT} > 118°C$
and 6 km/h < Vveh < 32.5 km/h
and α/filt.idle2 < 20%
} Set of laws SK10 activated

SK9 contains a lock-up law containing the "open", "controlled" and "closed" states; this set of laws is not covered by the safety function, given its importance in terms of transmission protection.

SK10 is of "driving in town" type.

If $T°_{AT} < 117°C \rightarrow$ SK9 is no longer applied

If $T°_{AT} < 115°C \rightarrow$ SK10 is no longer applied

The DSP program is still calculated in the background when SK9 or SK10 is active.

b - Specific function of the lock-up in the event of high temperature

This function is used to prevent the lock-up from being in the "controlled" state when the oil temperature is high, in order to limit the temperature of the lock-up track.

If $T°_{AT} > 125°C \rightarrow$ change to a specific lock-up law which only contains the "open" and "closed" states.

There is a range for 2nd, 3rd and 4th gears.

In practice, the normal law is used replacing the "controlled" state with the "closed" state.

This function is available in the DSP (SK1 to SK6), sport, snow, SK9, SK10, and SK8 (warm up) programs.

This function is removed for $T°_{AT} < 2°C$.

c - Engine radiator fan control

The transmission temperature is to be lowered by lowering the temperature of the engine coolant.

The fan unit is engaged when $T°_{AT} > 200°C$. It is disengaged when $T°_{AT} < 197°C$.

This function is therefore not active.

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5 - Warm up function WARML

In order to limit pollutant emissions when the engine is warning up, the catalytic converter must quickly reach its operating temperature. To do this, the engine must rotate at relatively high engine speeds for a certain amount of time after starting. The solution consists of using a specific set of gear changing laws SK7 during this operating phase.

If, when starting the engine, (Nmot $\geq$ 576 rpm), 15°C < T°AT < 30°C, SK7 is applied for 132.6s.

PRIORITY OF FUNCTIONS

1 - E.PROG

2 - SKTEMP

3 - SESP

4 - WARML

5 - DSP

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V - ADAPTIVE REGULATION OF LINE PRESSURE

A - AUTOADAPTIVITY TO ENGINE TORQUE

The ECU alters the maximum value of line pressure depending on the turbine torque to be transmitted.

It therefore adjusts the line pressure:

- between 15.5 and 18 bar in 1st and reverse gears,
- between 5.5 and 8.8 bar in the other gears.

The ECU imposes a line pressure of 15.5 - 18 bar in the following cases
if:
- a gear is being changed,
- downgraded mode is operational (transmission is locked in 3rd hydraulic)

In stabilised mode, the ECU can switch the pressure from one value to another depending on the turbine torque:

- 5.5 - 8.8 bar for turbine torque $\leq$ 230 mN,
- 15.5 - 18 bar for turbine torque > 230 mN.

B - AUTOADAPTIVITY TO GEAR CHANGES

A gear is always changed to another in the same way: a clutch or a brake is emptied whilst another clutch or brake is being filled.

Furthermore, free wheels are not used in this transmission either for the following reasons:

- so as not to interrupt the transmission of movement,
- so as not to damage the internal mechanics of the transmission,
- so as to obtain maximum comfort/driving pleasure (no hesitation).

when changing gears, and a defined overlap must be created for the receiver which is closing and for the one which is opening. In the receiver which is filling up, the pressure, starting from zero, should reach 16 bar; in the receiver which is being emptied, the pressure, starting from 16 bar, should reach zero.

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For the ECU, this therefore involves defining the exact value at which the pressure should be (which is falling or rising) at a given instant t between the start of the gear changing operation and the instant when the new gear is selected.

Furthermore, a pressure rise of short duration is caused in the cylinder during the filling phase so as to obtain a very short gear changing time (less than 500 ms).

This is operated by proportional electrovalves, where the operating COR, defined by the ECU, corresponds to the desired pressure value.

Logically, the ECU works out the suitable value of pressure and converts it into an RCO value.

The instantaneous value of rising pressure is calculated as a function of the following criteria:

- engine torque,
- engine speed difference to be handled,
- converter torque conversion,
- transmission oil temperature,
- constant,
- current gear and type of changing (upward, downward)
- pulling/downhill.

The receiver overlap is defined as a function of the load of the receiver which is opening. Where necessary, the process of the operation can be corrected as a function of the variations in turbine speed; this is the autoadaptivity taking the sets of parts which may be specific to each transmission into account.

Note: The reactions of the turbine speed and the gear changing time allow the ECU to provide autoadaptation for the gear changing management function. Wear of mechanical parts can also be taken into account (the discs of the cylinders for example). The adaptation values are worked out as a function of the gear change and the load class and are stored in the non volatile memory.

Note: The load of a receiver is worked out as a function of engine speed and turbine torque. A table gives the "load class" depending on the range in which the load value is situated.

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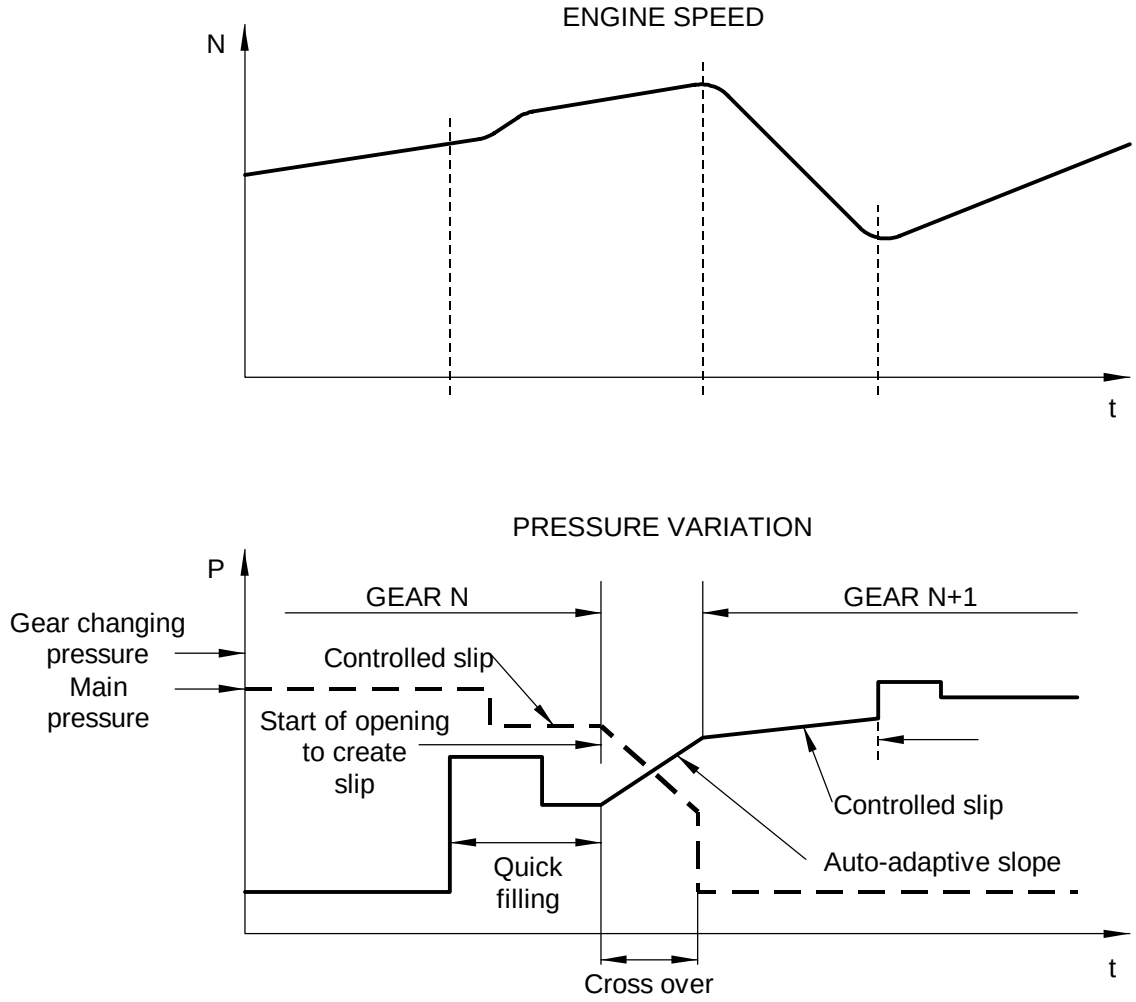
Illustration of the gear changing process



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VI - OPERATING THE LOCK-UP CLUTCH

The lock-up can have one of the following three states:

- open,
- controlled,
- closed.

in order to optimise its operation to the driving conditions.

A - NEED FOR THE VARIOUS STATES

Open state:

- multiplication of torque (starting off, power take up),
- anti-stall function,
- maximum filtering,
- lock-up track cooling function.

Controlled state:

- filtering of engine acyclisms,
- filtering of load variation hesitations,
- improved fuel consumption,
- use of engine brake,
- oil cooling.

Closed state:

- improved fuel consumption,
- oil cooling,
- use of engine brake,
- lock-up track cooling function.

B - STRATEGY

For each set of gear changing laws, and for each gear (2nd, 3rd or 4th), the ECU has a network of curves f (Ns, α/idle speed) which define the state of the lock-up. Each network contains 2 curves defined by 10 points which delimit the "lock-up open", "lock-up controlled or regulated" and "lock-up closed" zones; each curve is separate so as to obtain hysteresis.

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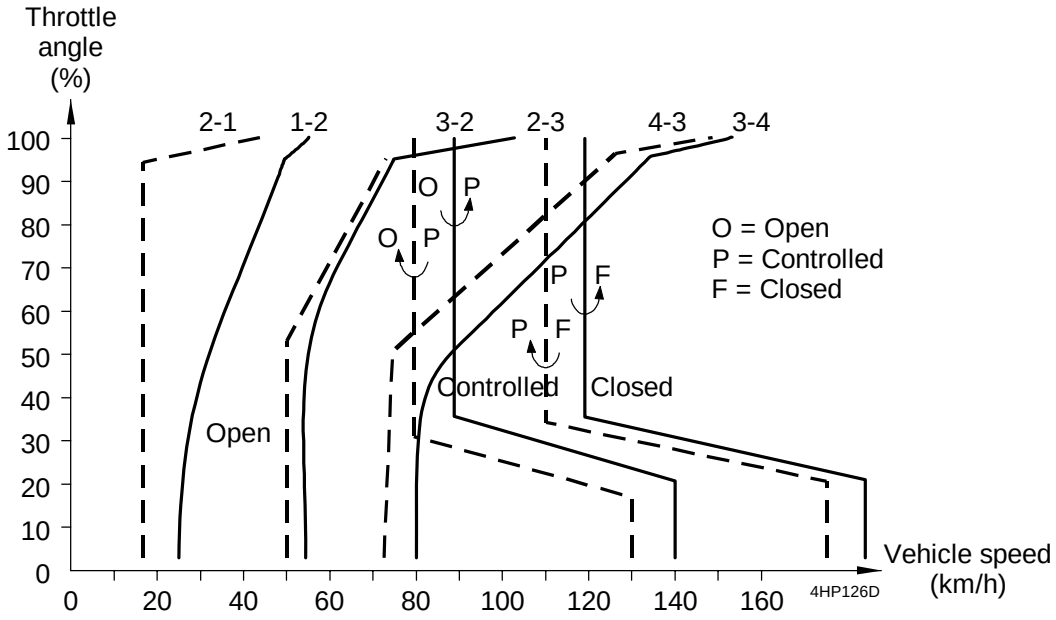
Especially when the engine is decelerating, and for an engine speed above a calibrated limit, the lock-up is in controlled mode.

Note: If the transmission temperature is too high, the ECU promotes the controlled and closed states in order to limit the slip inside the converter.

Example of lock-up operating law (for a specific set of gear changing laws and for a specific gear).



The operating curves above are typical "4th gear" curves

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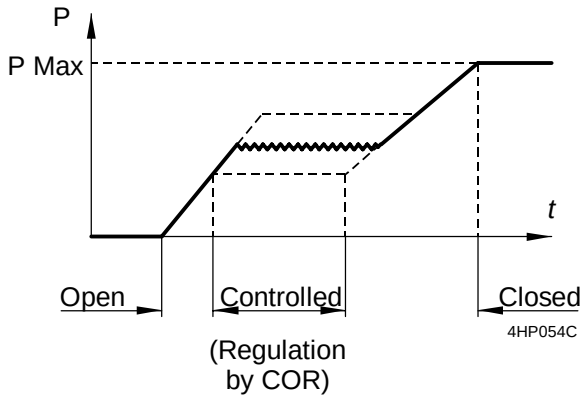
If the lock-up operating law specifies that it must be in the controlled state, it is up to the ECU to work out the most suitable value of slip.

This value is defined by a difference between the engine speed and the turbine speed (N input to transmission). The value of this difference is given in a cartographic map f (α/idle speed, Nmot).

After operating the proportional electrovalve designed for this purpose, the ECU checks that the actual engine speed is indeed the same as the speed from the cartographic map which is therefore the desired speed.

Illustration of the operating pressure



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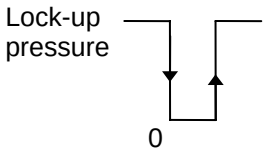
Features:

The controlled state is particularly delicate and complex to manage in the following cases:

- During variations caused by the engine speed; the desired slip, in other words the difference between the engine speed and the turbine speed, is determined and managed in an open loop using a specific strategy.

- If the vehicle switches from the "pulling" state to the "decelerating" state, the ECU must invert the sign of the value of the difference in engine speed (ΔN = turbine speed - engine speed and not the inverse).

  Physically, the operation is difficult to perform; so that transmission occurs correctly, the pressure exerted on the lock-up is set to zero for a fraction of a second.



Anti-stalling function: Torque converter lock-up released depending on turbine speed and turbine and brake speed deceleration.

VII - SAFETY FUNCTIONS

- Safety when changing down: a lower gear is only changed to automatically or forcibly if the final engine speed is below a limit. Where necessary, the gear change is delayed until conditions authorise it.

- Protection at overspeeds:

  If Nmot > limit
dNmot/dt > limit } A fault is detected by the diagnostic function $\Rightarrow$
MFS $\neq$ "N" or "P" switch to downgraded mode

  (MFS: Multifunction switch)

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VIII - FUNCTIONS PERFORMED BY THE ENGINE MANAGEMENT COMPUTER (EMC)

A - INFORMATION SUPPLIED TO THE EMC FROM THE AUTOMATIC TRANSMISSION

The EMC is informed by a logical 1 or 0 signal on terminal 42.

1 - Working out the "drive" state or "parking/neutral" state

- P/N → signal 1,
- Drive → signal 0.

2 - Recognition of change from P/N → D

When moving off, the signal must be 1. Therefore, if it then changes from 1 to 0, after a short confirmation time, the ECU recognises the change to D.

3 - Recognition of change from D → P/N

If the signal changes from 0 to 1, after a fairly long confirmation time, the ECU recognises the change to P/N (so as not to confuse it with a gear change).

Feature: For Reverse gear information, a specific line is used (terminal 47). The signal is of a logical 0 or 1 type. Reverse gear is selected if the signal = 1 (12V). For as long as "Reverse" = 1, this information allows the torque to be decreased by retarding the advance f (α/idle speed). This function is not active for the moment.

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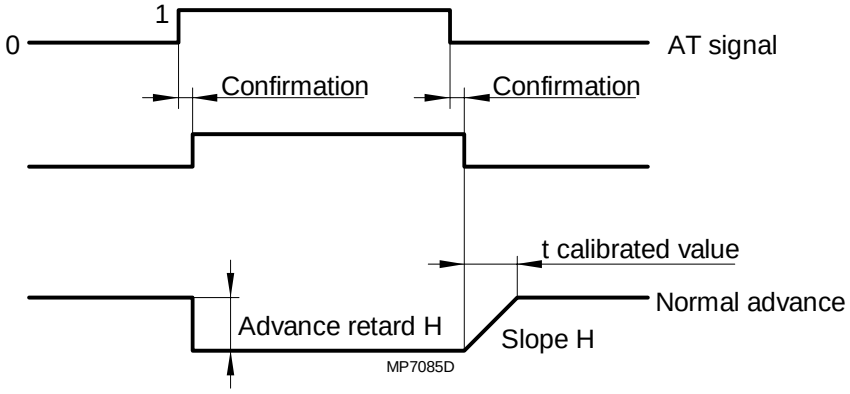
B - RETARDING THE ADVANCE WHEN CHANGING GEARS

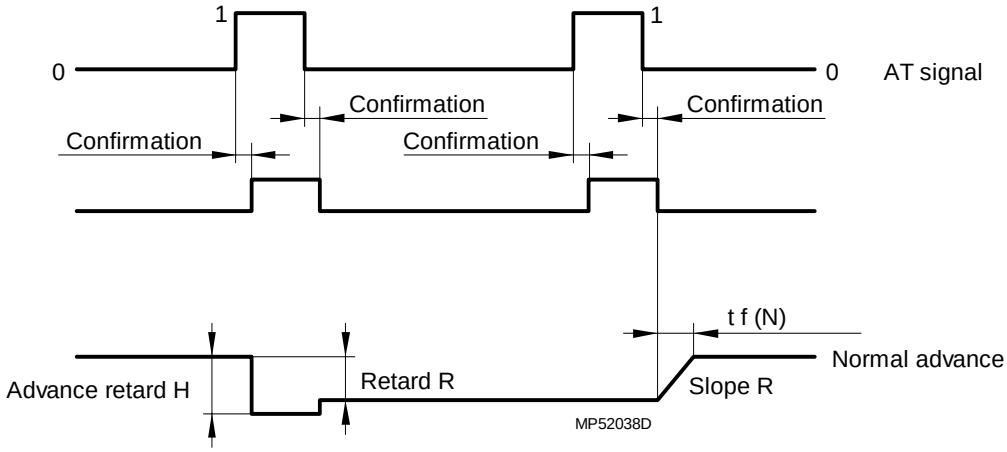
The automatic transmission ECU informs the M.P. 7.0 ECU of gear changes on the D-P/N line (terminal 42). So as to improve gear changing comfort, the M.P. 7.0 ECU reduces the torque by reducing the advance f (N, TB) which varies depending on the direction of gear change.

Key: H → upward gear change
R → deceleration

- Upward gear change.



- Deceleration.



Note: When changing from 0 to 1, the time for which the signal remains on 1 allows the M.P. 7.0 ECU to recognise:

- P/N state or,
- upward gear change,
- deceleration.

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C - AUTOMATIC TRANSMISSION PROTECTION

At very low vehicle speeds (Vveh < 5km/h approximately) or when there is a fault on the vehicle speed sensor line, if P/N is changed to D or 1st or 2nd or 3rd or R, a timer f (T°coolant) is triggered. During this timer, if the driver accelerates and if N > limit f (T°coolant) or T_B > limit f (N, T°coolant), the ECU cuts off the injection so as to cause a large drop in torque in order to protect the transmission.

Injection is restarted when the engine speed gradient reaches a limit f (T°eng).

Injection picks up progressively until it reaches Ticalculated.

The increment is of the type Ti calculated x Ktake-up where Ktake-up depends on the number of ignitions which occurred since the injection was cut off which represents the time for which the fuel was cut off.

The table which Ktake-up comes from is specific to the "Automatic transmission protection" function.

In addition, the optimum advance is applied from when injection is restarted to when Ti calculated is reached.

D - ANTI-STALLING

The idle speed reference value and the additional air regulation function depend on the position of the transmission (P/N, gear engaged).

- In drive, the air precommand is increased as a function of coolant temperature so as to overcome the additional load inflicted on the engine.

- To regulate the idle speed in a closed loop, the reference value is specific depending on coolant temperature, so as to prevent the vehicle from being driven.

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ASSOCIATED FUNCTIONS

I - CONTROL PANEL DISPLAY

To inform the driver of the position of the selector lever and which program is currently being used, the ECU controls:

- an LED display → remodelled XANTIA,
- a liquid crystal display (LCD) → XM, on the control panel using an input consisting of logical 0 - 12 V signals

Furthermore, the ECU can inform the driver of a problem in the system by causing the LEDs or LCD corresponding to the Sport and Snow program to flash.

A - COMMUNICATIONS PROTOCOL

As soon as the engine is started, the automatic transmission ECU regularly sends the display signals which are separated from each other by intervals which last for a number of bits between 6 and 15.

A signal consists of two pieces of information:

- the position of the selector lever,
- the program selected by the driver,

and consists of 12 bits:

- 8 information bits - b1 to b8 where
  - b1 b2 b3 b4 → lever position,
  - b5 b6 → program selected,
  - b7 b8 → fault indication

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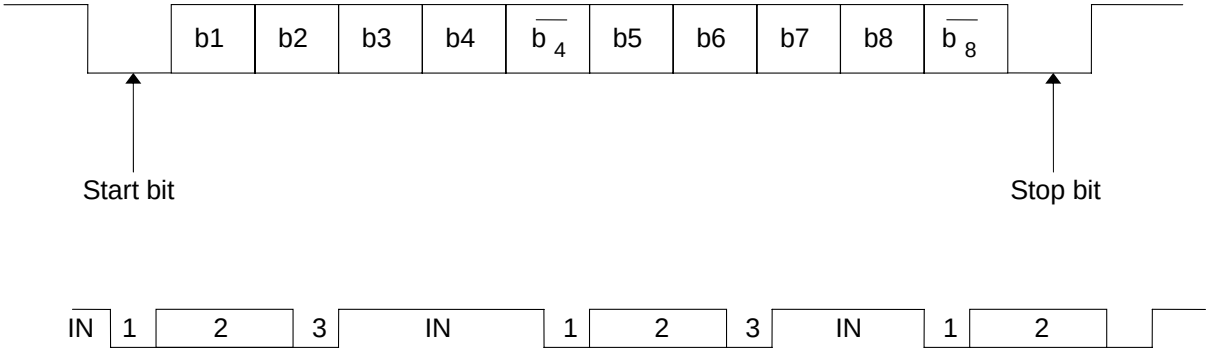
- 2 inverted bits $\overline{b}4$ and $\overline{b}8$ for creating transitions and therefore to allow the display to resynchronise itself at least once every 5 bits when the byte is being transmitted,
- 1 start bit (0),
- 1 stop bit (0).

The bits are numbered in the order in which they are received:



1 : start bit.

2 : 10 bits (data + transitions).

3 : stop bit.

IN : interval.

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B - MEANING OF THE BITS

1 - b_1, b_2, b_3, b_4

b_1 b_2 b_3 b_4	LED DISPLAY	LIQUID CRYSTAL DISPLAY	TYPE
0 0 0 0	P	P	position P
0 0 0 1	R	R	position R
0 0 1 0	N	N	position N
0 0 1 1	D	D	position D
0 1 0 0	3	3	position 3
0 1 0 1	2	2	position 2
0 1 1 0	1	1	position 1
0 1 1 1	P flashing	P flashing	intermediate position between P and R
1 0 0 0	R flashing	R flashing	intermediate position between R and N or R and P
1 0 0 1	N flashing	N flashing	intermediate position between N and D or N and R
1 0 1 0	D	4	4th gear
1 0 1 1	N flashing	N flashing	Positions D or R requested but not selected
1 1 0 0	not illuminated	- (bar)	gear change between D, 3, 2 and 1
1 1 0 1	3 flashing	3 flashing	Position 3 requested but not selected
1 1 1 0	2 flashing	2 flashing	Position 2 requested but not selected
1 1 1 1	1 flashing	1 flashing	Position 1 requested but not selected

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2 - b_5, b_6

b_5 b_6	MEANING	LED DISPLAY	LC DISPLAY
0 0	ECO program	none	ECO
0 1	SPORT program	LED 1	SPORT
1 1	SNOW program	LED 2	SNOW

3 - b_7, b_8

b_7 b_8	MEANING
0 0	No faults
0 1	Causes Sport or Snow LCD or LEDs to flash

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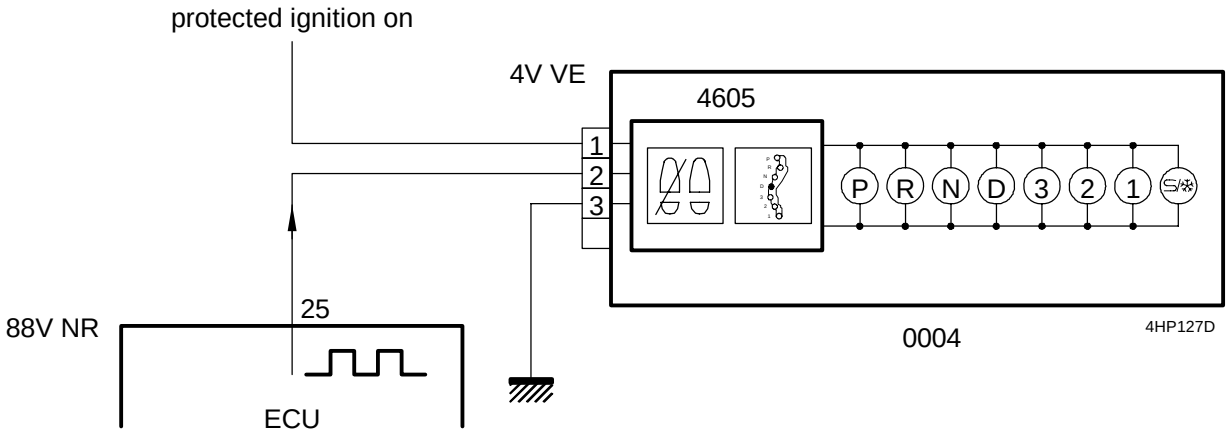
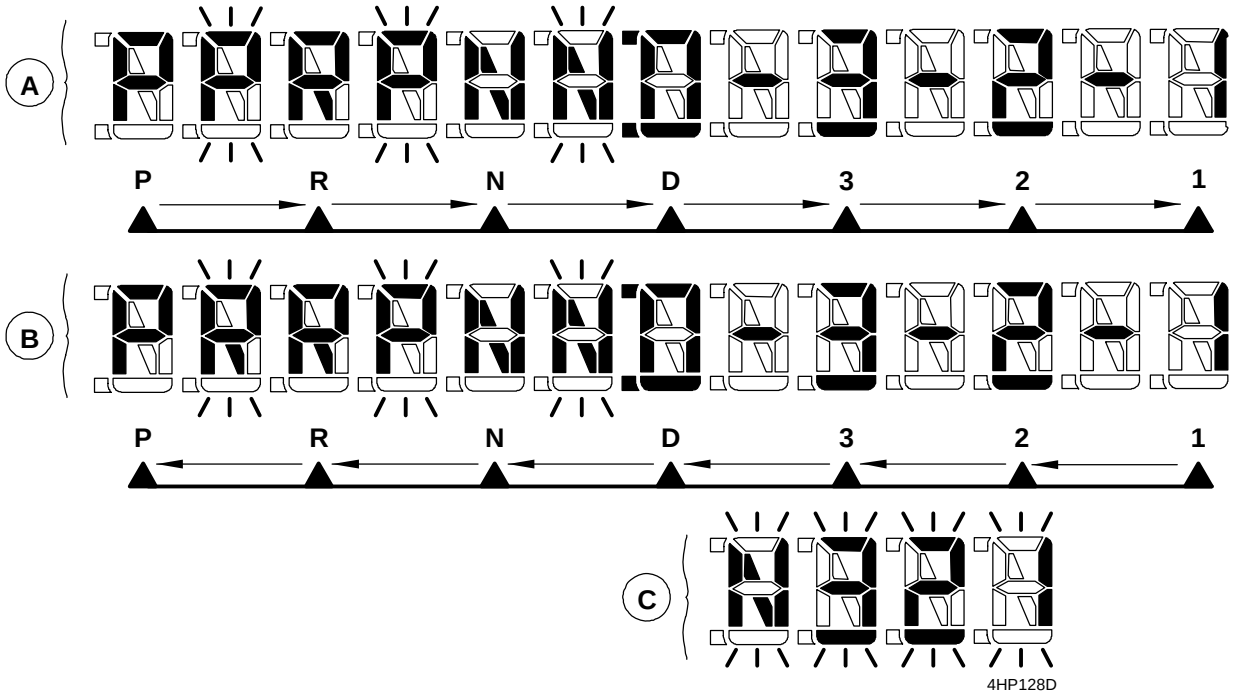
Remodelled XANTIA



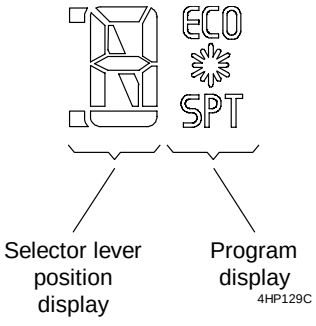
XM



A - Reminder of selector lever position from P → 1

B - Reminder of selector lever position from 1 → P

C - Gear selected but not engaged



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ZF 4HP20 AUTOMATIC TRANSMISSION

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II - OPERATION OF REVERSING LIGHTS

Every time the selector lever is moved to position R, the reversing lights are illuminated by the multifunction switch (see sensors and information chapter).

III - STARTING PREVENTION

The multifunction switch prevents the starter motor from operating unless the selector lever is in the P or N positions. To do this, it controls the starting relay (see sensors and information chapter).

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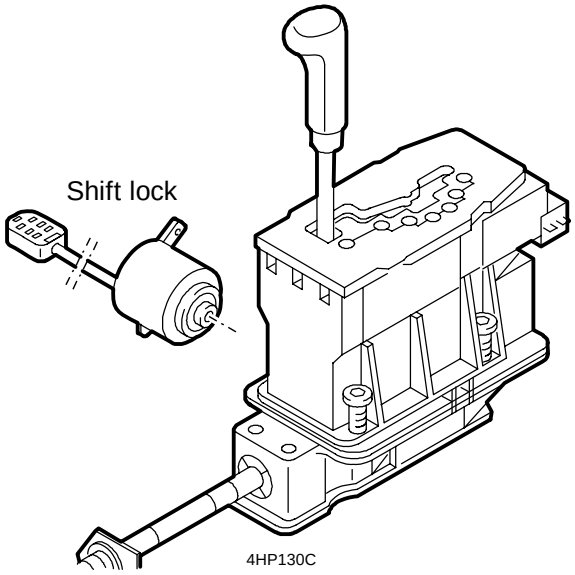
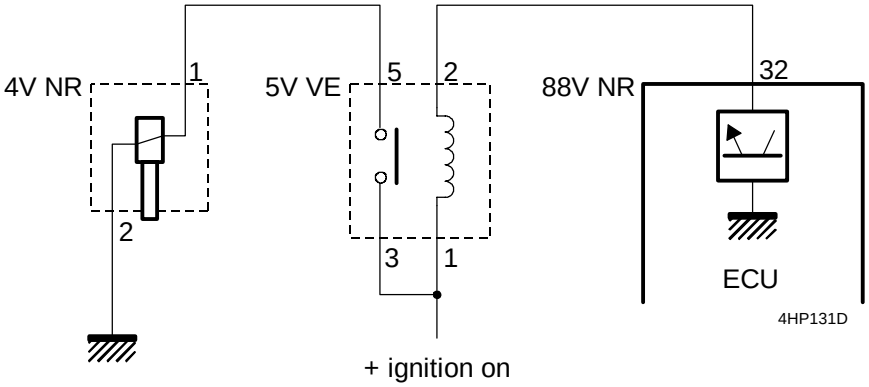
IV - SHIFT-LOCK

The shift-lock function is a safety function which requires the brake pedal to be pressed before the selector lever can be moved from position P to another position when the ignition key is in the + ignition on (or engine running) position.
It ensures:

- that the driver is present (by pressing on the brake pedal) before allowing the engine to drive the vehicle,
- that the vehicle does not move off suddenly when a gear is engaged.



This function is performed by an actuator, located in the central console and controlled by the ECU through a relay.



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Description of the function

The actuator must be operated so as to unlock the selector lever in two cases:
Case 1: normal unlocking

"lever in position P" and "ignition on" and "press and hold brake pedal down".

Note: To prevent the actuator being operated unnecessarily, it is not supplied in the following instance: ignition on (or engine running depending on case), brake pedal pressed then lever moved to position P. In this case, which corresponds to the normal configuration when the vehicle is stationary, a 5 second timer is started. The actuator is only supplied after the timer has elapsed if the driver is still pressing the brake pedal. The actuator can be unlocked before the end of the timer by releasing the pedal and then pressing it again. In all other cases (order in which information arrives not the same as above), the actuator is supplied instantly.

Case 2: locking prevention when the vehicle is moving
"lever in position P" and "ignition on (engine running accepted)" and "vehicle speed > 3 km/h".

The actuator control is interrupted either by leaving the + engine running or P position or by releasing the brake pedal.

Specific case
The SL actuator cannot withstand a permanent supply.

However, it is acceptable to limit the control to a duration greater than or equal to 1 minute whilst complying with the following condition: after the timer has expired, after the pedal has been released briefly, the actuator must be operated instantaneously and it must be operational (sufficient force developed).

Downgraded mode
If the function uses an ECU which can detect faults in the information tested (either the "lever in P", "pressure on brake pedal", "vehicle speed > 3 km/h" or "position of ignition key" information), it should be possible to prevent the actuator from working electrically. In a case such as this, an emergency function called a release should be available: using a tool or a key, this allows the lever to be manually unlocked from position P.

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V - KEY-LOCK

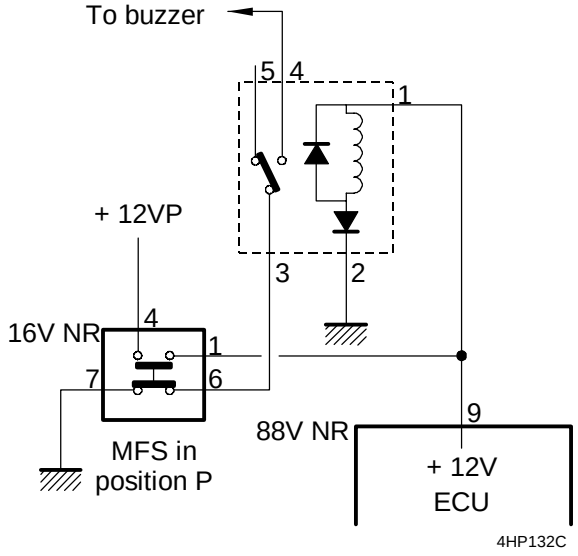
The key lock function is a safety function which requires the selector lever to be put into position P before the ignition key can be removed (the ignition switch cannot be moved from position A to position ST).
This:

- prevents the steering wheel from being locked by the steering lock when the vehicle is moving,
- along with the shift lock function, encourages the driver only to leave his vehicle with the lever in position P.

This ECU function is performed by an actuator located near to the ignition switch:

- selector lever not in position P → actuator not supplied → key locked,
- selector lever in position P → actuator supplied → key unlocked.

This function may be replaced by a buzzer which warns the driver that he is removing the ignition key although the selector lever is not in position P.



MFS = multi function switch

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For information: Key-lock operating logic

T1: Gives the driver a time delay between switching off the engine (key moved from M to A) and removing the key (key moved from A to St) → = 1 to several minutes.

T2: This monitors the return from P for a limited time after the ignition has been switched off to allow the key to be unlocked as soon as position P is returned to → = ¼ hour to several hours.

Downgraded mode:

If the ECU detects a fault in the "lever in P" or "ignition key position" information:

- either the key-lock is supplied as soon as the correct information is present,
- or a tool or a key can be used to manually unlock the lever from position P.

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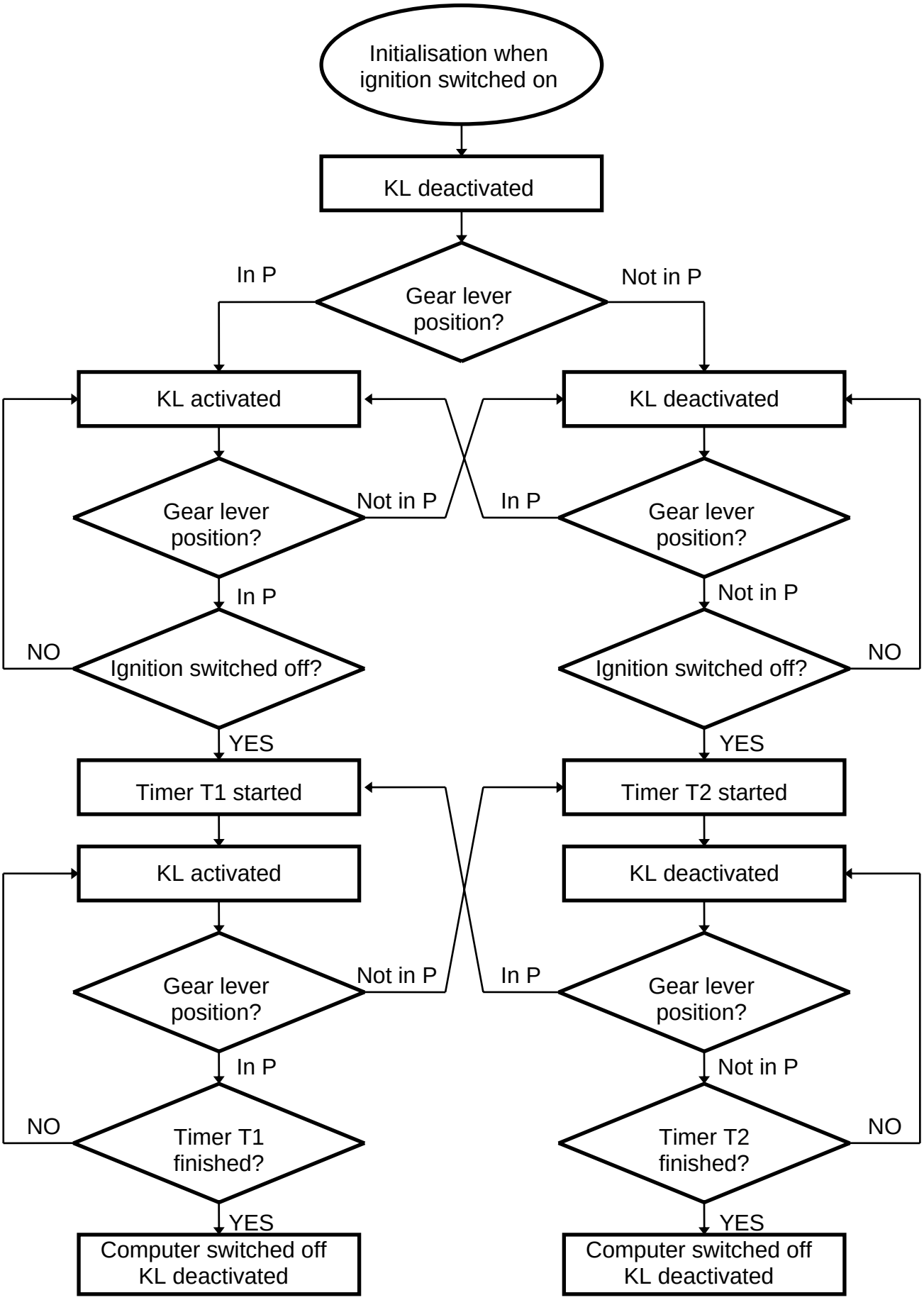

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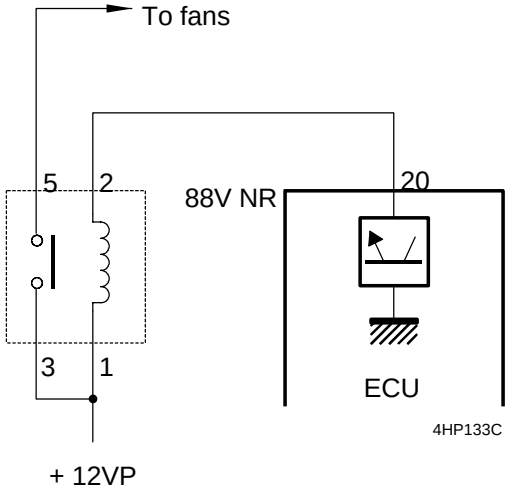
VI - OPERATING THE FANS

The ECU operates the fans by earthing a relay.



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DIAGNOSTIC

I - GENERAL

A - AIM

The aim of the auto-diagnostic is to:

- warn the driver should a system operating fault arise,
- help the repair technician locate the origin of the fault or faults.

B - RECORDING FAULTS

The auto-diagnostic records permanent faults as well as temporary system operating faults.

These faults, after being recorded, are permanently memorised even after the vehicle has been switched off and can only be erased following a voluntary action by the repair technician; faults can only be erased after they have been read to ensure that memorised faults are viewed at least once by repair staff.

Faults are stored in the memory under a fault code in the chronological order in which they appear.

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C - CLASSIFYING FAULTS

Fault are classified into two categories:

- serious faults requiring the vehicle to be repaired immediately (risk of damaging transmission, safety of passengers jeopardised…): as soon as they are detected, the driver may be warned by certain lights flashing,
- minor faults which do not require immediate repair: when these appear, the driver is not warned but the faults are stored in the ECU's non volatile memory.

Major faults have priority over minor faults.

D - DETECTING FAULTS

The ECU permanently monitors:

- its peripherals (sensors and actuators),
- the actual gear engaged (input speed / output speed),
- the converter slip (engine speed / turbine speed),
- the gear changing time (actual time / theoretical time),
- the operating temperature.

And finally, the ECU can detect:

- 42 permanent or temporary faults detected on the input and output signals, by analysing the decline in their electrical characteristics or by performing a coherence check,
- 3 automatic transmission operating faults:
  - fault whilst changing a gear (due to a pressure regulator being blocked for example),
  - two gears engaged at the same time, or slipping of a clutch,
  - excess engine speed.

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E - DOWNGRADED MODE

When a problem occurs, and so as to protect the transmission as well as to ensure the comfort of the vehicle's occupants, the ECU can activate one of its sliding scale emergency or replacement modes (13 downgraded modes).

Depending on the type of fault, the ECU chooses the following downgraded modes from amongst three types:

- 3rd hydraulic (4th if activated whilst driving),
- maintain gear engaged (until the ignition is switched off then 3rd hydraulic engaged),
- replacement value (absent data recomposed or replaced).

Whilst driving, this program might appear in the form of:

- a restriction in transmission functions (e.g. can no longer change gears or no kickdown),
- no display on the control panel (sport and snow lights flash) for major faults,
- the transmission being operated electronically with pre-programmed characteristics (gears can be changed alone),
- juddering when moving lever from P to R and from N to R.

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II - SERIAL COMMUNICATIONS WITH THE ELIT TESTER

Master / slave type exchange (the tester and the ECU take it in turns to be emitter and receiver):

- after a word is sent by the master, this word is returned to it by the slave along with the information indicating that it has been correctly received,
- after receiving the reply from the slave, the master is ready to send a second word.

Transmission speed: 9600 baud

The tester uses the following connections: Ubat, Earth, K line and L line (in the future).

Various functions offered by K (and L) lines:

- reading of recorded faults,
- reading of parameters (measured values),
- simulation,
- initialisation of auto-adaptives,
- downloading,
- erasing of faults,
- identification of ECU.

Reading memorised faults

For each memorised fault, the ECU's reply message is structured in the following way:

- fault code,
- nature of the fault (open circuit, short circuit...),
- type of fault (permanent, temporary),
- associated contexts,
- age of the fault (50 counter).

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Reading parameters

Variables:

- engine speed: rpm,
- transmission input speed: rpm,
- transmission output speed: rpm,
- engine torque signal: 28 Nm (when stationary),
- lock-up: open - controlled - closed (up to 2000 rpm converter slip), 1st and 2nd gears always open, 3rd and 4th gears always closed (direct drive) or controlled (regulated converter slip of approximately 50 rpm),
- throttle angle: 0 % no load, 99 % full load,
- transmission oil temperature: C°.

Pressures:

- gear engaged: 1-2-3-4 or R,
- lever position: P.R.N.D.3.2.1,
- regulator: number 3, --- mA
- regulator: number 4, --- mA
- regulator: number 5, --- mA
- regulator: number 6, --- mA

} Reference values

- electrovalve MV1: 1 or 0
- electrovalve MV2: 1 or 0

The value varies from 159 mA to 768 mA depending on gear engaged.

Digital inputs and outputs:

- stop lights input: 0 or 1.

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External controls:

- lever position: P.R.N.D.3.2.1,
- gear engaged: 1-2-3-4 or R,
- program(s): normal - sport - snow,
- DPS: ECU selection from amongst 6 gear changing laws depending on driving conditions,
- normal: SK1.SK2.SK3.SK4.SK5.SK6,
- sport: SK5.SK6,
- snow: winter (position D),
- snow: manual (position 1.2.3).

Specific program called warm up when the transmission temperature is less than 30° C when the ignition is switched on for a duration of 135 seconds.

Simulation

→ Activation of various electrovalves.

Downloading to the ECU

This is performed using the ELIT diagnostic tool. Downloading allows the automatic transmission ECU to be updated or to be upgraded in line with an EMC upgrade.

Important: updating using downloading must always be performed on both automatic transmission and engine management ECUs.

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Initialising the ECU

This is performed using the ELIT.

The ECU should be initialised in the following cases:

- ECU replaced,
- transmission replaced,
- downloading.

This consists of emptying the faults memory in order to erase all the auto-adaptation values.

Road test:

The ECU permanently adapts itself to the transmission.

Therefore, when replacing the transmission, the ECU or another component of the transmission, a road test must be performed.

Choose a route which allows frequent gear changes and uses all gears.

This test is absolutely essential so that the electronics can adapt themselves to the transmission by comparing the reference values to the actual values.

The difference recorded is then stored in order to allow optimum gear changing pleasure.

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III - DESCRIPTION OF THE DIAGNOSTIC

A - LIST OF FAULTS

Test conditions:

- 0 → when operating,
- I → when initialising (ignition on)

Return to normal:

- 0 → when operating,
- I → when initialising
- N → NO return

FUNCTIONS	CONTROL PANEL WARNING	EMERGENCY MODE	TEST CONDITIONS	RETURN TO NORMAL
Engine speed	yes	S1	0	I
Turbine speed	yes	S1	0	I
Transmission output speed	yes	S1	0	I
Throttle position information	no	S6 - S12	0	I
Multifunction switch	yes	S0	0	I
Engine torque signal	no	S9	0	I
Oil temperature	no	S3	0	0
Program selector	no	None	Test impossible	N
Stop switch	no	S8	0	0
+ actuator supply (regulator electrovalves)	no	SW*	0	I
+ permanent	no	S5	I	I
Ignition on	no	SW*	0	0
Earth	no	None	Test impossible	N
Electrovalves (individually) short circuit to + or open circuit/short circuit	yes	S0	0/I	I
Regulators (individually) short circuit to + or open circuit/short circuit	yes	S0	0	I
Torque reduction request output	yes	S7	0	I
ECU RAM	no	S0	I	I
EEPROM	yes / no	S5/S0	I	I
ROM / EPROM	no	S0	0	N
Watchdog	no	S0	I	I
Actuator control stage	yes	S0	I	I
Engaged gear coherence	yes	S0	0	I
Overspeed protection				
Gear changing operation	yes	S1	0	I
Shift lock command	yes	S0	0	I
Key lock command	no	None	0	I
Fan command	no	None	0	I
Lever position / program indicator	no	None	Test impossible	N

SW = Software function → normal operation where possible.

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List of emergency modes:

TYPE	EMERGENCY MODE
S0	3rd hydraulic (4th if the fault occurs whilst driving in 4th then 3rd when the ignition is switched off then on again). Positions P, R, N are authorised. No reverse gear protection.
S1	Gear engaged maintained then S0 upon return to P/N Lockup open
S3	Oil temperature replacement value 60°C for normal program 120°C for lock up program
S5	EEPROM substitution function
S6	Throttle position value f (engine speed, engine torque)
S7	No change down upon kickdown
S8	Stop switch info replacement depending on function $\rightarrow$ Lockup = brake active $\rightarrow$ DSP = brake not active
S9	Recalculated value function (throttle α, engine speed)
S12	Specific SK11 law

Note: Changing to 3rd hydraulic when driving in 4th might cause an engine overspeed. This is why the 3rd hydraulic emergency mode engages 4th gear until the ignition is switched off.

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ZF 4HP20 AUTOMATIC TRANSMISSION

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WIRING DIAGRAM

I - LAYOUT

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II - INSTALLATION

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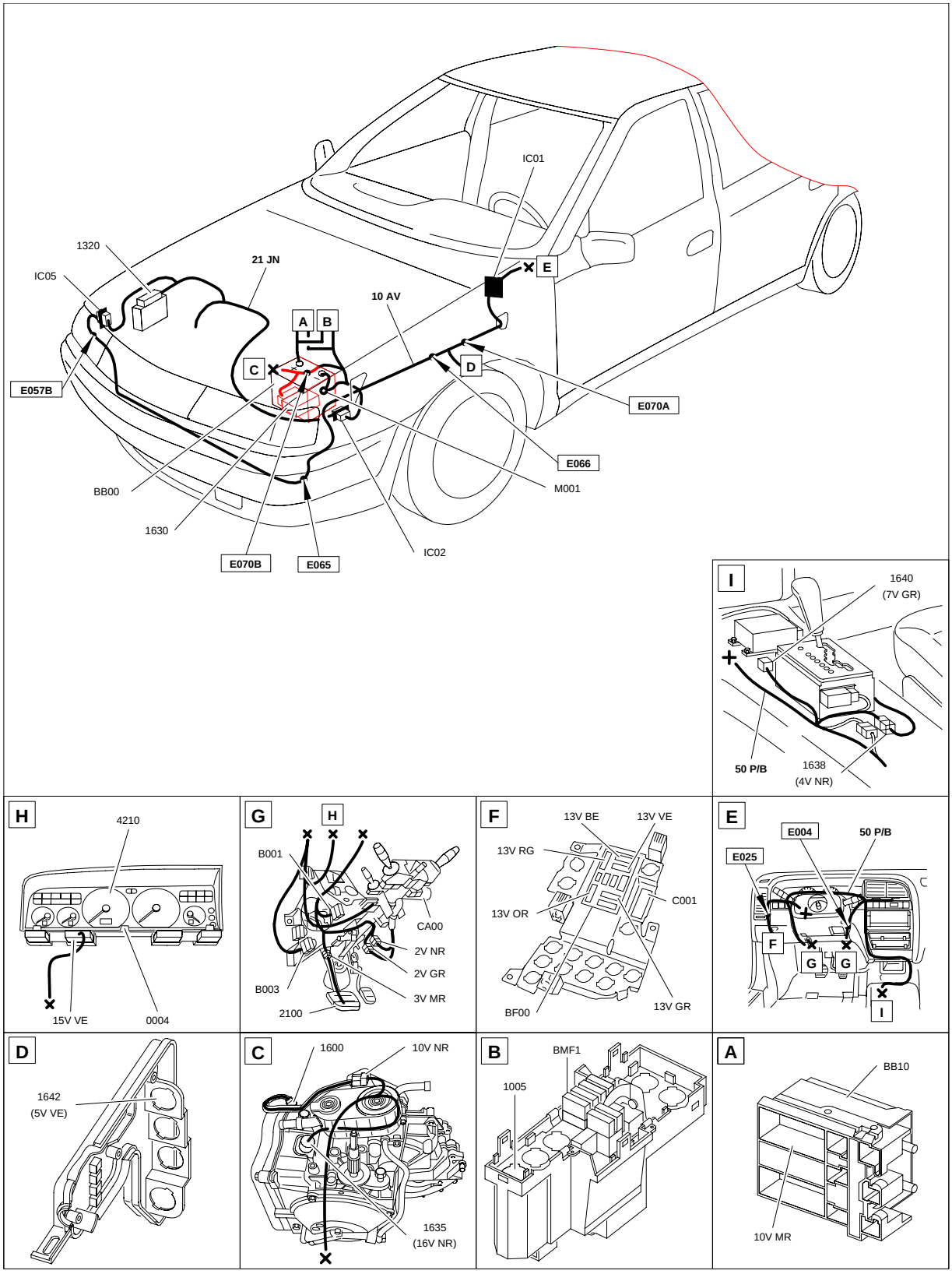
III - LOCATION



4HP136P

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IV - PARTS LIST

B001 - Positive equipotential socket
B003 - Earth equipotential socket
BB00 - Battery
BB10 - Supply unit
BF00 - Passenger compartment fuse box
BMF1 - Maxi fuse box
C001 - Diagnostic connector
CA00 - Ignition switch
M001 - Earth
0004 - Control panel
1005 - Starting prevention relay
1320 - Engine management computer
1600 - Selector lever position switch (MFS)
1630 - Automatic transmission ECU
1635 - Automatic transmission electro-hydraulic unit
1638 - Automatic transmission lever locking actuator (shift lock)
1640 - Automatic transmission program selector
1642 - Gear lever locking actuator control relay
2100 - Stop switch
10 - Start-up / current generation function
15 - Cooling function
22 - Reversing lights function
30 - Passenger compartment lighting function
64 - Electrically operated door mirrors function
73 - Cruise control function

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AFTER-SALES OPERATIONS

I - DOWNLOADING TO THE ECU

Updating the ECU software is performed by downloading. This operation is performed in after-sales using an ELIT or a LEXIA/PROXIA.

II - INITIALISING THE ECU

The ECU is initialised by means of an ELIT or LEXIA / PROXIA type diagnostic tool.

This procedure is to be performed with care since it resets all the auto-adaptives memorised by the ECU.
It is performed after:

- replacing the ECU,
- replacing the transmission,
- downloading.

Conditions: Ignition on, vehicle stationary, lever in P or N, then follow the procedure on the diagnostic tool.

III - TESTING AFTER THE WORK

The ECU permanently adapts itself to the transmission. Therefore, when replacing the transmission, the ECU or another component of the transmission, a road test must be performed choosing a route which allows frequent gear changes and uses all gears.

This test is absolutely essential so that the electronics can adapt themselves to the transmission by comparing the reference values to the actual values. The difference recorded is then stored in order to allow optimum gear changing pleasure.

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IV - LIST OF AUTHORISED OPERATIONS ON THE 4HP20 TRANSMISSION IN AFTER-SALES DURING THE FIRST YEAR OF WARRANTY*

- Drain and fill the transmission.
- ECU initialisation procedure (auto-adaptives).
- Replace ECU (after APPROVAL).
- Replace transmission (after APPROVAL).
- Replace selector lever position switch.
- Replace load potentiometer.
- Replace speedo control.
- Replace engine speed sensor.
- Replace heat exchanger.
- Replace the converter and its gasket.
- Replace the seal on the driveshaft.
- Replace the selector control.
- Replace the "shift-lock".

The operating procedures for the various authorised operations are given in the corresponding after-sales brochure.
Replacing the whole 4HP20 transmission or its ECU must be subject to prior approval.

This approval is given by the Regional Headquarters for France.

The point of sale fills in the "request for replacement approval" (copy enclosed) and sends this duly completed request to the Regional Headquarters.

After being analysed, additional technical assistance will be proposed in order to complete the diagnostic or replacement approval will be faxed back to the point of sale on the approval request.

* For UK, contact warranty department at Citroën UK or follow After Sales procedure for UK RHD vehicles.

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dealer stamp

REPLACEMENT APPROVAL REQUEST **

☐ **4HP20 TYPE AUTOMATIC TRANSMISSION**
☐ **4HP20 TYPE ECU**

DATE:

IDENTIFICATION	INFORMATION		
1/ Completed by:	Mr:		
2/ Tel / Fax:	Tel: Fax:		
3/ VIN:	N°:		
4/ Transmission and/or ECU n°	Transmission n°: ECU n°:		
5/ Mileage:	Miles:		
6/ Warranty start date:	.../.../...		
7/ Is the vehicle immobilised?:	YES		NON
8/ Description of the problem:			
9/ Oil level at 80° C (eg: maximum):			
10/ Lever position in which fault appeared:	P-R-N-D-3-2-1*		
11/ In which program did the fault appear:	Snow	Normal	Sport
12/ At what speed did the fault appear (mph):			
SELECTOR CONTROL			
13/ Correct setting:	YES		NON
14/ Coherence between indication of selector lever compared to control panel of P to 1:			
USING THE DIAGNOSTIC TOOL			
15/ Transmission ECU identification:			
16/ Engine ECU identification:			
FAULT READING			
17/ Title:			
18 Input or output speed of gears involved (rpm):			
19/ Gear engaged:	4-3-2-1-Rev*		
20/ Changing:	Up		Down
21/ Lock-up:	Open	Controlled	Closed
MEASUREMENT OF PARAMETERS			
.....			
ENGINE COMPUTER MEMORY			
22/ Are there any faults, if so which ones?			

23/ DR/SUBSIDIARY/IMPORTER answer:.....	
24/ Replacement approval n°:	N°

☐ : Tick the box *: Circle the relevant letter(s) or number(s)

** UK version may differ

ZF 4HP20 AUTOMATIC TRANSMISSION

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V - SPECIAL TOOLING

8010-T kit.

Part number = OUT 308 010 T.

PART N°	WORKSHOP REF.	DESCRIPTION
	A2	Pin for removing transmission
	B	Tool for D/P converter (x 2)
	D	Drift for removing driveshaft seals
	E2	Tool for supporting converter
	G	Ball joint extractor
	H	Tool for fitting converter seal
	J	Sleeve for fitting seals
	K1	Tool for fitting RH driveshaft seal (red)
	K2	Tool for fitting LH driveshaft seal (black)
	L	Test harness
	N	Tool for fitting selector shaft seal
	P	Inertia extractor
	Q	Guide for refitting transmission (x 2)

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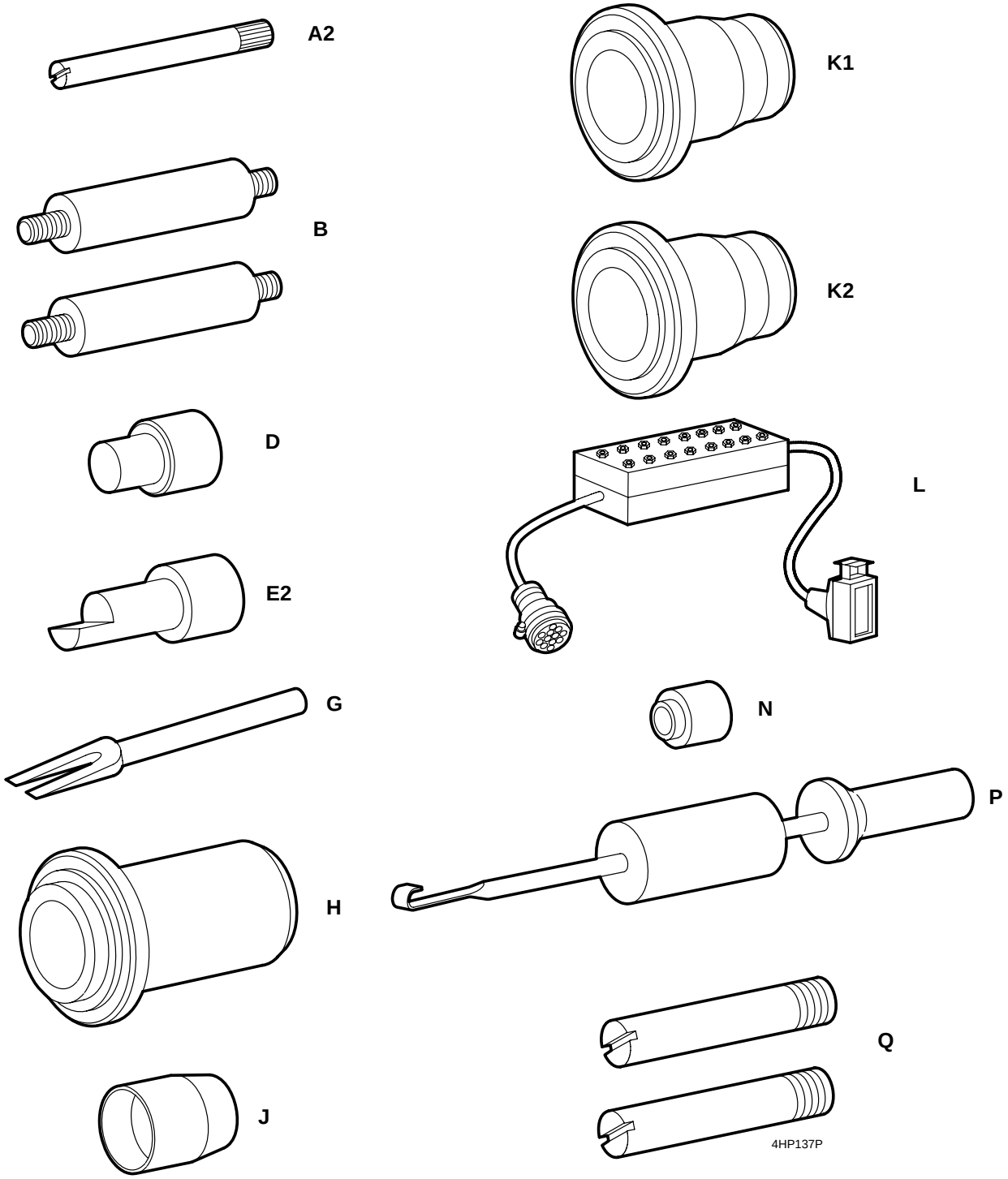
8010-T



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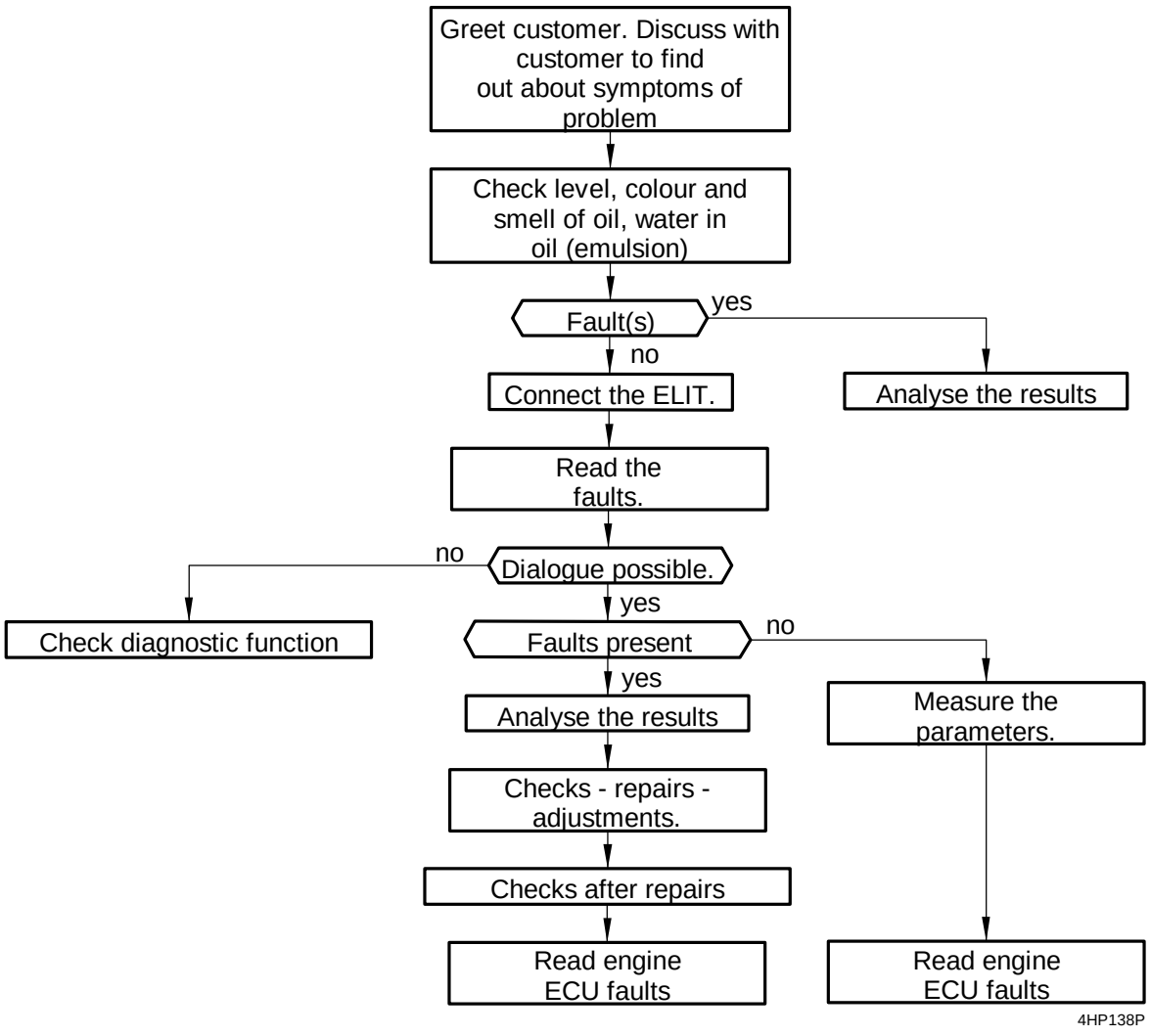
DIAGNOSTIC - LOCATING FAULTS

I - TRANSMISSION REPAIR PROCEDURE

IMPORTANT: When searching for a fault on this transmission, proceed in the following order.



Note: Sometimes, after checking the oil, a road test may have to be performed to confirm the symptoms.

IMPORTANT: After replacing the ECU or the transmission only, or downloading, carry out an initialisation procedure. Gear changes of varying qualities may be experienced for a certain amount of time (ECU adapting parameters to transmission).

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A - SPECIFIC CASE

Points to check: check the oil level:

- nature of the complaint,
- situation under which problem occurs (engine speed, vehicle speed, load, selector position).

Road test in presence of customer:

- customer's manner of driving (nervously, very economically, possible incorrect operations),
- external influences acting on the vehicle (temperature, road surface),
- selector position from P to 1 passing through R, N, D, 3, 2,
- choice of program: Sport - Snow - ECO,
- operate the selector slowly and check if its position agrees with the display on the control panel.

B - SEARCHING FOR FAULTS

The automatic transmission may show symptoms of faults which can be categorised in the following way:

- gear changing quality,
- operating faults,
- leaks.

1 - Problems with gear changing quality

Note: If gear changes suddenly deteriorate or if gears do not change at all, this may be the result of an emergency or replacement program. The customer is warned of this problem by the S and N lights both flashing simultaneously.

Warning: In an emergency program, there is a severe bang when changing from P/R or N/R.

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Perform a road test:

- note the situations in which the gear changing quality is faulty,
- try the 3 programs,
- note which gears cannot be engaged,
- can the reason for the complaint be reproduced over a short period, sporadically or did it just happen once?
- check the oil level and quality,
- read the fault codes with the ELIT.

2 - Transmission operating fault(s)

Faulty drive in Forward or Reverse gears.

Check in the following order:

- oil level and quality,
- road test,
- read the fault codes with the ELIT.

In some cases, it may be wise to read the fault codes of the ignition-injection ECU.

II - ANALYSE THE RESULTS

A - OIL CONDITION

To focus the fault finding procedure, remove the dipstick and smell the oil: does it smell burnt?

Engine running, take a small sample of oil (approximately 0.2 litres) to check whether there are any impurities in it (dust, metal particles).

Abnormal operation and even destruction of a clutch will lead to the oil heating up which might be filled with impurities.

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B - DIALOGUE IMPOSSIBLE

Check:

- the diagnostic line,
- the + permanent ECU supply,
- the ECU supply with ignition on,
- the operation of the diagnostic unit,
- if these checks are correct, perform a test with a new ECU.

C - DIALOGUE POSSIBLE

Warning:	Faults are detected by the ECU and the auto-diagnostic indicates that a function is faulty. The fault may be on the component in question, its wiring or the ECU itself.

If no faults are signalled, measure the parameters.

If one of the peripheral components of the transmission or the supply (+12V) is faulty, the ECU switches to downgraded mode: this downgraded mode varies depending on which component is faulty.

D - VISUAL WARNING IN THE EVENT OF FAULTS

1 - Flashing of the Sport and Snow warning lights - display of last gear selected

Automatic transmission fault.

2 - Flashing of Sport and Snow warning lights (without gear being displayed)

Transmission fault between automatic transmission and control panel display.

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E - EMERGENCY AND REPLACEMENT PROGRAM

1 - 4th hydraulic then 3rd hold after starting: P.R.N. possible

- If a fault occurs on one of the following components, the automatic transmission will remain in 3rd hydraulic permanently.
- ECU.
- ECU supply.
- Electrovalves supply.
- Pressure regulators.
- Multifunction switch.
- Speed sensor (transmission input and output).
- Gear monitoring.

2 - Oil temperature 120 or 60° C depending on phases

Possible origin(s) of fault:

- oil sensor or electrical line.

3 - Does not change to Kick-Down

Have to use lever to change down.

Kickdowns possible without moving the lever, only authorised with no load.

Possible origin(s) of fault:

- throttle potentiometer (throttle not opening fully - adjustment of accelerator cable),
- EMC.

The automatic transmission ECU uses a substitute value.

Warning: An incorrect carpet may prevent the KD function.

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4 - Gears do not change in position D, the same gear is maintained

When changing to position N or P, moves off in 4th hydraulic.

If the engine is stopped, 3rd hydraulic is selected.

Possible origin(s) of the fault:

- engine speed information,
- transmission output speed sensor.

F - QUICK DIAGNOSTIC

1 - Faults relating to the adjustment of the selector control

Vehicle moves forward or backward with selector in position (N).

Possible to start engine with selector in position (N) but not in position (P).

Difference between control panel display and selector lever position.

2 - Faults requiring the transmission to be removed and replaced

Vehicle no longer driven in forward nor reverse gears.

Oil level correct, the vehicle does not move, selector in position D-3-2-1.

Oil level correct, slipping when moving off, selector in position D, noise in reverse gear.

When warm, no vehicle drive in all selector lever positions. The vehicle starts after being stopped for a few minutes.

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3 - Fault requiring the multifunction switch to be checked on the transmission

Engine can be started in all selector lever positions.

Engine can be started, in position P or N (may also be caused by a faulty relay or electrical harness).

4 - Abnormal noise or vibrations

Metallic noise when idling from the converter cover.

Check:

- the converter mounting bolts are tight,
- condition of the converter drive plate (split).

Noise when starting (starter motor action), check plate is tight on converter and condition of converter cover.

Grinding from the oil pump pinions, check the transmission oil level.

5 - Faults relating to the EMC

- downgraded gear changing quality (torque reduction),
- lock-up always open (engine speed).

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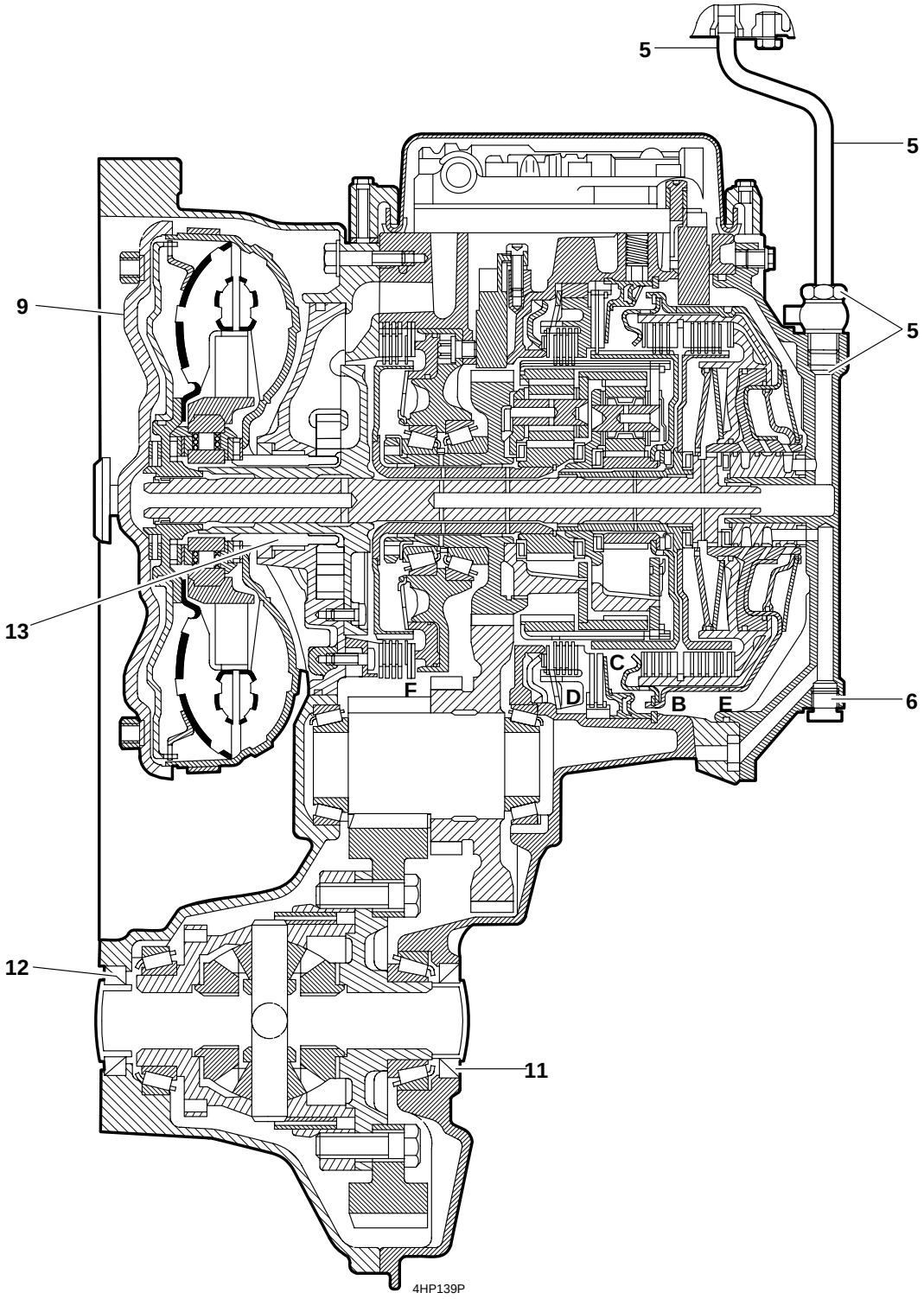
III - AUTOMATIC TRANSMISSION OIL LEAKS

A fall in the oil level may lead to a drop in pressure or premature wear of the clutches.

IMPORTANT: Check the oil level after all repairs.



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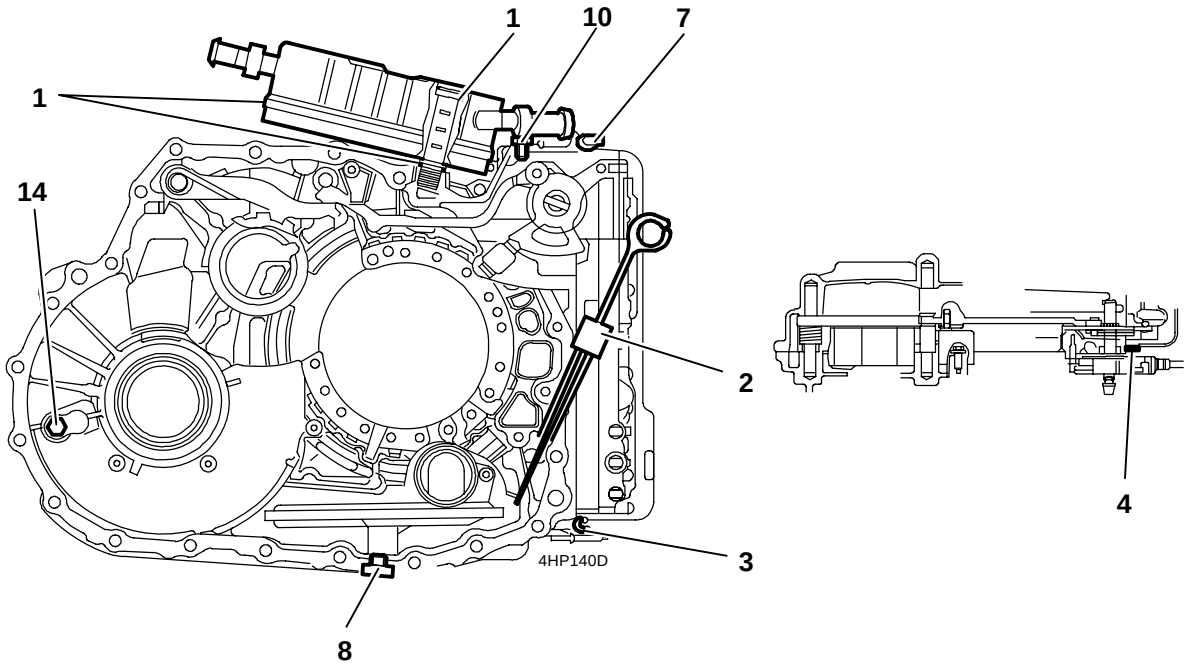

N°	ORIGIN OF LEAK	REMEDIES
1	Heat exchanger	Check for the presence and condition of the sealing rings on the socket bolts and replace seals or exchanger
2	Dipstick	Check that dipstick goes all the way down Check seal - Replace O-rings
3	Oil housing seal	Check tightness of bolts Replace oil housing seal (check tightening torque)
4	Selector shaft between multifunction switch and transmission housing	Check seal
5	Tubular connection between front cover and transmission housing	Check seals Check tightness Check tube visually
6	Front cover	Check seals Check tightness and condition of O-ring
7	Electrical connector	Check seals and tightness
8	Oil drain plug: differential transmission	Check seals and tightness
9	Engine flange, transmission around converter	Condition of converter seal Check if engine oil or transmission oil (crankshaft-converter sealing ring)
10	Transmission breather	Check oil level
11	Left hand driveshaft	Condition of lip seal
12	Right hand driveshaft	Condition of lip seal
13	Between transmission housing and converter housing	Damaged seal Replace transmission (if necessary)
14	Overflow plug on converter cover	Condition-tightness

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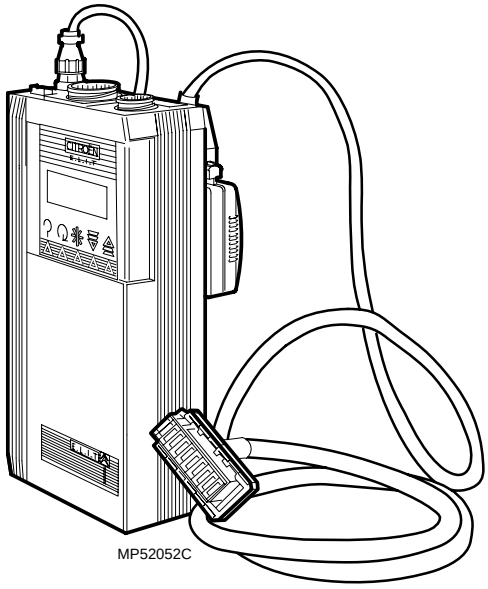
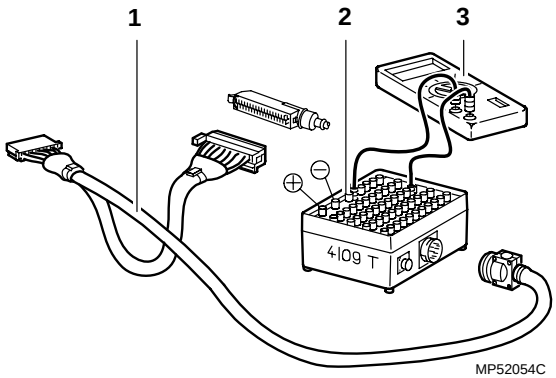
IV - PRESENTATION

A - DIAGNOSTIC TOOLING

1 - ELIT unit: 4125-T



2 - Terminal box: 4109-T



1 - Electrical harness (depending on application)

2 - Terminal box

3 - Multimeter

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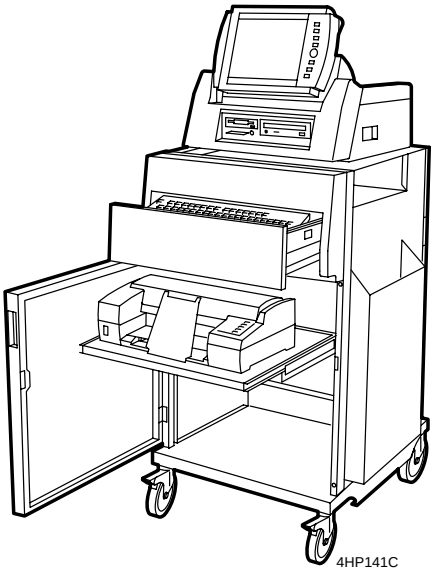
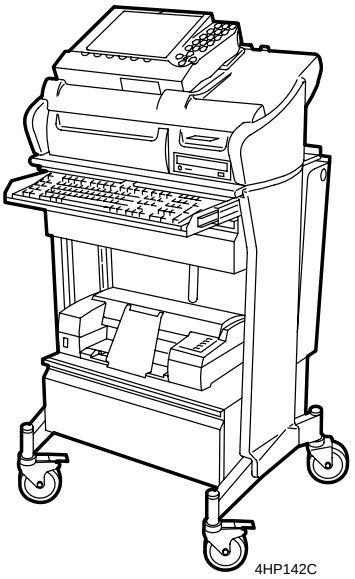
3 - PROXIA station: 4165-T



4 - LEXIA station: 4171-T



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V - DIAGNOSTIC: AUTOMATIC TRANSMISSION 4HP20

A - DIAGNOSTIC TOOLING

1 - ELIT unit: 4125-T

This is used for:

- reading faults,
- erasing faults,
- measuring parameters,
- simulation,
- initialising auto-adaptives,
- updating the ECU using downloading.

2 - PROXIA station: 4165-T

This is used for:

- reading faults,
- erasing faults,
- measuring parameters,
- testing actuators,
- initialising auto-adaptives,
- updating the ECU using downloading,
- viewing wiring diagrams.

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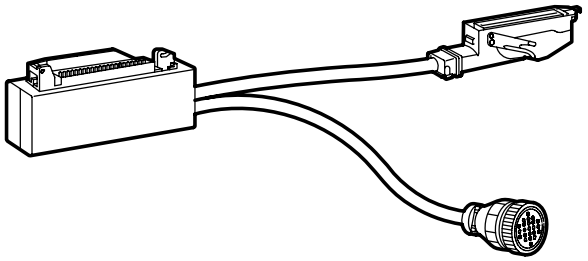
3 - LEXIA station: 4171-T

This is used for:

- reading faults,
- erasing faults,
- measuring parameters,
- testing actuators,
- initialising auto-adaptives,
- updating the ECU using downloading,
- viewing wiring diagrams.

4 - Terminal box: 4109-T. Harness: 4187-T



4HP143C

This tool, using a voltmeter and an ohmmeter, is used to check:

- sensors,
- actuators,
- the automatic transmission harness.

Warning:	On the XANTIA, the automatic transmission ECU is located under the battery which has to be removed in order to connect the test harness. Follow the initialisation procedures for ECUs on the vehicle after repairing them and reconnecting the battery.

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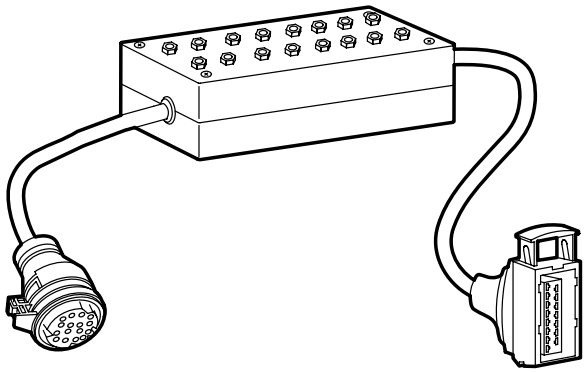
5 - KOSTAL socket control harness and function selector connector: 8010-T (L)



Using an ohmmeter, this tool is used for checking:

- sensors, electrovalves and regulators located on the hydraulic unit via the KOSTAL socket,
- the multifunction switch.

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B - FAULT FINDING TABLE

1 - List of faults

1 - Engine speed signal
2 - Transmission input speed
3 - Transmission output speed
4 - Multifunction switch
5 - Throttle position signal (load potentiometer through injection ECU)
6 - Transmission oil thermistor
7 - Ignition on supply
8 - Battery voltage
9 - Engine torque signal
10 - Electrovalve 1
11 - Electrovalve 2
12 - Pressure regulator 3
13 - Pressure regulator 4
14 - Pressure regulator 5
15 - Pressure regulator 6
16 - Engine torque reduction signal
17 - ECU
18 - Actuator supply output
19 - Gear engaged coherence
20 - Overspeed protection
21 - Gear changing control
22 - Shift lock, XANTIA
23 - Fan unit control
24 - Stop switch
25 - Key lock

Warning: The stop switch fault is memorised every time the ignition is switched on. Press the brake pedal to make the stop switch fault disappear before reading the faults whether in overall test or test by function.

Warning: Before working on the transmission, complete the diagnostic process by reading the faults on the injection ECU.

IMPORTANT: For all faults and problems signalled on the automatic transmission, check the oil level and quality.

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2 - Fault 1. Engine speed signal

COMPO-NENTS LOCATIONS	ECU CONNECTOR	ECU TERM.	COMPO-NENT TERMINAL	CONTROL VALUES	EMERG. MODE
Engine speed information through injection ECU 1320	Connected	40-28	43-19	Test device(s): diagnostic tool in parameter reading. Display in parameter reading of engine speed to be compared with value given by rev counter on control panel. Check no fault relating to engine speed sensor in injection ECU. Deal with injection ECU faults first then erase them.	Maintain gear engaged whilst driving. Switch to 3rd hydraulic after prior return to position P or N
				Test device(s): voltmeter. Engine running (regardless of engine speed): 6.5 < U < 7 volts Engine off, ignition on: U ≈ U battery. Ignition off: U ≈ 4.8 volts (for an open circuit on engine speed information, U ≈ 8 Volts)	
	Disconnected	40	43	Test device(s): ohmmeter. Check the continuity and the insulation with respect to earth and to battery + of the connection: auto. trans. ECU - injection ECU.	

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3 - Fault 2. Automatic transmission input speed

COMPO-NENTS LOCATIONS	ECU CONNECTOR	ECU TERM.	COMPO-NENT TERMINAL	CONTROL VALUES	EMERG. MODE
Turbine speed sensor in hydraulic unit cover 1635	Connected			Test device(s): diagnostic tool in parameter reading. The value must follow the engine speed plus slip of converter. " lockup " closed (converter locked up): the input speed should be equal to the engine speed	Maintain gear engaged whilst driving. Switch to 3rd hydraulic after prior return to position P or N
		16 - 28 44 - 28		Test device(s): voltmeter in AC position: the voltage rises with engine speed. Voltmeter in DC position: U ≈ 2.3 V, engine off, ignition on	
	Disconnected	16 - 44	15 - 16 KOSTAL	Test device(s): ohmmeter, R ≈ 830 ohms. Check the continuity and the insulation with respect to earth and to battery + of the connection: auto. trans. ECU - hydraulic ECU.	

4 - Fault 3. Automatic transmission output speed

COMPO-NENTS LOCATIONS	ECU CONNECTOR	ECU TERM.	COMPO-NENT TERMINAL	CONTROL VALUES	EMERG. MODE
Auto. trans. output speed sensor on hydraulic unit cover 1635	Connected	14 - 28 42 - 28		Test device(s): voltmeter in AC position: the voltage rises with vehicle speed. Test device(s): Voltmeter in DC position: U ≈ 2.3 V, engine off, ignition on	Maintain gear engaged whilst driving. Switch to 3rd hydraulic after prior return to position P or N
	Disconnected	42 - 14	1 - 2 KOSTAL	Test device(s): ohmmeter, R ≈ 830 ohms. Check the continuity and the insulation with respect to earth and to battery + of the connection: auto. trans. ECU - hydraulic ECU.	

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5 - Fault 4. Multifunction switch

The lever position is given by the combination of the state of 4 switches.

If the ECU sees a combination which does not correspond to a recognised position, a fault is detected.

If the detected fault has disappeared, it is declared temporary the next time the ignition is switched on.

COMPO-NENTS LOCATIONS	ECU CONNECTOR	ECU TERM.	COMPO-NENT TERMINAL	CONTROL VALUES	EMERG. MODE
Multifunction switch 1600 on the transmission housing	Connected			Test device(s): diagnostic tool in parameter reading. Check that the physical position of the lever corresponds to that read by the ECU. Check the adjustment of the connecting cable with the lever	.
		55 - 28	Fuse F7 (BB10)	Test device(s): voltmeter. Check + permanent supply of switch and ECU. Otherwise check fuse F7. If the fuse has blown, check there is no short circuit to earth. If the supply is correct, check the operation of the switch (See sub-section C, paragraph 6)	Maintain gear engaged whilst driving Switch to 3rd hydraulic when ignition switched on
	Disconnected			Test device(s): ohmmeter. Check the continuity and the insulation with respect to earth and to battery + of the connection: auto. trans. ECU - multifunction switch. If the connections are correct, check the operation of the switch (see sub-section C, paragraph 6)	

Warning: If the ECU does not recognise the position P, the ECU no longer authorises the "shift lock" lever to be unlocked by pressing the brake pedal.

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6 - Fault 5. Throttle position signal (load potentiometer through injection ECU)

COMPO-NENTS LOCATIONS	ECU CONNECTOR	ECU TERM.	COMPO-NENT TERMINAL	CONTROL VALUES	EMERG. MODE
Throttle position information via injection ECU 1320	Connected			Test device(s): diagnostic tool. Check there are no faults on the throttle potentiometer in the petrol injection ECU. Deal with faults on the injection ECU first then erase them. Press the accelerator pedal to vary the load. Check that the fault seen by the auto. trans. ECU has changed to temporary then erase it. Check by reading parameters with diagnostic tool that when in the full load position on accelerator pedal, there is a load greater or equal to 95% allowing the kickdown function to be activated, otherwise adjust the accelerator cable	Substitution value set up from load information and engine speed
		38-28	31-19 injection ECU	Test device(s): voltmeter. Engine off, ignition on, CAS function unlocked, 0 % load, pedal released, U ≈ 8.3 V Load 50 %, U ≈ 5.2 V. Load 100 % "full load", U ≈ 2.3 V The kickdown function is active in the 95/100% of throttle load range. For an open circuit on driver's wishes information U ≈ 10 V	
	Disconnected	38	31 injection ECU	Test device(s): ohmmeter. Check the continuity and the insulation with respect to earth and to battery + of the connection: auto. trans. ECU - injection ECU.	

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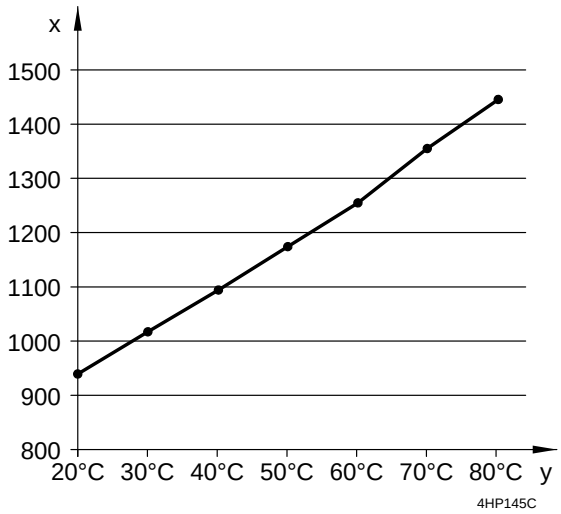
7 - Fault 6. Automatic transmission oil thermistor

COMPO-NENTS LOCATIONS	ECU CONNECTOR	ECU TERM.	COMPO-NENT TERMINAL	CONTROL VALUES	EMERG. MODE
Oil thermistor on hydraulic unit housing 1635	Connected	22 - 21		Test device(s): voltmeter. The voltage varies as a function of temperature. At 21°C: U ≈ 0.93 V At 60°C: U ≈ 0.97 V For an open circuit: U ≈ 5 V	Substitution values: 60°C or 120 °C, depending on driving conditions. Activation of fan units when substitution value is 120 °C
	Disconnected		4 - 9 KOSTAL	Test device(s): ohmmeter. Check the resistance of the probe as a function of temperature (see graph below)	

Note: As the probe is welded directly to the harness inside the hydraulic unit, replacing it requires the harness to be changed.



X = ohms.

Y = °C.

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8 - Fault 7. Ignition on supply

COMPO-NENTS LOCATIONS	ECU CONNECTOR	ECU TERM.	COMPO-NENT TERMINAL	CONTROL VALUES	EMERG. MODE
Ignition on supply		54,31 - 6,34	Fuse A (BMF1)	Test device(s): voltmeter. Ignition off: U = 0 V. Ignition on: 8 V < U < 16 V	

9 - Fault 8. Battery voltage

COMPO-NENTS LOCATIONS	ECU CONNECTOR	ECU TERM.	COMPO-NENT TERMINAL	CONTROL VALUES	EMERG. MODE
Permanent + supply	Connected	55 - 28	Fuse F7 (BF00)	Test device(s): voltmeter. Ignition off: 8 V < U < 16 V	

10 - Fault 9. Engine torque signal

COMPO-NENTS LOCATIONS	ECU CONNECTOR	ECU TERM.	COMPO-NENT TERMINAL	CONTROL VALUES	EMERG. MODE
Engine torque information through injection ECU 1320	Connected	39 - 28	6- 19 injection ECU	Test device(s): voltmeter. Position P, engine running: U ≈ 9.2 V at stabilised speed, increases with acceleration and decreases with deceleration Engine off, ignition on: U ≈ 11 V. Ignition off: U ≈ 4.8 V (for an open circuit on the torque signal U ≈ 8 V)	Substitution value set up from engine load and speed information
	Disconnected	39	6 injection ECU	Test device(s): ohmmeter, Check the continuity and the insulation with respect to earth and to battery + of the connection: auto. trans. ECU - injection ECU.	

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11 - Fault 10. Electrovalve 1

COMPO-NENTS LOCATIONS	ECU CONNECTOR	ECU TERM.	COMPO-NENT TERMINAL	CONTROL VALUES	EMERG. MODE
Electro-valve 1 in hydraulic unit housing 1635	Connected	52 - 30		Test device(s): voltmeter. Engine running, position P: U ≈ U battery As EV1 is constantly operated: engine off, position P: activate the electrovalve using the diagnostic tool. The voltage goes from U battery to 0 V	Switch to 4th hydraulic when driving. Switch to 3rd hydraulic when ignition switched on
	Disconnected		3 - 12 KOSTAL	Test device(s): ohmmeter. R ≈ 32 ohms. Check the continuity and the insulation with respect to earth and to battery + of the connection: Auto. trans. ECU - hydraulic unit	

Note: If the oil temperature fault is also present, check that the KOSTAL socket on the hydraulic unit is correctly clipped in first.

12 - Fault 11. Electrovalve 2

COMPO-NENTS LOCATIONS	ECU CONNECTOR	ECU TERM.	COMPO-NENT TERMINAL	CONTROL VALUES	EMERG. MODE
Electro - valve 2 in hydraulic unit housing 1635	Connected	52 - 33		Test device(s): voltmeter. Engine running, position P: U ≈ U battery Engine off, position P: activate the electrovalve using the diagnostic tool. The voltage goes from U battery to 0 V	Switch to 4th hydraulic when driving. Switch to 3rd hydraulic when ignition switched on
	Disconnected		3 - 13 KOSTAL	Test device(s): ohmmeter. R ≈ 32 ohms. Check the continuity and the insulation with respect to earth and to battery + of the connection: auto. trans. ECU - hydraulic unit.	

Note: If the oil temperature fault is also present, check that the KOSTAL socket on the hydraulic unit is correctly clipped in first.

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13 - Fault 12. Pressure regulator 3 (converter operation)

COMPO-NENTS LOCATIONS	ECU CONNECTOR	ECU TERM.	COMPO-NENT TERMINAL	CONTROL VALUES	EMERG. MODE
Pressure regulator 3 in hydraulic unit housing 1635	Connected	3 - 5		Test device(s): voltmeter. Engine off, ignition on ("lock up" open): U ≈ 1 V, (I = 159 mA), regardless of lever position ("lock up" open) The converter is only controlled from 2nd gear depending on driving conditions. Converter locked up, ("lock up" closed): U ≈ 4.6 V (I = 768 mA), regardless of lever position	Switch to 4th hydraulic when driving. Switch to 3rd hydraulic when ignition switched on
	Disconnected		6 - 5 KOSTAL	Test device(s): ohmmeter. R ≈ 6 ohms. Check the continuity and the insulation with respect to earth and to battery + of the connection: auto. trans. ECU - hydraulic unit.	

Note: If the oil temperature fault is also present, check that the KOSTAL socket on the hydraulic unit is correctly clipped in first.

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14 - Fault 13. Pressure regulator 4

COMPO-NENTS LOCATIONS	ECU CONNECTOR	ECU TERM.	COMPO-NENT TERMINAL	CONTROL VALUES	EMERG. MODE
Pressure regulator 4 in hydraulic unit housing 1635	Connected	3 - 1		Test device(s): voltmeter. Engine running, position P: U ≈ 4.6 V (I = 768 mA) Engine off, position R: U ≈ 1 V. Other positions: U ≈ 4.6 V	Switch to 4th hydraulic when driving. Switch to 3rd hydraulic when the ignition is switched on
	Disconnected		7 - 5 KOSTAL	Test device(s): ohmmeter. R ≈ 6 ohms. Check the continuity and the insulation with respect to earth and to battery + of the connection: auto. trans. ECU - hydraulic unit.	

Note: If the oil temperature fault is also present, check that the KOSTAL socket on the hydraulic unit is correctly clipped in first

15 - Fault 14. Pressure regulator 5

COMPO-NENTS LOCATIONS	ECU CONNECTOR	ECU TERM.	COMPO-NENT TERMINAL	CONTROL VALUES	EMERG. MODE
Pressure regulator 5 in hydraulic unit housing 1635	Connected	3 - 29		Test device(s): voltmeter. Engine running, position P: U ≈ 1 V, (I = 159 mA) (idle position) Engine off, position P, N, R: U ≈ 1.1 V Other positions: U ≈ 5.2 V	Switch to 4th hydraulic when driving. Switch to 3rd hydraulic when the ignition is switched on
	Disconnected		10 - 5 KOSTAL	Test device(s): ohmmeter. R ≈ 6 ohms. Check the continuity and the insulation with respect to earth and to battery + of the connection: auto. trans. ECU - hydraulic unit.	

Note: If the oil temperature fault is also present, check that the KOSTAL socket on the hydraulic unit is correctly clipped in first

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16 - Fault 15. Pressure regulator 6

COMPO-NENTS LOCATIONS	ECU CONNECTOR	ECU TERM.	COMPO-NENT TERMINAL	CONTROL VALUES	EMERG. MODE
Pressure regulator 6 in hydraulic unit housing 1635	Connected	3 - 4		Test device(s): voltmeter. Engine running, position P: U ≈ 4.6 V, (I = 768 mA) (maximum opening) Engine off, position R: U ≈ 1.1 V Other positions: U ≈ 5.2 V	Switch to 4th hydraulic when driving. Switch to 3rd hydraulic when the ignition is switched on
	Disconnected		11 - 5 KOSTAL	Test device(s): ohmmeter. R ≈ 6 ohms. Check the continuity and the insulation with respect to earth and to battery + of the connection: auto. trans. ECU - hydraulic unit.	

Note: If the oil temperature fault is also present, check that the KOSTAL socket on the hydraulic unit is correctly clipped in first

17 - Fault 16. Engine torque reduction signal

Retard advance when changing gear:

COMPO-NENTS LOCATIONS	ECU CONNECTOR	ECU TERM.	COMPO-NENT TERMINAL	CONTROL VALUES	EMERG. MODE
Torque reduction information to injection ECU 1320	Connected	51 - 28	42-19 injection ECU	Test device(s): voltmeter. Engine off, ignition on, positions P, N: U ≈ 9.2 V, other positions: U ≈ 0 V For an open circuit on the torque reduction line, regardless of the lever position: U ≈ 0 V	No kickdown function
	Disconnected	51	42 injection ECU	Test device(s): ohmmeter. Check the continuity and the insulation with respect to earth and to battery + of the connection: auto. trans. ECU -Injection ECU	

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18 - Fault 17. ECU

Erase the fault and check that the fault does not reappear, otherwise test with a new ECU.

19 - Fault 18. Actuator supply output

This fault is only detected when the ignition is switched on:

<table>
<tr><th>COMPO-NENTS LOCATIONS</th><th>ECU CONNECTOR</th><th>ECU TERM.</th><th>COMPO-NENT TERMINAL</th><th>CONTROL VALUES</th><th>EMERG. MODE</th></tr>
<tr><td rowspan="2">Supply line sectioner function
in the ECU</td><td>Connected</td><td rowspan="2">Supply for regulators 3- 6,34
supply for electro-valves
52 - 6,34</td><td></td><td>Test device(s):
voltmeter.
Actuators supplied:
> 7.5 Volts.
Actuators not supplied:
< 7.5 Volts.</td><td rowspan="2">Switch to 4th hydraulic when driving.
Switch to 3rd hydraulic when the ignition is switched on</td></tr>
<tr><td>Disconnected</td><td>5 - 3
KOSTAL</td><td>Test device(s):
ohmmeter.
Check the continuity and absence of a short circuit to battery + and earth on the regulator and electrovalves supply outputs. If these two checks are correct, test with a new ECU</td></tr>
</table>

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20 - Fault 19. Coherence with gear engaged

The difference between the input and output speeds of the transmission is too great for the gear engaged.

IMPORTANT: For all faults and problems signalled on the automatic transmission, check the oil level and quality.

COMPO-NENTS LOCATIONS	ECU CONNECTOR	ECU TERM.	COMPO-NENT TERMINAL	CONTROL VALUES	EMERG. MODE
Transmission input and output speed sensors, in the hydraulic unit housing 1635	Connected			Test device(s): diagnostic tool in parameter reading. Compare the turbine and vehicle speeds for the gear engaged. Check that the status of the electrovalves and regulators corresponds to the expected gear (see sub-section D, paragraph 1). If the fault reappears after erasing it, there is a mechanical fault; brake wear, internal oil leak, electrovalve or regulator seizing	Switch to 4th hydraulic when driving. Switch to 3rd hydraulic when the ignition is switched on
				Test device(s): ohmmeter, voltmeter. Check the engine speed signal and the transmission input and output sensors as specified in sub-section B, paragraphs 2, 3, 4	

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21 - Fault 20. Over speed protection

Engine speed or turbine speed greater than maximum limits.

IMPORTANT: For all faults and problems signalled on the automatic transmission, check the oil level and quality.

COMPO-NENTS LOCATIONS	ECU CONNECTOR	ECU TERM.	COMPO-NENT TERMINAL	CONTROL VALUES	EMERG. MODE
Engine speed and turbine speed information	Connected			Test device(s): diagnostic tool in parameter reading. Check that there is no interference on the engine speed and turbine speed. Compare these values to the engine speed given by the injection ECU and the display on the control panel	Switch to 4th hydraulic when driving. Switch to 3rd hydraulic when the ignition is switched on
				Test device(s): ohmmeter, voltmeter. Check the engine speed signal and the transmission input and output sensors as specified in sub-section B, paragraphs 2, 3, 4	

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22 - Fault 21. Gear change control

There is no variation in speed information after changing a gear.

IMPORTANT: For all faults and problems signalled on the automatic transmission, check the oil level and quality.

COMPO-NENTS LOCATIONS	ECU CONNECTOR	ECU TERM.	COMPO-NENT TERMINAL	CONTROL VALUES	EMERG. MODE
Transmission input and output speed sensors, in the hydraulic unit housing 1635	Connected			Test device(s): diagnostic tool in parameter reading. Compare the turbine and vehicle speeds for the gear engaged. Check that the status of the electrovalves and regulators corresponds to the expected gear (see sub-section D, paragraph 1). If the fault reappears after erasing it, there is a mechanical fault; brake wear, internal oil leak, electrovalve or regulator seizing	Maintain gear engaged whilst driving. Switch to 3rd hydraulic after prior return to position P or N
				Test device(s): ohmmeter, voltmeter. Check the electrovalve and regulator supplies (see sub-section B, paragraph 8)	

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23 - Fault 22. Shift lock

COMPO-NENTS LOCATIONS	ECU CONNECTOR	ECU TERM.	COMPO-NENT TERMINAL	CONTROL VALUES	EMERG. MODE
Lever locking relay 1642	Connected	32 - 34		Test device(s): voltmeter. Gear selector lever in position P. Brake pedal pressed: U = 0 V. Brake pedal released: U = U battery	No "shift lock" position: lever remains locked in position P and must be released manually
	Disconnected		1 - 2 (5 green tracks)	Test device(s): ohmmeter. Check the relay coil, R ≈ 60 ohms. Check continuity and insulation	

Note: If the lever remains locked although there is no "shift lock" fault, check the lever release actuator (see sub-section C, paragraph 4).

24 - Fault 23. Fan unit control

COMPO-NENTS LOCATIONS	ECU CONNECTOR	ECU TERM.	COMPO-NENT TERMINAL	CONTROL VALUES	EMERG. MODE
	Connected	20 - 34		Test device(s): voltmeter. The fan unit relay is activated when the oil temperature is greater than 120°C	
	Disconnected			Test device(s): ohmmeter. R ≈ 400 ohms.	

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25 - Fault 24. Stop switch

No action on the brake pedal has been detected since the ignition was switched on:

COMPO-NENTS LOCATIONS	ECU CONNECTOR	ECU TERM.	COMPO-NENT TERMINAL	CONTROL VALUES	EMERG. MODE
Brake pedal switch 2100	Connected	10 - 34		Test device(s): voltmeter. Ignition on Brake pedal released: U = 0 V. Brake pedal pressed: U ≈ U battery	No "shift lock" position: the lever is locked in position P and must be released manually
	Disconnected	10 - 54		Test device(s): ohmmeter. Stop lights disconnected (including third stop light). Brake pedal released: R = infinity. Brake pedal pressed: R ≈ 0 ohms	

Warning: The stop switch fault is memorised every time the ignition is switched on. Press the brake pedal to make the fault disappear before reading the faults with the diagnostic tool whether in general test or test by function.

26 - Fault 25. Key lock

COMPO-NENTS LOCATIONS	ECU CONNECTOR	ECU TERM.	COMPO-NENT TERMINAL	CONTROL VALUES	EMERG. MODE
	Connected	49 - 34		Test device(s): voltmeter. Gear selector lever in position P: U = 0 V. Other positions: U ≈ U battery	
	Disconnected			Test device(s): ohmmeter. Check the relay coil, R ≈ 88 ohms. Check continuity and insulation	

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C - ELECTRICAL TESTS

1 - Diagnostic connection

COMPONENTS LOCATIONS	ECU CONNECTOR	ECU TERMS.	COMP. TERMS.	CONTROL VALUES
Central diagnostic socket C001 in passenger compartment	Disconnected	50 - 28		Test device(s): voltmeter. Disconnect the ECU connector, connect the diagnostic tool to the 30 track socket: check U = U battery on terminal 50
		50	Terminal G1 (brown 30 track)	Test device(s): ohmmeter. Check the continuity and the insulation with respect to earth of the diagnostic connection

2 - Reversing lights control

Test devices: multimeter, multifunction switch test harness:

COMPONENTS LOCATIONS	ECU CONNECTOR	ECU TERMS.	COMP. TERMS.	CONTROL VALUES
Reversing lights function 2630 2635, reverse gear info for indexed rear view mirror. Gear selector lever in position R	Disconnected		Reversing lights supply, fuse F12 (BBF00)	Test device(s): voltmeter. Ignition on, check +12 Volts supply between terminal 8 on harness side and earth: U = U battery Otherwise check fuse F12
			8 - 9 black 10 track connector	Test device(s): ohmmeter. Gear selector lever in position R: R = 0 ohm. Other positions: R = infinity. Check the insulation with respect to earth
			9 - black 10 track connector. Harness side	Check the reversing lights circuit between terminal 9 and earth: R ≈ 2.3 ohms (2630 and 2635 in parallel)

Note: This information, provided by the multifunction switch, is independent to the automatic transmission ECU.

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3 - Starting authorisation

Test devices: multimeter, multifunction switch test harness:

COMPONENTS LOCATIONS	ECU CONNECTOR	ECU TERMS.	COMP. TERMS.	CONTROL VALUES
Starter motor relay 1005 Multifunction switch 1600 on transmission housing. Gear selector lever in position P, N	Disconnected		Harness side: 7/earth (black 10 tracks)	Test device(s): voltmeter. Ignition on, check the +12 Volt supply of the relay, between terminal 7 and earth: U ≈ U battery
			Harness side: 6/earth (black 10 tracks)	Test device(s): ohmmeter. Check the starter motor relay coil between terminal 6 and earth: R ≈ 63 ohms
			6/7 (black 10 tracks)	Test device(s): Ohmmeter. Gear selector lever in position P, N: R = 0 ohm. Other positions, R = infinity

Note: This information, provided by the multifunction switch, is independent to the automatic transmission ECU.

4 - Gear lever release actuator

COMPONENTS LOCATIONS	ECU CONNECTOR	ECU TERMS.	COMP. TERMS.	CONTROL VALUES
Gear lever release actuator 1638, in the console at the base of the lever	Connected		Harness side: 1 - 2 (black 4 tracks)	Test device(s): voltmeter. Ignition on, gear selector lever in position P, brake pedal pressed, check +12 Volt supply between terminals 1 and 2: U ≈ U battery. Otherwise check there are no faults preventing the "shift lock" and check relay 1642, (see sub-section B, paragraph 23)
			1 - 2 (black 4 tracks)	Test device(s): ohmmeter. Check the actuator coil between terminals 1 and 2: R ≈ 12 ohms

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5 - Program selector

Depending on the style of driving, the ECU chooses the most suitable gear changing law program (programs 1 to 5 ranging from more economical driving to more sporty driving). The driver can select specific programs using the sport / snow switch:

COMPONENTS LOCATIONS	ECU CONNECTOR	ECU TERMS.	COMP. TERMS.	CONTROL VALUES
Program switch supply			4 - 6	Test device(s): voltmeter. Ignition on: U ≈ 12 V. Otherwise check fuse F2
Snow program selection	Connected			Test device(s): diagnostic tool in parameter reading. Snow light illuminated: selection: snow. Program: 8 (Lever in position P, R, D). Program: manual (Lever in position 1, 2, 3)
		12 - 28	2 - 6	Test device(s): voltmeter. Ignition on: U ≈ 0 V. Other selection: U ≈ 10 V
	Disconnected	12	2	Test device(s): ohmmeter. Check the continuity and the insulation with respect to earth
Sport program selection	Connected			Test device(s): Diagnostic tool in parameter reading. Sport light illuminated: sport selection Program: 4. (or program 5 depending on driving)
		45 - 28	7 - 6	Test device(s): voltmeter. Ignition on: sport: selection U ≈ 0 V. Other selection: U ≈ 10 V
	Disconnected	45	7	Test device(s): ohmmeter. Check the continuity and the insulation with respect to earth
Normal program selection	Connected			Test device(s): Diagnostic tool in parameter reading. Sport and snow lights extinguished: selection normal. Program: 2. (or program 1 - 5 depending on driving)
		45 - 28	7 - 6	Test device(s): voltmeter. Ignition on: U ≈ 10 V.
		12 - 28	2 - 6	
	Disconnected	45	7	Test device(s): ohmmeter. Check the continuity and the insulation with respect to earth
		12	2	

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6 - Multifunction switch

Test device(s): ohmmeter, switch test harness or harness 4187-T and terminal box:

LEVER POSITION	36	37	9	8	BLACK 16 TRACK SWITCH CONNECTOR	ECU CONNECTOR
	2	3	4	5		
P	∞	R = 0 ohm	∞	∞	1	55
*	∞	R = 0 ohm	R = 0 ohm	∞		
R	∞	∞	R = 0 ohm	∞		
*	∞	∞	R = 0 ohm	R = 0 ohm		
N	∞	∞	∞	R = 0 ohm		
*	R = 0 ohm	∞	∞	R = 0 ohm		
D	R = 0 ohm	R = 0 ohm	∞	R = 0 ohm		
*	R = 0 ohm	R = 0 ohm	R = 0 ohm	R = 0 ohm		
3	R = 0 ohm	∞	R = 0 ohm	R = 0 ohm		
*	R = 0 ohm	R = 0 ohm	R = 0 ohm	R = 0 ohm		
2	R = 0 ohm	R = 0 ohm	R = 0 ohm	∞		
*	R = 0 ohm	R = 0 ohm	R = 0 ohm	R = 0 ohm		
1	∞	R = 0 ohm	R = 0 ohm	R = 0 ohm		

Note: Combinations marked "" correspond to intermediate positions. The role of combinations marked "*" is to have just a single line changing state when changing from one recognised position to another.*

Note: As the ECU connector is disconnected for this test, the lever must be released manually to remove it from position P.

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Test device(s): voltmeter, harness 4187-T, terminal box:

LEVER POSITION	36	37	9	8	ECU CONNECTOR
P	0 V	U battery	0 V	0 V	6
*	0 V	U battery	U battery	0 V	
R	0 V	0 V	U battery	0 V	
*	0 V	0 V	U battery	U battery	
N	0 V	0 V	0 V	U battery	
*	U battery	0 V	0 V	U battery	
D	U battery	U battery	0 V	U battery	
*	U battery	U battery	U battery	U battery	
3	U battery	0 V	U battery	U battery	
*	U battery	U battery	U battery	U battery	
2	U battery	U battery	U battery	0 V	
*	U battery	U battery	U battery	U battery	
1	0 V	U battery	U battery	U battery	

Note: Combinations marked "" correspond to intermediate positions. The role of combinations marked "*" is to have just a single line changing state when changing from one recognised position to another.*

7 - Hydraulic unit

Test device(s): ohmmeter, KOSTAL test harness or harness 4187-T and terminal box:

COMPO-NENTS	52	3	44	14	22		ECU CONNECTOR
	3	5	16	2	9	KOSTAL CONNEC-TOR	
EL1	R ≈ 32 ohms	∞	∞	∞	∞	12	30
EL2	R ≈ 32 ohms	∞	∞	∞	∞	13	33
REG3	∞	R ≈ 6 ohms	∞	∞	∞	6	5
REG4	∞	R ≈ 6 ohms	∞	∞	∞	7	1
REG5	∞	R ≈ 6 ohms	∞	∞	∞	10	29
REG6	∞	R ≈ 6 ohms	∞	∞	∞	11	4
Input speed	∞	∞	R ≈ 830 ohms	∞	∞	15	16
Output speed	∞	∞	∞	R ≈ 830 ohms	∞	1	42
Oil temperature	∞	∞	∞	∞	X	4	21

X: resistance which varies with temperature

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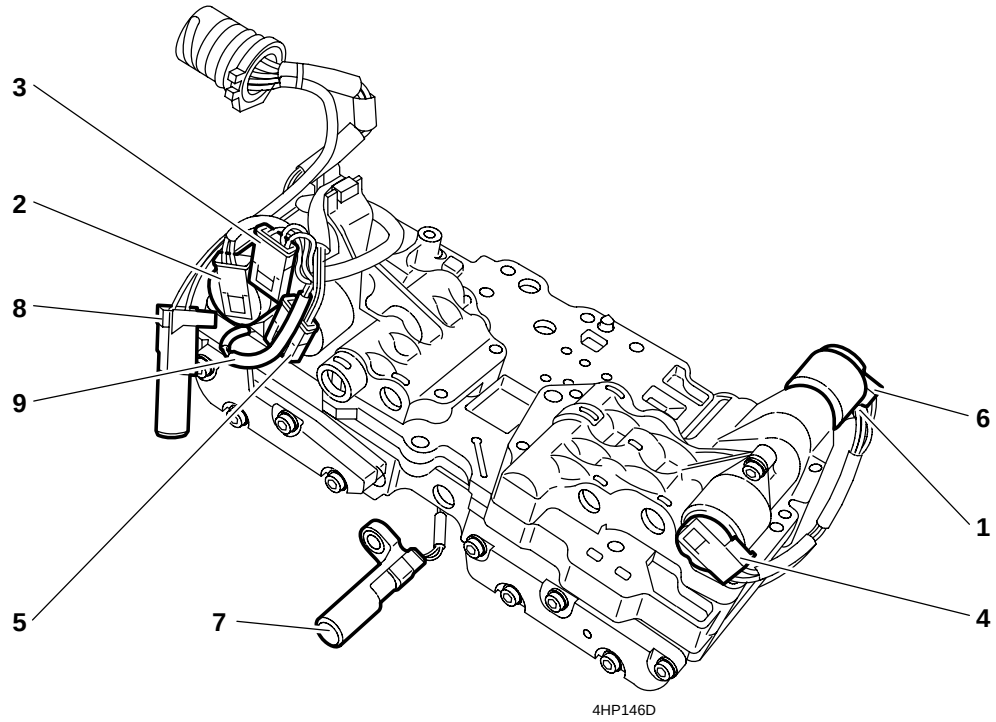

1 - Electrovalve 1 (green base, violet and grey wires)
2 - Electrovalve 2 (green base, violet and green wires)
3 - Pressure regulator 3 (black base, violet and yellow wires)
4 - Pressure regulator 4 (black base, violet and red wires)
5 - Pressure regulator 5 (black base, violet and blue wires)
6 - Pressure regulator 6 (black base, violet and white wires)
7 - Transmission input speed sensor (turbine) (brown wires)
8 - Transmission output speed sensor (yellow wires)
9 - Oil temperature sensor

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D - OPERATION

1 - Operation of electrovalves and pressure regulators

SELECTOR LEVER POSITION	GEAR ENGAGED	OPERATION OF ELECTROVALVES **		OPERATION OF PRESSURE REGULATORS			
		EL1	EL2	EDS3	EDS4	EDS5	EDS6
P		1	1	159mA	768mA	159mA	768mA
R	R	1	1	159mA	159mA	159mA	159mA
N		1	1	159mA	768mA	159mA	768mA *
D	1	1	1	159mA	768mA	768mA	768mA
	2	1	0	X	768mA	768mA	159mA
	3	1	0	X	768mA	159mA	768mA
	4	1	0	X	159mA	159mA	159mA
3	1	1	1	159mA	768mA	768mA	768mA
	2	1	0	X	768mA	768mA	159mA
	3	1	0	X	768mA	159mA	768mA
2	1	1	1	159mA	768mA	768mA	768mA
	2	1	0	X	768mA	768mA	159mA
1	1	1	1	159mA	768mA	768mA	768mA

** status 1: electrovalve operated

status 0: electrovalve at rest

* : except when snow program selected

X : varies depending on converter lock-up

159 mA "lock up" open

768 mA "lock up" closed

(converter lock up)

Note: When the 2 electrovalves are not operated, the automatic transmission is put into 3rd hydraulic when the ignition is switched on.

Warning: In 3rd hydraulic, reverse gear can be selected but this action produces a large bang.

Note: The currents of the pressure regulators shown when reading parameters using the diagnostic tools are the reference values and not the measurements of the operating currents.

2 - Kickdown

The kickdown function is active in the 95 / 100 % of throttle load range.

Using the diagnostic tool in parameter reading mode, check that when the accelerator pedal is fully pressed (full load position), there is a load greater than or equal to 95% thus activating the kickdown function, otherwise adjust the accelerator cable.

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E - DOWNLOADING TO THE ECU

1 - Updating the ECU by downloading

The downloading operation is used to update the automatic transmission ECU or to modify it following a change to the injection ECU.

IMPORTANT: Every time a downloading operation is performed to the automatic transmission ECU, the injection ECU must be updated (and vice versa).

IMPORTANT: After every downloading operation, initialise the auto-adaptives of the automatic transmission ECU.

2 - Initialising the auto-adaptives

Accessed from the "SPARE PARTS" menu, the auto-adaptive initialisation function is used to initialise the auto-adaptive parameters recorded by the automatic transmission ECU.

WARNING: After initialising the auto-adaptives, gear changes may vary in quality whilst the ECU adapts itself to the vehicle.

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F - SYMPTOMS OCCURRING DUE TO THE ABSENCE OF A FAULT ON THE DIAGNOSTIC TOOL

1 - No dialogue between the ECU and the diagnostic tool

Check the supply and earth of the ECU.

Check the diagnostic line (see sub-section C, paragraph 1).

Perform a test with a new ECU. If the ECU is faulty, the transmission will be in 3rd hydraulic when the ignition is switched on.

Warning:	In 3rd hydraulic, reverse gear can be selected but this action produces a large bang.

2 - Cannot start engine, lever in position P, N

Starting authorisation function via the multifunction switch:

- check that the injection ECU has been unlocked by the coded anti-start,
- check the starting authorisation (see sub-section C, paragraph 3).

3 - Cannot release lever from position P by pressing brake pedal

"Shift lock" function:

- check that the stop switch fault has disappeared after pressing the brake pedal,
- check that the ECU fitted deals with the "shift lock" function,
- check that the Ecu recognises position P of the gear lever. Check the adjustment of the selector control cable,
- check the multifunction switch (see sub-section C, paragraph 6),
- check the gear lever release actuator (see sub-section C, paragraph 4).

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4 - Reversing lights do not illuminate with selector lever in position R

Check the reversing lights control (see sub-section C, paragraph 2).

5 - No noticeable effect when selecting sport / snow

Check that the ECU recognises the selections requested (see sub-section C, paragraph 5).

6 - No drive, lever in position D, whilst an imposed gear has not been requested previously then no gear changes after returning to position D

Short circuit to positive on line 4 of the multifunction switch:

- check that the ECU recognises the gear lever position,
- check the multifunction switch (see sub-section C, paragraph 6).

Note: This fault is combined with the absence of the gear lever locking (position P not recognised).

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ZF 4HP20 AUTOMATIC TRANSMISSION

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WORKING ON A COMPENSATOR-BRAKE CONTROL VALVE

OVERHAULING A COMPENSATOR-BRAKE CONTROL VALVE

DISMANTLING

Remove, Fig. I :

- lock ring (7), with a screwdriver, **Fig. III**,
- rubber protector (8),
- circlip (9),
- the front slide-valve (11)/cup (10) assembly,
- front slide-valve return spring (6).

Turn the compensator-brake control valve upside-down.

Take off, Fig. I :

- circlip (16), slightly pushing in plug (15) using bush **"a"**, (with the compensator-brake control valve gripped in a vice), **Fig. IV.**
- plug (15)
- compensator spring (12)
- cup (13)
- cap (1) fitted with ball bearing race (2)
- rear slide-valve return spring (14)
- shuttle (4)
- rear slide valve (5)

Disengage :

- sealing ring (13)
- teflon seal (17)
- sealing ring (18) from under the teflon seal, **Fig. II**.

Clean the parts with lead-free petrol ; blow through the items with compressed air.

NOTE : Since slide-valves (5) and (11) and shuttle (4) are matching, they cannot be replaced.

REBUILDING

Spread LHM fluid over all the components and inside the compensator-brake control valve.

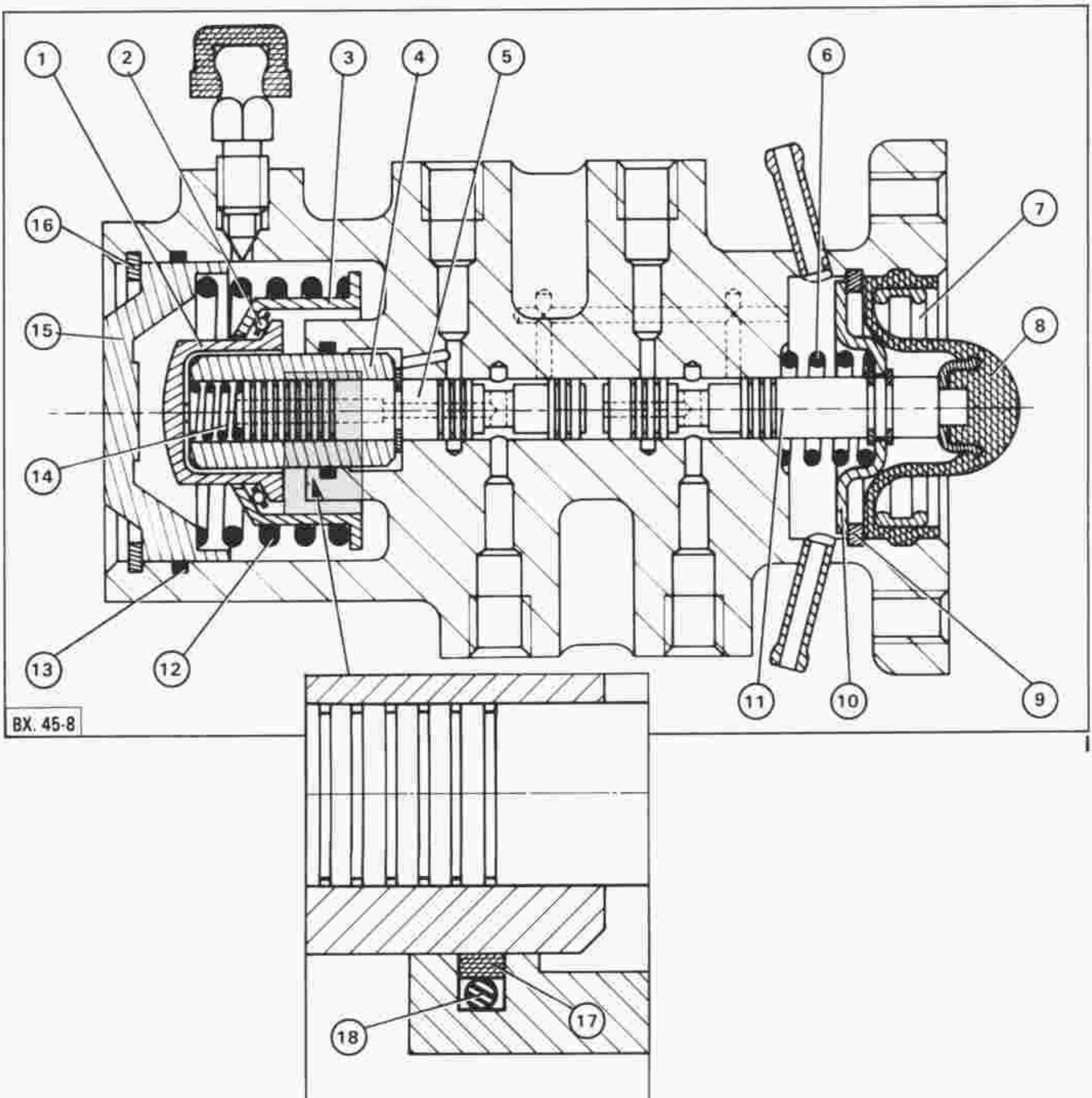
Relocate, Fig. I and II :

- sealing ring (18)
- teflon ring (17)

(Shape this ring like a heart to fit it in place ; then reshape it with the fingers and shuttle),

- sealing ring (13),

(with the paint mark facing the brake control valve interior).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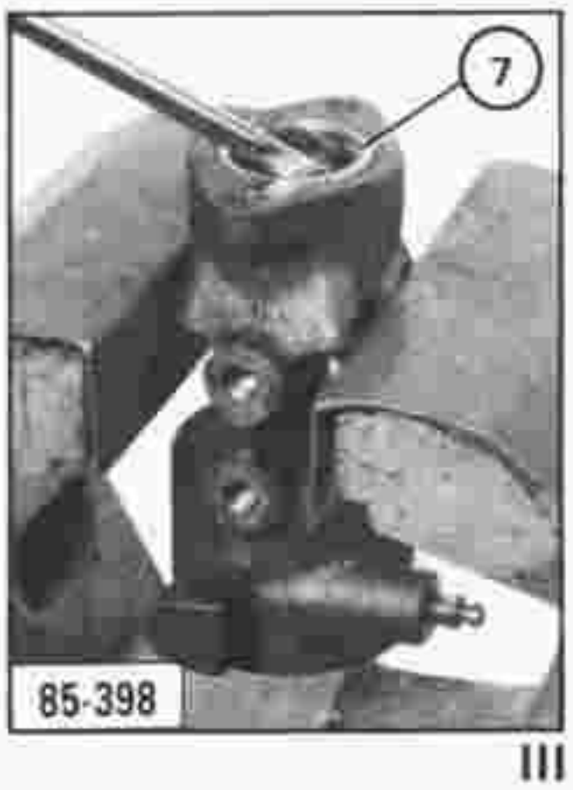
I

II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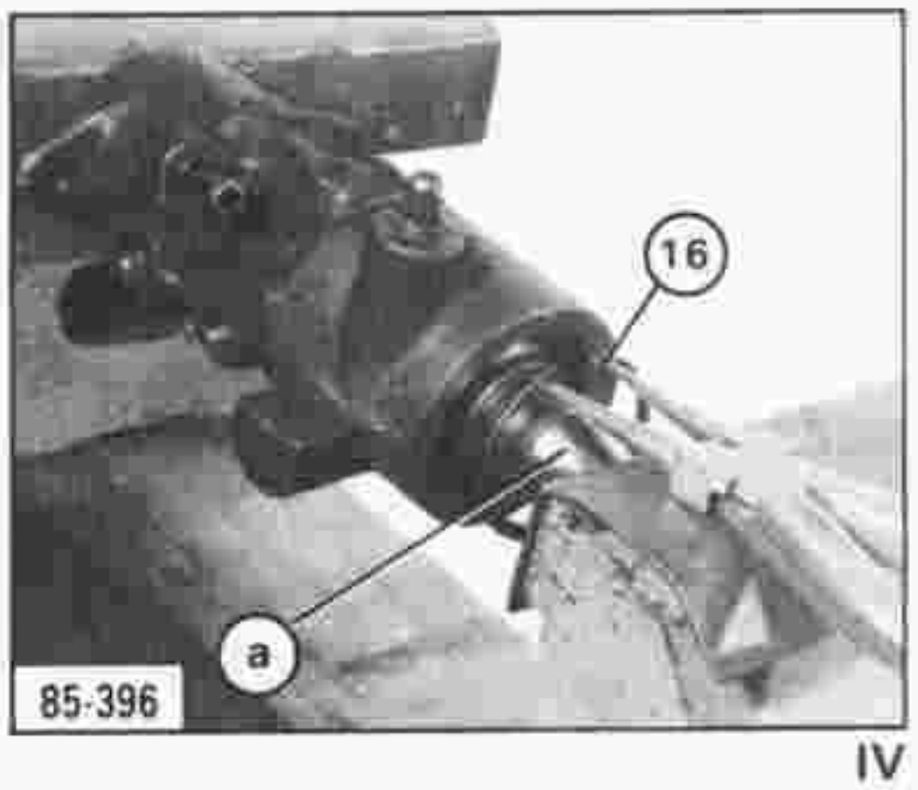
III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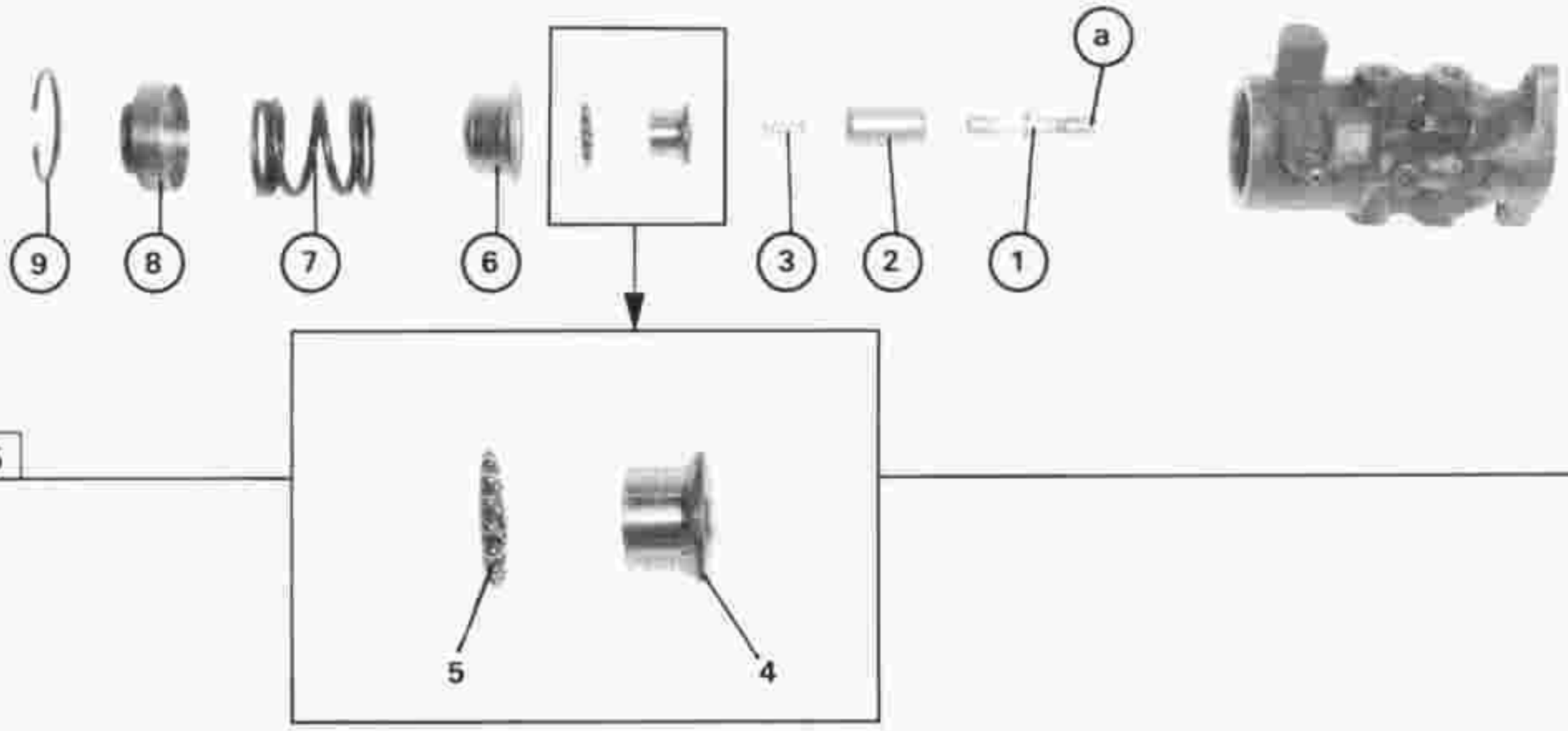
IV



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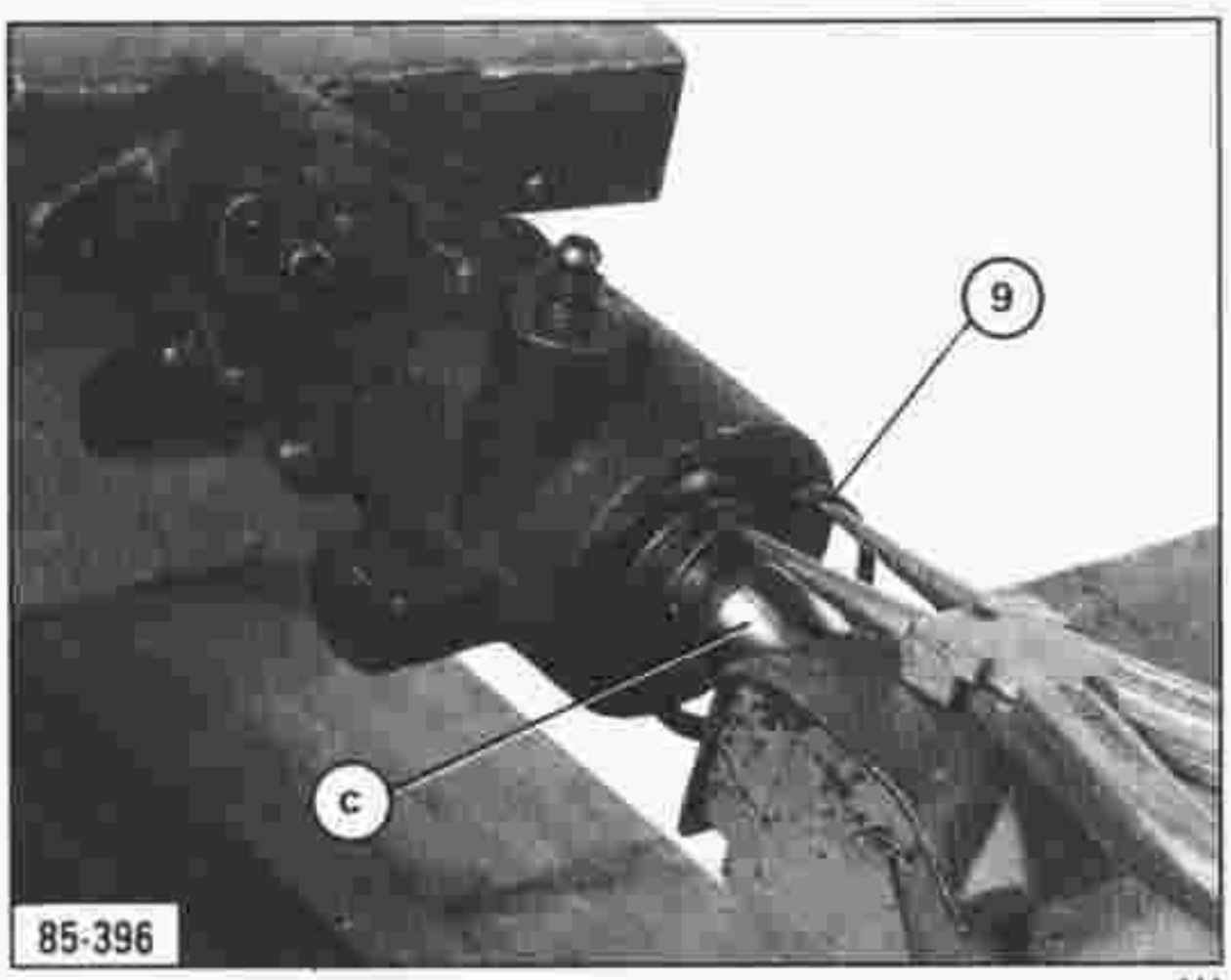

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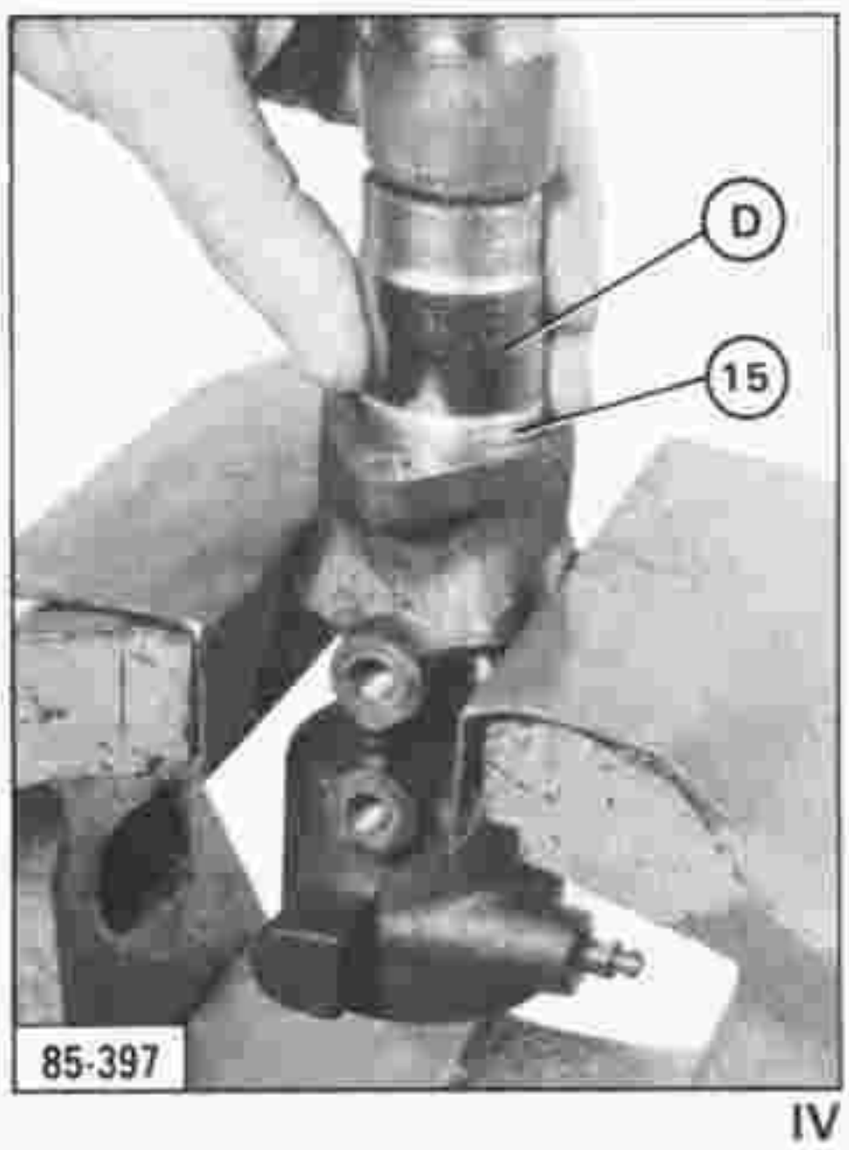
III



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IV

Engage :

– rear slide valve (1) and its stop ring into the brake control valve, **Fig. I**, with end **"a"** directed inwards,

– shuttle (2),

– spring (3).

Fit shutlle (2) with :

– cap (4) equipped with its ball bearing race (5), (pay attention to the direction in which the ball bearing race must be fitted).

Install :

– cup (6),

– compensator spring (7),

– plug (8).

Position circlip (9) slightly pushing plug (8) with bush **C**, (grip the compensator-brake control valve in a vice).

Turn the compensator-brake control valve upside-down.

Locate in the brake control valve : **Fig. II**

– spring (10),

– front slide-valve (11) and its cup (12), with end **"b"** pointing inwards,

– circlip (13),

– rubber protector (14),

– lock ring (15), by means of bush **D**, **Fig. IV**.

SPHERE APPLICATION TABLE

MODEL	VOLUME/PRESSURE/DAMPER CITROEN REFERENCE AMTEX PATTERN NEW RECONDITIONED FRONT	REAR
ACCUMULATOR SPHERE **BX/GSA/CX/XM >RP5494**	400/62.5 5 437 354 N45302 866050	
ACCUMULATOR SPHERE **XM RP5495>** **ALL XANTIA**	400/62 95 666 763 N45304	
GS/GSA	400/55/1.80 75 515 065 N45306 866016	400/35/1.10 95 533 774 N45340 866015
BX 14 **BX 16/19 >84**	400/55/1.80 95 564 253 N45306 866016	400/40/1.10 95 564 974 N45342 866025
BX 16/19 CARB SALOON **BX17D SALOON** **BX19D SALOON**	500/55/1.80 95 630 572 N45308 866020	400/40/1.10 95 564 974 N45342 866025
BX GTi **BX TURBO DIESEL SALOON** **BX 16v (not available in Amtex or recon,** **GTi may be fitted but ride is slightly softer.)**	400/55/1.65 95 630 610/96 024 568 **N45310** 866021	400/40/1.1 (96 635 425) N45342 866025
BX 16/19 CARB ESTATE **BX 17D/19D ESTATE**	500/55/1.65 96 024 565 **N45312** 866031	500/40/1.10 96 054 566 **N45346** 866034
BX TZI/TRI ESTATE **BX TURBO D ESTATE**	400/55/1.40 96 024 568 **N45310** 866021	500/40/1.00 96 032 914 **N45346** 866034

SPHERE APPLICATION TABLE

MODEL	VOLUME/PRESSURE/DAMPER CITROEN REFERENCE AMTEX PATTERN NEW RECONDITIONED FRONT	REAR
BX 4x4	400/55/1.40 96 024 568 N45310 866021	500/40 95 666 815 N45344 866077
CX SALOON- ALL MODELS EXCEPT GTi TURBO	500/75/1.90 95 613 812 N45314 866030	500/40/1.25 95 606 143 N45348 866035
CX GTi TURBO	500/75/1.65 95 606 140 N45316 866032	500/40/1.25 95 606 143 N45348 866035
CX ESTATE/SAFARI	500/75/1.90 95 613 812 N45314 866030	700/35/1.50 95 631 258 N45350 866045
XM 2.0 SALOON (HYDRACTIVE)	400/55/0.70 96 051 826 N45320 866075	400/30/0.50 96 051 827 N45352 866060
XM ALL TYPES HYDRACTIVE CENTRE SPHERES	500/70 75 520 295 N45322 866055	400/50 96 045 530 N45354 866065
XM 2.1 TD/2.5TD AND V6 SALOON	400/50/0.60 96 065 505 N45324 866075	400/30/0.50 96 051 827 N45352 866060
XM ESTATE ALL MODELS	400/50/0.60 96 065 505 N45324 866075	400/40/070 96 119 517 N45358 866076

SPHERE APPLICATION TABLE

MODEL	VOLUME/PRESSURE/DAMPER CITROEN REFERENCE AMTEX PATTERN NEW RECONDITIONED FRONT	REAR
XANTIA 1.6/1.8 & 19D NON HYDRACTIVE SALOON	400/70/1.65 96 666 858 N45330 866085	400/40/1.1 95 666 860 N45364 866086
XANTIA 1.9TD & 2.0 8v/16v NON HYDRACTIVE SALOON	400/55/1.5 95 666 857 N45332 866087	400/30/1.0 95 666 862 N45366 866088
XANTIA ESTATE NON HYDRACTIVE	400/55/1.5 95 666 857 N45332 866087	400/40 5272 40 N45370A
XANTIA 1.9TD/2.1TD/2.0 8v/16v HYDRACTIVE SALOON	400/50/0.6 95 666 859 N45334 866075	400/30/0.5 95 666 861 N45368 866060
XANTIA ESTATE HYDRACTIVE	400/50/0.6 95 666 859 N45334 866075	400/40 5272 38 N45370
XANTIA ALL TYPES HYDRACTIVE CENTRE SPHERES	500/70 75 520 295 N45322 866055	400/50 96 045 530 N45354 866065
XANTIA ALL TYPES REAR ANTI SINK SPHERE		400/50 96 145 672 N45372

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Citroen XM

Although not as unorthodox as the previous Citroen CX executive cars, the roomy XM is one of the most striking looking big saloons on the road both in 5-door hatchback and estate forms.

The XM is basically a very strong car and it doesn't rust. But it must have a service record showing Main Dealer servicing for the first three years plus oil changes every 6,000 miles after that. The LHM should have been changed every 36,000 miles and the timing belt every 72,000.

Loyal Citroen owners say that the XM is a great car for high speed, long distance driving. But it's not a relaxing car in town, especially when parking. So bear in mind how you'll use the car and investigate carefully before you commit yourself to buying.

The complex hydractive electronic suspension is excellent but needs specialist care. On the other hand it depreciates rapidly, especially the petrol versions, so it can prove a bargain.

Three generations

The XM spans three generations each updated and revised, but visually identical.

The Mark 1 was sold from October 1989 to the middle of 1993 — that's G, H and J registration, plus some on the K-plate. At first they were pretty unreliable, and early cars are now very cheap. However it's safest to avoid these unless you're a pretty competent mechanic.

The Mark 2 ran from late J registration to early L and are much more reliable than Mark Is - as reliable as most other executive cars in fact. You can pick them out by their two spoke steering wheel - but they also have ABS brakes and Hydractive II suspension. The suspension uses a faster computer, so comfort and roadholding are improved.

However the suspension computer on the Mark III is faster still and it transforms the XM into the car it was always intended to be. Look for the XM badge on the driver's side of the boot to confirm you're looking at a Mark III which were available from about late L-reg onwards. They're also very reliable and build quality is not far removed from German levels.

Whatever the age of the XM you're looking at, it's very important to make sure the car's been properly maintained. Ask the seller for the service record and the service invoices. If the car's fairly new, only buy if there's proof that it's been serviced by a Citroen Dealer every 6,000 miles.

On older cars, look for 2 or 3 years of Dealer servicing followed by visits to a Citroen specialist every 6,000 miles. Don't worry too much if the odd service has been missed - but if there's a pattern of neglect or there's no service record, don't buy at any price.

For complete peace of mind, have a word with any Citroen specialist involved with the car — before you agree to buy. Finally, when you go through the service record, make sure the mileage adds up to what's on the clock; don't buy if there's any reason to suspect the milometer's been turned back.

Suspension

Summary of models

Equipment levels on the XM were generous at the outset, and have improved steadily since.

Even the modest carburettor engined 2.0 model had PAS, an electric glass sunroof, electric front windows, remote central locking and a rear sun blind.

The Si, the next step up, added electric mirrors, electric rear windows, metallic paintwork, front fog lamps, electric adjust-ment for the driver's seat, and Citroen's then novel steering column-mounted audio controls.

The SEi featured ABS as standard (optional on other XM models), and improved on the Si spec with leather upholstery, air conditioning, alloy wheels and an alarm.

Diesel turbo models carried SD and SED badges, being the equi-valent of the Si/SEi.

The short-lived Mk 2 kept the badging of the Mk 1; minor changes included heated electric mirrors and better velour trim on base models, and heated washer jets on Si/ SED models.

ABS across the range plus the 'Hydractive II' suspension system came in mid-1993.

June 1994 saw the launch of new 2.0 16v and 2.0 Turbo engines, and the adoption of new SX, VSX and top Exclusive equip-ment levels. Revisions included better security measures including dead-locks, body side impact protection beams, and an airbag on all models.

Checklist:

Item	Budget

To test the LHM fluid in the suspension, you'll need a hypodermic syringe minus the needle. This is the most important check on any XM so it's well worth buying one at your local chemist, before you go to look at a car. Locate the black plastic reservoir at the rear of the engine compartment on the passenger side, open it and draw up a sample with the syringe.

The LHM fluid should be a sparkling green colour like Fairy Liquid. Golden brown means it needs changing as soon as possible. If it's grey, milky or any other colour apart from green or brown, reject the car because the whole suspension system probably needs replacement.

Put a drop of LHM on the tip of your tongue, remembering to spit it out straightaway. If it tastes bitter, it's been topped up with normal brake fluid and will rot all the rubber in the system, so reject the car. If the LHM has been changed every 36,000 miles it will be fine, unless the car has done a very high mileage.

Start the engine. The engine should turn over vigorously, start first time, and settle easily into a fast idle. If it doesn't then the car's probably been neglected or has done a high mileage. In fact a warm engine that doesn't start easily should be rejected.

If left standing for a few hours an XM will sink down but it should be back up to normal ride height within about 30 seconds of the engine starting. You'll actually see the whole car lifting. But if it takes a while to do so, particularly if there are any strange noises, get the car checked over by a Citroen specialist before you agree to buy.

The 'suspension spheres' are the most important part of the suspension because they act as the springs to keep the car level. And they act as the pressure reservoir for the hydraulic system.

The nitrogen in the spheres leaks away slowly, so budget £250 every 2 years for new spheres and new LHM, although spheres on V6s may need changing more often than that. You can get recharged spheres but reports suggest that they don't last long on the XM.

To see if the spheres need changing, check the accumulator sphere first as that's the one that needs changing most often. If you hear a hollow whirr-click noise from the front of the engine every few seconds, it's almost certainly dud. A whirr-click every 20 or 30 seconds means it's got plenty of life.

To check the other spheres, switch the suspension to 'Auto' on the panel between the seats, then drive for a few miles. If the suspension feels hard and unyielding, the spheres need changing. Don't go on with the road test and don't buy unless the seller is willing to get the spheres changed so you can check the suspension properly.

If the car appears to ride pretty well, the next thing to check is that suspension computer switches correctly between the 'Auto' and 'Sport' settings. Try to find a smooth but twisty road, select the 'Sport' setting, and drive down it at 40 to 50 mph.

On 'Sport' setting, the car should feel firm and stable, cornering with very little roll. Drive down the same road with the setting on 'Auto'. This time the car should feel softer on the straights when driven gently but under hard acceleration or if you start to corner enthusiastically or brake hard, the computer should automatically switch back to the 'Sport' setting until you're cruising again.

If you don't notice any difference, then it could be that one or more of the sensors has stopped working or the computer is faulty. When this happens, it automatically goes to 'Sport' setting. This could cost plenty to fix so rejection is the safest course.

Suspension spheres and LHM	£250
Suspension arm bearings	£300
Fit new clutch	£600
Replacement gearbox	£1500

Reject any Citroen XM if:

- LHM fluid is discoloured or dirty
- Car rises slowly or jerkily after being left
- Engine doesn't start easily
- Suspension modes don't work
- Gearbox problems
- Servicing has been neglected
- ABS light stays on
- Radiator is leaking coolant
- Second fan doesn't come on

Also worth a look

- **FORD GRANADA & SCORPIO** – Well equipped and spacious, the original 'Granny' was tough and economical. A successful seller, parts are cheaper than average. The 2.9 V6 is the best choice with 1.8 and 2.0 models a bit sluggish.
- **HONDA LEGEND** – Spacious, comfortable, up-market saloon and coupe that lacks the image of the German makes it's aimed to rival. Refined engines and good performance; automatics are the predominant choice.
- **PEUGEOT 605** – Comfortable, roomy but never popular and looks like a slightly bigger 406. High depreciation makes it a bargain. V6 is smooth and swift, turbo diesels offer good fuel economy.
- **ROVER 800** – Boxy executive saloons and hatchbacks, based on the old Honda Legend. Spacious and comfortable but pre-1991 cars were poorly built and reliability can be a problem. Cheap to buy, costly to fix.
- **VAUXHALL CARLTON** – Comfortable and understated, better than but never as popular as the Ford Granada. Offers good handling and ride, rugged four-cylinder engines, or smooth and potent six-cylinder units. Estates are especially spacious.
- **VOLVO 940/960** – Strong, safe and very spacious, but stodgy to drive until heavily revised in late 1994. Later models benefit from chassis redesign and improved suspension. The cavernous estate is the one to have.

CarCheck is designed to help **YOU** pick out a

To check the suspension arm bearings, raise the car to its 'High' position. Both rear wheels should be absolutely upright. If you can see any sign of either rear wheel tilting inwards, the suspension arm bearings probably need replacing, this is confirmed if the inside edges of the tyres are worn. Budget around £300 per side at a specialist or £500 at a Main Dealer.

The steering and brakes work off the hydraulic system as well. The steering should be very light, but if it needs a noticeable amount of effort or feels notchy, probably when the engine is cold, the accumulator sphere may need replacing - though it could be several other things. If you notice heavy or notchy steering, again - seek specialist advice before making a decision.

Most XMs are fitted with anti-lock brakes so look for the orange ABS lamp in the instrument cluster that comes on when you turn theignition on - it should then go out after about 3 seconds. If it doesn't, or it comes on during the test drive, don't buy unless the seller is willing to get it fixed because ABS can be very expensive.

Engines

For all XM engines, check if the engine's cool, then undo the radiator cap on the driver's side of the radiator. If the water isn't up to the level marked on the outside, don't buy as the car's either losing water or it's been neglected.

The basic 2.0 litre petrol engine with 8 valves is good for 150,000 miles if it's been well maintained, and it's the easiest XM engine to work on. There are no known additional problems with the turbo version, but insist on a meticulous service record showing oil changes every 6,000 miles, otherwise the turbo will only have a limited life.

The same applies to the latest 16 valve 2 litre XMs — the oil must have been changed religiously. On all these engines, the service record must also show that the cam belt was changed at 72,000 miles. If it doesn't, don't buy because it suggests serious neglect.

Careful owners change the cam belt at 48,000 miles, not 72,000 miles as specified by Citroen. It is also wise to have the water pump checked and a new camshaft oil seal fitted at the same time. On diesels, the fuel filter should be changed every 12,000 miles to protect the injection pump.

It's better to avoid the V6s. They're complicated, so engine or gearbox problems are very expensive to get fixed. For example, the back manifold often cracks, which leads to exhaust leaks, and this can only be fixed by removing the engine.

If you're considering a 24 valve version, only buy if a Citroen exchange engine has already been fitted — the original engines wear very quickly. Even then, the clutch on the 24-valve will probably need replacing every 25,000 miles or so at a cost of £600 or more a time.

Both diesels have turbochargers, so the 2.1 is reasonably quick, while the 2.5 is fast and very sought-after.

Ask the seller to let the engines idle for a while with the bonnet shut. On turbo-diesels and the petrol turbo, push the throttle to the floor after about 5 minutes and hold it there while the engine revs up. Don't worry if this produces a bit of black smoke, but if there's a cloud of blue/grey smoke, the turbo's on its way out so walk away.

Keep the engine idling while you look through the grille — you'll see sound and reliable car.

We recommend that once you have found one that passes all the CarCheck tests, you then get the car checked by a professional engineer.

We also recommend that you check ownership and history with Equifax-HPI or the AA (see **Useful Numbers**).

Click here for **PhoneChecks** and **FaxChecks**

two cooling fans. First one fan will come on, and then the other. If this doesn't happen by the time the temperature gauge shows the engine's close to overheating, the switch module has probably failed. This only costs around £70 to replace but the head gasket and the cylinder head may have been damaged already, so don't buy.

Transmissions

The manual ones are pretty reliable but don't have an unlimited life. Do a test on a traffic-free stretch of road by accelerating hard in second, third and fourth gear, making a smart change up at about 4,000 revs. Then change back down again from fourth, down through third into second. If there are any crunches, or the gears won't engage easily, or there are any odd noises, reject the car.

On the diesels and the 2 litre petrol-engined XMs, they automatics are fairly reliable, but on the V6s, the automatic boxes can fail any time from 70,000 miles onwards.

As a precaution, you should do these simple tests on any auto XM, once the engine is fully warmed up. Just find somewhere quiet and put your foot hard on the brake. Then move the selector to D position. If there are any rattles or intermittent noises from under the car, the gearbox is near the end of its life. Move the selector to N, any jangling noises here also spell a gearbox on the way out.

Replacing a gearbox can cost over £1,500 at a specialist or well over £2,000 at a Main Dealer. But these symptoms don't emerge until a box is on its last legs, so any auto XM is that much more of a risk.

Mark I

With a Mark 1 XM, it's even more important to check that the car has had main dealer servicing for the first 3 years of its life, making it much more likely that the car has had the modifications devised by Citroen to improve reliability.

To check that this is indeed the case, open the bonnet and locate the front of the inner wing, just behind the headlight on the passenger side. There should be a series of electrical wires all meeting at a point. These are the earths for the electronics, the biggest problems on early cars.

If these cables push on to a round fitting bolted to the body, they haven't been modified and you should only buy if you're an experienced mechanic. On the other hand, if the cables end in metal loops and are bolted onto the earth post, the car's probably had the modifications.

Then check any electrical gadgets that happen to be fitted – for example: the electric sunroof, electric windows, electric front seat adjustment, electric mirrors, fog lamps, built-in alarm system and air conditioning.

If some of these don't work, and you've already noticed other signs of neglect, don't buy. And even if everything else checks out okay, don't buy unless the car is cheap to compensate you for the risk of possible future problems.

However even if a Mark I version passes all the tests, take your time before making a decision. Preferably go to see both the last owner shown on the registration document and the people who have done the servicing. Ask them what they know about the car's history and in most cases, they'll be happy to advise you. Reject their advice at your peril.

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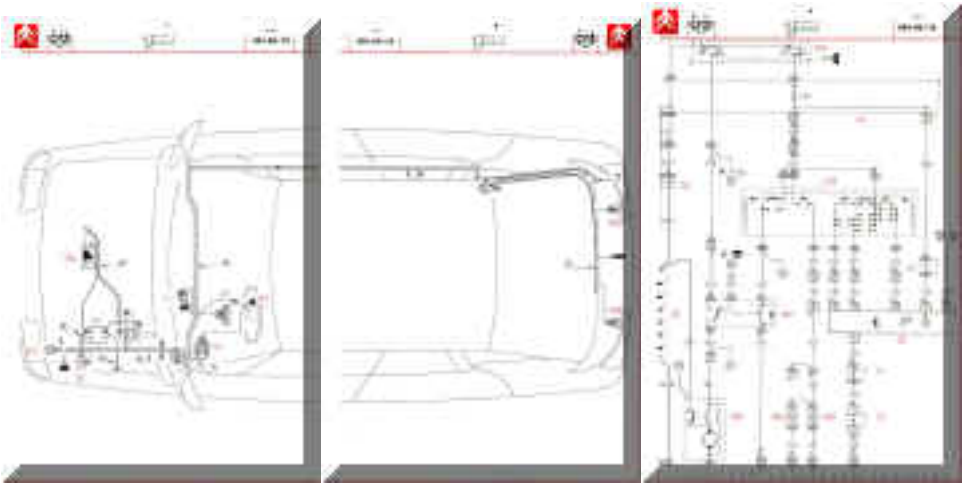

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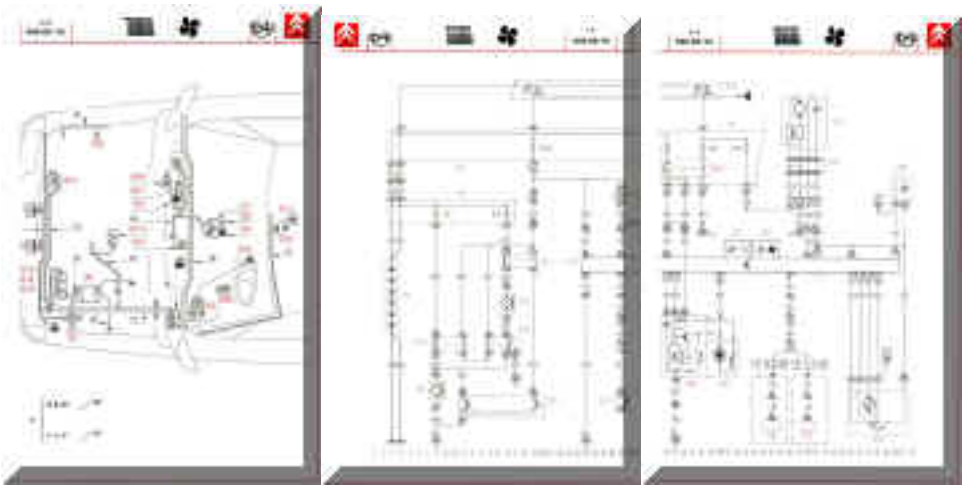

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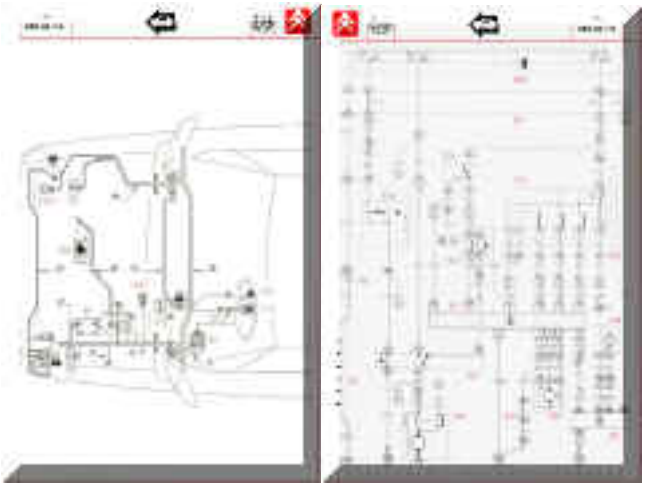

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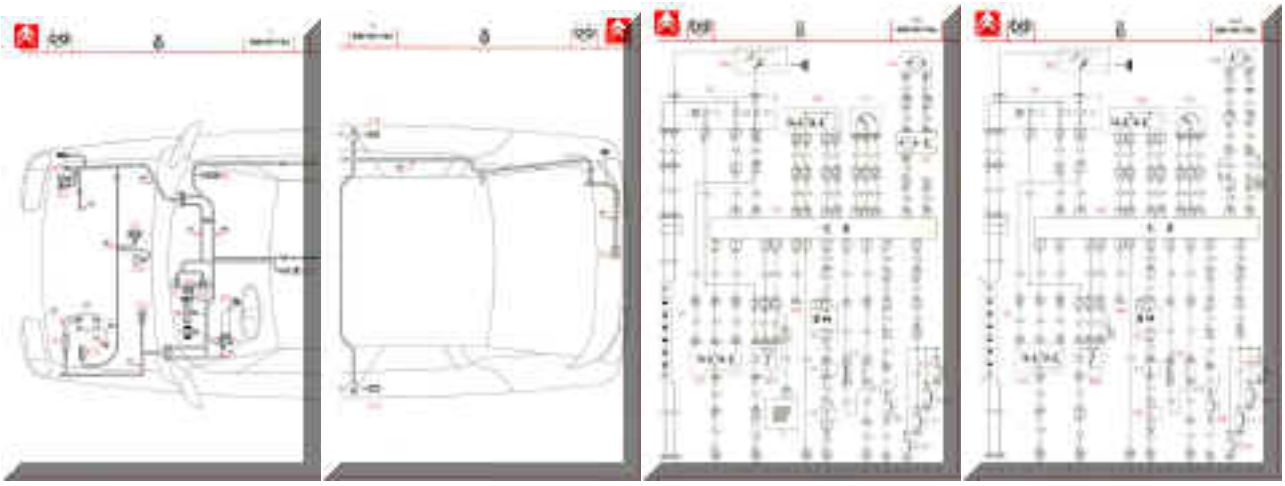

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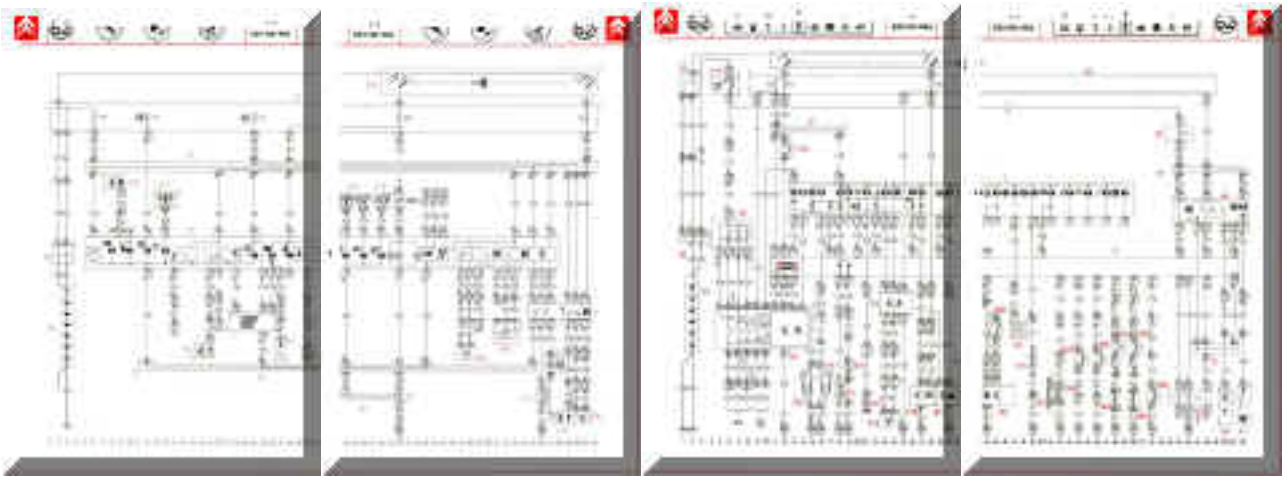

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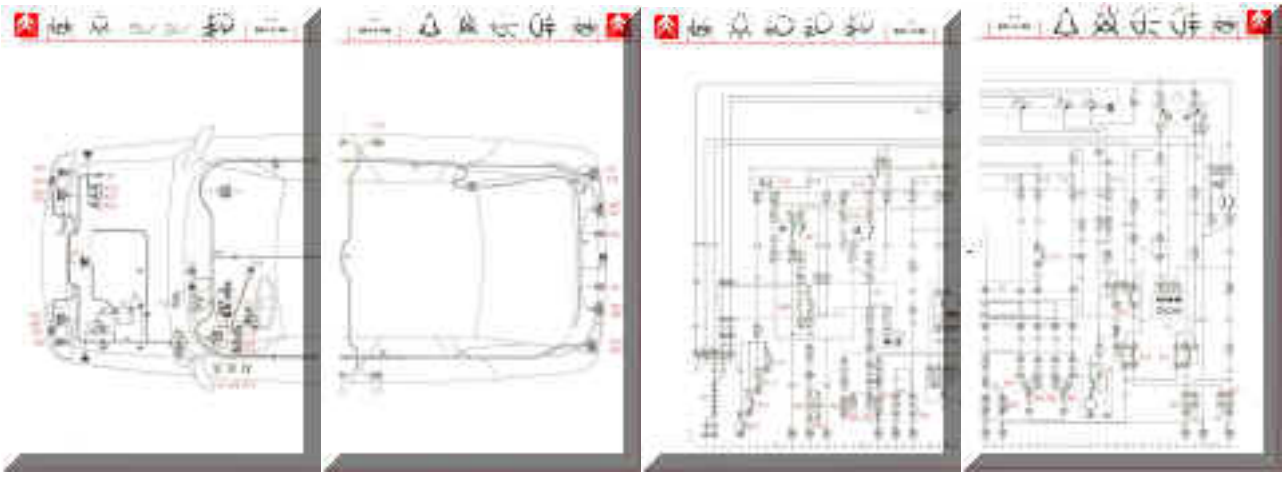

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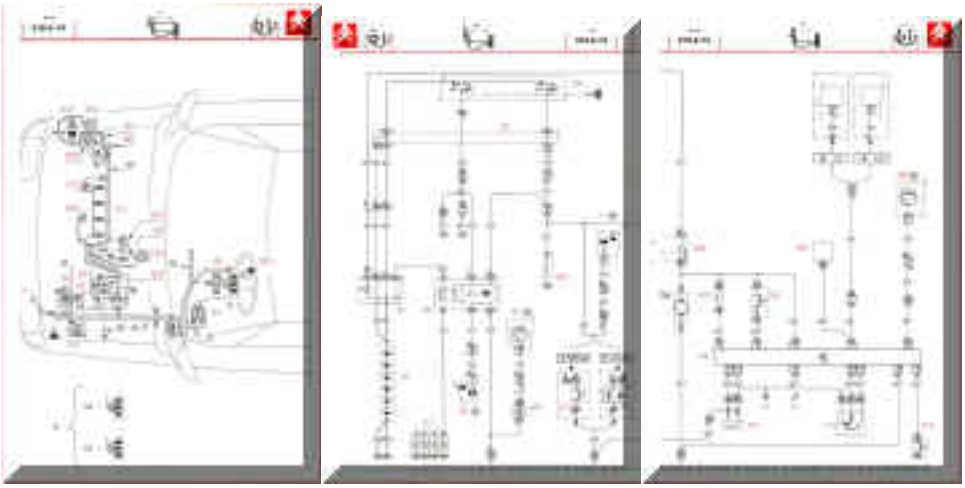

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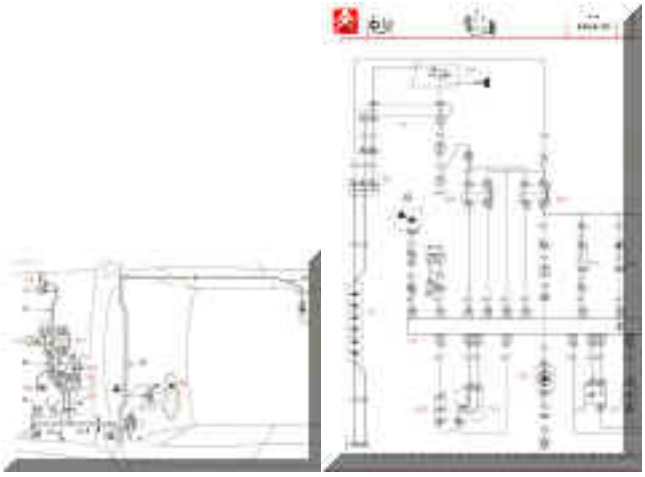

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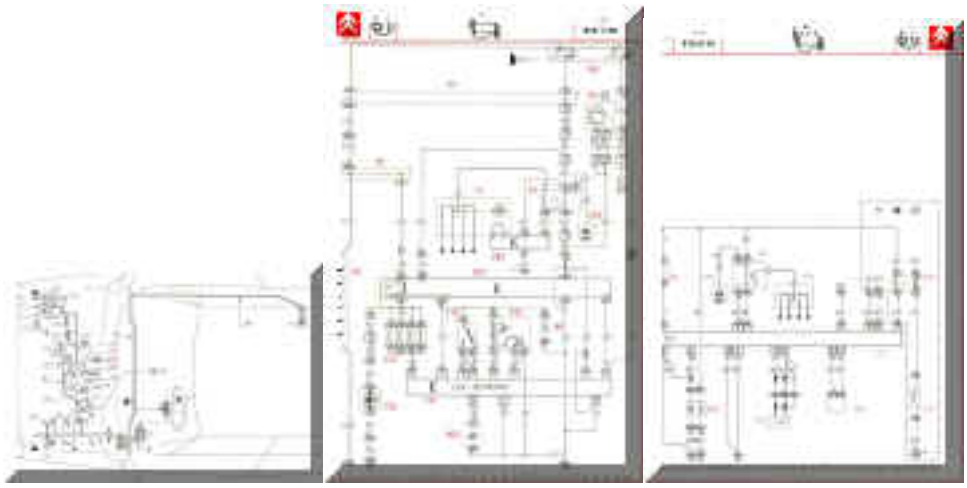

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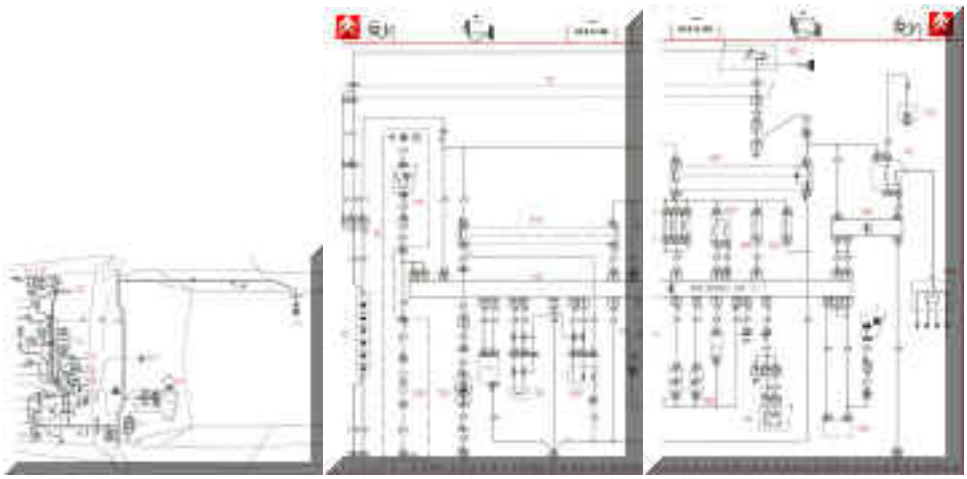

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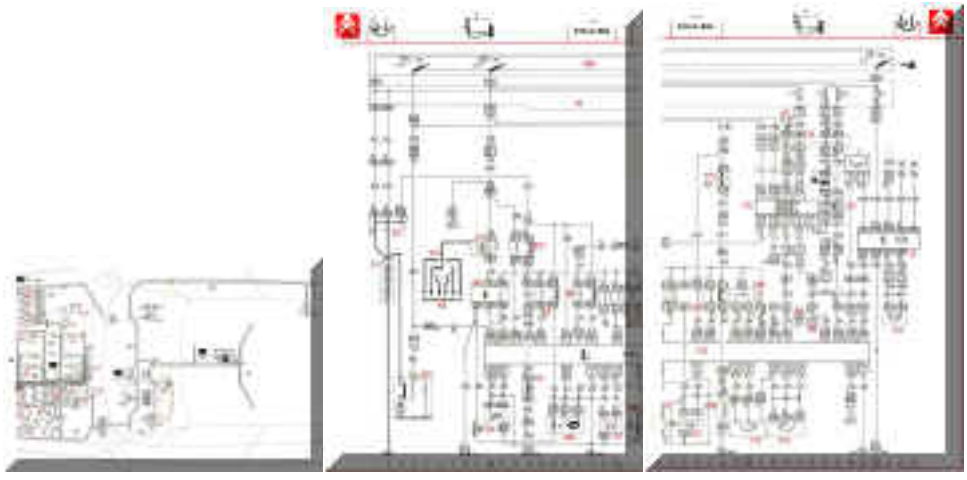

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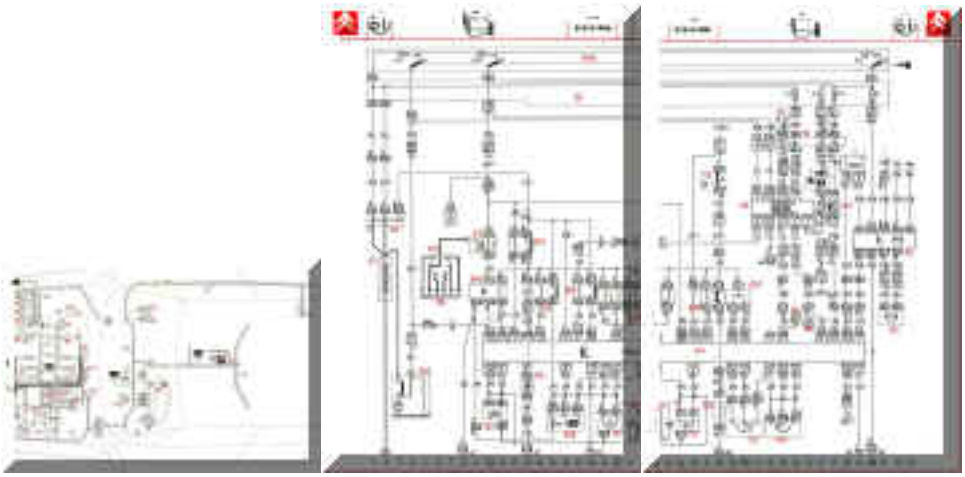

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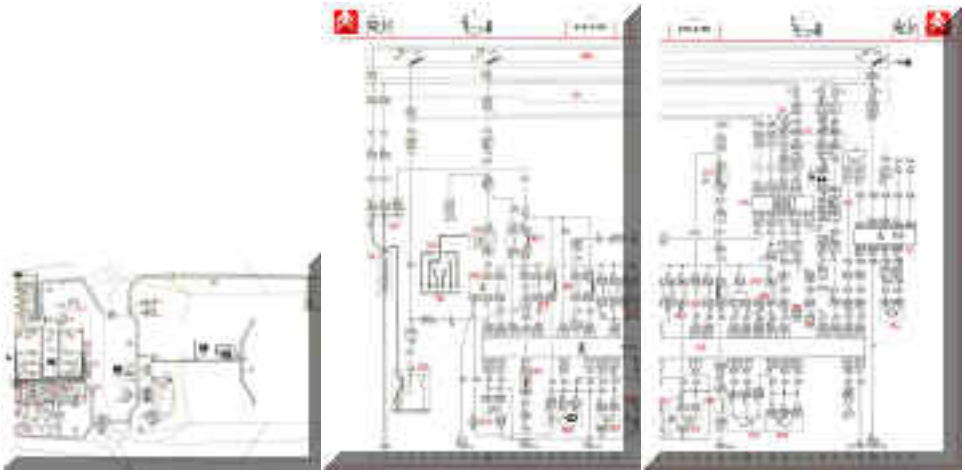

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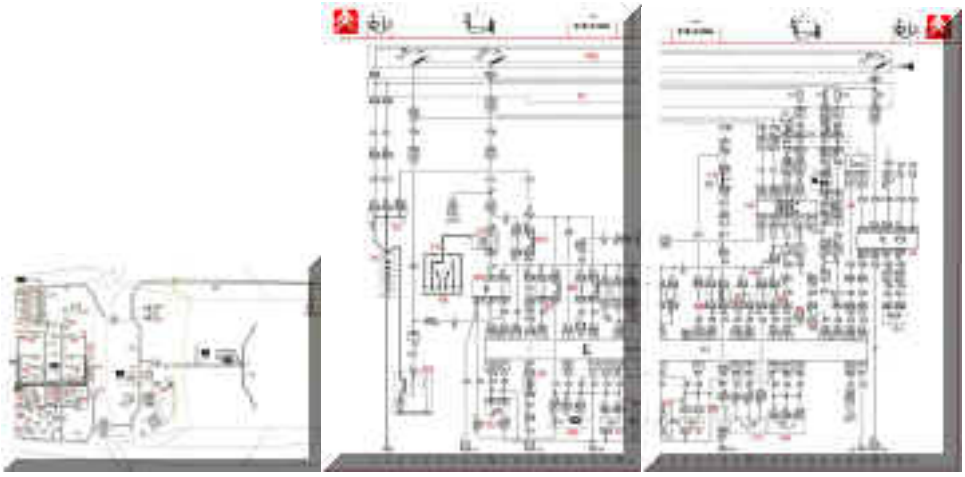

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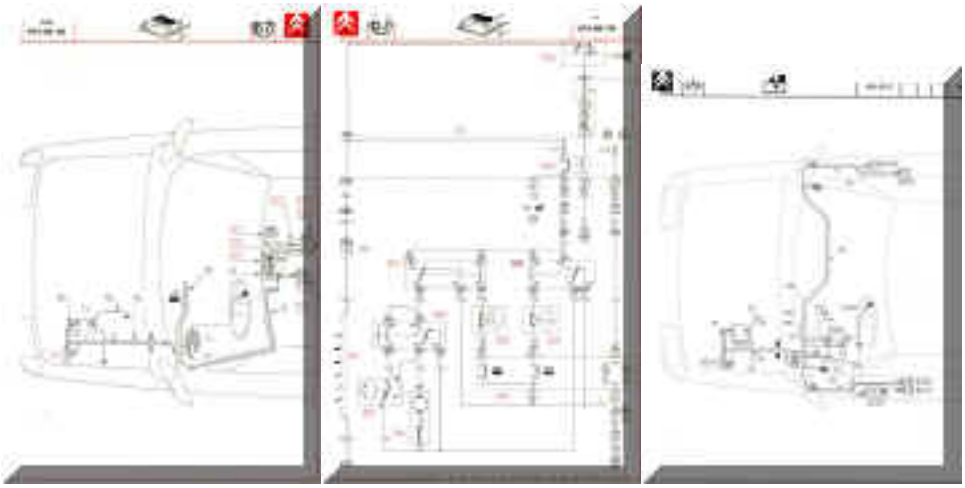

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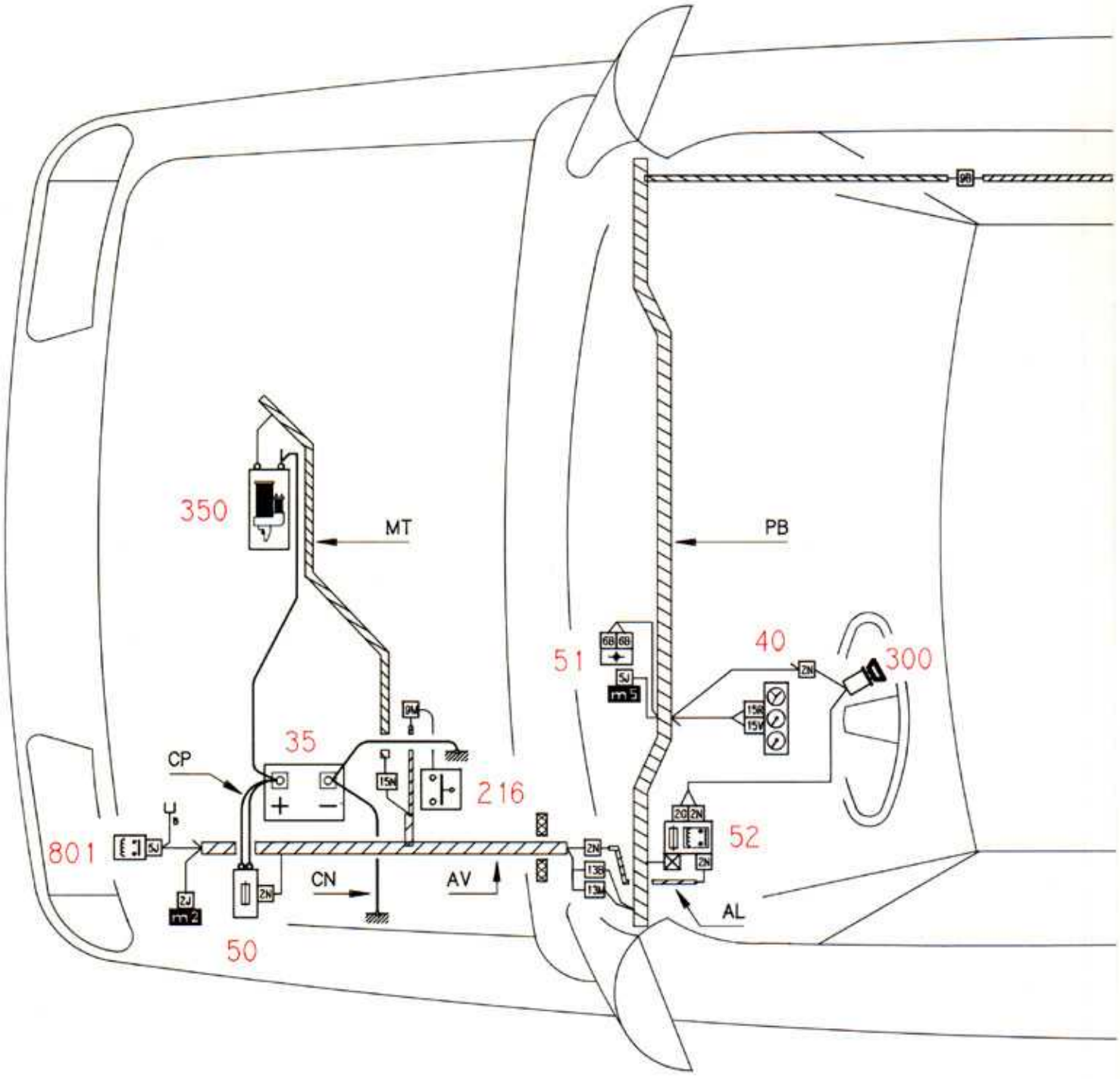
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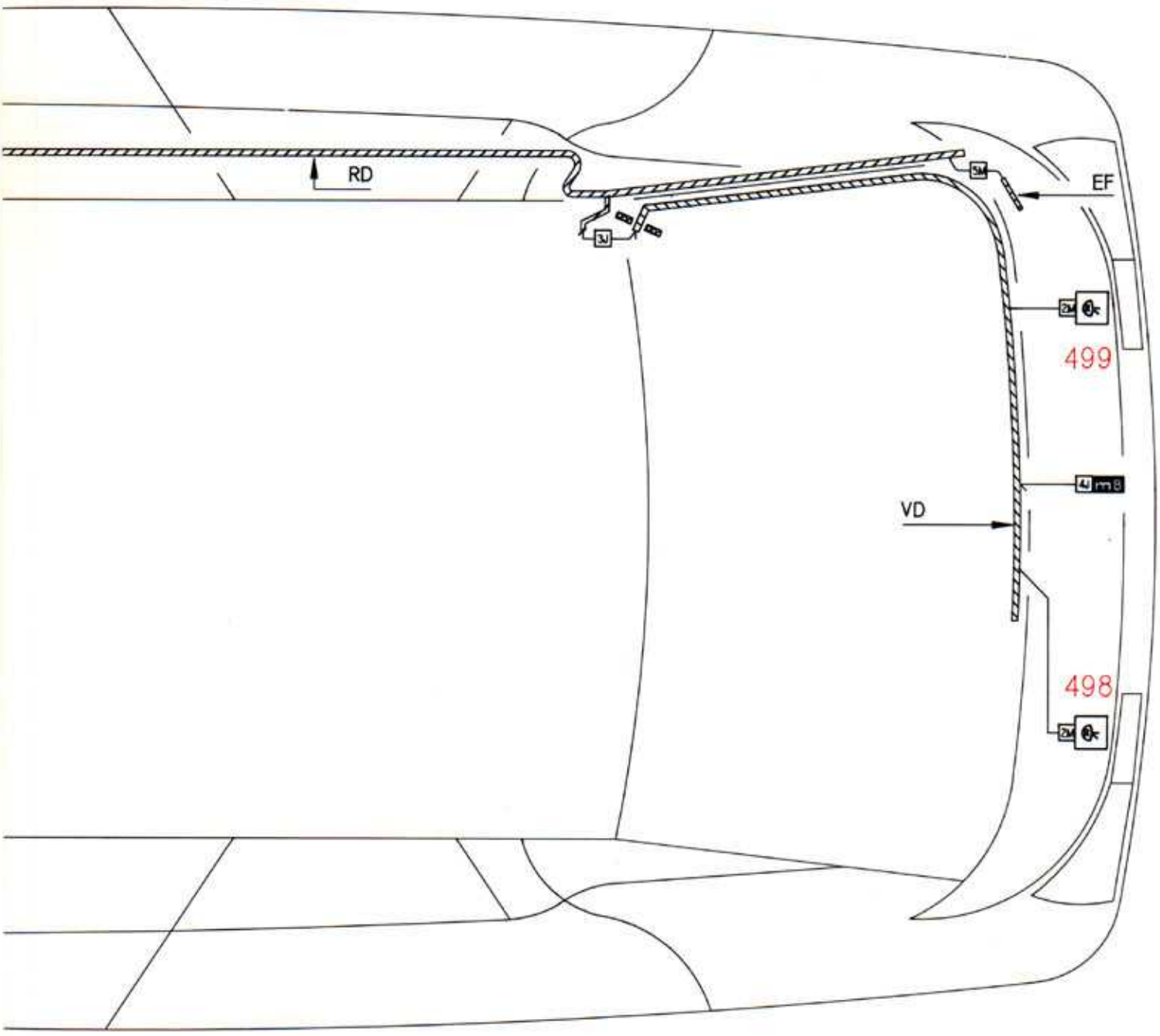
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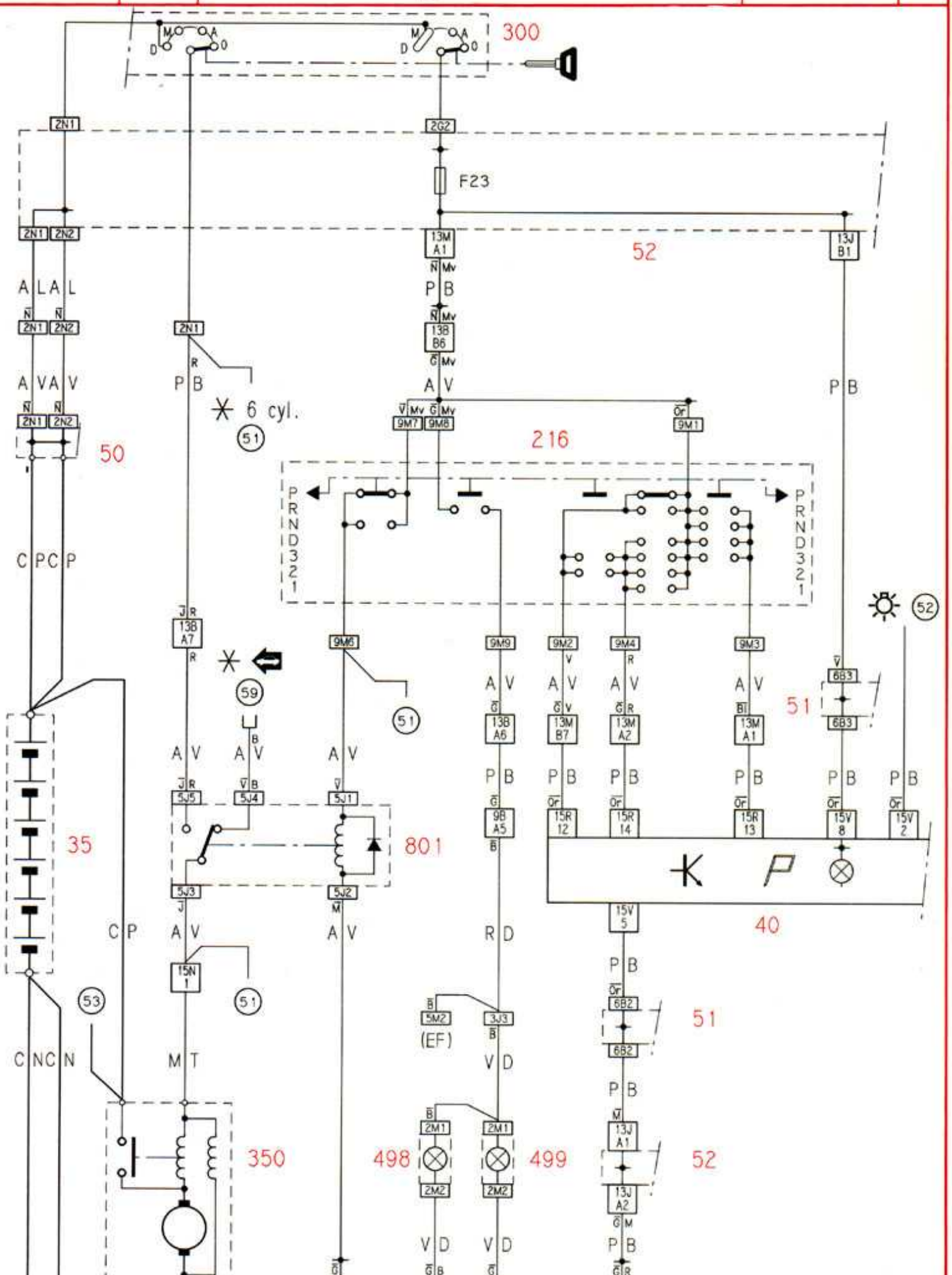
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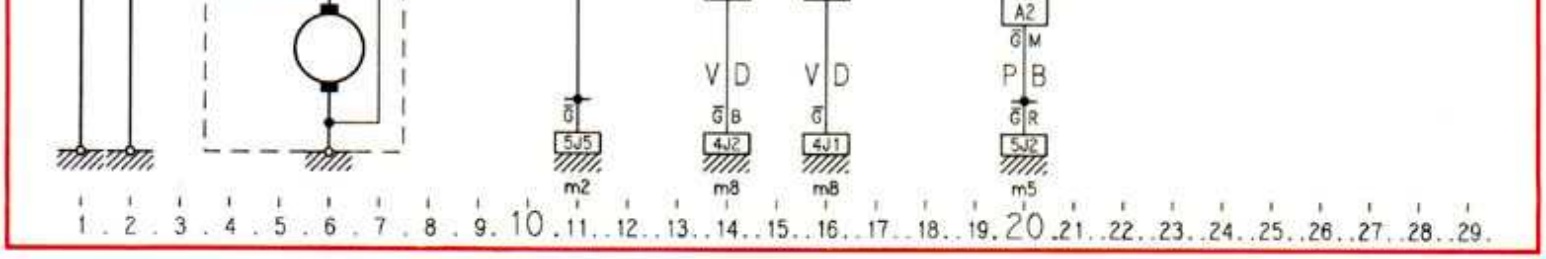
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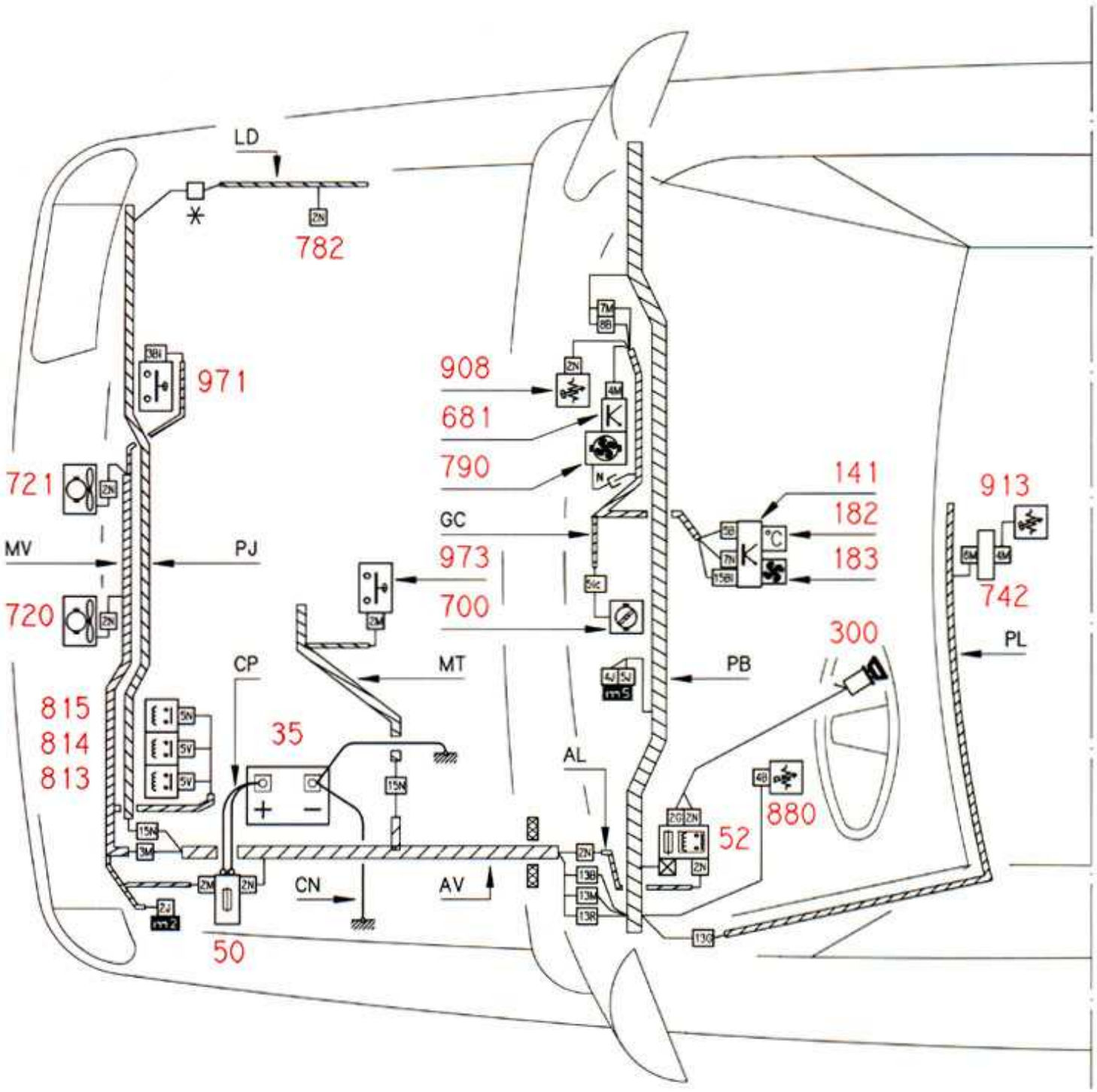
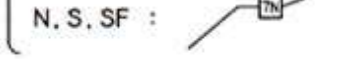


* { X.X.X : 5N ; N.S.SF : 7N }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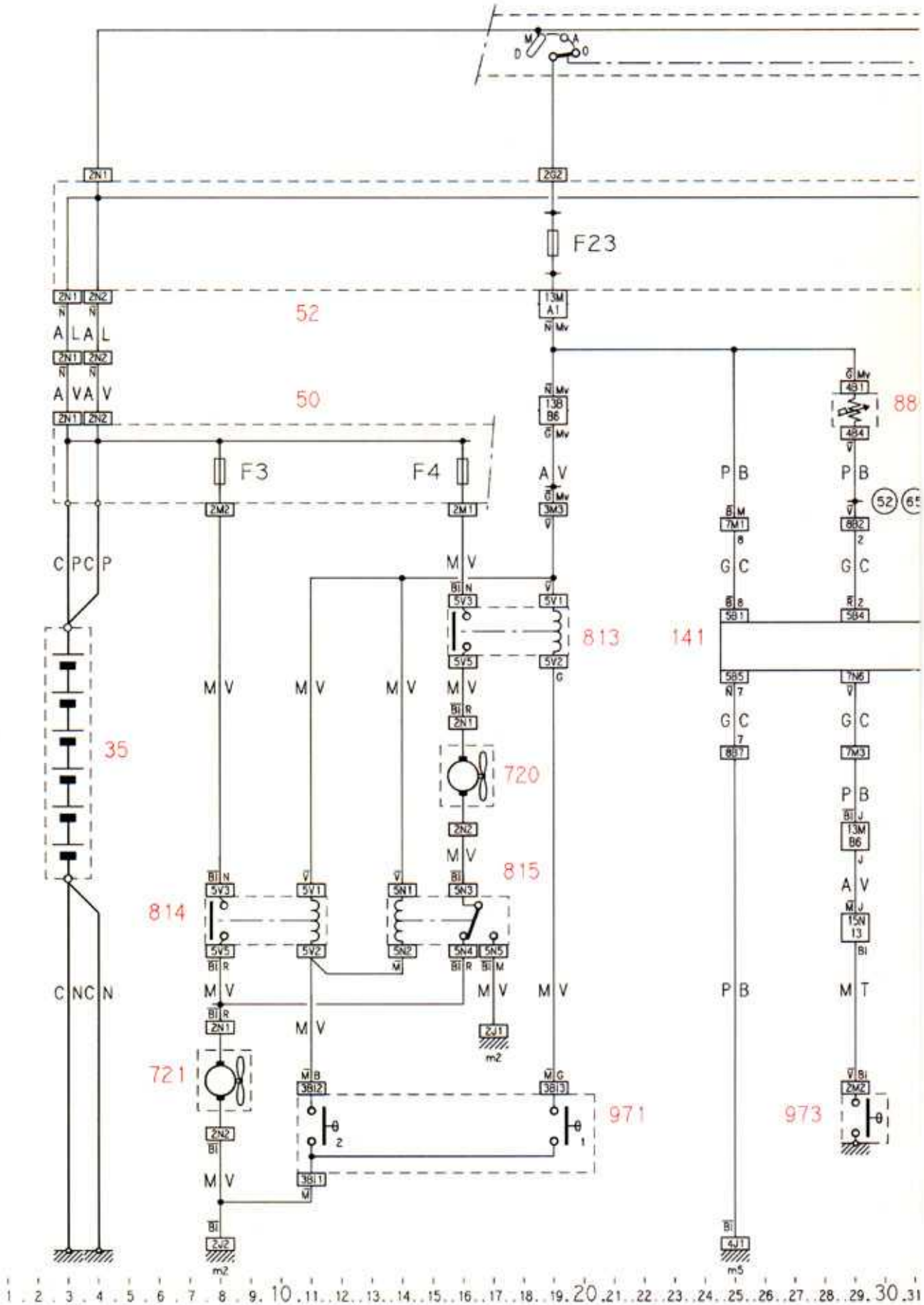
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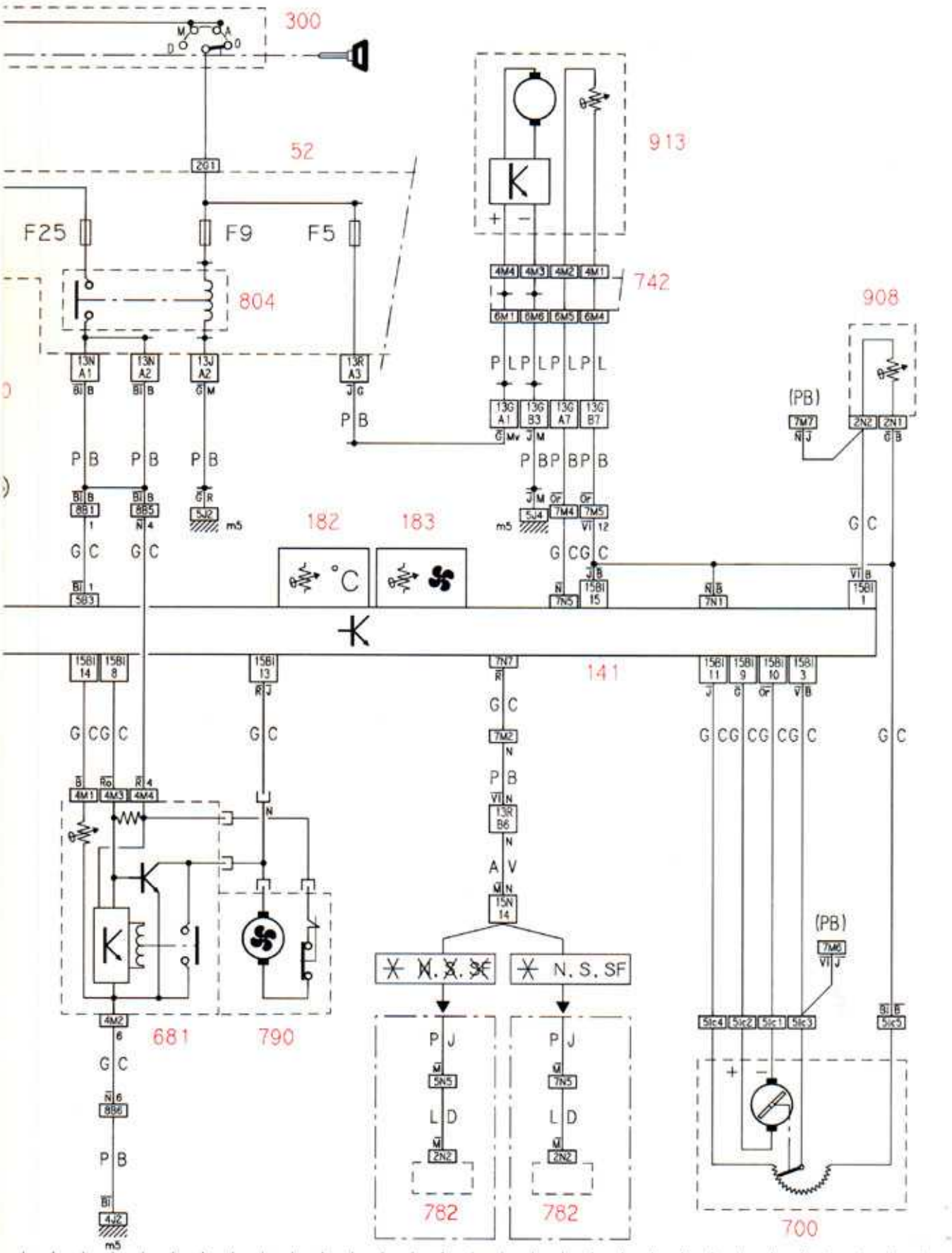
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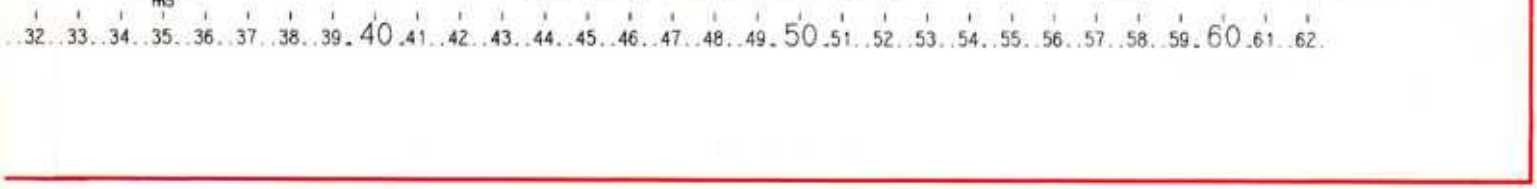
ms
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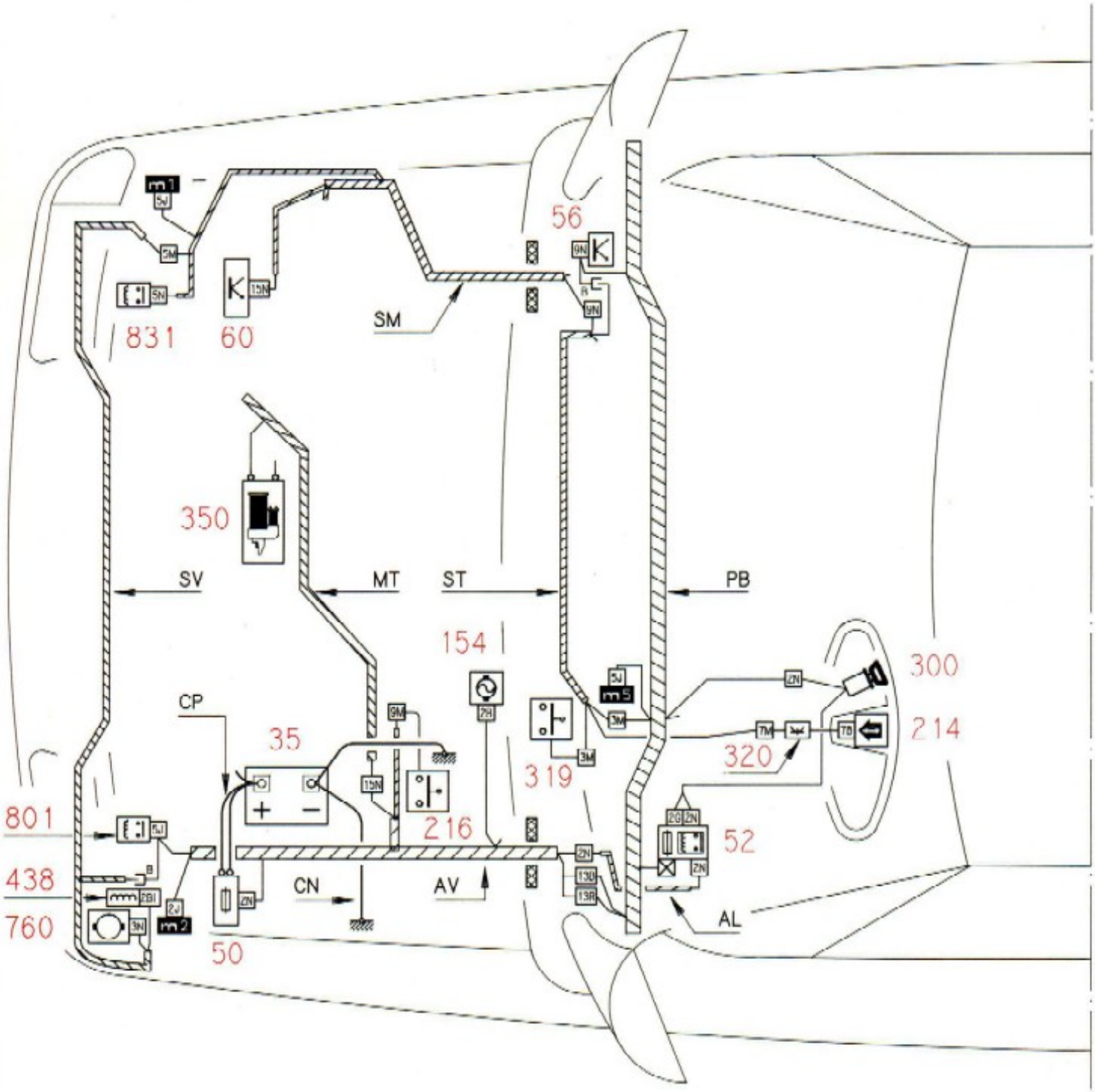
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831
60
SM
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SV
MT
ST
PB
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300
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CP
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801
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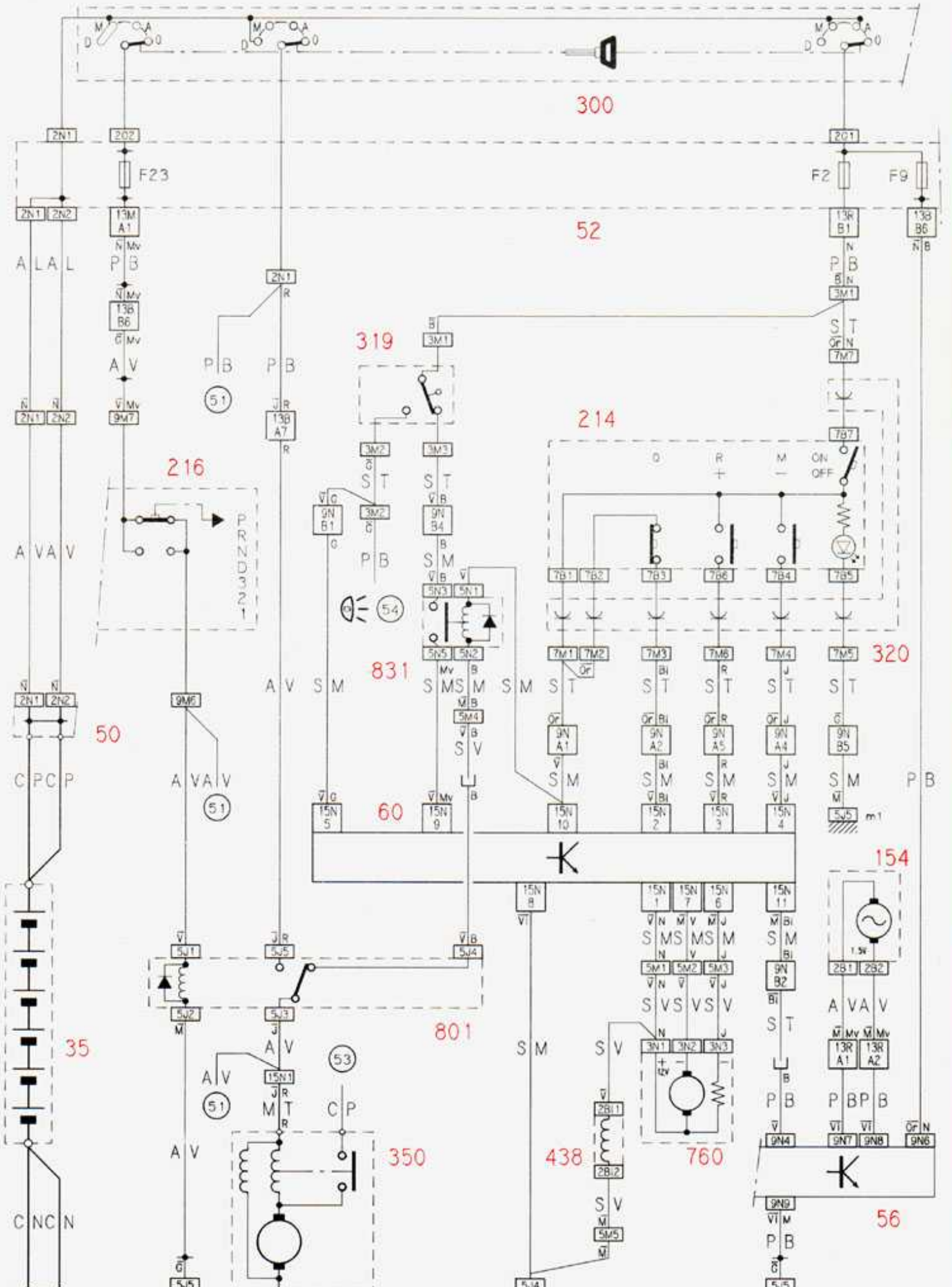
760
50
CN
AV
AL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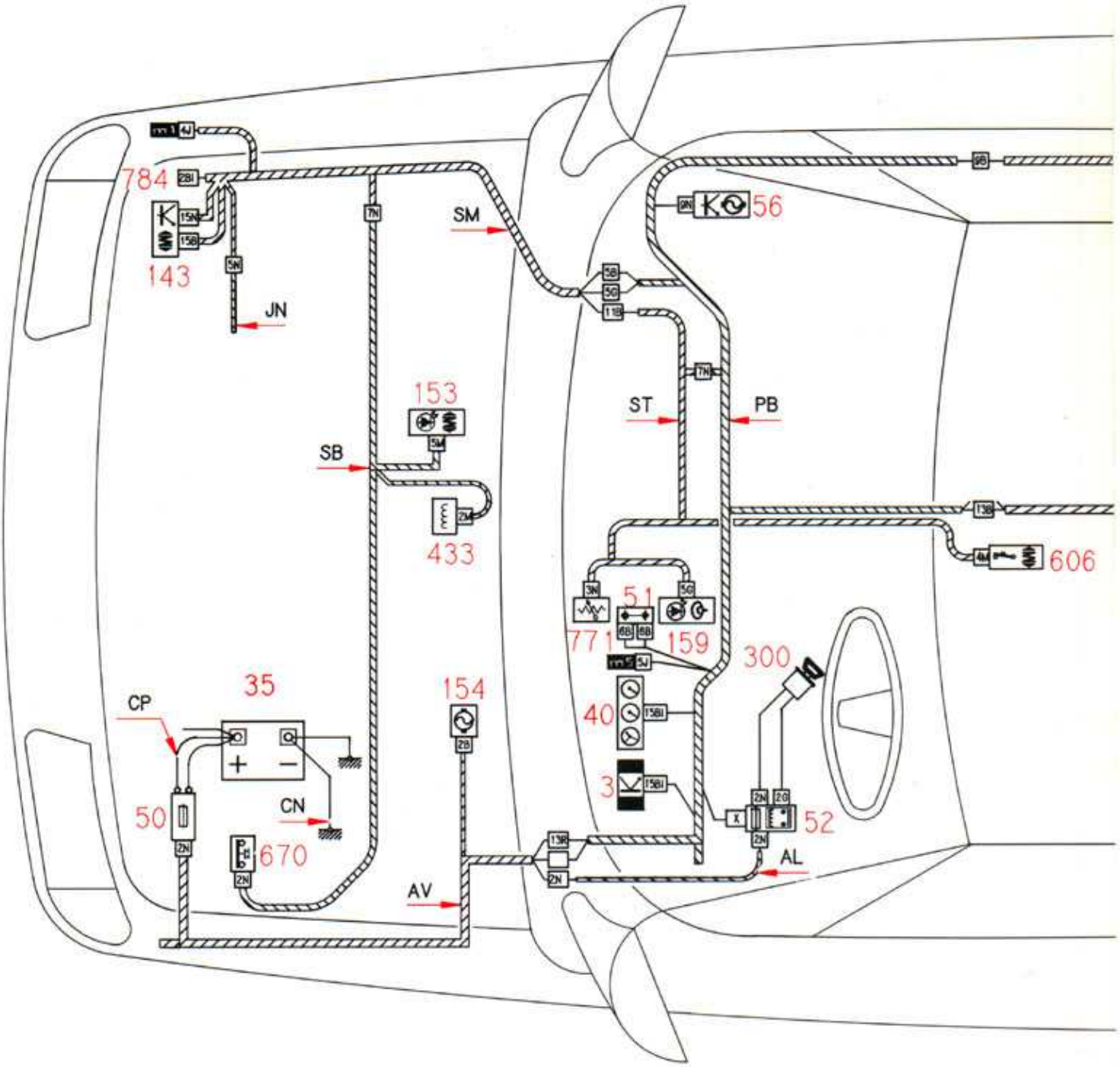
52
319
214
216
831
320
50
60
154
35
801
350
438
760
56
F23
F2
F9
PRND321
ON
OFF

1 . 2 . 3 . 4 . 5 . 6 . 7 . 8 . 9. 10 .11. .12. .13. .14. .15. .16. .17. .18. .19. 20 .21. .22. .23. .24. .25. .26. .27. .28. .29.


784
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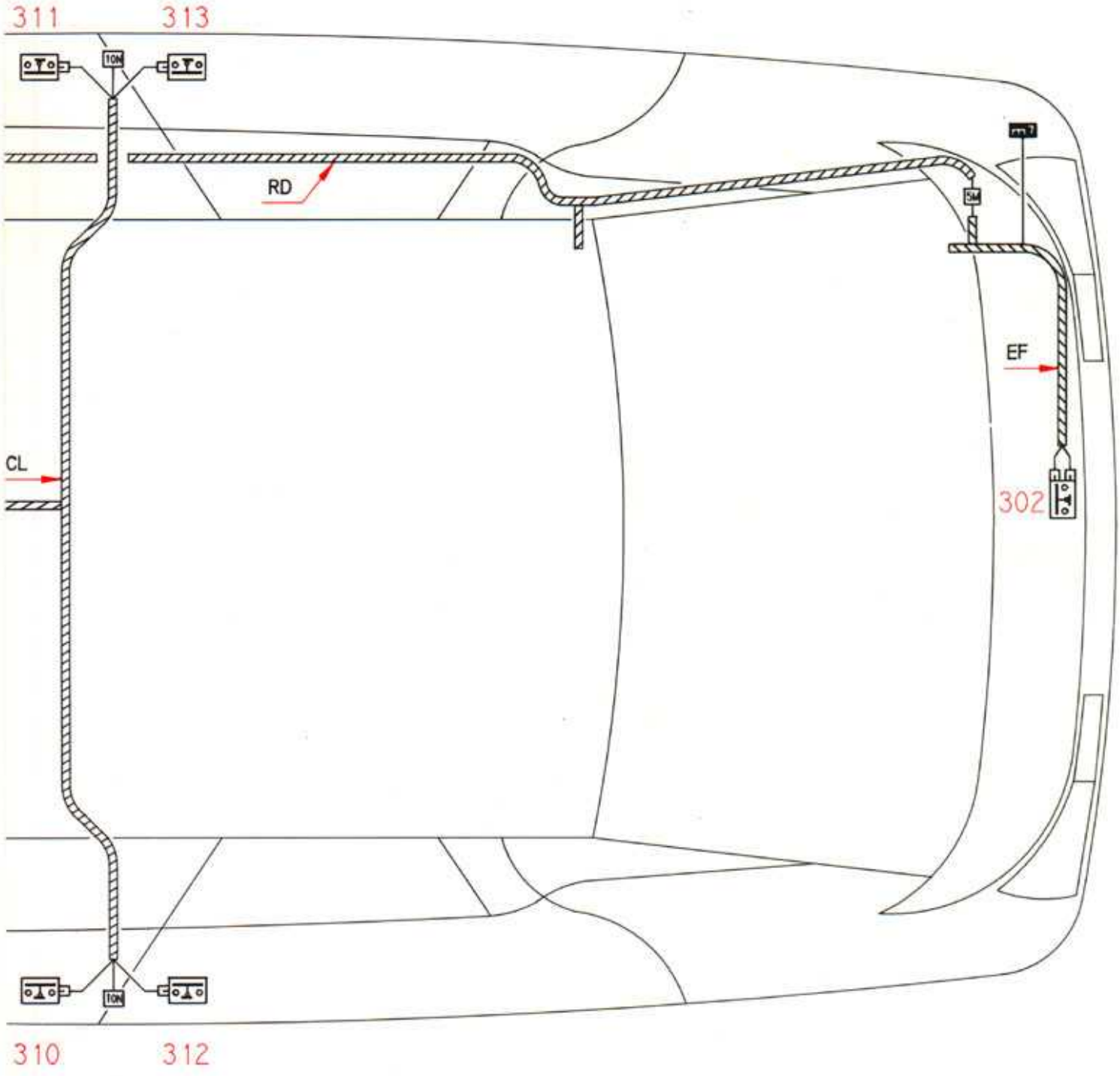
AL
AV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313
10N
RD
5M
EF
CL
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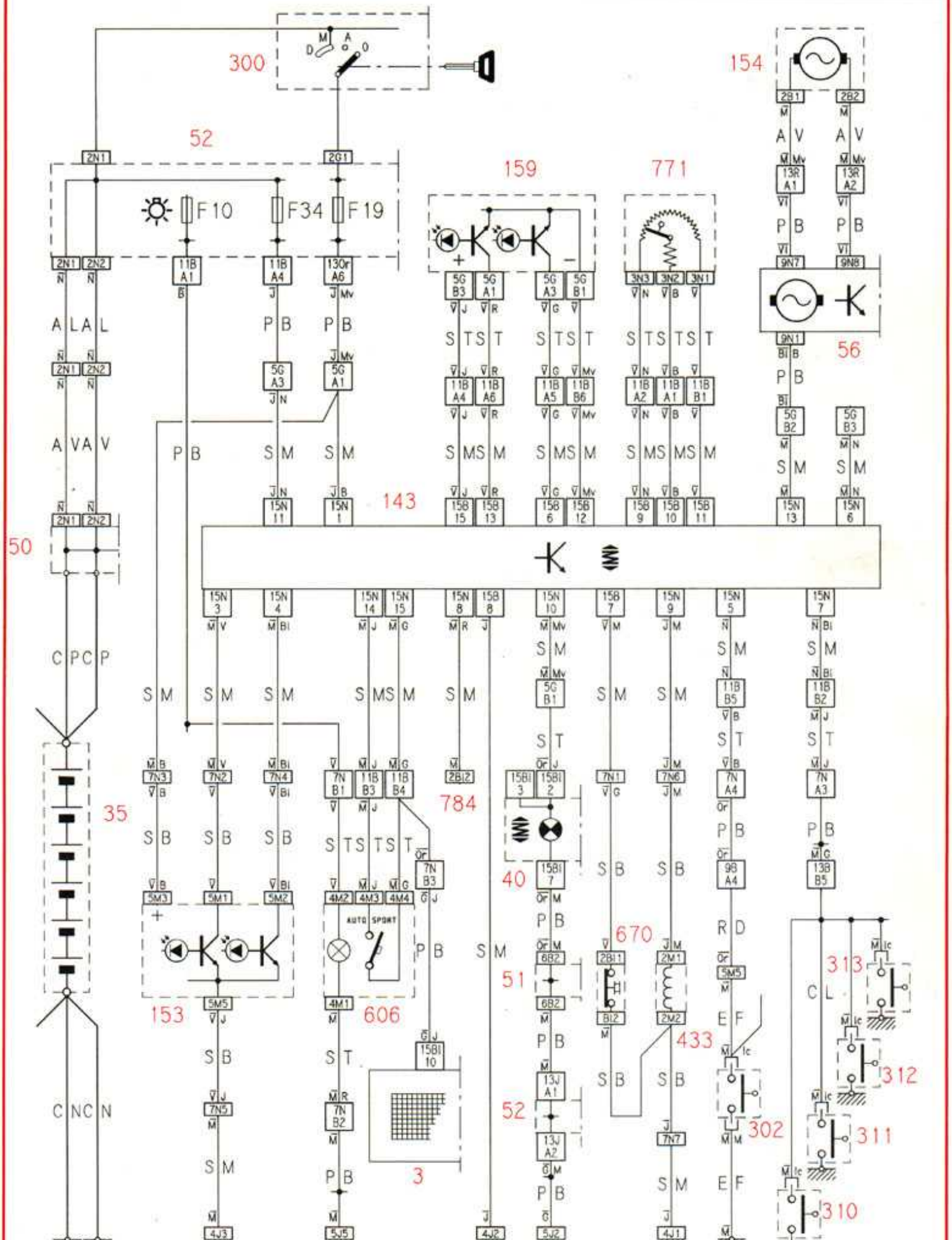
10N
310
312


300
52
154
159
771
F10
F34
F19
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153
606
784
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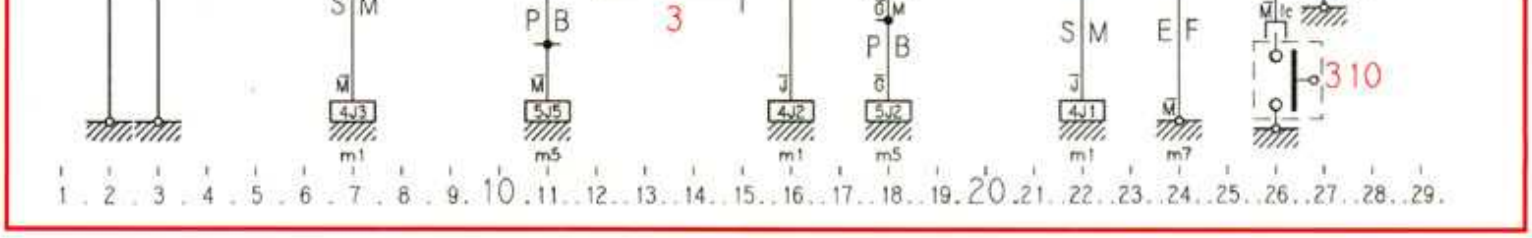
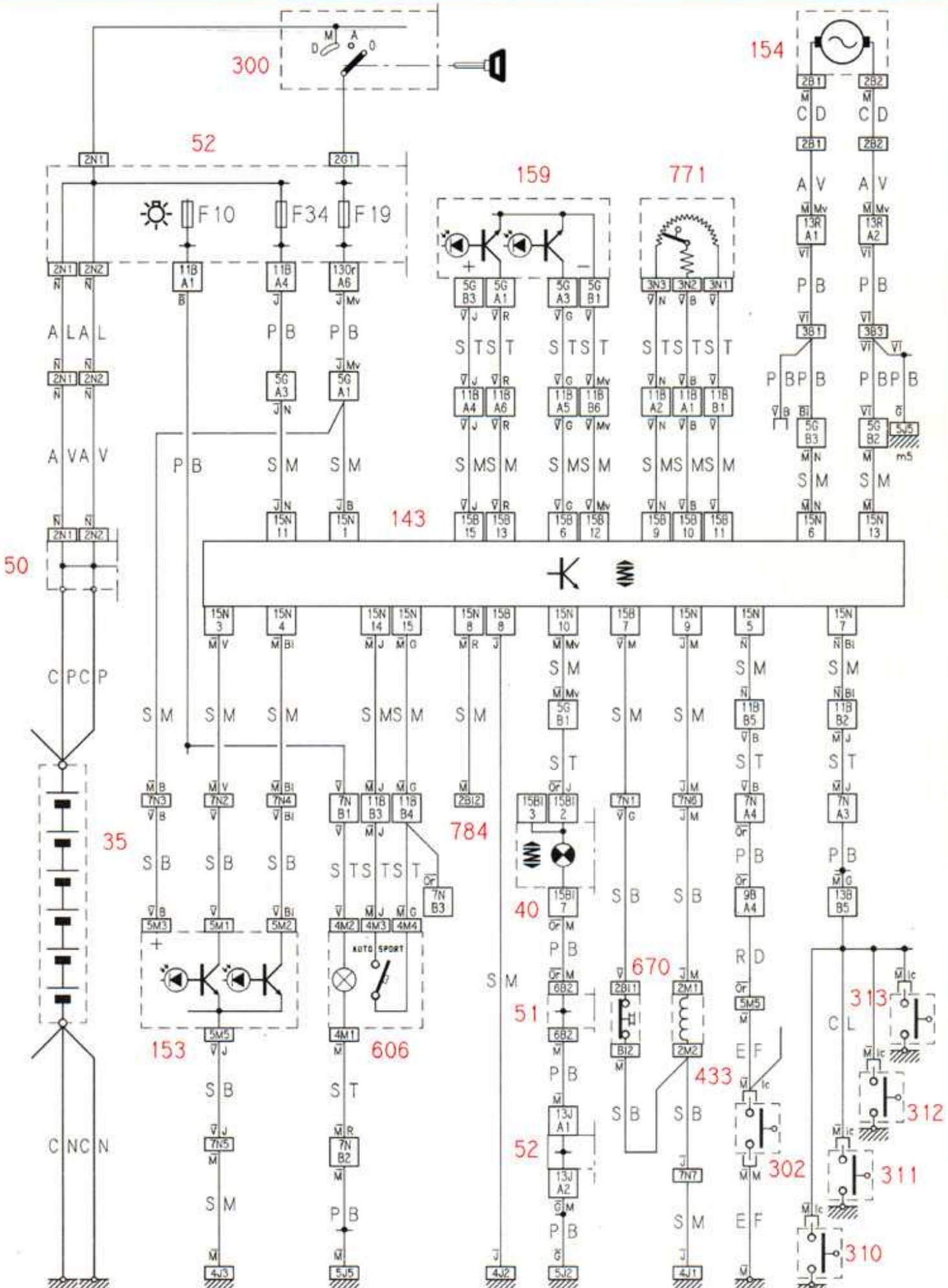
51
52
670
433
313
312
311
310
302
3
AUTO SPORT


S M
4J3
m1
P B
5J5
m5
3
J
4J2
m1
G M
P B
G
5J2
m5
S M
J
4J1
m1
E F
M
m7
M Ic
310
1 . 2 . 3 . 4 . 5 . 6 . 7 . 8 . 9 . 10 . 11 . 12 . 13 . 14 . 15 . 16 . 17 . 18 . 19 . 20 . 21 . 22 . 23 . 24 . 25 . 26 . 27 . 28 . 29 .


300
52
159
771
154
F10
F34
F19
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784
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433
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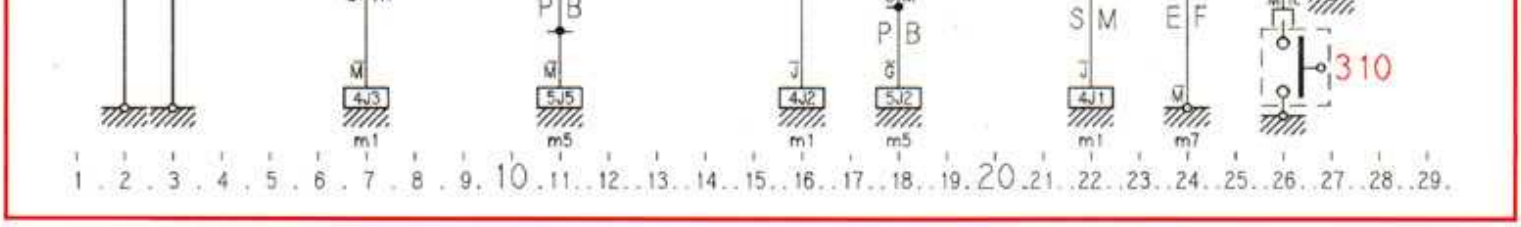
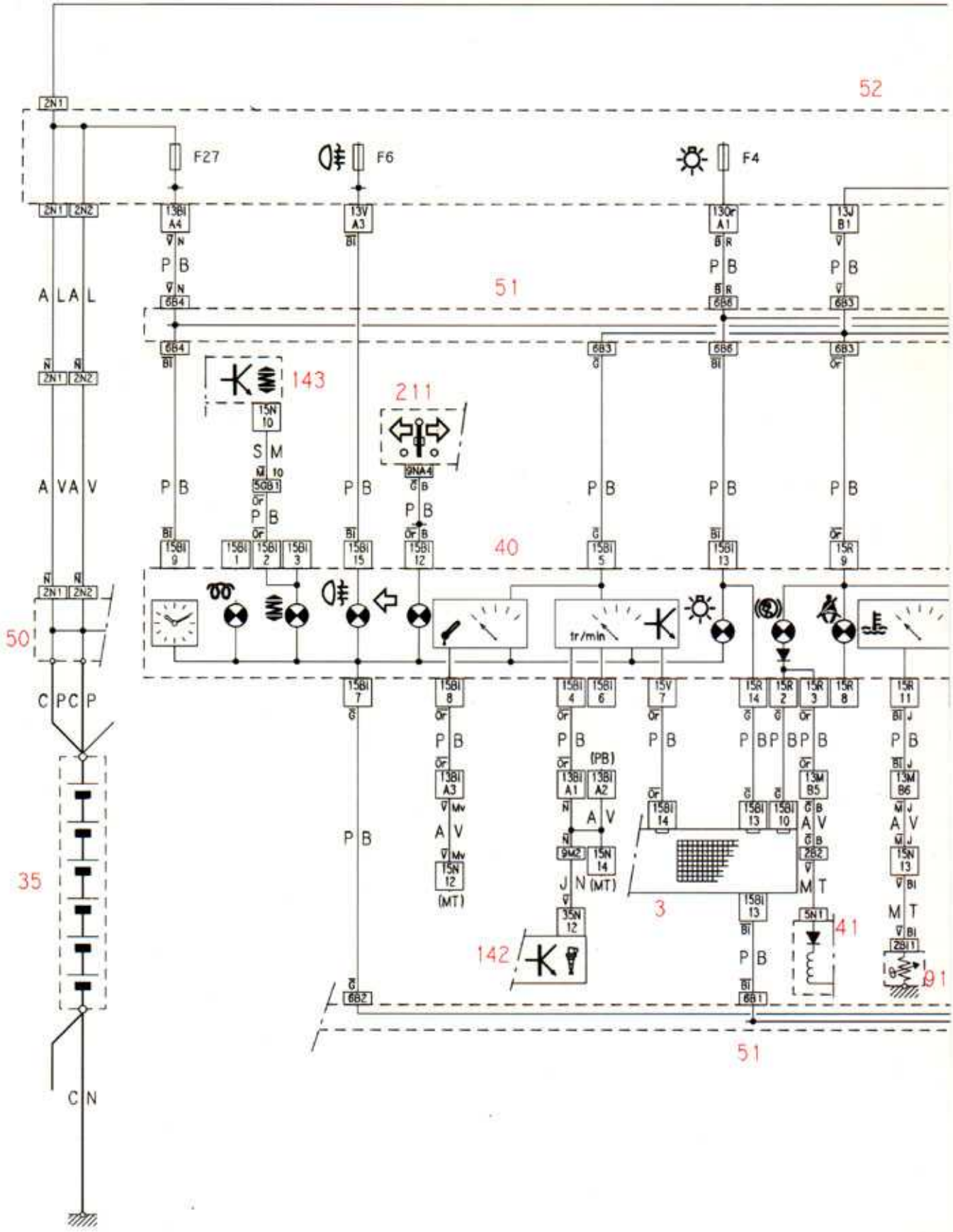
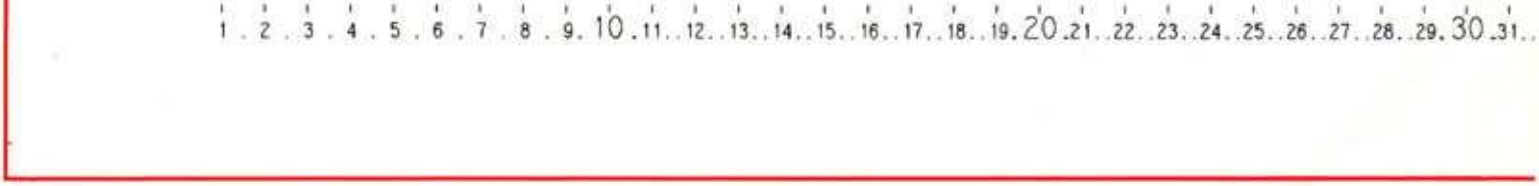
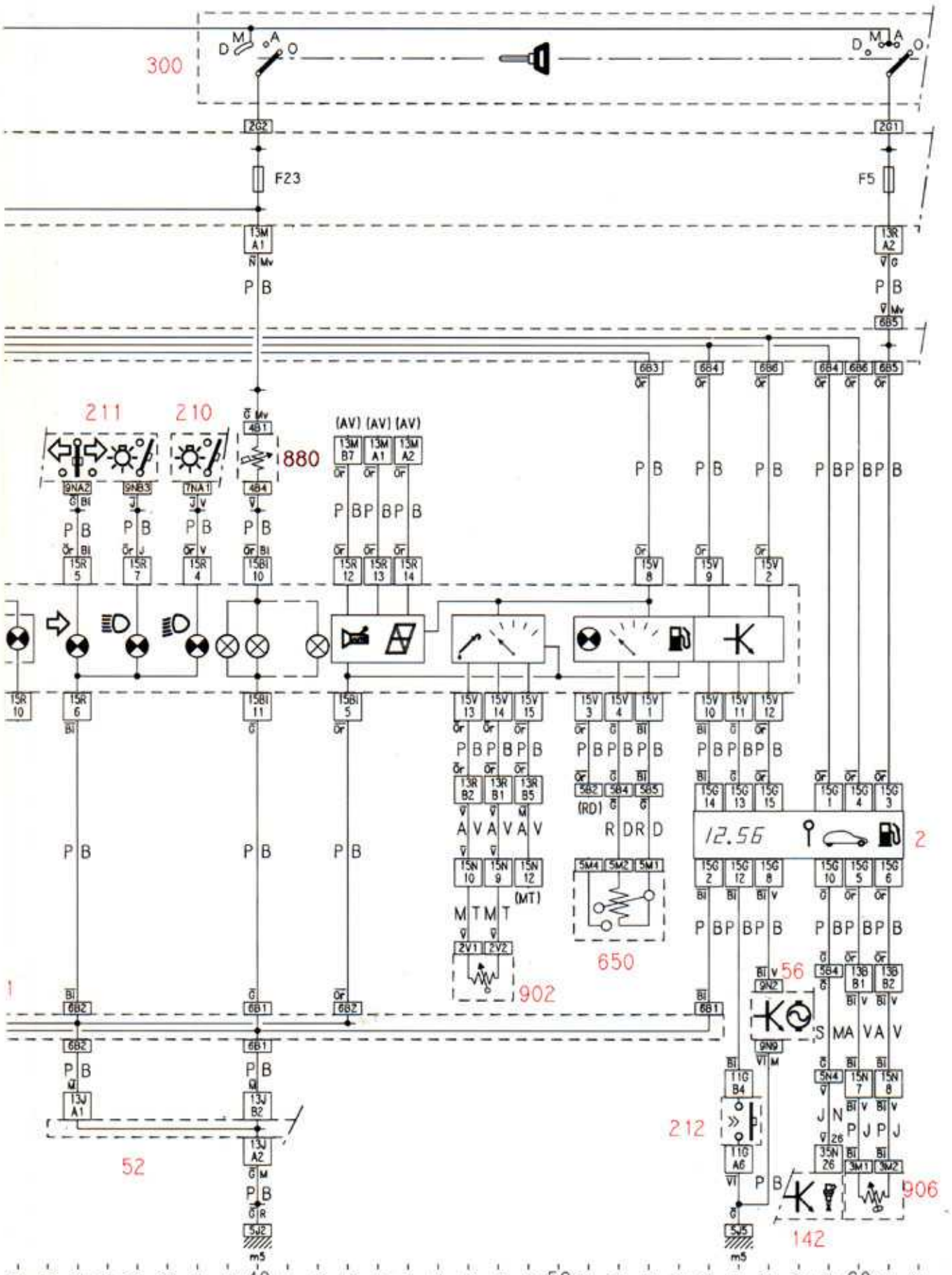
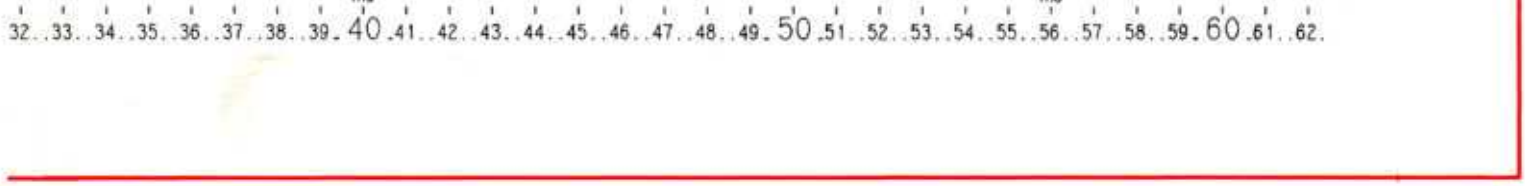
AUTO SPORT

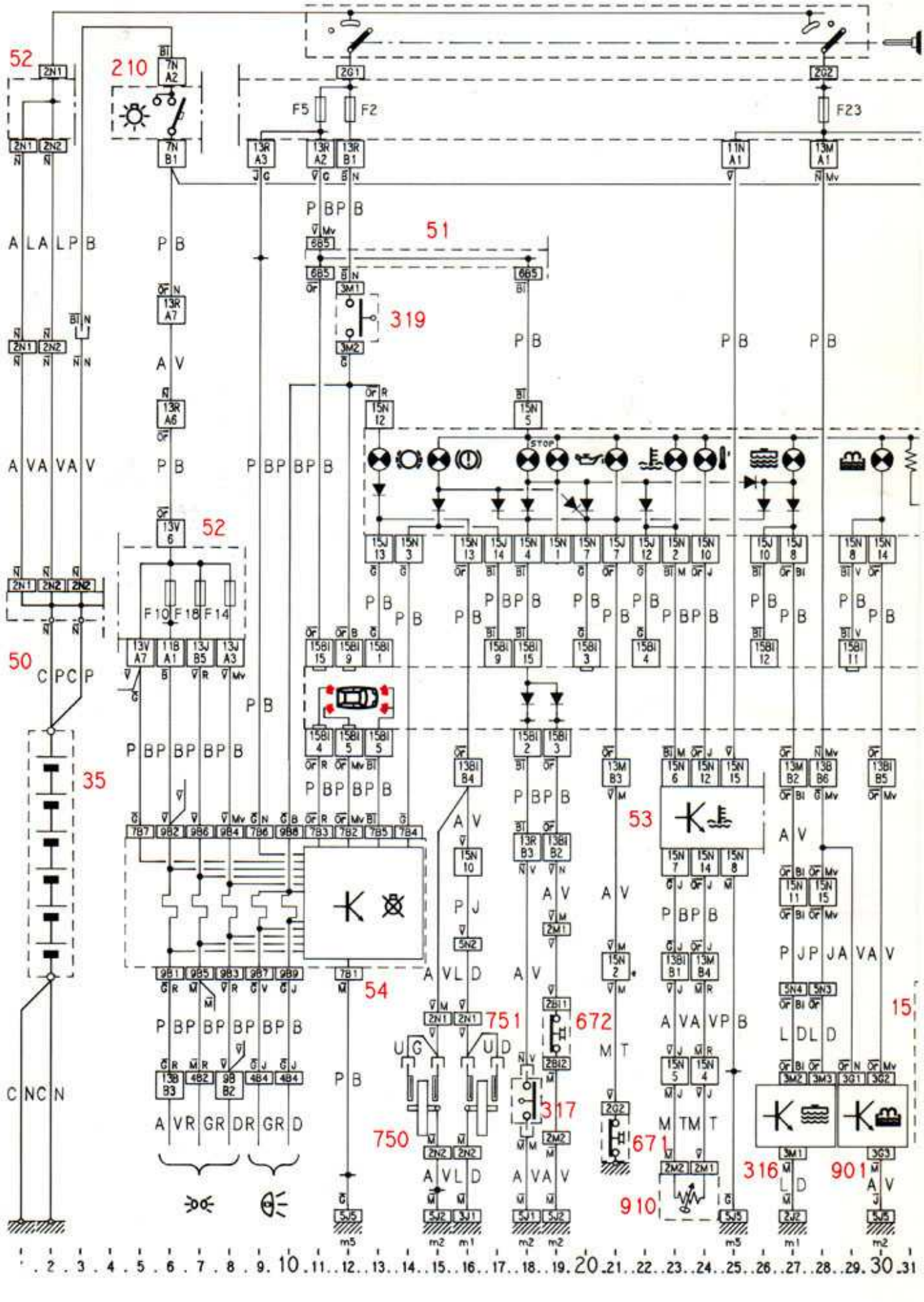

P B
M
4J3
m1
P B
M
5J5
m5
J
4J2
m1
P B
G
5J2
m5
S M
J
4J1
m1
E F
M
m7
310
1 . 2 . 3 . 4 . 5 . 6 . 7 . 8 . 9. 10 . 11 . . 12 . . 13 . . 14 . . 15 . . 16 . . 17 . . 18 . . 19. 20 . 21 . . 22 . . 23 . . 24 . . 25 . . 26 . . 27 . . 28 . . 29.


52
F27
F6
F4
51
143
211
40
50
35
3
41
142
91
51
tr/min
A L A L
A V A V
C P C P
C N
1 . 2 . 3 . 4 . 5 . 6 . 7 . 8 . 9 . 10 . 11 . 12 . 13 . 14 . 15 . 16 . 17 . 18 . 19 . 20 . 21 . 22 . 23 . 24 . 25 . 26 . 27 . 28 . 29 . 30 . 31


1 . 2 . 3 . 4 . 5 . 6 . 7 . 8 . 9. 10 . 11 . . 12 . . 13 . . 14 . . 15 . . 16 . . 17 . . 18 . . 19. 20 . 21 . . 22 . . 23 . . 24 . . 25 . . 26 . . 27 . . 28 . . 29. 30 . 31 . .


300
F23
F5
211
210
880
(AV) (AV) (AV)
12.56
2
650
902
56
212
906
142
52
m5
32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62


32..33..34..35..36..37..38..39.40.41..42..43..44..45..46..47..48..49.50.51..52..53..54..55..56..57..58..59.60.61..62.


52
210
51
319
52
50
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54
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750
317
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910
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901
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F5
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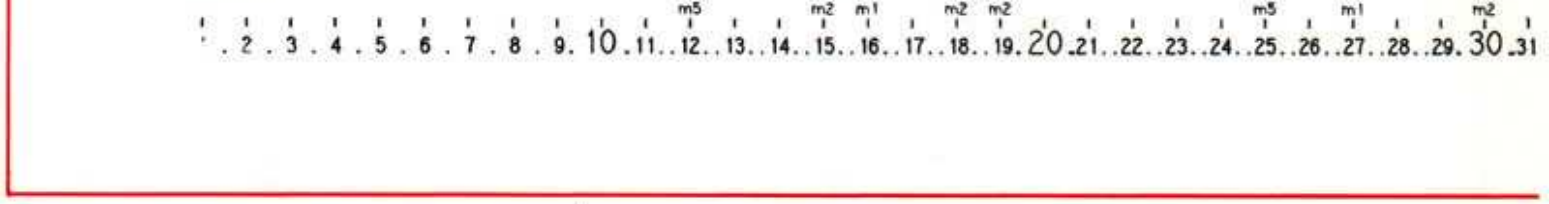
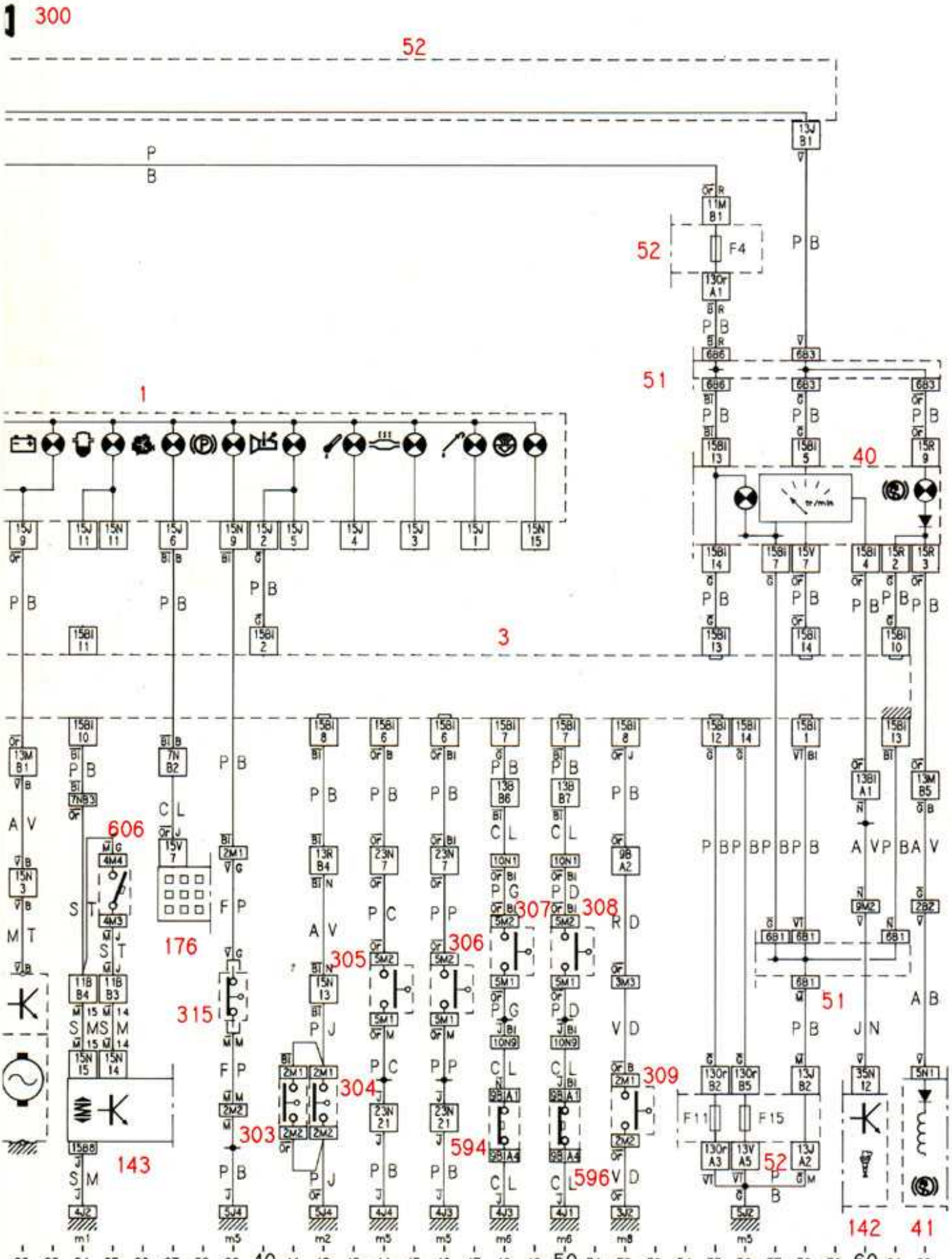
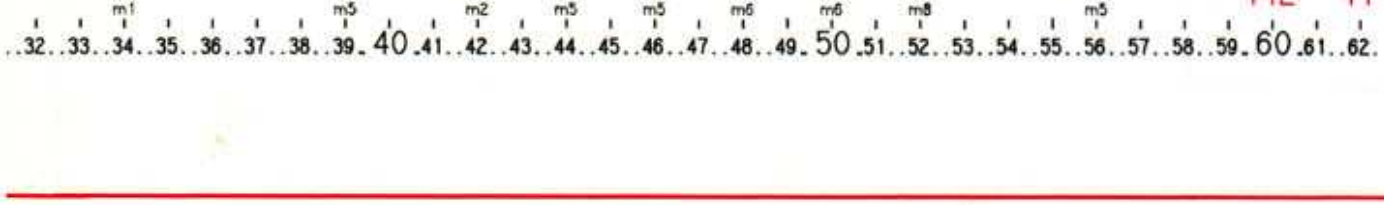
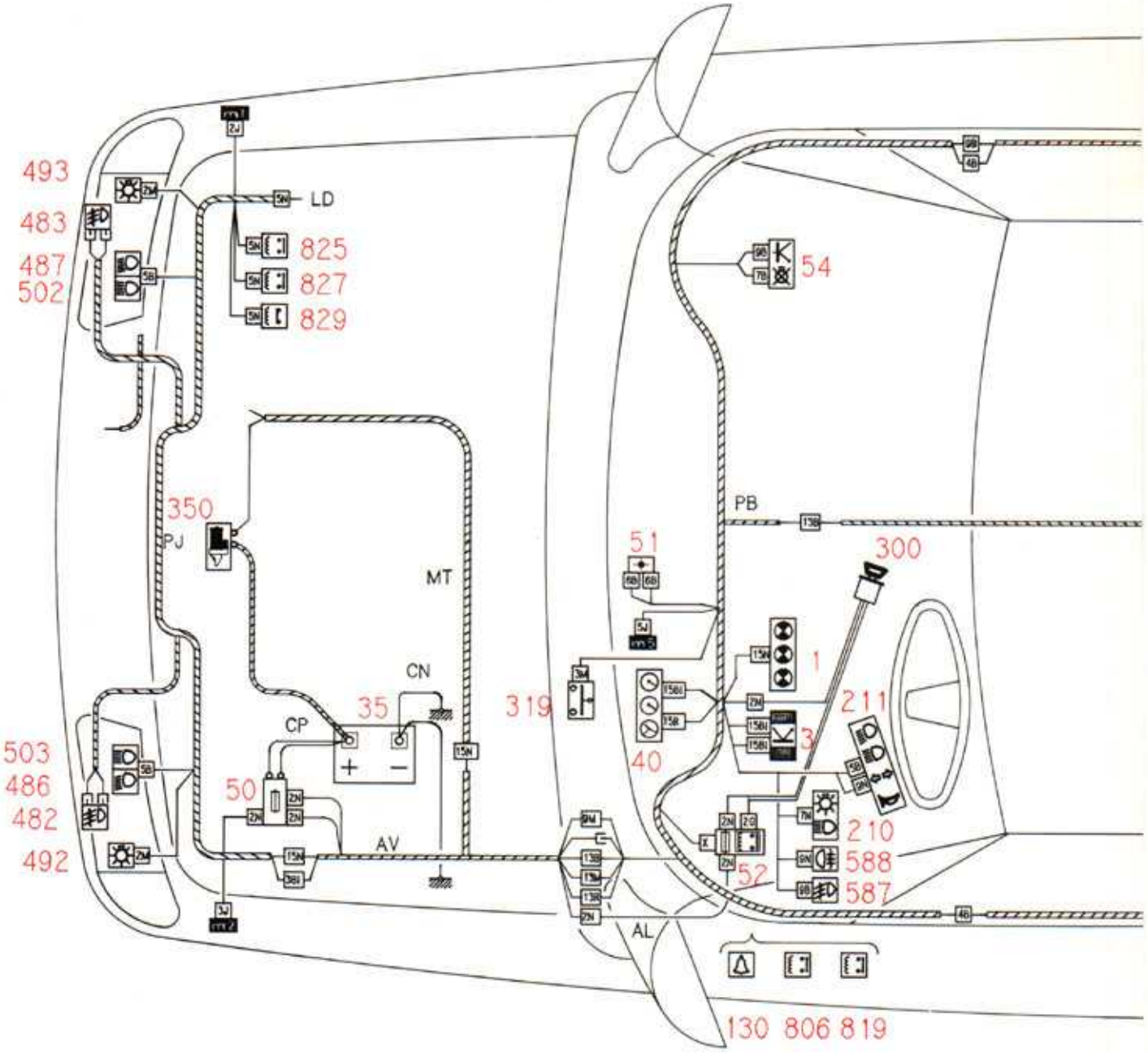
F23
F10
F18
F14
STOP


m5
m2 m1
m2 m2
m5
m1
m2
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31


300
52
1
3
40
51
606
176
315
305
306
307
308
304
303
594
596
309
143
142
41
F4
F11
F15
m1
m5
m2
m6
m8
32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62


m1
m5
m2
m5
m5
m6
m6
m8
m5
32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62


493
483
487
502
LD
825
827
829
54
350
PJ
MT
PB
51
300
CN
35
319
1
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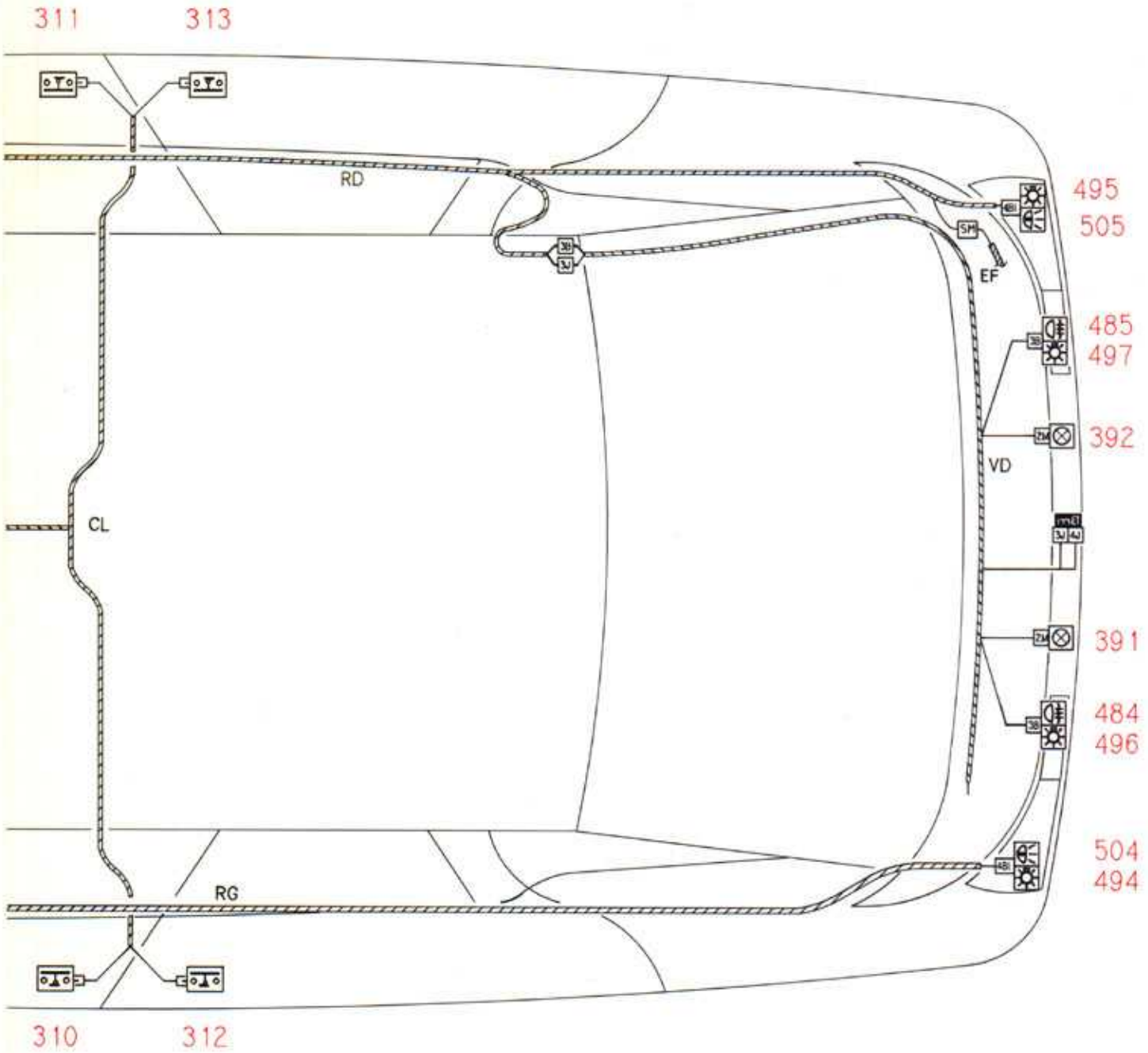
3
CP
503
486
482
492
50
40
210
588
587
52
AV
AL
130 806 819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RD
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505
EF
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VD
CL
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484
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504
494
RG
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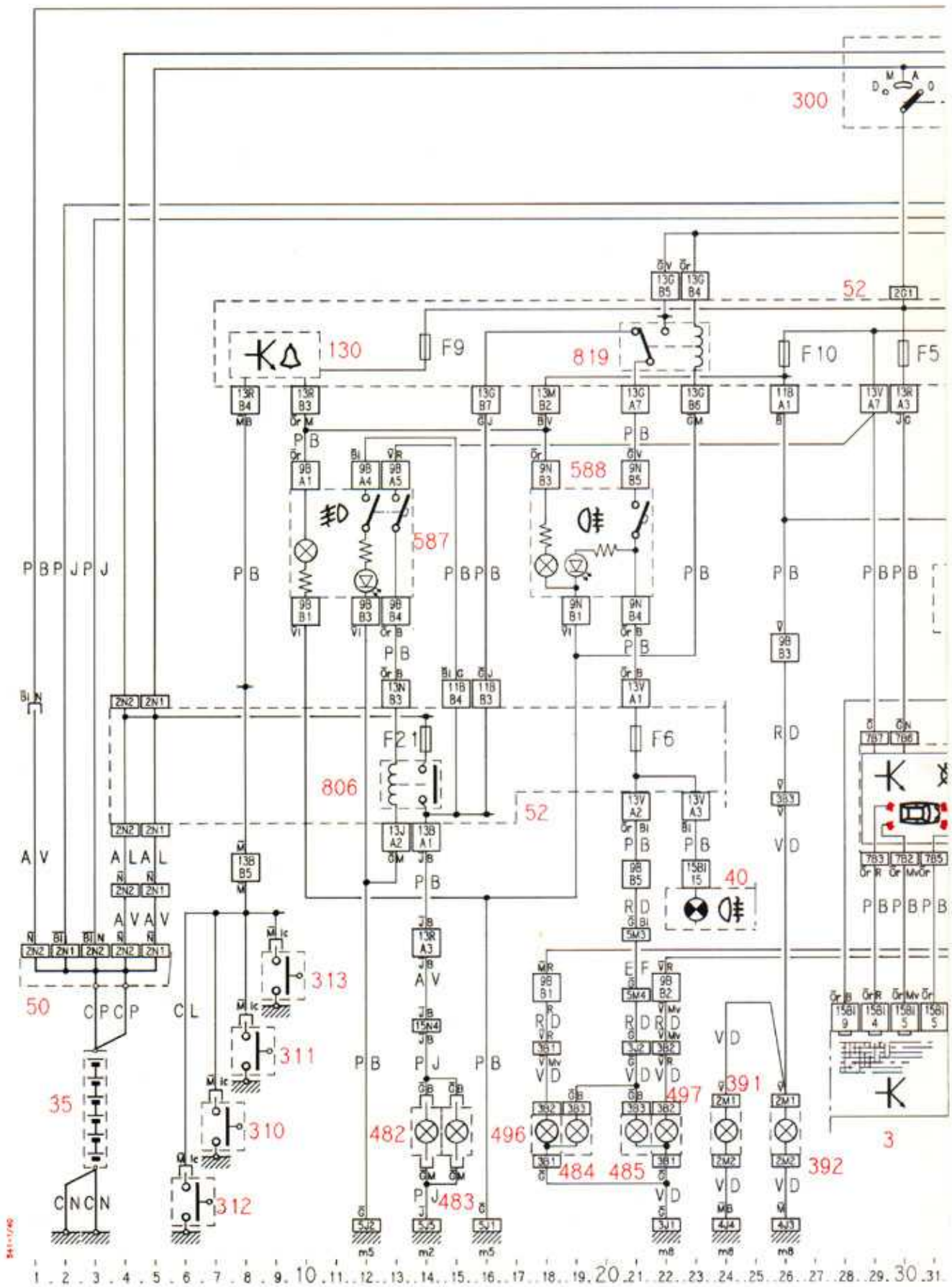
312


300
52
130
F9
819
F10
F5
588
587
F21
F6
806
52
40
313
311
310
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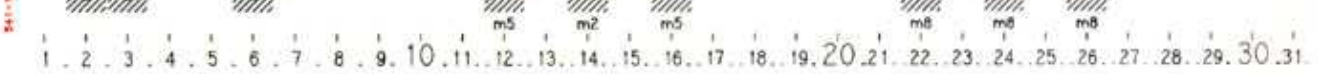
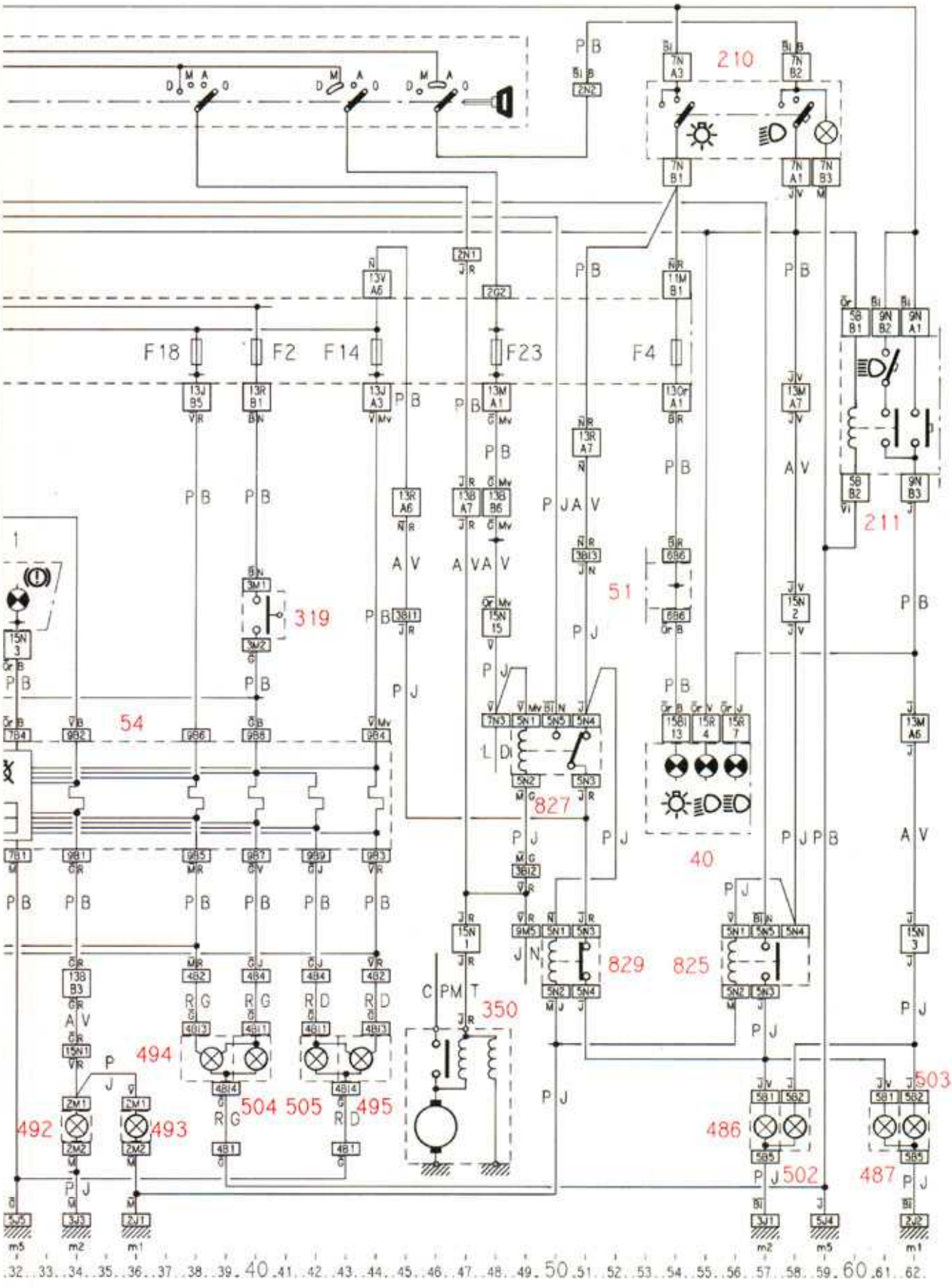
484
485
497
391
392
3


m5
m2
m5
m8
m8
m8
1 . 2 . 3 . 4 . 5 . 6 . 7 . 8 . 9. 10 . 11 . . 12 . . 13 . . 14 . . 15 . . 16 . . 17 . . 18 . . 19. 20 . 21 . . 22 . . 23 . . 24 . . 25 . . 26 . . 27 . . 28 . . 29. 30 . 31 .


210
211
F18
F2
F14
F23
F4
319
51
54
827
40
829
825
350
494
504
505
495
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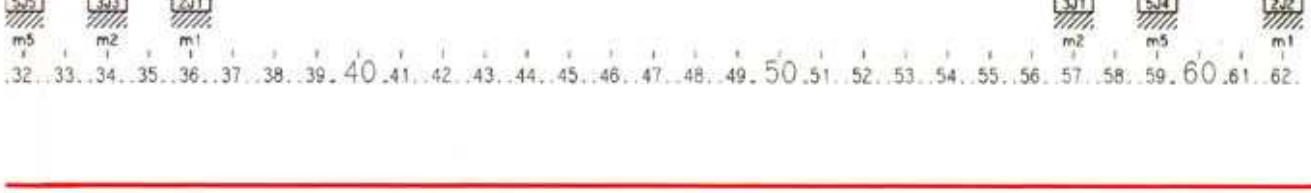
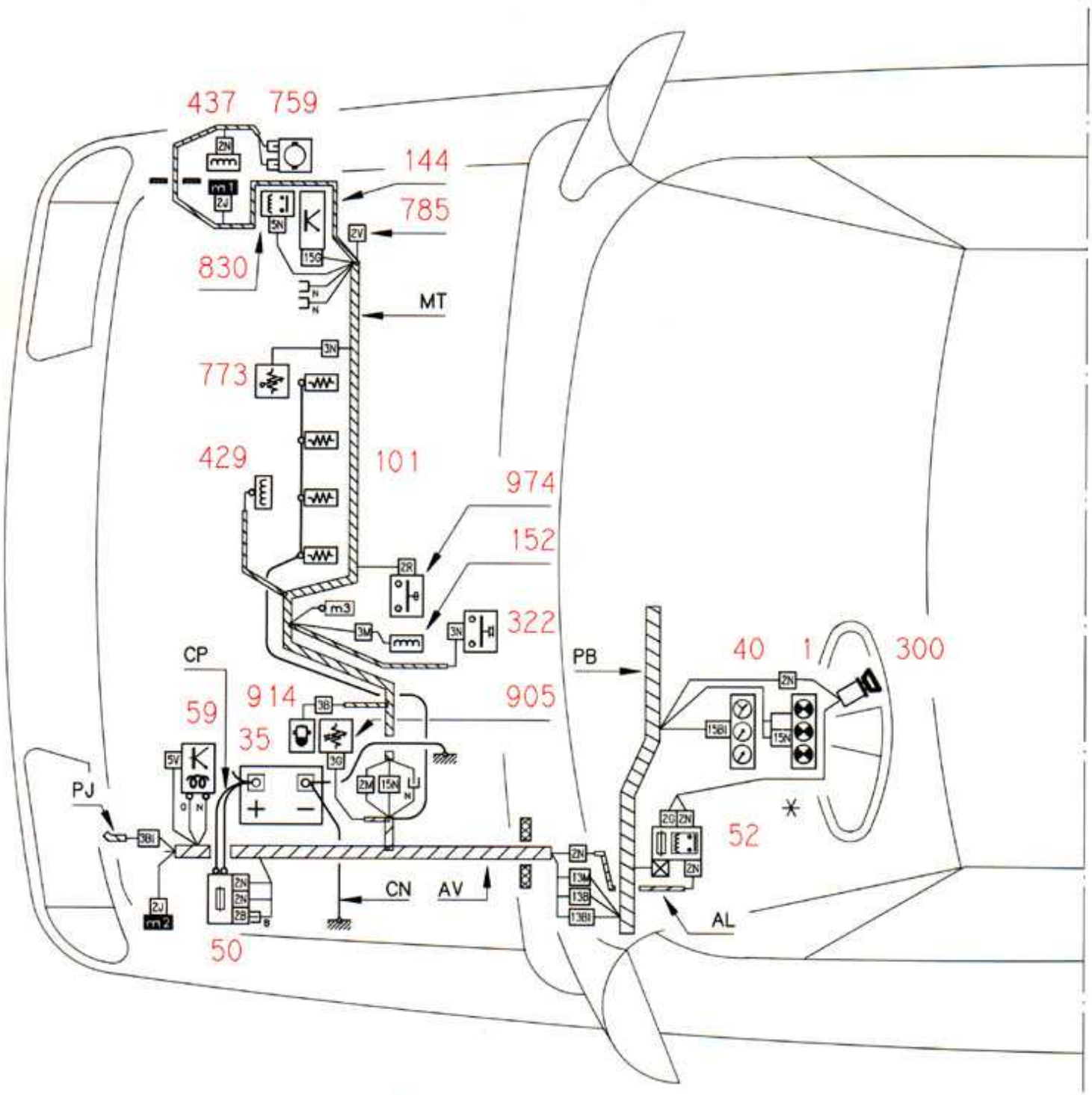
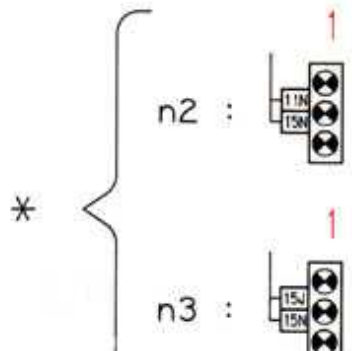
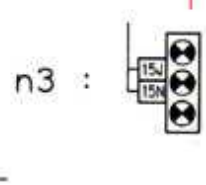
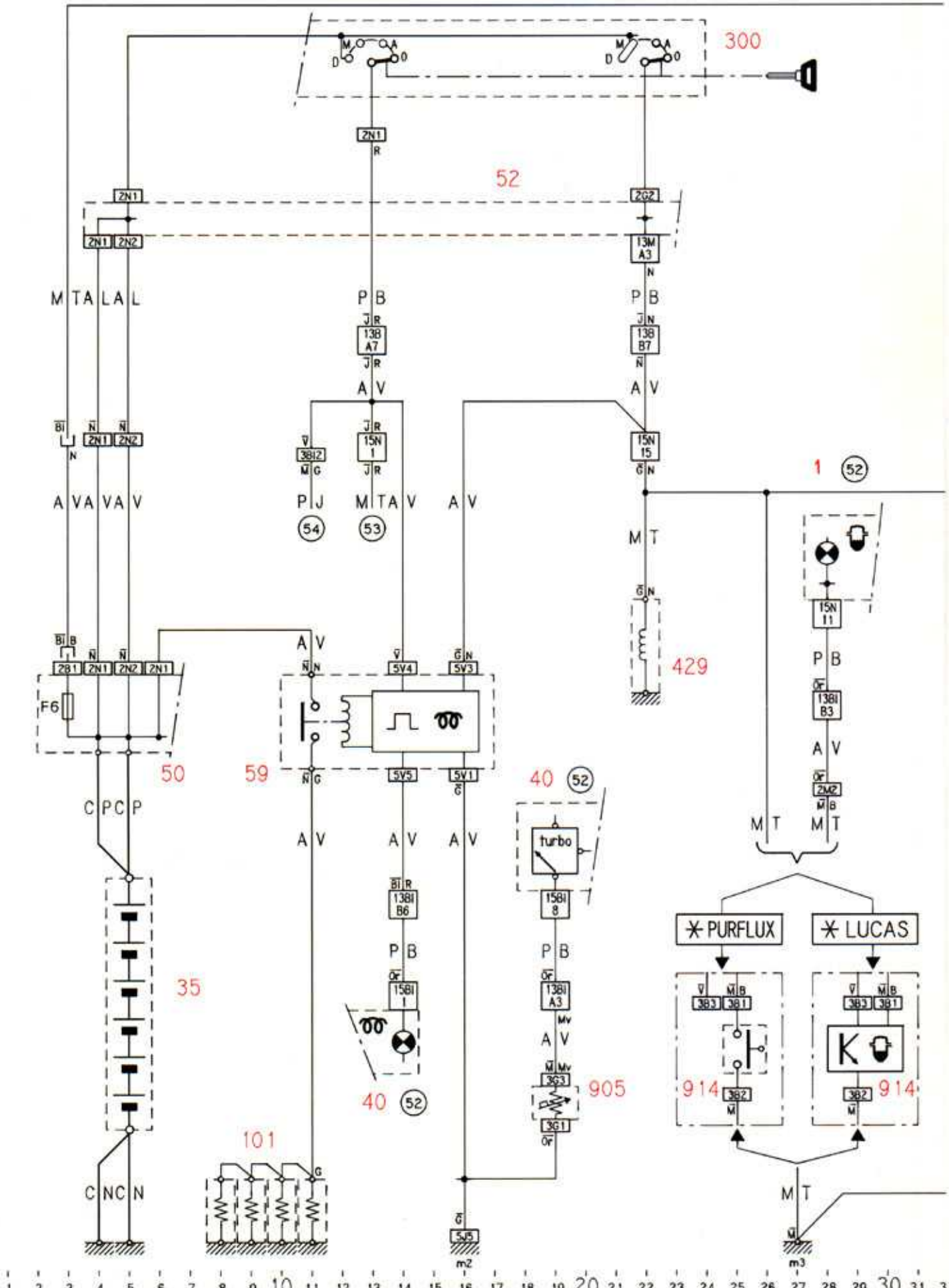
493
486
502
503
487

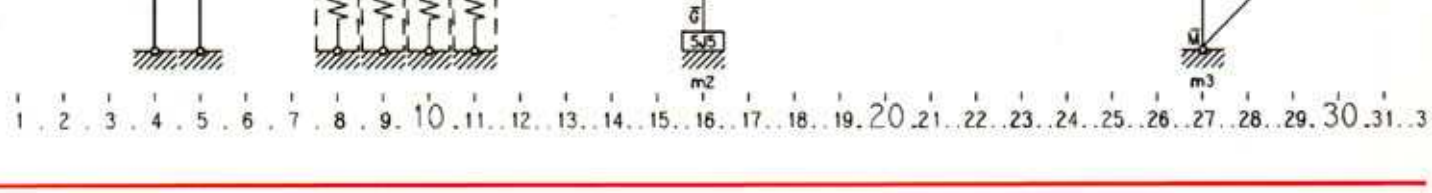

m5
m2
m1
m2
m5
m1
32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62

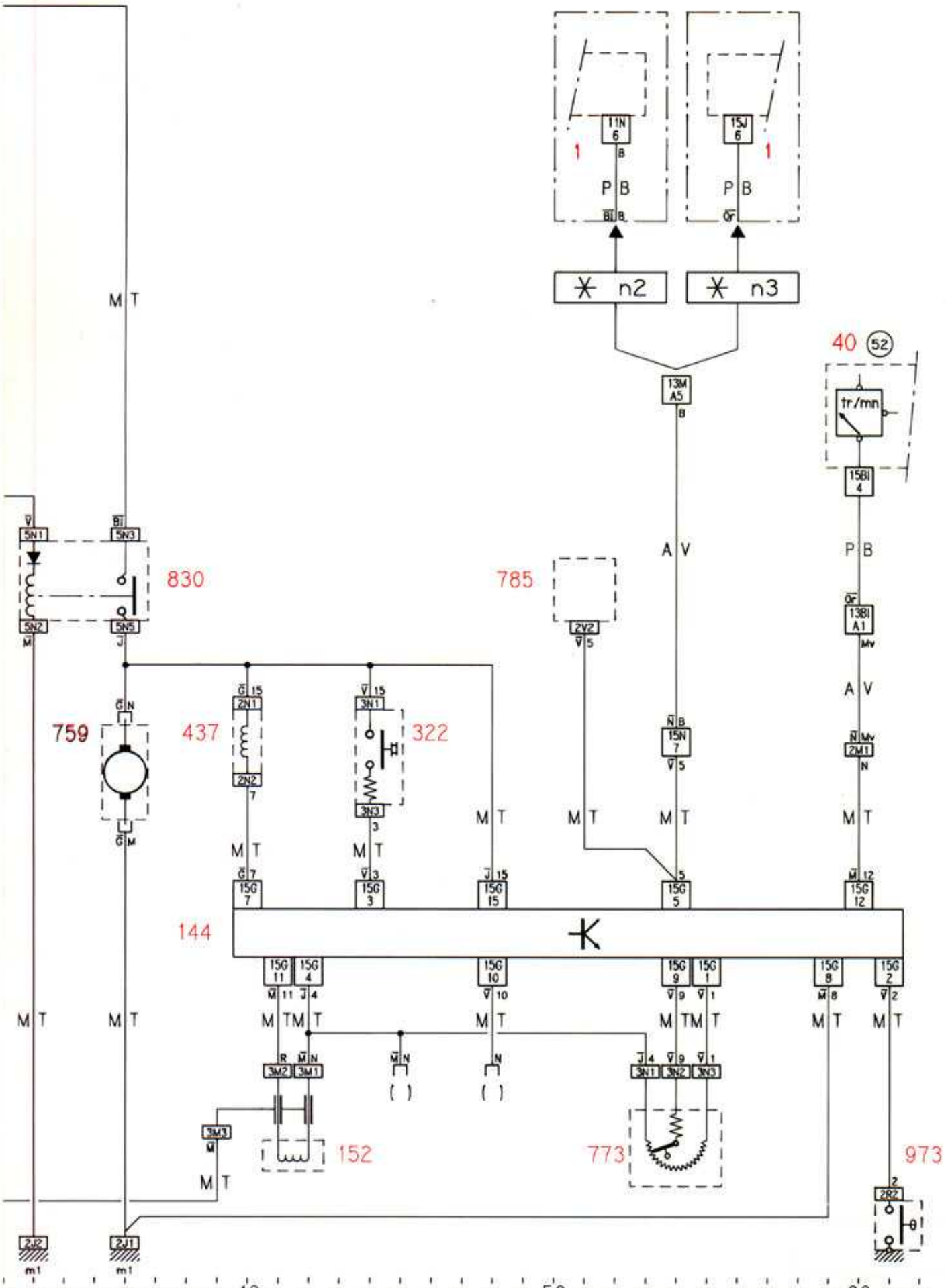

437
759
144
785
830
MT
773
429
101
974
152
322
CP
914
905
59
35
PB
40
1
300
PJ
52
CN
AV
AL
50

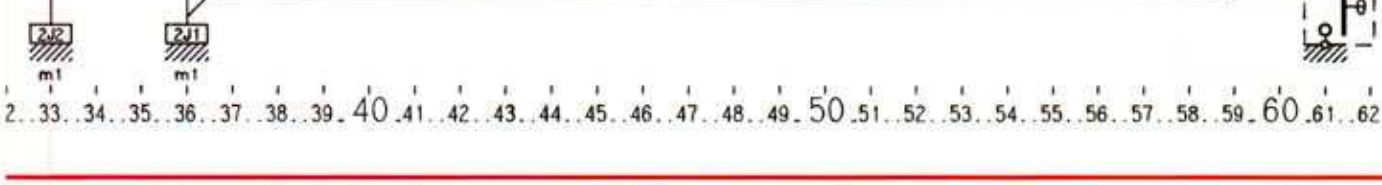

*
n2 :
1
n3 :
1

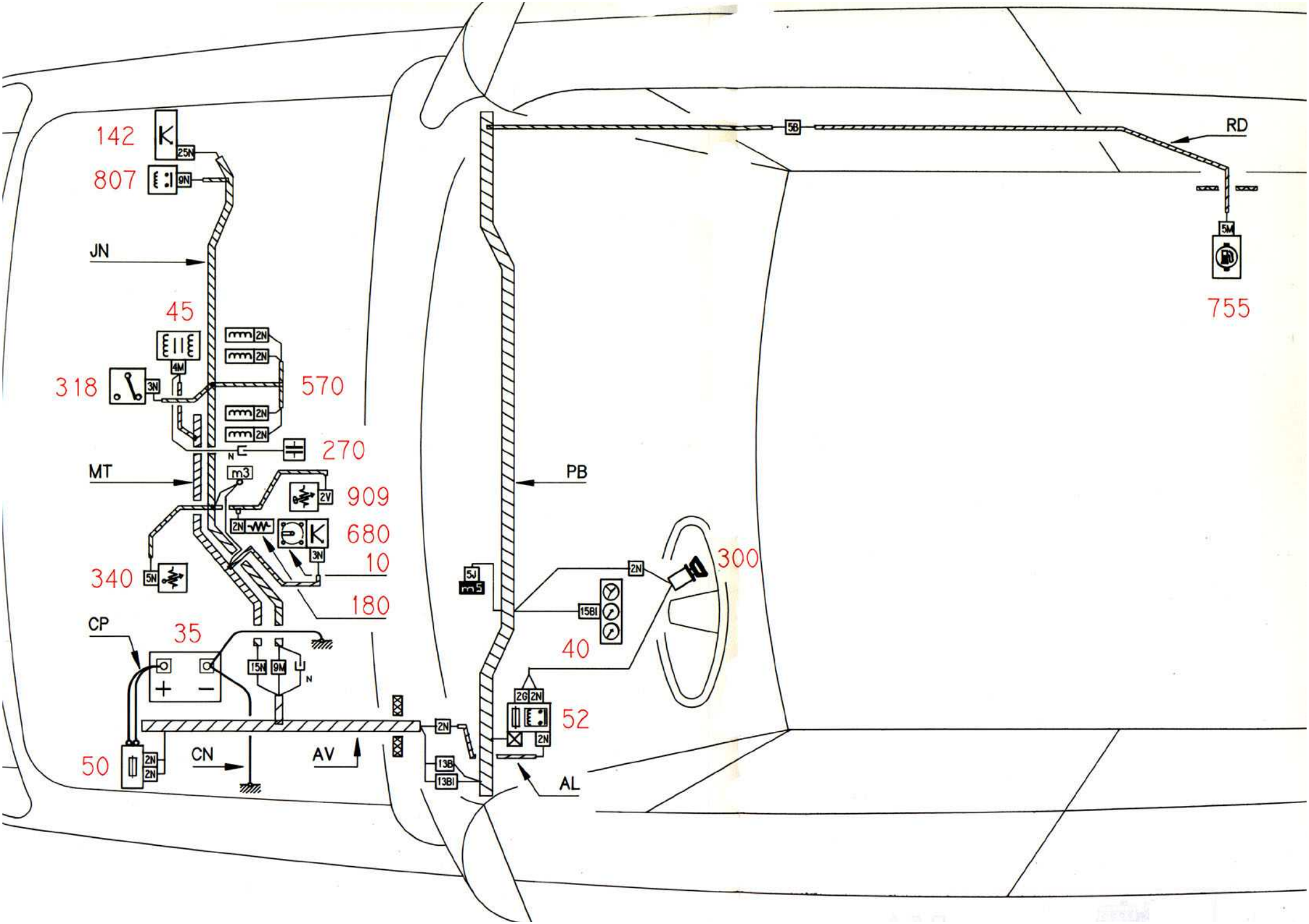

n3 :
15V
15N

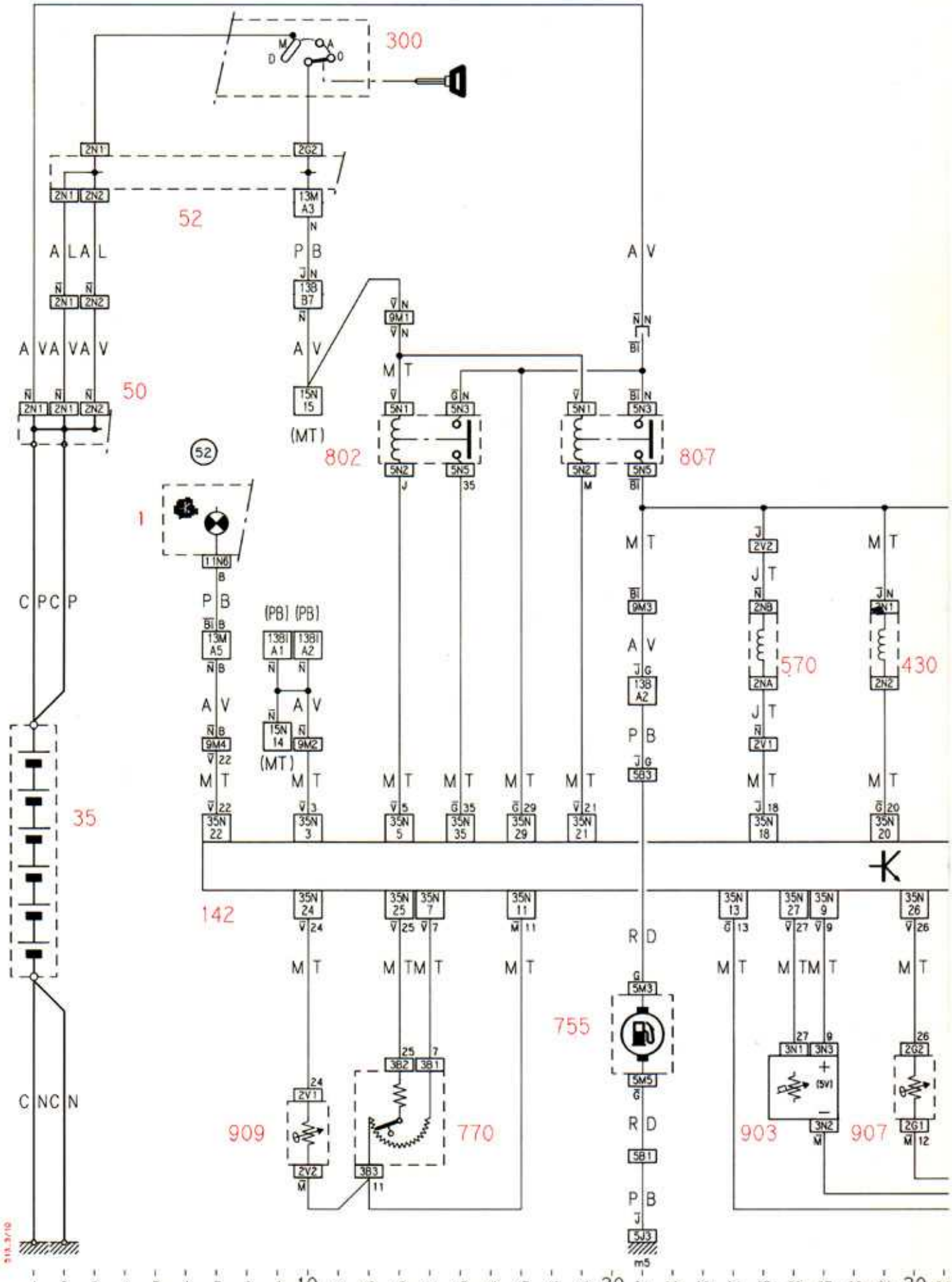

300
52
2N1
2G2
13M A3
M T A L A L
P B
13B A7
13B B7
A V
15N 1
15N 15
3BI2
P J
M T A V
A V
54
53
1
52
M T
429
15N 11
13BI B3
2M2
2B1
F6
50
59
5V4
5V3
5V5
5V1
40
turbo
15BI 8
13BI B6
15BI 1
13BI A3
3G3
3G1
905
35
101
C P C P
C N C N
PURFLUX
LUCAS
3B3
3B1
3B2
914
5J5
m2
m3

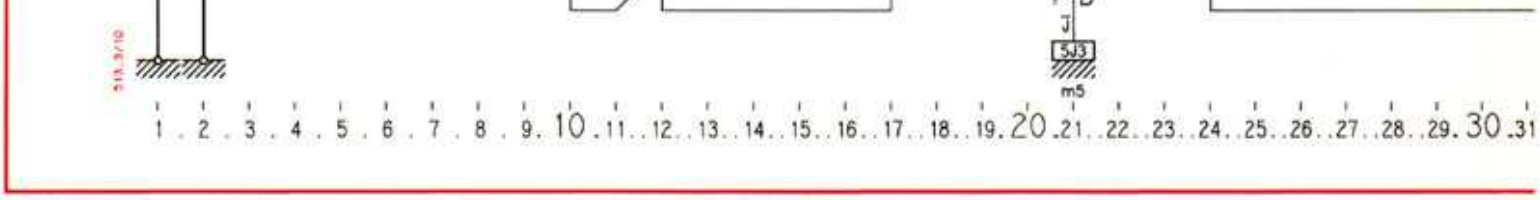

m2
m3
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 3

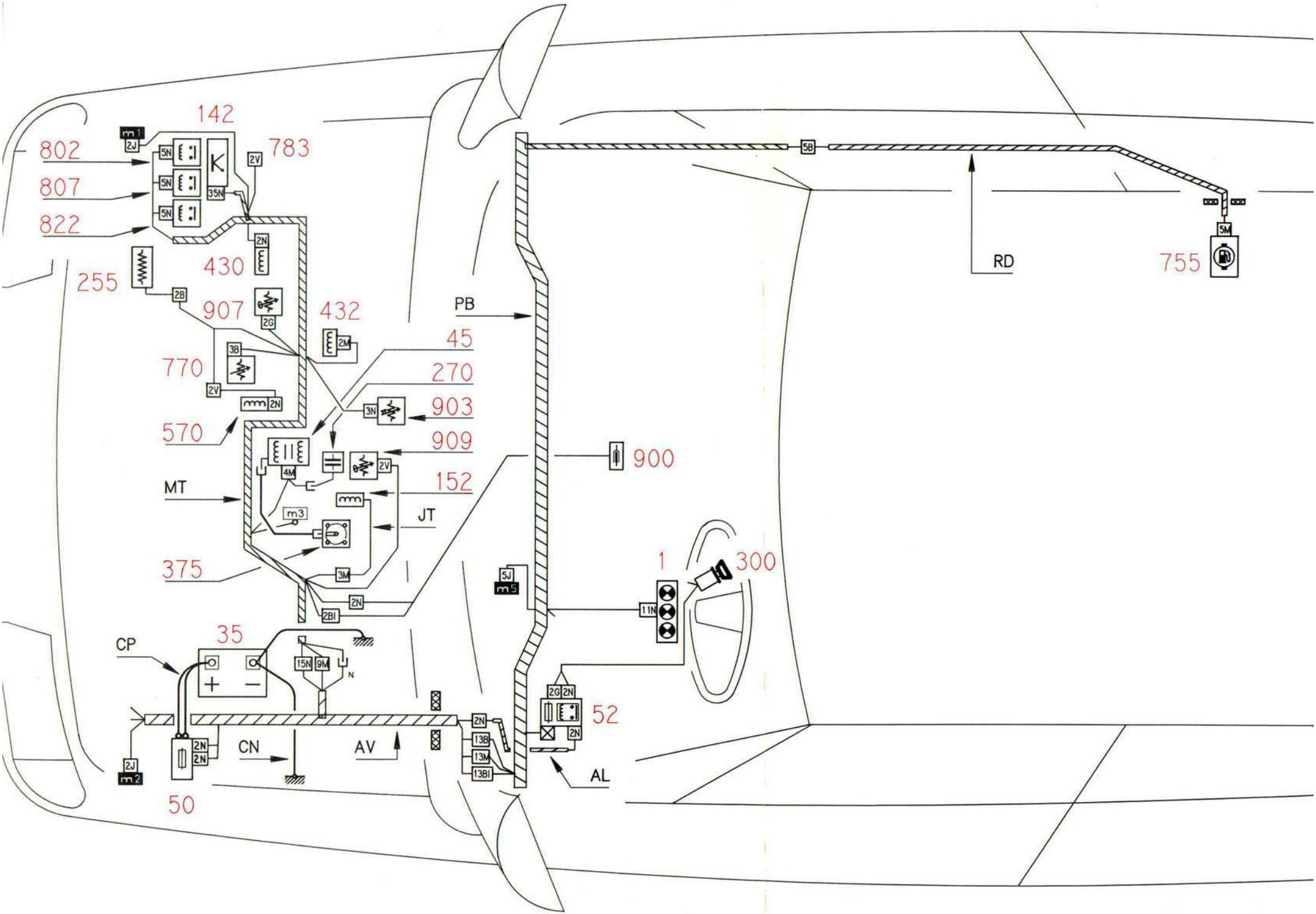

11N 6
15J 6
1
1
P B
P B
n2
n3
40
52
tr/mn
13M A5
15Bi 4
A V
P B
13Bi A1
A V
2M1
M T
5N1
5N3
5N2
5N5
830
785
2V2
759
437
322
2N1
2N2
3N1
3N3
15N 7
15G 7
15G 3
15G 15
15G 5
15G 12
144
15G 11
15G 4
15G 10
15G 9
15G 1
15G 8
15G 2
3M2
3M1
3N1
3N2
3N3
3M3
152
773
973
2R2
2J2
2J1
m1
33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62

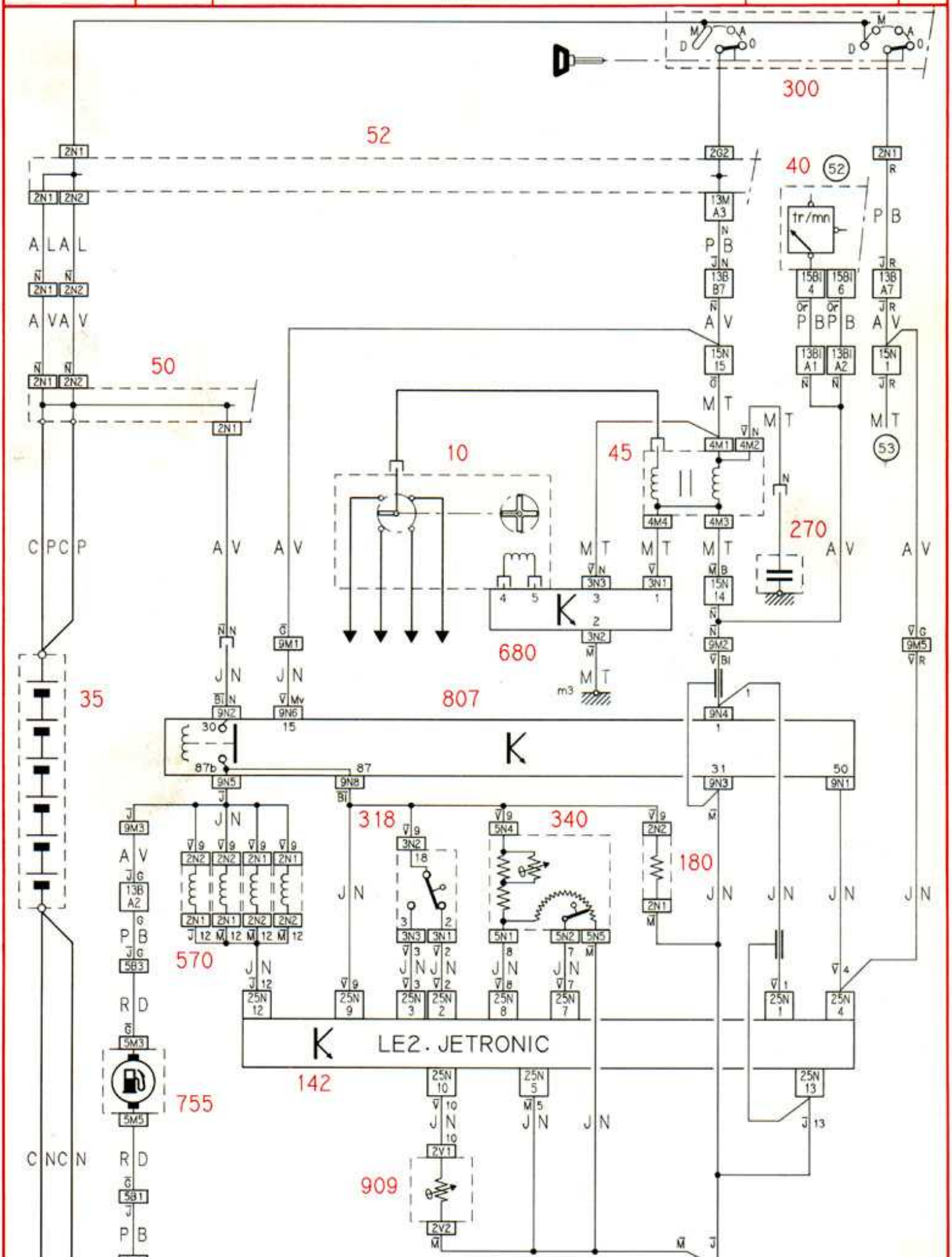

2J2
m1
2J1
m1
2..33..34..35..36..37..38..39.40.41..42..43..44..45..46..47..48..49.50.51..52..53..54..55..56..57..58..59.60.61..62.

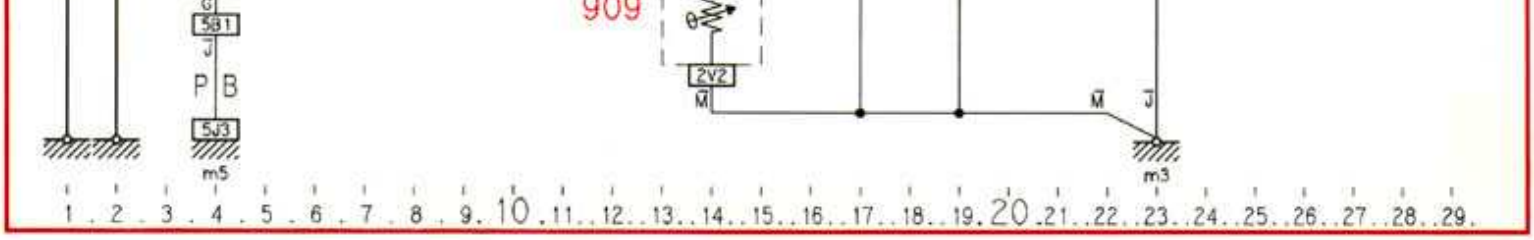

142
807
JN
45
318
570
270
MT
909
680
10
340
180
CP
35
50
CN
AV
PB
RD
755
300
40
52
AL

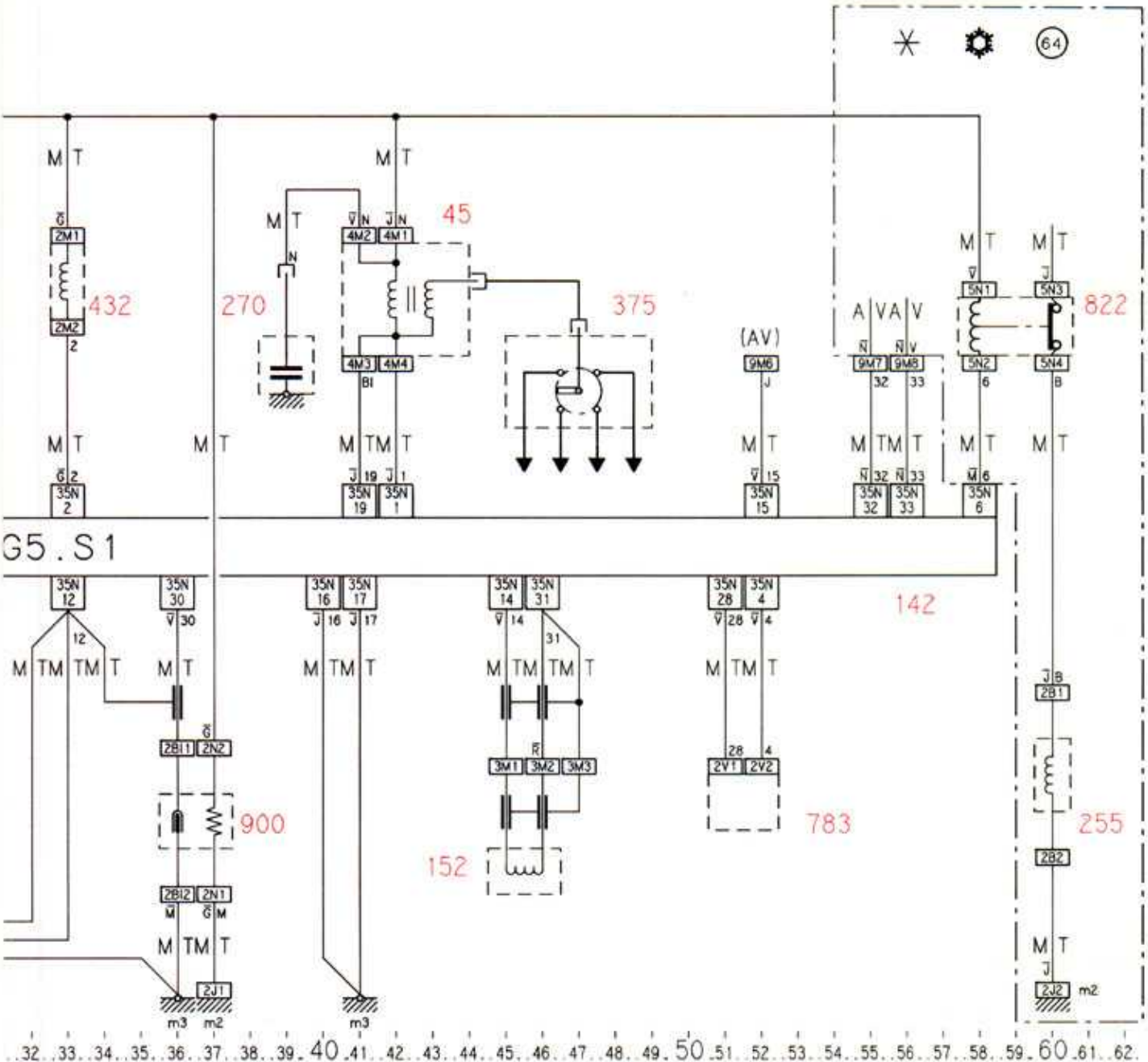

300
52
50
1
35
142
802
807
570
430
755
909
770
903
907
(MT)
(PB) (PB)
(5V)
m5


J
5J3
m5
1 . 2 . 3 . 4 . 5 . 6 . 7 . 8 . 9. 10 . 11 . . 12 . . 13 . . 14 . . 15 . . 16 . . 17 . . 18 . . 19. 20 . 21 . . 22 . . 23 . . 24 . . 25 . . 26 . . 27 . . 28 . . 29. 30 . 31


142
802
807
822
783
255
430
907
432
45
770
270
903
570
909
900
MT
152
JT
375
1
300
35
CP
52
CN
AV
AL
50
RD
755
PB


300
52
40
tr/mn
50
10
45
270
680
807
35
318
340
180
570
LE2. JETRONIC
142
755
909


909
5B1
P B
5J3
m5
2V2
M
M
J
m3
1 . 2 . 3 . 4 . 5 . 6 . 7 . 8 . 9. 10 . 11 . . 12 . . 13 . . 14 . . 15 . . 16 . . 17 . . 18 . . 19. 20 . 21 . . 22 . . 23 . . 24 . . 25 . . 26 . . 27 . . 28 . . 29.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4M3
4M4
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9M6
(AV)
9M7
9M8
5N1
5N2
5N3
5N4
822
35N 2
35N 19
35N 1
35N 15
35N 32
35N 33
35N 6
G5.S1
142
35N 12
35N 30
35N 16
35N 17
35N 14
35N 31
35N 28
35N 4
2B11
2N2
900
2B12
2N1
2J1
m3
m2
3M1
3M2
3M3
152
2V1
2V2
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2B2
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2J2
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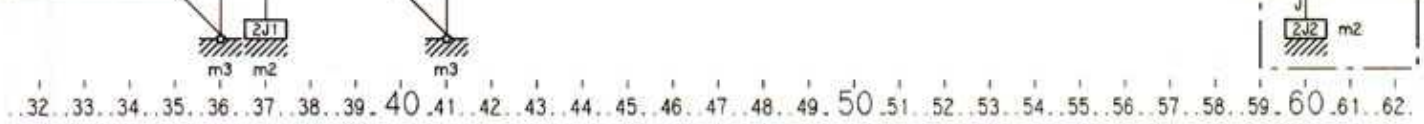
2J1
m3
m2
m3
2J2
m2
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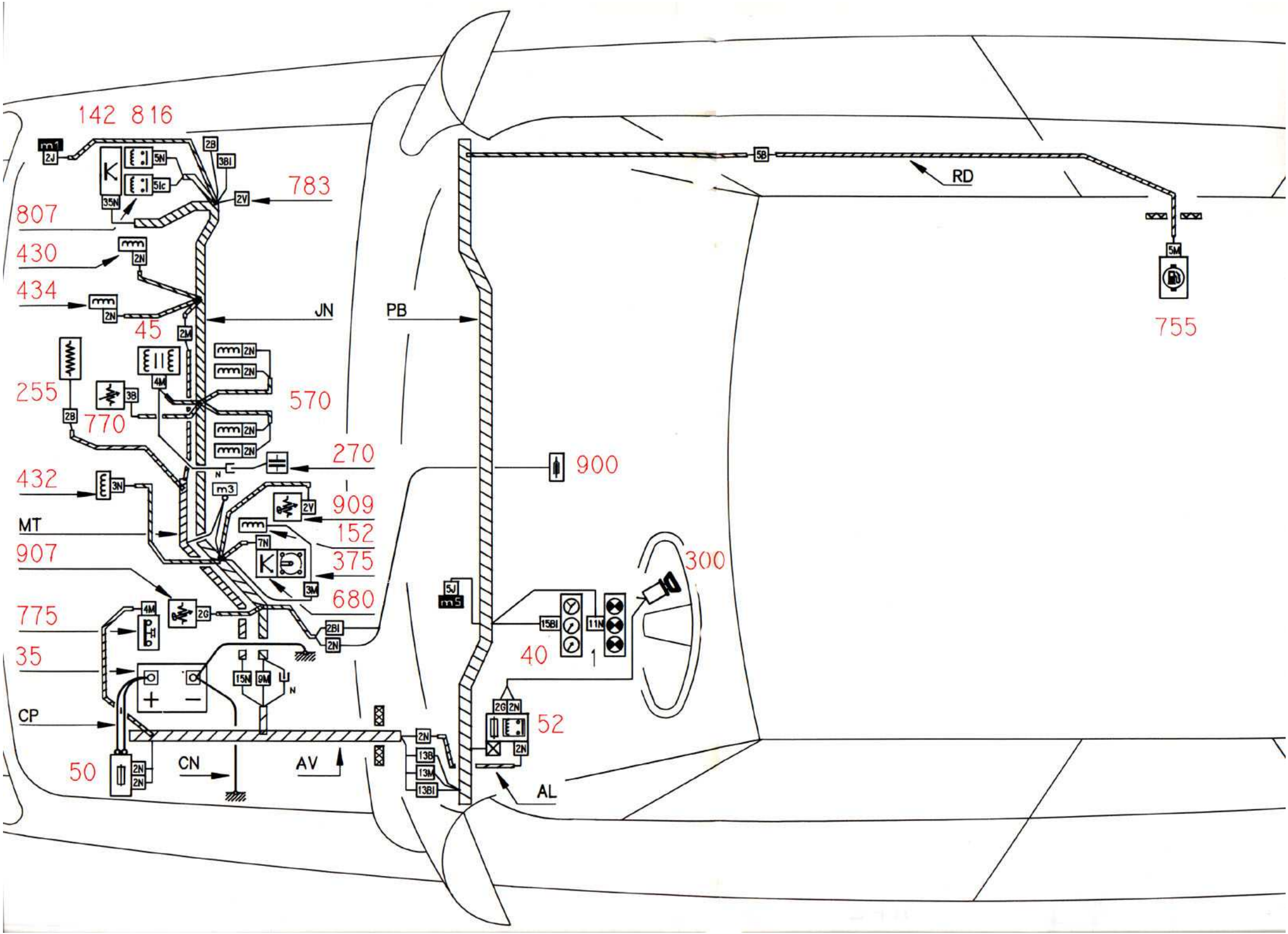

142 816
783
807
430
434
45
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PB
255
770
570
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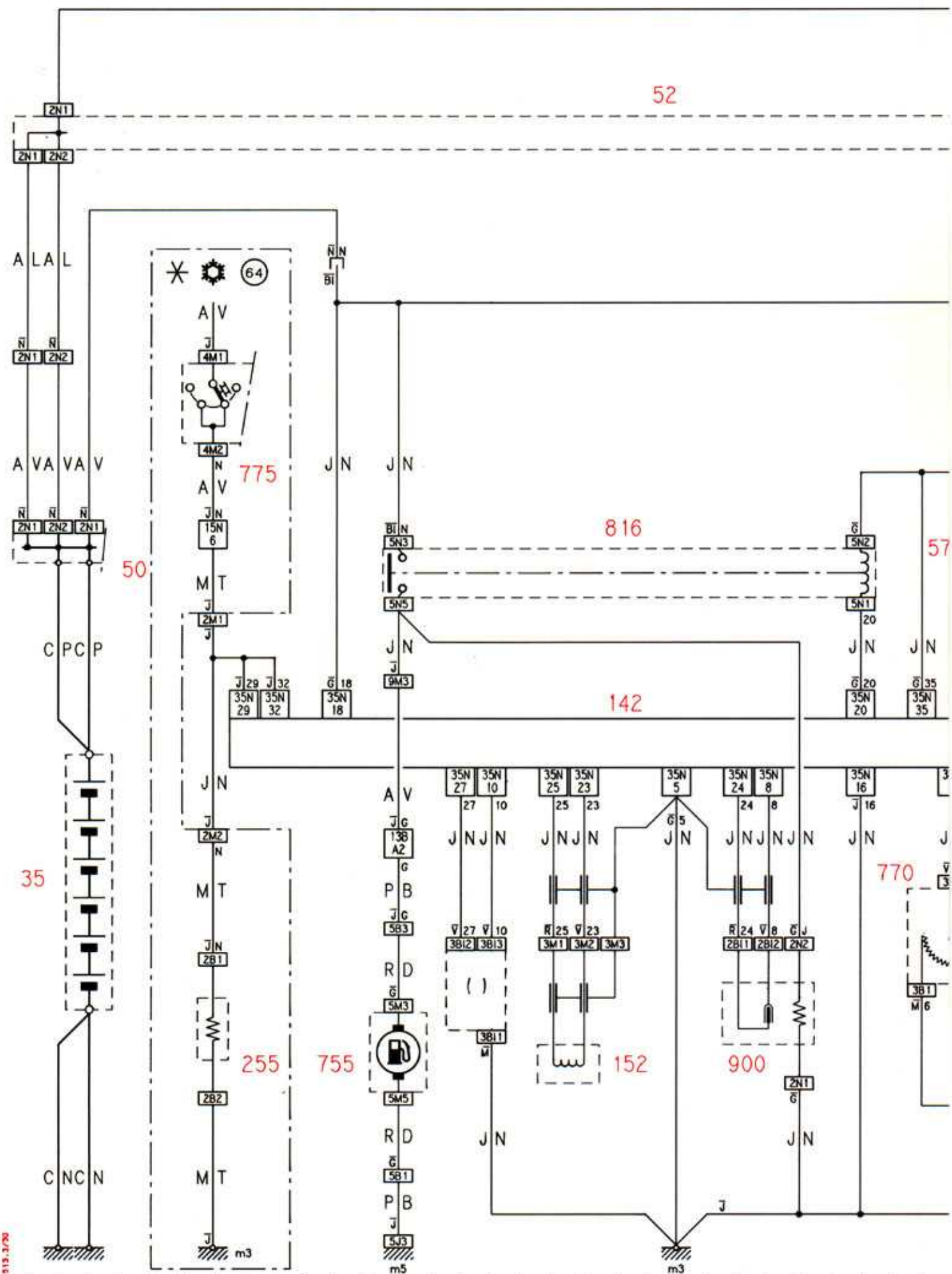
RD
755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C P C P
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A V
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4M2
775
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M T
2M1
2M2
2B1
2B2
255
50
35
J N
816
5N3
5N5
5N2
5N1
57
9M3
35N 29
35N 32
35N 18
142
35N 20
35N 35
35N 27
35N 10
35N 25
35N 23
35N 5
35N 24
35N 8
35N 16
13B A2
P B
5B3
R D
5M3
5M5
5B1
5J3
755
3BI2
3BI3
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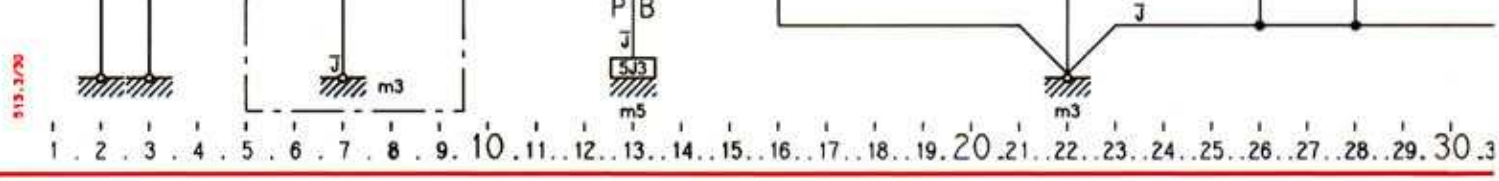
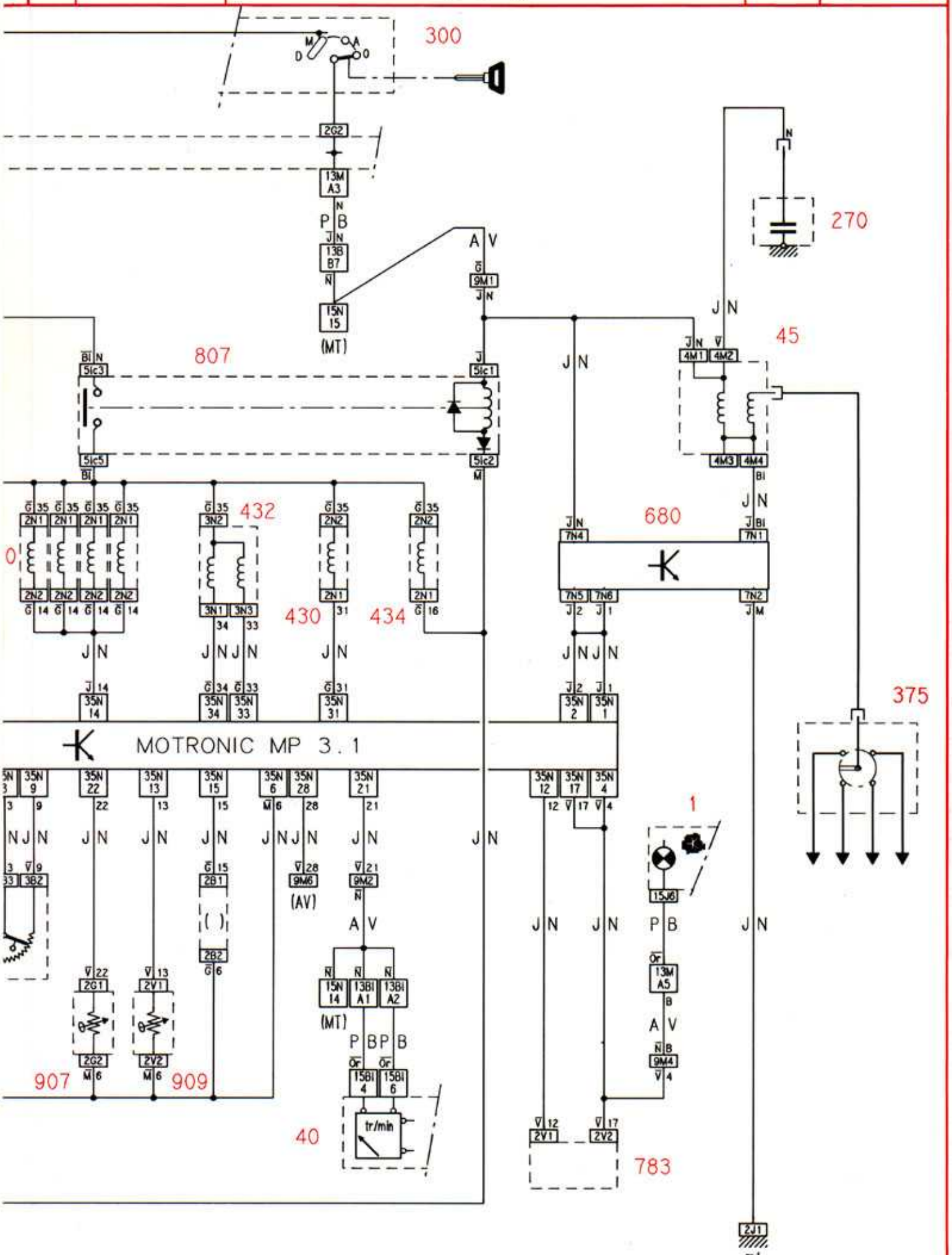
m5


J
m3
P
B
J
5J3
m5
J
m3
1 . 2 . 3 . 4 . 5 . 6 . 7 . 8 . 9. 10 .11..12..13..14..15..16..17..18..19.20.21..22..23..24..25..26..27..28..29.30.3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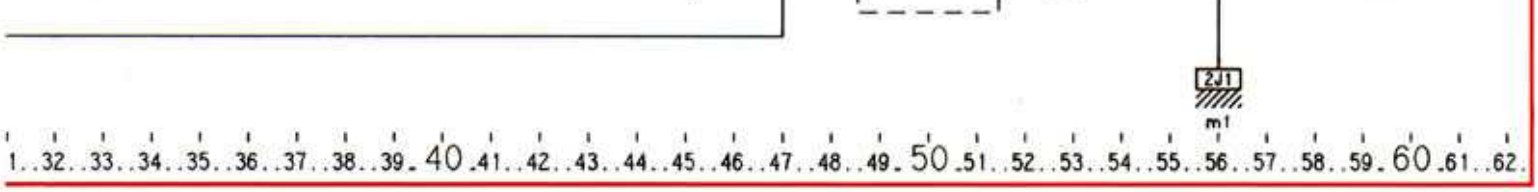
807
45
680
375
MOTRONIC MP 3.1
907
909
40
783
(MT)
(AV)
tr/min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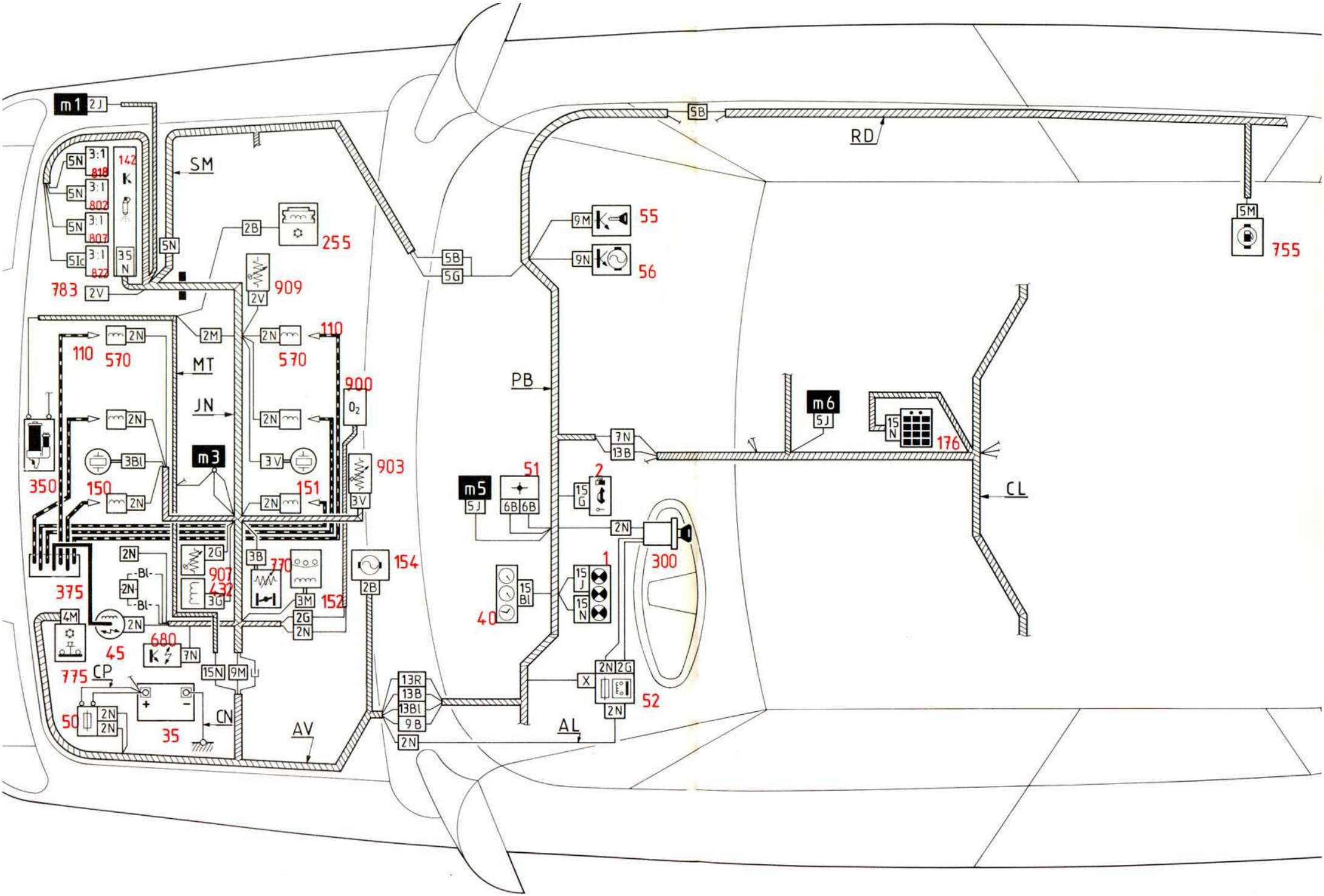
m1
1..32..33..34..35..36..37..38..39.40.41..42..43..44..45..46..47..48..49.50.51..52..53..54..55..56..57..58..59.60.61..62.


m1
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SM
5N
3:1
818
802
807
822
142
35
N
783
2V
2B
255
909
2V
5B
5G
9M
55
9N
56
RD
5B
5M
755
110
570
2N
2M
MT
JN
900
O_2
903
3V
3Bl
m3
350
150
151
375
2G
3G
907
432
3B
770
3M
152
154
2B
4M
45
680
7N
775
CP
15N
9M
50
35
CN
AV
13R
13B
13Bl
9B
AL
PB
m5
5J
51
6B
2
15
G
7N
13B
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CL
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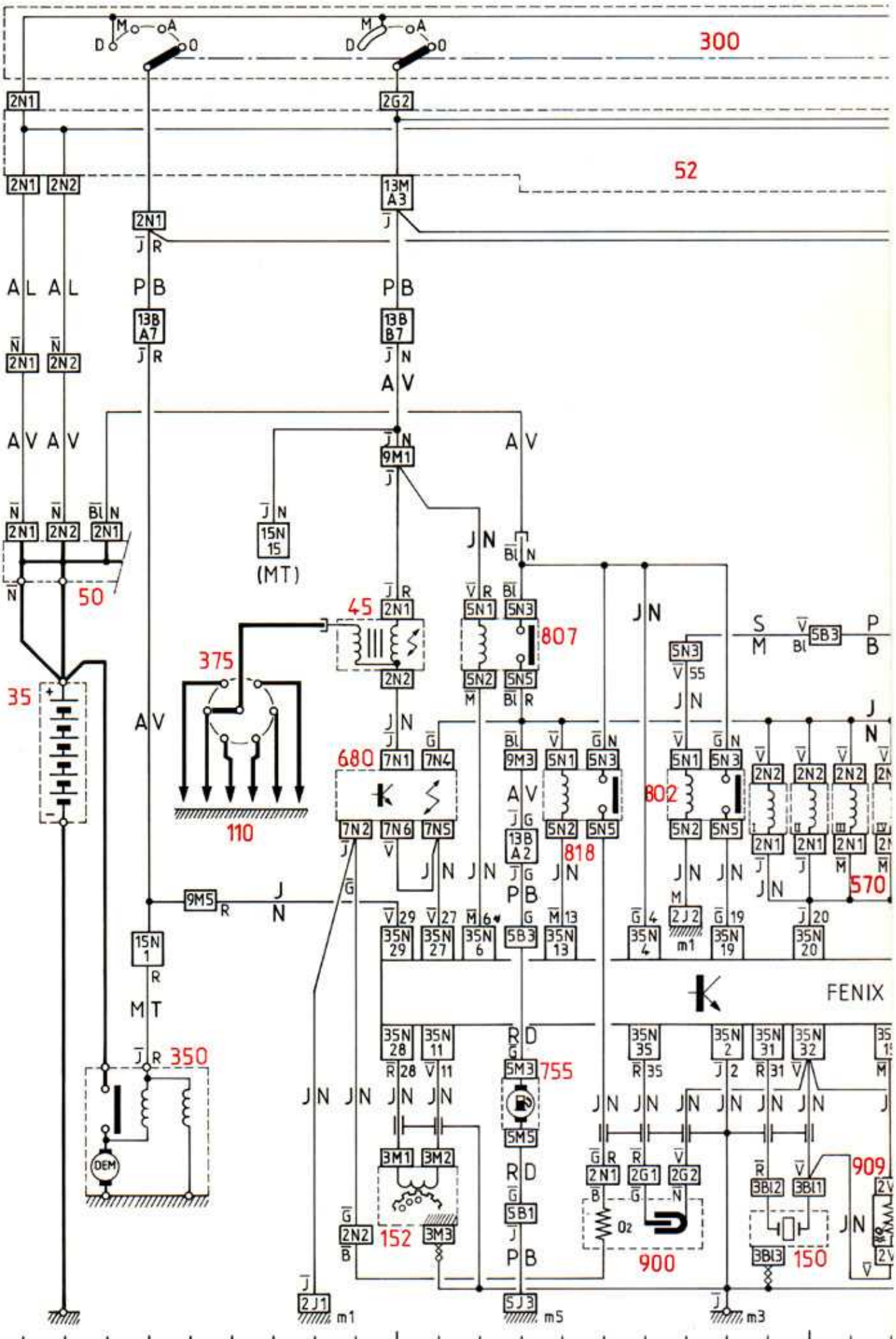
2N
2G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2N2
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13B A7
13B B7
9M1
15N 15
(MT)
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45
375
35
110
680
807
818
802
570
9M5
15N 1
MT
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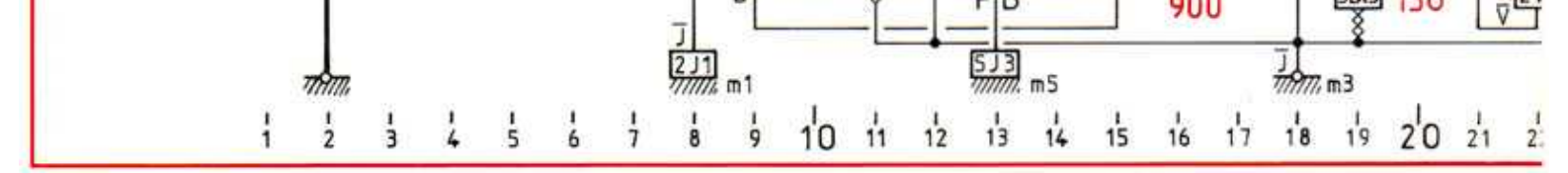
DEM
FENIX
755
152
900
909
150
2J1
m1
5J3
m5
m3
2J2
m1


900
2J1
m1
5J3
m5
m3
1
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3
4
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6
7
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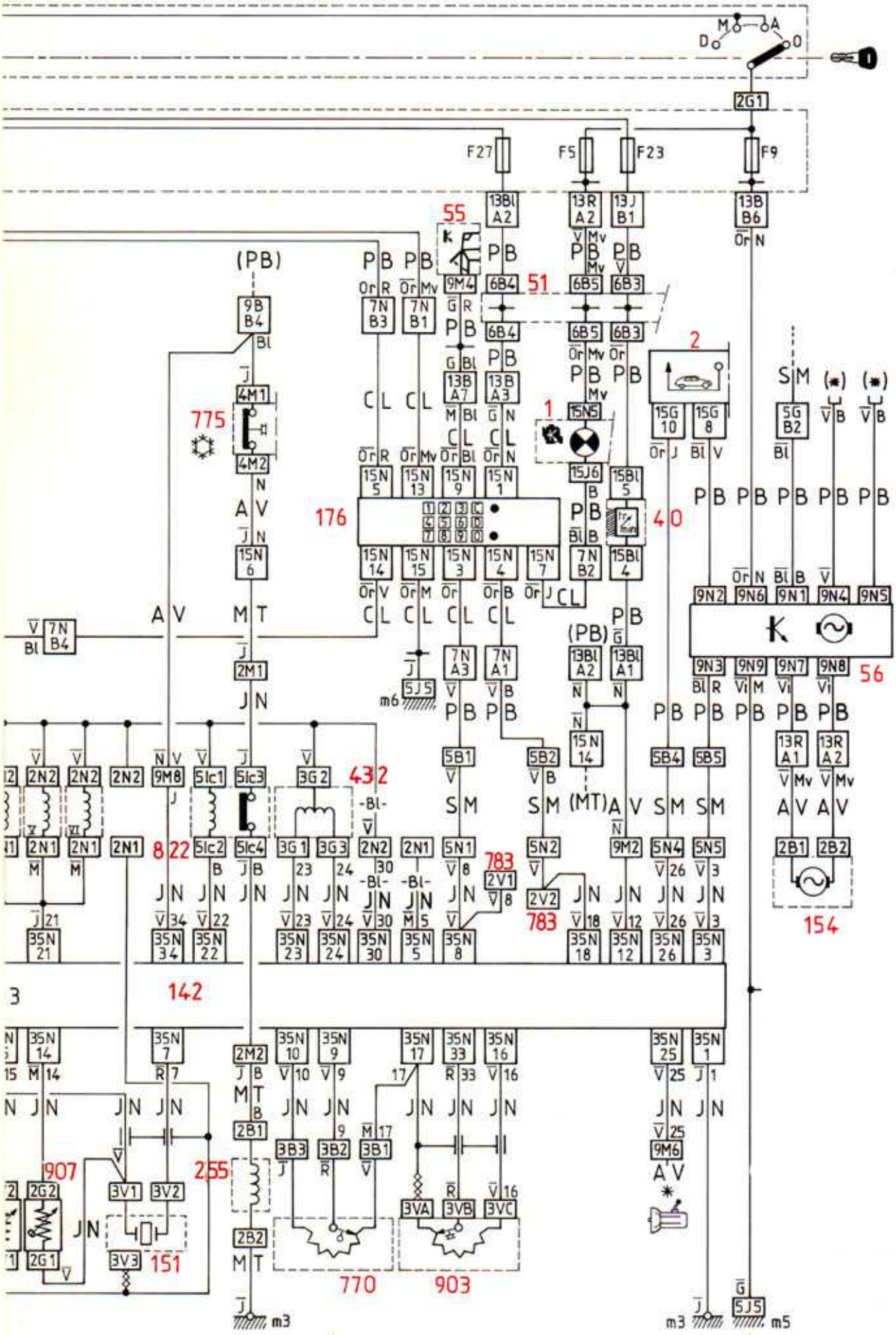
21


M
A
D
O
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F27
F5
F23
F9
13Bl A2
13R A2
13J B1
13B B6
55
51
(PB)
9B B4
4M1
4M2
775
7N B3
7N B1
9M4
6B4
6B5
6B3
13B A7
13B A3
15N 5
15N 13
15N 9
15N 1
15N 6
176
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15N 15
15N 3
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15N 7
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15Bl 5
7N B2
15Bl 4
40
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15G 10
15G 8
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SM
(*)
9N2
9N6
9N1
9N4
9N5
56
7N B4
2M1
5J5
m6
7N A3
7N A1
13Bl A1
5B1
5B2
5B4
5B5
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13R A2
2N2
2N1
9M8
5Ic1
5Ic3
5Ic2
5Ic4
3G 2
3G 1
3G 3
432
822
783
2V1
2V2
5N1
5N2
9M2
5N4
5N5
2B1
2B2
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35N 22
35N 23
35N 24
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35N 5
35N 8
35N 18
35N 12
35N 26
35N 3
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35N 14
35N 7
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3V2
3V3
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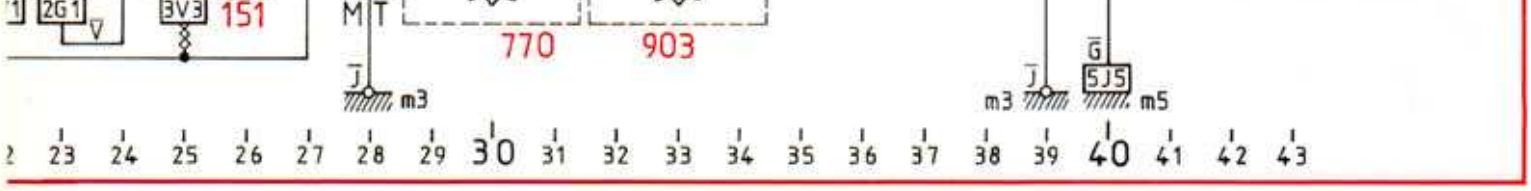
2G1
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5J5
m5

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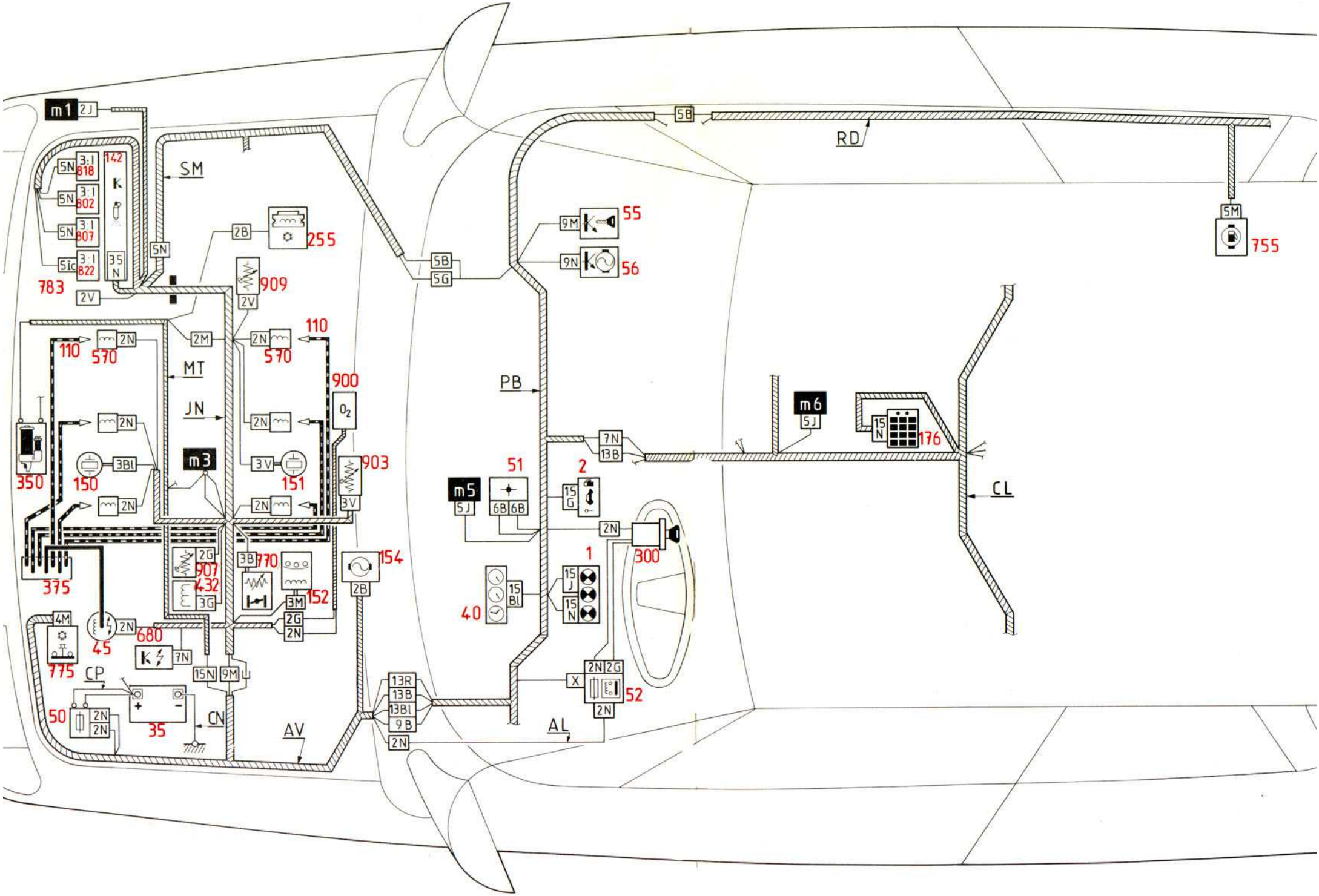
m1
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RD
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O_2
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3Bl
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2G
907
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3B
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152
3M
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2B
4M
775
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7N
15N
9M
CP
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13B
13Bl
9B
AL
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m5
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6B
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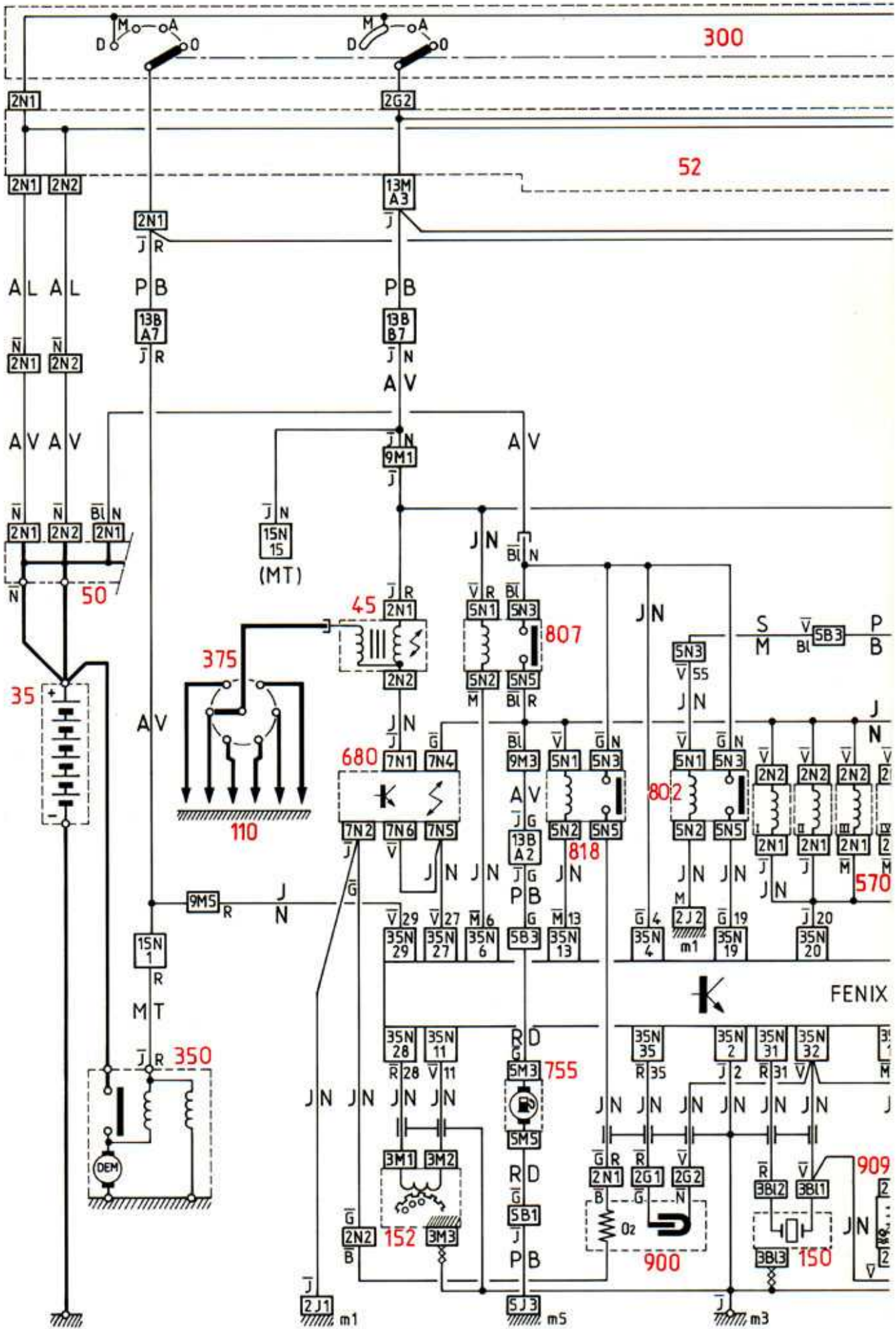
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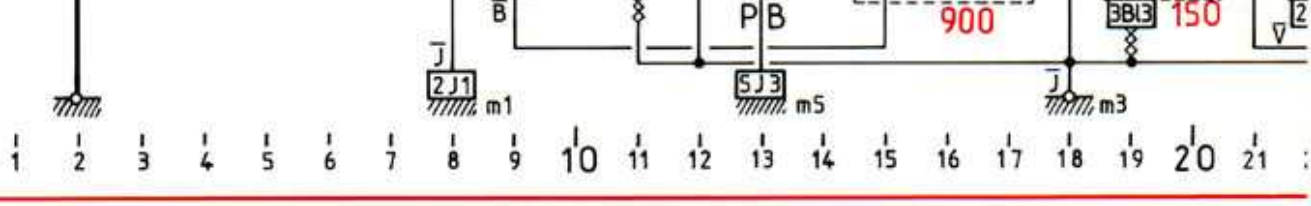
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P B
900
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150
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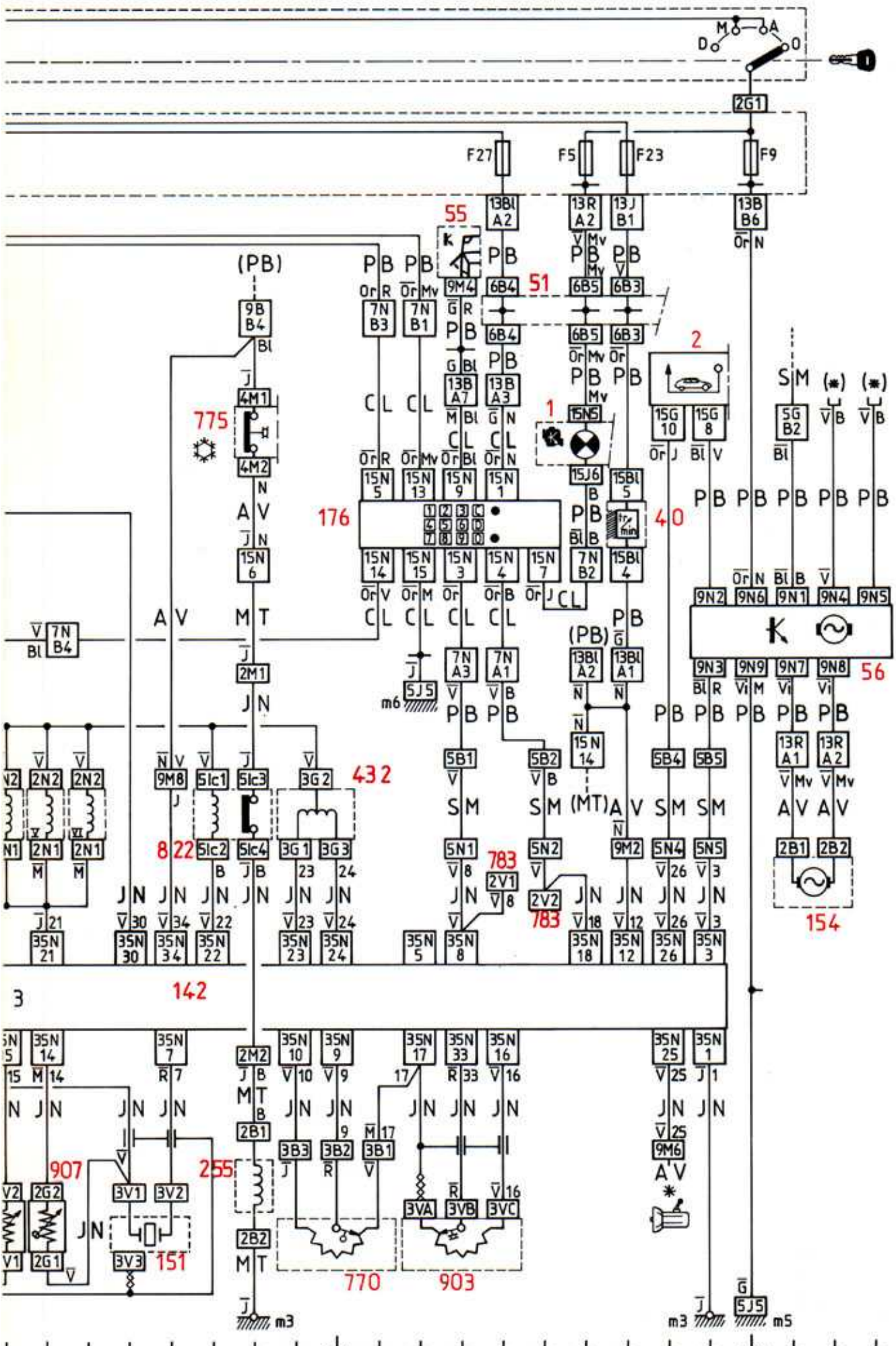
m5
m3
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21


F27
F5
F23
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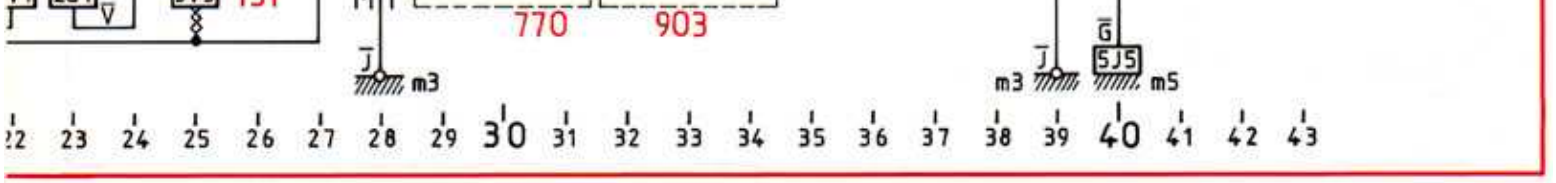
m3
m5
m6



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m3
m5
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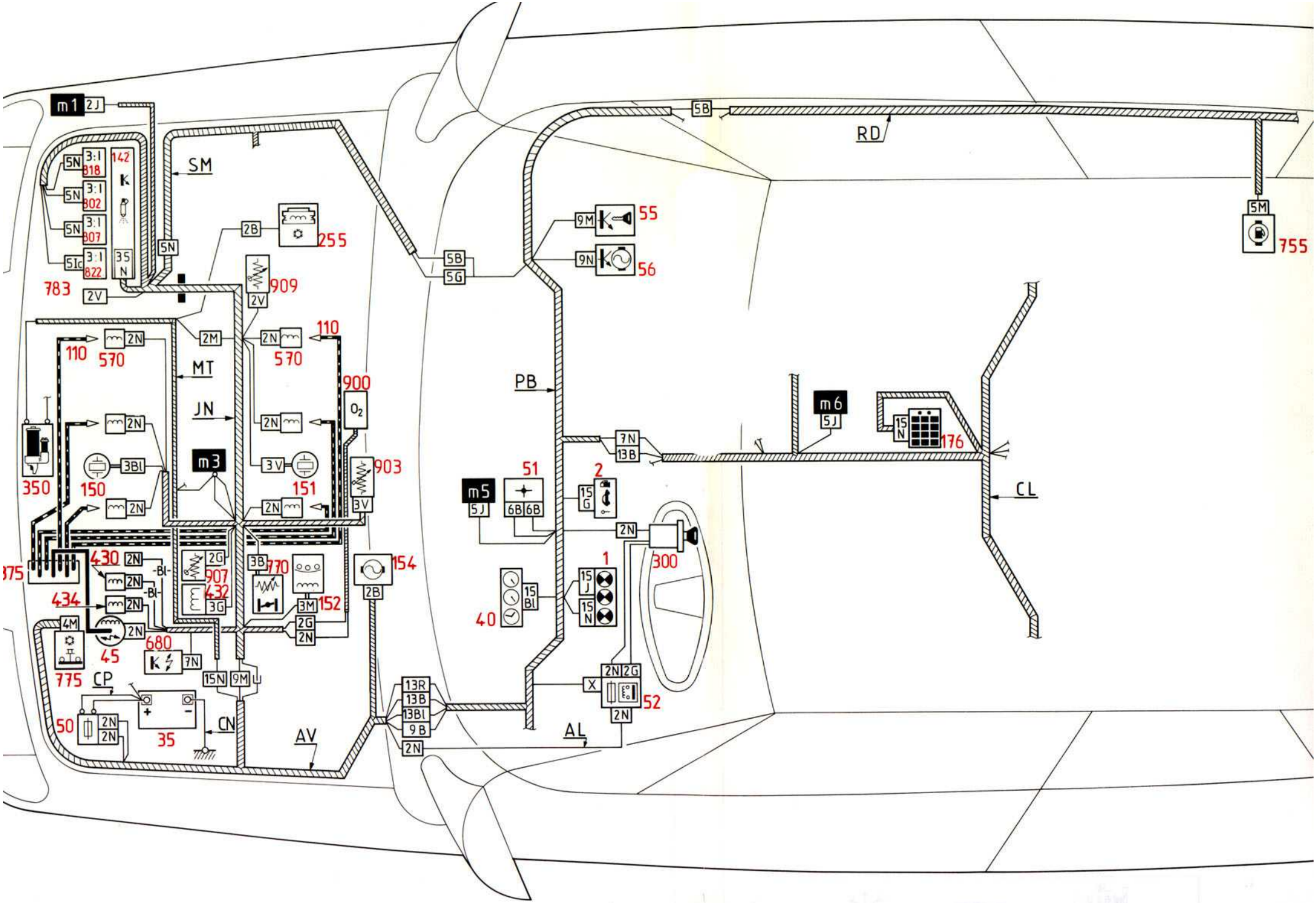
m1
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807
3:1
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5B
5G
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9N
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5B
RD
5M
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110
570
2N
2M
MT
JN
110
570
900
O_2
PB
m6
5J
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7N
13B
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3Bl
m3
3V
151
903
3V
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m5
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432
3G
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2B
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4M
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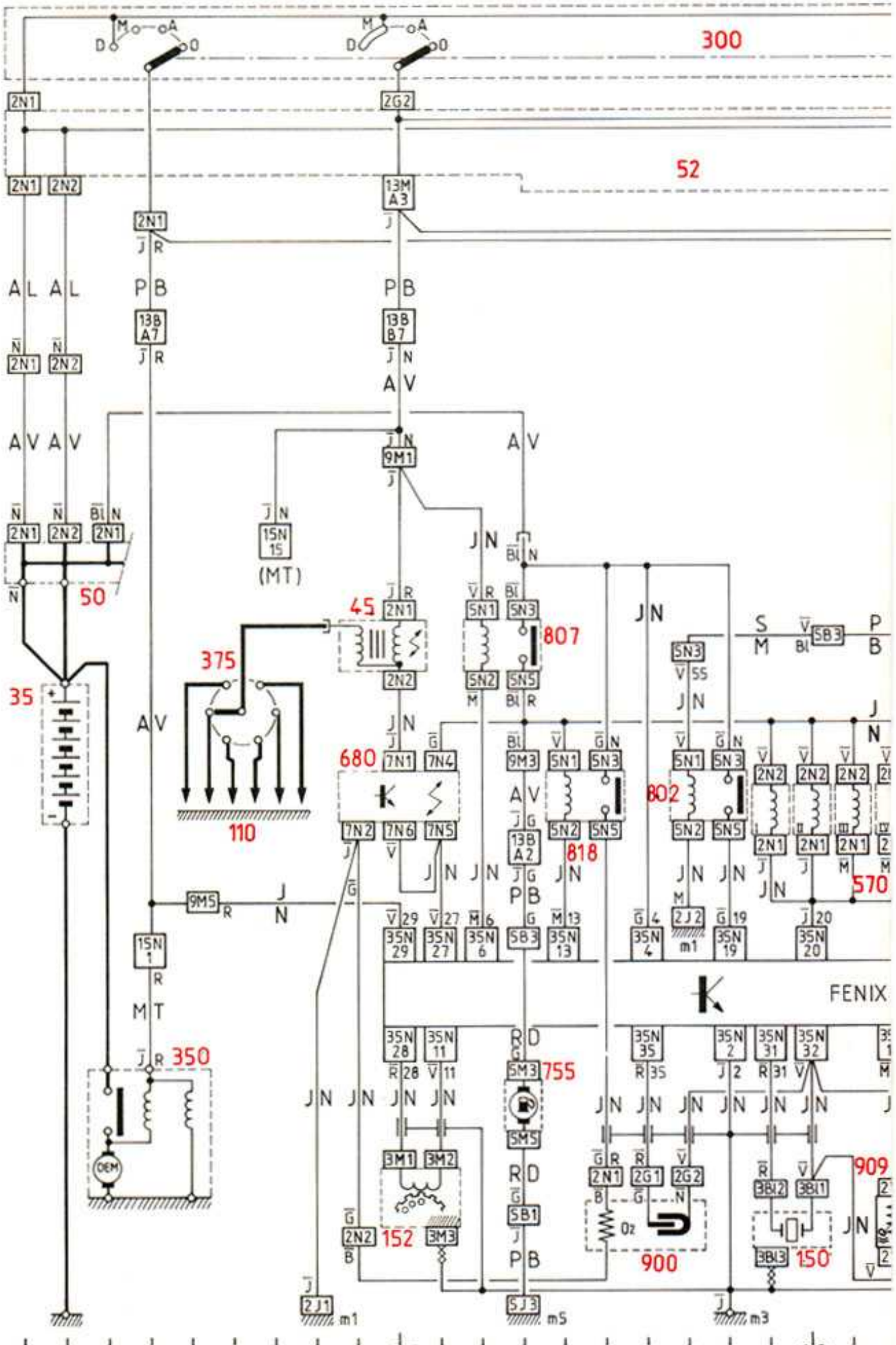
300
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FENIX
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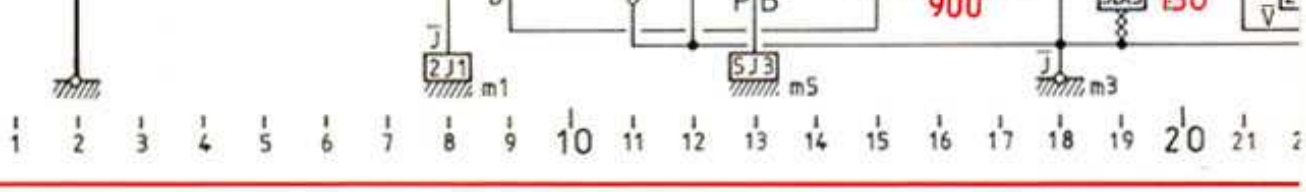
DEM


900
2J1
m1
5J3
m5
m3
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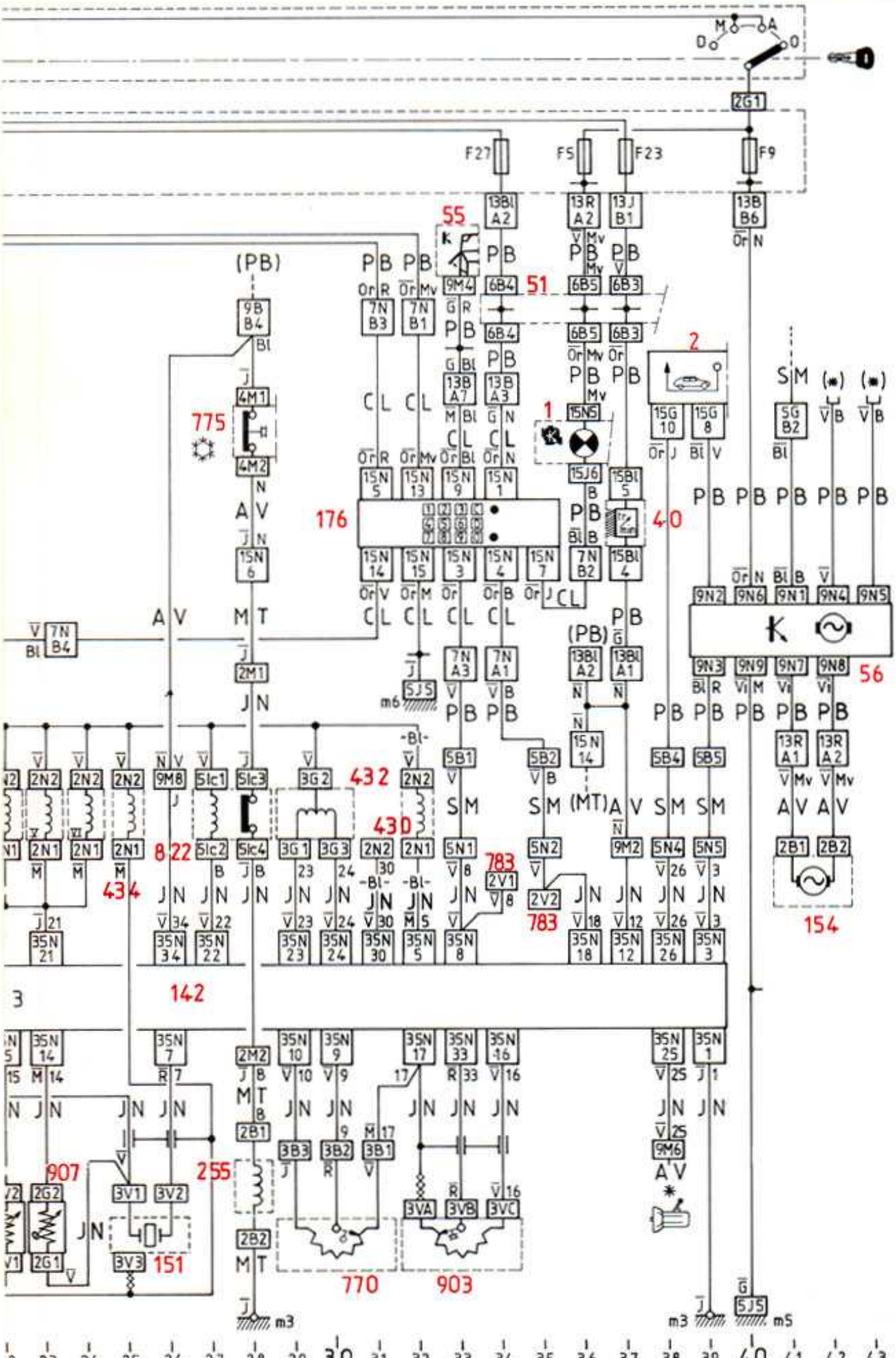
2G1
F27
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F23
F9
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2
1
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775
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430
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434
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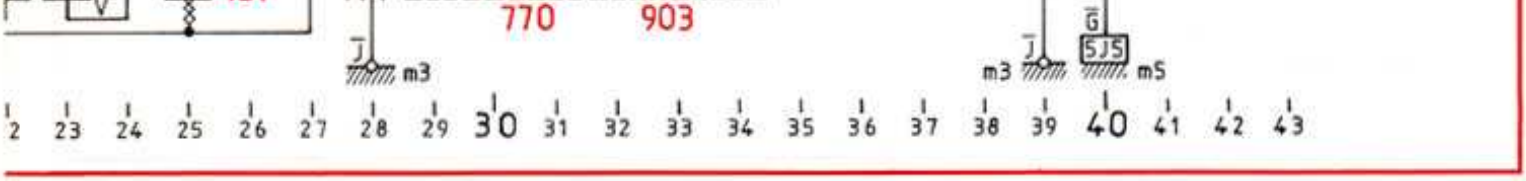
142
907
255
151
770
903
m3
m5
m6


V
J
m3
770
903
J
G
SJS
m3
m5
2
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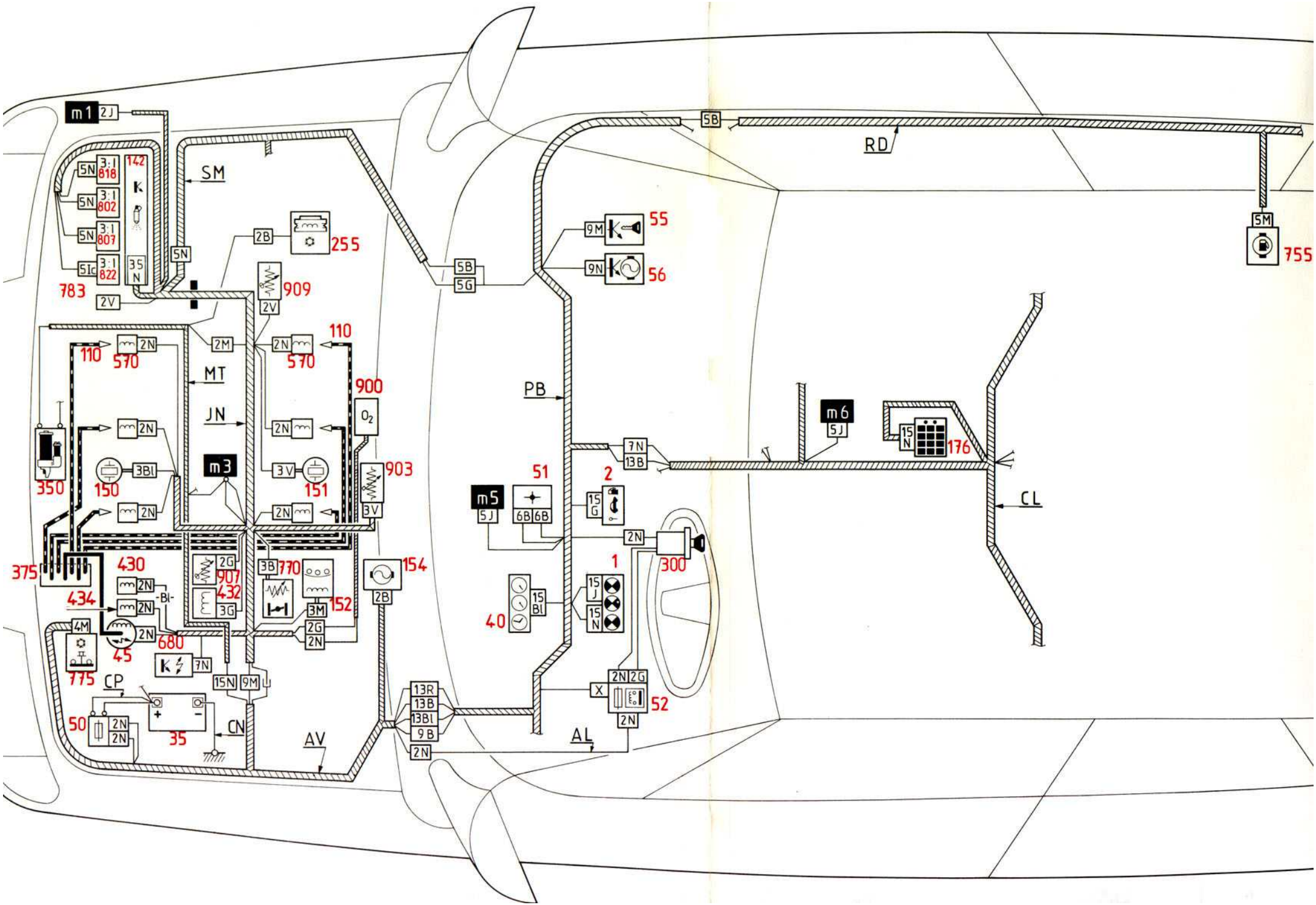

m1
2J
SM
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802
3:1
807
3:1
822
142
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2V
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903
3V
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m3
151
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375
430
434
2G
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432
3G
3B
770
152
3M
154
2B
-Bl-
680
4M
45
775
7N
15N
9M
CP
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35
CN
AV
13R
13B
13Bl
9B
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5G
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9N
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PB
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m5
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m6
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CL
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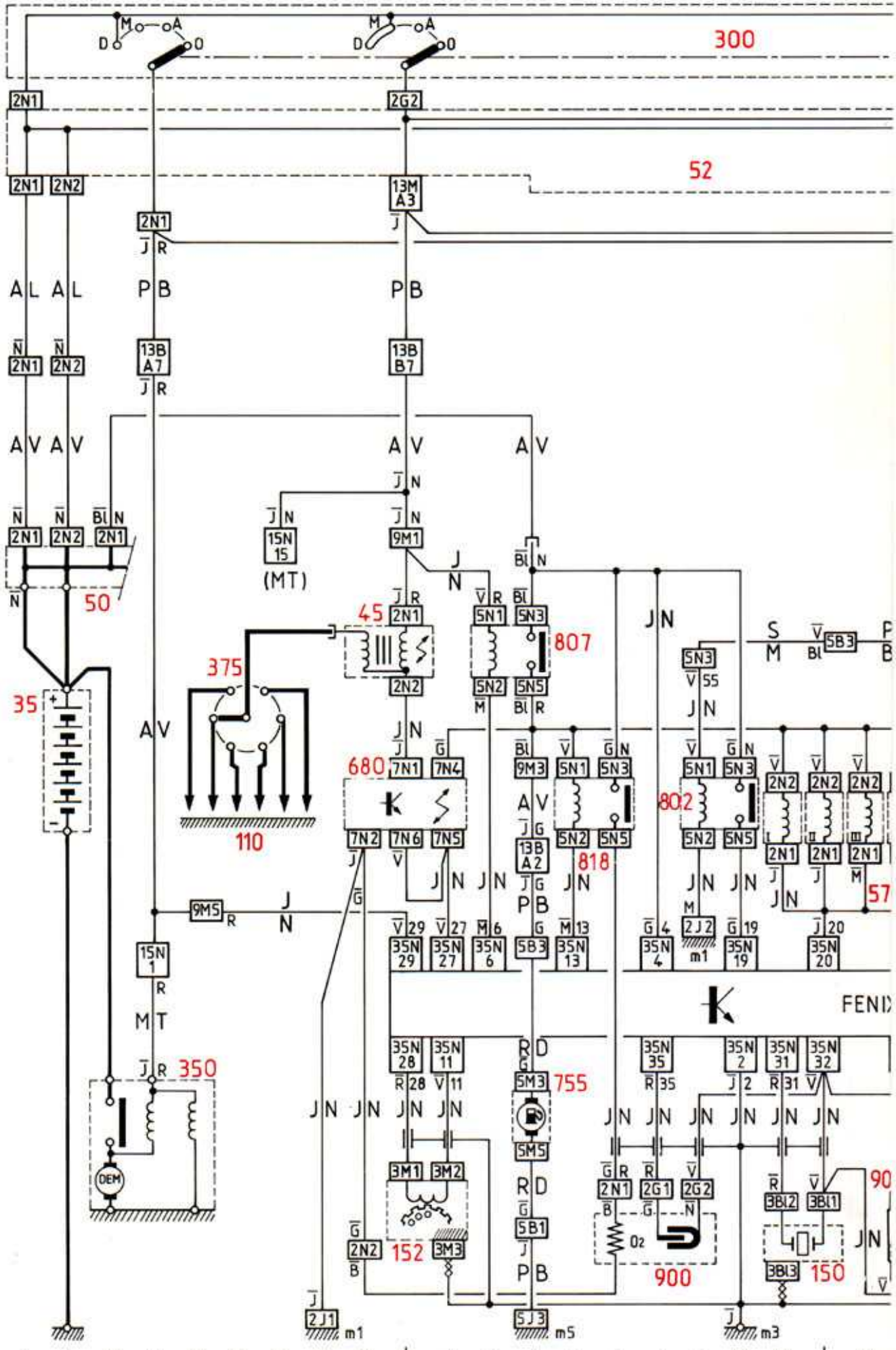
5M
755


300
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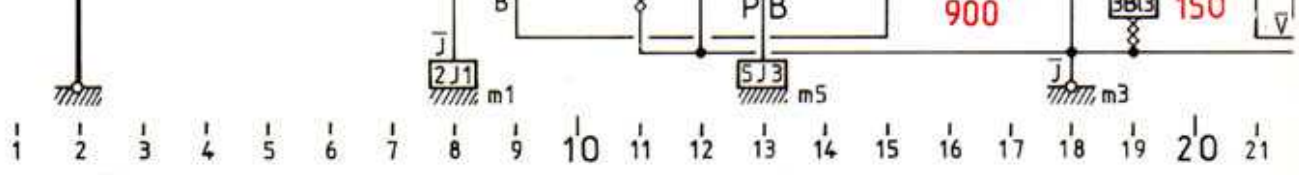
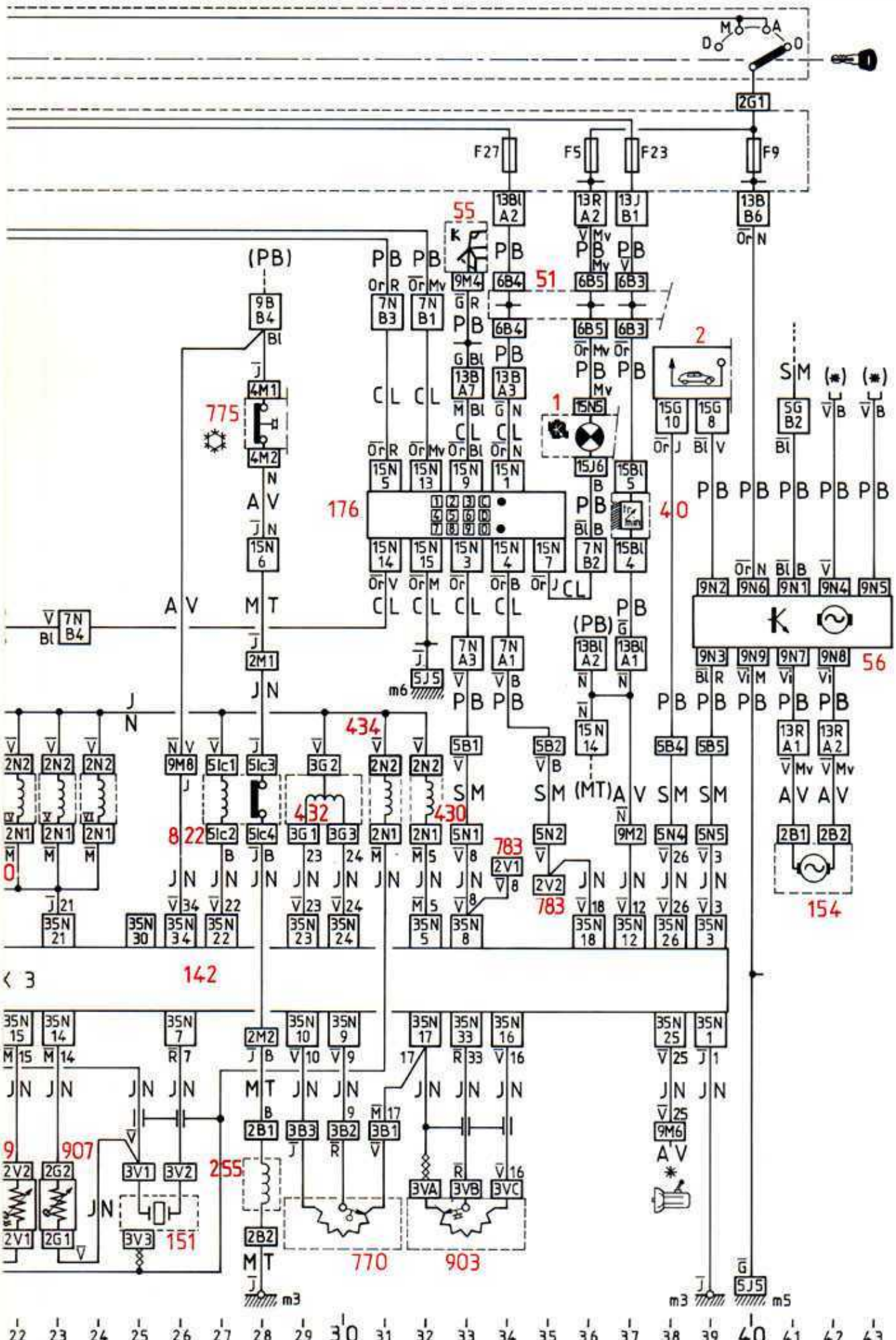
DEM


B
P B
900
3B13
150
2J1
m1
5J3
m5
m3
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21


F27
F5
F23
F9
2G1
55
51
2
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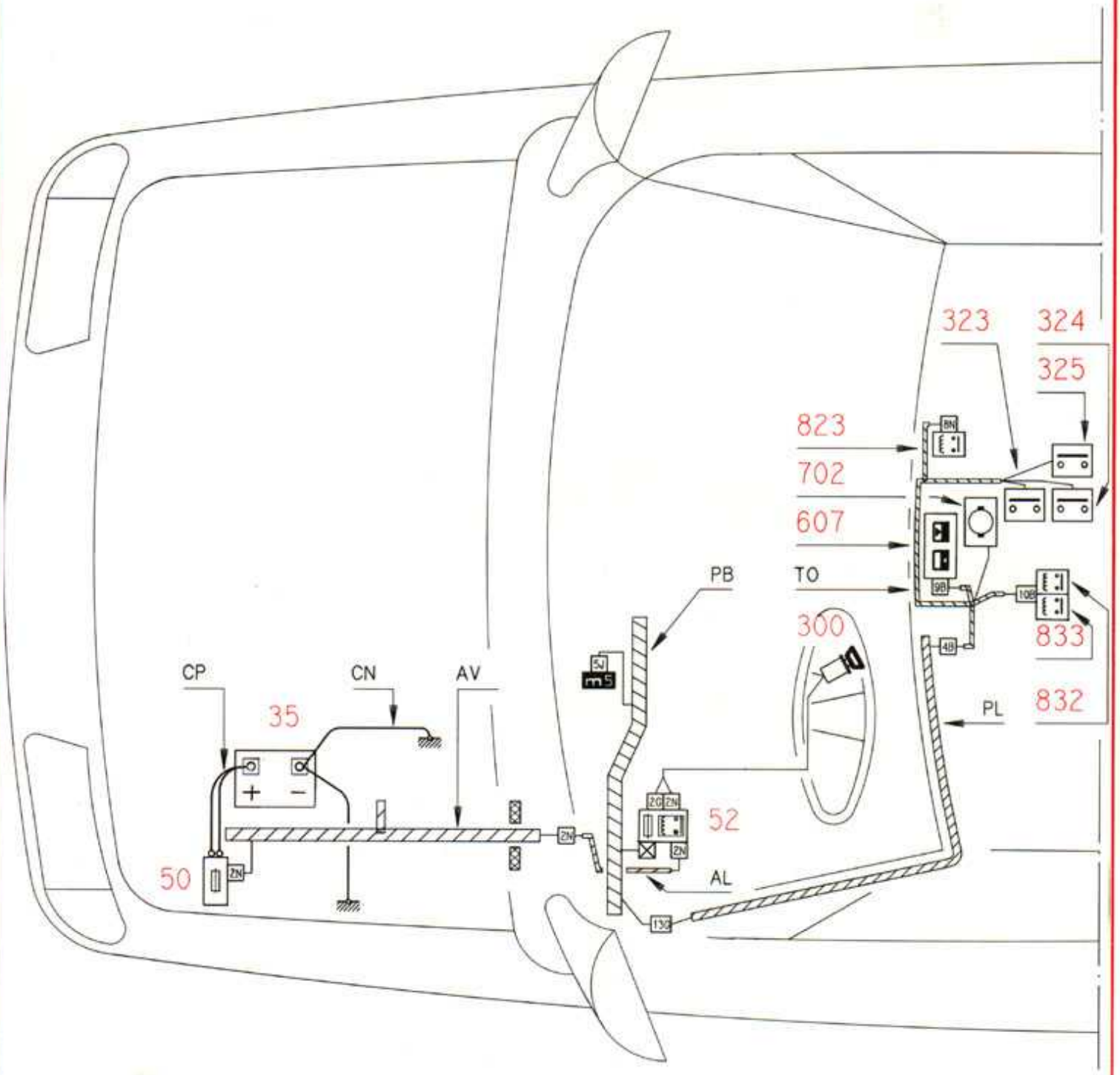
40
56
176
775
434
432
430
822
783
154
142
907
255
151
770
903
(PB)
(MT)
m3
m5
m6

22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43


323
324
325
823
702
607
TO
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832
PL
CP
CN
AV
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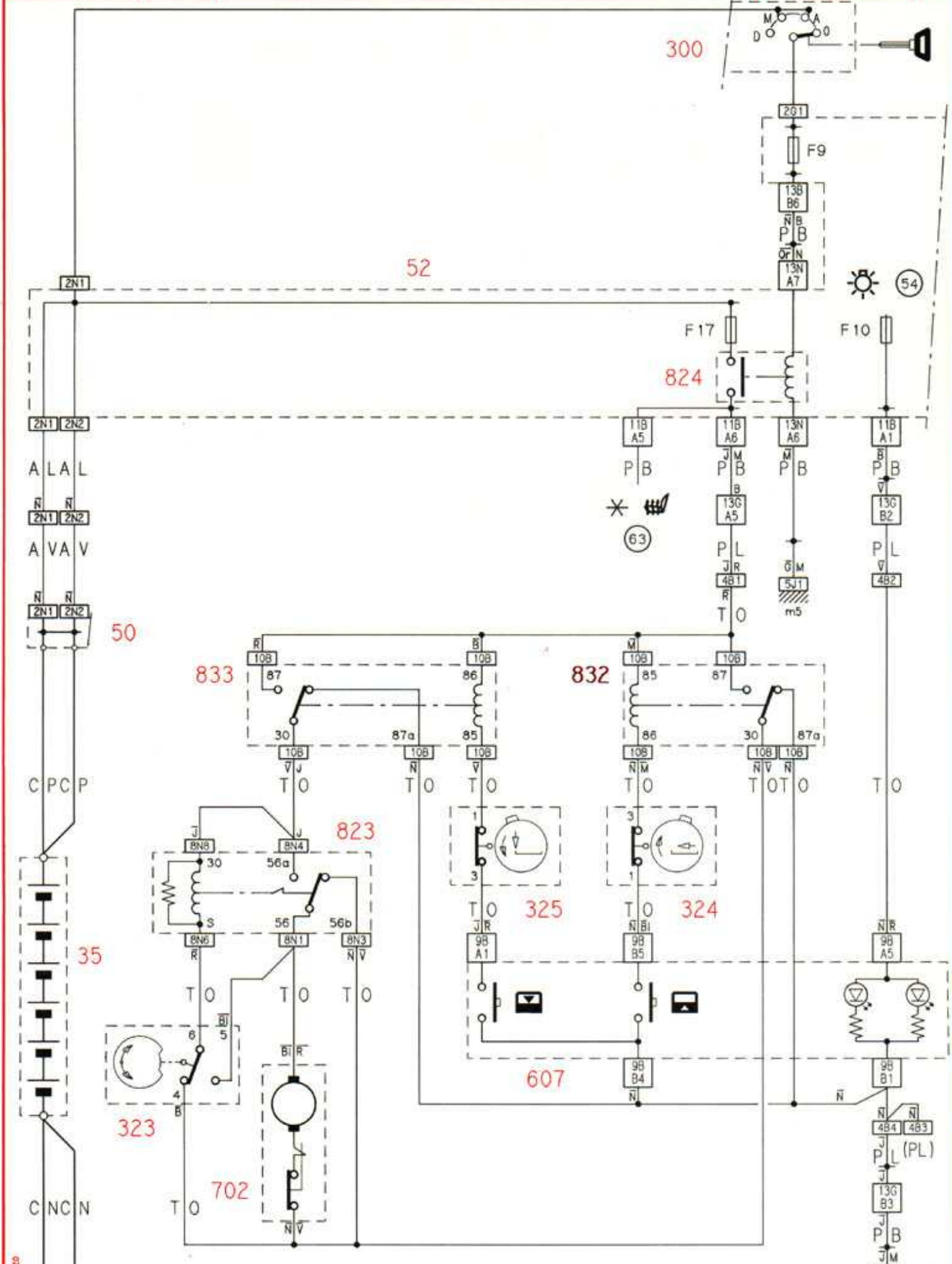
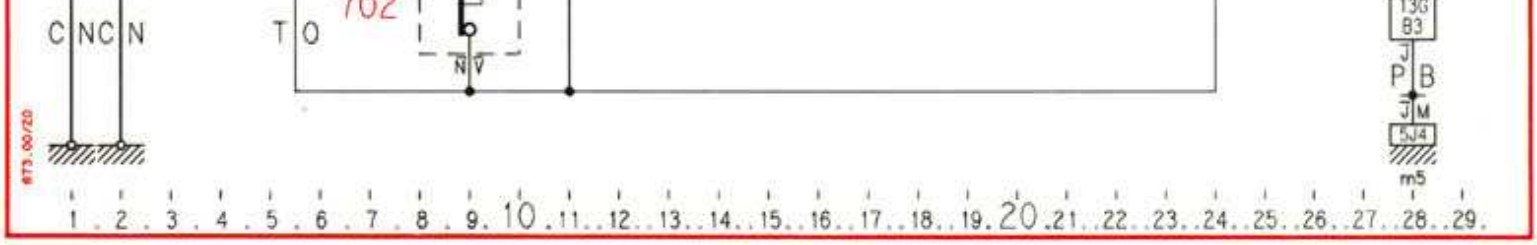
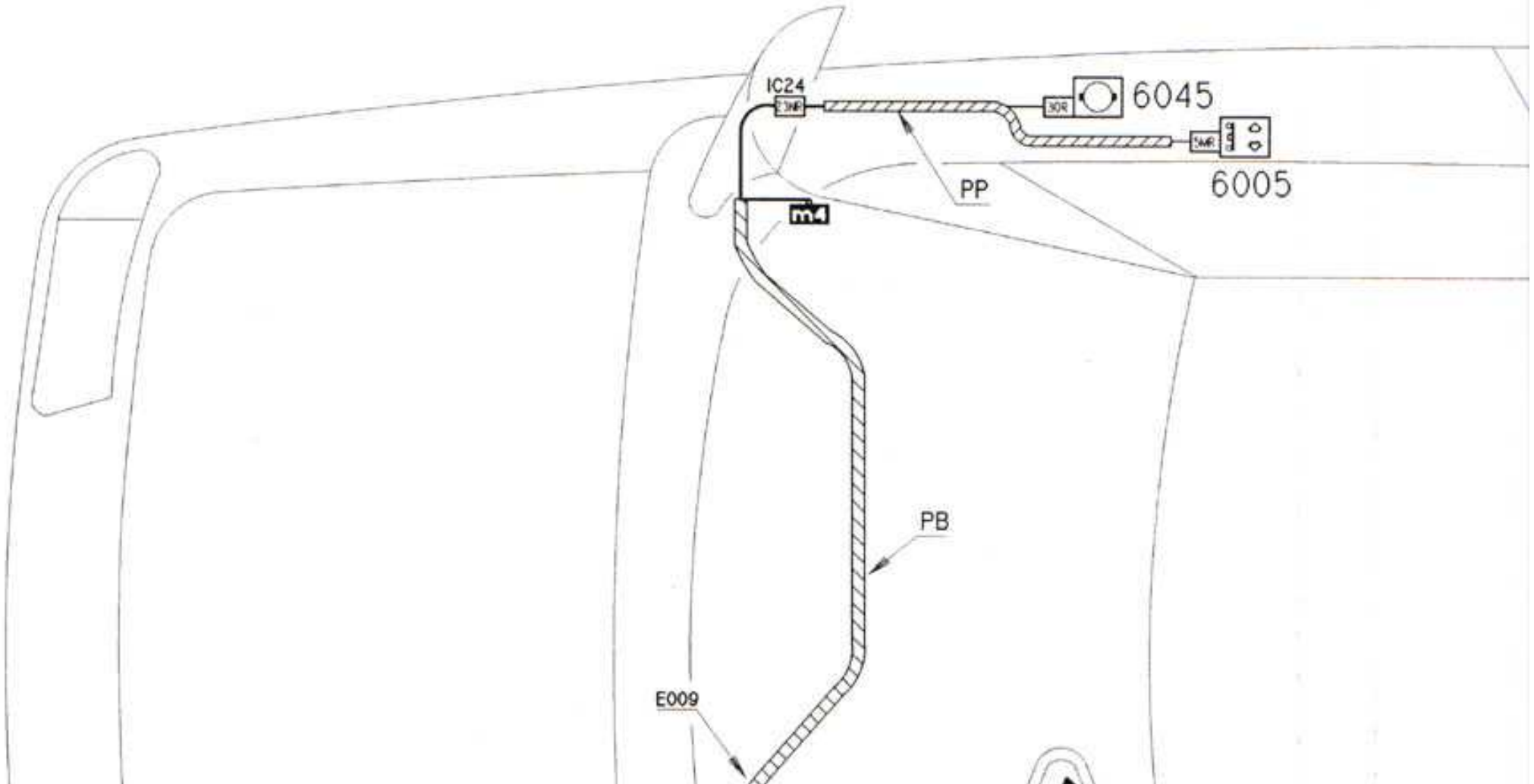
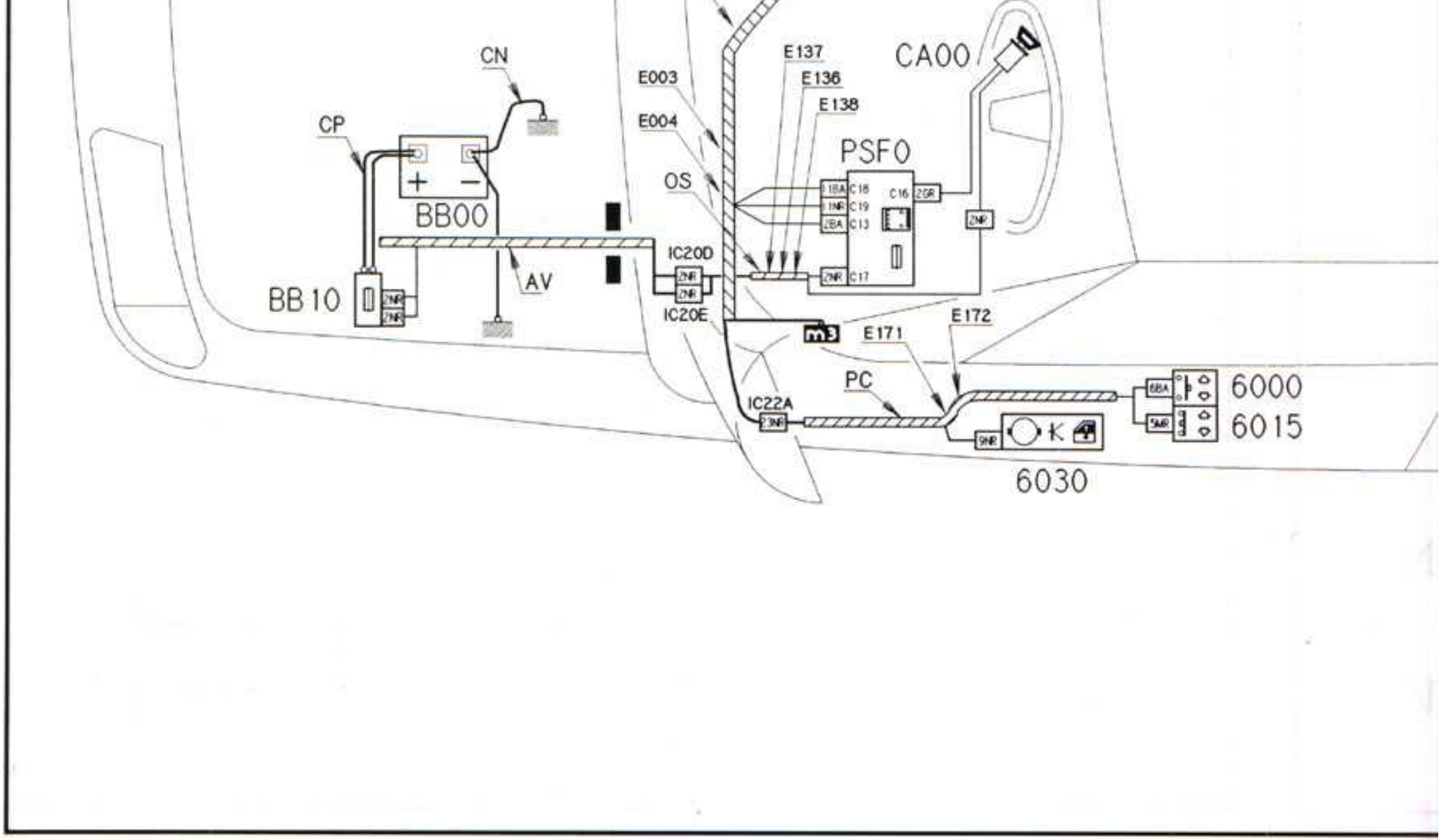
50
52
AL
2N
2G
13G
8N
9B
10B
4B
5J


300
52
824
50
833
832
823
325
324
35
323
702
607
F9
F17
F10
54
63
m5
(PL)


C NC N
T O
702
N V
13G
B3
J
P B
J M
5J4
m5
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29


IC24
6045
6005
PP
PB
E009


CN
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BB10
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E003
E004
OS
E137
E136
E138
CA00
PSF0
IC20D
IC20E
E171
E172
PC
IC22A
6000
6015
6030

Clarion Co., Ltd. Export Division—22-3, Shibuya 2-chome, Shibuya-ku, Tokyo, 150 Japan Tel: 03-400-1121 Fax: 03-400-8679 Telex: J22908, J22152
Service Dept.—50 Kamitoda, Toda-shi, Saitama, 335 Japan Tel: 0484-43-1111 Telex: J2962628 CLAFAC-J

clarion Service Manual

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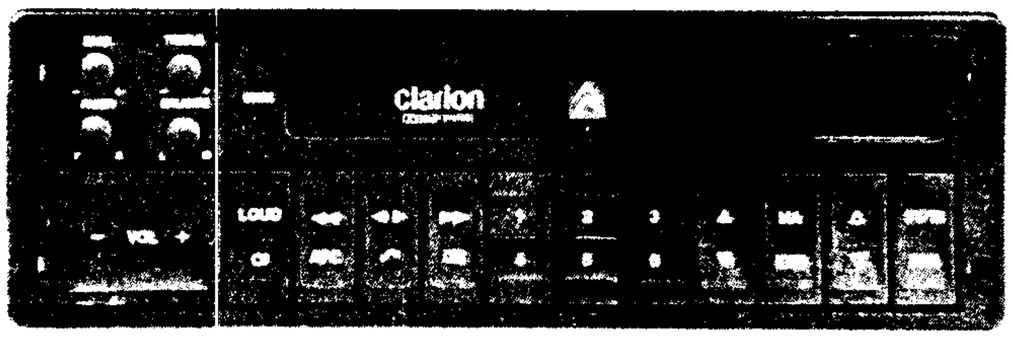


CITROEN
UKW•MPX/MW/LW RADIO
CASSETTE COMBINATION
Model PU-9358A-A

■SPECIFICATIONS:

Radio section

Circuit system:	Superheterodyne	
Tuning system:	Electronic tuning	
Receiving frequency:	MW	531 to 1602kHz
	LW	153 to 281kHz
	UKW	87.5 to 108MHz
Intermediate frequency:	MW, LW	459kHz
	UKW	10.7MHz
Quieting sensitivity:	MW	Less than 33dB (at 20dB S/N)
	LW	Less than 40dB (at 20dB S/N)
	UKW	Less than 12dB (at 30dB S/N)
Separation:	UKW	More than 20dB
Auto. stop sensitivity:	MW DX	20 to 40dB
	LO	40 to 60dB
	LW DX	27 to 47dB
	LO	47 to 69dB
	UKW DX	17 to 33dB
	LO	35 to 55dB

Tape section

Reproduction system:	Auto reversing 4 track, 2 channel stereo cassette tape playback (Monaural also capable)
Tape speed:	4.76cm/sec. (1-7/8 ips)
Crosstalk:	More than 40dB
Separation:	More than 30dB
S/N ratio: Normal	More than 45dB/53dB (Dolby-on)
Metal	More than 47dB/55dB (Dolby-on)
Wow & flutter:	Less than 0.15% (W.R.M.S)
FF/REW time:	Less than 100sec. (C-60)

Composite

Load impedance:	4Ω×4
Power output:	8W×4 (at 10% dist.)
	More than 12W×4 (at max. output)
Power supply voltage:	DC. 14.0V Negative ground
Power consumption:	Less than 7A (at max. output)
	Less than 3mA (at BACK UP)
Dimensions:	Width 178mm
	Height 50mm
	Depth 160mm

- Dolby noise reduction manufactured under license from Dolby Laboratories Licensing Corporation.
- "Dolby" and the double-D symbol □□ are trademarks of Dolby Laboratories Licensing Corporation.

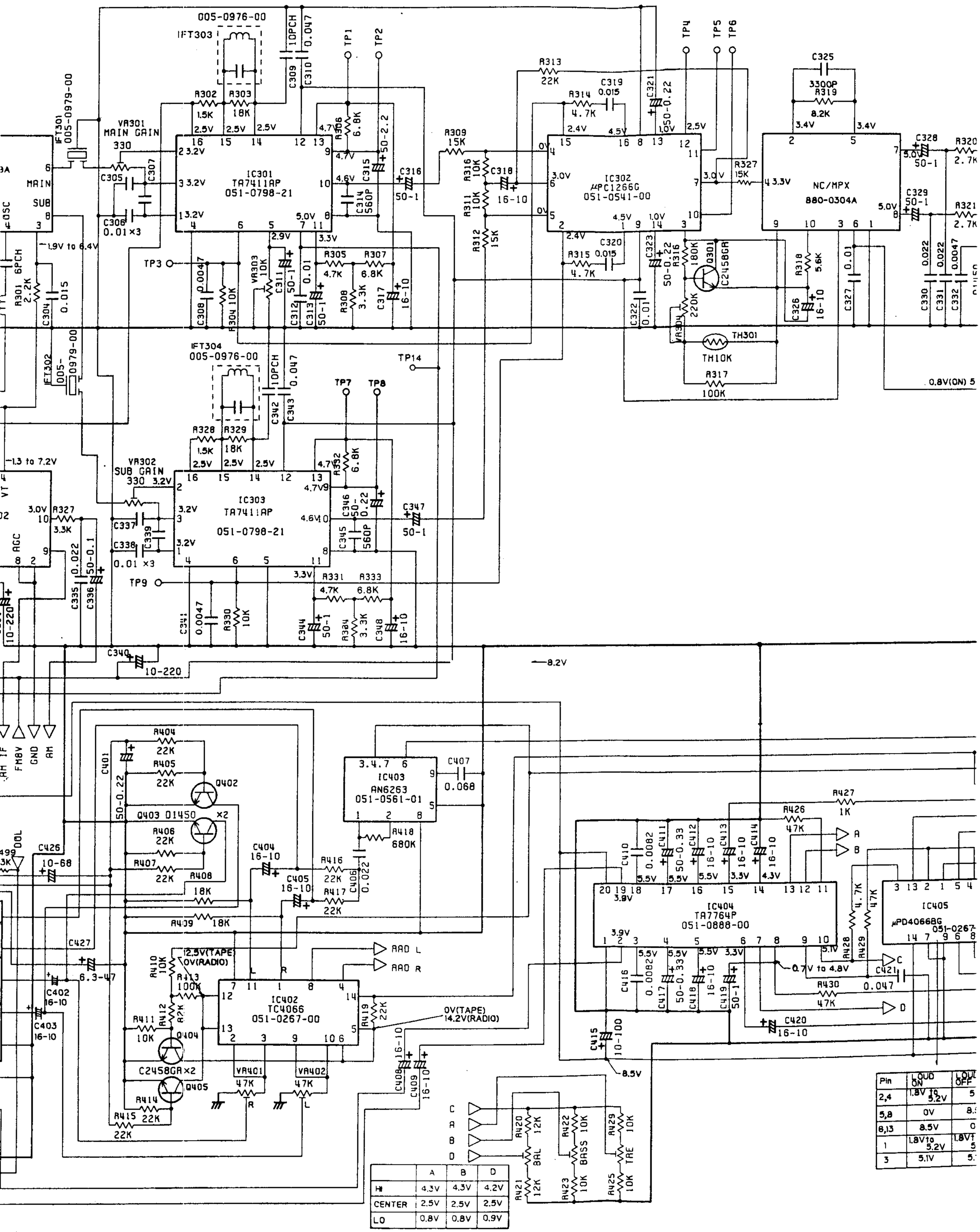
■COMPONENTS:

Main unit		1
Mounting bracket	300-7516-00	1
Removable tool	341-1387-00	2

■CIRCUIT DIAGRAM: 1/2

	A	B	D
HI	4.3V	4.3V	4.2V
CENTER	2.5V	2.5V	2.5V
LO	0.8V	0.8V	0.9V

AM: 1/2



PU-9358A-A

PU-9358A-A

E F G H I J

IC302 μPC1266G 051-0541-00

NC/MPX 880-0304A

IC404 TA7764P 051-0888-00

IC405 μPD4066BG 051-0267-55

IC501 TA8201AK 051-0735-10

IC502 TA8201AK 051-0735-10

IC503 TA8201AK 051-0735-10

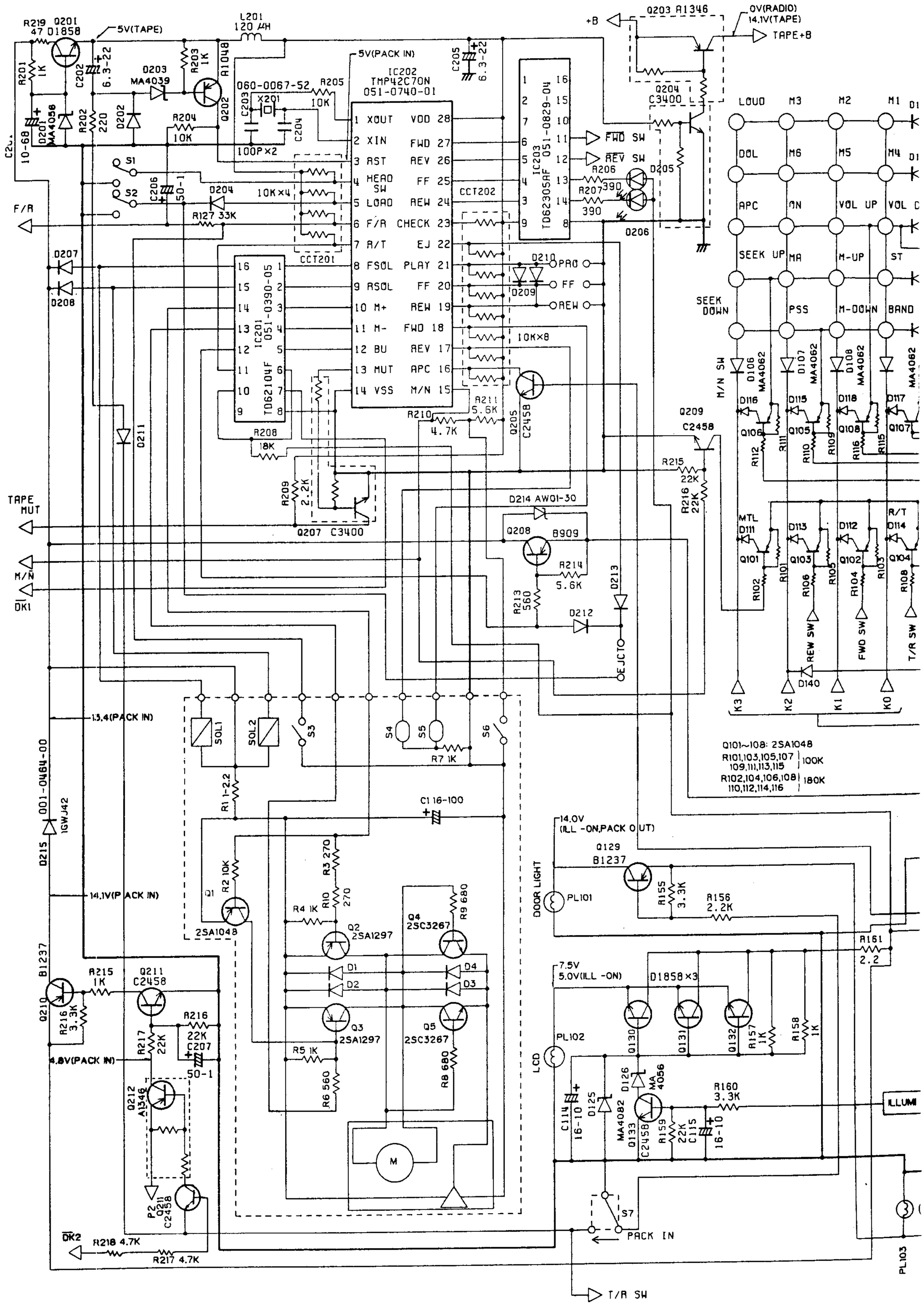
IC504 TA8201AK 051-0735-10

IC406 NJM4558 051-0350-55

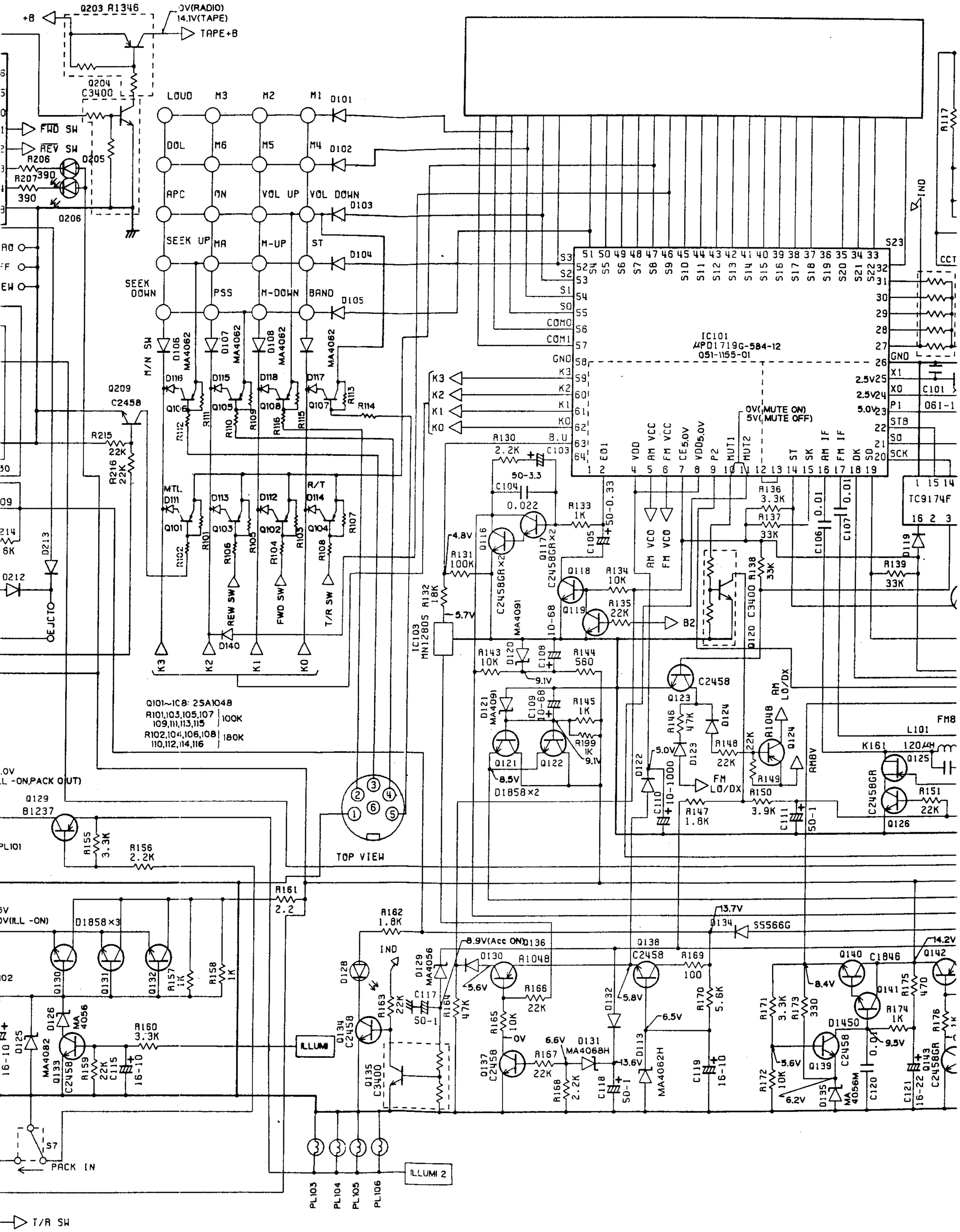
RY101 014-0522-00

Pin	LOUD ON	LOUD OFF
2,4	1.8V to 5.2V	5.1V
5,8	0V	8.5V
6,13	8.5V	0V
1	1.8V to 5.2V	1.8V to 5.2V
3	5.1V	5.1V

■CIRCUIT DIAGRAM: 2/2

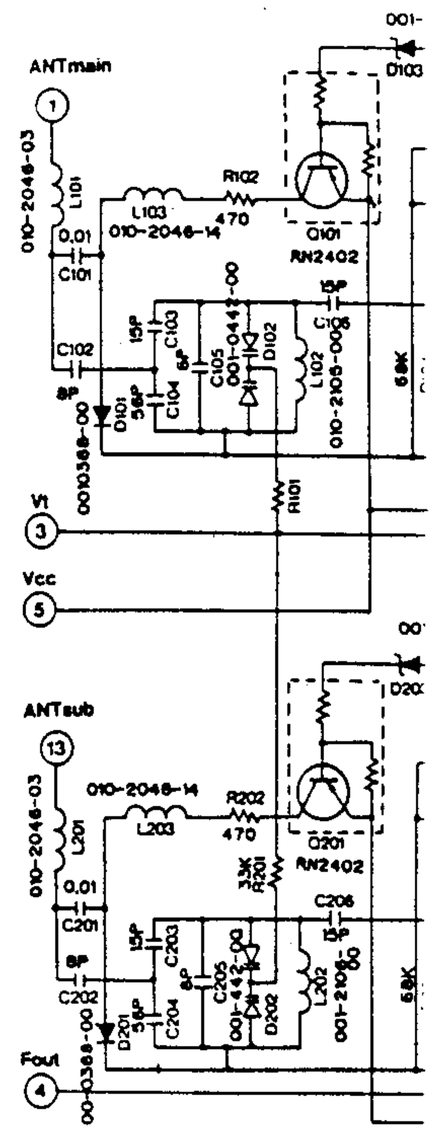


PU-9358A-A


+B
Q203 A1346
0V(RADIO)
14.1V(TAPE)
TAPE+B
Q204
C3400
FWD SW
REV SW
R206
Q205
R207 390
390
Q206
LOUD
M3
M2
M1
D101
DOL
M6
M5
M4
D102
APC
ON
VOL UP
VOL DOWN
D103
SEEK UP
MA
M-UP
ST
D104
SEEK DOWN
PSS
M-DOWN
BAND
D105
M/N SW
D106 MA4062
D107 MA4062
D108 MA4062
MA4062
D116
D115
D118
D117
Q106
Q105
Q108
Q107
R113
R114
R112
R111
R110
R109
R116
R115
Q209
C2458
R215
22K
R216 22K
MTL.
R/T
D111
D113
D112
D114
Q101
Q103
Q102
Q104
R107
R102
R101
R106
R105
R104
R103
R108
REW SW
FWD SW
T/R SW
D140
K3
K2
K1
K0
Q101~108: 2SA1048
R101,103,105,107 109,111,113,115 100K
R102,104,106,108 110,112,114,116 180K
IC101
μPD1719G-584-12
051-1155-01
S3
S2
S1
S0
COM0
COM1
GND
K3
K2
K1
K0
S23
51 50 49 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33
52 S4 S5 S6 S7 S8 S9 S10 S11 S12 S13 S14 S15 S16 S17 S18 S19 S20 S21 S22 32
53 31
54 30
55 29
56 28
57 27
58 26
59 25
60 24
61 23
62 22
63 21
64 20
1 2 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
EO1 VDD AM VCC FM VCC CE5.0V VDD5.0V P2 MUT1 MUT2 ST SK AM IF FM IF DK SO SCK
GND X1 X0 P1 STB SO SCK
2.5V25
2.5V24
5.0V23
0V(MUTE ON)
5V(MUTE OFF)
IND
A117
CCT
C101
061-1
TC9174F
1 15 14
16 2 3
D119
R139 33K
R136 3.3K
R137 33K
C106 0.01
C107 0.01
R138 33K
D120 C3400
R130 2.2K
B.U
C103
50-3.3
C104
0.022
R133 1K
50-0.33
C105
4.8V
R131 100K
Q116
C2458GR×2
Q117
C2458GR×2
R132 18K
5.7V
IC103
MN12805
Q118
R134 10K
Q119
R135 22K
B2
10-68
MA4091
R143 10K
D120
C108
R144 560
9.1V
D121 MA4091
C109 10-68
R145 1K
R199 1K
9.1V
Q121
Q122
8.5V
D1858×2
AM VCO
FM VCO
C2458
Q123
R146 47K
D124
D123
5.0V
R148 22K
R1048
Q124
AM LO/DX
FM LO/DX
R149
R150 3.9K
C111 50-1
D122
C110 10-1000
R147 1.8K
AM8V
FM8
L101
K161 120μH
Q125
C2458GR
R151 22K
Q126
Q129
B1237
R155 3.3K
R156 2.2K
PL101
TOP VIEW
R161 2.2
R162 1.8K
IND
D128
Q134 C2458
R163 22K
C117 50-1
R164 47K
D129 MA4056
8.9V(Acc ON)
D136
Q130
A1048
5.6V
R166 22K
R165 10K
0V
Q137 C2458
6.6V
D131 MA4068H
R167 22K
R168 2.2K
C118 50-1
D132
5.8V
Q138 C2458
D113 MA4062H
6.5V
R169 100
13.7V
D134 S5566G
R170 5.6K
C119 16-10
R171 3.3K
R173 330
8.4V
Q140
C1846
Q141
R175 470
14.2V
Q142
R174 1K
D1450
9.5V
Q139 C2458
5.6V
R172 10K
6.2V
D135 MA4056M
C120 0.01
C121 16-22
Q143 C2458GR
R176
Q130
Q131
Q132
R157 1K
R158 1K
D126 MA4056
D125 MA4082
Q133 C2458
R159 22K
C115 16-10
R160 3.3K
ILLUMI
Q135 C3400
ILLUMI 2
PL103
PL104
PL105
PL106
S7
PACK IN
T/R SW
Q129
B1237
R155 3.3K
R156 2.2K
R161 2.2
D1858×3
R157 1K
R158 1K
R160 3.3K
.0V
LL -ON,PACK OUT)
6V
0V(ILL -ON)
D213
D212
EJCTO
09
214
6K
30
02

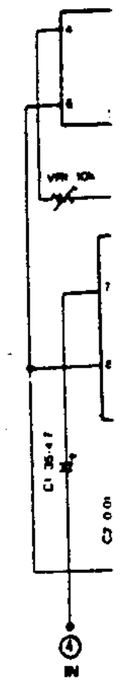
■BLOCK CIRCUIT

◎UKW TUNER PACK: 88



◎MW/LW TUNER PACK:

◎NC/MPX BLOCK Ass'y:



■BLOCK CIRCUIT DIAGRAM:

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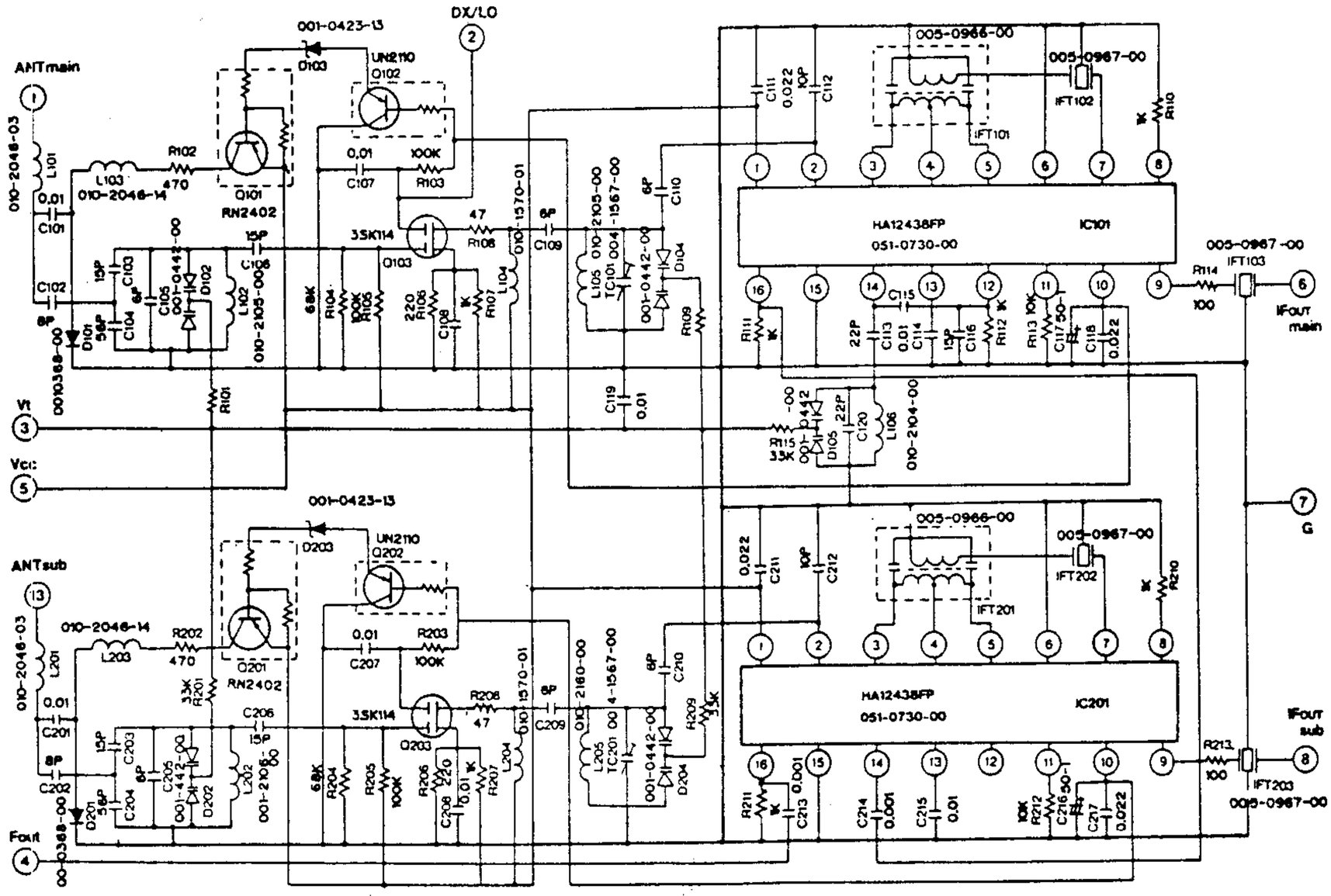

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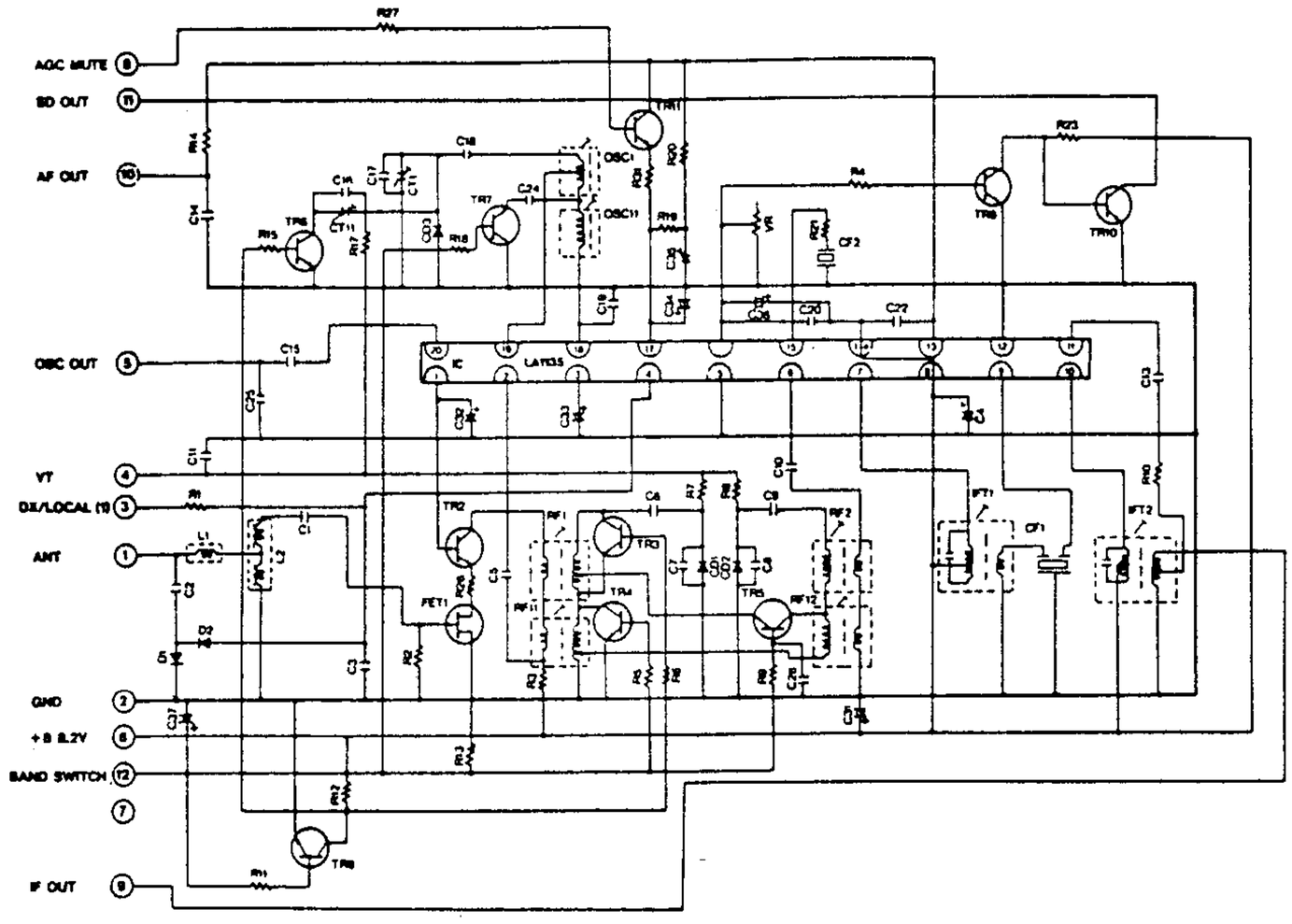

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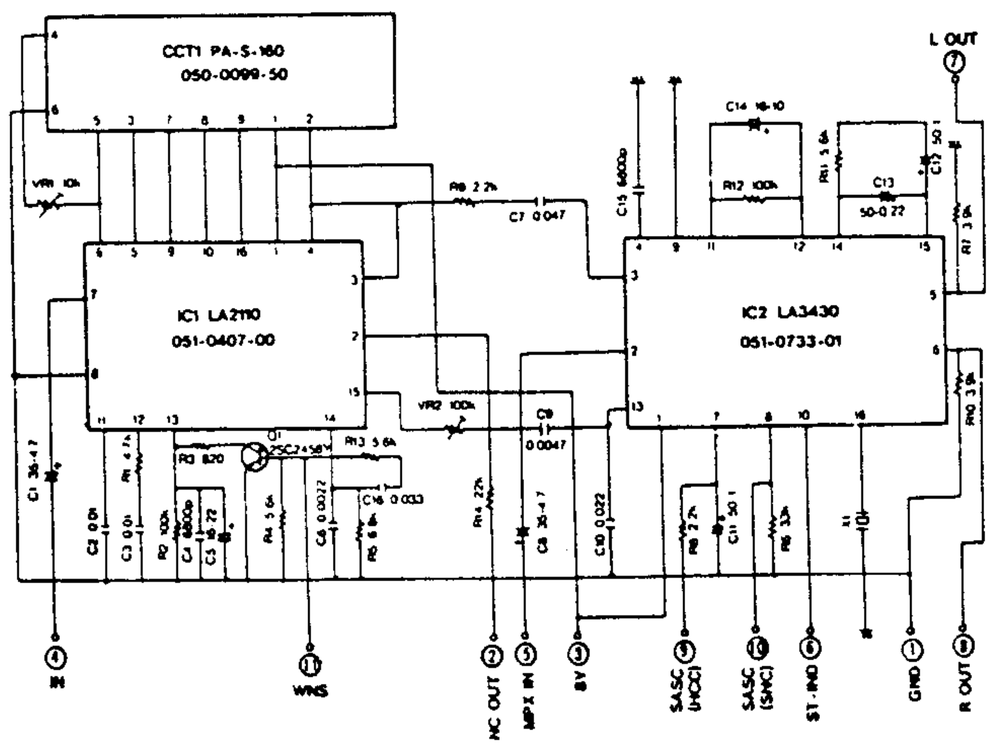


Dot Matrix Display Removal and Repair

The steering wheel needs to be removed to gain access to the rest of the dash. First, disconnect the battery and go and have a cup of tea. After 10 minutes the Airbag mechanism will have discharged. With the key in the ignition turn the steering wheel though 90 Deg from the straight-ahead position. Next, using a Torx screwdriver or as shown a Torx bit in a socket set bit driver, insert at the angle shown. The bolts are not at right angles to the steering wheel. Remove the top bolt by inserting Torx screwdriver or driver bit here:

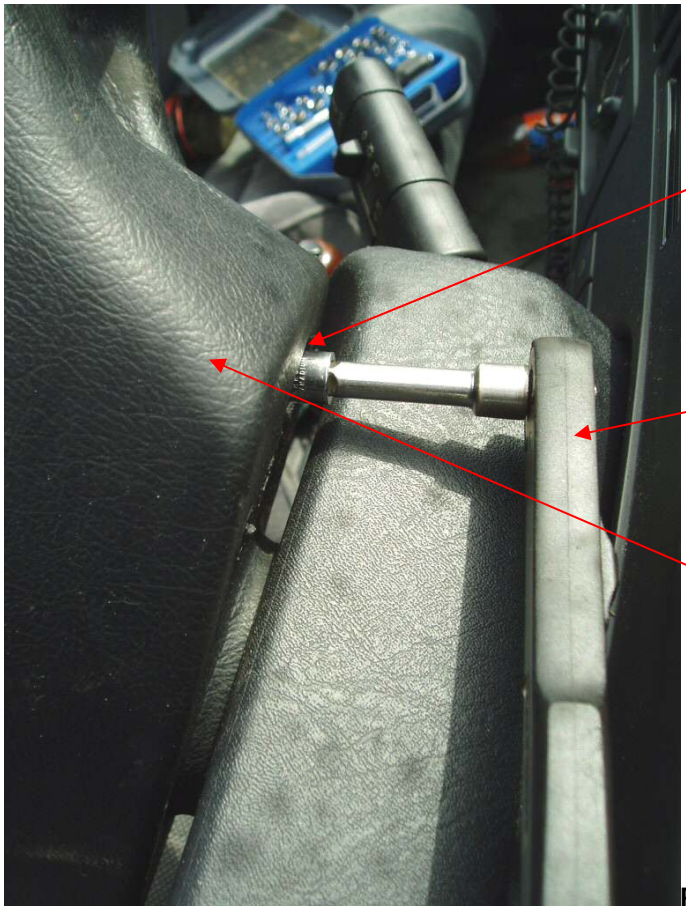


Photo1

……. and the bottom one:

Photo2

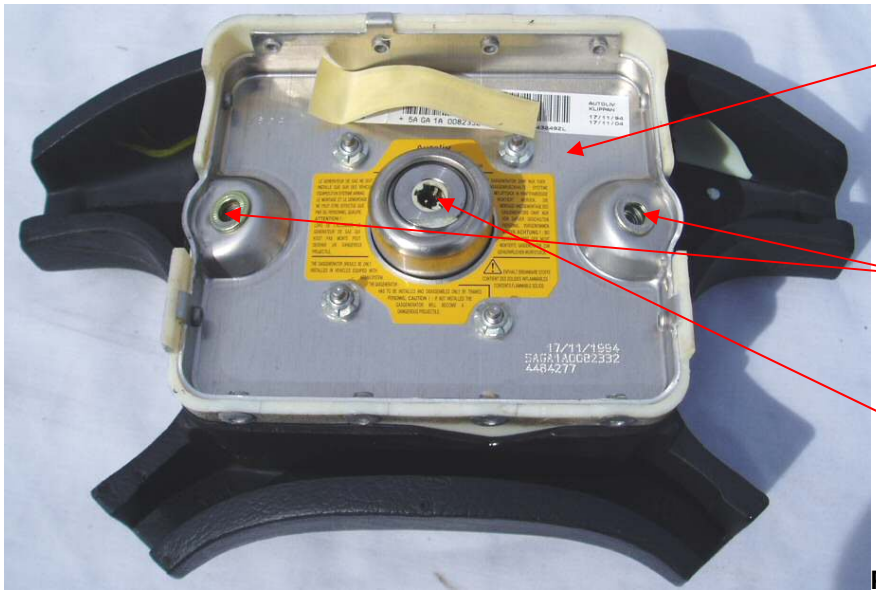
 ©2005 Norrie

Return the steering wheel to the straight-ahead position and remove the ignition key.

Airbag Removal

The airbag is now free with the exception of the electrical connection. There is an orange plug inserted into the middle part of the airbag. The orange plug is shown in Photo 4. Ease the plug out of the airbag with a long thin screwdriver before withdrawing the airbag fully. Photo 3 shows the airbag from the underside once removed.

View of underside of Airbag assembly



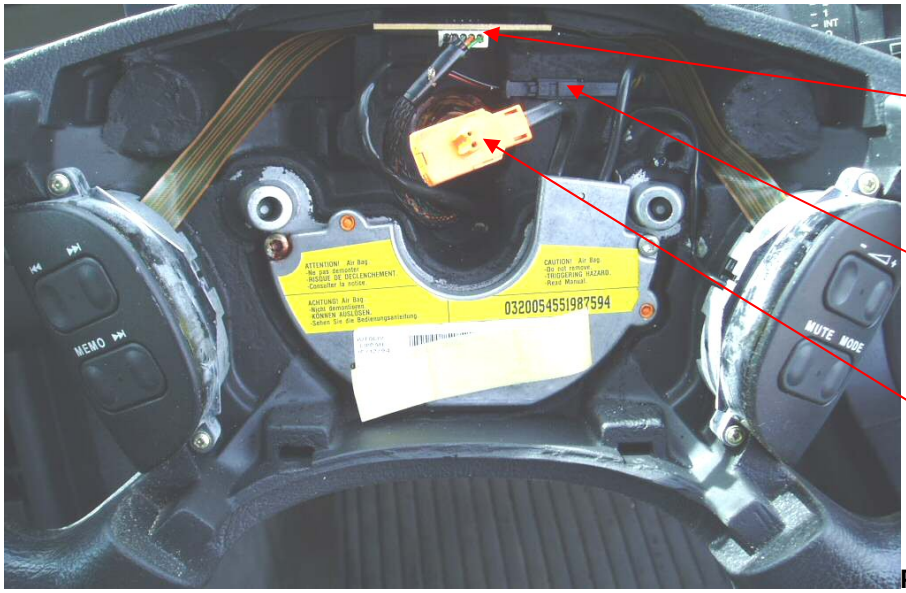
Airbag as viewed from underside

Angled Torx bolt holes

Electrical connection. Orange plug fits in here

Photo3

View of steering wheel with Airbag removed



Radio controls connector

Airbag supply connector

Airbag signal Orange connector

Photo4

 ©2005 Norrie

Next, unclip both connectors shown in Photo5 and separate each. Undo and remove the central retaining nut which holds the steering wheel onto the steering column.

View with Airbag removed

Photo5

The steering wheel should now lift off towards you. A sharp tug may be required to pull it free. Once free, thread the cables and the connectors through the slot at the bottom as shown in Photo5. The steering wheel should now be able to be removed form the car completely.

View with Steering Wheel removed

Photo6

Steering column shroud removal

There are 5 Torx screws which are accessed from the underside of the lower shroud. Remove them and set them aside. Next, gently pull the lower half of the shroud downwards and to the rear of the car. The left hand (RHD) part will be trapped behind the steering column height adjuster. Slacken the adjuster and let the steering column fall. This should create just enough space to let the lower shroud out. Take care to pull out the illumination lamp just above the ignition switch.

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Lower Shroud removed

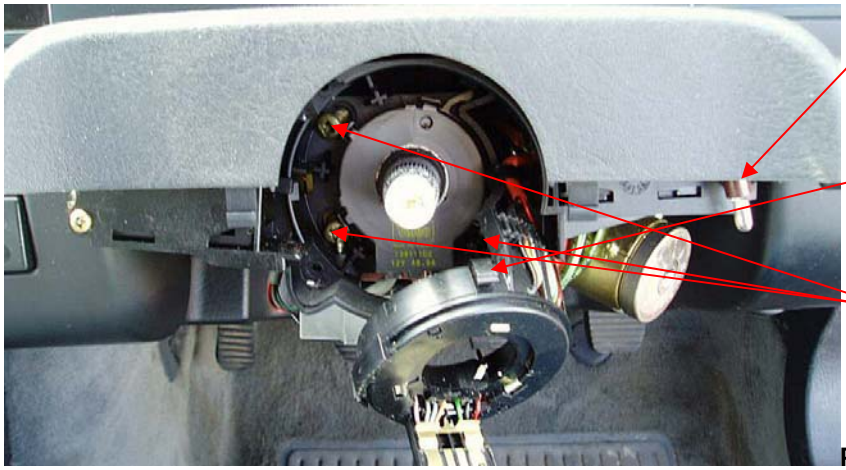

Photo7

Next, prise the retaining clips to allow the slider for the radio buttons to pull free from the column and let it dangle as shown.
To remove the upper shroud simply pull upwards and to the rear of the car. The trailing edge has a rubber skirt which is tucked under the dash to cover the workings when the column is lowered to its lowest position. With the upper shroud removed the indicator and wiper stalks should be clearly visible.

Remove 2 no screws to remove dash

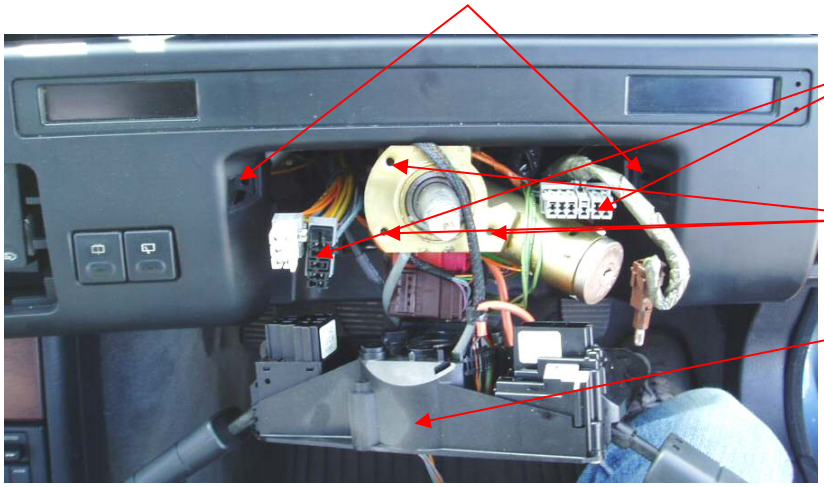

Photo8

 ©2005 Norrie

Dismantling the dash sufficient to reach displays and bulbs

To remove the dash there are 12 fixing screws in total, some Philips some Torx. The locations are shown on Photo 9 (2no shown in Photo 8). Prise off the bezel which holds the alarm LED in place. Prise off the bezel around the heater controls and pull off the slider at the bottom.

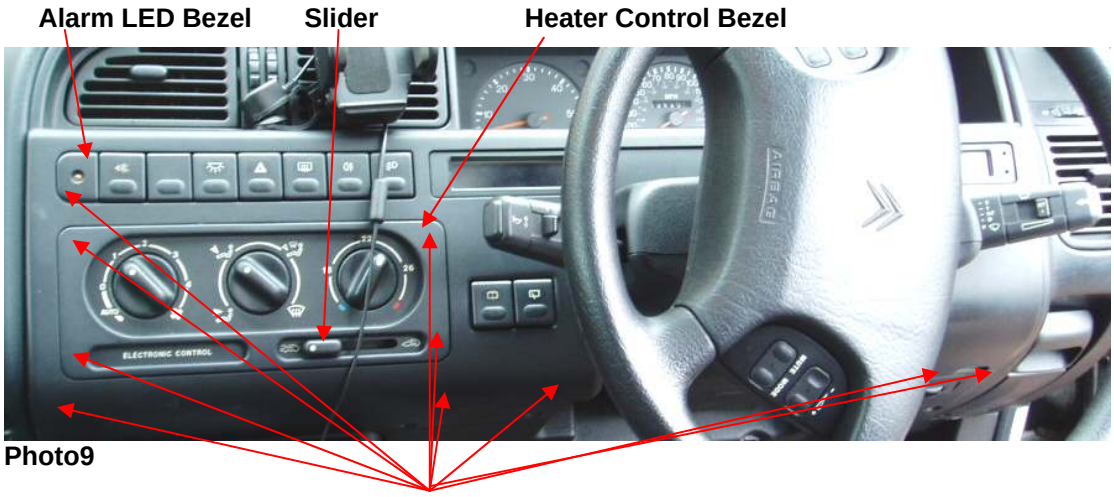

Photo9

Once the dash is pulled forward the instruments can be accessed from the rear. There is no need to completely remove the dash. It is possible to access all the bulbs and the displays by tilting forwards only. If there's not enough slack in the looms which terminate in the coloured plugs then just disconnect the plugs. They are all colour coded and not interchangeable so you can't put them back in the wrong place !

Rear view of dash

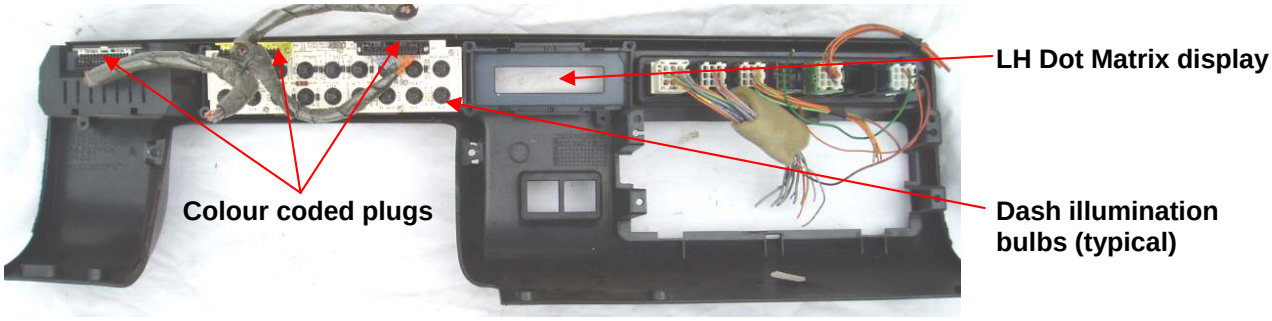

Photo 10

The Dot Matrix display is clipped into place. There are no fixing screws.

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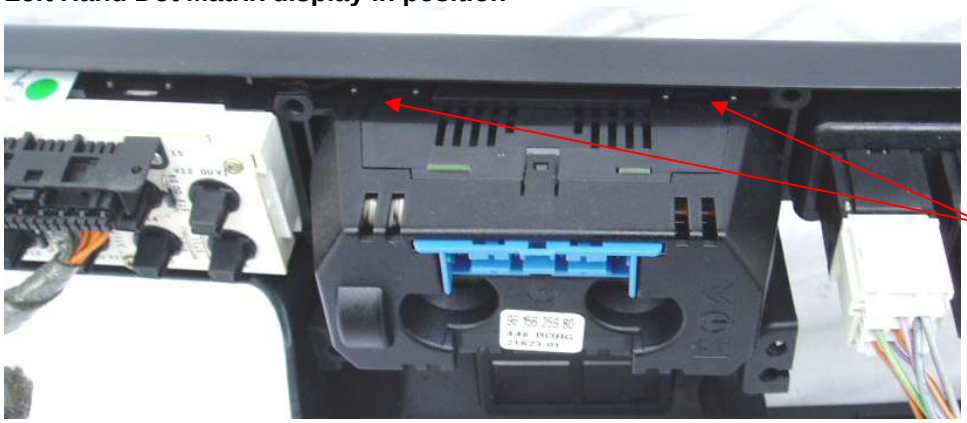
Left Hand Dot Matrix display in position

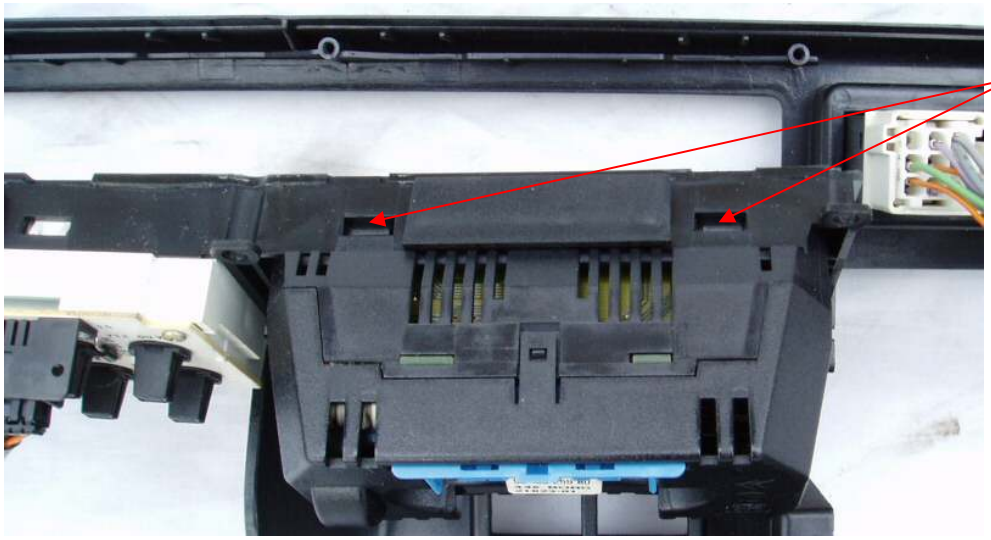


Insert flat blade screwdriver here to prise holding tabs

Photo 11

Dot Matrix Display support frame shown removed for clarity only

This photo shows the carrier frame for the displays and the warning lamps. It is shown here removed from the dash to demonstrate the location of the tabs for the display. There is no need to dismantle to this level for access to the displays or bulbs. Once the two top tabs are free, rotate the display backwards and the bottom two tabs will release by themselves. Don't force things to do something when they resist badly. Remember it's all only plastic.



Insert flat blade screwdriver here to prise holding tabs

Photo 12

Photo showing LH Dot Matrix fully removed from dash

Photo13

 ©2005 Norrie

Home made Sphere Recharging Jig
In this day and age the cost of a new sphere has reduced dramatically from the sort of prices we paid 10 years ago. As such, on cost grounds, it is debatable whether it's worth recharging spheres at all. From an environmental point of view, however, there's usually still plenty of life left in a sphere even after most of the gas has gone. I made this jig 15 years ago when a new sphere was £35-£40 and therefore well worth it.

Recharger Body

The frame of the jig is made from 10mm thick black steel plate. It has 5 sides welded at all corners. The photo shows a sphere in position ready to be refilled with Nitrogen Gas. The large threaded bolt at the left hand side is what keeps the sphere in position whilst being recharged.

To recharge the sphere the first thing you have to do is slacken the plug on the top of the sphere. If you haven't tested the sphere for residual pressure you must assume it is fully charged to be safe. I've found that the best way to slacken the plug is to turn the sphere upside down and grip the plug in the vice. Then, using a sphere removing tool, grip the sphere and turn through 1 revolution. Remove the sphere from the vice and turn up the right way. Grip the sphere in the vice again. Using a pair of molegrips slowly undo the plug. The residual gas pressure will begin to leak past the plug threads but most will still be retained by the o-ring on the underside of the plug.

Photo1

You can either let it bleed away slowly like this for an hour or two or you can speed up the process. Keep turning the plug anticlockwise. When the o-ring can no longer keep contact with the sphere and the plug at the same time it

 ©2005 Norrie

releases the residual gas suddenly. This will take you by surprise the first time you do it. There's no danger since the plug still has most of its threads screwed into the top of the sphere and therefore it can't go anywhere. It will be obvious when all the gas pressure has been released. The plug will go slack and you'll be able to turn it with your fingers.

The top of the plug is then machined with a 6mm diameter end mill set in a pillar drill to cut two small recessed dogs in the surface. These recesses are used to grip the plug under pressure and screw it back into the sphere.

Photo2

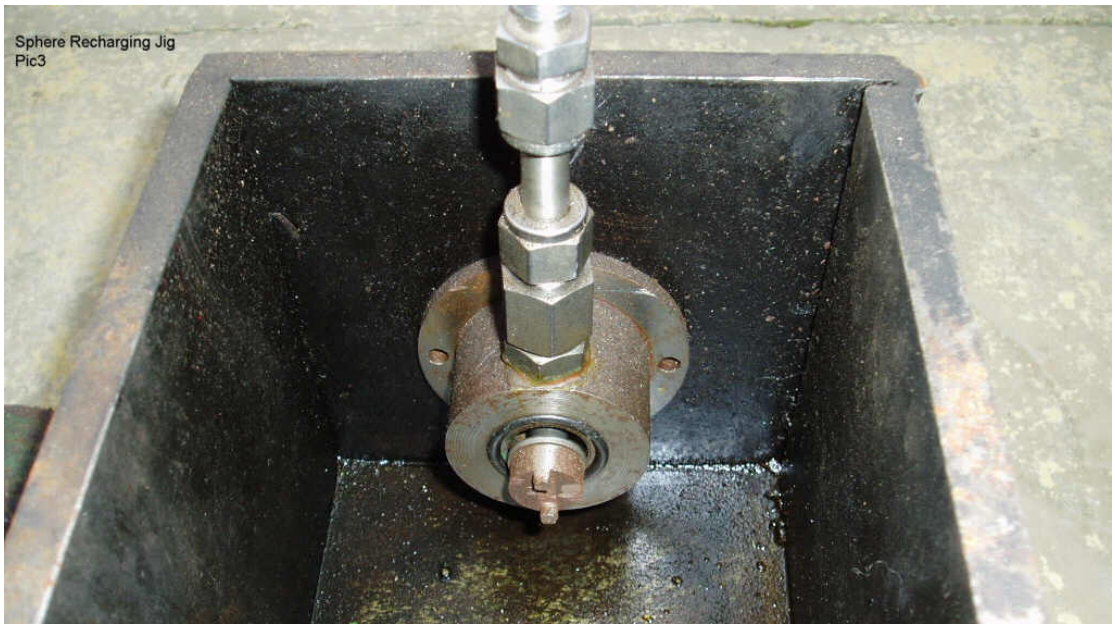


Photo3

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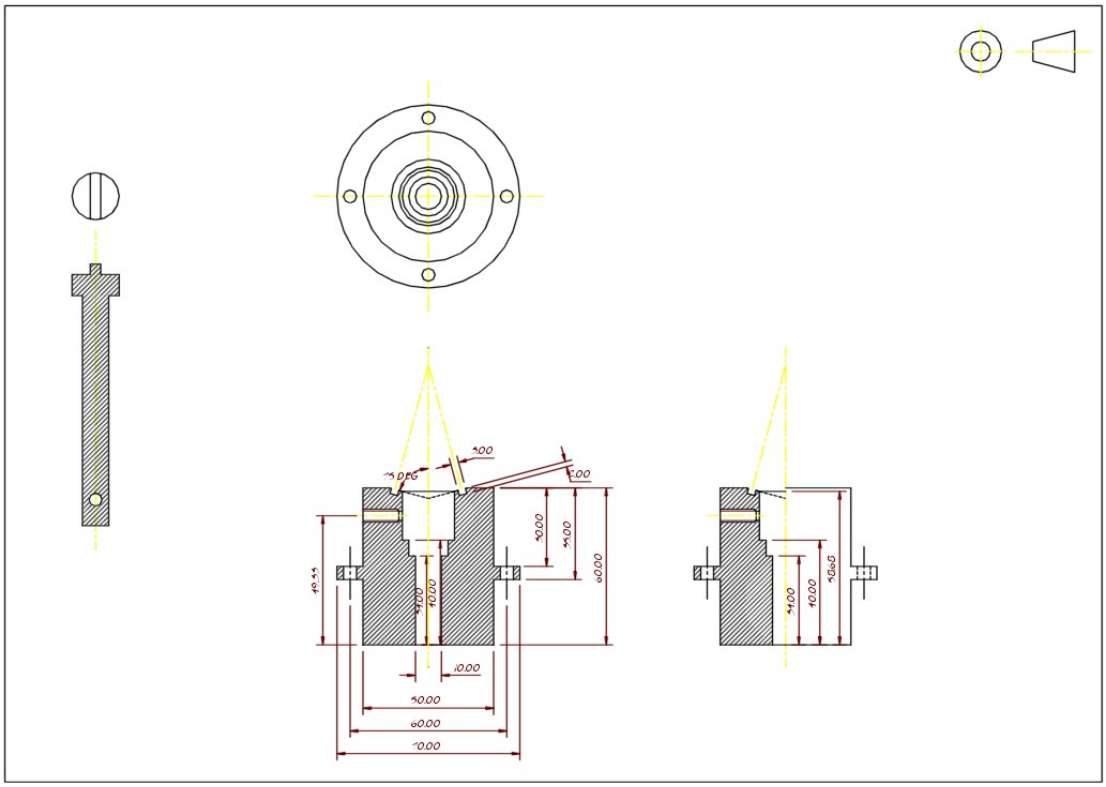
Here’s a drawing of the clever bit. It has been inserted at a reasonably high resolution so it should be expandable.



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Repairing the door lock of a Citroen XM

Having trouble with those spinning locks? As usual the repair is easy once you know how. Say goodbye to those days of climbing into the car through the tailgate. Just follow the instructions for a full set of working locks. The same instructions apply to both front doors and the tailgate.

Removing the lock from the car door

Open the door to reveal the door edge. Remove the small rubber bung just next to the door lock. Insert a 3mm allen key and remove the grub screw.

Photo1

Next, pull the lock away from the door. You may need to pull on the handle slightly to allow the lock to come out. The black plastic surrounding the lock may stick to the thin plastic base between the door lock and the door. Just prise them apart with a small screwdriver.

Photo2

Next, prise the black plastic shroud off the door lock. Warning – make sure the plastic is warm. It is brittle and will shatter if prised off when cold. There are several points around the perimeter where the black plastic grips the metal. Just ease them off one at a time with a small screwdriver working your way around the edge.

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Photo3

Next, remove the little rolled dowel pin which holds the whole lock assembly together. Punch it out with a small nail or a pin punch. Otherwise push it out with a screwdriver until there's enough to grab on the other side with a pair f pliers. Then pull it free from the lock. Once out, the inside barrel of the lock should move quite easily (depending on the extent of the corrosion) in the direction of the hole where you put the key in.

Photo4

The black plastic lever to the left in the photograph should just pull out sideways once the barrel is clear. The right hand assembly in the photo above is where the main lock mechanism is located.

Photo5

Push the inner barrel assembly out of the outer barrel by pushing on the bit where the key goes in whilst holding the outer barrel firmly.

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Photo6

The inner barrel is in two halves which separate very easily. The ball bearing at the top left of the photo is one of two ball bearings which stop the barrel rotating when anything other than the correct key is pushed into the lock. The right hand ball bearing with the spring is the anti-theft mechanism which allows the barrel to spin if the wrong key or a screwdriver is used instead of the correct key.
Pull the two halves apart to reveal the tumblers. This is the part which needs lubricating. Thoroughly cover the components in grease and/or WD40 or its equivalent. Push the key in and out of the lock many times to release the mechanism.

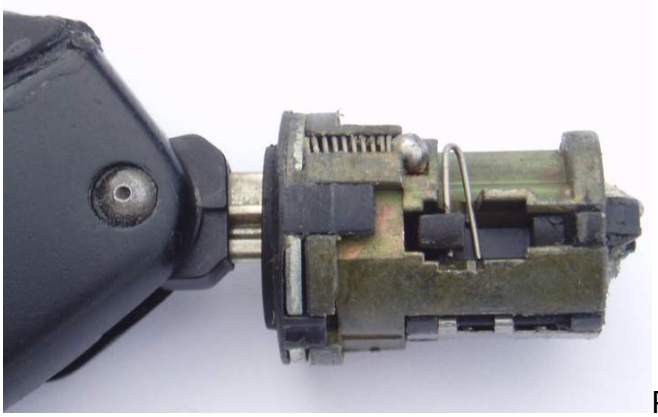


Photo7

When the key is presented to the lock it will go so far in until it meets a slight resistance. At this point the ball bearings are still engaged and the barrel won't turn. This is the condition in which you will find most locks that won't operate.

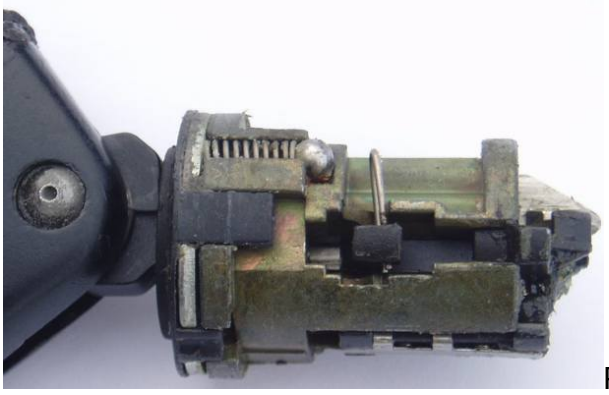


Photo8

 ©2005 Norrie

If the tumblers are well lubricated the key will pass into the lock by the last little bit of travel. You can see the return spring in the middle of the photograph is compressed which helps to push the key out when you withdraw it. The very end of the key can be seen protruding through the end of the barrel to the right. Just before the ridge at the right hand side you can see a small square block of metal. In the lower photo the square block has moved out of line with the ridge towards the right hand side. The hollow left behind is the space that the two ball bearings drop into. When the two ball bearings drop into the hollow they no longer prevent the barrel from being turned and so the key is rotated to operate the mechanism inside the door.

Reassembly

Once the barrels are all lubricated and working it is now time to reassemble the lock. Reassembly is the reverse of disassembly. The two ball bearings are not diametrically opposed so there's only one way the inner barrel can fit into the next barrel. In the same way the next barrel can only fit into the outer barrel in one location so you can't get it wrong.

Photo9

When fitting the barrel assembly into the gold coloured part, make sure the key hole (which is of centre is located to the bottom of the assembly.

 ©2005 Norrie

Series 1

All diagnostic connectors are located in the right hand side of the car in the large black box. The cover can easily be removed by first removing the front cover exposing the relais followed by the top cover. This will expose the ECU's. From front to back the following ECU's can be found (dependant on the equipment installed) Hydroactive I or II, Engine ECU, ABS ECU. The diagnostic connectors can be found floating arround in the ECU compartment, and can be identified by their color. The diagnostic connectors are protected by a cover which can be removed.

Hydroactive diagnostic connector : blue.

Engine diagnostic connector : green (pin 2)

ABS diagnostic connector : grey

Airco diagnostic connector : black

Series 2

I'm unsure from what, till what time the large 30 pins diagnostic connector is used. The connector is 3 pins wide and 10 pins long with the connector housing being brown. The pins are numbered 1,2,3 from top to bottom and A,B,C….,I,J from left to right.

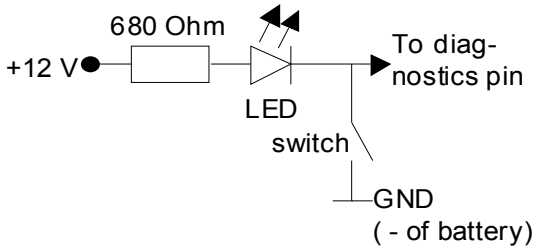
Hydroactive diagnostics pin : E2

Engine diagnostics pin : C3

ABS diagnostics pin : E1

Airco diagnostics pin : F1

The following circuit can be used to read out the diagnostic codes.



In case the large 30 pins diagnostic connector is present only a wire to connect the diagnostic pin to ground is needed. The readout will work via the diagnostic lights on the dashboard. (In case it doesn't work, one can always revert back to the circuit described above.)

To start readout of the codes:

1. Connect the circuit above, with the switch opened.
2. Turn on ignition
3. Within 3 seconds close the switch for 3-5 seconds, and open it again
4. The start code 12 will apear. Blink, pause, blink,blink.
5. Press the switch again for 3-5 seconds, and open it again.

6a. Now the diagnostic codes will follow in case there is an error code stored.

6b. If no more codes are stored the end code 11 will apear. Blink, pause, blink.

7a repeat step 5 and 6 until all codes are read out

7b After the end code you can clear all codes.

To clear all stored error codes:

1. First read out all codes described above
2. After the end code, close the switch for excactly 15 seconds.
3. Open the switch again
4. Now all stored codes are cleared.

Alternatively you can erase all error codes by disconnecting the battery for 10 (or more) minutes. This will not only clear the codes, but also erase the 'learned' settings (eg for the engine) and refer back to factory default.

To test engine components:

Don't use this if you don't know what you are doing!!

1. Be sure ignition is turned off.
2. Close the switch
3. Turn on ignition
4. Within 1-12 seconds open the switch again
5. Wait some seconds
6. First code 91 will appear. Meaning the fuel pump will be activated periodically.
7. Close the switch for 3-5 seconds to test the next component.
8. Repeat until you arrived at the component which you want to test.

To tune the engine ecu:

Don't use this if you don't know what you are doing!! (I never tried it, so I don't guarantee it will work. It should work however on a Fenix 3B ecu (3.0 V6-12)

1. Be sure ignition is turned off.
2. Close the switch
3. Turn on ignition
4. Within 1-12 seconds open the switch again
5. Within 3 seconds close the switch again for 3-5 seconds.
6. Open the switch for 3 seconds (5 max)
7. Close the switch again for 3-5 seconds.
8. Open the switch again.
9. The ECU should indicate code 22 by blinking. Meaning program start.
10. Enter code 2 by means of close 5 secs, open 3 secs, close 5 secs, open again.
11. The ECU will return 12 by blinking. Meaning 4 degrees ignition advance.
12. Close switch for 10-20 seconds. ECU will indicate code 11, meaning 2 degrees earlier.

Regretfully I don't have more data on this.

Code	Description	Check	Comp
****	ECU XM Magneti Marelli G5	XM 2.0 RDZ XU10M Monopoint XM 2.0 R6A XU10J2 Monopoint (from '91)	***
11	End test		***
12	Start test		***
13	Injection air temp sensor	4k@10C; 2,5k@20C; 680@55C	907
14	Cooling water temp sensor	4k@10C; 2,5k@20C; 680@55C; 230@90C	909
21	Throttle spindle potentiometer	4,5V max swing on pin 2	770
22	Idling actuator / Idle speed regulator		432
23	Idle speed control failure		
31	Automatic adjustment air/fuel ratio	oxygen/lambda sensor too quick (disconnect heater element to resolve)	900
33	Inlet manifold air pressure sensor	170 hPA : 0.25V, 1040 hPA : 4.8V between pin 9 and 12 (gnd) on ECU	903
34	Canister discharge valve (active carbon filter)		430
41	Engine speed sensor	345 Ohm between pin 14 and 31; check isolation to ground	152
42	Fuel injector	Check resistance of injector. 1.5 Ohm	570
45	Ignition coil 1-4	Check voltage between pin 1 and ground, should be +12V. Check primary windings should be 1.4 Ohm (between pin 1 and 4 on coil), secondary 8.6kOhm (Valeo) or 14kOhm (Bosch)	
52	Air/fuel mixture control loop	inlet or outlet manifold leak or lambda-sensor failure	
54	ECU malfunction		142
57	Ignition coil 2-3	Check voltage between pin 2 and ground, should be +12V. Check primary windings should be 1.4 Ohm (between pin 2 and 4 on coil), secondary 8.6kOhm (Valeo) or 14kOhm (Bosch)	

Code	Description	Check	Comp
****	ECU XM Bosch Motronic MP3.1	XM 2.0 RFZ XU10J2/Z Multipoint (till jun-93)	***
11	End test		***
12	Start test		***
13	Injection air temp sensor	4k@10C; 2,5k@20C; 680@55C	907
14	Cooling water temp sensor	4k@10C; 2,5k@20C; 680@55C; 230@90C	909
21	Throttle spindle potentiometer	Closed 0.5V, fully open 4.5V (minimal)	770
22	Idling actuator / Idle speed regulator		432
31	Automatic adjustment air/fuel ratio	Check ogygen sensor, inlet&outlet manifold on leakage, fuel pressure, fuel injectors, spark plugs, air filter element, compression.	900
33	Inlet manifold air pressure sensor	Is integrated in the ECU and cannot be checked. Check vacuum hose to ECU.	
34	Canister discharge valve (active carbon filter)		430
41	Engine speed sensor	245 Ohm between pin 23 and 25; check isolation to ground	152
51	Oxygen/lambda sensor	When engine hot and running should constantly change from 0 to 1V measured between pin 24 and pin 8.	900
52	Air/fuel mixture control loop	inlet or outlet manifold leak or lambda-sensor failure	
53	Sensor power supply	Pin 16 and 5 should be connected to ground. Pin 18 should have +12V.	
54	ECU malfunction		142

Code	Description	Check	Comp
****	ECU XM Bosch Motronic MP3.2	XM 2.0 Turbo RGY or RGX XU10J2T/Z/L/L3 Multipoint	***
	Warning: Not checked against actual schematics!		
11	End test		***
12	Start test		***
13	Injection air temp sensor	4k@10C; 2,5k@20C; 680@55C	907
14	Cooling water temp sensor	4k@10C; 2,5k@20C; 680@55C; 230@90C	909
21	Throttle spindle potentiometer	Closed 0.5V, fully open 4.5V (minimal)	770
22	Idling actuator / Idle speed regulator		432
31	Automatic adjustment air/fuel ratio	Check ogygen sensor, inlet&outlet manifold on leakage, fuel pressure, fuel injectors, spark plugs, air filter element, compression.	900
33	Inlet manifold air pressure sensor	Is integrated in the ECU and cannot be checked. Check vacuum hose to ECU.	
34	Canister discharge valve (active carbon filter)		430
41	Engine speed sensor	330 Ohm between pin 48 and 49; check isolation to ground	152
43	Engine knock control loop	correct fuel grade, mechanical state engine	
44	Anti-knock sensor	Check mounting of sensor (torque: 20Nm)	150
51	Oxygen/lambda sensor	When engine hot and running should constantly change from 0 to 1V measured between pin 28 and pin 10.	900
52	Air/fuel mixture control loop	inlet or outlet manifold leak or lambda-sensor failure	
53	Sensor power supply		
54	ECU malfunction		142
65	Sensor reference cylinder		
71	Fuel injector 1	Check fuel injector resistance. Should be 16 Ohm each.	
72	Fuel injector 2	Check fuel injector resistance. Should be 16 Ohm each.	
73	Fuel injector 3	Check fuel injector resistance. Should be 16 Ohm each.	
74	Fuel injector 4	Check fuel injector resistance. Should be 16 Ohm each.	

Code	Description	Check	Comp
****	ECU XM Bosch Motronic MP5.1	XM 2.0 RFZ XU10J2/Z Multipoint (from jul-93)	***
11	End test		***
12	Start test		***
13	Injection air temp sensor	4k@10C; 2,5k@20C; 680@55C	907
14	Cooling water temp sensor	4k@10C; 2,5k@20C; 680@55C; 230@90C	909
21	Throttle spindle potentiometer	Closed 0.5V, fully open 4.5V (minimal)	770
22	Idling actuator / Idle speed regulator		432
31	Automatic adjustment air/fuel ratio	Check ogygen sensor, inlet&outlet manifold on leakage, fuel pressure, fuel injectors, spark plugs, air filter element, compression.	900
33	Inlet manifold air pressure sensor	Is integrated in the ECU and cannot be checked. Check vacuum hose to ECU.	903
34	Canister discharge valve (active carbon filter)		430
41	Engine speed sensor	320-340 Ohm between pin 11 and 30; check isolation to ground	152
42	Fuel injectors	Check resistance of each injector. Should be 16 Ohm each.	570
51	Oxygen/lambda sensor	When engine hot and running should constantly change from 0 to 1V measured between pin 28 and pin 10.	900
52	Air/fuel mixture control loop	inlet or outlet manifold leak or lambda-sensor failure	
53	Sensor power supply	Pin 19, 2 and 14 should be connected to ground. Pin 18, 37 should have +10-15.5V on them (+ from battery)	
54	ECU malfunction		142

Code	Description	Check	Comp
****	ECU XM Bosch Motronic MP5.1.1	XM 2.0 RFV XU10J4R/L/L3 (16V) Multiploint	***
11	End test		***
12	Start test		***
13	Injection air temp sensor	4k@10C; 2,5k@20C; 680@55C	907
14	Cooling water temp sensor	4k@10C; 2,5k@20C; 680@55C; 230@90C	909
21	Throttle spindle potentiometer	Closed 0.5V, fully open 4.5V (minimal)	770
22	Idling actuator / Idle speed regulator		432
27	Vehicle speed sensor	R=300 Ohm on sensor; When driving a speed relative signal on pin 9	154
31	Automatic adjustment air/fuel ratio	Check ogygen sensor, inlet&outlet manifold on leakage, fuel pressure, fuel injectors, spark plugs, air filter element, compression.	900
33	Inlet manifold air pressure sensor	Is integrated in the ECU and cannot be checked. Check vacuum hose to ECU.	903
34	Canister discharge valve (active carbon filter)		430
41	Engine speed sensor	320-340 Ohm between pin 11 and 30; check isolation to ground	152
42	Fuel injectors	Check resistance of each injector. Should be 16 Ohm each.	570
43	Engine knock control loop	correct fuel grade, mechanical state engine	
44	Anti-knock sensor	Check mounting of sensor (torque: 20Nm)	150
51	Oxygen/lambda sensor	When engine hot and running should constantly change from 0 to 1V measured between pin 28 and pin 10.	900
52	Air/fuel mixture control loop	inlet or outlet manifold leak or lambda-sensor failure	
53	Sensor power supply	Pin 19, 2 and 14 should be connected to ground. Pin 18, 37 should have +10-15.5V on them (+ from battery)	
54	ECU malfunction		142

Code	Description	Check	Comp
****	ECU XM V6 Fenix 3B		***
11	End test		***
12	Start test		***
13	Injection air temp sensor	4k@10C; 2,5k@20C; 680@55C	907
14	Cooling water temp sensor	4k@10C; 2,5k@20C; 680@55C; 230@90C	909
15	Fuel pump relais		807
21	Throttle spindle potentiometer	4,5V max swing on pin 9	770
22	Idling actuator / Idle speed regulator		432
23	Throttle spindle potentiometer idle value	0,5 +/- 0,1V between pin 9 and 17 (gnd)	770
27	Vehicle speed sensor	R=300 Ohm on sensor; When driving 1,5Volt on pin 3	154
31	Automatic adjustment air/fuel ratio	oxygen/lambda sensor too quick (disconnect heater element to resolve)	900
33	Inlet manifold air pressure sensor	400Pa=2,5V; 600Pa=1,25V between pin 33 and 17 (gnd)	903
34	Canister discharge valve (active carbon filter)		430
36	Relais oxygen/lambda sensor heater		818
41	Engine speed sensor	330 Ohm between pin 11 and 28; check isolation to ground	152
42	Fuel injectors	14 Ohm each injector (2-3 Ohm between pin 20/21 and pin 30)	570
43	Engine knock control loop	correct fuel grade, mechanical state engine	
44	Front anti-knock sensor		150
51	Oxygen/lambda sensor	When engine hot and running should constantly change from 0 to 1V on pin 35 from pin 32 (gnd)	900
52	Air/fuel mixture control loop	inlet or outlet manifold leak	
53	Sensor power supply	10-15,5V on pin 4 ECU from gnd (pin 1).	
54	ECU malfunction		142
56	Anti-theft start code not entered		176
62	Rear anti-knock sensor		151

Code	Description	Comp
****	ECU XM V6 Fenix 3B (activate components)	****
	Component activation is performed	
91	Activate fuel pump relais	807
92	Activate fuel injectors	570
93	Activate idling actuator	432
94	Activate canister discharge valve	430
95	Activate relais airco compressor	822

****	ECU XM V6 Fenix 3B (Mixture adjustment)	****
11	Make mixture richer	
22	Make mixture leaner	
33	Program start	
99	upper or lower limit reached	

****	ECU XM V6 Fenix 3B (Ignition timing adjustment)	****
11	2 degrees advance	
12	4 degrees advance	
13	6 degrees advance	
14	8 degrees advance	
19	default setting	
22	Program start	
99	upper or lower limit reached	

Code	Description	Check	Comp
****	ECU Hydroactive I/II suspension	Version HI and HII pinning are totally different.	****
11	End test		***
12	Start test		***
21	Brake pressure switch	Switch will open when firm brake pressure applied (HI measure between pin 7 white and ground, HII between pin 11 black and gnd)	670
22	Accelerator pedal position potentiometer (situated under pedal)	Pedal up=3-4V; pedal down<3V. HI measure between pin 10 white and ground. HII between pin 4 black and ground.	771
23	Steering wheel position sensor	Will alternate between 0 and +5V when slowly moving steering wheel. HI: Measure on both on pins 6 and 13 white to pin 12 white which is ground. HII: pin 9,10,15 black and 13 white are for steering wheel sensor. Two pins for position, other two for power supply and ground.	159
24	Vehicle speed sensor	HI: R=300 Ohm on speed sensor, when driving ca 1,5V on pin 13 black. HII: measure speed signal on pin 11 white.	154
25	Vehicle height sensor	Will alternate between 0 and +5V when vehicle height is changed. HI: Measure on both on pins 3 and 4 black to ground. HII measure on both pins 13 and 14 black to ground.	153
31	Electrovalve firm/soft suspension	R=3-5 Ohm, when valve is operated suspension is soft. HI: Measure between pin 9 black and ground. HII: Measure between pin 1 white and ground. When valve is acivated measure 12 volt, followed by an alternating signal at a few hundred Hertz.	433
32	Back electrovalve firm/soft suspension	Only present on Hydroactive II. R=3-5 Ohm, when valve is operated suspension is soft. HII: Measure between pin 2 white and ground. When valve is acivated measure 12 volt, followed by an alternating signal at a few hundred Hertz.	
53	ECU powersupply	HI: check fuse 34. HII: check fuse 7.	
54	ECU malfunction		

Code	Description	Check	Comp
****	ECU ABS (Teves version)	Teves version is with two seperature units, Bendix has valves and ecu integrated.	
11	End test		***
12	Start test		***
13	Electrovalves supply	check resistance on electrovalves 2-4Ohm each. Pin 1,2,3,4,5 on 7 pin connector against pin 5 on 5 pin connector	41
15	Electrovalves relais.	Check resistance between pin 2 and 3 on 5 pin connector 50-60Ohm	41
21	Electrovalves relais.	Check resistance between pin 2 and 3 on 5 pin connector 50-60Ohm	41
22	Electrovalves relais.	Check wiring to electrovalves on shortcircuit or loose connection	
24	LH rear wheel sensor	Measure R=1-1,4kOhm (after 3-94 R=2,2-3,2kOhm), between pin 15 and 32 on ECU	157
25	RH front wheel sensor	Measure R=1-1,4kOhm (after 3-94 R=2,2-3,2kOhm), between pin 16 and 33 on ECU	156
31	RH rear wheel sensor	Measure R=1-1,4kOhm (after 3-94 R=2,2-3,2kOhm), between pin 17 and 34 on ECU	158
32	LH front wheel sensor	Measure R=1-1,4kOhm (after 3-94 R=2,2-3,2kOhm), between pin 18 and 35 on ECU	155
33	LH rear wheel sensor signal	Check signal, check air-gap between teeth-sensor, check teeth condition	157
34	RH front wheel sensor signal	Check signal, check air-gap between teeth-sensor, check teeth condition	156
35	RH rear wheel sensor signal	Check signal, check air-gap between teeth-sensor, check teeth condition	158
41	LH front wheel sensor signal	Check signal, check air-gap between teeth-sensor, check teeth condition	155
42	Electrovalve RH front inlet	Check resistance of electrovalve between pin 2 on 7 pin connector and pin 5 on 5 pin connector	41
43	Electrovalve RH front return	Check resistance of electrovalve 2-4 Ohm between pin 4 on 7 pin connector and pin 5 on 5 pin connector	41
44	Electrovalve LH front inlet	Check resistance of electrovalve 2-4 Ohm between pin 3 on 7 pin connector and pin 5 on 5 pin connector	41
45	Electrovalve LH front return	Check resistance of electrovalve 2-4 Ohm between pin 5 on 7 pin connector and pin 5 on 5 pin connector	41
51	Electrovalve rear	Check resistance of electrovalve 2-4 Ohm between pin 1 on 7 pin connector and pin 5 on 5 pin connector	41
55	Error in ECU memory		140

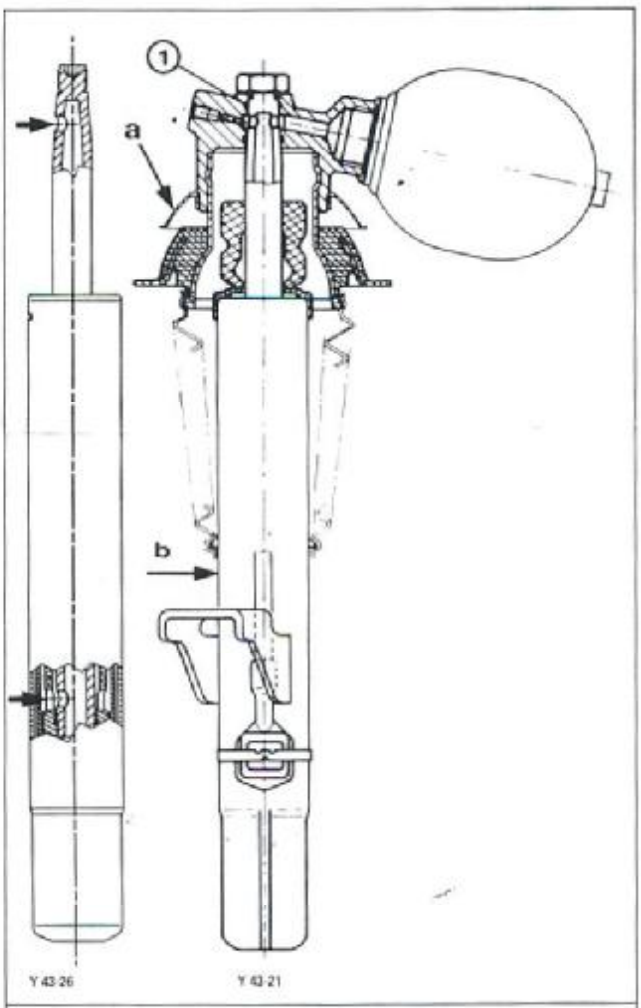
Code	Description	Check
****	ECU ABS (Bendix version)	Teves version is with two seperature units, Bendix has valves and ecu integrated.
11	End test	
12	Start test	
13	Electrovalves supply	
15	Electrovalves relais.	Check Relais
21	Electrovalves relais.	Check Relais
22	Electrovalves relais.	Check Relais
24	LH rear wheel sensor	Measure R=1-1,4kOhm (Bendix type) or R=2,2-3,2kOhm (Bendix/Siemens type), between pin 19 and 28 on ECU
25	RH front wheel sensor	Measure R=1-1,4kOhm (Bendix type) or R=2,2-3,2kOhm (Bendix/Siemens type), between pin 1 and 6 on ECU
31	RH rear wheel sensor	Measure R=1-1,4kOhm (Bendix type) or R=2,2-3,2kOhm (Bendix/Siemens type), between pin 29 and 31 on ECU
32	LH front wheel sensor	Measure R=1-1,4kOhm (Bendix type) or R=2,2-3,2kOhm (Bendix/Siemens type), between pin 15 and 30 on ECU
33	LH rear wheel sensor signal	Check signal, check air-gap between teeth-sensor, check teeth condition
34	RH front wheel sensor signal	Check signal, check air-gap between teeth-sensor, check teeth condition
35	RH rear wheel sensor signal	Check signal, check air-gap between teeth-sensor, check teeth condition
41	LH front wheel sensor signal	Check signal, check air-gap between teeth-sensor, check teeth condition
42	Electrovalve RH front inlet	
43	Electrovalve RH front return	
44	Electrovalve LH front inlet	
45	Electrovalve LH front return	
51	Electrovalve rear	
55	Error in ECU memory	

Code	Description	Check	Comp
****	ECU Airconditioning (Full automatic, Semi automatic with/without airco)		
11	End test		***
12	Start test		***
13	Airflow direction valve position potentiometer signal	Full auto only; pin 3 black voltage should vary when changing vent position.	710
14	Airflow direction valve position potentiometer short-circuit		710
15	Recirculation valve position potentiometer signal	Full auto only; pin 4 black voltage should change when changing recirculation.	711
16	Recirculation valve position potentiometer short-circuit		711
17	Airflow direction valve position signal swing not correct	Full automatic only. Electrovalve on RH side of mid-console.	710
18	Hot air/cold air control valve position signal swing not correct.	Full automatic only. Electrovalve on LH side of mid-console.	700
21	Hot air/cold air control valve position potentiometer signal	Full auto: pin 15 black. Other: pin 3 blue. Signal should vary when changing temperature between min and max.	700
22	Hot air/cold air control valve position potentiometer short-circuit		700
23	Evaporator temperature sensor signal	Full auto: Between pin 14 black and pin 1 black. Semi auto: Between pin 2 blue and pin 1 black. R=10k@10C; 6k@20C; 5k@25C; 4k@30C	912
24	Evaporator temperature sensor short-circuit		912
25	Outdoor temperature sensor signal	In air-inlet. Full auto: Between pin 13 black and pin 1 black. Semi auto: Between pin 1 blue and pin 1 black. R=20k@10C; 12,5k@20C; 10k@25C; 8k@30C	908
26	Outdoor temperature sensor short-circuit		908
27	Recirculation valve position signal swing not correct	Full automatic only. Electrovalve on blower unit?	711
31	Interior temperature sensor signal	Full auto: Between pin 10 blue and pin 1 black. Semi auto: Between pin 5 black and pin 1 black. R=20k@10C; 12,5k@20C; 10k@25C; 8k@30C	913
32	Interior temperature sensor short-ciruit		913
33	Interior air blower motor signal line interrupted	Semi auto only. If only highest speed works, check transistors on control module on blower motor.	681
34	Interior air blower motor signal line short-circuit	Semi auto only.	681
35	Hot air/cold air flap motor line interrupted	Full auto: Between pin 6 and 7 black. Semi auto: Between pin 9 and 10 blue. R=50Ohm.	700
36	Hot air/cold air flap motor line short-circuit	See fault 35. Typical fault are worn motor brushes, which cause short-circuit. Can be solved by reshaping brushes (eg. with a knife).	700
41	Air blower speed potentiometer signal interrupted	Semi auto only. Visually check potentiometer track on pcb.	183
42	Air blower speed potentiometer signal short-circuited	Semi auto only. Visually check potentiometer track on pcb.	183

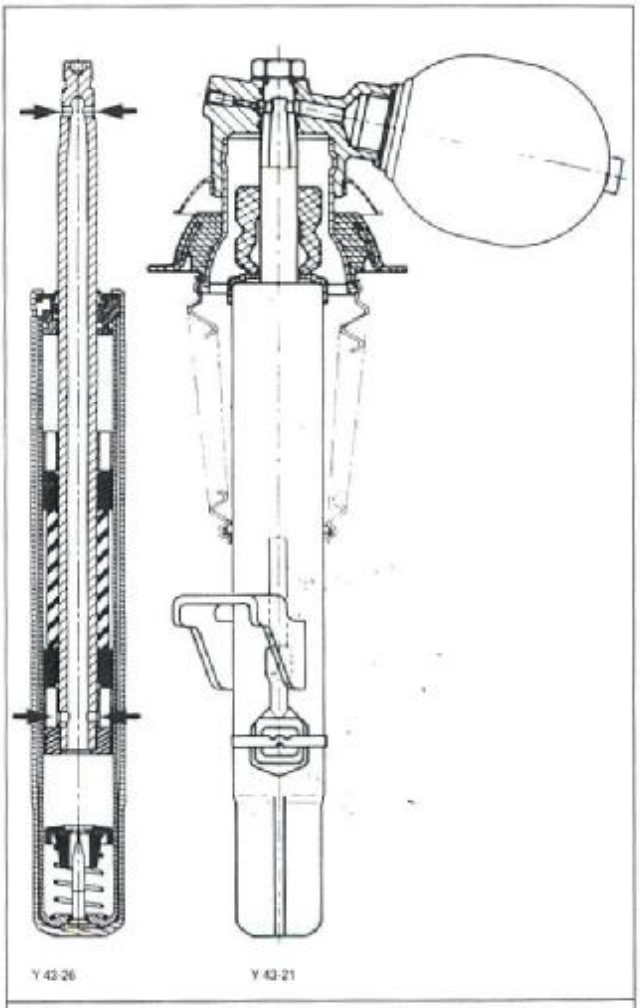
43	Temperature selection potentiometer signal signal interrupted	Semi auto only. Visually check potentiometer track on pcb.	182
44	Temperature selection potentiometer signal signal short-circuit	Semi auto only. Visually check potentiometer track on pcb.	182
46	Airco compressor electro-magnetic clutch	Full and semi auto: pin 2 white. Check if short circuit in wiring.	255
51	Recirculation flap motor line interrupted?	Full auto only. Between pin 8 and 9 black measure R=50Ohm.	711
52	Recirculation flap motor line short-circuit?	See fault 51. Typical fault are worn motor brushes, which cause short-circuit. Can be solved by reshaping brushes (eg. with a knife).	711
53	Airflow direction flap motor line interrupted	Full auto only. Between pin 10 and 11 black measure R=50Ohm.	710
54	Airflow direction flap motor line short-circuit	See fault 53. Typical fault are worn motor brushes, which cause short-circuit. Can be solved by reshaping brushes (eg. with a knife).	710
55	Cooling water temperature sensor signal	Full auto only. Measure between pin 11 blue and pin 1 black.	916
56	Cooling water temperature sensor short-circuit		916
63	Interior air blower motor signal line interrupted	Full auto only. If only highest speed works, check transistors on control module on blower motor.	681
64	Interior air blower motor signal line short-circuit	Full auto only.	681

CITROËN CUSTOMER SERVICES AFTER SALES TECHNICAL DEPARTEMENT	**TECHNICAL BULLETIN**	**XM** **9**
CONCERNING : **ALL COUNTRIES**	CONCERNING : **ALL CITROEN XM MODELS** **Front suspension units**	**No. 11**
APPLYING TO : **ALL COUNTRIES**		31st March 1992
THIS DOCUMENT TO BE FILED IN : **BULLETIN BINDER No. MAN 058930**		1472

Since **October 1991**, **CITROEN XM** front suspension units have been modified.



NEW ARRANGEMENT



FORMER ARRANGEMENT

New suspension cylinder

The suspension push-rod is drilled with a single hole in the upper section (→) and with a single hole in the lower section (*in place of two previously*).

New sphere support :

The seal **(1)** on the sphere support has been modified (Ø 2 x 18 *in place of Ø 2.7 x 18.4*) ; also modified is the seal location (repositioned toward the top).

P.T.O.
→

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REPAIR

1. Interchangeability

The new suspension cylinders can be fitted to early type suspension sphere supports.

However, the fitting of a new type sphere support to an early suspension cylinder is **FORBIDDEN**.

2. Identification

The new sphere supports **bear the reference 275.1.A or B, at (a).**

The new suspension cylinders **bear the reference 275.1.A or B, at (b).**

Start number 275 — day of manufacture; 1 — year of manufacture; A — assembly line A or B

3. Replacement Parts

When current stocks are exhausted, only the new parts will be available from R. P. DEPARTMENT, both supports and cylinders.

NOTE : The cylinders are sold with both types of seal (early and late).

The repairer should choose the appropriate seal for the suspension sphere support fitted to the vehicle.

DESCRIPTION		NEW ARRANGEMENT	EARLY ARRANGEMENT
SUSPENSION CYLINDER	LEFT	96 663 042	96 125 066
	RIGHT	95 663 043	96 125 067
SPHERE SUPPORT Without hydractive	LEFT	96 149 930	95 050 461
	RIGHT	96 149 933	95 050 463
SPHERE SUPPORT With hydractive	LEFT	96 149 931	95 050 462
	RIGHT	96 149 934	95 050 464
SEALS		96 145 321 (Ø 2 x 18) 96 065 851 (Ø 2.45 x 21.15)	25 037 009 (Ø 2.7 x 18.4) 96 065 851 (Ø 2.45 x 21.15)

4. Repair

Mixing of the two types on the same vehicle is permitted.

The fitting of late type suspension sphere support entails, **WITHOUT FAIL**, the fitting of a late type suspension cylinder.

Gaiter 5271 92

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Xm

JUNE 1998

RPO No: 7847 ⟶

REF. 0 No XM 000-00/14

PRESENTATION

● 1999 MODEL YEAR

MAN 108931

"The technical information contained in this document is intended for the exclusive use of the trained personnel of the motor vehicle repair trade. In some instances, the information could concern the security and safety of the vehicle. The information is to be used by the professional vehicle repairers for whom it is intended and they alone would assume full responsibility to the exclusion of that of the manufacturer".
"The technical information appearing in this brochure is subject to updating as the characteristics of each model in the range evolve. Motor vehicle repairers are invited to contact the CITROËN network periodically for further information and to obtain any possible updates".

AUTOMOBILES CITROËN
DIRECTION EXPORT EUROPE
DOCUMENTATION APRÈS VENTE

GB

1

GENERAL SPECIFICATION

PRESENTATION : 1999 MODEL YEAR RANGE 1

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5 – Hydractive suspension 11

MODIFICATIONS TO THE ELECTRICAL SYSTEM : 1999 MODEL YEAR RANGE 12

1 – General 12
2 – Electrical harnesses –
3 – Audio system –

PRESENTATION : 1999 MODEL YEAR RANGE

1 – MAINTENANCE

The 1999 Model Year service schedules are characterised by an increase in the mileage intervals between engine oil changes.

The new service intervals are as follows :

- petrol vehicles (all types) – direct injection diesel vehicles : 12,500 miles (instead of 10,000 miles)
- indirect injection diesel vehicles (Turbo D) (pre–combustion chambers) : 110,000 miles (instead of 6,000 miles)

WARNING : The new mileage intervals are based on using an engine oil, the quality of which meets the performance standards ACEA (A3.96 – B3.96) or API (SJ/CF) (synthetic or semi–synthetic oils).

2 – EUROPE MARKETED RANGE

2.1 – Index

Ref. letters used in the tables "commercial range of vehicles" :

(a) = automatic gearbox	(f) = fiscal rating in "HP" (France)
(m) = manual gearbox	L3 = CEE 95 L3
(l) = "long" gearbox	L4 = CEE 2000 (EURO 2000)

2.2 – Commercial range of CITROEN XM vehicles – Saloon

Vehicle		Engine		Gearbox
Type code	Trim level	Plate. Type	Power kW/hp. (f)	Reference. Type
CITROEN XM 2 l injection (1998 cc) :				
Y4–CZ	SX	RFV (L3) XU10J4R	97,4/135 (9)	20TA53 BE3 (m) (*)
Y4–TV			97,4/135 (10)	20GZ5G 4HP18 (a)
Y4–TX			97,4/135 (9)	20TA52 BE3 (m) (l) (*)

(*) gearbox equipped with a new reverse gear brake.

CITROEN XM 2 l turbo – CT (1998 cc) :				
Y4–GG	SX	RGX (L3) XU10J2TE	108/150 (10)	20GM32 ME5T (m)
	EXCLUSIVE			
Y4–TT	SX		108/150 (11)	20GZ1G 4HP18 (a)
	EXCLUSIVE			
CITROEN XM 6 cylinders (2946 cc) :				
Y4–WG	SX	ES9J4 (L3) XFZ	140/194 (13)	20LE33 ML5T (m)
	EXCLUSIVE			
Y4–WH	SX		140/194 (14)	20HZ02 4HP20 (a)
	EXCLUSIVE			

Vehicle		Engine		Gearbox
Type code	Trim level	Plate. Type	Power kW/hp. (f)	Reference. Type

CITROEN XM turbo D12 (2088 cc) :

Y4–GZ	For conversion into ambulance	P8C (L3) XUD11BTE	80/110 (7)	20GM31 ME5T (m)
	SX			
	EXCLUSIVE			
Y4–RN	SX		80/110 (8)	20GZ5D 4HP18 (a)
	EXCLUSIVE			
Y4–WE	SX	P8C (L4) XUD11BTE	80/110	20GM31 ME5T (m)

CITROEN XM 2,5 l turbo diesel (2446 cc) :

Y4–NZ	SX	THY (L3) DK5ATE	94,5/130 (9)	20KM50 MG5TB (m)
	EXCLUSIVE			

2.3 – Commercial range of CITROEN XM vehicles – Estate

CITROEN XM 2 l injection (1998 cc) :

Y4–GB	SX	RFV XU10J4R	97,4/135 (9)	20GM36 ME5T (m)
Y4–TU			97,4/135 (10)	20GZ5G 4HP18 (a)

CITROEN XM 2 l turbo – injection (1998 cc) :

Y4–GM	Varebiler	RGX XU10J2TE	108/150 (9)	20GM33 ME5T (m)
	SX			
Y4–TS	Varebiler		108/150 (10)	20GZ1G 4HP18 (a)
	SX			

CITROEN XM 6 cylinders (2946 cc) :

Y4–WJ	SX	ES9J4 XFZ	140/194 (13)	20LE33 ML5T (m)
Y4–TN			140/194 (14)	20HZ02 4HP20 (a)

CITROEN XM turbo D12 (2088 cc) :

Y4–MZ	Varebiler	P8C XUD11BTE	80/110 (7)	20GM31 ME5T (m)
	SX			
Y4–CW	Varebiler		80/110 (8)	20GZ5D 4HP18 (a)
	SX			
Y4–WF	SX	P8C (L4) XUD11BTE	80/110	20GM31 ME5T (m)

CITROEN XM 2,5 l turbo diesel (2446 cc) :

Y4–RM	Varebiler	THY DK5ATE	94,5/130 (9)	20KM50 MG5TB (m)
	SX			

MECHANICAL DEVELOPMENTS : 1999 MODEL YEAR RANGE

1 – ELECTRONIC CONTROL UNITS

1.1 – Engine management ECU

4 cylinders (1998 cc) :

Engine type	Gearbox	Injection system			Remarks
		Supplier Type	PSA reference Manufacturer reference	Software version Indication	
RFV XU10J4R	Manual	BOSCH	96 309 013 80	1037357305	Improved driving performance
	Automatic	MP 52 (*)	0261204694	26FM435	
RGX XU10J2TE	Manual	BOSCH	96 304 296 80	1037357230	
	Automatic	MP 32 (*)	0261200808	26FM0349	

6 cylinders (2946 cc) :

Engine type	Gearbox	Injection system			Remarks
		Supplier Type	PSA reference Manufacturer reference	Software version Indication	
UFZ ES9J4	Manual	BOSCH MP 7.0 (*)	96 255 522 80	1037357243	Improved driving performance
			0261204412	26FM413	
	Automatic		96 255 523 80	1037358274	
			0261204413	26FM0432	

NOTE : (*) downloading an update to the ECU.

4 cylinder Turbo Diesel engine :

Engine type	Gearbox	Injection system			Remarks
		Supplier Type	PSA reference Manufacturer reference	Software version Indication	
P8C XUD11BTE/L3	Manual Automatic	LUCAS EPIC	96 305 092 80	41502211	
			R 040 100 20 C	0B	
	Manual		96 314 459 80	41501411	
			R 040 100 16 D	0C	
P8C XUD11BTE/L4			96 304 668 80	41501412	New indirect injection diesel engine
			R 040 100 15 D	0C	
THY DK5ATE	Manual	BOSCH MSA 11 7.6	96 286 071 80	L3 16	
			00281001336		

1.2 – Automatic gearbox ECU ZF 4HP20

Supplier : BOSCH (*).

PSA reference : 96 328 731 80.

Software version : PS08G03.

(*) ECU updated by downloading.

2 – XUD11BTE/L4 ENGINE

Vehicles fitted with XUD11BTE/L4 engines have been marketed since the 02/1998.

The XUD11BTE/L4 engine replaces the XUD11BTE/L3 engine in countries offering tax incentives.

The new emission standard L4 is stricter than the preceding standard (L3 emission standard) :

- reduction in nitrogen oxide (Nox) emissions
- reduction in soot emissions

2.1 – Principal evolutions

Components integrated in the air inlet system :

- air flowmeter
- throttle housing (on inlet manifold)

Specific elements :

- the catalytic converter is impregnated with 70 g of precious metal
- engine wiring harness
- precombustion chamber (specific cylinder head)
- inlet manifold connection (adapted for the throttle housing)
- diesel fuel injectors (specific rating = 150 bars)
- diesel injection ECU (location of new channels)
- exhaust gas recycling valve
- electrovalve allowing the gradual operation of the throttle butterfly housing located on the inlet manifold

NOTE : The XUD11BTE/L4 engine can only be coupled with manual gearboxes.

2.2 – Main specification

2.2.1 – Vehicle

Type code :

- "Saloon" version : Y4WE
- "Estate" version : Y4WF

2.2.2 – Engine

Engine code : XUD11BTE/L4.

Legislation type : P8C.

Cubic capacity : 2088 cc.

Compression ratio : 21.5/1.

Max. power E.E.C. (DIN) : 80 kW (110 HP).

Corresponding engine speed : 4300 rpm.

Max. torque E.E.C. (DIN) : 25 m.daN (26 m.kg).

Corresponding engine speed : 2000 rpm.

Emission standard : L4 (EURO 2000).

2–way catalytic converter : yes.

Injection system : LUCAS DIESEL.

2.3 – Description : exhaust gas recycling system

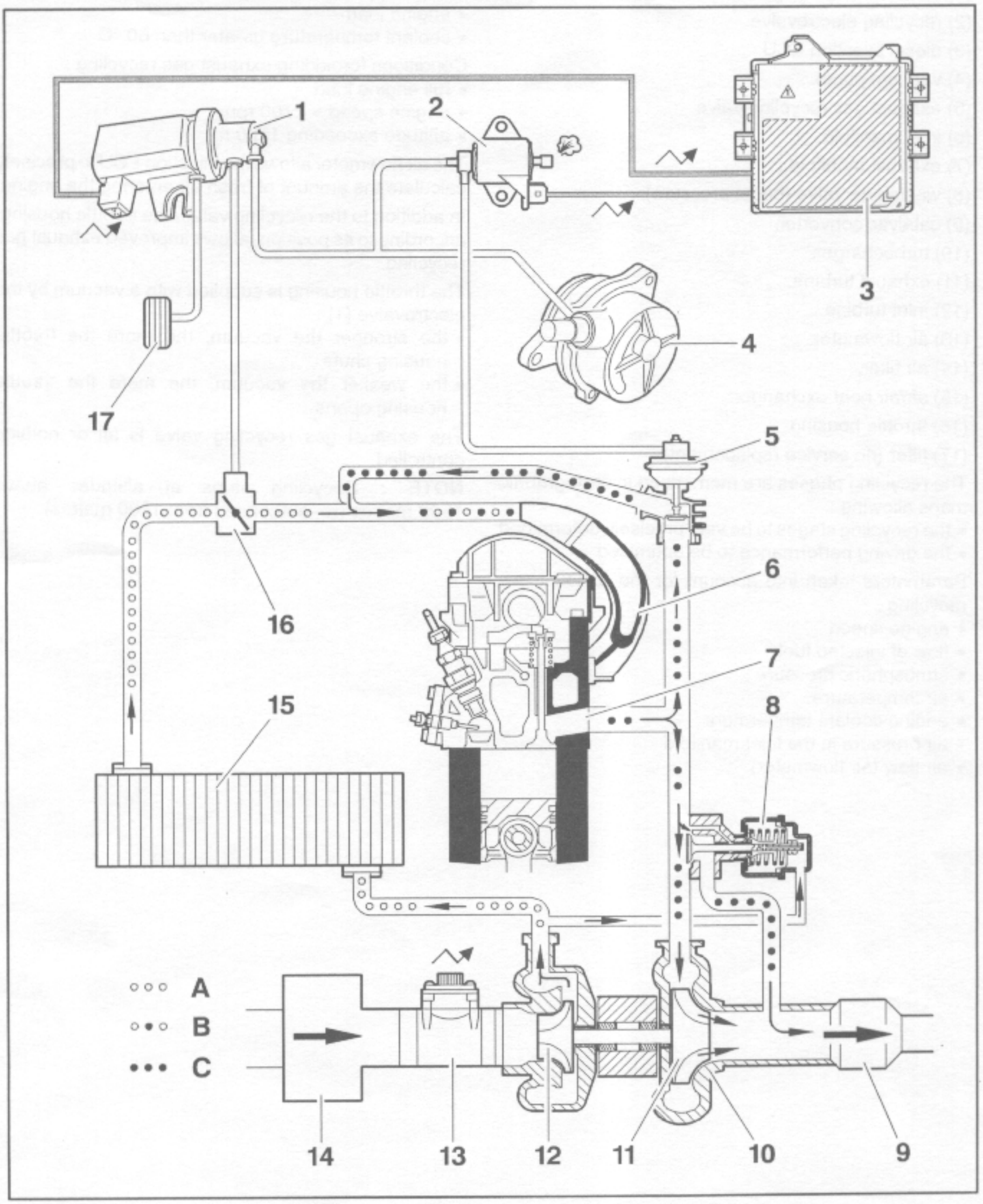

Fig : B1HP0Z8P

Air circulation (in the direction of arrows).

A – air.

B – exhaust gas + air.

C – exhaust gas.

(1) proportional electrovalve (progressive control of the throttle housing).
(2) recycling electrovalve.
(3) diesel injection ECU.
(4) vacuum pump.
(5) exhaust gas recycling valve.
(6) inlet manifold.
(7) exhaust manifold.
(8) wastegate valve (boost pressure).
(9) catalytic converter.
(10) turbocharger.
(11) exhaust turbine.
(12) inlet turbine.
(13) air flowmeter.
(14) air filter.
(15) air/air heat exchanger.
(16) throttle housing.
(17) filter (no service replacement).

The recycling phases are memorised in cartographic maps allowing :
- the recycling stages to be very precisely determined
- the driving performance to be optimised

Parameters taken into account for the exhaust gas recycling :
- engine speed
- flow of injected fuel
- atmospheric pressure
- air temperature
- engine coolant temperature
- air pressure in the inlet manifold
- air flow (air flowmeter)

Conditions for recycling of exhaust gas :
- engine speed < 2700 rpm
- engine load
- coolant temperature greater than 60 °C

Conditions forbidding exhaust gas recycling :
- full engine load
- engine speed > 2700 rpm
- altitude exceeding 1500 m

The air flowmeter allows the injection ECU to precisely calculate the amount of fresh air entering the engine.

In addition to the recycling valve, the throttle housing, according to its position, allows improved exhaust gas recycling.

The throttle housing is supplied with a vacuum by the electrovalve (1) :
- the stronger the vacuum, the more the throttle housing shuts
- the weaker the vacuum, the more the throttle housing opens

The exhaust gas recycling valve is all or nothing controlled.

NOTE : Recycling stops at altitudes above 1500 metres (re–authorised from 1200 metres)

3 – DK5ATE ENGINE

Evolutions :
- fuel supply system
- diesel fuel filter

3.1 – Fuel supply system

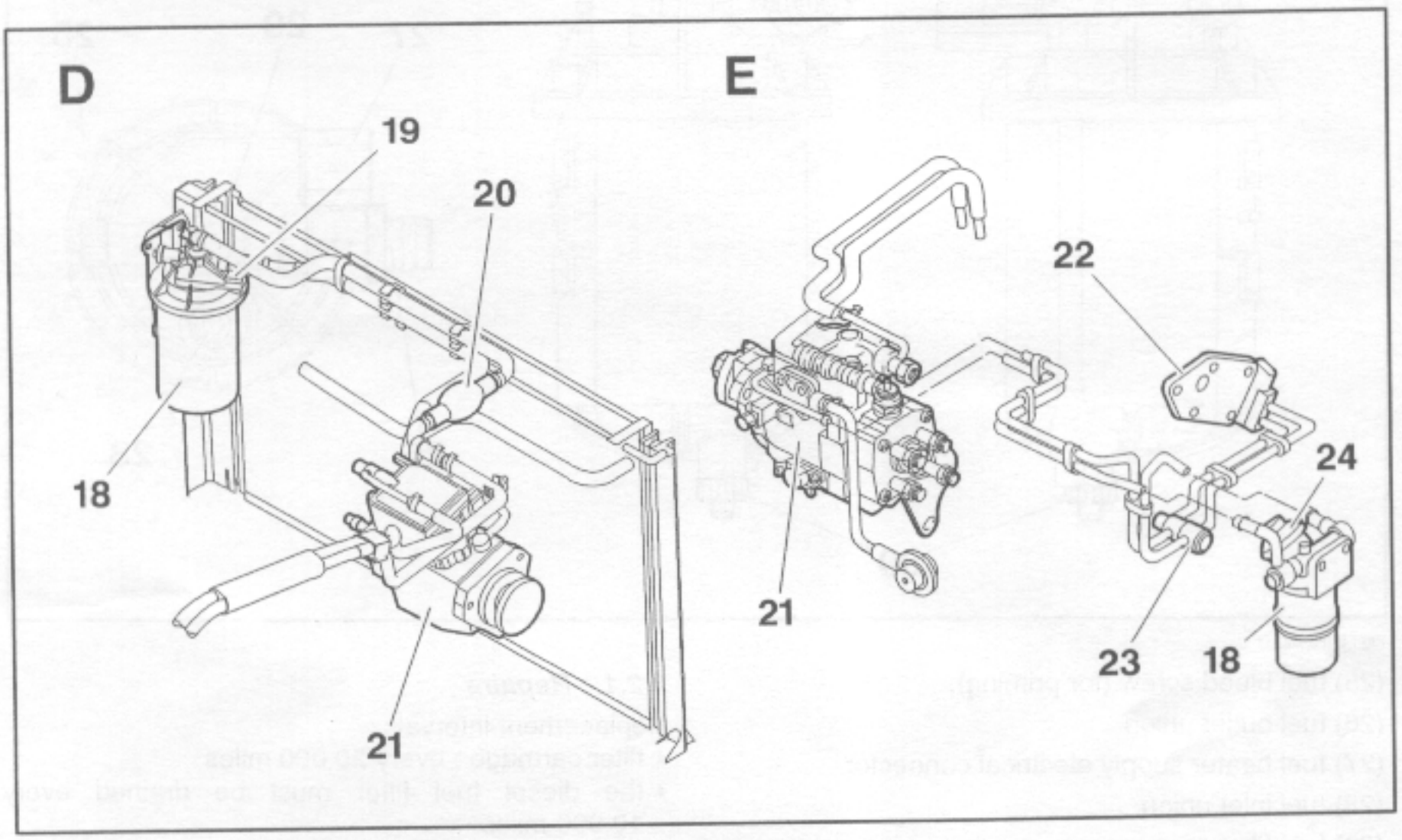

Fig : B1HP0Z9O

D – new arrangement.
E – former arrangement.
(18) diesel fuel filter.
(19) diesel fuel heater (electrical).
(20) bulb type fuel primer.
(21) diesel fuel injection pump.
(22) diesel fuel heater (thermal).
(23) thermostatic regulator.
(24) priming pump.

3.1.1 – Former arrangement

Special features :
- priming pump integrated in the fuel filter
- fuel heater on cylinder head
- fuel filter equipped with a water–in–fuel sensor
- thermostatic valve allowing the fuel temperature to be regulated
- fuel filter with aluminium well

3.1.2 – New arrangement

Special features :
- specific fuel pipes
- priming pump separate from the fuel filter
- new fuel filter with plastic well

3.2 – Diesel fuel filter

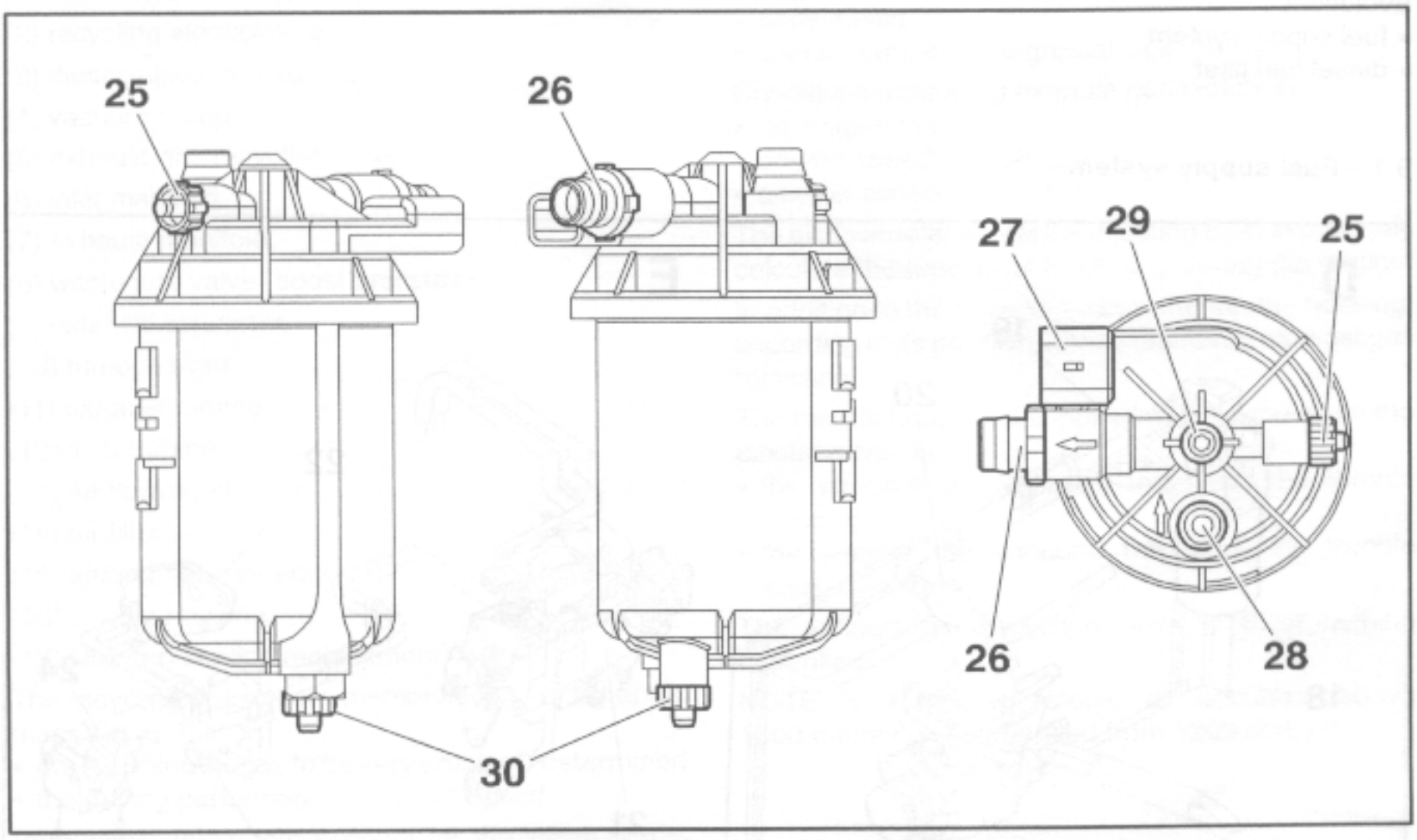

Fig : B1HP0ZAD

(25) fuel bleed screw (for priming).

(26) fuel outlet union.

(27) fuel heater supply electrical connector.

(28) fuel inlet union.

(29) fuel filter cover screw.

(30) coolant bleed screw.

Tighten the bolt (29) to 0,5 m.daN.

Special characteristics of the new fuel filter :
- specific fuel filter cartridge
- incorporation of an electric fuel heater in the fuel filter

NOTE : The fuel filter is not fitted with a water level detector.

Characteristics of the fuel filter cartridge :
- type (: C460)
- diameter : 70 mm
- height : 85 mm

The fuel pipes are connected to the fuel filter by click–fit connectors.

The heater integrated in the fuel filter is electrically supplied after the ignition is switched on.

Fuel heater operating conditions :
- fuel heater is activated :
  when the temperature is < 7°C
- fuel heater stops :
  when the temperature is > 20°C

3.2.1 – Repairs

Replacement intervals :
- filter cartridge : every 20,000 miles
- the diesel fuel filter must be drained every 10,000 miles

3.2.2 – Replacement parts

Both old and new parts are available from the Replacement Parts Division.

4 – WHEEL BOLTS AND RIMS

NOTE : This evolution concerns vehicles equipped with light alloy wheel rims.

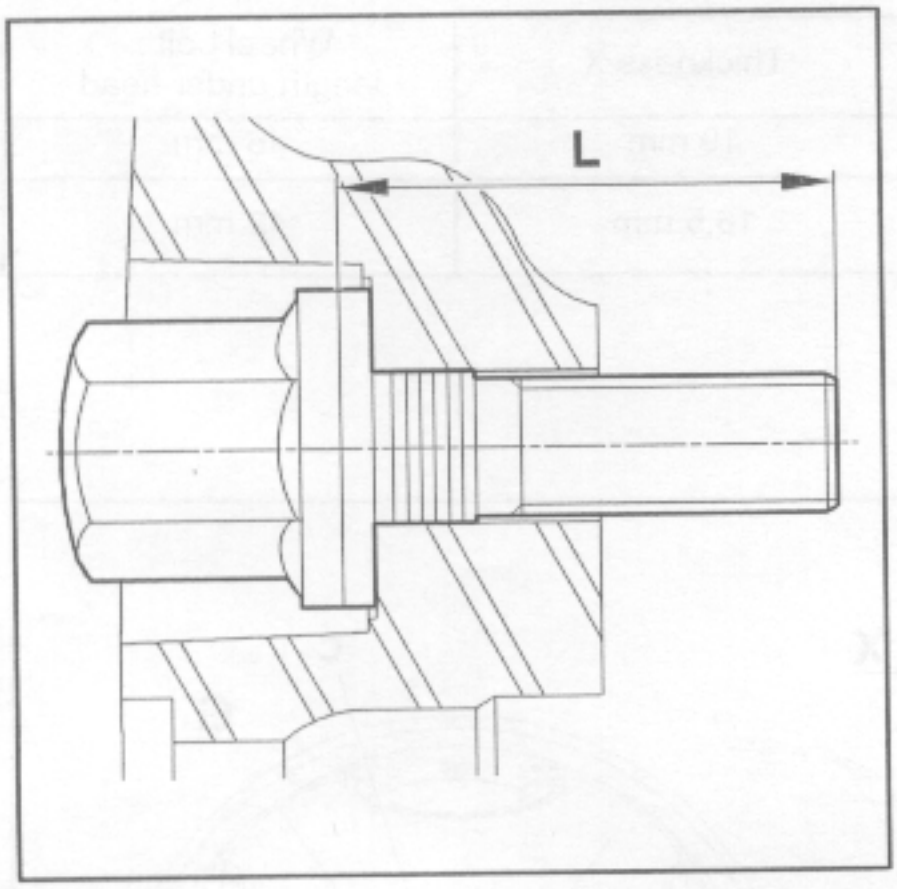

Fig : B2GP00BC

Evolution of the length under the head of the light alloy wheel bolts : L = 42 mm (instead of 46 mm).

NOTE : The spare wheel has not evolved and can use the 2 types of bolt.

4.1 – Identifying the fittings

4.1.1 – "MONTE–CARLO" wheel rim

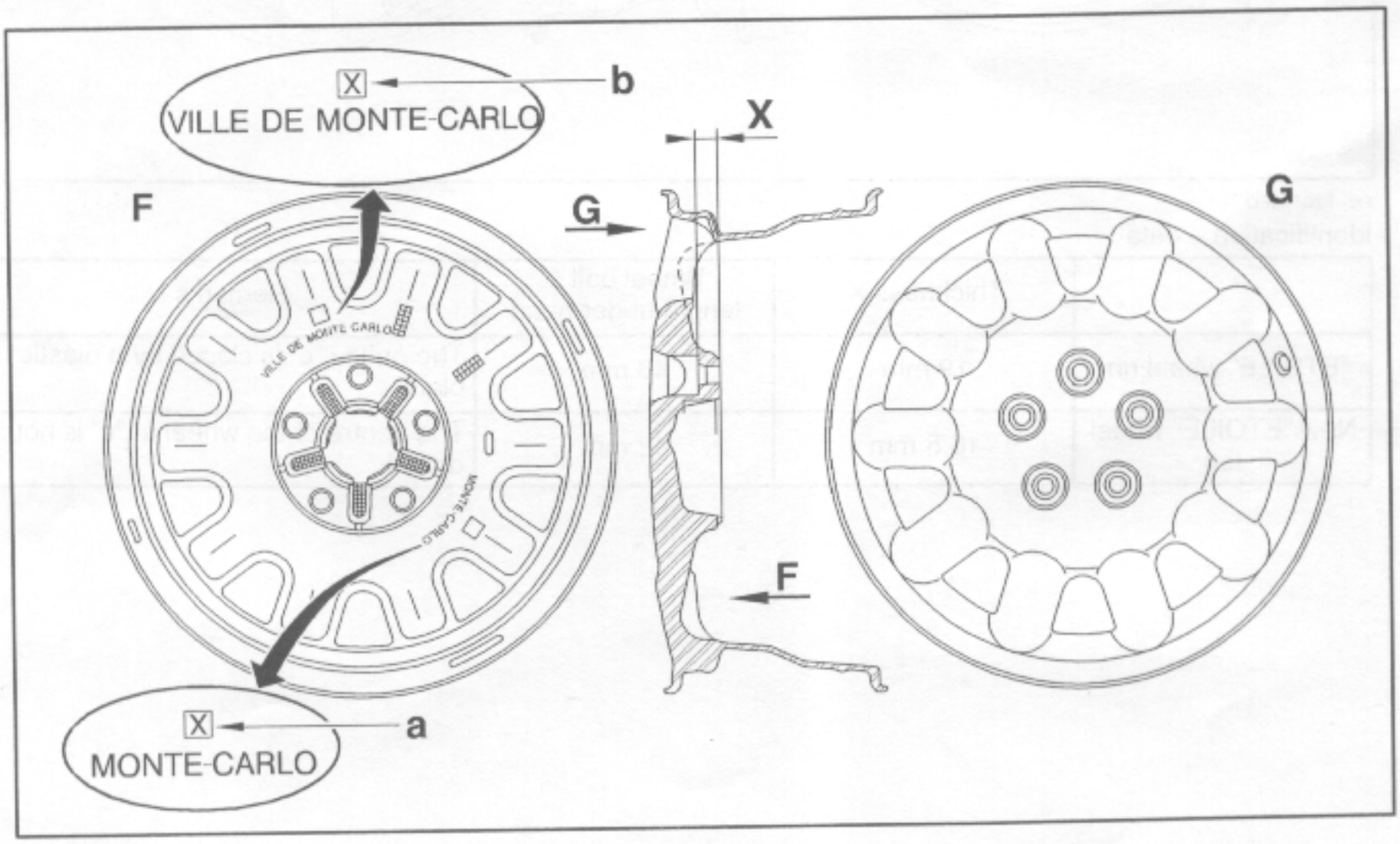

Fig : B2GP00DD

The "VILLE DE MONTE–CARLO" wheel rims replace the "MONTE–CARLO" wheel rims (identical style, but adapted for the new bolts).
The new wheels carry the markings "MONTE–CARLO" and "VILLE DE MONTE–CARLO" on their inner surface.
Identification – data :

Wheel rims	Identification	Thickness X	Wheel bolt : length under head
MONTE–CARLO	Marking at "a"	19 mm	46 mm
VILLE DE MONTE–CARLO	Marking at "b"	16,5 mm	42 mm

4.1.2 – "ETOILE" wheel rim

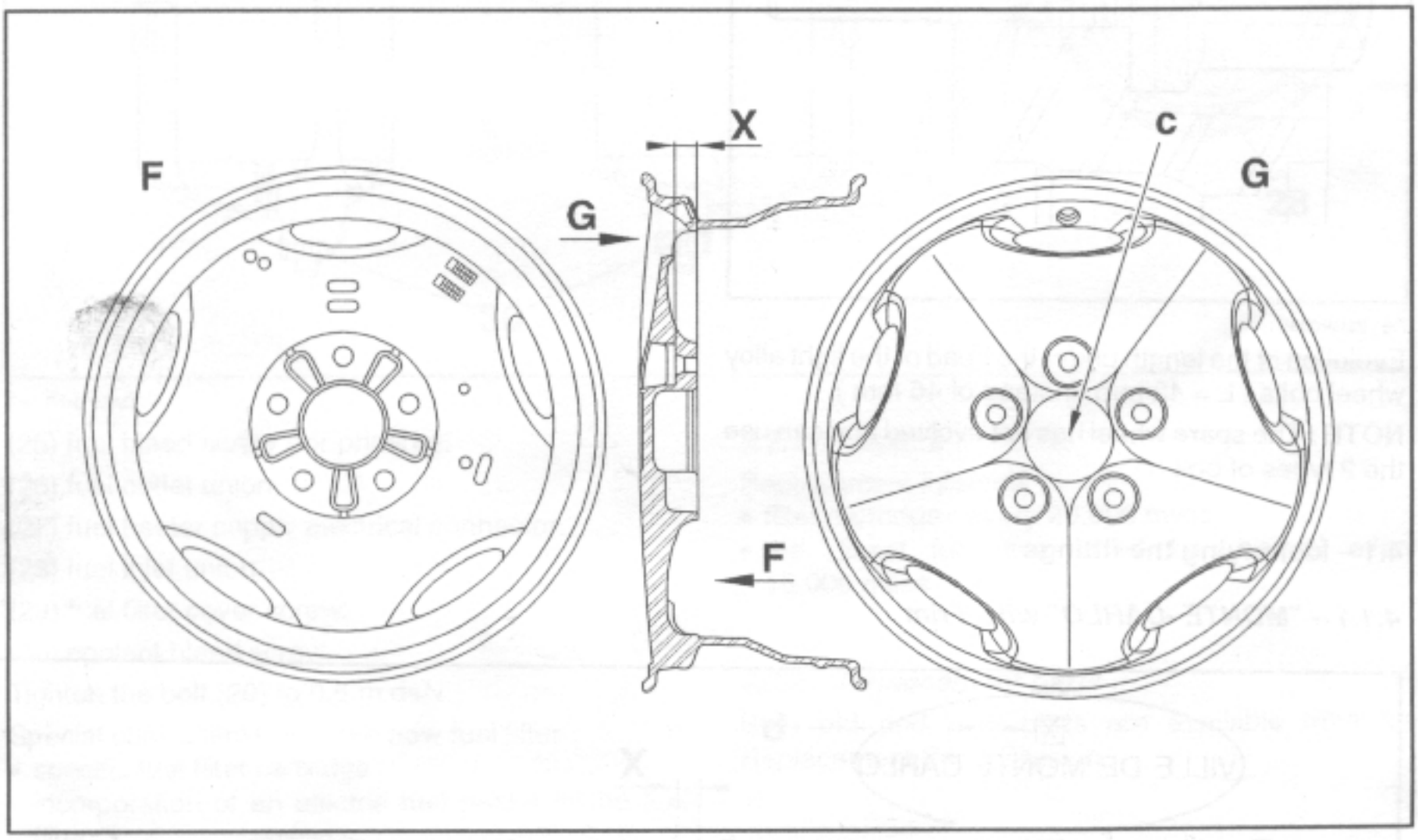

Fig : B2GP00ED

Identification – data :

	Thickness X	Wheel bolt : length under head	Remarks
"ETOILE" wheel rim	19 mm	46 mm	The orifice "c" is closed by a plastic blank
New "ETOILE" wheel rim	16,5 mm	42 mm	The centre of the wheel at "c" is not drilled

4.2 – Replacement parts

Both old and new parts are available from the Replacement Parts Division.

IMPERATIVE : Respect the pairing of the wheel rim type/length of bolt.

WARNING : The locking wheel nuts should be adapted to the length of the bolts.

Locking wheel nuts :
- earlier kit : reference (ZC 9 863 038 U)
- new kit : reference (9405 06)

5 – HYDRACTIVE SUSPENSION

5.1 – Brake pressure switch

Removal of the brake pressure switch, located in the braking circuit, allowing the hydractive ECU to control the firm state of the suspension during braking.

5.2 – Hydractive II ECU

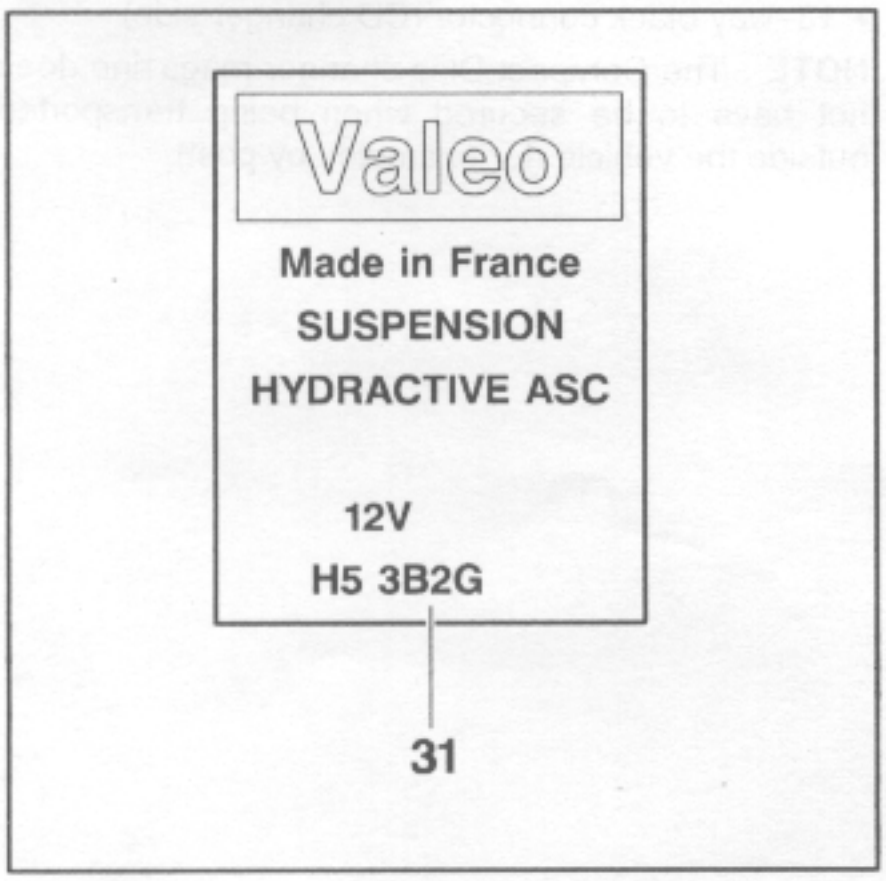

Fig : B3BP13CC

(31) application rating.

New hydractive II ECU with application rating H5 3B2G.

The hydractive ECU controls the suspension's firm state by monitoring the vehicle's speed (vehicle speed sensor).

The hydractive electronic control unit has parameter tables which can be configured for each vehicle version (application rating H5 3B2G).

5.3 – Interchangeability

The hydractive ECU H5 3B2G can replace hydractive ECUs with the following application ratings :
- H5 S2J5G
- H4 S2J2G
- H4 S2I2G
- H4 S2H2G
- H4 S2G2G

IMPERATIVE : The hydractive ECUs bearing the application rating H5 3B2G should be configured when the ECUs are fitted to the vehicle.

5.4 – Replacement parts

Only the new parts will be available from the Replacement Parts Division once stocks have been exhausted (application rating H5 3B2G).

NOTE : Fitting a new hydractive ECU to an old vehicle will render the brake pressure switch inactive (no longer used by the hydractive ECU).

MODIFICATIONS TO THE ELECTRICAL SYSTEM : 1999 MODEL YEAR RANGE

1 – GENERAL

The electrical equipment changes after the following modifications :

- fitting of a new engine oil pressure switch (all engines except ES9J4)
- brake pressure switch removed (hydractive suspension)

2 – ELECTRICAL HARNESSES

2.1 – Engine electrical harness

New LUCAS DIESEL EPIC electronic injection system (XUD11BTE/L4 engine).

Fitting of a new engine oil pressure switch (all engines except ES9J4).

Removal of the throttle housing electric heater (ES9J4 engine).

Incorporation of an electric fuel heater in the fuel filter (2.5 l Turbo engine).

2.2 – Suspension electrical harness

Removal of the brake pressure switch, located in the braking circuit, allowing the hydractive ECU to control the firm state of the suspension during braking.

NOTE : The hydractive ECU controls the suspension's firm state by monitoring the vehicle's speed (vehicle speed sensor).

3 – AUDIO SYSTEM

Replacement of the 4040 RDS audio system Compact Disc changer.

Reminder : system make (audio system + Compact Disc changer) : Philips.

When replacing the CD changer, the following modifications must be made :

- adaptation of the CD changer mounting under the driver's seat
- adaptation of the harness connecting the audio system and the CD changer

NOTE : The new CD changer can be connected on old vehicles equipped with a first fitting audio system : 3040 RDS and 4040 RDS.

IMPERATIVE : Do not insert a mini Compact Disc into the CD changer magazine (80 mm diameter).

The CD changer is controlled from the audio system via a screened cable.

Screened cable connections :

- 7–way black connector (radio side)
- 13–way black connector (CD changer side)

NOTE : The Compact Disc changer magazine does not have to be secured when being transported outside the vehicle (for example : by post).

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Heated Mirror Element Repair
Citroen XM Series 2, 2.0 Turbo Manual RHD RP6785

BACKGROUND

I suspect that most XM's no longer have heated rear view mirrors unless the glass has been replaced. At £32 each that's only going to happen if they break.

REMOVING THE GLASS

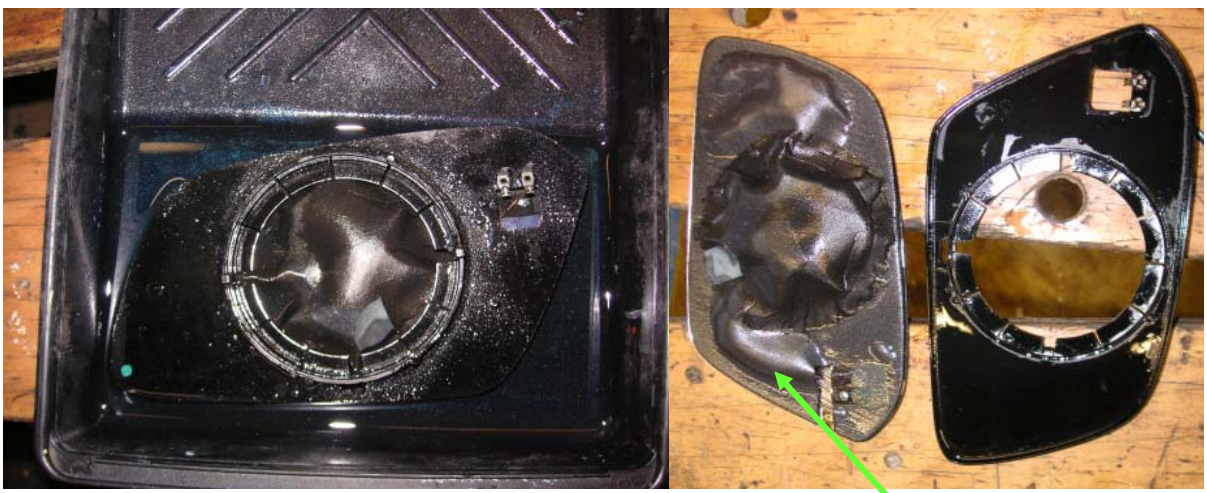
Tip the mirror glass upward, then between the bottom of the glass and the mirror housing you'll see a wire clip. Poke it sideways until it disconnects and disappears out of sight then gently push on the glass to free it. Basically the wire clip acts like a snap ring, freeing the one end lets it go loose. When you've got the glass out it will be easy to see how it works…..

CHECKING THE CIRCUIT

I guess you'd better check the wiring before you get too deep into the repair. On the back of the plastic mirror support are two connectors. These will show 12V when the rear window heater is switched on.
With the connectors disconnected check the resistance between the two spades on the back of the support. They should be about 10 ohms (you can't measure this accurately) but in any case they will be open circuit.

REMOVING THE PLASTIC SUPPORT BACKING

Put the whole mirror in a paint roller tray and cover it with petrol. Come back to it in the morning, the glue will have completely dissolved and the plastic support will just peel off. Underneath the soft rubber will also lift off, it will be swollen but don't damage it as it shrinks back to size as it dries out….



PETROL SWOLLEN RUBBER
IS STILL USEFUL

PEEL OFF THE RUBBER TO REVEAL THE BROKEN WIRE ELEMENT AND THE EMULSIFIED GLUE

CHECKING THE ELEMENT

My first element had eleven breaks in it but the second only five. I suspect they were likely to fail in many other places as well though. Each loop had been seriously degraded by the weather and the whole thing wasn't worth repairing. Adding up all the bits of wire totalled 4.2 metres and it was 0.1mm thick.

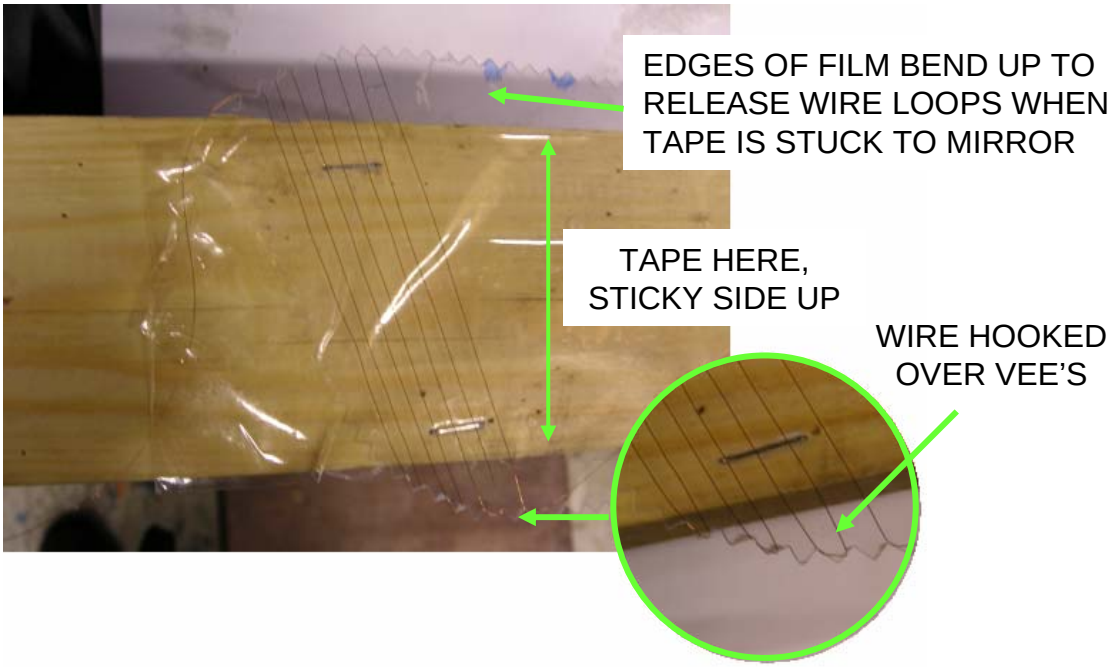
NEW ELEMENT

Maplin will sell you wire of 0.125mm gauge for £6.49 (stock code YN92A) but at 2200 metres long one coil would do 335 mirrors, go on check it!
(OK the cross sectional area is 156% more so you would need 6.3 metres to get the same resistance).
Obviously, being a tight git I looked in yellow pages for transformer rewinders and knocked on the door of the nearest. (Nearer and quicker than Maplin in any case). A few turns wrapped round a bit of cardboard for no charge suited me fine.

ELEMENT MANUFACTURE

This is the bit that took a lot of thinking about. How to loop the wire back and fore over the mirror without getting too close to the edge and in a tidier way then the original? After several trials and a fair bit of wasted wire this is what I did….

Draw round the glass onto a piece of overhead projector film (just the right stiffness). Cut inside the line with the wife's pinking shears to make the winding template.



Staple the OHP film onto a bit of wood so the edges overhang, (the top will be the back of the glass). Put a couple of strips of wide clear sticky tape over the top, sticky side up. (Either fold the ends under or staple them down). Then starting at the right place wind the wire back and fore over the clear sticky tape and hook each end over the vee created by the scissors. When you get to the end, trail the wire back over the top so it finishes in the right place to go through the slot it the rubber, just like the original. The clear sticky tape will keep the wire aligned and the vee's will set the spacing.

REASSEMBLY

Place the mirror glass down onto the clear sticky tape and push the overhanging edges of the OHP film up to ensure the tape is stuck, (The mirror back isn't flat). When you're confident cut the ends of the tape free from the wood and gently lift the mirror up. The OHP film will bend up and release all the loops. Turn over the mirror, straighten up the ends of the loops and add more sticky tape to completely cover the mirror back. Trim the edges of the tape and make a slight cut to allow the wire ends to exit in the right place.

Spray the back of the tape with carpet adhesive and replace the now dry piece of soft rubber back on the glass. *(Maybe this should be done tomorrow)?* Spray the rubber with adhesive and stick the plastic support back on as well. Ensure the ends of the wires come neatly through the slot in the rubber and pass through the hole in the plastic support.

When it's all reassembled carefully scrape the new element wires to remove the lacquer and solder them back onto the spade connectors.
Finally squeeze silicone mastic all around the edge between the black plastic support and the glass to keep the weather out. Don't forget to cover the wires and hole for the connectors as well.

REFITTING

Fit the wire clip back onto the plastic support and hook the loop over the post to form the snap ring. Reconnect the spade connectors the push the glass assembly back into the mirror housing.

TESTING

With the engine running switch on the rear window heater, after a minute or so touch the mirror glass. It will be very hot…… JOB DONE

NOTE

If the pinking shears you manage to get hold of are like mine, then the wire spacing will be wider than the original. This reduces the length of wire in the element. My wire was also 0.125mm diameter instead of 0.1mm. Both these combined probably double the heat going into the mirror to 25 watts. (I didn't check).
So far the glass hasn't gone bang and the sticky tape hasn't dripped out of the bottom but you wouldn't want to keep you hand on the glass for too long.

WARNING

This document, like most on the internet is unchecked. It could be complete rubbish and may be dangerous or illegal. Acting on it without any understanding of what you are doing would be foolish. Do it at you own risk……

Dismantling the Heater Unit / Fan Assembly on a Citroen XM

The heater unit is a large complex assembly of plastic mouldings. In order to remove it from the scrap car I had to remove absolutely everything before it would come out. It must be the first component fitted to the car after the carpets. After that the entire dash is built around it. There's no way of getting this unit out of the car without dismantling the whole dash including the steel frame which supports the dash.

You can see the whole unit viewed from the nearside (RH Drive) here:

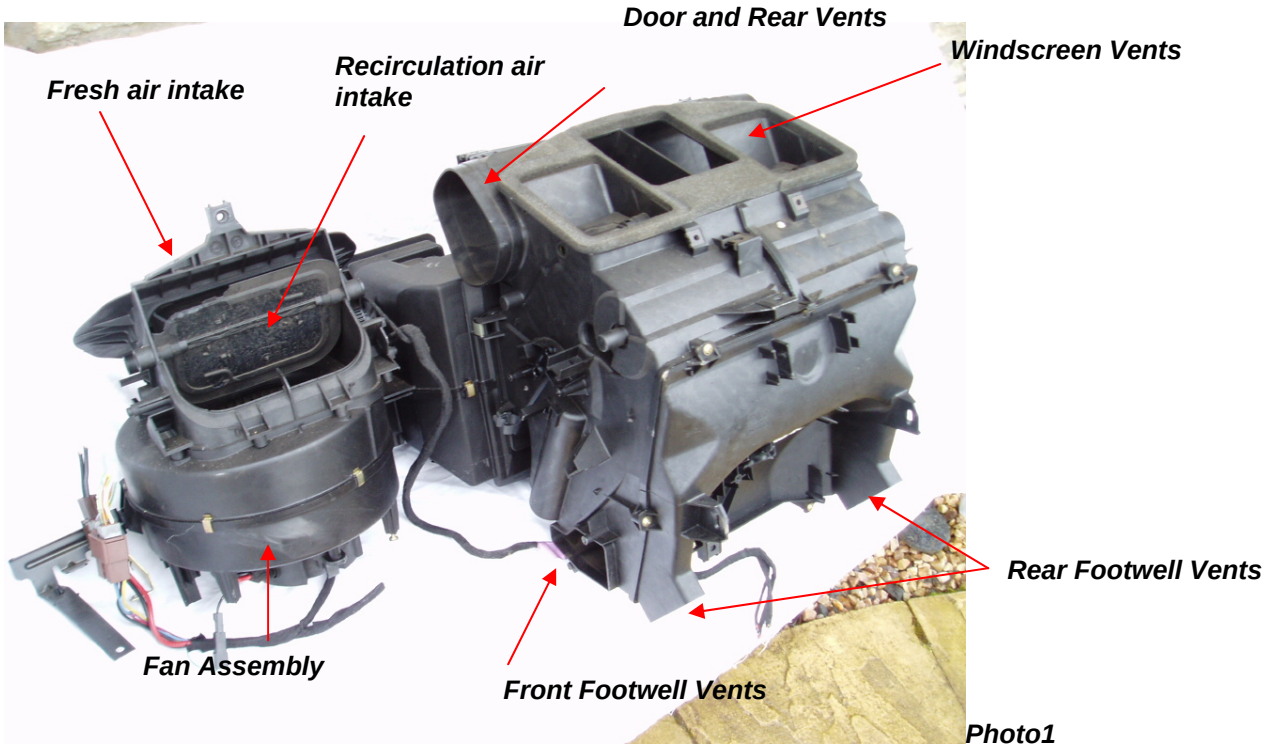


Photo1

……. and viewed from the offside here:

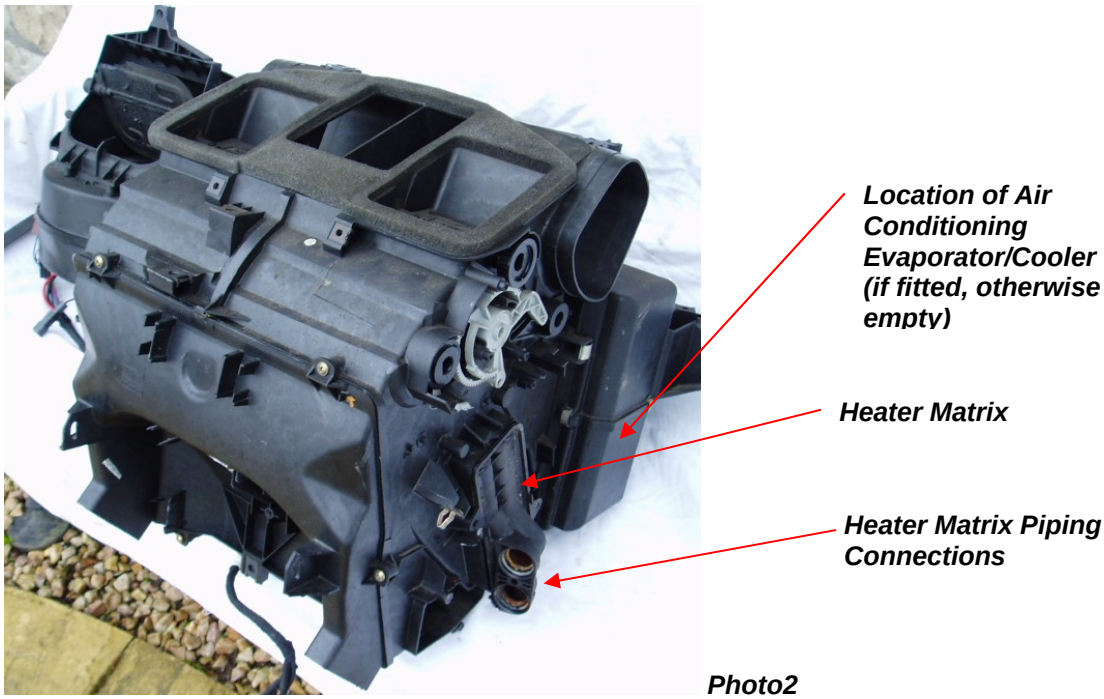


Photo2

 ©2005 Norrie

Control Knob Assembly on dash

The heater controls are all centred around the panel shown in the photo below. The purpose of the three large knobs from left to right are:

Fan Speed
Air Direction
Temperature Setpoint
The slider knob at the bottom determines the air mix from Full Fresh to Full Recirculation.

For the air direction control you can see the connecting cable which joins the knob to the flap control shaft. The Temperature Setpoint Knob feeds information on the desired temperature to the controller located inside the controls assembly. The temperature sensor which is located within the central interior light is also connected to this unit. After comparing the setpoint with the sensed temperature the controller sends the correcting information to the servo motor shown in Photo 13.
The slider which controls the fresh air is connected to the flap in Photo 1 by the grey cable shown just at the top of Photo3

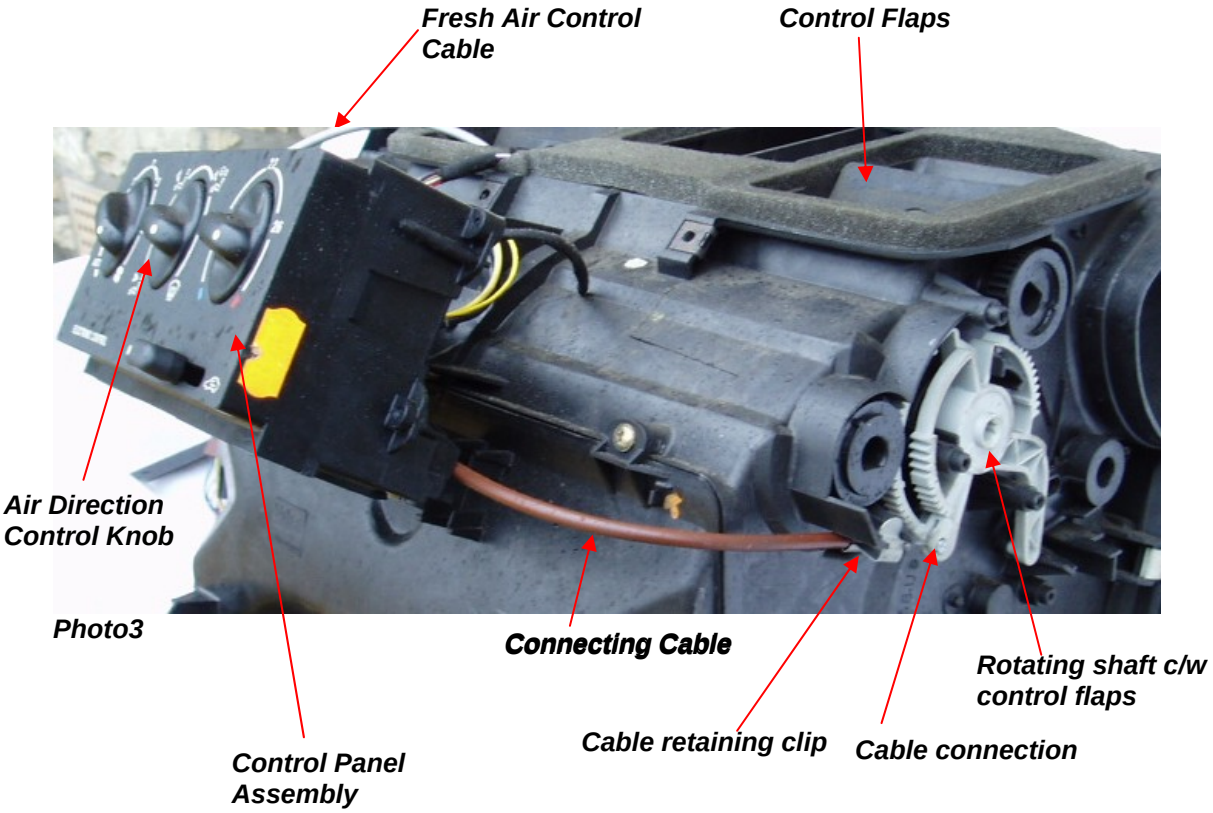


Photo3

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Removing the Fan Assembly

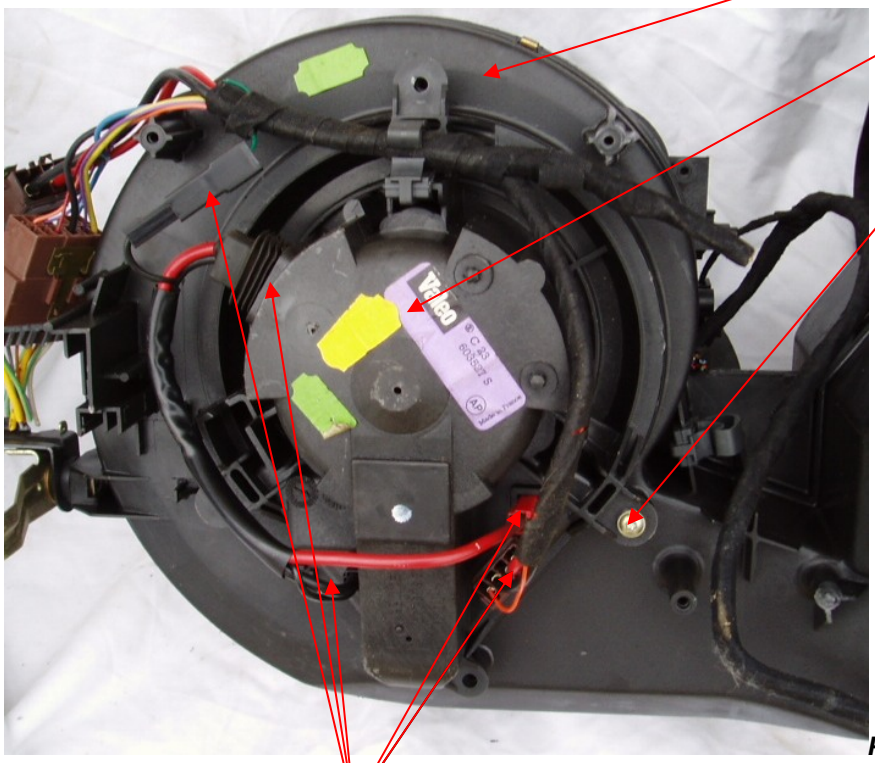

Photo4

The Main Heater Unit is shown removed from the car for clarity. To remove the fan in situ fist remove the carpeted panel above the passenger footwell which hides the fan.
Next, disconnect the cabling to the fan at the two large brown multiplugs.
Next, unscrew the 3 fixing screws which hold the fan in place.
The fan assembly should now fall into your hands.
Disconnect all the wiring except the fan at the 4 connector plugs shown in Photo 4

Disconnecting the fan

Photo5

 ©2005 Norrie

Slide a flat blade screwdriver in beside the electrical connector as shown in Photo5. Inside there is a clip which is holding the connector in place. Prise it upwards slightly and pull on the connector. It should come out fairly easily.

Fan Assembly:

Fan Assembly with all wiring removed

Photo6

Fan Removal

The Fan is mounted on 3 rubber mountings and is located in the plastic motor support assembly as shown in Photo7. To remove the fan and motor from the assembly the three rubber mountings must be prised from the plastic support unit. There are three locations around the perimeter where rubber nodules clip into place. To remove insert a flat bladed screwdriver into each hole in turn. Working around the perimeter, insert the screwdriver into the hole until it pushes on the rubber. Push on the rubber at the same time as levering the rubber towards the fan impeller. Work around the fan edging the rubber mountings out a little bit at a time. Once the nodules are clear of the holes the fan and motor assembly will fall out of the plastic support unit.

First one side…

Photo7

 ©2005 Norrie

…then the other side.

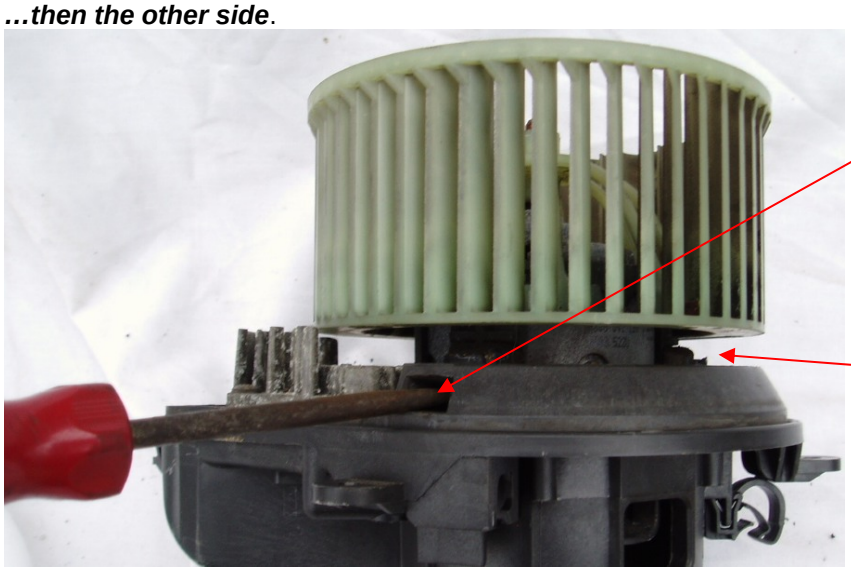

Photo8

Motor and support unit separated

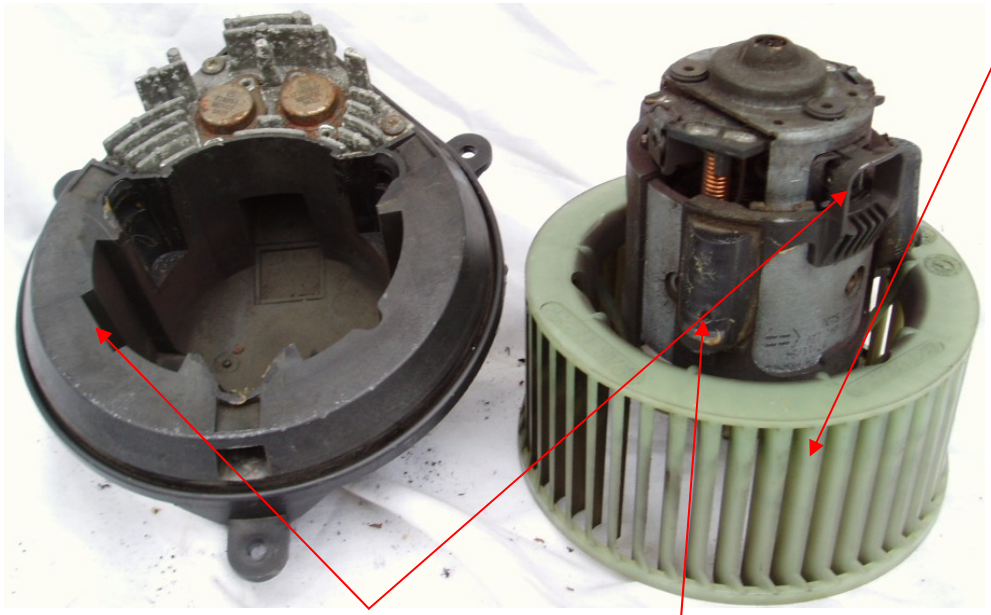

Photo9

When refitting the fan/motor assembly into the plastic support housing apply a smear of grease to the rubber nodules. It makes it much easier to assemble and disassemble again if necessary.

When refitting make sure the electrical connector for the motor aligns with the cut out in the plastic support unit.

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Fan Speed Control Module

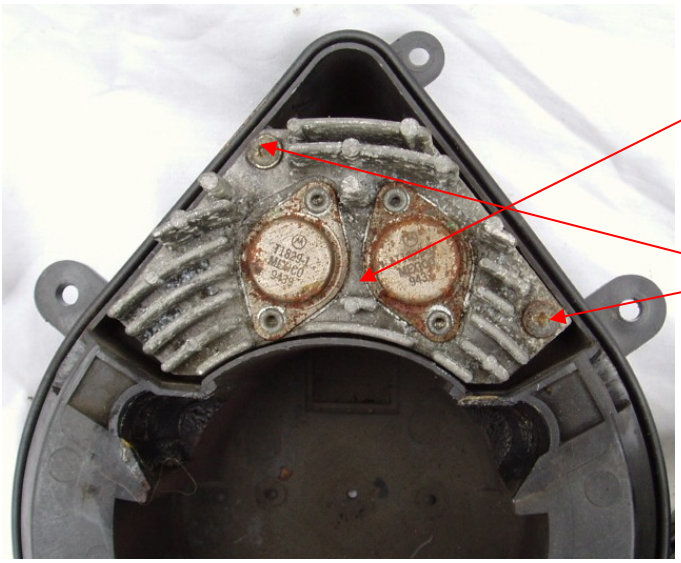


Photo10

Most of the time when Fan Failure occurs it is down to the two transistors you can see in Photo10. In my case they tested out OK. My problem was simply the connectors for the wiring. As they have got older they have relaxed and there's not as much pressure on the contacts. I cleaned up all the spade terminals and squeezed the connectors with a pair of pliers until a good bit of resistance was felt pulling them on and off.

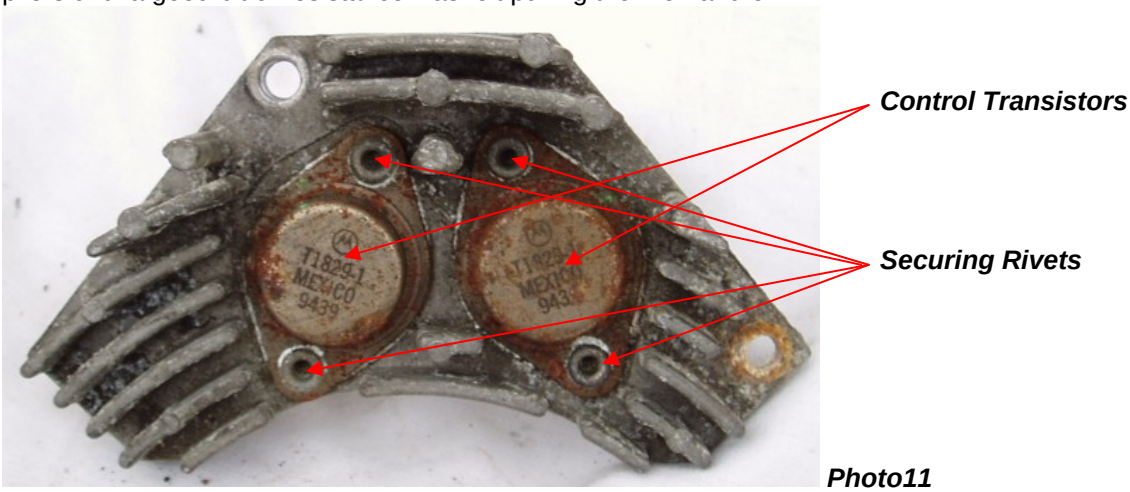


Photo11

To remove the transistors for replacement:
Firstly de-solder the transistor connections as shown in Photo12
Next, drill out the retaining rivets until the heads come off
Pull the transistors off the heatsink
Reassemble with new transistors
Re-rivet the transistors to the heatsink
Re solder the transistor connections onto the printed circuit board

The power for the fan is routed through the transistors when the requested speed on the dash is anywhere between zero and full speed. However, at full speed there's no need for the transistors and therefore the full speed bypass relay provides the full 12v straight to the windings of the motor

 ©2005 Norrie

Back side of speed control module.

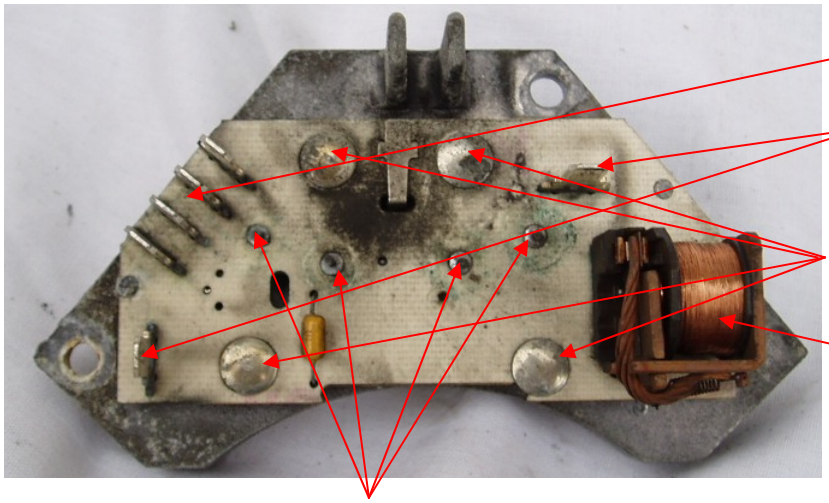


Photo12

Temperature Control Servo Motor

The servo motor rotates a shaft inside the heater unit. The shaft has an asymmetric flap fixed to it. As the flap rotates it directs more or less of the air, pumped by the fan, to pass or bypass the heater matrix accordingly. If Air Conditioning is fitted then the evaporator (cooling coil) is located in the position shown. If no aircon is fitted then the section is left empty. When cooling, the temperature is controlled by the refrigerant controls and not the heater control flap.
On some earlier models there was no automatic climate control fitted. The knob on the front fascia, instead of being a rheostat, operated a cable. The cable operated the same flap rather than the servo motor.

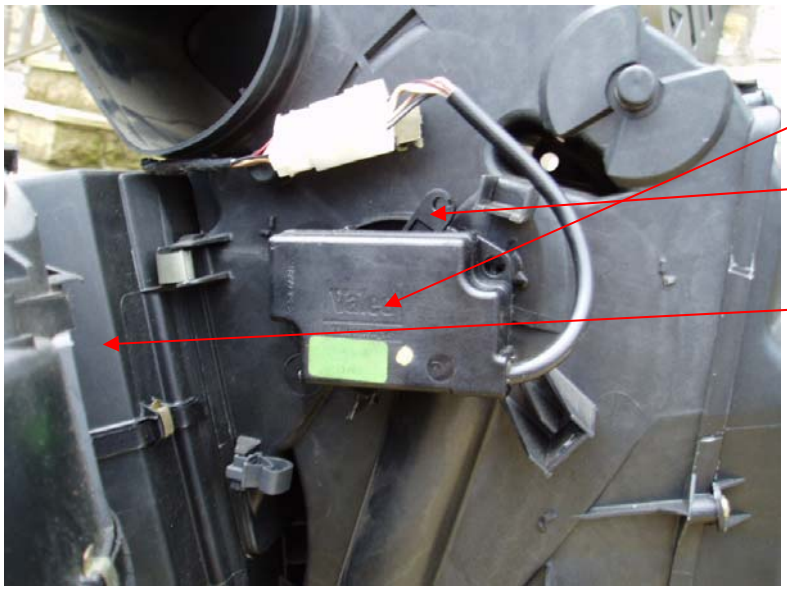


Photo13

 ©2005 Norrie

Temperature Control Servo Motor

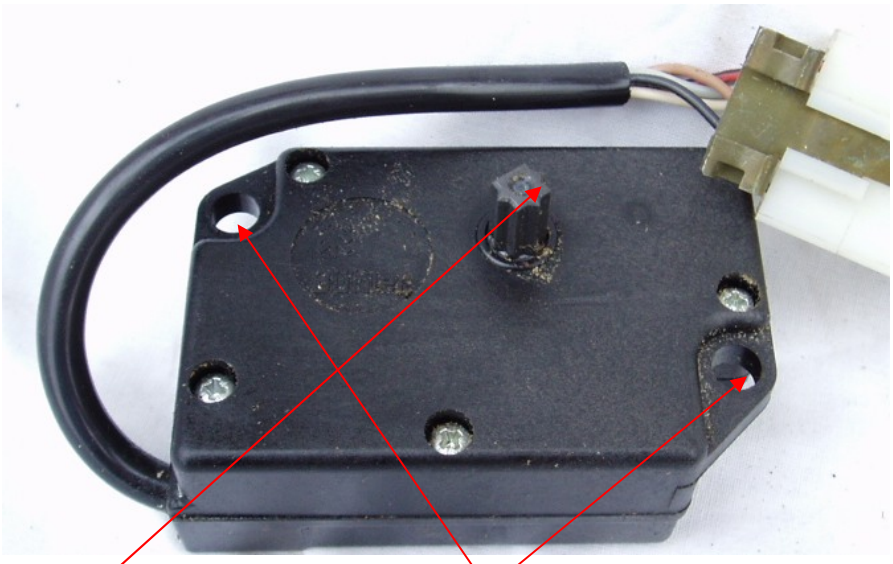


Photo14

Drive shaft

Locating holes for mounting pins

 ©2005 Norrie

Hydractive 2 suspension system

In comparison to a regular hydropneumatic suspension, Hydractive 2 adds the following elements:

1) Additional hydraulic elements (compared to hydropneumatic):
- Two additional spheres with no damping elements (similar to accumulator spheres), one for the front wheels, and one for the rear wheels.
- Two electro-hydraulically controlled suspension control blocks, which fit the spheres above, again one for the front wheels and one for the back wheels.

The control blocks connect the left and right corner sphere and the height corrector, and depending on the electric control, the center sphere. This enables the suspension to have two spring/damping settings, which can be quickly selected by an electric signal. The suspension has a soft setting with low resonance frequency, and a hard suspension setting with a higher resonance frequency. The roll characteristics of the suspension also change depending on suspension setting. In hard mode the cross-flow of fluid between left and right corner spheres is severely limited. This considerably dampens rolling motion. In the soft setting the fluid passes through the double damper element arrangement. The roll motion damping of the suspension is significantly lower than for the hard setting.

2) Electronic sub-system:
- A set of sensors that sense the dynamics of the vehicle
- A user command input enables the driver to choose the suspension mode between 'normal' and 'sport'
- An ECU (Electronic Control Unit) that uses the inputs from the sensor and the user select input to generate the control signal for the suspension control block, and a status signal for the user
- A suspension status light on the dashboard that tells the driver which setting is selected

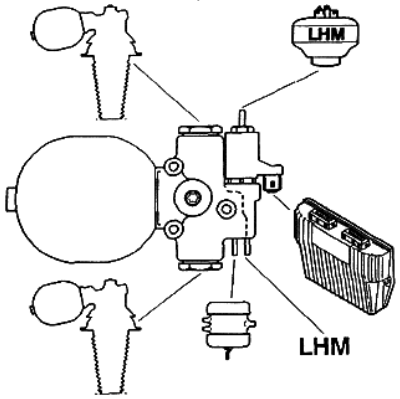
The ECU reacts to inputs from it's sensors to dynamically select the soft or hard mode of the suspension, based on two sets of rules, one each for the normal and sport suspension setting. The ECU uses a relatively simple but effective set of rules to be able to decide on the suspension setting within 25ms.

Hydraulic elements

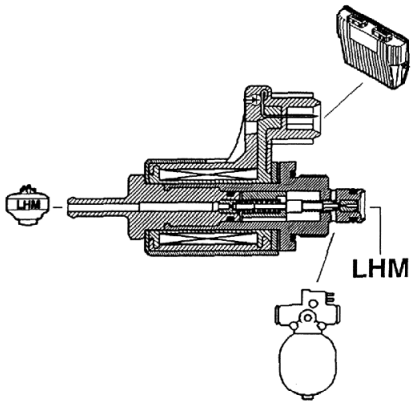
1) Suspension control block

The suspension control block consists of several distinct elements:
- A standard Citroen sphere base which fits an accumulator type sphere (without a damper block)
- A hydraulically controlled valve that connects or isolates the sphere above from the rest of the suspension circuit, in effect, a 'control piston' within the control block.
- A ball and piston valve arrangement that limits fluid cross-flow between the left and right suspension strut. The arrangement is such that the ball valve limits cross flow, but is disabled for suspension height corrections, to guarantee that the fluid pressure in the corner struts remains equalized.
- Two damping elements similar to the ones used on suspension spheres, that act as dampers for the center sphere.

The suspension control blocks for the front and rear suspension are the same.
The picture below shows the suspension control block, with the electric valve already mounted.



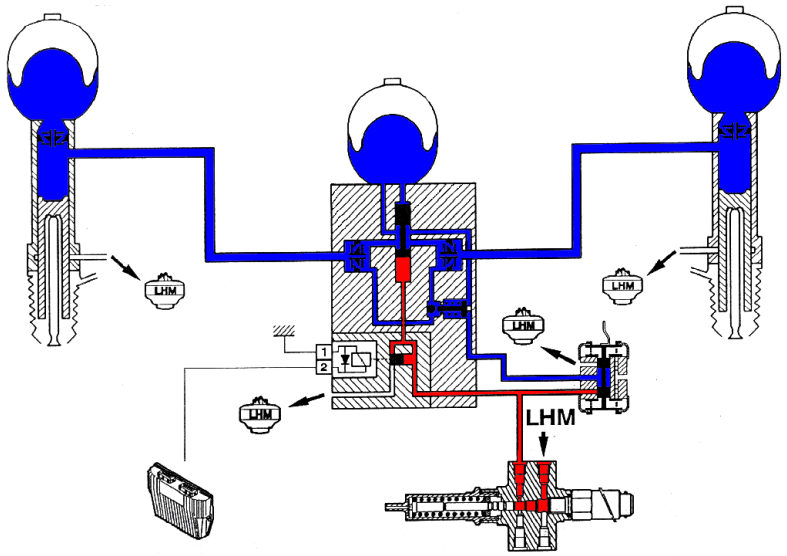
2) Electrically controlled valve
The valve is located on the suspension control block and is driven by the ECU. It's resistance is 4 ohms and the nominal voltage, for continuous duty is 2.6V. However, due to the inductance of the winding, the ECU uses pulse width modulation to achieve a constant current through the winding. This makes the valve react quicker by increasing the drive voltage when it is turned on, but also reduces heat buildup since the voltage reduces once the inductive effects have been overcome, should the valve stay on for a long enough time. The valve is designed to be on indefinitely as long as the proper current is driven through it. The cross-section of the valve is shown below:



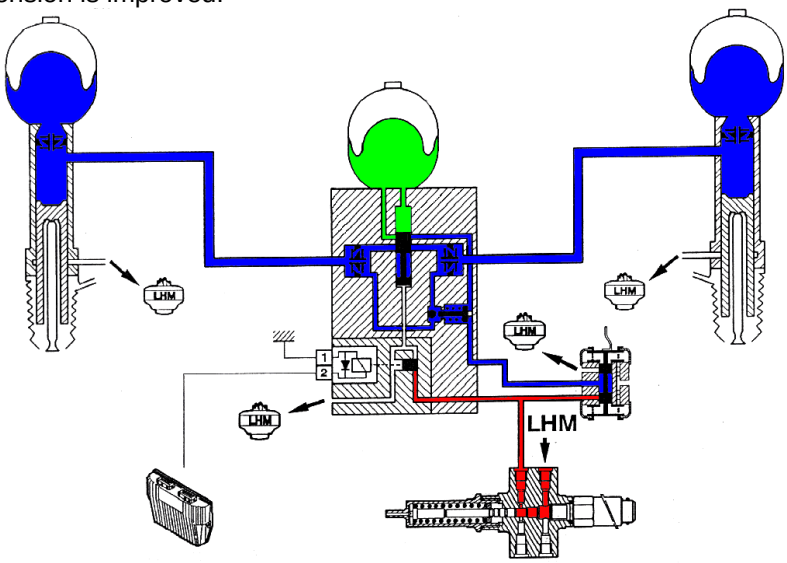
The valve itself does NOT control the flow of fluid into the center sphere. instead, it controls the fluid flow to the hydraulically controlled valve inside the suspension control block body. The valve enables passage of the main feed pressure from the main feed to the control piston located within the control block (orifice marked LHM to orifice marked with the control block outline in the picture above), or it enables the pressure activating the control piston to escape through a simple non-return valve through the valve body (to the orifice marked with the LHM tank outline in the picture above). In this way the valve actually only controls the control piston, in effect implementing an electro-hydraulic relay of sorts.
The electric portion of the valve is energized when the suspension is in it's SOFT setting. Electrically, the default position of the suspension is HARD. However, due to the indirect action of the suspension valve within the suspension regulator body, depending on the suspension pressure and the pressure in the main feed, with the electric valve disconnected, the suspension can remain in either position for extended periods of time. With the main suspension pressure feed at nominal pressure, both the electric and the hydraulic part of the valve will remain in HARD mode.

3) The center sphere
The center sphere is an accumulator type sphere that is used to provide a lowering of the spring constant of the suspension when the sphere is connected to the rest of the suspension circuit. The spheres differ depending on the vehicle version and also depending on weather they are used for the front or rear suspension.

Operation:

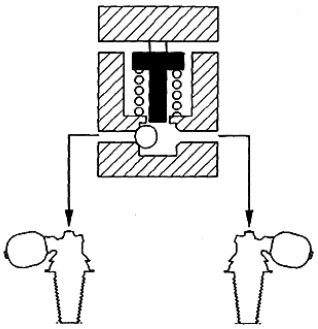


The picture above depicts the soft setting of the control block. The blue areas are LHM fluid under suspension pressure, the red area is the suspension hydraulics feed, under the system feed pressure (equal to the main accumulator pressure under normal operation).
The center element is the suspension control block. The electric valve (bottom left corner) opens the feed pressure to move the control piston in the control block, which opens the center sphere to the rest of the suspension. Note the blue area - the fluid passes through two damping blocks (one for each strut connection) into the middle sphere. When both the struts move in unison, effectively, the middle sphere behaves as a standard sphere with a damper element with a hole twice the area of a single damper element in the suspension block. However, when the fluid moves from one strut to the other, as is the case when the vehicle rolls left-right, it has to pass through both damper elements consecutively. In addition to that, the middle sphere presents a 'spring' that dampens cross flow by absorbing quick changes in pressure between the dampers, additionally slowing the flow of fluid between the corner spheres. In this manner the roll behavior of the suspension is improved.

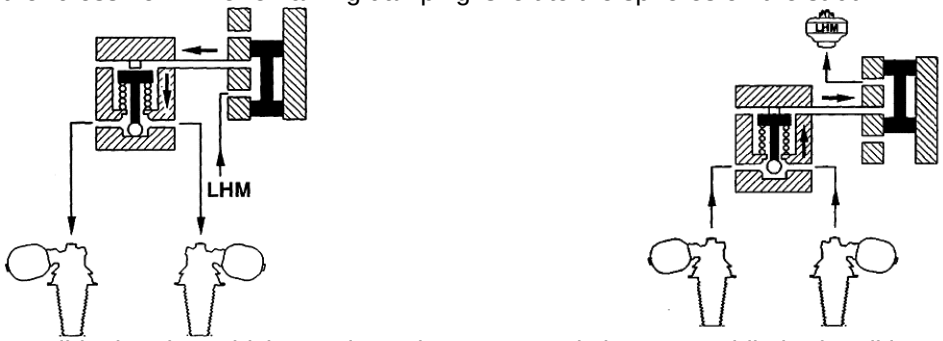


The above picture shows the suspension control block in the hard setting. The electric valve does not let the main feed pressure pass and move the control piston. The pressure inside the middle sphere, which is always higher than that of the return path under normal operating conditions, will move the control piston into a position which closes off the middle sphere completely. The remaining pressure in the middle sphere remains unknown (green area in the picture). The control rules for the electric valve are designed with this in mind, so that the pressure is periodically equalized by enabling the control block to assume the soft setting

for a short period of time. This is done because it is possible that the suspension pressure (blue area) is different at the time the control block goes into hard mode and at the time it returns to soft mode, due to either the dynamics of the suspension (acceleration, braking, movement due to uneven surface), or the vehicle height being set differently.
Cross-flow of fluid from one strut to the other still has to pass through both damper blocks, but it is additionally limited using a simple piston and ball valve, which is now positioned between the damper elements instead of the middle sphere. The ball is positioned in the fluid so that any cross flow moves the ball and thus limits the cross flow. This dampens the cross-flow considerably (see picture below), and thus also body roll.



In the picture above, a situation is shown where the vehicle is making a left turn, and tends to roll to the right. This compresses the right strut and expands the left strut, causing a cross flow of fluid, from the compressed strut to the expanded one. This moves the ball in the valve towards outlet to the left strut, closing off further cross-flow. The remaining damping is left to the spheres on the strut.



Because it is possible that the vehicle needs to change ground clearance while body roll is present, such as when the vehicle is braking in a curve, the ball valve has an additional piston arrangement in the fluid path from the height corrector. In the pictures above, two situations are shown where height correction is needed. In the left picture, the suspension needs to be raised. This would mean that the pressure on the height regulator side becomes higher than that of the suspension. This situation presses down the piston, which dislodges the ball in the anti-roll valve, to enable the pressure to raise equally in both the left and right strut. If the ball was not dislodged, the pressure would increase only in one strut, thus locking the ball position, and resulting in incorrect suspension operation.
The right picture shows the opposite situation, where the suspension needs to be lowered. In this case, fluid needs to go out of both struts, which dislodges the ball. Because the pressure on the regulator side is now lower than that of the suspension, and both sides of the piston part of the valve effectively present the same surface area, the pressure of the suspension will open the piston towards the return line, and the fluid will escape from the struts lowering the vehicle.

The electronic subsystem

The suspension ECU takes signals from the various sensors and based on two sets of rules (one each for normal and sport suspension), activates the electric valves. Although there are two electric valves that select the suspension setting (one for the front and one for the rear wheels), the ECU operates them as if they were one valve, so in effect, the ECU only has a single output signal.

The ECU uses 7 sensors, which generate a total of 10 'input parameters':

1) Vehicle speed
2) Steering wheel position (2a) and speed (2b)
3) Body movement magnitude (3a) and speed (3b)
4) Gas pedal press (4a) and release (4b) speed
5) Brake pressure sensor
6) Door/boot open sensor
7) Ignition switch on/off

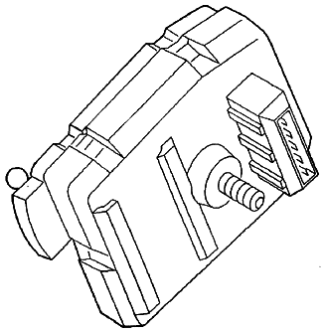
The sensors work as follows:

1) Speed sensor
The sensor is Hall effect based and produces 8 impulses per rotation, or approximately 5 impulses per meter traveled (this depends somewhat on tire size). It is located on the gearbox where the speedometer cable attaches, or in some versions, on the cable itself.

2) Steering wheel angle/speed sensor
The sensor is optoelectronic. It produces a quadrature signal from two optoelectronic sensors, by interrupting the passage of an infra-red beam of light through 28 holes on the sensor corona. The ECU senses signal changes on both optoelecronic sensors to effectively increase the resolution of the sensor (28 impulses per steering wheel revolution) by a factor of four. This produces one edge change every 3.214 degrees of steering wheel rotation.
The signal from the sensor is used in three ways:
a) The straight line position is assumed if the vehicle speed is more than 30km/h and the total accumulation of full quadrature impulses generated was zero within a period of 90 seconds. This is then used as a reference for steering wheel position. Accumulation of full quadrature impulses effectively means that for the accumulation process, the sensor resolution is not multiplied by 4. This is done to avoid sensing small movements which the driver might use to correct miniscule road irregularity or a steering wheel free-play. In order for a pulse to accumulate in this mode, depending on the actual position of the steering sensor, a hole or fill-in has to pass beneath both optoelectronic sensors. In addition, the number of pulses observed in each direction is tallied and the zero position is also corrected using the resulting count. Because the number of steering wheel turns is known (2.94 full left to full right), the sensor can generate a maximum of 84 pulses, 42 in each direction from straight. This process is a lesser rate correction, because up to a 5 pulse difference is possible due to wheel alignment and similar phenomena. A total tally of anything more than 47 pulses in either direction from the current center line, automatically corrects the internal center line reference by the difference between the actual number of pulses observed minus 47.
b) Pulse edges from both optoelectronic sensors within the steering wheel sensor are counted relative to the zero position set in (a) to derive the steering wheel position. The sequence of edge changes from both optoelectronic sensors is used to derive the direction the wheel is turning.
c) The time between the pulse edges is also measured, which is used to derive the steering wheel speed.

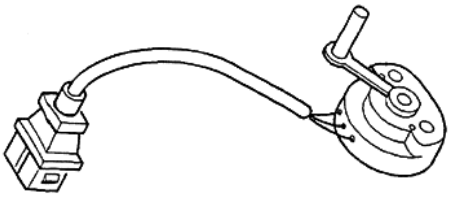
3) The body movement sensor
This is similar to the steering wheel sensor. It consists of two optoelectronic sensors with two infrared beams being either blocked or alowed to pass by a disc which has 45 notches on it's corona, producing 45 full quadrature pulse cycles per revolution. The ECU again uses the signal edges from the two optoelectronc sensors to quadruple the resolution of the sensor. Excessively long intervals between impulses are taken as suspension travel as a result of a different height setting being chosen, and are not taken into account. Similar to the steering wheel sensor, the body movement sensor is used to derive the body movement amplitude, as well as speed of movement.
Due to the way the sensor is set up, it is capable of detecting squat/dive and to an extent, roll. The sensor is connected to the front anti-roll bar to the right of the height corrector linkage. Since the sensor is mounted off center on the anti-roll bar, it's sensitivity to roll is about three times less than it's sensitivity to squat/dive. Only a small amount of the full circumference of the corona is used due to this linkage arrangement, unfortunately, the documentation is not exactly clear as to what number of impulses from the sensor corresponds to what amount of body movement. The picture below shows how the sensor looks. Note the

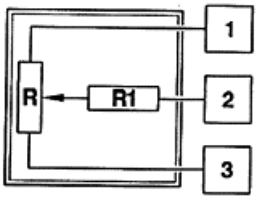
'handle' on the back side (left side of the picture), ending in a small ball joint. This is connected to the linkage using a small plastic rod with ball sockets on each end, the same as used in the height corrector linkage. The sensor is made by Valleo and is located between the right wheel and the height corrector, a few inches from the roll-bar.



4) The gas pedal position

This sensor is a 4.7kohm potentiometer linked to the gas pedal by a sprung lever. The wiper of the potentiometer has an integrated 2kohm series resistance. The sensor is located below the dashboard right next to the gas pedal mechanism, and the little 'lever' on it is mover by the gas pedal moving (see pictures below). The lever is sprung by a spring inside the sensor.

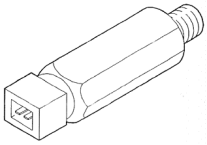




The entire travel of the potentiometer is divided into 256 steps by the ECU. In effect, the sensor is supplied from a 5V reference source within the ECU, which is also the full scale reference for an 8-bit A/D converter. The sensor then divides the 5V reference voltage, connected between pins 1 and 3, and the input of the A/D converter within the ECU is connected between pins 2 and 3. Due to the gas pedal initial position and maximum travel variations the full travel of the pedal will result in 160 to 220 steps out of 256 being usable. However, the signal from the sensor is only taken as a relative value, so the actual number of usable steps is not an issue.

5) The brake pressure sensor

This is a simple pressure activated switch. The activation pressure is 30 bars. The sensor is located on a hydraulic conduit connector block, right next to the ABS block. The two are located at the bottom of the left front wing, in front of the wheel, and under the battery. The sensor looks as shown below:



6*) The door/boot open switches*

These switches are located on the door frame and in the boot latch. There are actually two inputs for switches on the ECU. The door switches are all wired together and connected to one input, and also routed to the interior light dimmer/timer. The boot switch is connected to the other input and also routed to the boot light and the boot lid opened detection input for the status display on the dashboard. The door open and bonnet open signals for the status display are generated by a separate set of switches completely independent of the ones described above!

7) Ignition switch

This is used as a power on sensor and will generate an internal reset and self-diagnostic of the ECU. Turning the ignition on and off also generates internal events that guarantee proper pressure equalisation between the central and corner spheres.

Operation:

The ECU is a microcontroller-based unit, that implements suspension control rules. In general, the ECU uses signals from sensors 2, 3 and 4, and to an extent 5, 6 and 7 in relation to vehicle speed (sensor 1) to form various threshold tables. When any of the given sensor inputs cross a threshold value in a table, the suspension is put into hard mode (in other words, there is an implied logical 'OR' function for the sensor inputs). The threshold cross for each table is also subject to a timeout value - the signal has to remain under the threshold value for a certain amount of time before a given sensor input will not generate a 'hard suspension' signal.
In addition, there are four rules which supercede the operation as stated above:
1) The ECU puts the suspension into SOFT mode when the ignition is turned on or off. This setting supercedes all other rules until a 30 second time out runs out or the vehicle speed exceeds 24 km/h, whichever comes first.
2) If the ECU determines that there is a problem within itself or any of the sensors or the electric valves, the suspension will go into hard mode at first occasion and stay in hard mode until the ignition is turned off, or the doors are opened while the vehicle speed is lower than 24 km/h. The ECU runs a self-diagnostic when the ignition is turned on. Some sensors, however, cannot be tested at power-up. The ECU will generate faults if the sensor inputs do not correlate - for instance, no body movement but speed greater than 24 km/h, etc.
3) When the suspension stays in hard mode for more than two minutes, the ECU generates a momentary reset of the suspension to soft mode, to assure equalization of the pressures between the corner and the center spheres. If the hard mode signal persists, the suspension will return to hard mode within 50 ms, after which the 2 minute timeout will be restarted. The timeout is reset every time the suspension returns to soft mode.
4) Under 24km/h opening the doors or boot overrides any other rules.

Rules that use input from other sensors are given below:

The steering wheel sensor is used to derive two inputs: steering wheel speed and steering wheel angle. Both values are treated separately. The purpose of this is to calculate the lateral acceleration of the vehicle (vehicle speed, steering angle) and the potential change in lateral acceleration (vehicle speed, steering wheel speed). I suspect it was done this way to save a large amount of memory which would be required for a three-parameter lookup (vehicle speed, steering wheel angle, steering wheel speed). The steering wheel sensor rules actually give a measure of potential body roll. Body roll is significantly reduced in hard mode, therefore the rules have to be set up so that the body roll is minimized when there is potential for it, but that the suspension stays soft to absorb bumps when there is no body roll caused by the vehicle changing direction.

The table below gives a threshold of steering wheel angle. If the steering wheel angle is more than the threshold for a given vehicle speed, the suspension will go into hard mode. It will go into soft mode again if the threshold angle in the table is not exceeded again within a period of 1.5 seconds:

Vehicle speed (km/h)	Steering wheel angle (deg.)	
	NORMAL	SPORT
<34	N/A	N/A
34-39	174	119
40-49	100	67
50-59	84	56
60-68	68	45
69-78	55	37
79-89	42	28
90-99	33	22
100-119	26	17
120-139	23	15
140-158	20	13
159-179	13	9
>179	10	7

The table below gives a threshold of steering wheel speed. If the steering wheel speed is higher than the threshold for a given vehicle speed, the suspension will go into hard mode. It will go into soft mode again if the threshold speed in the table is not exceeded again within a period of 1.5 seconds.

Vehicle speed (km/h)	Steering wheel speed (deg/s)	
	NORMAL	SPORT
<24	N/A	N/A
24-29	535	357
30-39	401	267
40-49	246	164
50-59	178	119
60-68	110	73
69-78	82	55
79-89	62	41
90-99	53	35
100-119	42	28
120-139	30	20
140-158	22	15
>158	20	13

The body movement amplitude and speed is derived from the output of the body movement sensor. The amplitude and speed are, however, used in a different manner.
The body movement speed is used as the parameter for the activation of two types of corrections:
1) 'flat tire' correction. If the body movement speed exceeds 300mm/sec the suspension goes into hard mode, and all the hard mode thresholds are limited to 60mm. The timeout of the correction is 0.4s.
2) Excessive body movement correction. If the body movement exceeds 60 mm more than three times within three seconds, the suspension will be put into hard mode, and all the hard mode thresholds are limited to 60 mm. the timeout for this correction is also 0.4s.
The corrections stay enforced until one or more of the following conditions are satisfied:
1) body movement amplitude remains under the 'hard' threshold during the correction timeout.
2) The suspension selector is set to 'Sport'.
3) The vehicle speed becomes higher than 159km/h.
4) The steering wheel angle is higher than a threshold value dependent on vehicle speed as specified in the table below.
Once either of the above conditions is satisfied, the suspension will go to normal operation, with thresholds set as in the table below. Crossing the thresholds will put the suspension into hard mode, and keep it there for 0.8 seconds unless the thresholds are crossed again, which resets the timeout, so it starts anew, and keeps the suspension in hard mode.

Vehicle speed (km/h)	Dive (mm)	Squat (mm)	Steering wheel position (deg)
<10	N/A	N/A	N/A
10-33	84	60	N/A
34-39	84	60	87
40-49	54	48	50
50-59	54	48	42
60-68	54	48	34
69-78	54	48	27.5
79-89	54	48	21
90-99	48	48	16.5
100-109	48	48	13
110-119	48	42	13
120-129	48	42	11.5
130-139	42	42	11.5
140-149	42	42	10
150-158	42	36	10
159-179	42	36	6.5
>179	36	36	5

Note that the rules governing suspension setting vs. body movement are the same for both normal or sport suspension settings.

Gas pedal speed is taken in relation to vehicle speed. This is done to anticipate the vehicle dynamics as a result of acceleration or engine braking. The rules for this sensor represent a reaction to potential vehicle squat (on acceleration) or dive (on engine braking). Both are significantly reduced when the suspension is in HARD mode.
The number of A/D converter 'steps' traveled within 25ms is taken as the measure of gas pedal position rate of change (i.e. gas pedal speed). Separate rules are used for pedal pressing and releasing, as are given in the following table:

Vehicle speed (km/h)	Gas pedal press speed (steps/25ms)	
	NORMAL	SPORT
0-14	2	1.3
15-49	3	2
50-99	4	2.6
100-134	5	3.3
135-199	6	4
>199	7	4.6
	Gas pedal release speed (steps/25ms)	
0-19	10	6.6
20-78	5	3.3
79-168	6	4
>168	7	4.6

The table again gives thresholds, which, once crossed, cause the suspension to go into hard mode. The suspension will go back to soft mode if the threshold is not crossed within 1.6 seconds of the suspension going into hard mode.

The brake pressure sensor detects pressure in the front brake hydraulic circuit. Since this is a fixed threshold sensor, the suspension setting rule is simple. If the vehicle speed is higher than 24km/h AND the pressure sensor is active, indicating that the pressure in the brake circuit is 30 bar or more, the suspension will go into hard mode. The suspension will remain in hard mode as long as the rule above is satisfied. This is done to prevent excessive dive when brakes are applied.

The door and boot open sensors will override the hard setting of the suspension as long as the vehicle speed is below 24 km/h. The suspension will consequently go into soft mode whenever any door or the boot is opened, and will remain in soft mode for 30 seconds after all the doors are closed if the vehicle speed remains below 24 km/h. As long as the vehicle maintains a speed of at least 24km/h, normal rules apply, and will continue to apply even if the doors remain open. It is important to note that the suspension will go into soft mode even with the ignition switch turned off. Should the doors remain open with the ignition switch in the off position, the suspension soft setting will be subjected to a 10 minute timeout to avoid draining the battery, as the soft setting requires the electric valves to be energized.

The ignition switch change of state provokes a soft setting starting a 30 second timeout, which can be terminated by the vehicle speed reaching 24km/h. When the ignition is turned on, the ECU also goes through a self-test sequence, which lasts 3 seconds.

The suspension mode select switch chooses one of two sets of rules for suspension behavior. The rules are slightly more strict for the sport setting, the suspension will go into hard mode much more readily, because most of the thresholds are reduced.

The suspension status light has a double function:
1) When the ignition switch is turned on, and the suspension mode is set to normal, the light will go on during the three-second duration of the ECU self test, if the test is successful. If the test is unsuccessful, i.e.

there is something wrong with the ECU or the sensors at self-test time, there will be one or more flashes of the light during the 3 second self-test interval.
2) When the suspension is set to sport, the status light will remain lit to indicate the sport setting has been chosen.
The status light actually lights up or extinguishes itself only when the suspension rules have been changed in response to the mode select switch. This takes a short while because the internal timeouts are reset and some of the sensors are re-calibrated. Because of this the light changing state is slightly delayed from the mode switch changing state.

Differences between Hydractive I and II

Hydractive I has roughly the same functionality for the hydraulic elements, with one exception: there is no roll limit ball/piston valve for the soft setting. Because of this hydractive I limits roll by using significantly more damped corner spheres, to increase the potential cross-flow of fluid between the struts in order for the dual damper arrangement of the center sphere to damp them. This however, requires a greater damping setting for both modes, or a sacrifice in handling quality, a situation which is difficult to find a good compromise for.
The actual hydraulic elements, although similar in function, are quite different for hydractive I and II, just about the only thing similar are the spheres. The suspension control elements do not have integrated electric valves. Instead, one electric valve is located separately, and the control pistons within the control units are hydraulically controlled, through hydraulic conduits which provide the connection to the electric valve. The integration of the electric valve and the control element body in hydractive II reduces the number of hydraulic conduits.
The greatest difference in the way hydractive I and II are set up is the ECU. Although the sensors are almost completely the same (except for the speed sensor which is a tachogenerator in hydractive I and a hall switch in hydractive II), the logic of operation of the ECU is different. Hydractive I only has one single set of rules, which is applied only when the suspension is set to 'automatic'. When the suspension mode is set to 'sport', the suspension is set to hard, and stays in that setting until the suspension mode is returned to 'automatic', except during a brief period of the ECU self-test, which is similar in operation to Hydractive II.
Hydractive II uses both the soft and hard setting for both mode settings, which have been changed from 'automatic' and 'sport' in hydractive I to 'normal' and 'sport' in hydractive II. With hydractive II, each suspension mode setting has a separate set of rules.

Possible improvements and projects

A replacement ECU for hydractive I could be made that would enable the suspension to behave similar to hydractive II, the only difference would be the absence of hydraulic roll limiting in soft mode.
Also, a replacement ECU could be made that could be used for both Hydractive I and II setups, which would have several settings, instead of just two. It would even be possible to make the mode continuously variable between a constant hard setting, and a setting which mostly stays soft, having very relaxed rules that generate a transition to hard mode.
The hydractive II setup could also be modified to control the front and rear electric valves separately. In particular, a setting with more stringent rules for the rear suspension could be very beneficial in situations where a relatively lightly loaded car is used to tow a trailer. In this situation, having only the rear suspension more readily go into hard mode, or even stay in hard mode, could be a good idea. However, this is only possible for hydractive II – hydractive I is hydraulically connected to operate both suspension control blocks simultaneously.
Another possibility would be an 'acceleration based' rule for steering wheel speed/angle and vehicle speed - i.e. a true three-parameter lookup table. Memory technology has considerably advanced since either Hydractive I or II ECUs were designed, the memory overhead for a three parameter lookup would be insignificant in terms of today's available memory capacity.
A replacement ECU would of course have a 'download' feature, for instance via a serial port. This could be used to customize suspension behavior, possibly even by the user.

Improving suspension comfort

1) Adjustments to the hydraulic elements
Although so called ‘comfort spheres’ are available, this is not the real answer to the constant complaints of drivers used to older Citroens that the XM’s suspension is ‘not as comfortable’.
Comfort spheres are only mounted onto the struts. This reduces the damping of the suspension in both modes, because ‘comfort spheres’ usually have the damping elements with a larger bore, and they are always connected to the suspension, regardless of suspension setting. Unfortunately, this also compromises handling, because it affects roll and dive/squat behavior.
In order to adjust the suspension differently, the ‘spring constant’ of the spheres has to be adjusted lower together with the damping. In order to do this, the pressure in the spheres has to be increased, but this may limit suspension travel in hard mode, unless the sphere volume is also enlarged. It will also result in greater changes in suspension behavior for different load situations. All these requirements significantly reduce the options for usable spheres.
A better option would be to partially disassemble the suspension control element and bore out the damper elements within it. Also, a higher pressure sphere can be fitted as the center sphere (for instance, an accumulator sphere). In case of the middle sphere the volume is not critical as there are three spheres working when the suspension is in soft mode, which gives a sufficient headroom for fluid displacement. This setup will not affect hard mode roll performance, but will affect soft mode roll. It will also significantly reduce damping and resonance frequency in soft mode.
This alternative setup will not significantly affect handling because that is mostly determined by the hard suspension setting, and this has not been changed.

2) Adjustments to the electronic elements
Changes to the ECU rules without changing any of the hydraulic elements could probably increase the comfort of the suspension as well, however, this may compromise handling, because the basic suspension behavior is dictated by the hydraulic elements. The suspension could be ‘tuned’ to run in soft mode more often, by relaxing the rules that put it into hard mode.
Changes to the hydraulic elements should ideally be accompanied by changes to the ECU rules. In any case, any changes to the existing ECU are only possible by reprogramming it. The available documentation leaves the question of reprogramming open – there is no data about this. A replacement ECU would, of course, easily be made to be reprogrammed as needed.

XM Hydractive system repair

The XM's are fitted with a suspension control system which Citroen called 'Hydractive'. The system has undergone several revisions during its lifetime but during the production run of XM's it went from revision H2 to H4 with several sub-revisions depending on model and year of manufacture. The system works by having 3 spheres in parallel per axle (not the case for earlier versions but the principle described here remains the same). The two wheel spheres are permanently connected to the wheels but the third 'centre' sphere can be switched in and out of circuit with something called an 'electrovalve'. As its name suggests it is a hydraulic valve which is operated by an electrical signal. This electrovalve either connects the centre sphere in parallel with the other two or isolates it from the system and prevents any interaction with the system. When closed, only the two wheel spheres are available to absorb the bumps in the road. When open, all three spheres are able to absorb bumps in the road. Consequently when the valve is open the suspension is in 'soft' mode and when closed the suspension is in 'hard' mode. As the names suggest the least comfortable for the occupants is 'hard' mode which is akin to a car which does not have hydro-pneumatic suspension.

However, a common problem with the XM is its unnerving desire to remain in 'hard' mode. This is caused by the third or centre sphere remaining isolated from the system due to the inactivity of the electrovalve. A picture of the electrovalve is show below:

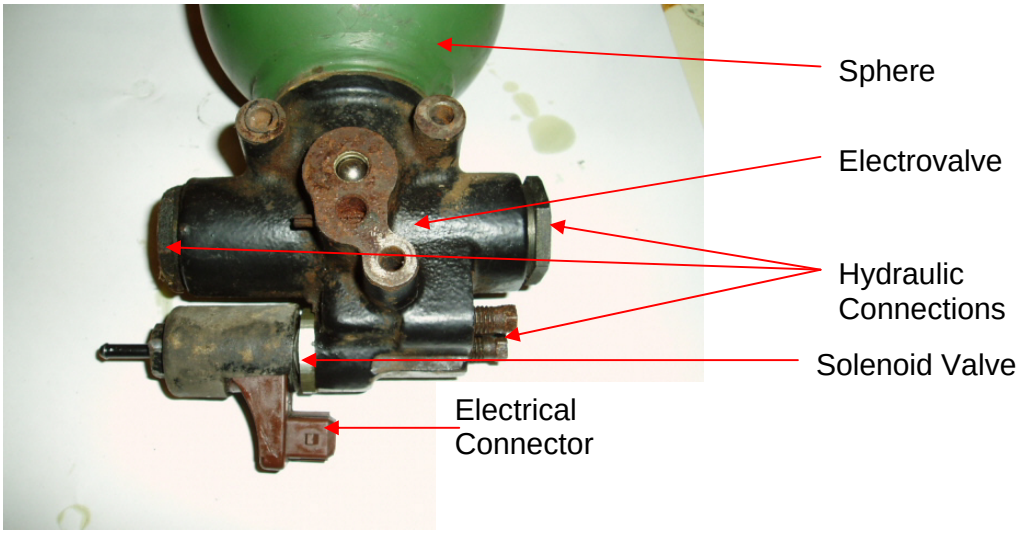


Photo1

 ©2006 Norrie

The valve is activated by sending an electrical signal to the electrical connector shown above. This connector is part of a solenoid valve which in turn operates the main valve hydraulically. A picture of the solenoid valve coil is shown below:

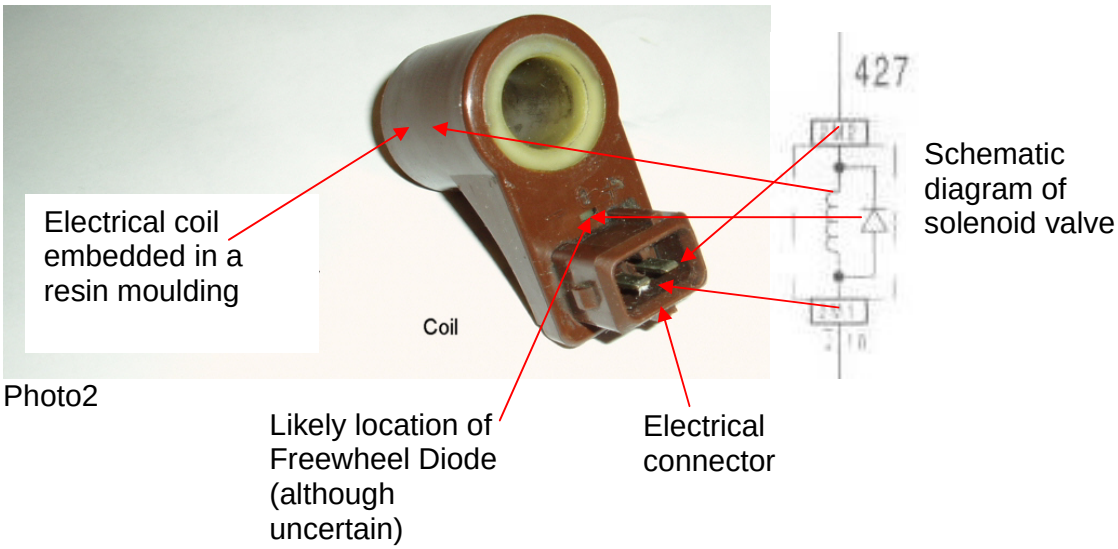


Photo2

The wire-wound coil is cast into a resin moulded casing to afford the electrical components protection from rain and roadsalt. Embedded in the moulding is a device called a ‘Freewheel Diode’. An electrical schematic is shown above. The electrovalve is activated by a signal from the suspension ECU (Electronic Control Unit) which is located under the bonnet on the offside (RHD) inner wing. Within the ECU the device which switches the power off and on to the valve is called a MOSFET (Metal Oxide Semiconductor Field Effect Transistor) the name of which is inconsequential to this document. When the MOSFET switches the power on there is an electro-magnetic field created around the coil inside the solenoid valve. This field opens the solenoid valve which in turn operates the electrovalve. However, when the MOSFET switches the power off the electro-magnetic field surrounding the coil collapses because there is no longer any current to sustain it. As the field collapses it induces an EMF (Electro Magnetic Force) in the windings of the coil which created the field in the first place. The EMF induced attempts to keep the current flowing in the coil in the same direction as it was travelling. This is exactly the same principle as the operation of an HT ignition coil in a petrol engine. Unfortunately the MOSFET doesn’t like the fact that the current tries to keep going because it damages the part of the MOSFET which constitutes the switch. Since this was known at the time of design, a protective device was added to the circuit known as a Freewheel Diode. The purpose of the diode is to provide a path for this unwanted current to flow through which will protect the MOSFET by conducting it out of harms way. The diode (an electrical one-way-valve) creates a short-circuit. The unwanted current leaves the coil heading for the MOSFET but finds it much easier to travel the short way, through the diode, back to the coil again. There is not

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much energy left in the collapsing field and it soon dissipates in the resistance of the coil as heat (within milliseconds). For a reason which I do not understand the diode which is embedded in the solenoid valve is prone to failure. When it fails, it fails open circuit ie as if there was no diode there at all. The resulting effect of the diode failure is that the overrun current created by the collapsing field of the solenoid valve is dissipated through the MOSFET. This causes the MOSFET to overheat and eventually fail. For reasons I won't go into here the MOSFET oscillates off and on very quickly when 'on' and switches 'on' and off very often on a normal car journey. Every time it switches off, damage is sustained. Although the lifespan of the MOSFET after diode failure is unknown it would be safe to say it is in the region of weeks to months.

Once the MOSFET fails it can never open the electrovalve and hence the suspension remains in hard mode permanently. The electrovalve emits a distinctive 'hum' or 'buzz' when in operation which is quite audible. With the car on the ramps and the engine and ignition off, open one of the doors. This will cause the ECU to send the signal to the electrovalve for approx 1 minute (after which it will automatically stop - just close and re-open door to re-energise). With your ear in the vicinity of the electrovalve listen for the buzz. The front electrovalve is very easy to access so you can try unplugging the electrical connection and reconnecting it. The buzzing noise should be heard to cease and then restart as the connector is pulled off and put back on again. Try to identify each valve (Front and Rear) independently. They can fail independently to each other.

When the MOSFET overheats the surrounding PCB (Printed Circuit Board) can be seen to be discoloured due to the presence of the high temperatures. A photograph of a replaced MOSFET can be seen here:

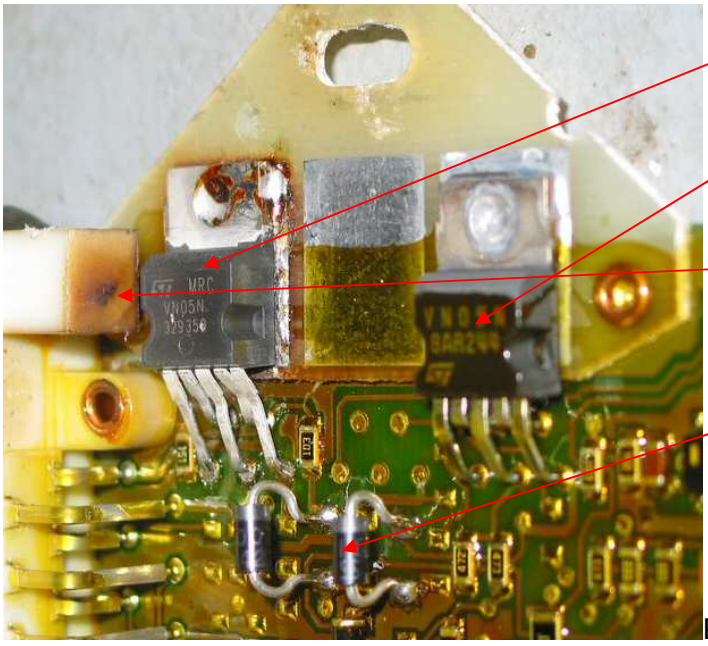

Photo3 (courtesy Jannik Steen)

 ©2006 Norrie

The MOSFET's fitted to the suspension ECU are VN05N's. They are fairly easily replaced. Just snip the legs of the old one and remove the legs one by one using a soldering iron. To remove the body of the MOSFET from the PCB just heat a large old screwdriver on the gas hob until red hot. Place on the metal part of the MOSFET shown above with the circular depression in the middle. The solder will melt within a second or two and the device will fall off the PCB. Clean out the solder holes with a wick or a 'solder sucker' and re-solder the new MOSFET in place.

The diodes unfortunately cannot be replaced in their original locations due to being embedded in the resin moulding of the coil. However, it is possible (although slightly less efficient) to place them at the opposite end of the connecting wire to the electrovalve ie inside the ECU. The photo above shows two such diodes (IN4007) retrospectively soldered to the PCB inside the ECU as a repair for blown diodes in the electrovalve. The diodes located here will serve the same purpose as the diodes in the solenoid coil. The photograph above is high resolution and can be blown up whilst still retaining the required detail. Alternatively it can be found at the original author's site here: http://kernelpanic.dk/xmhaecu/

I hope this explains the root of the problem associated with the electrovalves on the XM and dispels some of the urban myths surrounding the subject.

I also appreciate that this does not apply to some of the early Hydractive systems where only one hydractive sphere was present and the diodes were built into the ECU. However, the early systems don't seem to suffer from this particular problem, they have their own set of problems which are not discussed here. It is really aimed at the later systems which suffer from this problem.

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The Hydractive valve (Front or Rear) Assembly on a Citroen XM

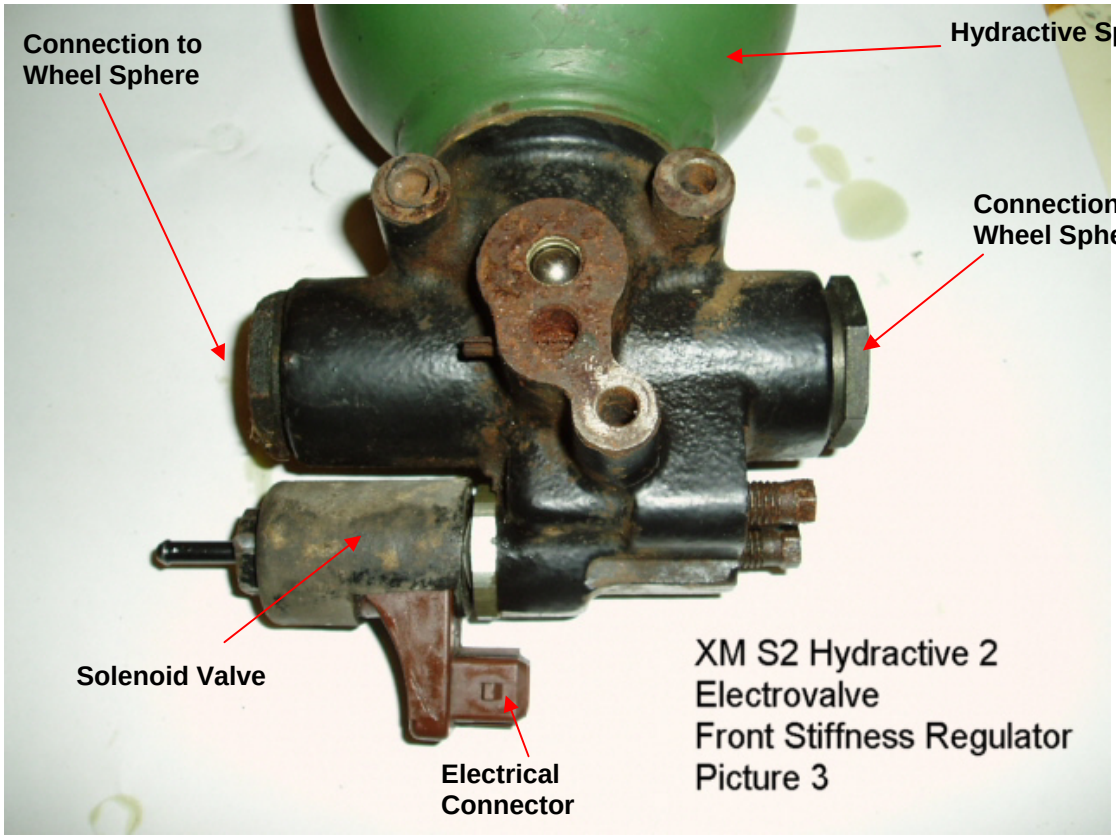

Photo1

……. and removing the solenoid valve here:

Photo2

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Control Knob Assembly on dash

Solenoid Valve disassembled

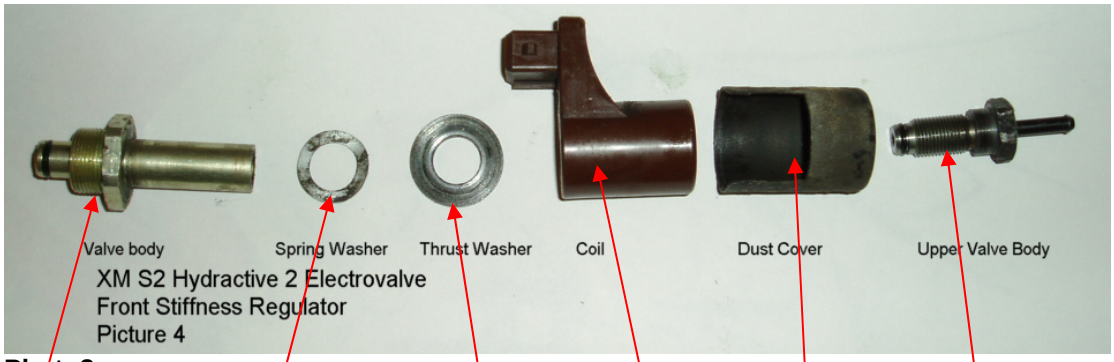

Photo3

Valve Body

Spring Washer

Thrust Washer

Coil

Dust Cover

Upper Valve Body

Valve Body disassembled

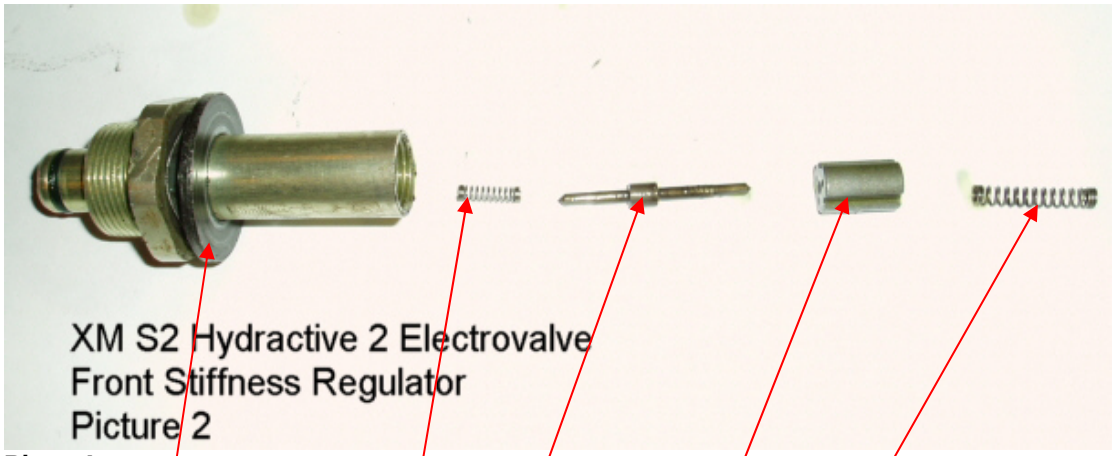

Photo4

Thrust Washer

Small spring

Needle

Block

Large Spring

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Solenoid Coil

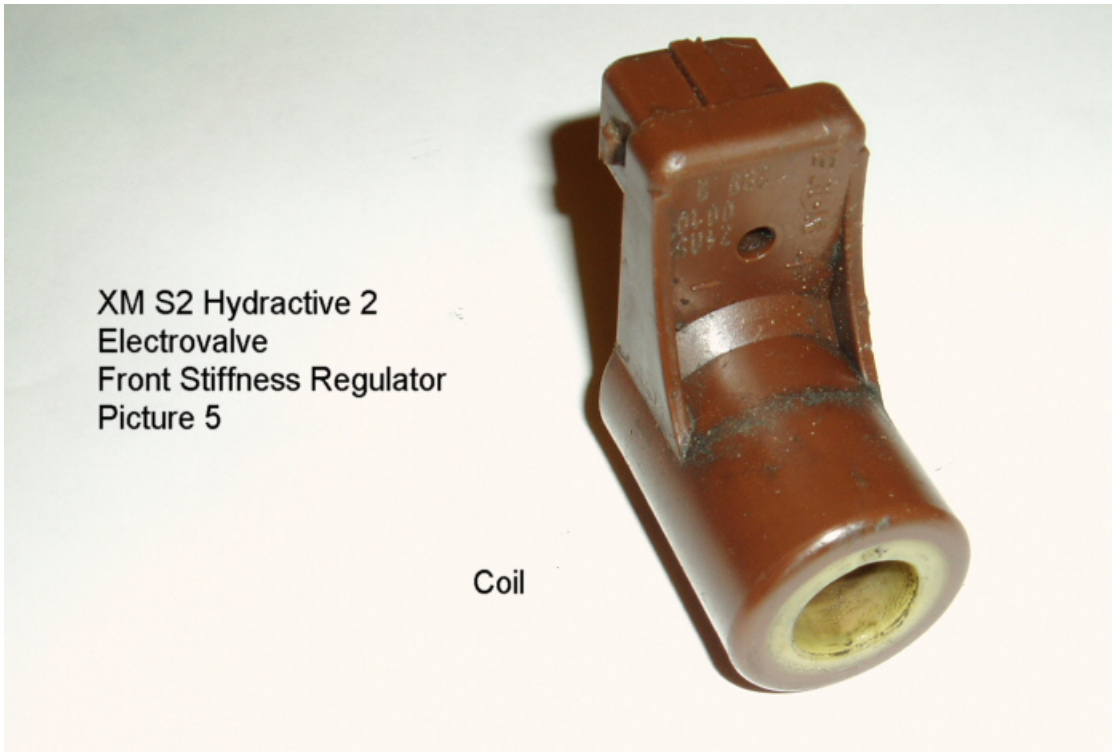

Photo5

Another view of the coil:

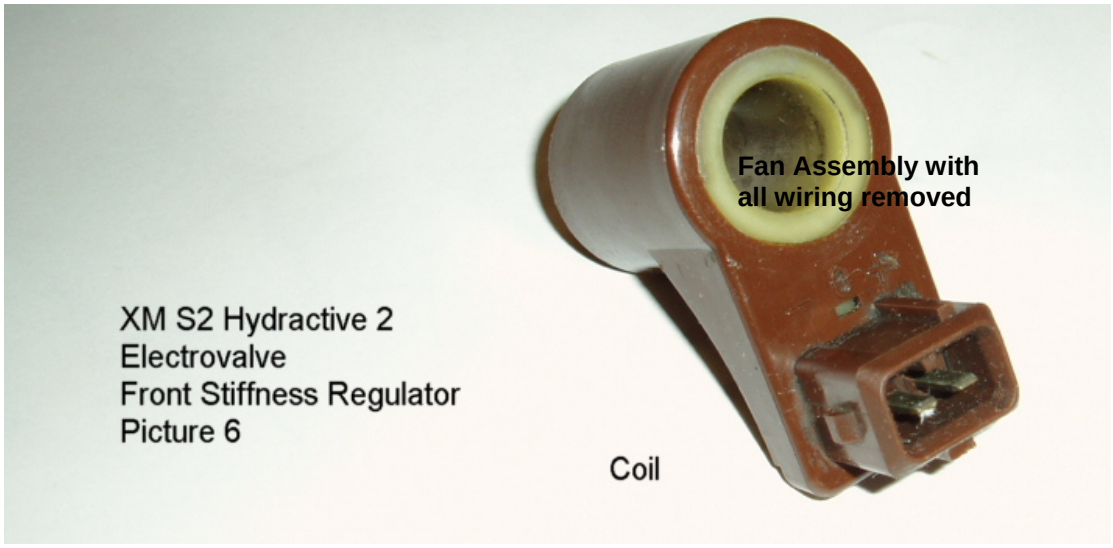

Photo6

 ©2007 Norrie

OVERHAULING : FLOW DISTRIBUTOR

1 – RECOMMENDED TOOLS

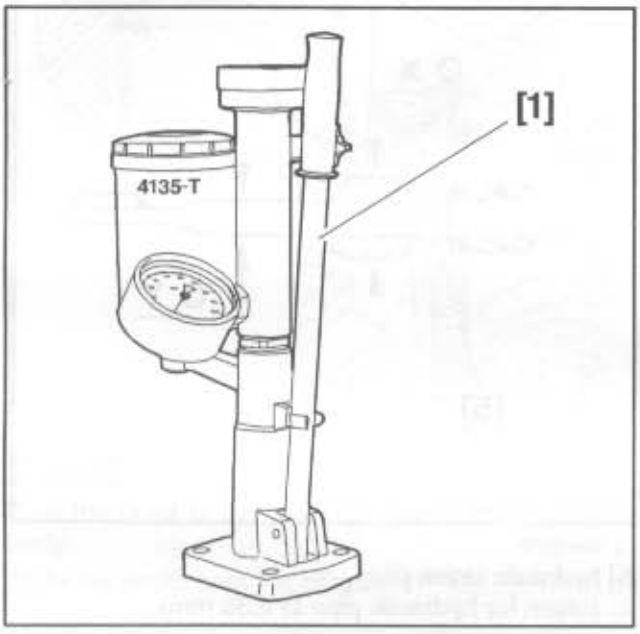

Fig : E5–P03XC

[1] hydraulic testing pump 4135–T, or hydraulic test bench 4034–T.

NOTE : Use tool [1] with plug "T" and pressure gauge Q = 250 bars from the tool kit [2].

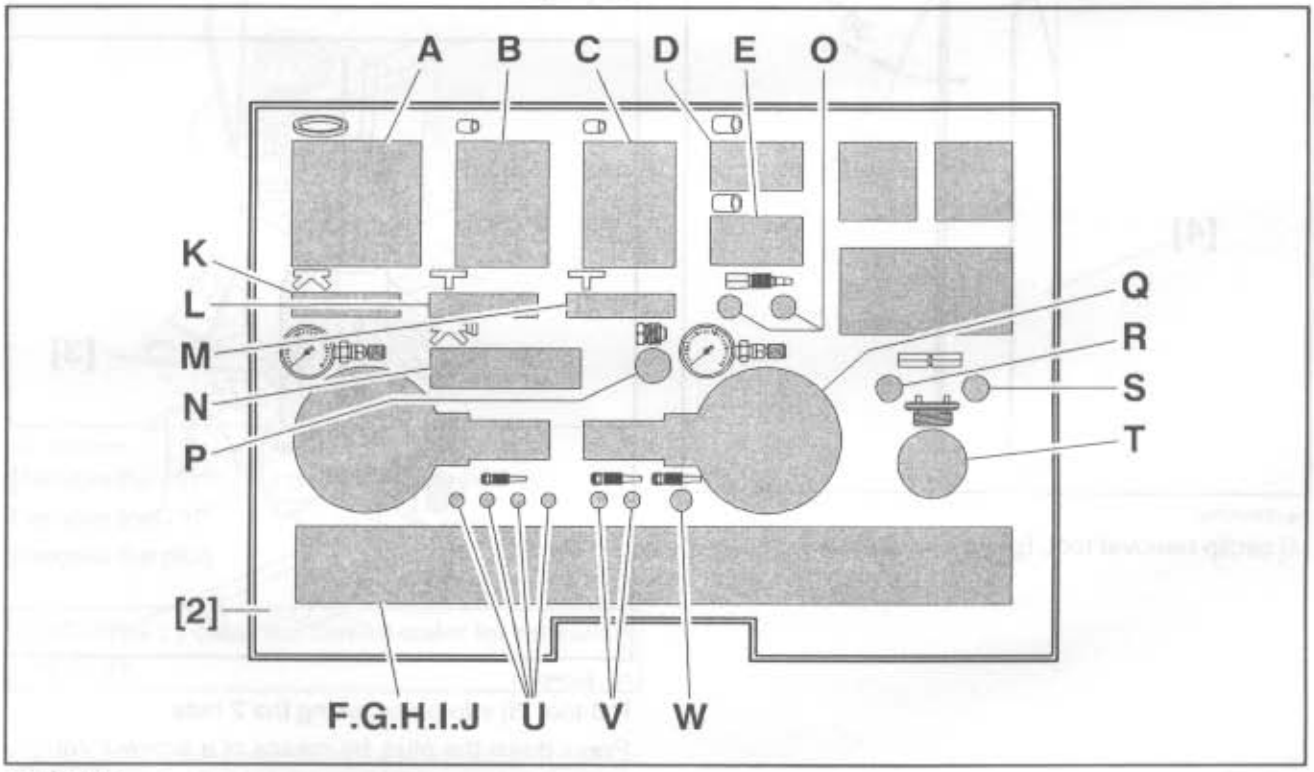

Fig : E5–P08DD

[2] hydraulic check tool kit 4146–T.

2 – TOOLS TO BE MADE

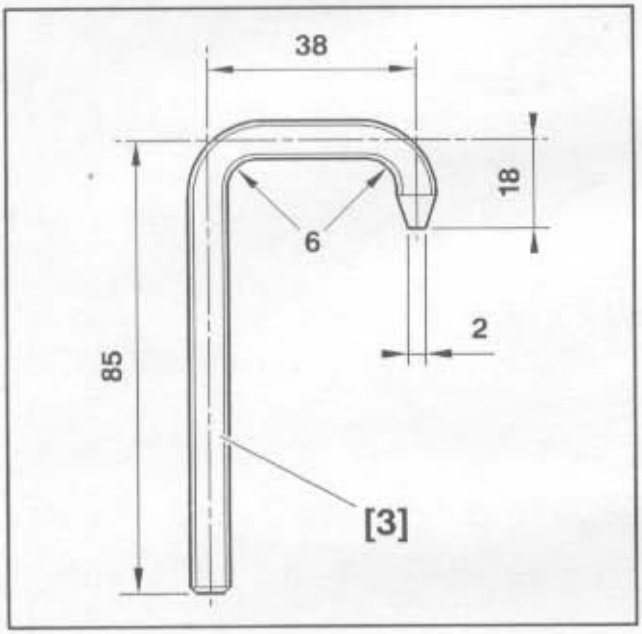

Fig : E5AP07MC

[3] threaded rod M7 x 100.

Tool [3] is used to keep the plug held down while removing the circlip.

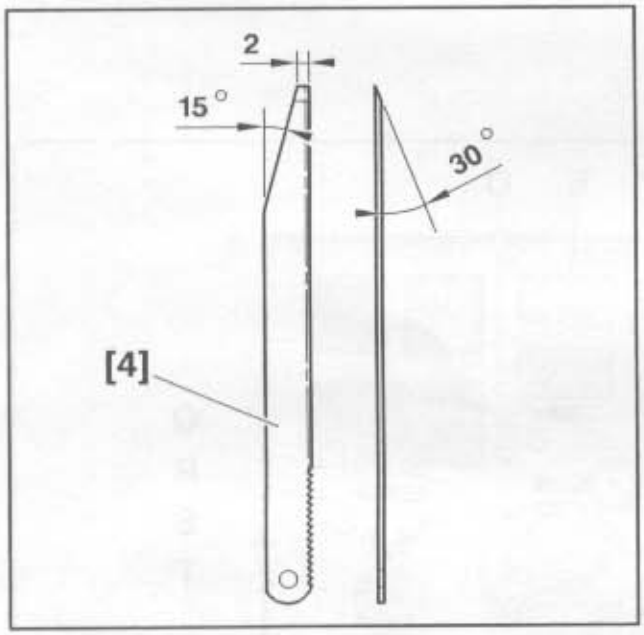

Fig : E5AP07NC

[4] circlip removal tool, (ground saw blade).

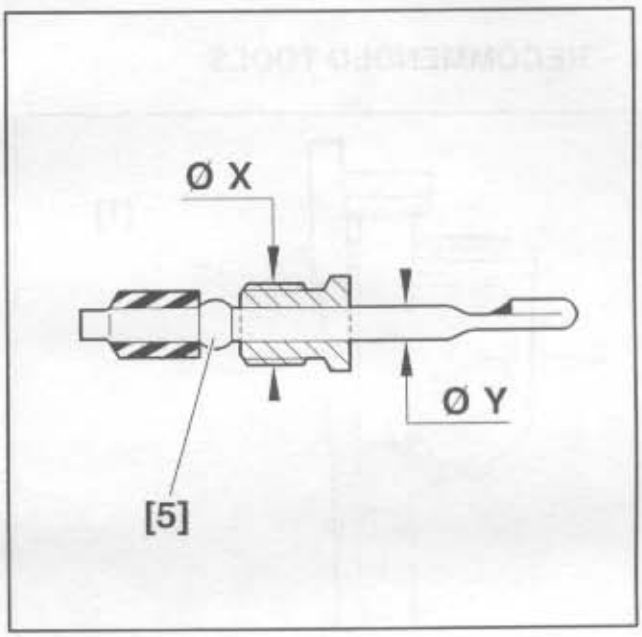

Fig : E5AP07PC

[5] hydraulic union plug
(union for hydraulic pipe Ø 6.35 mm).

3 – DISMANTLING

Plug the orifices.

Clean the flow distributor (in particular the area around the plugs).

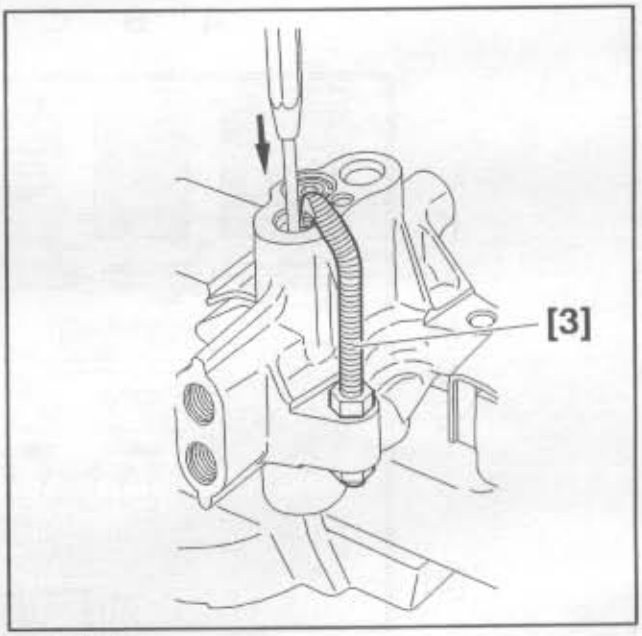

Fig : B3EP07QC

Put tool [3] into place, using the 2 nuts.

Press down the plug, by means of a screwdriver.

Hold the plug in place, by means of tool [3].

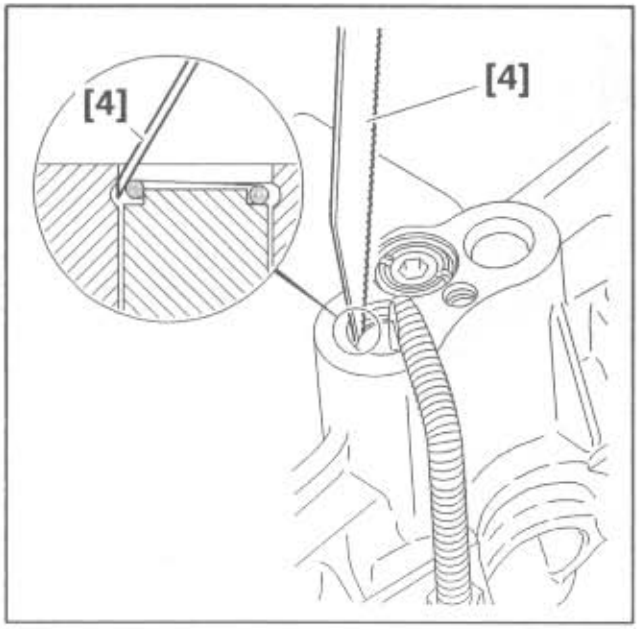

Fig : B3EP088C

Turn the point of the tool [4] towards the distributor body.

Slide the circlip onto the plug.

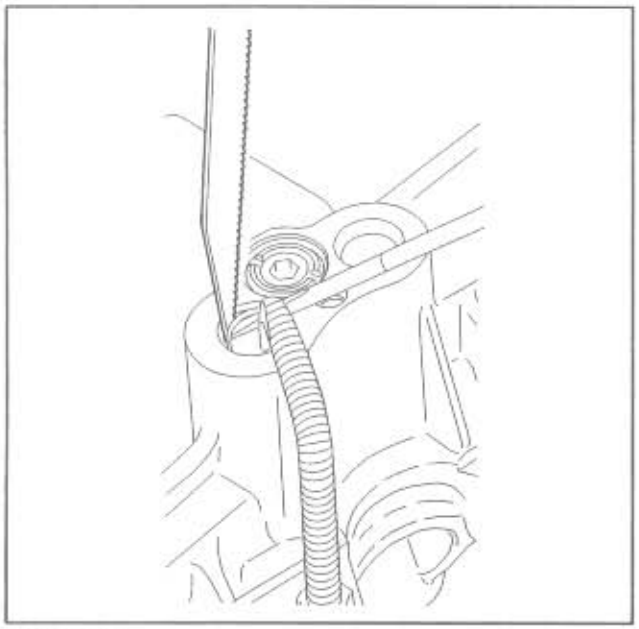

Fig : B3EP089C

Remove the circlip using a small screwdriver.

Remove tool [3].

Remove the plug.

WARNING : Follow the correct order for removing the plugs.

IMPERATIVE : Ensure the springs are in their correct positions.

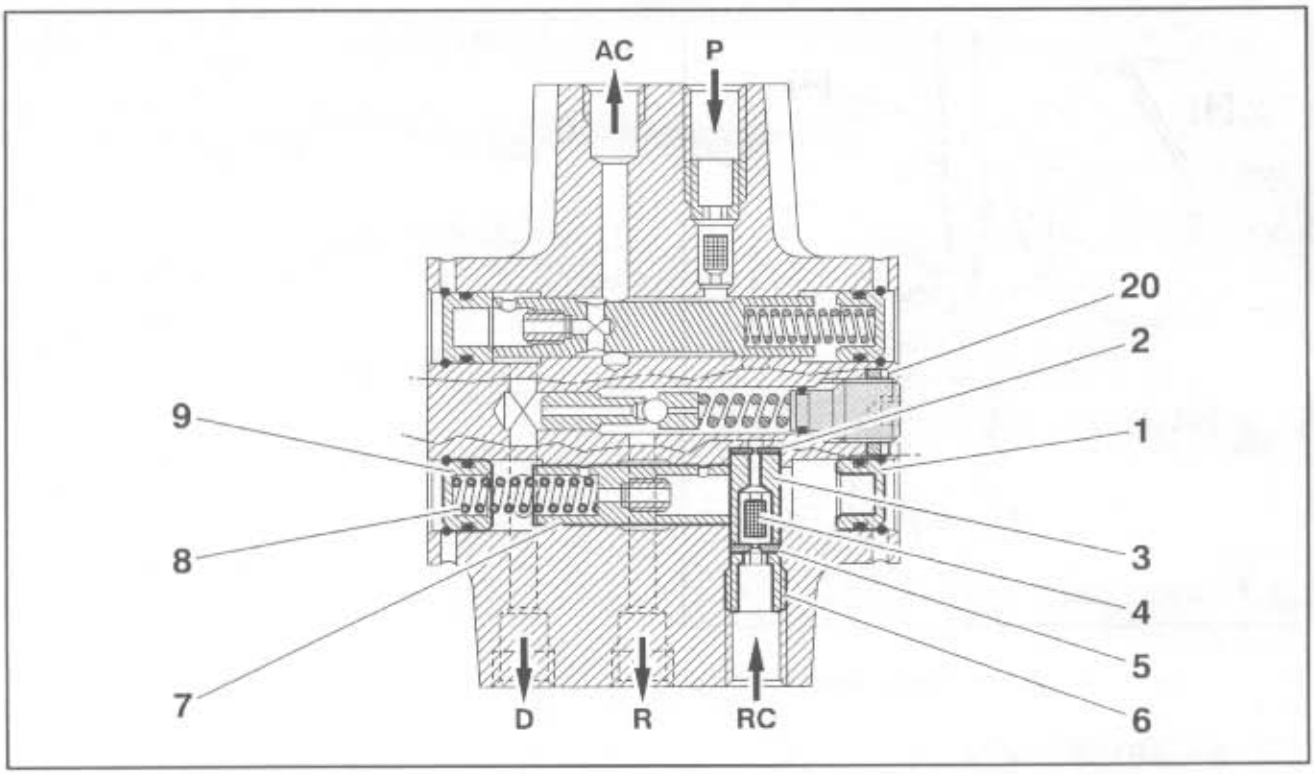

Fig : B3EP07RD

Remove plug (1).

Place a cloth over the plug and blow compressed air through the orifice RC (regulator return).

Remove plug (9).

Place a cloth over the plug and blow compressed air through the orifice D (steering, Ø 4,5 mm).

Remove :
- the spring (8)
- the regulation valve (7)

NOTE : Filters (4) and (14) in orifices (RC) and (P) are held in place by sleeves (6) and (13).

There are 2 possible types of sleeve :
- threaded with internal hex
- pushed in with a smooth internal diameter

Only the filters held in place by the threaded sleeves can be removed.

Remove :
- the sleeve (3) (6)
- the thick jet (5)
- the stop (3) with the filter (4)
- the thin jet (2)

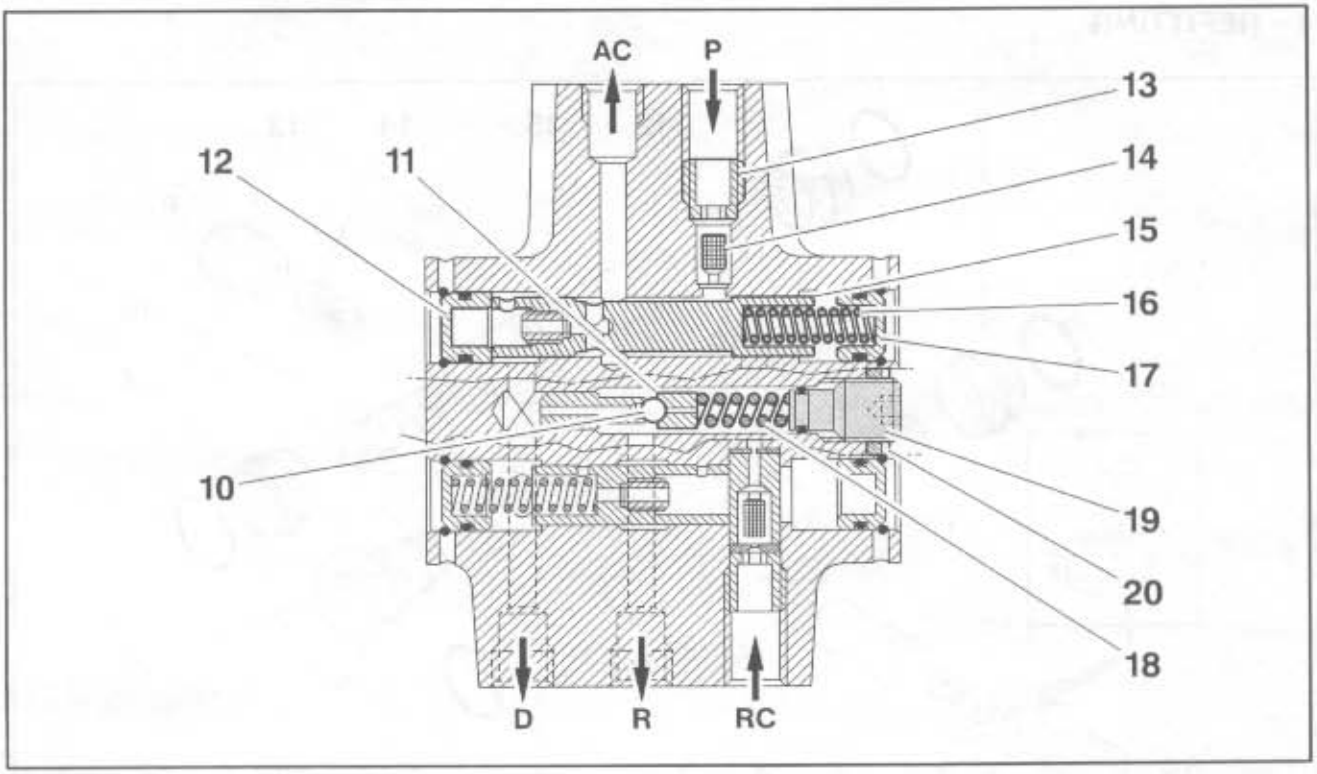

Fig : B3EP07SD

Remove :
- the sleeve (3) (13)
- the filter (14)
- the plug (17) (press on the opposite plug to remove)
- the spring (16)
- the distribution valve (15)
- the plug (12)

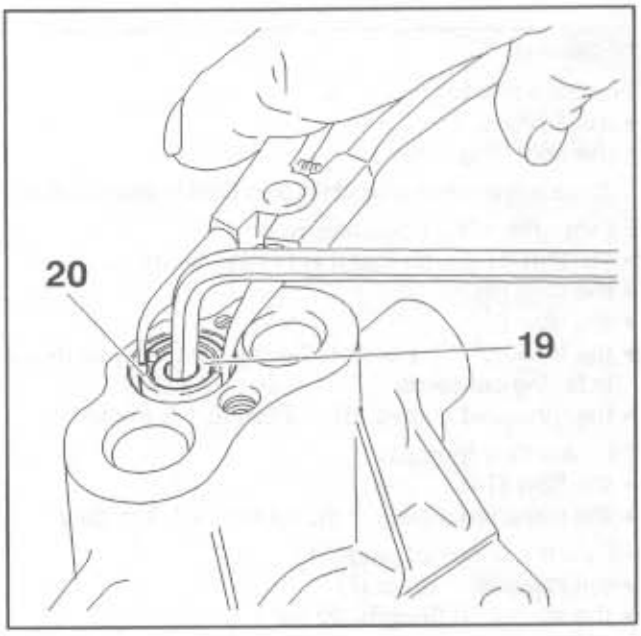

Fig : B3EP07TC

Using a pair of thin–nosed pliers :
- loosen the sleeve (20)
- remove the adjusting screw (19)

Remove :
- the spring (18)
- the spacer (11)
- the ball bearing (10)

IMPERATIVE : Clean the parts before reassembly, without removing the jets which are fitted in the valves.

4 – REFITTING

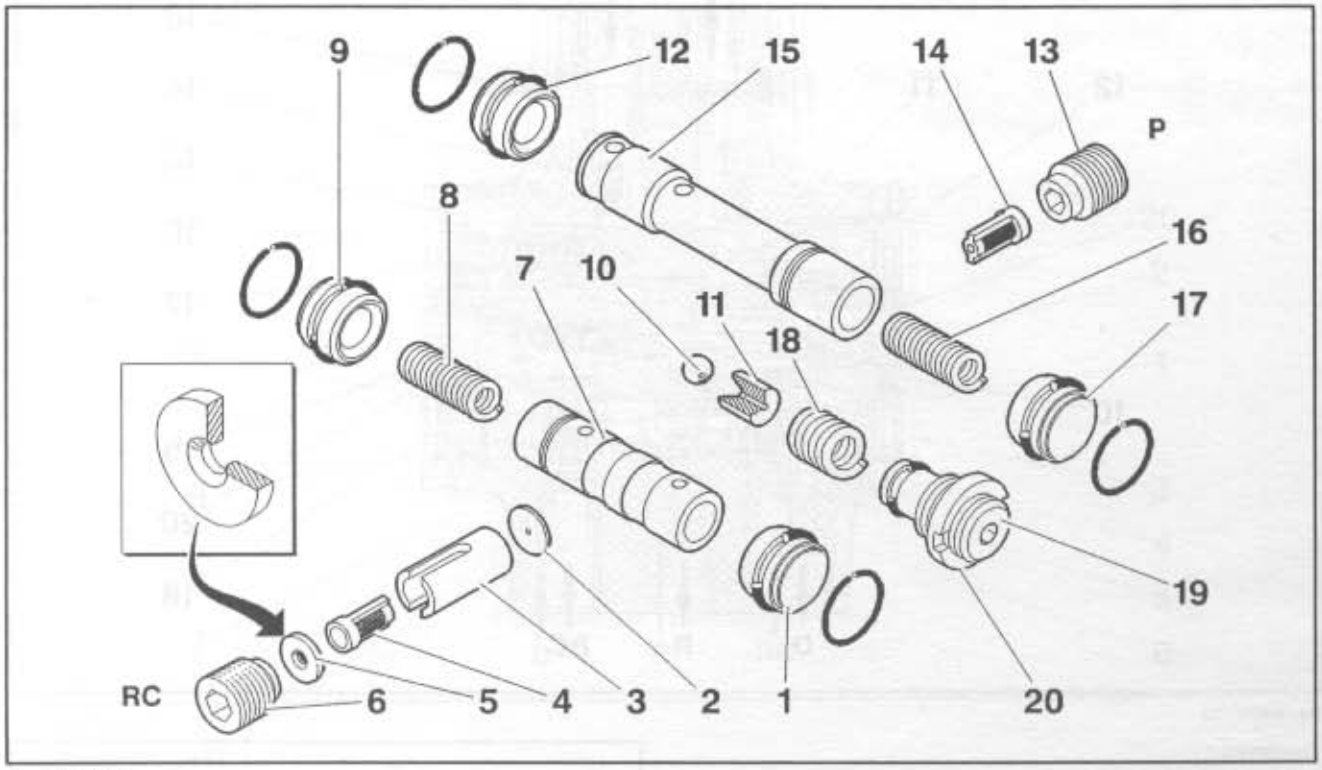

Fig : B3EP07UD

Fit new seals to :
- the 4 plugs
- the adjusting screw

Lubricate the parts with LHM plus fluid before refitting.

Fit via orifice RC (regulator return) :
- the thin jet (2), so that it is resting on its seat
- the stop (3)
- the filter (4)
- the thick jet (5), position the tapered side so that it is facing outwards
- the threaded sleeve (6), tighten to 1.3 m.daN

Fit via orifice (pump) :
- the filter (14)
- the threaded sleeve (13), tighten to 1.3 m.daN

Fit via the orifice of plug (9) :
- the regulation valve (7)
- the spring (8) (length: 30 mm)

Refit the plugs (9), (1) and (12) :
- put tool [3] into place, using the 2 nuts
- press down the plug, by means of a screwdriver
- hold the plug in place, by means of tool [3]
- fit a new circlip, using a small screwdriver

Fit via the orifice of plug (17) :
- the distribution valve (15)
- the spring (16) (length: 24 mm)
- the plug (17)

Fit :
- the ball bearing (10), so that it is resting on its seat
- the spacer (11)
- the spring (18) (length: 17 mm)
- the adjusting screw (19) together with its sleeve (20) (lightly screw against the spring)

5 – CHECKING–ADJUSTING

5.1 – Adjusting the pressure control

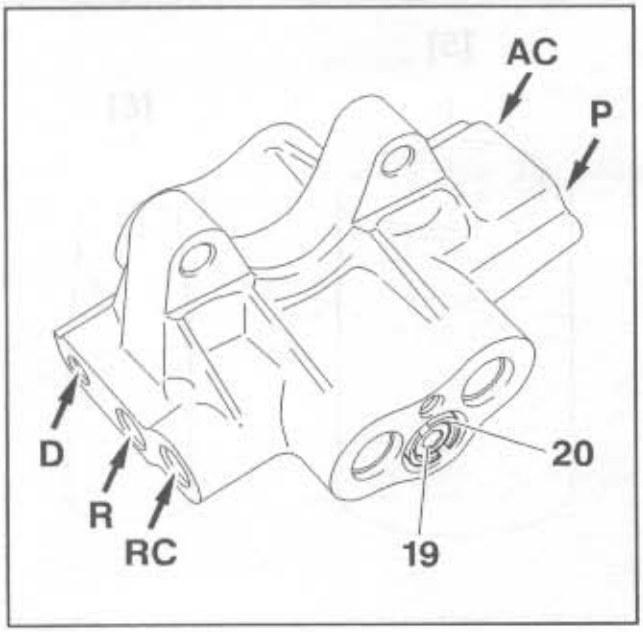

Fig : B3EP07VC

Fit the plugs [5] to the following orifices :
- AC (regulator supply)
- P (pump)
- RC (regulator return)

Equip tool [1] with the 250 bars pressure gauge.

Connect tool [1] to orifice "D" of the distributor.

Orifice "R" remains open to allow the fluid to flow freely (reservoir return).

Shut the bleed tap of pump [1].

Operate the pump with a steady action.

The pressure rises then stabilises.

The rating pressure is adjusted using the screw (19).

The fluid flows out through orifice R.

Adjustment values :

Vehicle	Calibration pressure
XANTIA (all types)	140 ± 5 bars

Turn on the hydraulic bench tap to release the pressure.

Tighten the sleeve nut (20) using a pair of thin–nosed pliers, without altering the position of the adjusting screw (19), tighten to 1,5 m.daN.

5.2 – Checking the seals

Fit a plug [5] to the orifice R.

Shut the bleed tap of pump [1].

Pressurize : 160 bars.

There must be no leak from the plugs or the adjusting screw.

Turn on the hydraulic bench tap to release the pressure.

Remove the flow distributor.

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Citroën UK Ltd Slough

TOOLS TO BE USED

4034-T: Hydraulic test rig.

Tool to be manufactured using MR diagram on page 8

MR. 630-64/80
- **A**: 1 "U" shaped threaded rod M7 x 100
- **B**: 1 ground hacksaw blade
- **C**: 4 hydraulic union blanking plugs 6.35 mm dia.

OVERHAULING A FLOW DISTRIBUTOR

OVERHAULING A FLOW DISTRIBUTOR

The procedures for overhauling the flow distributors of both CITROËN BX vehicles and CITROËN XM vehicles are identical. The flow distributors differ only by their flow rates (restrictors and springs) and by their operating pressure limits.

Operating pressure limits on the vehicle

CITROËN BX = 140 $^{+5}_{-10}$ bars

CITROËN XM = 160 $^{+5}_{-10}$ bars

DISMANTLING

Seal the orifices and clean the flow distributor especially in the areas around the caps.

Manufacture the MR tools
A and **B** (see page 8).

Removing the caps: Fig. I, II and **III**

- fit the MR tool **(A)** to the flow distributor
- fully depress the cap with a screwdriver and maintain it in this position with the MR tool **(A)**
- insert the ground end of the hacksaw blade into the bore of the limiter and slide it between the circlip and the distributor body. Lift and remove the circlip with a small screwdriver
- remove MR tool **(A)** and withdraw the cap.

STRIPPING

Proceed in the order shown. Mark the position of the springs.

Remove:

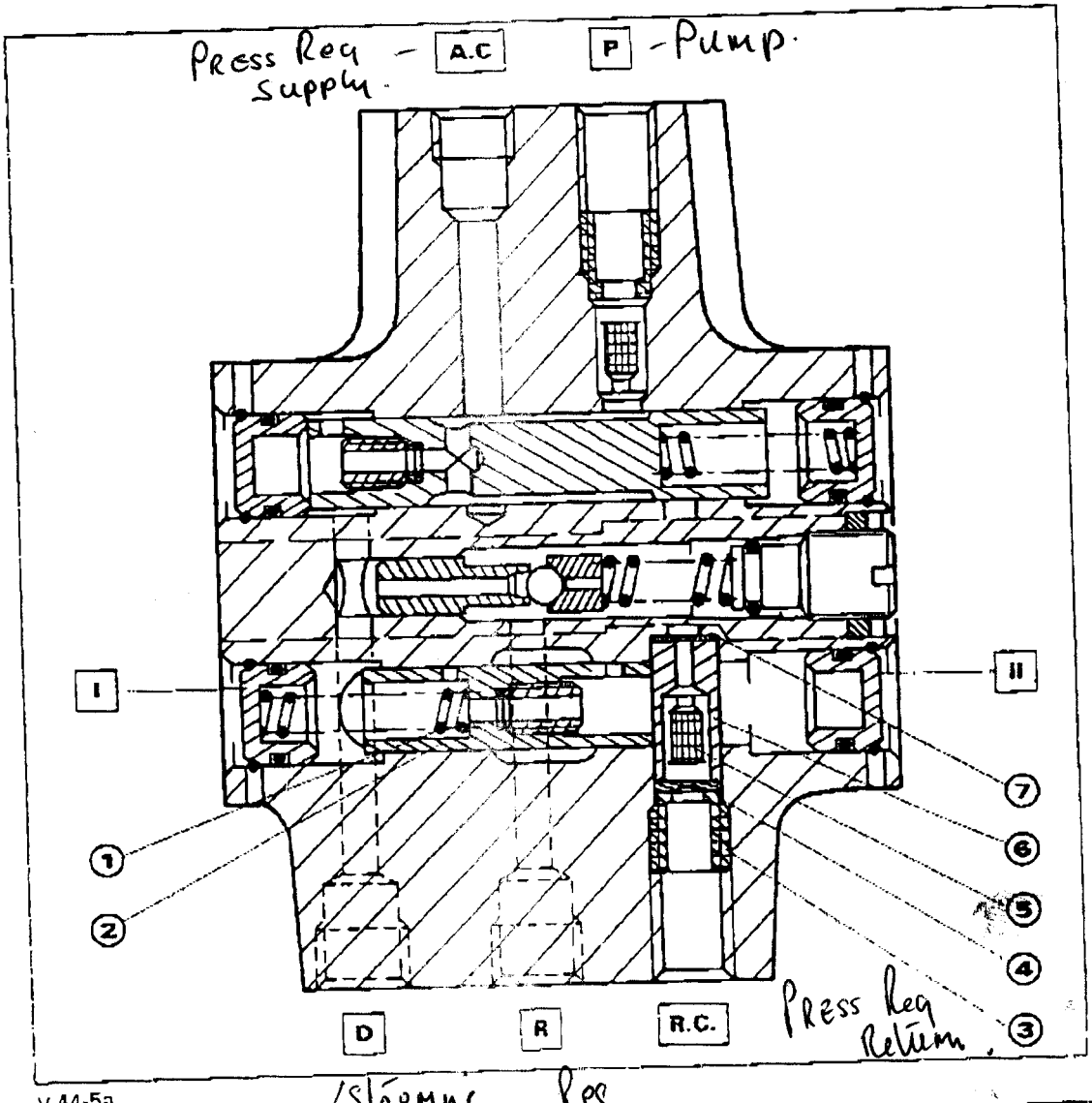
- the cap **I** ; place a cloth beneath the cap and blow compressed air into orifice **D** (steering) 4.5 mm dia.
- the spring **(1)**
- the regulating slide valve **(2)**

Remove through orifice **R.C.** (pressure regulator return):

- the threaded sleeve **(3)**
- the restrictor **(4)**
- the stop **(6)** with the filter **(5)**
- the restrictor **(7)**

Remove the cap **II**; insert a screwdriver into the distributor body and push out the cap.

92-253 92-254 92-255



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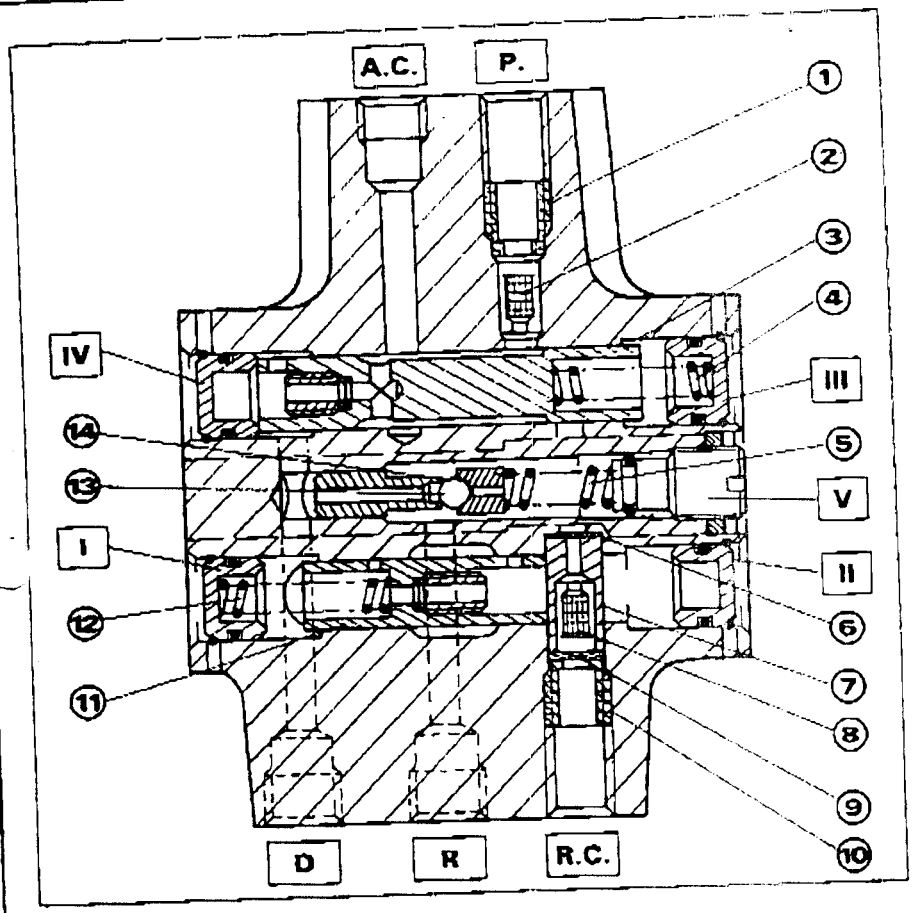

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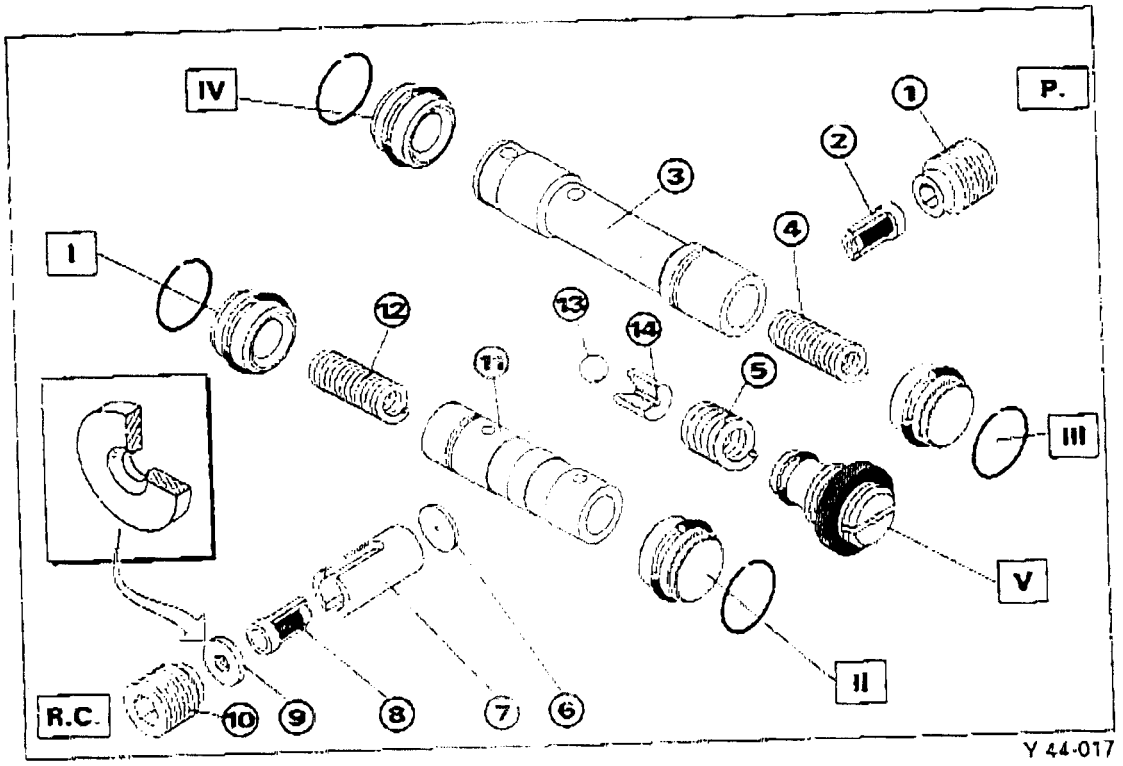

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Remove:

- the cap **III**; depress the opposing cap IV to extract it
- the spring **(4)**
- the distribution slide valve **(3)**.

Remove cap **IV**.

Remove through orifice **P** (pump)

- the threaded sleeve **(1)**
- the filter **(2)**.

Slacken the collar and remove the adjusting screw **V**

remove:

- the spring **(5)**
- the spacer **(14)**
- the ball **(13)**.

Clean and blow out the components without removing the restrictors from the slide valves.

REASSEMBLY

Fit:

- new seals to the four caps and the adjusting screw
- new filters.

Lubricate the new components with LHM **Plus** before refitting.

Proceed in the order shown.

Refit through orifice **R.C.**

- the narrow restrictor **(6) on its seat**
- the filter **(8)** in the stop **(7)**
- the wide restrictor **(9), entry cone towards the exterior**
- the threaded sleeve **(10)**; tighten to **1.3 mdaN**.

Refit through orifice **I**:

- the regulating slide valve **(11)**
- the spring **(12)**
- the cap and the circlip, fully depress the cap and maintain it in this position with MR tool **(A)**. Refit the circlip in its locating groove with a small screwdriver. **Fig. III.**

Refit cap **II**.

Refit cap **IV**.

Refit through orifice **III**:

- the regulating slide valve **(3)**
- the spring **(4)**
- the cap **III**.

Refit through orifice **P**:

- the filter **(2)**
- the threaded sleeve **(1)**; tighten to **1.3 mdaN**.

Refit through orifice **V**:

- the ball **(13)** on its seat
- the spacer **(14)**
- the spring **(5)**
- the adjusting screw **V** with its collar, tighten lightly against the pressure of the spring.

OVERHAULING A FLOW DISTRIBUTOR

Adjusting the pressure limiter

Use test rig **4034-T** with a **200 bars** pressure gauge **Fig. I**.

Fit 6.35 mm dia. blanking plugs to the following orifices, **Fig. II**:

- **A.C.** (pressure regulator supply)
- **P.** (H.P. pump)
- **R.C.** (pressure regulator return).

Connect the distributor to the test rig **4034-T** via 4.5 mm dia. orifice **D** (steering).

Orifice R (reservoir return) remains open to allow fluid flow.

Close the tap on the test rig.

Operate the pump with a regular action. The pressure increases and stabilises at the value determined by the setting of the screw **(1)**. Fluid flows from orifice **R** ➪

Open the tap on the test rig.

Tighten the threaded sleeve **(2)** with thin-nosed pliers while preventing the adjusting screw **(1)** from turning **Fig. III**.

Tighten to **1.5 mdaN**.

Pressure setting using test rig **4034-T** (*ball off its seat*)

CITROËN BX = 125 - 130 bars

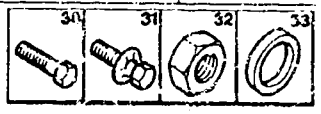
CITROËN XM = 135 - 140 bars.

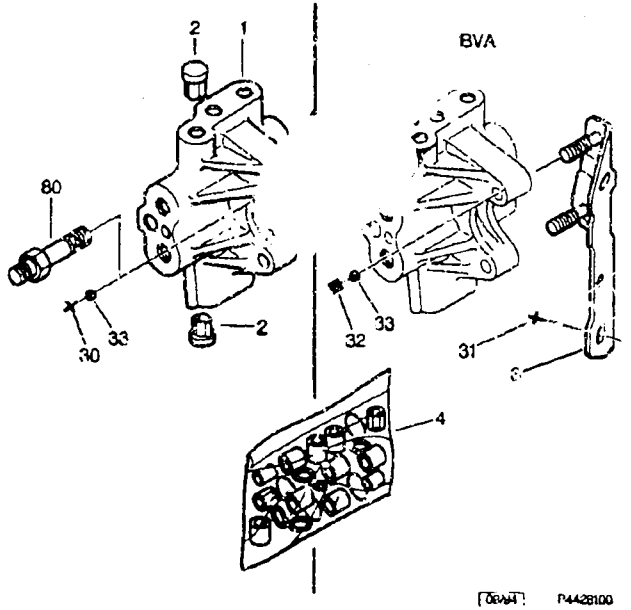
Checking for leaks:

- Fit a blanking plug to orifice **R**.
- Close the tap on the test rig.
- Subject the flow distributor to a pressure of 150 bars.
- There should be no leaks from the caps or the adjusting screw.
- Open the tap on the test rig.
- Remove the flow disbributor.

15/05/2000

STEERING DISTRIBUTOR





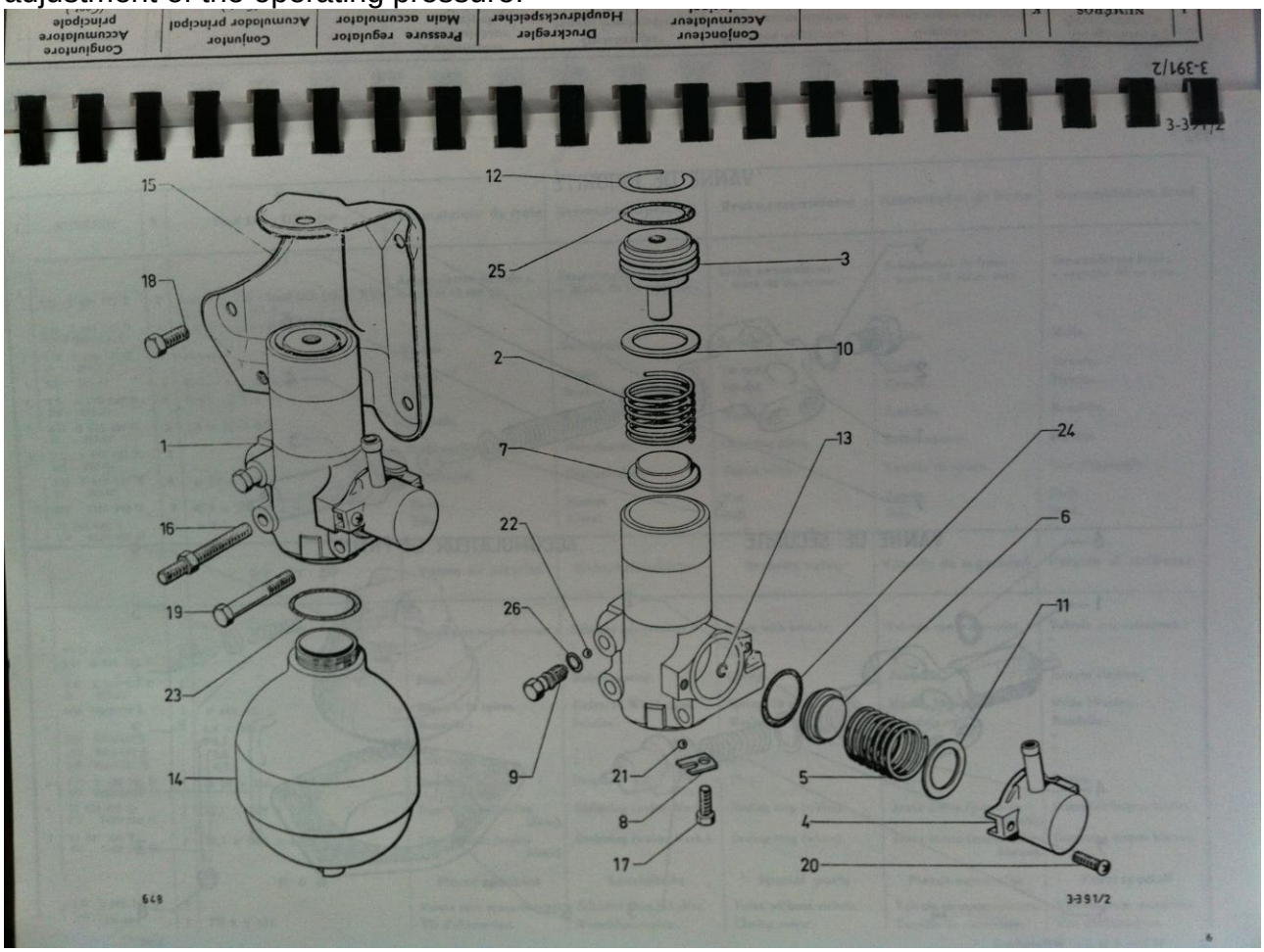
P4428100

- POWER STEERING

1	96 771 904 **RP 4024 00**	01 01	*DISTRIBUTOR*
2	**95 534 068**	02	**FILTER**
3	**96 088 843**	01	**DISTRI SUPPORT** -BVA
4	**95 069 034**	01	**REPAIR KIT**
30	79 03 101 757 **RP 6921 27**	02 01	*CAPSCREW 7X100-35*
31	79 03 201 759 **RP 6923 75**	02 01	*SELF-TAP SCREWS 6X125-25*
32	79 03 032 036 **RP 6932 05**	02 01	*HEXAGONAL NUT 7X100*
33	79 03 058 011 **RP 6962 73**	02 01	*SPRING WASHER DIAM 7,2X14,2-1,7*
80	2210 09 **RP 2210 64**	01 02	*SCREW COLUMN 7X100-15-35*
	79 03 101 757 **RP 6921 27**	01 01	*CAPSCREW 7X100-35* *-2,975L, RIGHT HAND DRIVE* *INF*

Changing Seals and Shims on a Pressure Regulator

A pressure regulator that leaks LHM slowly (small patch on the ground after being parked overnight) can be the result of a leaking seal. I've never had this low pressure leak problem with older Citroens in all the years I've been driving them, but the dreaded slow drip has been there for a while now on my daily driver XM 2.5. This note sums up the replacement of two seals (items 24 and 25 in Fig. 1) which cured this problem and the adjustment of the operating pressure.



Pressure regulators on all LHM Citroens are virtually identical and operate on the same principle. They pass fluid from the hydraulic pump to all hydraulic circuits on the car at the correct pressure, returning the supply to the reservoir when the upper pressure limit is reached and then pressurising it again as soon as the pressure drops below the cut in pressure. The PR is supplied by a 6.35mm pipe from the hydraulic pump, a 4.5mm pipe then takes fluid at the correct pressure from to all circuits, and a rubber hose returns the fluid supply to the reservoir (when the pressure lies between the cut in and cut out values).

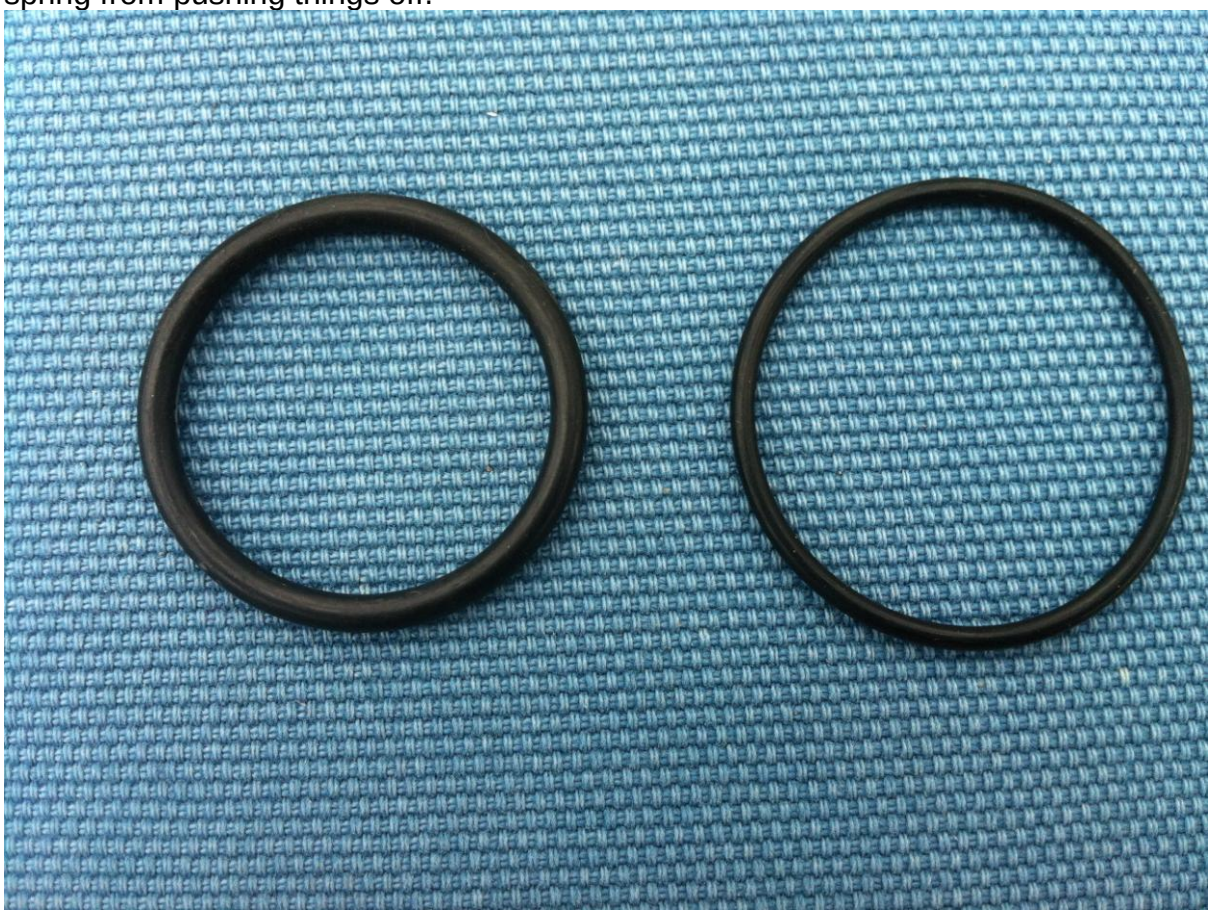
If you have a pressure gauge its worth removing the 4.5mm pipe from the PR and connecting a gauge to see what the cut in and out pressures are on the car. Shim washers (items 10 and 11 in Fig. 1) can easily be added to adjust the pressure limits upwards if necessary. Cut out is the max pressure (it should lie in the range 162-175 bar), cut in is the pressure at which the needle starts to rise again after opening the bleed screw (item 9) slightly (it should be 140-147 bar).

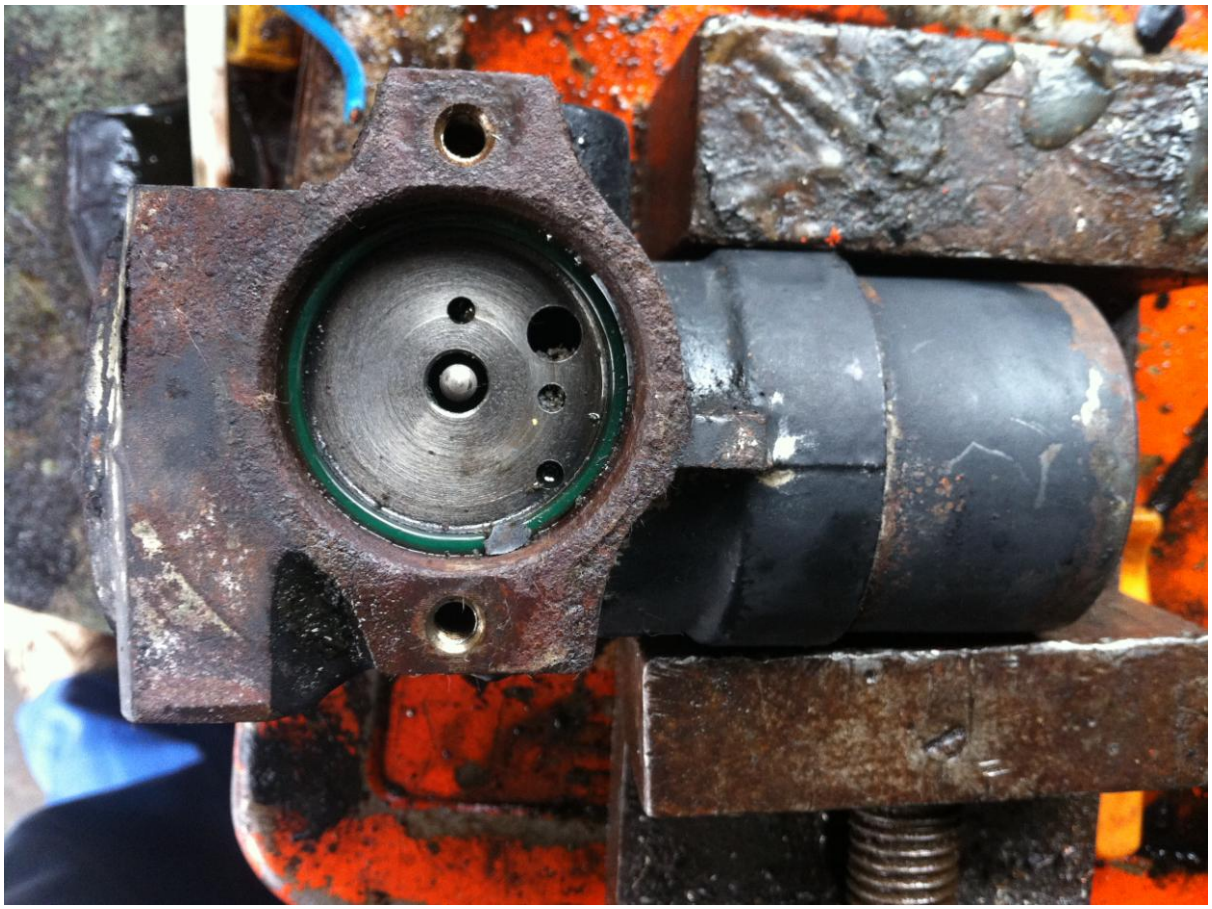
The PR is held onto the car by three bolts, 2 on the side and one on the end, and an accumulator sphere screws into it. First step is to take it off the car. Dead easy to remove on an SM and GS, just open the bonnet and set to; a bit awkward on an XM, needs to be on axle stands or ramps; difficult on a manual DS as it's low down on the inlet manifold side of the engine; afraid I can't remember how easy it is on a CX or Xantia. Once off, give it a clean externally. There are two sections that need to be dismantled, both have strong springs inside that will fly out so care is needed when dismantling - holding it in a vice or clamp is essential. Needless to say when it’s apart cleaning everything and keeping it clean is important.

First take the side unit off, which connects to the return hose (item 4 in Photo 1: its plastic on XMs and Xantia, aluminium on older Citroens). This involves undoing two crosshead or Allen key M5 bolts gradually – it needs to be held on to stop the spring causing things to fly off as the bolts come away. At one end of the spring are shim washers and at the other is an O ring seal sitting in the PR body. If the pressure reading was low extra shims can be added. They seem to be in thicknesses of 0.3, 0.6 and 0.9mm; adding a 0.3mm thick one will increase the pressure by 2-3 bar so it's easy to get the pressure in the recommended range. They measure 28mm OD and 21mm ID.

The O ring measures 33.2 x 37.0 x 1.9mm (ID, OD, thickness). It may be possible to source some that are exactly this size, but if not a supplier can provide some that are dimensionally very close indeed. The new seal just needs to be placed where the old one was, the spring positioned, the shims added and the side unit cover placed over then put back in place. Again when doing up the two retaining bolts care is needed to stop the

spring from pushing things off.





Second step is to remove the unit inside the end of the PR. This needs to be pressed in by several mm to enable a simple circlip to be removed. I use a big balljoint separator with a long central screw to depress the end against the spring force and reveal the circlip. Now if you're persistent the circlip can be removed with a couple of small screwdrivers and a hammer to get underneath it, but it can be fiddly and frustrating. An easier option is to drill a hole say 3-4mm in the side of the PR level with the circlip so that a small screwdriver or similar can be poked through it to push the circlip out. Once out, I unwound the screw of the balljoint separator and the spring pushes the assembly out.

On the top of the spring is a thick end cap with a peripheral seal. The O ring is smaller and fatter than the other one - it measures 29 x 34.4 x 2.7mm. Between the end cap and the spring are washer shims - they measure 32mm OD and 24.5mm ID. Again the seal is easy to replace and the shims can be adjusted as before. Reassembly is the reverse process, just need to be careful to ensure the assembly enters the hole centrally as it's depressed, pop the circlip back in and release.

Changing the seals and shims is a 20 min job, getting the PR off and putting it back on the car can take a lot longer than that depending on which model it is! But this is an easy DIY job really and a good way to get the system pressure right. My XM is now cutting out at 172 bar and cutting in at 147 bar, which seems to me to have sharpened the brakes a little and smoothed the ride a shade too!

the pressure regulator cuts in and out too frequently. Engine switched off, the suspension sinks too rapidly, especially if the vehicle is not equipped with anti-sink suspension (SC-MAC)- all models with Hydractive 2- from R.P.No.5928

HYDRACTIVE SUSPENSION SINCE RPO No. 05928

	INFO RAPID	XM 6
AFTER-SALES DEPARTMENT VEHICLE QUALITY	DEALER-BRANCH-AGENTS	No. 8

CONCERNED

All CITROEN XM Models - with Hydractive 2 - from R.P.No.5928.

FINDINGS

The pressure regulator cuts in and out too frequently. The suspension sinks too rapidly when the engine is switched off, especially if the vehicle is not equipped with anti-sink suspension (SC-MAC - CITROEN ANTI-SINK SYSTEM).

DIAGNOSIS

The seat "S" of one of the stiffness regulators is damaged and no longer forms a seal in the "Normal" suspension mode.

AFTER-SALES REMEDY

Change the defective stiffness regulator electrovalve.

Operating procedure:

1 Diagnosing a fault within the stiffness regulator electrovalves(s)

Connect the ELIT, select "Hydractive Suspension", then "Measure Parameters".

Put the vehicle on a ramp.

Exhaust all the residual pressure in the suspension circuit :

- switch on the ignition and lower the suspension using the manual control
- wait for the vehicle suspension to sink completely
- slacken the pressure regulator bleed screw

Front stiffness regulator :

- the front stiffness regulator electrovalve is mounted on the front subframe to the left of the height corrector, except on 24 Valve models, where it is mounted on the left hand side close to the ABS valve block
- remove the engine soundproofing undertray if fitted

PAGE 2 - b4au0kq0 - the pressure regulator cuts in and out too frequently. Engine switched off, the suspension sinks too rapidly, especially if the vehicle is not equipped with anti-sink suspension (SC-MAC)- all models with Hydractive 2- from R.P.No.5928 -

- disconnect the rubber return pipe on the electrovalve (clic clip) and plug the pipe
- connect a rilsan pipe fitted with a rubber sleeve, to the return union on the electrovalve
- insert the other end of the rilsan pipe into a clear container (empty bottle for example, to catch a possibly significant amount of fluid)
- tighten the pressure regulator bleed screw
- start the engine to pressurise the suspension circuit
- the vehicle being in the normal ride position, use the ELIT to confirm that the suspension is in the soft mode. There should be no escape of fluid
- IF THERE IS A SIGNIFICANT AND CONTINUOUS FLOW, THE ELECTROVALVE IS DEFECTIVE
- refit the electrical connector and return pipe to the electrovalve

REAR stiffness regulator :

- the rear stiffness regulator electrovalve is mounted on the subframe, above the anti-roll bar and to the left of the height corrector
- as the electrovalve is inaccessible, exhaust the pressure from the suspension circuit, then disconnect the rubber return pipe at its connection with the rilsan pipe at the left hand front corner of the rear subframe (between the subframe and the fuel tank, close to the 4-way union of the rear suspension fluid return piping)
- check the rear stiffness regulator electrovalve using the same procedure as described for checking the front

2 Remedy and replacement parts

Replace the stiffness regulator electrovalve with the defective seating "S".

The electrovalve is available from the Replacement Parts Division under reference 96 119 952.

Exhaust all the residual pressure in the suspension circuit.

Switch on the ignition and lower the suspension using the manual control.

Wait for the vehicle suspension to sink completely.

Slacken the pressure regulator bleed screw.

Remove the electrovalve.

Fit the new electrovalve and tighten to 3.5 m.daN.

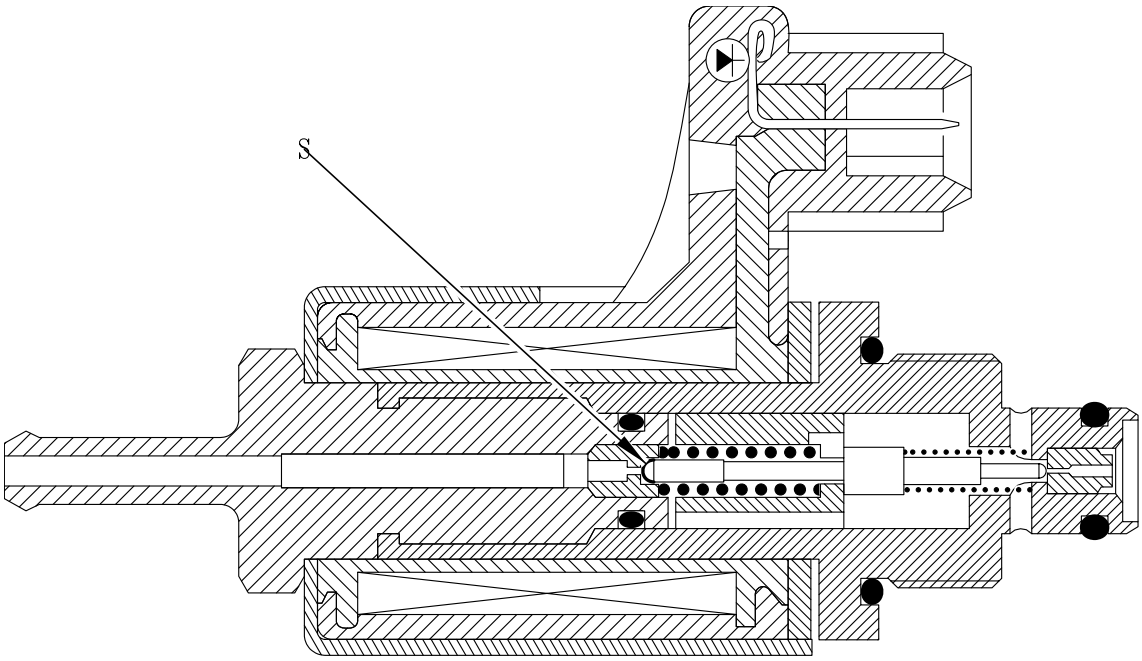
Having carried out the repair, use the ELIT to erase any possible fault codes recorded by the Hydractive suspension ecu.

Start the engine and allow it to run for approximately thirty seconds before tightening the pressure regulator bleed screw.

Labour code and invoicing time :

- labour code: front regulator: 2387 0910
- invoicing time: Petrol: 2.10hrs
- invoicing time: Diesel: 2.40hrs
- labour code: rear regulator: 2394 0910
- invoicing time: All types: 3.10hrs
- labour code: fault finding and diagnosis as described in the Info-Rapid: 1302 9999
- invoicing time: 1.00hrs

PAGE 3 - b4au0kq0 - the pressure regulator cuts in and out too frequently. Engine switched off, the suspension sinks too rapidly, especially if the vehicle is not equipped with anti-sink suspension (SC-MAC)- all models with Hydractive 2- from R.P.No.5928 -



- Fig. : 1 -

Removing an ABS sensor (rear) on a Citroen XM

The ABS sensor design using a plastic sensor in an aluminium alloy casting is just asking for trouble. Water penetrates into the gap between the plastic and the aluminium and corrodes the aluminium. The resultant aluminium oxide in crystalline form takes up more room than the original aluminium metal. The only place for the increased volume of material is to invade the sensor space and crush the sensor housing.

You can see the damage to the sensor here:

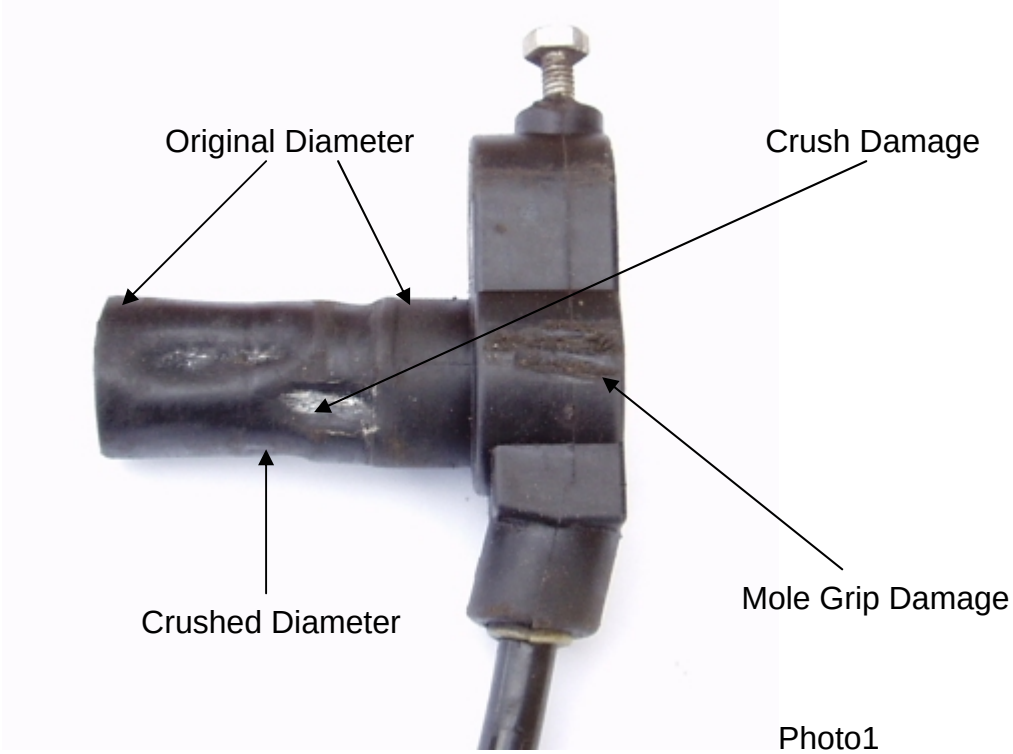


Photo1

Note the original diameter of the sensor, the crushed diameter as it passed through the aluminium and the small part of the sensor to the left which has retained its original shape/size. The teeth marks on the body in the middle to the right are the marks from the mole grips used to extract the sensor. Given time, more care could be taken to avoid these marks but they are not detrimental to the operation of the sensor.

How the sensor is fitted to the swinging arm

When the sensor is new, it's a sliding fit through the hole in the swinging arm. In order to keep the sensor the specified distance from the toothed wheel it must be able to be adjusted. This is achieved by allowing the sensor to slide in and out of the hole towards and away from the toothed wheel respectively. When the sensor is in the right location the small locking screw at the top of the sensor at right angles to the slider is tightened. This grips the slider barrel and keeps the sensor stationary. The slider itself is bolted to the swinging arm by an M6 bolt. The dust shield has been omitted from the photograph for clarity.

 ©2005 Norrie

Photo2

The end of the sensor which protrudes through to the other side of the aluminium remains in its original shape and diameter. Subsequently when you try to extract the sensor through the hole it offers a lot of resistance. Due to the corrosion the hole is smaller than the diameter of the sensor.

Photo3

 ©2005 Norrie

The order of the components can be seen here:

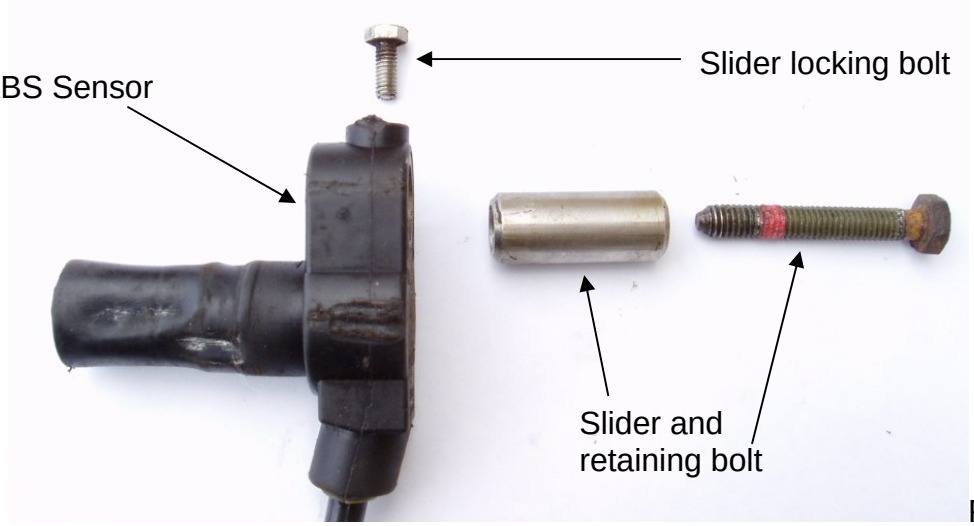


Photo4

To remove the sensor from the swinging arm:

(this assumes that the wheel, brake disk, hub and bearing have all been removed to reveal the other end of the sensor shown in photo3)
Firstly, remove the M3 bolt on the top of the sensor which holds the sensor in the right place.
Next, remove the M6 bolt which holds the slider on to the swinging arm. At this point the slider will be stuck inside the sensor housing.
Next, grip the end of the slider with a pair of mole grips and rotate. The slider will begin to rotate. Working back and forth, slowly extract the slider from the sensor housing until it is completely removed.
Next heat the aluminium with a blowtorch or oxyacetylene torch and spray the sensor on both sides with release oil. This will have to be done several times. Grip the sensor body with mole grips and attempt to rotate. Remember the body is plastic. If you force it too much the sensor will break and have to be drilled out. This process may take several hours during which the release oil is slowly penetrating the aluminium oxide to free the sensor. I didn't manage to rotate the sensor very far. You can see the indentations in the plastic in photo1. These were full of aluminium oxide stuck to the swinging arm and thus prevented the sensor from rotating more than 5-10 degrees in either direction. Keep trying to rotate the sensor until you can feel the other end moving.
If possible use a small file or Dremmel type tool to shave off some of the plastic housing inside the swinging arm. This will aid the removal as it passes through the now reduced size hole.
Once the sensor is relatively free moving, even over the restricted rotational range, use a drift and slowly hammer on the end of the sensor pushing it out of the hole. The sensor is plastic so it will deform enough to clear the hole.
The sensor is now removed.

 ©2005 Norrie

Refitting the sensor

Refitting is the reverse of removal as they say.
Clean out the hole in the swinging arm thoroughly getting rid of all the aluminium oxide.
If refitting the old sensor, just clean it up as best you can again getting rid of as much aluminium oxide as possible.
The sensor will no longer be a tight fit in the hole but it won't affect its operation. The exact position of the sensor in relation to the toothed wheel is determined by the solidity of the slider and the small bolt to hold the sensor in the right position.
Make sure that the inside of the hole in the swinging arm is painted with something to prevent the water getting to it again.
Make sure that the sensor is either well greased or covered in some waterproof, non-setting goo of some sort.
Having replaced the hub with the toothed wheel, the dust shield and the slider, push the sensor back into the hole. Push it all the way in until it hits the toothed wheel.
Pull the sensor back out of the hole by the required distance (0.6 – 1.8mm).
Tighten the M3 fixing bolt to lock the sensor in position.

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Intermittent Speedo Repair

There appear to be two common faults with the electronic speedo's fitted to XM's. In the first instance the sender on the final transmission appears to become faulty. I have read that this has something to do with water ingress into the inner parts of the sender thus corroding the internals with obvious consequences. In the case of the failure of the sender neither the speedo works nor does the trip/fuel computer. However, it's the second most common fault which this self-help file covers. The second most common fault is a failure of the multiplug on the instrument cluster inside the dashboard. In this case the sender still sends signals to the trip/fuel computer so the miles per gallon etc still work but the speedo does not work (or does but intermittently)

The fault lies in the red coloured multiplug which connects part of the instrument cluster to the outside world. The individual cables terminate in a red multiplug which in turn mates with a socket on the instrument cluster PCB. However, the individual cables are quite stiff and are expected to turn through 90deg just after leaving the multiplug. The instrument cluster is a neat fit inside the dash and the connectors are mounted along the bottom edge of the PCB. When the instrument cluster is mounted in its normal position inside the dash the bottom edge of the PCB is only just above the dash chassis. The cables leaving the multiplug face downwards and must turn sharply through 90degrees to miss the dash chassis. The individual cores are therefore in a permanently stressed state relying on the little knife edges inside the multiplug to keep them connected.

Photo 1

Cables stressed here as they leave the multiplug(s)

I don't know for sure why the core associated with the speedo should be any more stressed compared to any other core but it seems prone to failure. It may be that all cores are stressed by the same amount but because the core to the speedo is carrying only a 1v pulse (compared to other cores carrying nearer 12v) then it is much more vulnerable to degradation in contact quality.

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In any case, after many hours of searching the pcb for a dry solder joint I followed some advice from a fellow club-xm member and attacked the red multiplug. The following sequence of annotated photos guide you through the process of repairing the fault.

Removing the shroud around the instrument cluster

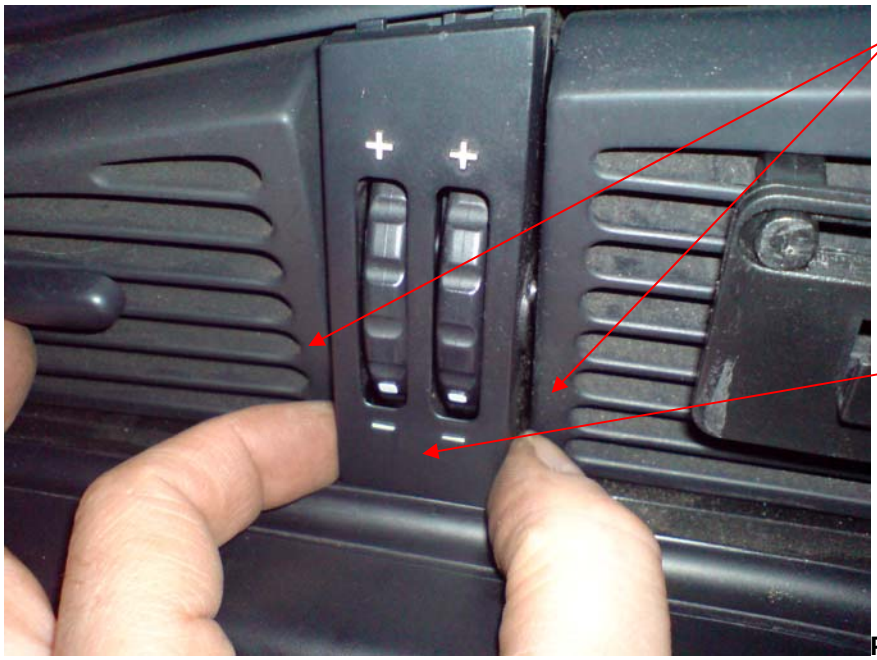


Photo 2

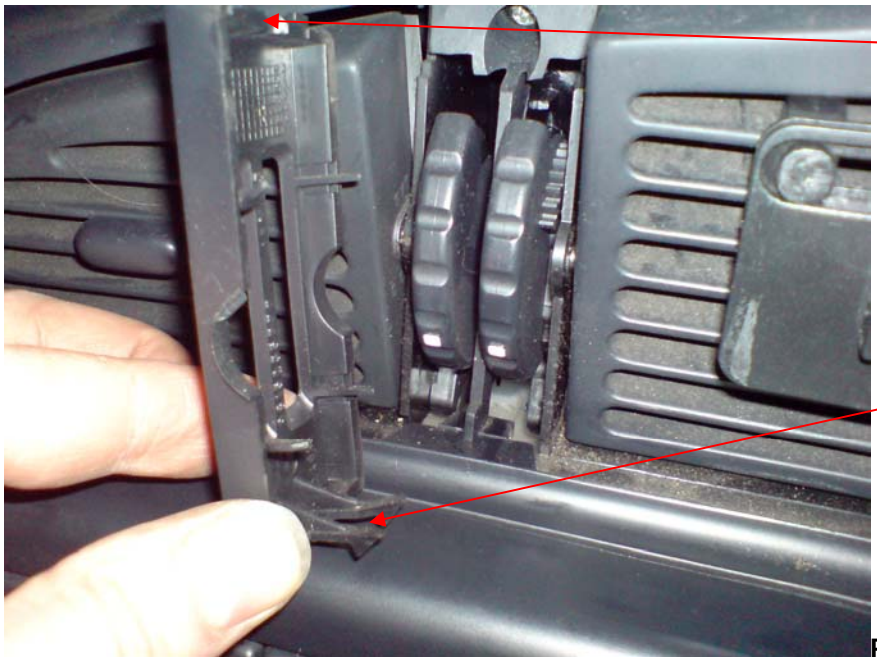


Photo 3

 ©2008 Norrie

Photo 4

Next remove the two screws which face upwards into the top part of the dash. One is located above the rev counter and the other above the temperature gauge.
Drop the steering wheel height adjustment to its lowest level to expose the two Torx screws above. Remove the screws.

Photo 5

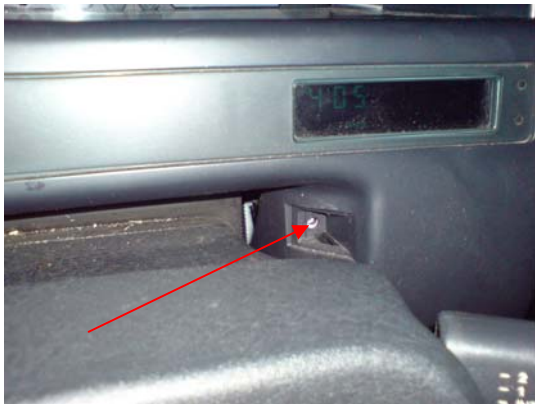


Photo 6

There are a further 5 Torx screws accessed from below as shown above. Remove these screws

Photo 7

 ©2008 Norrie

Remove the bezel from around the alarm LED

Photo 8

Remove the Torx screw behind the alarm LED bezel

Photo 9

 ©2008 Norrie

The lower half of the dash should now be free and it should pull forward at the top edge by about 10mm or so. There should now be enough clearance to be able to remove the shroud that encompasses the instrument cluster. You will find that the left hand side of this shroud gets stuck because there are two tangs which stick downwards behind the lower part of the dash. To get the shroud past the lower dash the lower dash must be prised down and towards the rear of the car by approx 30mm.

The two tangs protrude below the upper level of the lower dash and make it difficult to withdraw the shroud

Photo 10

Once the shroud is pulled free the instrument cluster is exposed. The cluster is held in by 2 screws and two nuts on captive bolts. Firstly remove the two screws one in each of the bottom corners of the cluster.

Remove 2 no screws

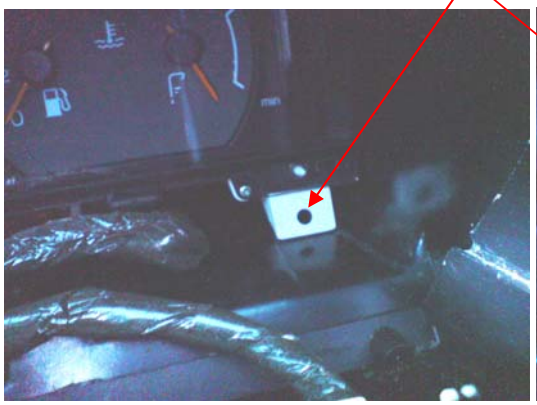


Photo 11

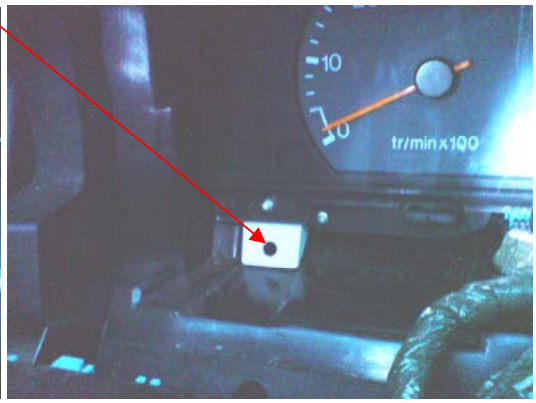


Photo 12

 ©2008 Norrie

The two nuts securing the top part of the instrument cluster are set to the back of the instrument bay and are difficult to reach. I used a flexible drive on my ¼" drive socket set with a 7mm A/F socket. Be careful. The nuts and the washers can be hard to find again if you drop them. Use a magnetic bit or screwdriver to fish the nuts and washers out to a safe place. Replacement of these is very tricky especially the right hand one. My fingers are just long enough to grab the nut between firs and second finger and just reach the end of the threaded captive bolt. With a bit of patience you can get them back on.

Photo 13

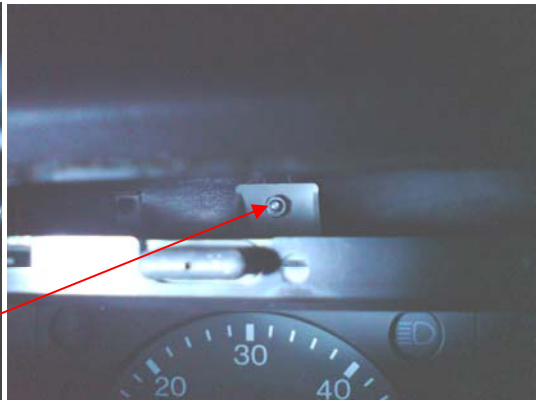
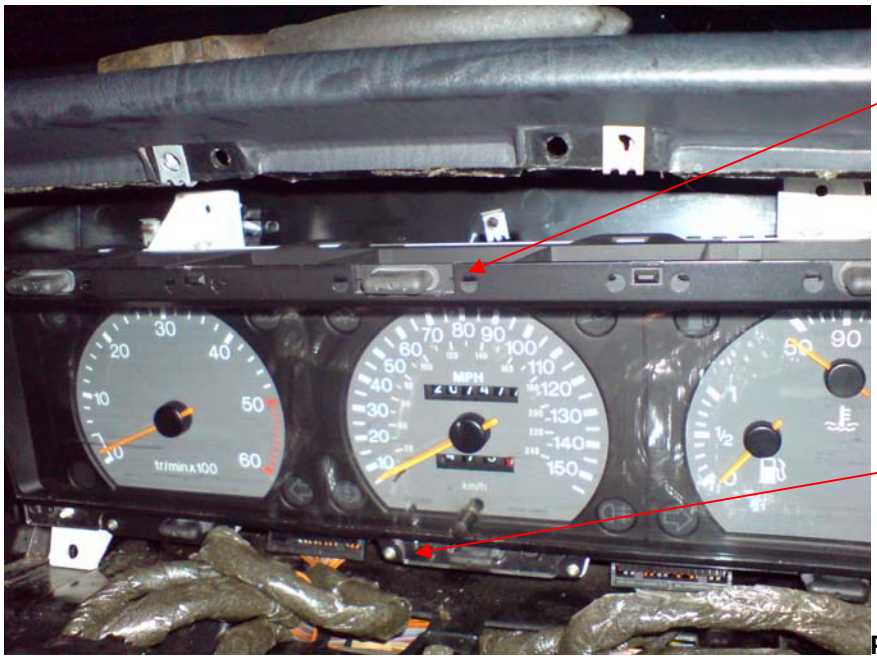


Photo 14

Securing nut

Flexible socket driver c/w 7mm socket

Now the instrument cluster should be free of all fixings. To remove the instrument cluster from the dash you must first tilt the top of the cluster towards you. The two top fixings will come off the two captive bolts.



Tilt top of instrument cluster towards you

Pull bottom of instrument cluster out slightly too

Photo 15

 ©2008 Norrie

Photo 16

Now move the instrument cluster to the left until the right edge of the cluster clears the top part of the dash. When it is clear it should be possible to pull the cluster free from the dash but still with the cables attached.

Photo 17

 ©2008 Norrie

Next, disconnect the plugs from the Instrument cluster PCB.

This is the normal "Locked" position of the plug handle.

Photo 18

Rotate the plug handle upwards and you will feel a click when the plug releases from the socket.

Black plastic "comb" which covers the cable terminations. This needs to be removed as described below

Photo 19

 ©2008 Norrie

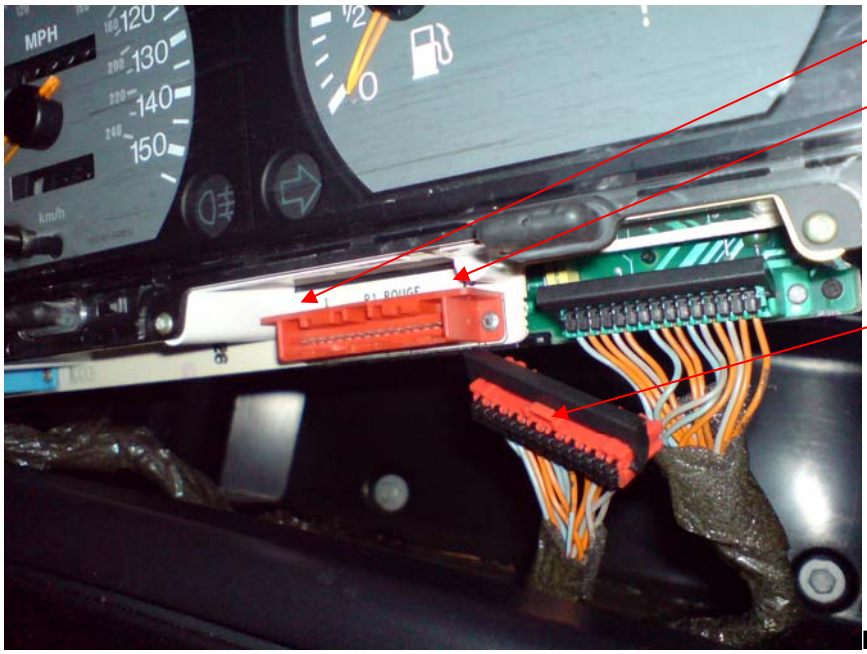


Photo 20

Disconnect all three plugs and remove the instrument cluster from the dash. This would be a good time to test all the lamps on the instrument cluster and replace any broken/missing ones. Please note some may be deliberately missing if the feature is not installed on your particular model. At this point it is also possible to access the rear of the Warning Lamp panel which houses the lamps for the ignition, handbrake, stop lamp etc etc. Check all lamps and replace as necessary.

Prise the black plastic comb as shown in Photo19 out of the plug with a small screwdriver. What you see at the back of the plug looks like this (sorry for the quality of the photograph, macro photography is very difficult with these digital cameras. There's no manual control over focus)

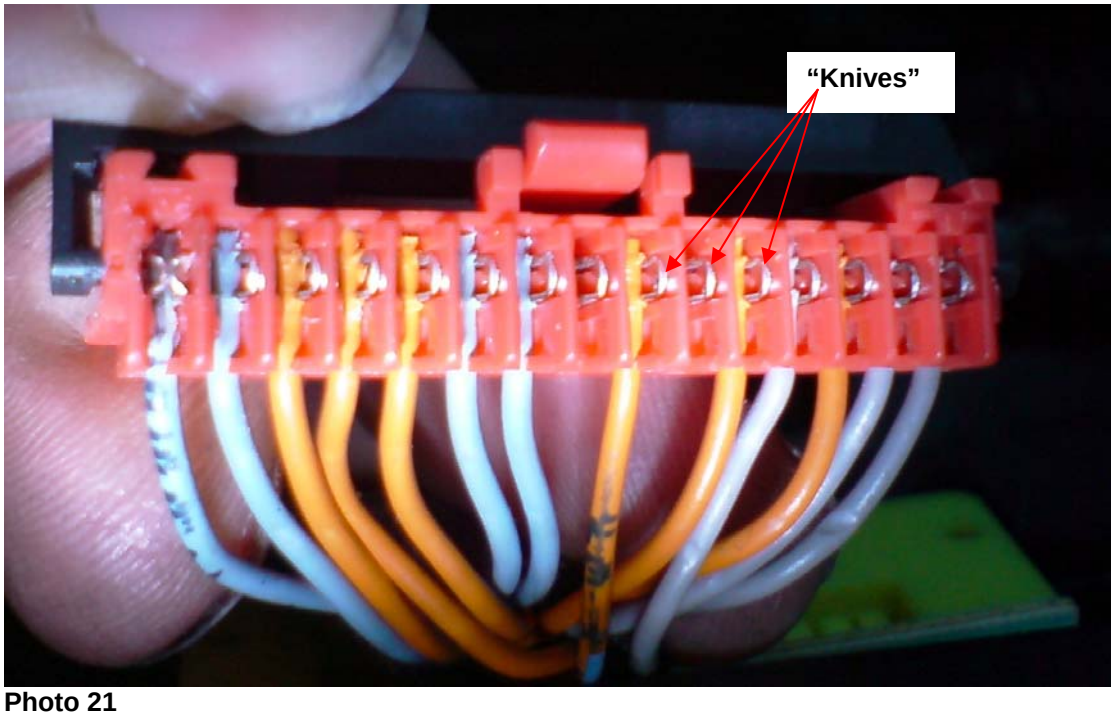


Photo 21

The cables are pressed into each cable groove by a crimping tool. As each cable enters its respective groove the sharp edges of the "knives" slice through the insulation and the copper

 ©2008 Norrie

core of the cable is trapped at the bottom of the two tapering knife edges. This is where the electrical connection is made. The cable relies on the friction between the insulation and knives to keep the cable in its groove. The black plastic comb also helps to keep them in place. However, the stress on the cables due to inadequate turning space causes the insulation to slip on the knives allowing the cable to rise out of the tapering knife edges. As it does so it loses electrical contact.

My solution was simply to bend over the tops of the pair associated with the cable with the problem. In the case of the faulty speedo the cable carrying the pulse signal from the speed sender on the final drive is connected to Pin 1. I took a pair of very small pointed nose pliers and bent over the two loops at the tops of the knives towards each other. This has the effect of pushing the cable further into the tapering knives and prevents them from coming back out.

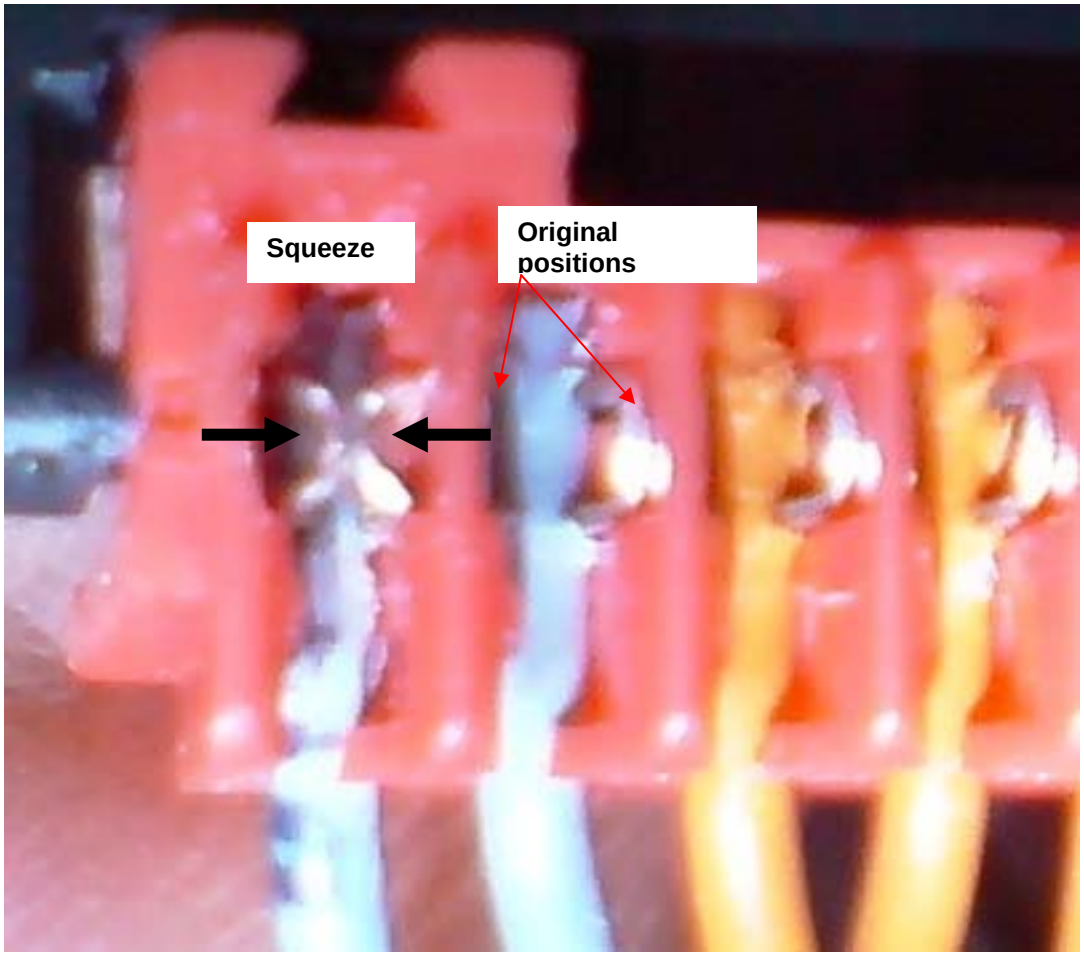


Photo 22

I only crimped the cable associated with the speedo fault. I suppose you could do the same with all of the cables on all three of the plugs. I didn't know at the time if this would fix the problem otherwise I would have done it myself.

Reassembly is the reverse of the above procedure. Remember to push the handle on each multiplug downwards to lock them into the sockets.

Many thanks to XMExclusive and Peter.N. of club-xm.com for their guidance and help in tracing the original problem.

 ©2008 Norrie

Steering Gaiter Replacement (LH side)
Citroen XM Series 2, 2.0 Turbo Manual RHD RP6785

BACKGROUND
Changing a steering gaiter sounds easy doesn't it. Don't you believe it!
Now's the time to try gluing it back together.

ATTEMPT ONE – DON'T BOTHER WITH THIS
The left hand gaiter is on the wrong side of the arm that attaches to the ram so it's not a case of removing the track rod end and sliding a new one on. I bought a nice stretchy rubber one from Motorquip hoping to pull it over the ram arm. I got a rubber wine bottle cork, just the right length, drilled a 1/2 " hole in it and pushed it over the threaded ram arm. Lubricating the cork and the gaiter with P80 (free sample from http://www.ipcol.com) I managed to pull the gaiter into place. Fitting it onto the rack was even more difficult because you can't get your hand in. Eventually it was all on and cabled tied into place….. Until I put right lock on then it pulled off. After a day playing around with jubilee clips, glue and circlips I gave up and ordered another pair from the local Citroen specialist (3 time the price but bound to be better). They turned out to be identical down to the mould number so I didn't bother trying.

Aftermarket rubber gaiter (left) is too stiff and too short to stay on and also won't close up short enough. Genuine Citroen gaiter (right) is plastic, and has slightly offset convolutions to allow it to close up short. It doesn't need any clips to hold it in place but can't be stretched over the arm.

REMOVING THE RACK

If you've got to change this gaiter then there is only one option, remove the rack assembly, take off the RH tie rod and the pinion and pull the rank through the housing. Before you do this though buy the bits from Citroen and check them carefully. There a two versions of tie rods, type A and B. Type A is 18mm and B is 22mm. Citroen have no idea which is fitted to your car and don't even know what the dimension refers to. With hindsight it's clearly the tie rod diameter because I got the wrong ones. Fortunately the LH gaiter is the same and that's the only one I really needed.

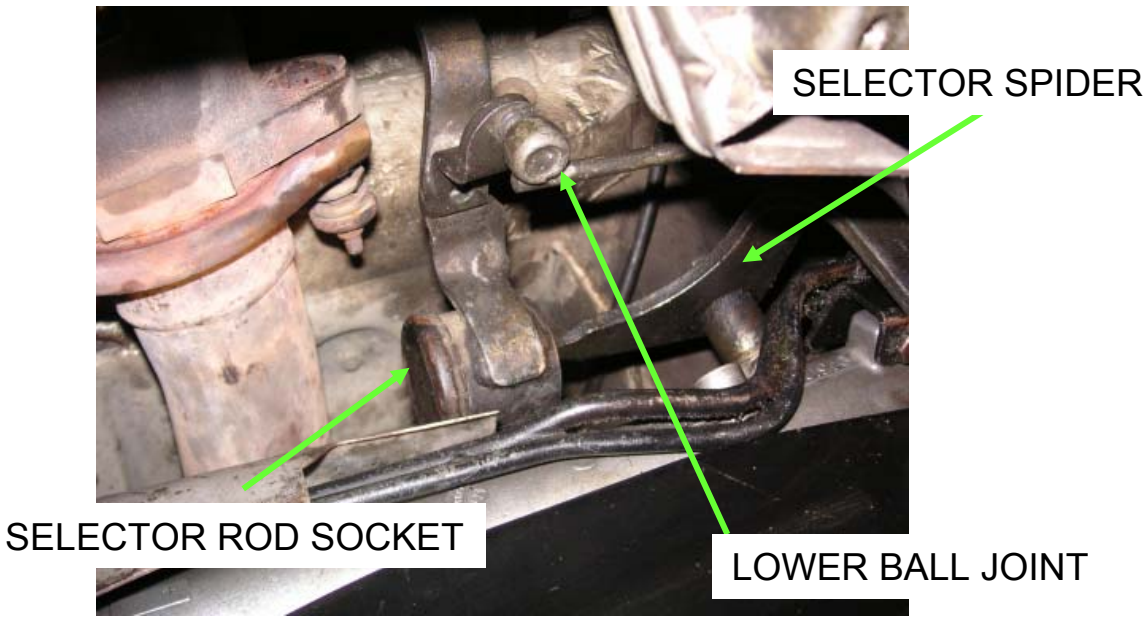
LH boot old (left) and new (right) I'm really not sure that one is diameter 22mm and the other 18mm but since the old one was undamaged and the car was in bits I put the old one back.

Same goes for the RH gaiter fortunately both of these can be replaced without removing the rack assembly.

Removing the rack assembly is not well documented so here not what I did but what I recommend:-

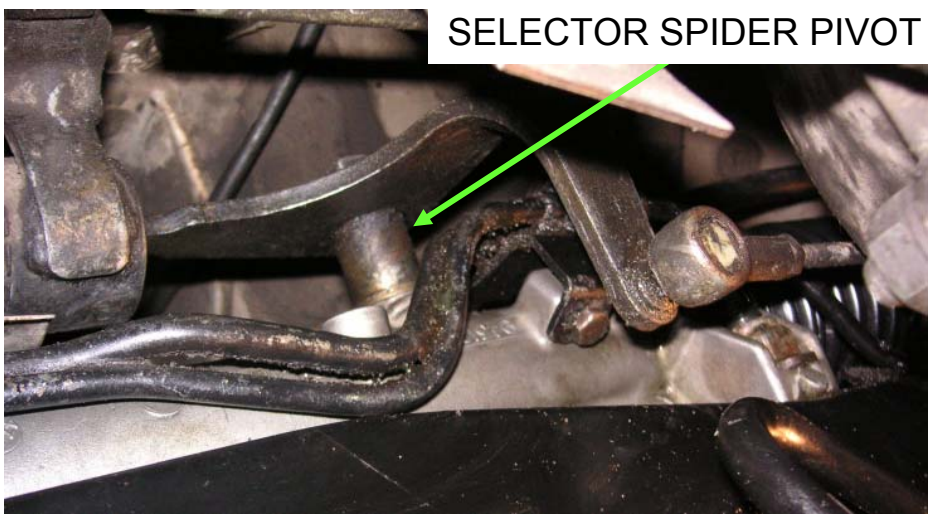
Don't do anything in the footwell.

Under the car remove the lower ball joint from the gear selector rod by twisting it with pliers.

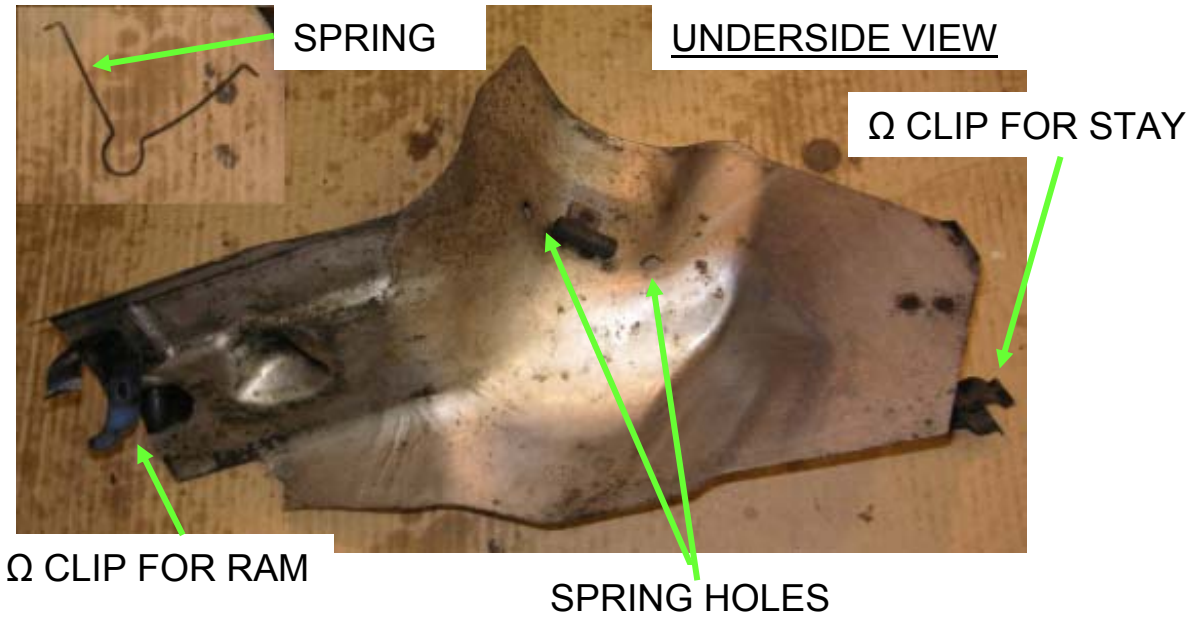


This allows the selector rod socket to be moved off the rubber ball of the spider.

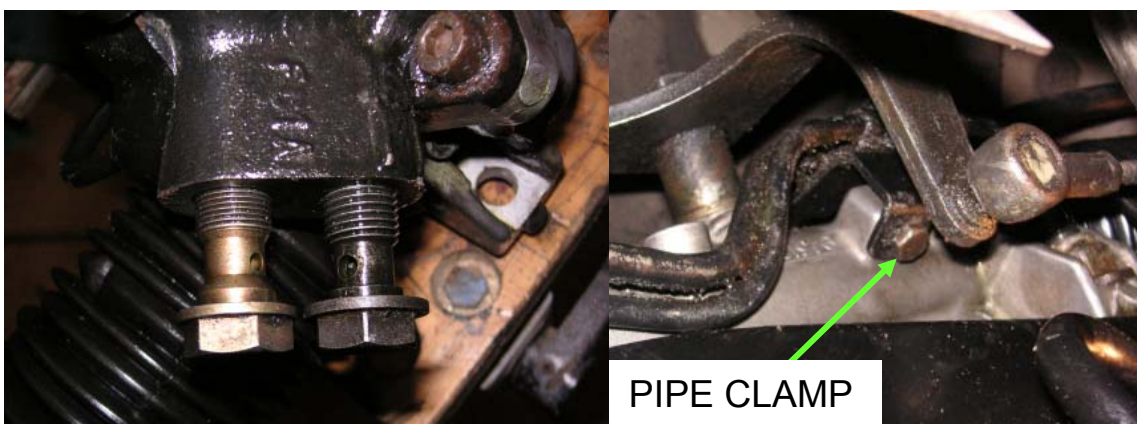
Remove the selector spider which is bolted into the top of the steering rack assembly. It has a long M10 setscrew and a mushroom washer on top, a loose bush through the middle and a thrust washer underneath before bolting into the rack casting.



Now that's out of the way the steering rack shield can be removed. This sits on the rack and is held on with two spring omega clips and a separate spring round the pinion housing. The spring round the pinion housing just has the ends of its legs poking through 6mm holes in the cover. Push one in with a screwdriver and the spring will flick off to be found later.



Now remove the two banjo bolts that hold the hydraulic pipes into the pinion housing. They are different and not interchangeable so don't be concerned as you remove them. You did depressurise the system didn't you? If not get out from under the car first!



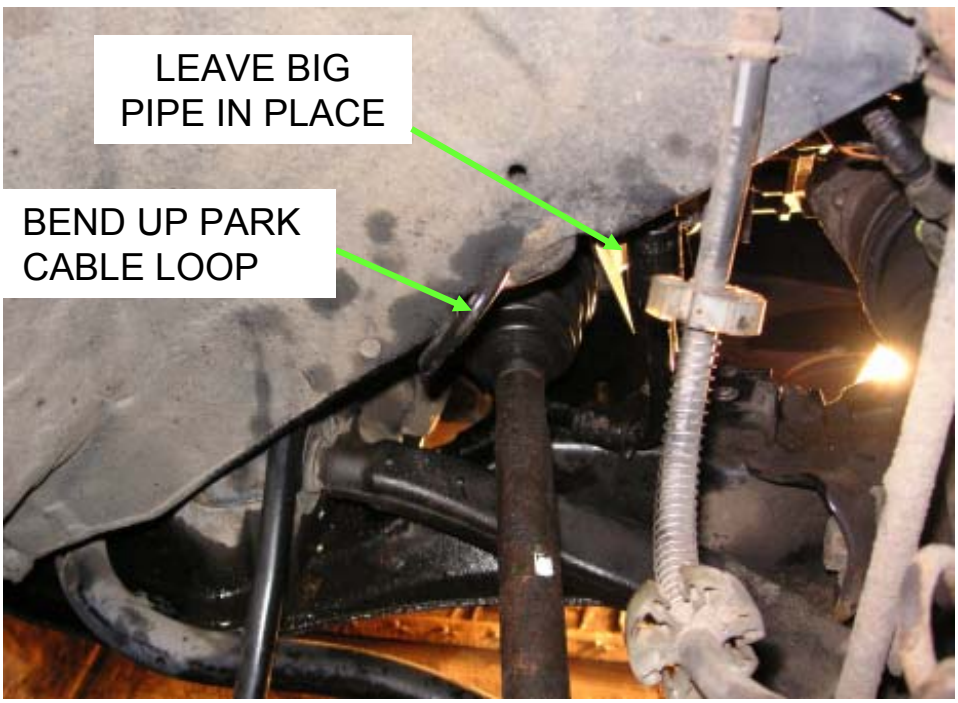
Also remove the M6 bolt that holds the pipe clamp.

Next you need to remove the steering column flex joint.
You can't get the rack out if you leave any of it in place so just undo the splined clamp pinch bolt and leave the rubber bit intact on the column. Try and mark it if you like but my attempt failed due to access and visibility and I had to move the steering wheel afterwards anyway!

Now's the time to remove the tie rod end ball joints. Easy if you've got a tool.

All that's left to do is undo the two big bolts that hold the rack housing to the subframe and remove the rack, if only…..

I've seen it suggested that removing the exhaust will help but I can't see it myself, the turbo would help but didn't seem practical. I removed the RH park brake cable and bent up the metal loop that guides it under the wheel arch. You also have to remove the RH wheel arch stay that the rack shield and ABS plug are mounted on. Removing the hydraulic pipe clamp doesn't help.



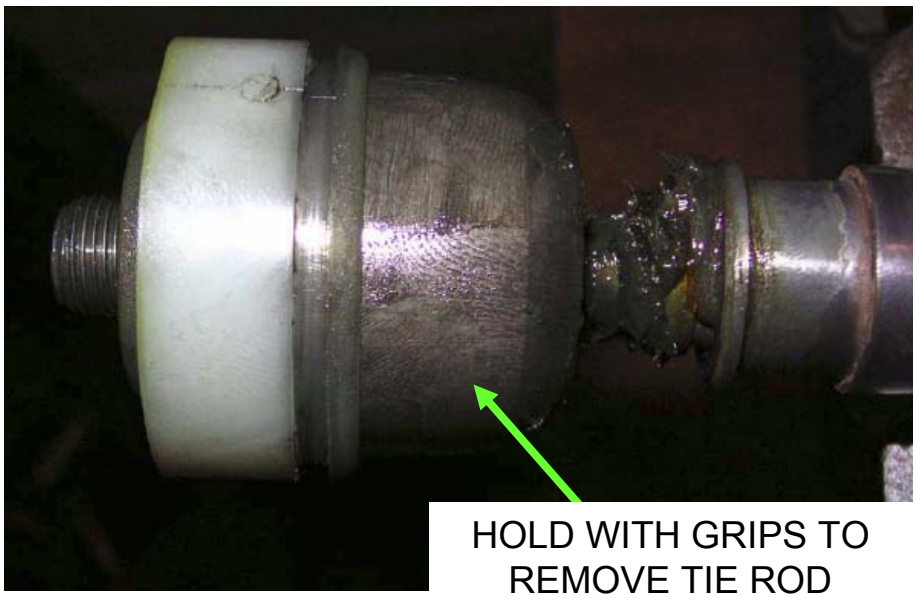
After much cursing and a lot of help the rack assembly complete with tie rods and ram attached can be manipulated out from the RH side of the car. It can honestly…..

Don't forget to collect up the penny washers shims with strange markings that the rack sits on and the rectangular washers and square nut that bolt it down. Oh and the spring from the tin cover if you haven't already got it.

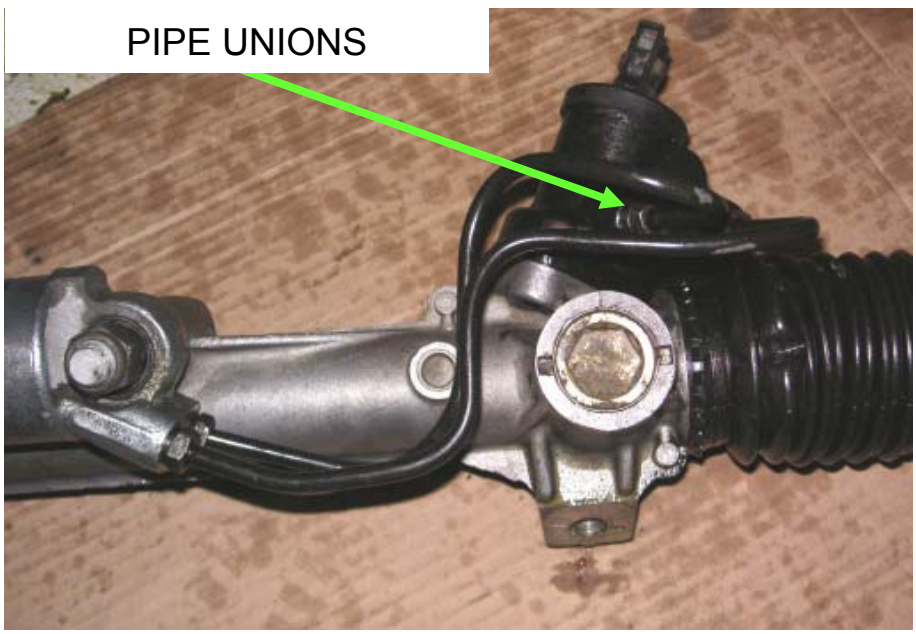
DISASSEMBLY

Now the rack assembly is on the bench give it a good clean prior to stripping.

Pull back the RH gaiter to get access to the tie rod inner ball joint. Put the rack assembly on full lock and clamp the rack in soft jaws. Mole grips on the ball joint will remove the tie rod (RH thread). It wasn't very tight.



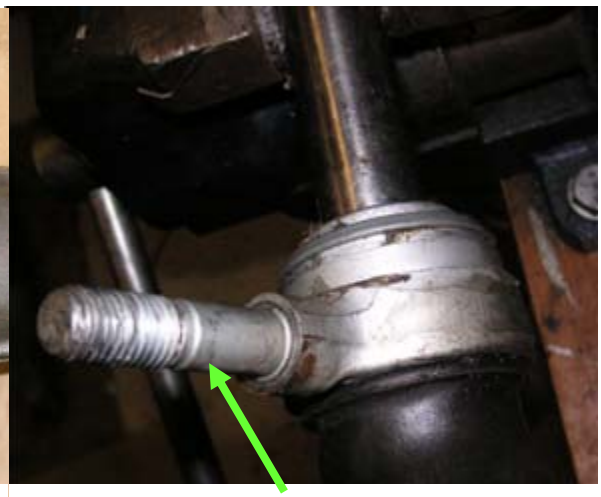
Disconnect the two pipes from the pinion housing. They are standard flares and don't require any rubber seals.



Slacken and remove the two cap heads that hold the pinion housing in place. The two flats on the pinion spline don't reference the flexi joint so you don't need to mark it.

Remove the housing then pull the rack from the main housing. The rack is preloaded behind the pinion but there is no need to disturb it.

RACK PRELOAD IS STAKED IN PLACE



THE RAM ARM THAT CAUSES ALL THE GRIEF

Once the rack is out, clean and grease it and fit the new boot.
Push the rack back in the housing and refit the pinion housing. You might need a hand to prise the rack against the preload spring to enable the pinion to engage but it's not difficult.
The pinion housing wasn't sealed or gasketed but I put a smear of silicone on for luck.

The rest of the rebuild is simple. If you've got the correct boot and gaiter for the tie rods it's probably worth changing them now?

DESPITE APPEARANCES THE RH GAITER IS ONE PIECE.

RE-FITTING

To protect the LH gaiter wrap it in newspaper before putting the rack assembly back in the car. It will need to be ripped off from the end though so don't be generous with the tape.
Make sure the clamp bracket that holds the feed and return pipes doesn't rip into the boot, it's sharp. Maybe a small piece of cardboard will protect it?

Before bolting the rack back down the pinion spline needs engaging with the flex coupling, here's where you should aim to get the steering wheel aligned, I failed.

After getting the rack assembly refitted and the pipes reconnected run the engine and cycle the rack left to right to bleed it through. Holding it on full lock will apply full pressure and check for sealing of the banjos which don't have any copper washers on. When you're happy it's leak free refit the rack shield before you refit the gear selector spider.

The rest of the assembly is straightforward but for sure the park brake cable will have come off the equaliser so that will be the final job underneath.

Unless you've been very lucky or careful, the first time you drive the car the steering wheel will be out of alignment by one spline tooth. Moving it round is easy but it does mean removing the airbag. Airbag removal is documented elsewhere but basically this is what you do:
Open the drivers electric window and wind the seat back. (You want to be as far away from the airbag as possible and you can't move these with the battery disconnected).
Disconnect the battery then go and make a cup of tea. (10 minutes I read somewhere). On your return remove the two Torx bolts in the back of the airbag, pull it forward and remove the connector. Put it somewhere safe….
Undo the big nut in the centre of the wheel then **before** removing it disconnect the wires for the cable reel. I didn't do this, the wheel came off with a jerk and the reel exploded, it took a couple of hours to reassemble.
Move the wheel round and reassemble. Finally reconnect the battery then turn the ignition on through the open window and check the airbag light. I'm sure it will be fine but better be safe!

WARNING
This document, like most on the internet is unchecked. It could be complete rubbish and may be dangerous or illegal. Acting on it without any understanding of what you are doing would be foolish. Do it at you own risk……

Peter Sturgess, July 2005 http://jump.to/.splash

Steering Lock removal and Repair
The bottom plastic column shroud must be removed to gain access to the steering lock. Once removed, locate the 8mm A/F bolt as indicated in Photo1

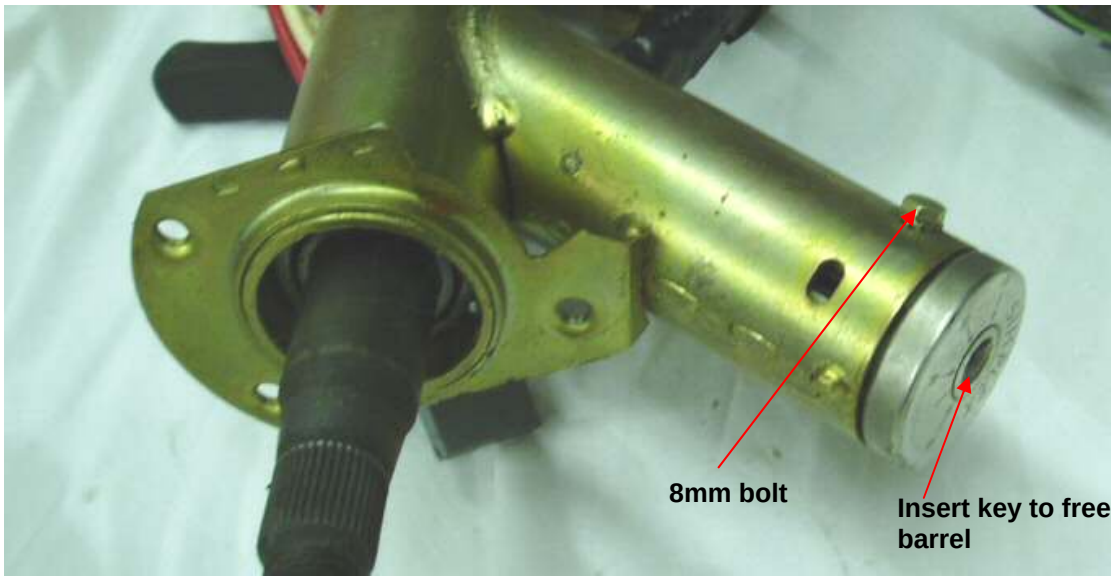


Photo1

Feed the slack cable in at the position shown to allow the barrel to slide out from the protective housing. Insert the ignition key to free the retaining pin on the opposite side of the barrel (not shown in photo)

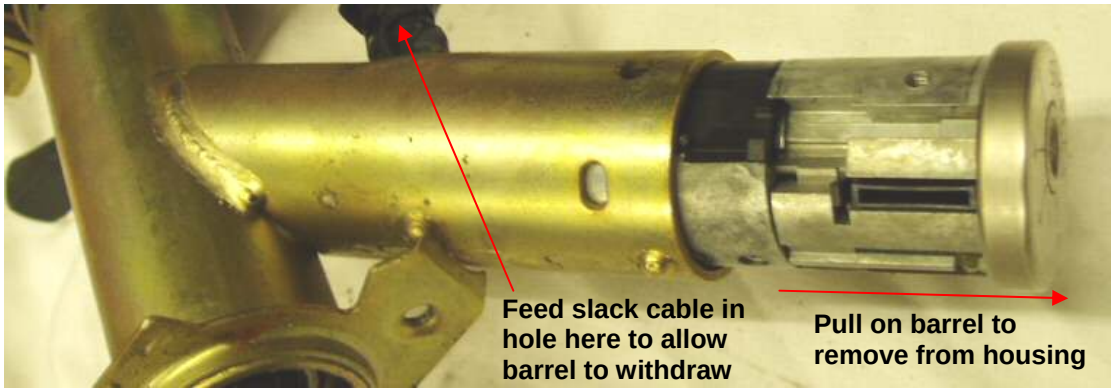


Photo2
Keep feeding the slack cable through the hole until the barrel is free from the protective housing.

 ©2005 Norrie

View of barrel assembly removed from protective housing

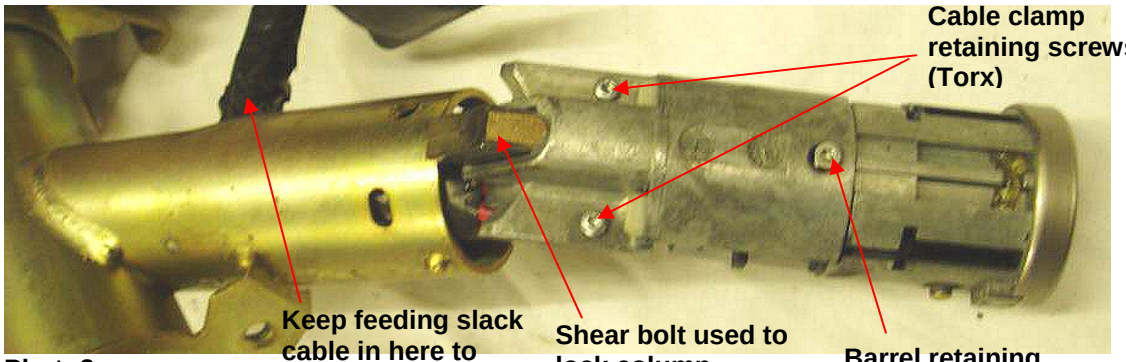


Photo3

Undo the two screws which hold the cable clamp in position. Tilt the barrel assembly with respect to the cable connector and the two halves will separate. The barrel assembly will then be free from the car and will look like photo4 below:

View of barrel removed from assembly

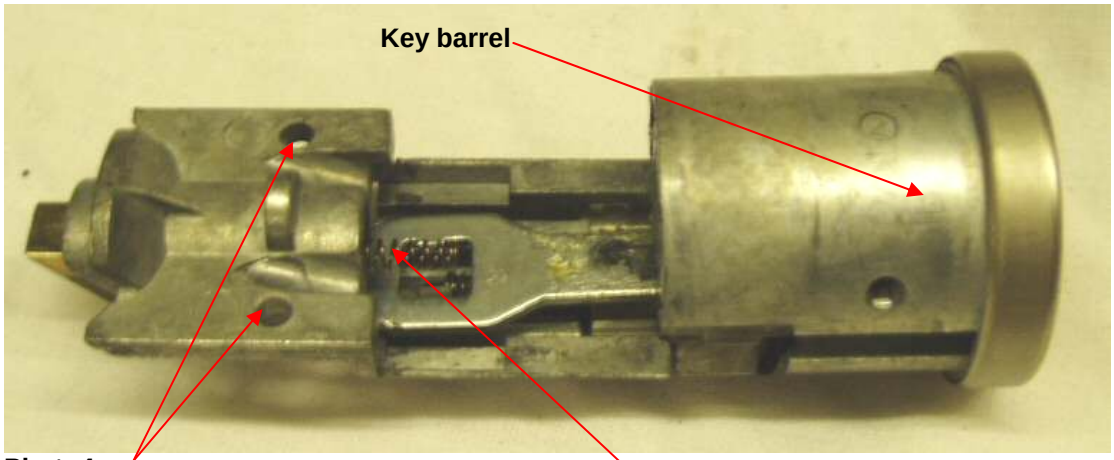


Photo4

At this point, to dismantle any more the ignition key would be required. However, I did not have the key for the above lock so I got stuck. At this stage it should be possible to lubricate any part of the barrel with grease or oil accordingly.

 ©2005 Norrie

Citroen XM
Strut Top Repair Manual

This is not a sight you want to see.

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Appendix A – Removing a strut top from the car
Appendix B – Refitting a strut top to the car
Appendix C – Aligning the parts of the strut top for left and right handed versions

Version 1.0	*Released as Draft. Further revisions will be issued in due course. Appendices A & B to be completed. Appendix C to be added. Check the Self-Help section here for updates: club-xm.com/forum*

1.0 Acknowledgements

The photos and diagrams contained in this repair manual were taken from the following sources:

- Club-XM.com/forum (thanks to Paul aka 'minijet' and Ken aka 'kenhall1202')
- http://www.aussiefrogs.com/forum (thanks to 'GreenBlood' although he in turn credits XM-L but I can't find who owns the photos. If the owner lets me know I will edit the acknowledgements)
- The author's own photographs

2.0 **Background**

There are many reasons why a Citroen XM reaches the end of its useful life. It's usually at the point where the repair cost to keep it on the road approaches or matches its residual value. For the real enthusiast the repair cost may even be more than the value of the car but is judged to be an acceptable expense to keep the car on the road.

Inevitably the reasons to scrap an XM will naturally fall into groupings of common failures. These are likely to reflect design or manufacturing weaknesses in the original assembly. Of these, one failure would appear to stand head and shoulders above all others and that is the failure of the Strut Tops, Strut Mountings or as they are called in the Citroen parts manual, "Sphere Brackets". The failure of these parts probably results in the scrapping of more XMs than all other failures.

The strut tops are the assemblies which provide the fixing mechanism between the body of the car and the suspension strut (often called a MacPherson Strut after the designer). They are fixed to the underside of the inner wings and the upper part protrudes through a hole in the wing. The strut top has a hydraulic connection from the suspension pipe network and also has a sphere attached to provide the 'spring' and the 'damper'.

There are two components which are part of the strut top assembly which are bonded together with a rubber compound injected into the annular gap between them. The anchor plate has a cone-shaped section formed on it probably by a metal spinning process. It would appear that the anchor plate is not annealed after the spinning or stamping process so the cone part of the plate has the stresses of that process locked into the steel. These stresses result in accelerated surface oxidation which in turn delaminates the moulded rubber from its surface.

3.0 Anatomy of a Strut Top

An exploded view of the parts of the strut top are shown below (sketch courtesy of Paul aka minijet from Club-XM.com) :

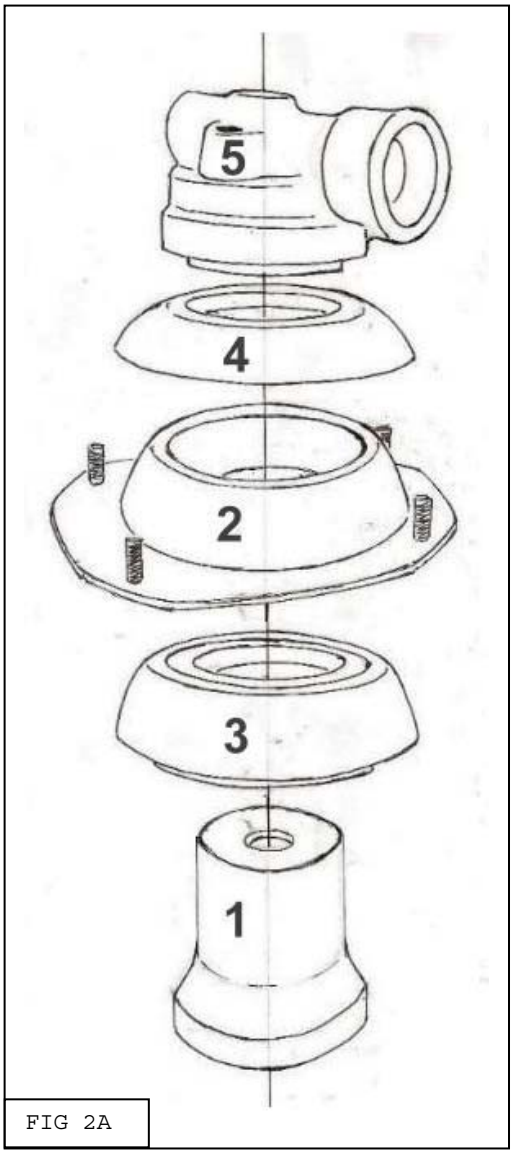


FIG 2A

Since all of these components are sold assembled as a complete part there are no official names for the individual components. Therefore we will name them here for future reference (again taking the lead from Paul's annotation of the attached drawing)

Part 1 – Lower Steel Cylinder
Part 2 – Anchor Plate
Part 3 – Injection Moulded Rubber
Part 4 – Dust Shield
Part 5 – Upper Hydraulic Block

It is envisaged that, in the factory, Parts 1 and 2 are assembled in a jig. They are then placed in a mould and the rubber (Part 3) is injected into the annular gap between the two parts adhering to the inner surfaces in the process. The assembly of Parts 1, 2 and 3 is then offered through the dust cap (Part 4) before entering the upper hydraulic block (Part 5). To lock Parts 1 and 5 together, a mandrel is entered into Part 1 from below and approximately 10 ball bearings are made to expand outwards. This stretches the steel body of Part 1 in a series of dimples which locate in an annular groove machined on the inside of Part 5. The dimples, having been expanded into the groove prevent Parts 1 and 5 from coming apart. The assembly of parts 1, 2 and 3 are not handed and would fit the right or left hand side of the car at this point in their manufacture. However, when Part 1 is offered up into Part 5, the two parts are aligned which results in the finished component being left or right handed accordingly.

This is a photo of an old strut top with an early design of retaining dimples. Originally only 4 dimples were used but due to a number of failures this was increased to 10.

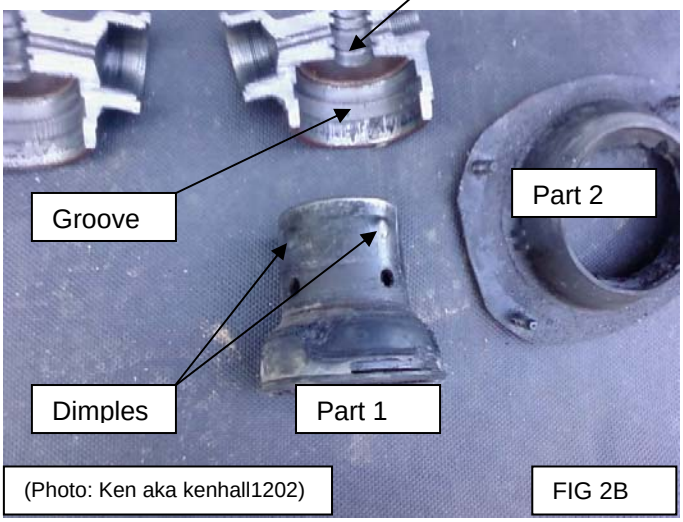


FIG 2B

4.0 Common Failure Modes

The first common failure is the deterioration of the rubber itself. After some time the Rubber Moulding (Part 3) appears to be 'torn' out of its fixings. This may occur if the strut top is subjected to greater forces than those for which it was designed. This can occur if the car is run with flat spheres and therefore the shock coming up through the strut from the roadwheel is transmitted directly through the rubber due to the lack of a 'spring' in the sphere. To make matters worse, the lower section of Steel Cylinder (Part 1) is a smaller diameter than the central hole at the top of the cone in the Anchor Plate (Part 2). When the moulded Rubber (Part 3) finally fails, the strut pushes Parts 1, 3, 4 and 5 upwards and through the inner wheel arch leaving the Anchor Plate Part 2 behind.

FIG 3A (Photo: Paul aka minijet)

There is not enough space inside the engine compartment to accommodate this extra height and therefore the strut top pushes on the inside of the bonnet lid bending it up locally in the process. This bend in the bonnet is usually severe and can sometimes break the bonnet hinges at the side closest to the failed strut top.

FIG 3B (Photo: www.aussiefrogs.com)

Here you can see the strut having pushed the strut top clear of the body and the lower part of the strut sticking through the hole that is left.

FIG 3C (Photo: www.aussiefrogs.com)

When the Anchor Plate Part 2 is removed from the car after failure this is what it looks like:

FIG 3D (Photo: Paul aka minijet)

As you can see the rubber appears to be ‘torn’ out of the anchor plate.

Once removed from the car the associated strut top looks something like this:

FIG 3E

(Photo: Paul aka minijet)

Part of the lower rim at the right hand side is missing. It is likely that this was sheared off resulting in the reduction of the diameter to allow it to pass up through the cone section of the Anchor Plate (Part 2).

A second failure mode is the delamination of the Moulded Rubber (Part 3) from the Anchor Plate (Part 2). I believe this is caused by the surface corrosion of the Anchor Plate (Part 2) due to the stresses left in the cone section during cold working with no annealing treatment afterwards. The surface to which the rubber is bonded corrodes and spalls leaving a thin film of rust bonded to the rubber but separated from the remainder of the cone. Once the rubber has delaminated from the steel cone it is then free to rotate and rise and fall with the strut. Although the rubber begins at a larger diameter than the hole in the cone on the Anchor plate, repeated impacts breaks the rubber down until at some point it can fit through the cone. Once this happens the results are the same as shown above.

A third failure mode is a slight variation on the above. In this case the cone on the Anchor Plate (Part 2) corrodes so badly that the actual steel cone fails again allowing the steel Cylinder (Part 1) complete with Moulded Rubber (Part 3) attached to come right up and through the bonnet.

So, regardless of the failure mode the end results are the same. The bonnet is damaged and would require a good bodyshop to straighten and repair the bonnet to a condition where the damage is hidden. The hydraulic piping connected to the Hydraulic Block (Part 5) is usually damaged and requires to be replaced. And finally there is a new strut top is required which, at the time of writing, is approximately £400 from Citroen, if they can actually source the parts.

However, help is at hand. In the next section

5.0 Repair Type 1

The repairs are listed in order of the severity of the failure. Repair Type 1 is not only a repair. It can be regarded as a preventative measure for strut tops which are still in good or fair condition. It is designed to halt the deterioration at the level it has currently reached and extend the life of the existing strut tops, probably until the end of life of the car as a whole.

The repair consists of adding a plate to the underside of the existing Anchor Plate (Part 2). To do this the strut top must be removed from the car (See Appendix A for removal instructions)

The Anchor Plate (Part 2) is shown here without the Rubber Moulding (Part 3), the Dust Shield (Part 4) and the Hydraulic Block (Part 5) for clarity.

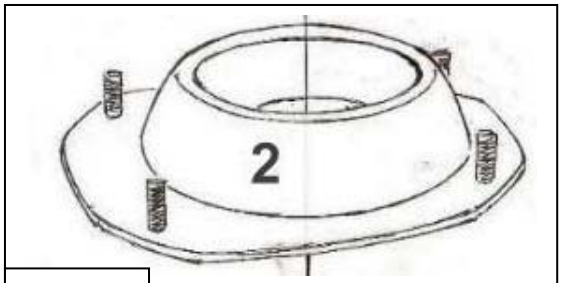


FIG 4A

Press the captive studs out of the Anchor Plate (Part 2).
Carefully clean the underside of the Anchor Plate (Part 2) so that no dust, mud or salt remains. The cleaner this is the longer it is going to last.
Clean the top half of the Anchor Plate (Part 2) as best you can. Cleaning under the Dust Shield (Part 4) will be difficult. If already torn, remove the thin rubber coating on the upper cone of the Anchor Plate (Part 2).

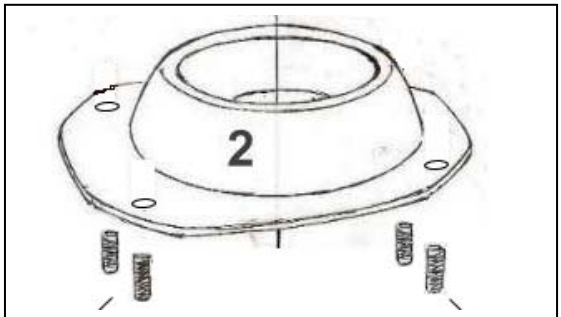


FIG 4B

Press the captive studs into the new Repair Plate (Part 2A).
Coat the underside of the Anchor Plate (Part 2) and the upper side of the new Repair Plate (Part 2A) with a good quality wax sealant.
Offer up the new Repair Plate (Part 2A) to the underside of the Anchor Plate (Part 2) passing the studs up through the original holes in the Anchor Plate (Part 2).
Press the Anchor Plate (Part 2) and the new Repair Plate (Part 2A) together.
Now carefully coat the upper and lower parts of the Anchor Plate and Repair Plate with the same high quality wax sealant.

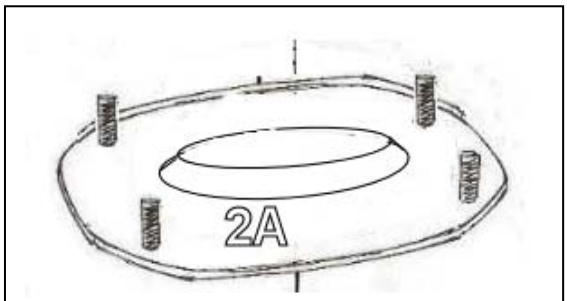
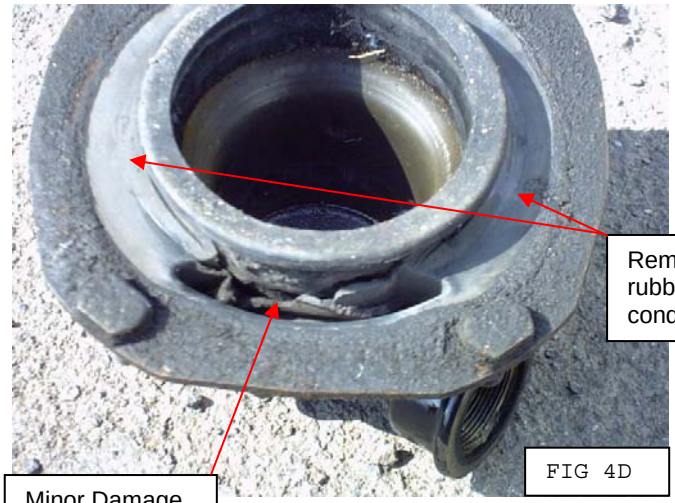


FIG 4C

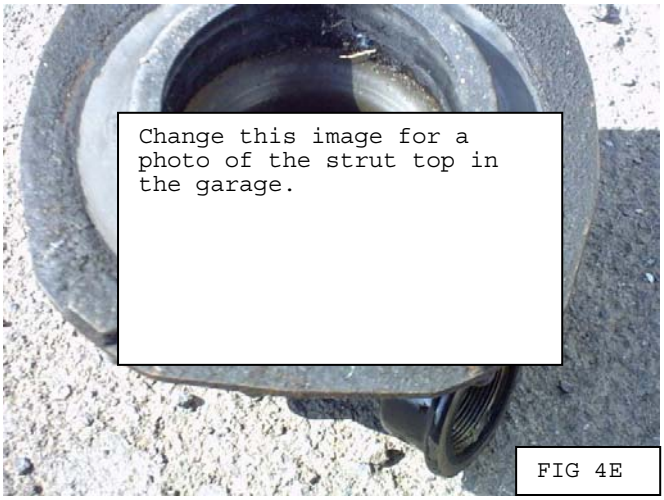
If the Moulded Rubber (Part 3) had started to separate from the Anchor Plate (Part 2) simply clean as best as you can and squeeze some wax sealant into the gap to keep the moisture and the salt out. If the rubber had become completely detached then the assembly of Parts 1, 3, 4 and 5 will need to be aligned with Parts 2 and 2A at the correct angle before tightening the nuts on Part 2A. (see Appendix C for alignment details)
Although not clear on FIG 4B, the centre hole has a bevel upwards which pushes into the Moulded Rubber Part 3 to prevent it moving.
The studs should be long enough to pass through the holes in the inner wing so that the original securing nuts can be refitted

Refit the strut top to the car (See Appendix B for refitting instructions).

This is an example of a Rubber Moulding Part 3 which has started to deteriorate but is salvageable:



This is another strut top which would be suitable for this type of repair. Although the rubber moulding Part 3 has become completely detached from the Anchor Plate Part 2 it is still in good condition and still fully adhered to the Steel Cylinder Part 1.



Ultimately it is a judgement you must make whether the rubber moulding is suitable for reuse. There are too many permutations of partial degradation to analyse them here. If you are in any doubt as to the suitability for reuse then consider Repair Type 2.

6.0 Repair Type 2

This repair is required when the Rubber Moulding Part 3 has deteriorated so such a degree that it is considered not to be reusable. In which case the Rubber Moulding (Part 3) should be replaced with a Repair Moulding (Part 3A) and a new Repair Plate (Part 2A) fitted to the underside of the strut top. To do this the strut top must be removed from the car (See Appendix A for removal instructions)

The Anchor Plate (Part 2) is shown here without the Rubber Moulding (Part 3), the Dust Shield (Part 4) and the Hydraulic Block (Part 5) for clarity.

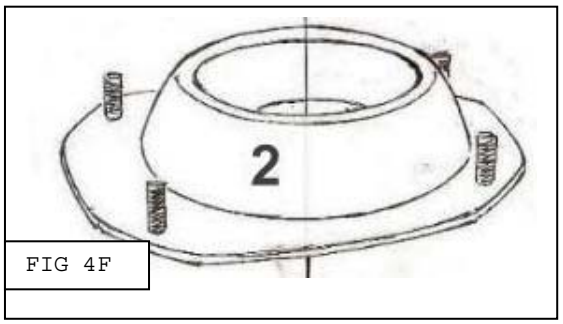
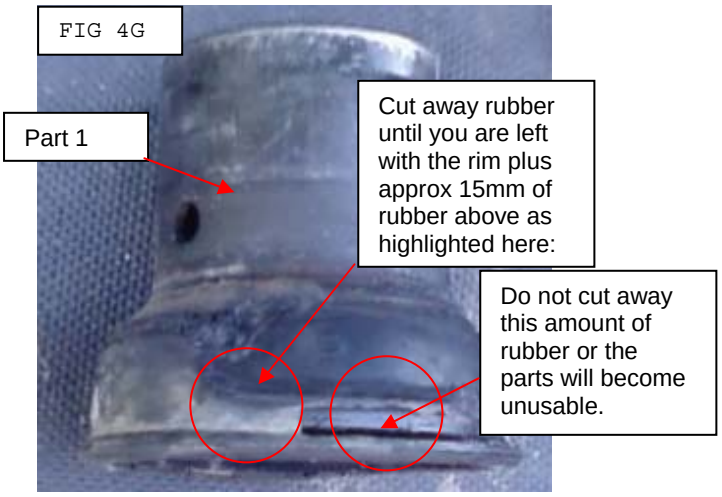


FIG 4F

Using a long sharp blade cut the rubber moulding out of the gap between the cone of the Anchor Plate (Part 2) and the cone of the Steel Cylinder (Part 1). However, do not remove the rubber rim on the lower edge of the steel cylinder. This rubber edge must be retained because the gaiter which covers the strut ram is secured using this rubber rim. If you remove it there will be no support for the gaiter. Cut out all of the rubber until there is none left except the rubber edge on the bottom of the Steel Cylinder (Part 1). The Anchor Plate (Part 2) should now be able to be separated completely from the assembly of Parts 1, 4 and 5.

FIG 4G



Press the captive studs out of the Anchor Plate (Part 2).
Carefully clean the underside of the Anchor Plate (Part 2) so that no rust, mud or salt remains. The cleaner this is the longer it is going to last.
Clean the top half of the Anchor Plate (Part 2) as best you can. Cleaning under the Dust Shield (Part 4) will be difficult. If already torn, remove the thin rubber coating on the upper cone of the Anchor Plate (Part 2). Clean off all the rust from the cone. Treat with rust inhibitor.

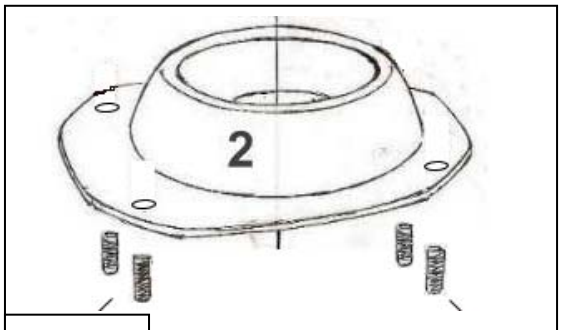


FIG 4H

Press the captive studs into the new Repair Plate (Part 2A).
Coat the underside of the Anchor Plate Part 2 and the upper side of the new Repair Plate (Part 2A) with a good quality wax sealant.

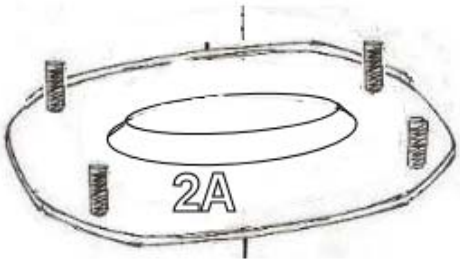


FIG 4I

If the upper assembly of Parts 1, 4 and 5 have been separated from Part 2, reassemble now by passing Part 1 down through the hole in the cone of Part 2.

Stretch the new Rubber Moulding (Part 3A) over the rubber rim at the bottom of the Steel Cylinder (Part 1). This will be difficult. Do not apply lubricant to help get it over the rim since the lubricant will then allow the new Rubber Moulding (Par 3A) to slide up and down on the Steel Cylinder (Part 1) and you don't want that to happen.

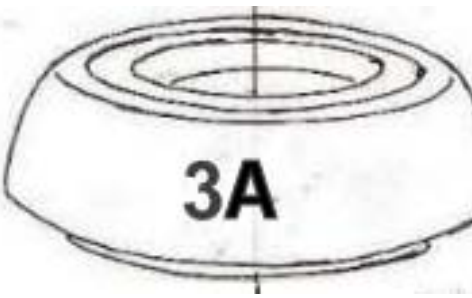


FIG 4J

Once the new Rubber Moulding (Part 3A) is beyond the rim at the bottom coat the outer surface of the Steel Cylinder (Part 1) with the injectable rubber compound. Also coat the inside of the cone on the Anchor Plate (Part 2). Offer up the new Repair Plate (Part 2A) to the underside of the Anchor Plate (Part 2) passing the studs up through the original holes in the Anchor Plate (Part 2). Press the Anchor Plate (Part 2) and the new Repair Plate (Part 2A) together. Before tightening the nuts on the 4 studs the Anchor Plate (Part 2) must be correctly aligned with the remainder of the components since the strut tops are sided. It is still possible at this point to choose whether to make a left hand or right hand strut top. See Appendix C for the correct handings.

The order of assembly is shown in Fig 4K.

Now carefully coat the upper and lower parts of the Anchor Plate and Repair Plate with the same high quality wax sealant.
Coat the lower surface of the Moulded Rubber (Part 3A) with some wax sealant to keep the moisture and the salt out.

Although not clear on FIG 4K, the centre hole has a bevel upwards which pushes into the Moulded Rubber (Part 3A) to prevent it moving.

The studs should be long enough to pass through the holes in the inner wing so that the original securing nuts can be refitted

Refit the strut top to the car (See Appendix B).

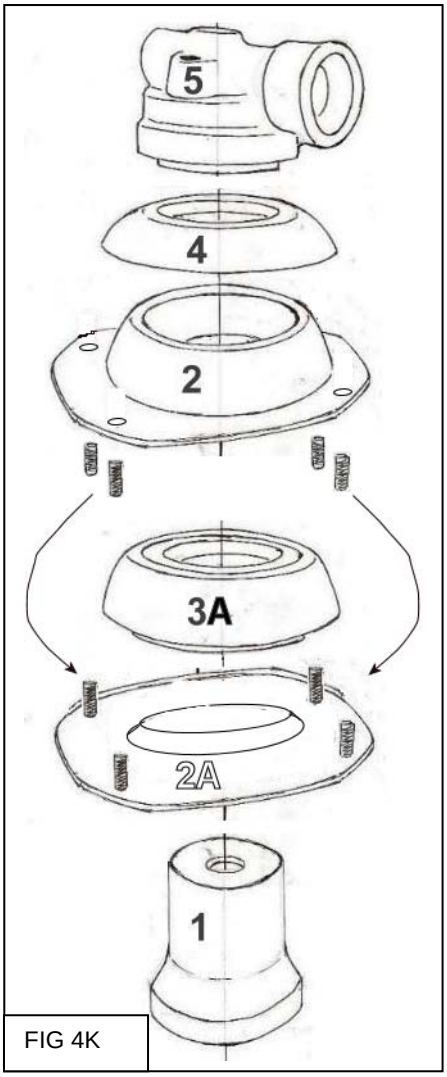


FIG 4K

7.0 Repair Type 3

This repair is required when the Anchor Plate (Part 2) is too badly corroded to re-use. In which case the Anchor Plate must be salvaged from another failed strut top or a new, remanufactured Anchor Plate (Part 2B) must be fitted.

Once in possession of a salvaged or remanufactured Anchor Plate follow the instructions for Repair Type 2.

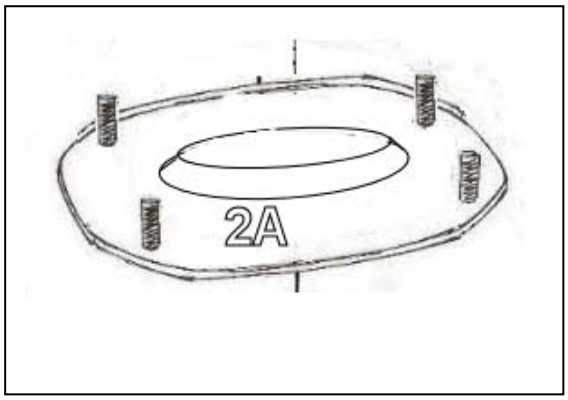
8.0 Repair Kits

The repairs listed in Section 4 require new parts to be fitted as part of the repair.

The repair kits are as follows:

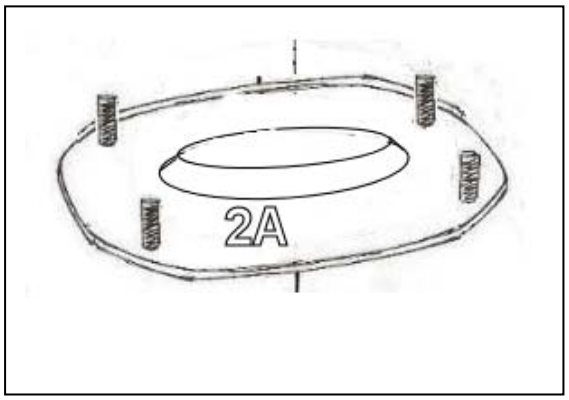
Repair Kit No. ST-RK01

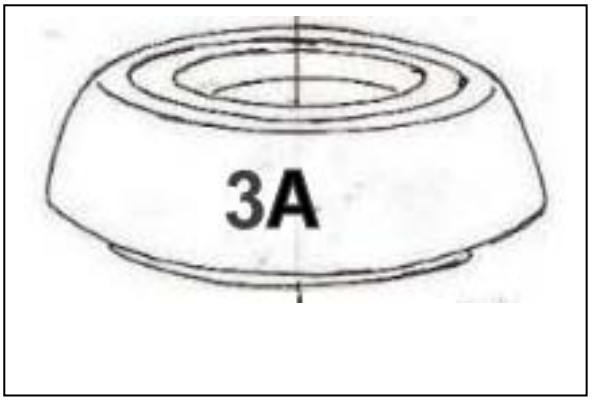
This repair kit consists of a new Repair Plate (Part 2A)



Repair Kit No. ST-RK02

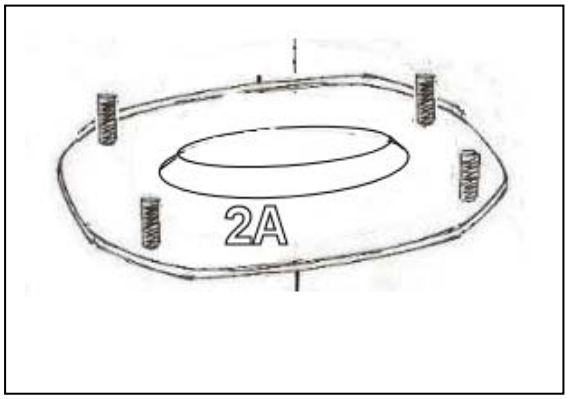
This repair kit consists of a new repair Plate (Part 2A) and a new Rubber Moulding (Part 3A).

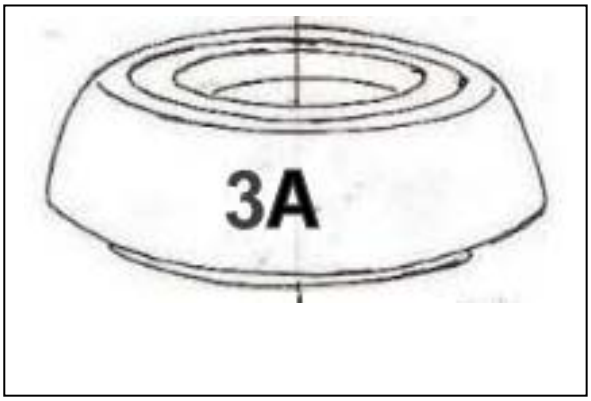


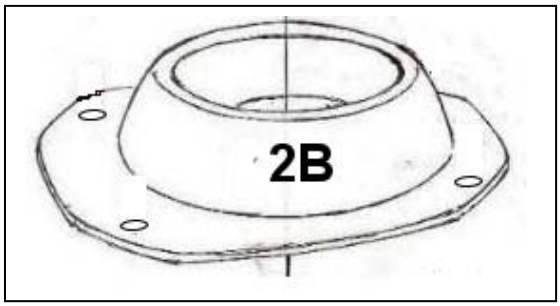


Repair Kit No. ST-RK03

This repair kit consists of a new repair Plate (Part 2A) and a new Rubber Moulding (Part 3A) and a remanufactured Anchor Plate (Part 2B).







9.0 Disclaimer

And now for the nasty bit….

As we all know we live in very litigious times. We have been brainwashed into believing that for every accident there *must* be a perpetrator. It is not acceptable that an accident just happens. Someone must be accountable and that someone must be sued and because of that risk everyone now needs insurance. Personal accountability has been all but eliminated.

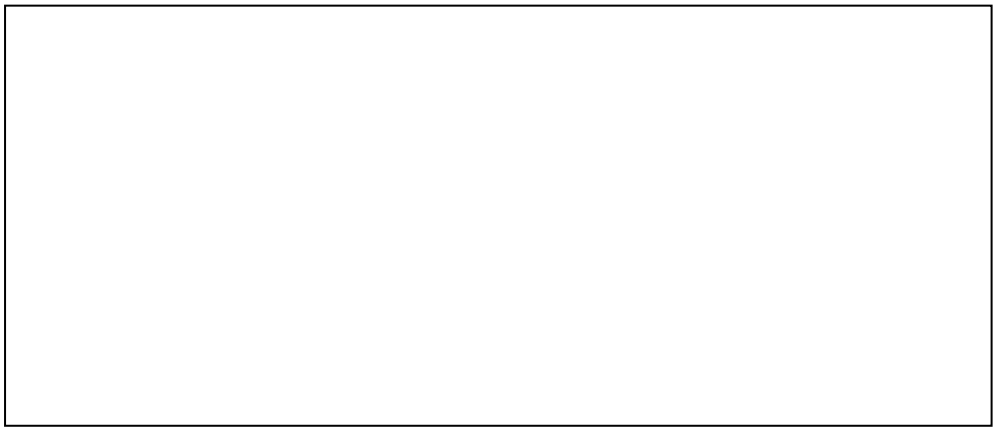
I'm sorry, I don't live in that world. I believe in personal responsibility and accountability.

The purpose of this manual is to assist the owner of a Citroen XM to keep his or her cherished possession in working order for as long as possible. It is aimed at responsible adults who understand the concept of personal responsibility. When deciding to utilise any of the information contained in this manual it is incumbent on the reader to act like a sane, sound-minded adult human being, assess the risks and take the appropriate action. If you are the kind of person who, when faced with a failure of your strut top with any permutation of consequential effects, will come looking for someone to sue then you are the wrong person to be reading this manual. **If this is you then you are expressly forbidden to read or implement any ideas or concepts contained in this document. You are in a dangerous place and should leave immediately. This manual is not for you.**

For the rest of the responsible, sane adults I hope you will find this manual of use.

The author cannot be held liable for any damages no matter of what magnitude as a result of implementing any of the ideas or concepts contained in this manual. Any use of the information is at the sole risk of the reader and implementer of such ideas and concepts. If you do not agree to this then you should burn this manual and purchase your new strut tops from Citroen.

Now it is likely that this manual will be read by some whose first language is not English. For those people, you must take a copy of this page and put it into an online language translator. No liability will be accepted on the basis of not being able to read or understand English.



The box above contains the strongest legal disclaimer in the world. It is valid in every single legal justice system in the world. The disclaimer is written in every conceivable language existing on this planet. Do not be fooled into thinking the box is empty. That disclaimer absolves me of any liability whatsoever. If, as a result of implementing any ideas or concepts in this manual, the unthinkable happens, don't even think for one millisecond about coming back here to complain or sue. I am ex-directory, operate under a pseudonym and live off-shore. Furthermore, and most importantly, I have **no money**. Suing me would gain you precisely nothing.

I hope I have made myself crystal clear. If you are in any doubt whatsoever, please put this manual in the bin.

Appendix 1

Removing a strut top from the car.

There follows a description for the removal of the strut top from the car.

Appendix B

Refitting a strut top to the car.

There follows a description for the refitting of the strut top to the car.

Appendix C

Aligning the upper and lower sections of the strut tops.

There follows a description for the correct alignment of the lower and upper parts of the strut top to achieve the left and right handings.

If your sunroof gets stuck especially in the open position:
There is a key for manual operation of the sunroof. The key is stored in the fuse box 'cupboard' below the matrix of fuses. It is clipped into place with two spring clips. The key has a Philips (or crosspoint) screwdriver at one end and a 4mm Allen (hex) key on the other.

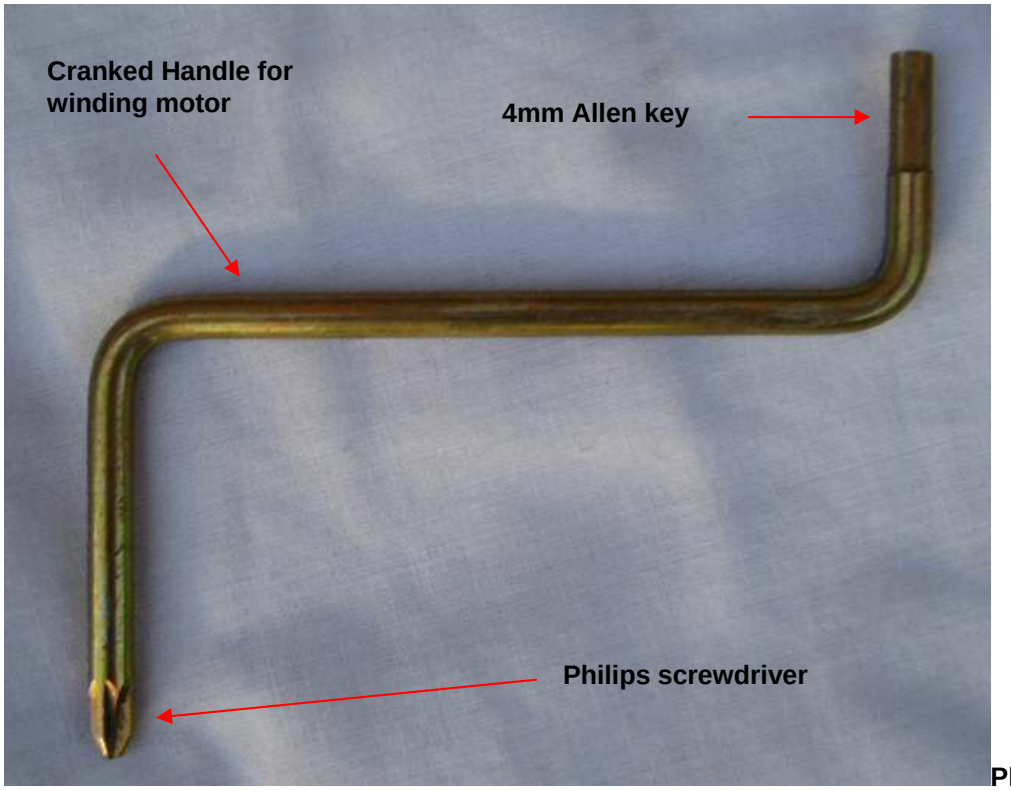


Photo1

Remove the light fitting using the Philips end of the key. This exposes the motor and gearbox. Insert the allen key in the cream coloured plastic disc. Disengage the clutch by moving the silver lever from its rest position through 90 deg clockwise. Turn the crank handle in the appropriate direction until the sunroof is closed (or open as appropriate)

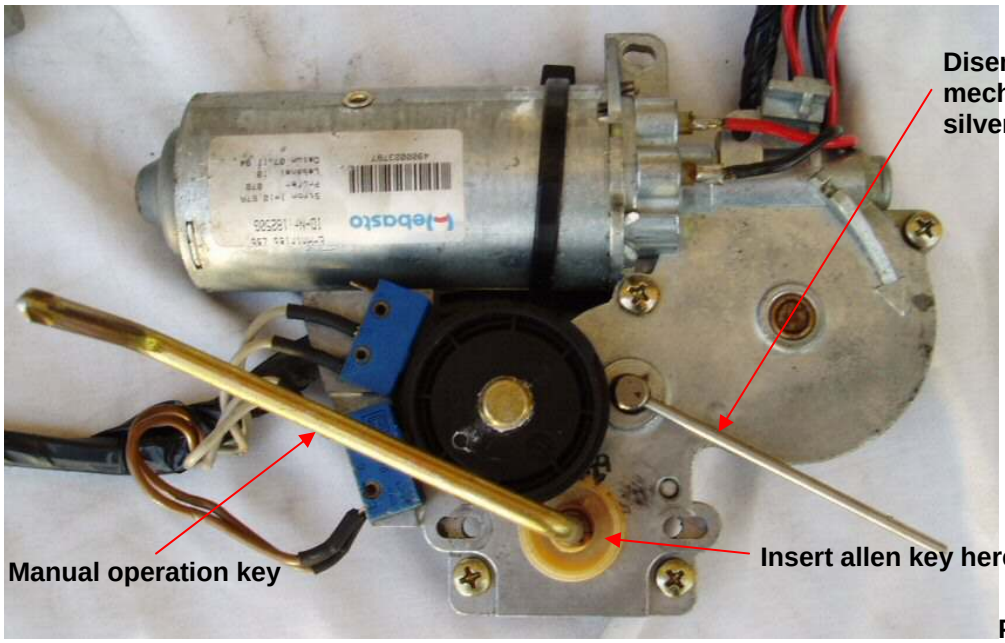


Photo2

 ©2005 Norrie

Željko Nastasić
Gábor Deák Jahn

The Citroën Technical Guide

There are many car manufacturers, makes, models and versions on the road today but—as we all know—none of them compares to Citroën in its engineering excellence, especially regarding suspension comfort, roadholding, and stability.

In this book we tried to describe how the various subsystems work. We never intended to replace service manuals or similar technical instructions. Illustrations are schematic, focusing on the principles of operation rather than on minute details of implementation.

This guide is not linked to any specific Citroën model but describes all systems and solutions used on a large number of cars from the glorious line of DS, ID, CX, GS, GSA, BX, XM, Xantia, Xsara and the C5.

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ORGA number 60

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We would like to thank the following people for their valuable contribution:

- Adam Reif (HPi diesel engine)

Fuel Injection

Electronic Fuel Injection

The Otto engine needs a mixture of fuel and air for its operation. It would be the task of the fuel supply—carburetor or injection—to provide the engine with the ideal mixture. Unfortunately, there is no such thing as an ideal mixture.

Perfect combustion, as chemistry calls it, would require air and fuel in proportion of 14.7 parts to 1 (this is the so-called stoechiometric ratio). While this might be satisfactory for the scientists, the real-life conditions of a vehicle call for slightly different characteristics.

We use the ratio of actual mixture to the stoechiometric mixture, called *lambda* (λ), to describe the composition of the mixture entering the engine: $\lambda=1$ denotes the chemically ideal mixture, $\lambda<1$ means rich, $\lambda>1$ is lean.

The best performance would require a slightly rich mixture, with the lambda around 0.9, while fuel economy would call for a slightly lean one, between 1.1 and 1.3. Some harmful components in exhaust gas would reduce in quantity between lambda values of 1 to 1.2, others below 0.8 or above 1.4. And if this is not yet enough, a cold engine requires a very rich mixture to keep running. After warming up, the mixture can return to normal, but the temperature of the incoming air still plays a significant role: the cooler the air, the denser it becomes, and this influences the lambda ratio as well.

All these requirements are impossible to satisfy with simpler mechanical devices like carburetors. Electronic fuel injection provides a system that can measure the many circumstances the engine is operating in and decide on the amount of fuel (in other words, the lambda ratio) entering the engine. By carefully adjusting the internal rules of this device, manufacturers can adapt the characteristics of the fuel injection to the actual requirements: a sporty GTi would demand rather different settings than a city car; besides, catalytic converters have their own demands that, as we will later see, upset the applecart quite vehemently.

Earlier fuel injection systems only knew about fuel, the ignition was supplied by traditional methods. Later on, these systems (now called engine management systems) took on the duty of generating the sparks as well. But even with this second incarnation, the fuel injection part remained practically the same, thus the following section applies to both kind of systems.

Fuel injection

The two most important inputs describing the actual operating condition of the engine, thus determining the fuel demand are the **engine speed** (revolution) and **engine load.** The engine speed can be measured easily on systems using traditional ignition: the ignition primary circuit generates pulses with their frequency proportional to engine speed (the tachometer uses this same signal to show the rpm to the driver). When the injection system provides the ignition as well, it cannot at the same time rely on it, so an additional sensor is used instead.

The engine load is usually determined by measuring the quantity of air the engine tries to suck in. There are various methods of attaining this: earlier systems used a flap which is deflected by the air flowing through the sensor—the angle of deflection is proportional to the amount of air passing through **(air flow sensor, AFS).** Later systems used a pressure sensor measuring the pressure inside the inlet manifold **(manifold absolute pressure, MAP sensor).** Yet another system (although not used on Citroëns) heats a platinum wire and lets the incoming air passing around cool it; by measuring the current needed to keep the wire temperature at a constant value above the temperature of the incoming air, the mass of air can be determined. Some simpler systems do not even measure the amount of air but use a pre-stored table in their computer to approximate it based upon the engine speed and the position of the throttle pedal—not that accurate but certainly much cheaper.

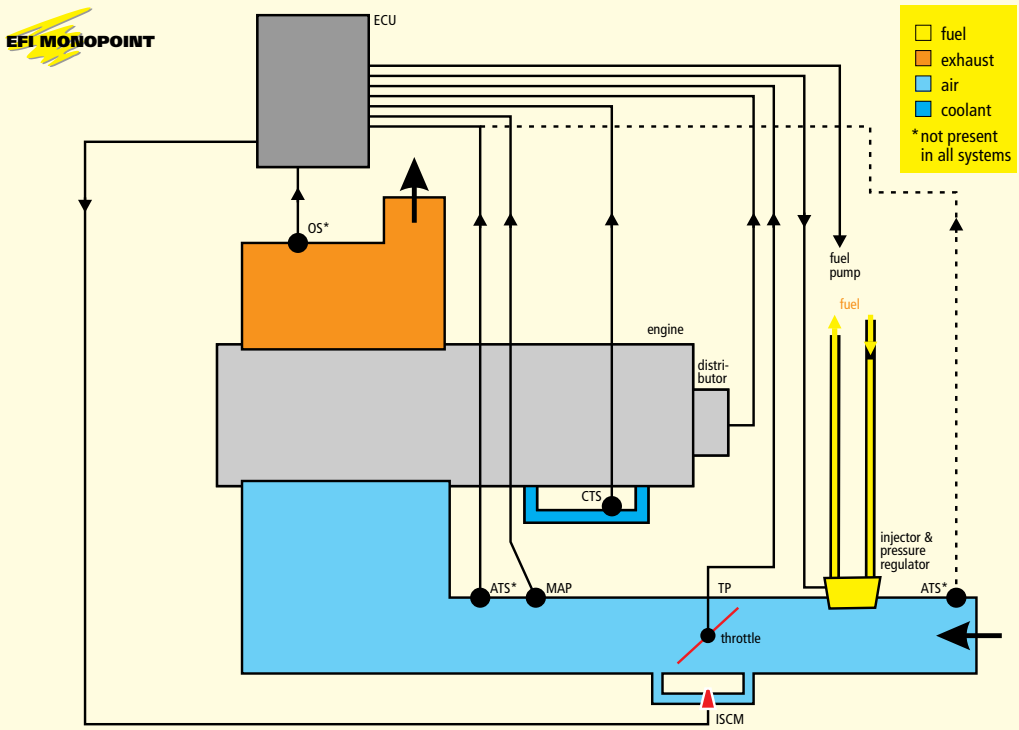
Under ideal conditions, these two inputs would already be enough to control the engine. A large table can be set up, like the one illustrated here (of course, this is an illustration only, the actual values mean nothing here), and for any pair of incoming engine speed and load values the necessary fuel amount can be determined. By keeping the pressure of fuel constant behind the injector valves, the amount of fuel injected depends solely on the time period the injectors are opened for, hence, the table can contain injector opening times.

Amount of fuel injected		Engine load			
		0%	5%	…	100%
Engine speed	idle	3	3	…	3
	850 rpm	4	5	…	5
	900 rpm	5	6	…	7
	…	…	…	…	…
	6,000 rpm	9	8	…	10

An this is exactly how it is done in modern injection systems: the controlling microcomputer keeps a lookup table like this to determine the base pulse width. Earlier systems were constructed from discrete, analog elements, not like a small computer; a more or less equivalent circuit made of various hybrid resistance arrays and semiconductors were used for the same purpose.

Chip tuning, by the way, is the simple operation of replacing the said table with another one, yielding different characteristics (usually to gain power, allowing for worse fuel economy). As the computer stores this table in a programmable memory—similar in function to the BIOS in desktop computers—, replacing it is possible. The earlier systems with analog circuits cannot be modified that easily.

So, we obtained the base pulse width from the table but as the operating conditions of automotive engines are



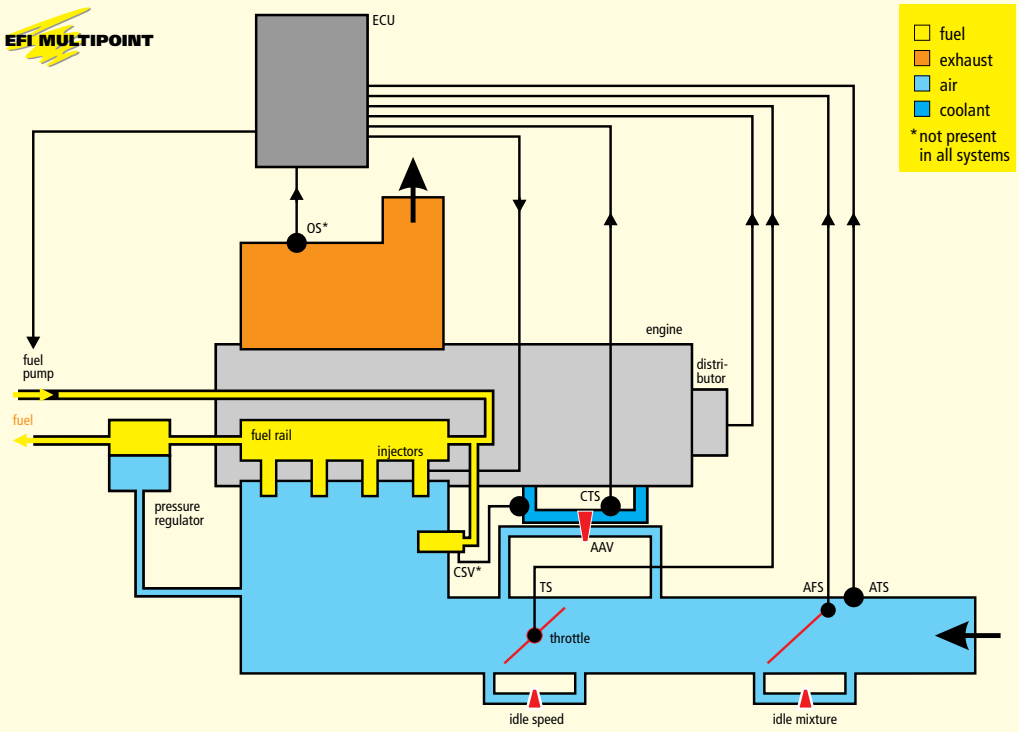
Idle speed is more complicated: the throttle is closed, so there has to be a bypass to let the engine receive fuel to run. In simpler systems this bypass is constant (but manually adjustable to set the correct idle speed) in a warm engine, providing a fixed amount of air, although the computer can decide on a varying amount of fuel to be injected. Later systems generally use a controlling device changing the cross section of the bypass, regulating the amount of air coming through (these systems often have no facility to adjust the idle speed, the computer knows the correct revolution and maintains it without any help from mechanical devices). The controlling device can either be an **idle speed control valve (ISCV)** or an **idle control stepper motor (ICSM).** The first one can only open or close the idle bypass, so any regulation must be done by rapidly opening and closing it by the computer, the second one can gradually change the bypass, hence fine tuning is easier and smoother.

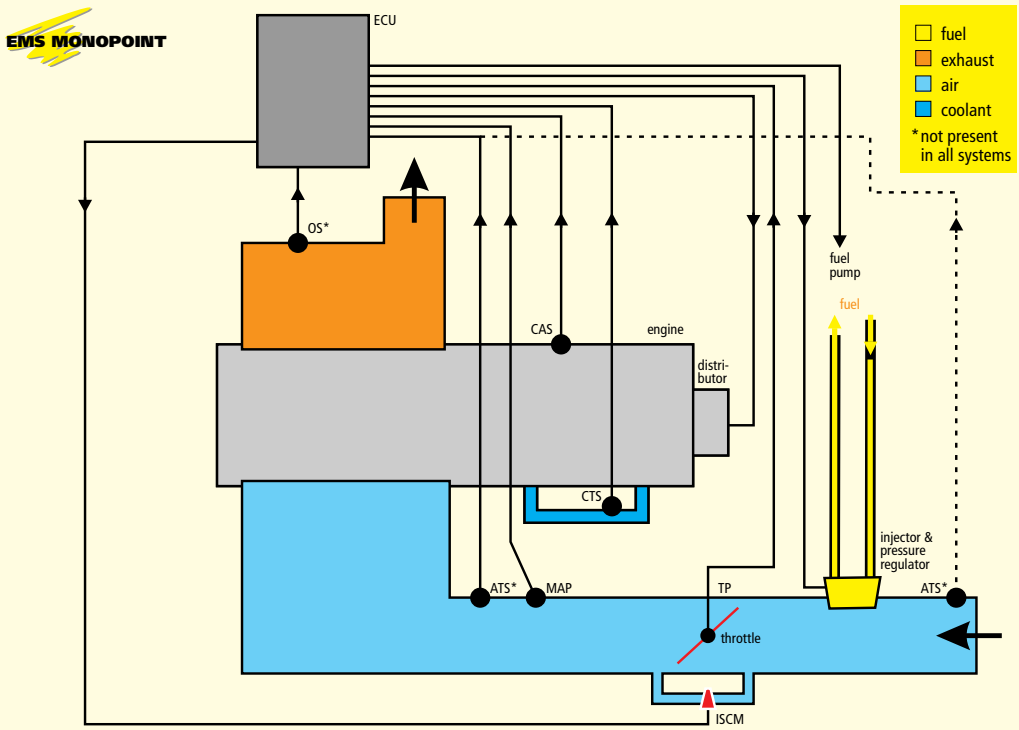
hardly ideal for any reasonable amount of time, several corrections have to be applied. Our air flow meter measures the volume of the air but we would need to know the mass of the air to calculate the required lambda ratio—remember, colder air is denser, thus the same volume contains more gas, requiring more fuel to provide the same mixture. To accomplish this, the injection system uses an **air temperature sensor (ATS)**—although on some systems it measures not the air but the fuel-air mixture—and lengthens the injector pulse width according to this input (except for the case of the airflow meter using a heated wire, this one takes the air temperature into account automatically, consequently, there is no need for correction).

Just like the choke on carburetors, there is a complete subsystem dealing with cold start and warm up, as the requirements under such circumstances are so different from the normal operation that they cannot be fulfilled by the regular control. The ECU monitors the **ignition key switch** to learn when the engine is started, then looks for the input from the **coolant temperature sensor (CTS)** to

It is not only the external circumstances that require special consideration. While most of the time an engine works under partial load, so it makes sense to spare fuel by basing on a relatively leaner mixture across this range of operation, cold start and warm-up, modest deceleration and fully depressed throttle, idle speed all require different treatment.

The position of the throttle pedal is communicated to the computer by a **throttle position switch (TS)** or **throttle potentiometer (TP).** These devices signal both fully open and fully closed (idling) throttle positions. When the pedal is fully depressed, the computer makes the mixture richer to provide good acceleration performance.





see whether this is a cold start or a warm one. If the coolant fluid is measured cold, a special warm-up sequence will be started.

The engine needs significantly more fuel, a richer mixture during this period. This extra fuel is used for two purposes: first, part of the fuel injected is condensed on the cold walls of the engine, second, to ensure better lubrication, the engine should run at an elevated revolution during this period.

There are two ways to provide more fuel: through the usual injectors, making the computer inject more gas than normal, or by using an additional **cold start injector (CSV)**—there is only one such injector even in multipoint systems. This injector is fed through a **temperature-timer switch,** protruding into the coolant just like the CTS, plus it is heated by its own electric heater. The injector operates as long as the ignition key is in the starting position but its behavior later on is governed by the timer switch. The colder the engine initially is, the longer it stays closed to let the cold start injector do its job. In a warm engine (above 40 °C) it does not close at all.

Without a cold start injector, the computer itself adds about 50% extra fuel initially and drops this surplus to about 25% until the end of a 30-second time period.

From that point, the surplus is dictated by the warming of the engine, communicated by the CTS to the computer. EFI systems without an idle speed control device often use an electromechanical **auxiliary air valve (AAV).** This valve, which is fully open when the engine is still cold but will close gradually as it warms up, lets an additional amount of air measured by the AFS pass through the system. Because it is measured, it tricks the computer into providing more fuel. The valve is heated by its own heating element as well as the engine, thus it closes shortly.

The injectors are electrovalves. As with any electromagnet, there is a small time delay between the arrival of the control signal and the actual opening of the valve due to the build-up of electromagnetic fields. The length of this delay depends heavily on the voltage the injectors are fed with. The same pulse width would result in shorter opening time, hence less fuel injected if the battery voltage drops below nominal (which is often the case on cold mornings). The injection computer therefore has to sense the battery voltage and to lengthen the injector pulse width if necessary.

The final, total pulse width (also called *injector duty cycle)* is calculated by summing up all these values received: the base pulse width from the RPM/AFS table lookup, the various correction factors based on the temperature sensors, throttle position and the like, plus finally, the voltage correction.

As the computer has already calculated the exact amount of fuel to be injected, there is only one task left: actually injecting it. There are two possible ways: to inject the fuel into the common part of the inlet, still before the throttle butterfly, or to inject them close to the inlet valves, individually to each cylinder. Depending on the solution chosen, the system will be called **monopoint** or **multipoint.** Monopoint fuel injection requires a single common injector; the smaller cost and simpler setup makes it more common on smaller engines (in the case of Citroëns, the 1380 ccm ones). In all cases, the computer actually calculates the half of the fuel amount required as it will be injected in two installments, once for each revolution of the engine.

The injectors of the multipoint system can be operated simultaneously or individually. Previous Citroëns on the road today still use simultaneous operation. Individual cylinder injection, however, holds great potential—just to name one, some of the cylinders of a larger engine can be temporarily shut off by cutting off their fuel supply if the car is operating at partial load, saving a considerable amount of fuel—, so we are sure to meet this sort of fuel injection systems in the future.

All systems—regardless of the number of injectors—use a similar fuel supply layout. The fuel is drawn from the **tank** by a continuously operating **fuel pump,** transported via a filter to the injectors, then back to the tank. There is a **pressure regulator** in the circuit as well to keep the pressure of the fuel at a constant pressure above that in the inlet manifold (this regulator is a separate unit on multipoint systems while integrated into the injector on monopoint ones). As the pressure difference between the two sides of the injectors are constant, the amount of fuel injected depends solely on the opening time of the injectors. The pressure used in contemporary EFI systems is 3 to 5 bars.

This is practically all there is to it, there are only a couple of safety and economy features in addition. If the engine revolution exceeds a certain limit (between 1,200 and 1,500 usually) and the throttle is closed—this is called decel-

eration—, the momentum of the car is sufficient to rotate the engine through the wheels. To save fuel, the injection is cut off. As soon as the engine speed drops below the limit or the throttle is opened, the injection is reintroduced—supposedly smoothly and gradually, however, many drivers complain about some jerkiness.

To avoid prolonged operation at revolutions exceeding the specification of the engine, the injection is cut off above a maximum engine speed (6,000-7,000 rpm, depending on the engine). And finally, to avoid the hazard of fire in a crash and the fuel squirting from the injection system with the engine stopped or possibly destroyed, the relay of the injectors is controlled by the ECU, allowing fuel injection only when the ignition (or the signal of the corresponding sensor) is present.

Who will light our fire?

Models with simpler fuel injection have traditional (electronic) ignition systems which are practically equivalent to the solution used on cars with carburetors.

The **distributor** has two purposes: generating the driving signal for the ignition system and to distribute the high voltage to the four cylinders in turn. This two parts inside the distributor are electrically separate but mechanically coupled—both are driven by the camshaft to keep them in sync with the strokes of the engine.

The ignition signal thus starts from the distributor. A magnetic induction sensor (consisting of a rotating four-sided magnet and a pick-up coil) sends a pulse to the ignition module at each firing point. This pulse will be switched to the **ignition coil** (an autotransformer; *auto* here does not mean that it is manufactured for automotive use, autotransformers have their primary and secondary coils connected) by a power transistor inside the module. The current change in the primary coil induces very high voltage spikes in the secondary circuit. These spikes then go back to the HT part of the distributor which in turn sends them to the **spark plug** of the actual cylinder requiring the spark.

It takes some time for the spark to ignite the fuel-air mixture inside the combustion chamber: this means that the spark has to arrive slightly before the piston reaches its top position (top dead center, TDC), so that it will receive the downward force of the detonation in the right moment. However, as the engine speed increases, so does the speed of the piston or the distance it travels during a given period of time. Therefore, the exact time of the spark has to be advanced as the revolution increases. Traditional systems do this by adding a vacuum line connecting the inlet manifold to the distributor. As the vacuum increases with the engine revolution, its sucking force rotates the inner part of the distributor slightly away from its original position, causing all its timing devices switch earlier, as required by the value of the timing advance.

Clever systems can get away without a distributor: some CXs have such an ignition setup. This systems has two ignition coils, both serving two spark plugs at the same time. These two spark plugs belong to cylinders whose pistons move in unison: one is compressing, the other exhausting. Although both plugs generate sparks at the same time, the one in the exhausting cylinder will be wasted.

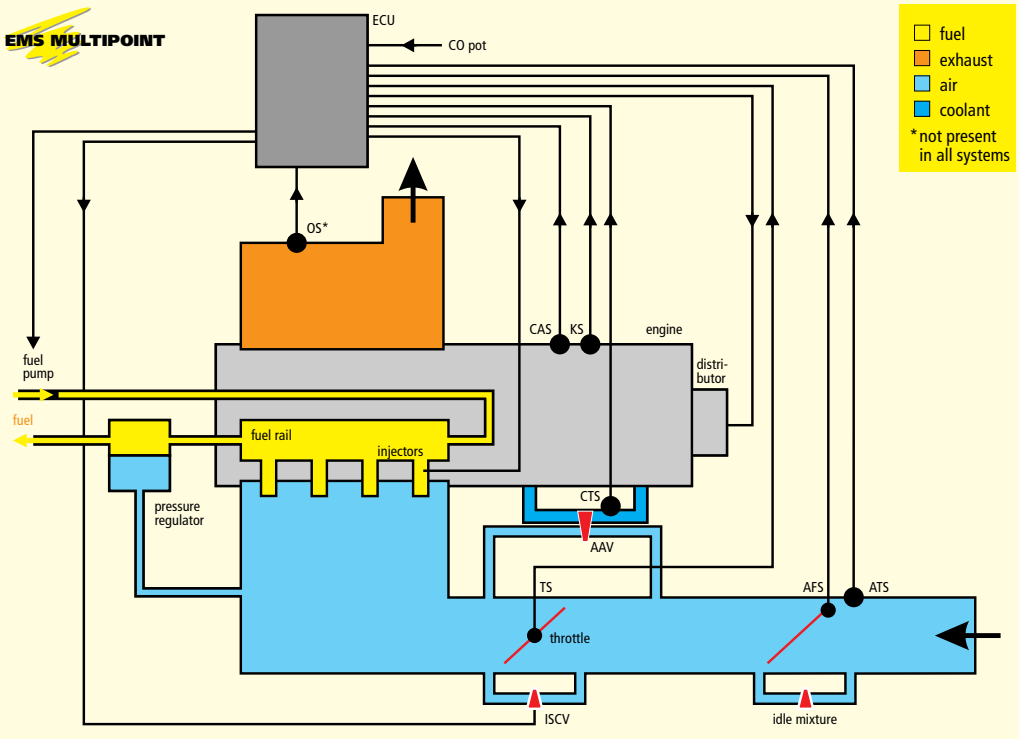
Two birds with one stone

We made the ignition seem too simple in the previous section. While it works as described, there are many factors to be considered if we want to build a modern ignition system. For instance, the timing advance depends not only on engine speed but on many other factors as well: engine load, engine temperature and to some extent, the air temperature.

Just like the carburetor was not really good at deciding the amount of fuel required by the engine, the traditional ignition is similarly not perfect in estimating the timing advance and other characteristics of the sparks needed. An electronic system similar to the one used for fuel injection shows clear advantages over any earlier system.

And as they use about the same sensors and rely on each other, what could be more logical than to integrate them into a common system, elegantly called an **engine management system?**

If we compare the schematics of the corresponding EFI and EMS systems, they look almost the same. There are two notable differences: the small arrow on the line connecting the ECU to the distributor has changed its direction and a new sensor, a **crank angle sensor (CAS)** has appeared.



Both changes have to do with the fact that the enhanced system, whose new task is to generate the ignition signals as well, cannot at the same time build on them as inputs. This new sensor—practically a replacement for the induction magnet in the distributor of earlier systems—informs the computer of both engine speed and camshaft position.

The flywheel has steel pins set into its periphery. As it rotates, the inductive magnet of the CAS sends pulses to the computer. Two of the pins are missing and this hole passes before the sensor just as the first piston reaches its TDC position. The missing pins cause a variance in the sensor output that can be read by the ECU easily.

The rest is the same: the base pulse width is calculated based on the CAS and AFS/MAP sensors. The correction factors—air temperature, idle or full load, starting, warming up, battery voltage—sum up into an additional pulse width. Besides, the same input signals (AFS, CAS, CTS and TS/TP) are used for another lookup in a table, yielding the correct dwell time and timing advance for the ignition. The dwell period remains practically constant but the duty cycle varies with the chaging engine speed. The ignition signal is amplified and sent to a distributor containing only secondary HT components: it does not create the ignition signal only routes the HT current to each spark plug in firing order.

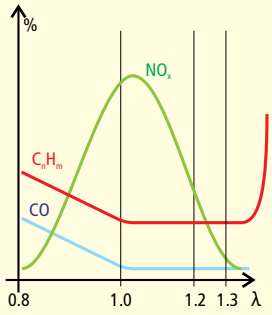
Some systems also have a **knock sensor (KS),** sensing the engine vibration associated with pre-ignition (so-called pinking). If this occurs, the ignition timing is retarded to avoid engine damage.

Think green

As we saw, fuel injection and engine management systems are capable of determining the ideal amount of fuel to be injected, depending on the conditions of operation and several other factors in the engine. It is capable of deciding on lean mixture for general, partial load to save fuel, or on rich mixture when performance considerations call for this.

Unfortunately, this is not what such systems are used for today. With the proliferation of catalytic converters, the only concern of our systems is the welfare of the converter.

Ideal combustion would not generate polluting materials in the exhaust gas. Fuel is a mixture of various hydrocarbons (C_nH_m), which when burned together with the oxygen (O_2) of the air, should transform to carbon-dioxide (CO_2) and water vapor (H_2O). However, combustion is never ideal, besides, fuel contains many additives: the exhaust gas, in addition to the products mentioned, has various byproducts as well, some of them toxic: carbon-monoxide (CO), various unburned hydrocarbons (C_nH_m), nitrogen-oxides (NO_x) and lead (Pb) in various substances coming from the anti-knock additives found in the fuel.



The relative amount of these byproducts depend on the lambda ratio of the air-fuel mixture burned. As shown on the diagram, a value between 1.2 and 1.3 would give a relatively low percentage of toxic byproducts while, as we can recall, being a lean mixture would be in the right direction towards fuel economy.

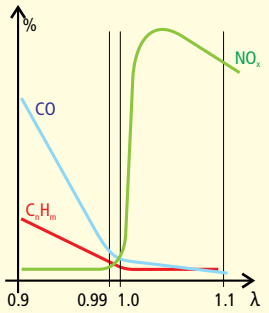
By using platinum (Pt) or rhodium (Rh) as a catalyst—a catalyst is a substance whose presence is required to enable (or to boost) a chemical transformation while it does not take part in the process itself, remaining intact—the following processes can be carried out:

$2\ CO + O_2 \rightarrow 2\ CO_2$ (oxidation)

$2\ C_2H_6 + 7\ O_2 \rightarrow 4\ CO_2 + 6\ H_2O$ (oxidation)

$2\ NO + 2\ CO \rightarrow N_2 + 2\ CO_2$ (reduction)

These precious metals are applied in a very thin layer to the surface of a porous ceramic body with thousands of holes to make the surface contacting the exhaust gases much greater. Actually, a converter does not contain more than 2 or 3 gramms of these metals.



If you compare this diagram with the previous one, you will see that the real gain is the supression of nitrogen-oxides. CO and C_mH_n will be reduced as well, although to a much lesser extent. Nevertheless, the overall reduction in polluting byproducts is quite high, amounting up to 90 percent. Lead substances are not considered as lead must not reach the converter anyway, it would clog the fine pores of the converter in no time. The fuel used in cars equipped with a catalytic converter has to be completely free of lead.

But there is something of even greater consequence depicted on the diagram: to keep the amount of pollutants down, the lambda has to be kept inside a very small value range, practically at $\lambda=1$ all the time. If the lambda drops just a fraction below 1, the CO emission rises sharply, while a small step above 1 skyrockets the NO_x emission. The main task of the fuel injection is therefore to ensure that the air-fuel mixture sticks to the stoechiometric ratio all the time. This means higher consumption than the one of a car with fuel injection without a converter to start with.

There are situations where this lambda cannot be observed. A cold engine will simply stall without a much richer mixture, thus the cold start mechanism does not obey the lambda control. The catalytic converter does not work at all below 250 °C, so this is not a significant compromise (its normal operating temperature is 400 to 800 °C, above 800 °C is already harmful; unburned fuel getting into the exhaust and detonating inside the converter could cause overheating, thus ignition and similar problems has to be rectified as soon as possible in catalytic cars).

Dynamic acceleration (full throttle) is also something not observing the welfare of the converter. Reducing pollution might be a noble cause but to be able to end an overtaking is even more important…

The system uses an **oxygen sensor (OS,** also called lambda sensor) which measures the oxygen content of the exhaust gas. It is located between the engine exhaust and the catalytic converter. Similarly to the converter, it is not functional below 300 °C, hence it has its own heating element to make it reach its operating temperature faster.

The computer uses the input from this sensor to keep the mixture injected always as close to $\lambda=1$ as possible. If the sensor is still too cold to give accurate input, the computer can ignore it safely.

The HPi engine

Diesel engines

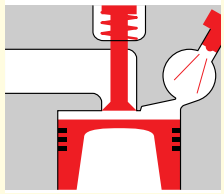
Diesel oil has been a contender to gasoline for many decades. Earlier diesel engines were not refined enough to win the hearts of many drivers but recent advances in technology made these engines not only worthy competitors in all areas but in some features—fuel economy or low end torque, to name just two—even exceeding the characteristics of their gasoline counterparts. And in addition to the general technological advantages, Citroën's diesel engines have a widely accepted reputation—even among people blaming the quirkiness of its suspension or other features—of being excellent and robust.

As it is widely known, diesel engines have no ignition to initiate their internal combustion, they rely on the self-combustion of the diesel oil entering into a cylinder filled with hot air. Due to this principle of operation, the supply of the fuel has to comply with much more demanding requirements than it is necessary in the case of gasoline engines.

Unlike in the gasoline engine, not a mixture but air enters into the cylinders via the inlet valves. During the adiabatic compression all the energy absorbed is used to increase the temperature of the gas. The small droplets of fuel will be injected at high velocity near the end of the compression stroke into this heated gas still in motion. As they start to evaporate, they form a combustible mixture with the air present which self-ignites at around 800 °C.

This self-ignition, however, is not instantaneous. The longer the delay between the start of the injection and the actual ignition (which depends on the chemical quality of the diesel oil, indicated by the *cetane number),* the more fuel will enter the cylinder, leading to harsher combustion, with the characteristic knocking sound. Only with the careful harmonization of all aspects—beginning of injection, the distribution of the amount injected in time, the mixing of the fuel and air—can the combustion be kept at optimal level.

Small diesel engines suitable for cars were made possible by a modification to the basic principle, that allowed these stringent parameters to be considerably relaxed. It includes a separate swirl chamber connected to the cylinder via a restrictor orifice. The air compressed by the piston in the cylinder enters this chamber through the orifice, starting to swirl intensively. The fuel will then be injected into this swirl, and the starting ignition propels the fuel-air mixture still incompletely burned into the cylinder where it will mix with the air, continue and finish the combustion process. Using a prechamber results in smaller ignition delay, softer combustion, with less noise and physical strain on the engine parts, but introduces some loss of energy because of the current of air having to pass between the chambers. Citroën engines of this type use a tangentially connected spherical prechamber.



As diesel engine evolution continued, better simulation and modeling techniques became available, which, together with the improvements in fuel injection technology, lessened or removed the problems initially solved by the introduction of the prechamber. The direct injection engines of today have no prechamber, instead, the piston has a specially formed swirl area embedded in its face.

Mechanical injection

Although the basic principles of fuel injection are similar to what we have already discussed for gasoline engines, there are some notable differences. First of all, diesel engines operate without restricting the amount of air entering the engine: there is no throttle, the only means of regulating the engine is to vary the amount of fuel injected.

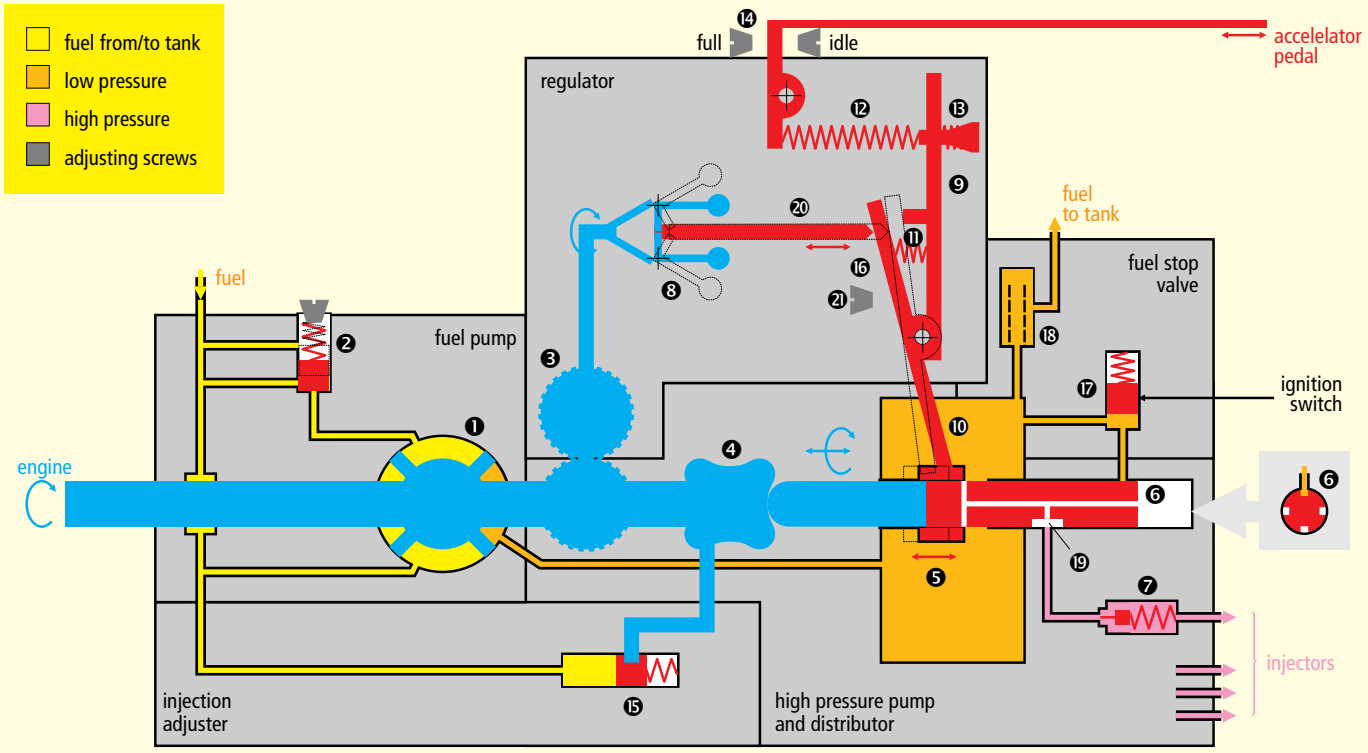
The fuel is injected into the engine, creating a combustible mixture in the same place it is going to be burned. Because the forming of this mixture results in its self-combustion, the diesel injection system is, in essence, an ignition control system. Unlike on the gasoline engine, fuel injection and ignition cannot be separated in a diesel engine.

The complete mechanical injection system is built into a single unit which can be divided into five individual—although interconnected—subsystems:

- a **low pressure fuel pump** to deliver the fuel for the rest of the injection system;
- a **high pressure pump and distributor** that routes the fuel to the appropriate cylinders in firing order (similar in purpose to the distributor on gasoline engines) and generates the high pressure needed for the injection as well;
- a **regulator** that determines the amount of fuel to be injected in relation to the engine speed, modified by additional factors like idle speed, cold starting, full load, etc.;
- an **injection adjuster** to compensate for the higher engine speed by advancing the start time of the injection;
- a **fuel stop valve** to cut off the fuel supply when the ignition has been switched off.

The diesel fuel is drawn—through a filter—from the tank by the **low pressure pump** ❶ operated by the engine. A pressure regulating valve ❷ ensures that the fuel pressure will not exceed a preset limit; when the pressure reaches this value, the valve opens and lets the fuel flow back to the primary side of the pump.

The **piston** ❻ of the high pressure part is driven through a coupling ❹ consisting of a cam disc and four cam rollers. The piston rotates together with the shaft coming from the



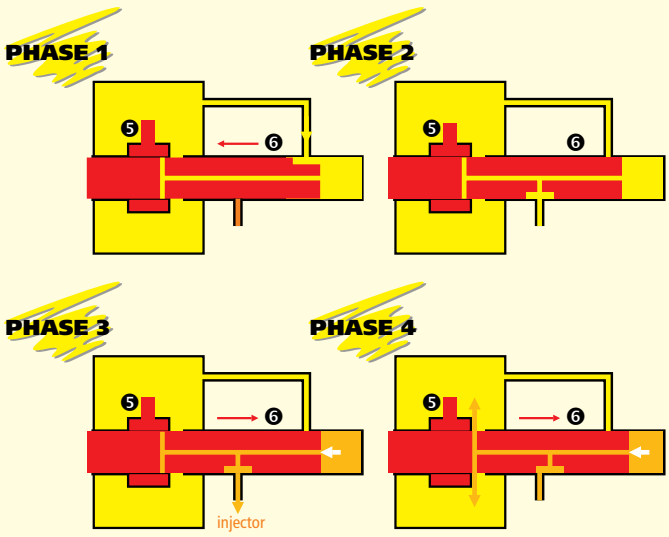
engine but the coupling adds a horizontal, alternating movement as well: for each turn, the shaft and the piston ❻ performs four push-pull cycles.

It is the pushing movement of this piston ❻ that creates the high pressure and sends the fuel to the injectors. The fuel, provided by the pump ❶ arrives through the fuel stop electro-valve ⓱, which is constantly open while the ignition switch is on but cuts the fuel path when it is turned off.

First, the piston ❻ is pulled back by the coupling ❹, letting the fuel enter the chamber and the longitudinal bore inside the piston. As the side outlets are blocked by the regulator collar ❺, the fuel stays inside the chamber *(phase 1)*.

In the next phase, the piston rotates and closes the ingress of fuel from the stop valve ⓱. On the other side of the piston, the high pressure outlet opens but as the fuel is not yet under pressure, it will stay in the chamber.

In *phase 3* the piston is energetically pushed by the cam disc and rollers of the coupling ❹, injecting the fuel stored in the chamber into the output line with a significant force.



As the piston ❻ moves to the right, at some point the side outlets will emerge from under the regulator collar ❺—the fuel injection into the real output will stop immediately, and the rest of the fuel stored in the chamber will leave through this path of lesser resistance. This is *phase 4,* the end of the injection cycle.

Actually, this operation is repeated four times for each revolution of the incoming shaft. There are four high pressure outlets radially around the piston, each serving a given cylinder. As the outlet slot ⓳ of the piston turns around, it allows only one of the outlets to receive the fuel.

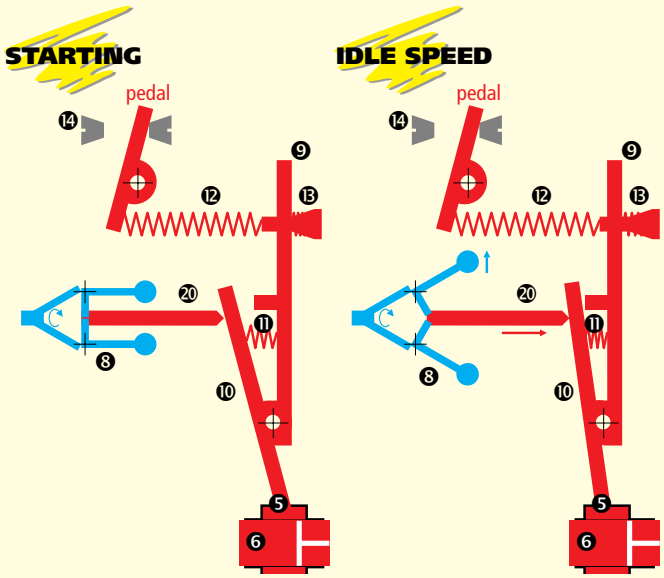
The pressure valves ❼ serve to drop the pressure in the injector lines once the injection cycle is over. To reduce the cavitation caused by the pressure waves generated by the rapid closing of the injector valves, a ball valve minimizing the back flow is also used.

The length of phase 3, thus the amount of fuel injected depends on the position of the collar ❺. If it is pushed to the right, it will cover the side outlets for a longer time, resulting in a longer injection phase, and vice versa. If it stays in the leftmost position, no fuel will be injected at all.

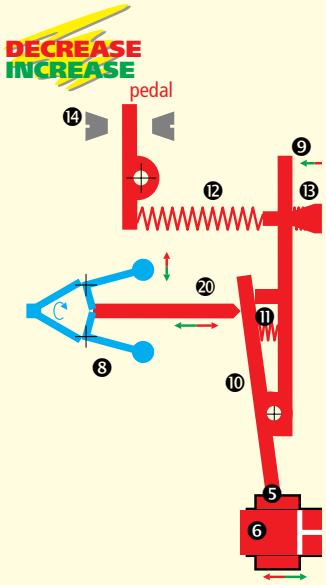
And this is exactly what the **regulator part** does: it moves this collar ❺ to the left and to the right, as the actual requirements dictate. The lever ❾ attached to the collar is rotated around its pivot by several contributing forces. The two main inputs are the position of the **accelerator pedal** as communicated through a regulator spring ⓬ and the actual **engine speed,** driving a centrifugal device ❽ via a pair of gears ❸. The higher the engine speed, the more the shaft ⓴ protrudes to the right, pushing on the lever ❿.

When the engine is being started, the centrifugal device ❽ and the shaft ⓴ are in their neutral position. The starting lever ❿—pushed into its starting position by a spring ⓫—sets the position of the collar ❺ to supply the amount of fuel needed for the starting.

As the engine starts to rotate, a relatively low speed will already generate a large enough force in the centrifugal device ❽ to push the shaft ⓴ and overcome the force of the



rather weak spring ⓫. This will rotate the lever ⓾, moving the collar ❺ to the left, setting the amount of fuel required for idling. The accelerator pedal is in the idle position as well, dictated by the adjustment screw ⓮. The idle spring ⓭ keeps the regulator in equilibrium.



Normally, the amount of fuel will be regulated by the position of the pedal as both springs ⓫ and ⓭ are fully compressed and do not take an active part in the process. When the driver pushes on the pedal, the regulating spring ⓬ stretches, both levers ❾ and ⓾ rotate and move the collar ❺ to the right, to allow the maximum amount of fuel to be injected. As the actual engine speed catches up, the centrifugal device ❽ opens up, pushing the shaft ⓴ to the right, countering the previous force, gradually returning the collar ❺ towards the no fuel position, until the point is reached where the amount of fuel injected maintains the equilibrium. When the driver releases the pedal, the inverse of this process takes place. During deceleration—pedal at idle, engine rotated by the momentum of the car—the fuel is cut off completely.

Without such regulation, if enough fuel is provided to overcome the engine load, it would continue accelerating until self-destruction (this is called *engine runaway).* Speed regulation is a feedback mechanism comparing the actual speed of the engine to the one dictated by the gas pedal and modifies the amount of fuel as necessary. If either the engine speed changes (because of varying load, going over a hill, for instance) or the driver modifies the position of the accelerator pedal, the regulation kicks in, adding more or less fuel, until a new equilibrium is reached. If the engine is powerful enough to cope with the load, keeping the pedal in a constant position means constant cruising speed in a diesel car; gasoline vehicles need speed regulated fly-by-wire systems or cruise controls to achieve the same.

The excess fuel will finally leave the pump unit through an overflow valve ⓲, flowing back to the fuel tank.

Something needs to be corrected...

The chemistry involved in the combustion dictates some parameters of fuel injection, the most important being the **smoke limit,** the maximum amount of fuel injected into a given amount of air, that results in combustion without resulting in soot particles. Although gasoline engines also have this limit, they normally operate with a constant fuel to air mixture that automatically places the amount of fuel below this critical limit. Diesel engines, in contrast, operate with a variable fuel to air mixture, using this very variation for power regulation. With diesel fuel observing the smoke limit is a much stricter task because once soot starts to develop, this changes the character of the combustion itself, resulting in a sudden and huge increase in the amount of particulates—a bit like a chain reaction.

Because the maximum amount of fuel injected depends on how far the lever ⓾ is allowed to rotate counter-clockwise, the inability of the pump to inject too much fuel, thereby crossing the smoke limit, is insured by an end stop ㉑ for this lever. This very basic means of smoke limit correction, adjusted for worst case conditions, was developed further on turbocharged engines, and still further on electronically controlled injection systems.

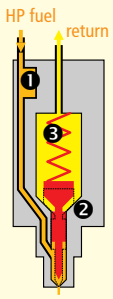
Timing is of enormous importance in a diesel engine. During the stroke of combustion, several events take place in close succession: the fuel injection system starts its delivery, then the fuel is actually injected (the time elapsed between these two is the *injection delay),* slightly later the fuel will self-ignite (this delay is the *ignition delay),* then the injection will stop but the combustion is still raging, first reaching its maximum, then dying away slowly (on the scale of milliseconds, that is).

Just like in a gasoline engine, the ignition delay remains constant while the engine speed changes. The fuel has to ignite before the piston passes its TDC position, but with the increasing engine speed, the distance the piston travels during a given period of time becomes longer. Therefore, the injection has to be advanced in time to catch the piston still in time. The **injection adjuster** ⓯ feeds on the fuel pressure provided by the pump ❶, proportional to the engine speed.

This will move the piston, which in turn, through the levers, modifies the relative position of the cam rollers to the cam disc inside the coupling ❹, increasing or decreasing the phase difference between the revolutions of the engine and the rotating-alternating movement of the distributor piston ❻.

Some engines also have additional minor **correction mechanisms** ⓰ that modify the idle speed and timing depending on engine temperature, to provide better cold start performance. The engine temperature is measured indirectly, through the coolant acting on cylinder and piston-like elements filled with paraffin. As the paraffin expands or contracts as the coolant temperature dictates, the transformed mechanical movement, coupled through cables to two movable end stops for both the lever ❾ and the injection adjuster ⓯, modifies the idle speed and the injection timing of the engine. Because correct timing depends on temperature, the corrections, although relatively slight, in-

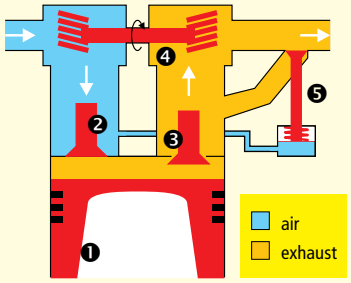
sure that the amount of fuel injected as well as the timing provide better combustion and lower pollution when the engine is started and operated at low temperatures. They do not have any effect once the engine reaches the normal operating temperature.



Now that the correct amount of fuel is carefully determined and the necessary high pressure generated by the pump, it has to be injected into the swirl chamber. The pressurized fuel entering the **injector** through a filter ❶ tries to press the piston ❷ upwards but a spring ❸ counters this force. As soon as the pressure exceeds the force of the spring (which can be adjusted by placing appropriately sized shims behind it), the piston jumps up and the fuel rushes into the swirl chamber through the small orifice now opened. After the injection pump closes its pressure valve at the end of the injection period, the spring ❸ pushes the piston ❷ back, closing the orifice until the next injection cycle.

Each swirl chamber has its own **glow plug** whose only purpose is to heat up the chamber in cold weather. They start to glow when the ignition key is turned into the first position and stay glowing for some time afterwards unless the starting was unsuccessful.

Turbo



More power requires more fuel. An efficient way to boost the performance is to provide both more air and fuel to the engine. The exhaust gases rushing out from the engine waste a great deal of energy; a **turbocharger** ❹ spun by the exhaust flow taps into this source of energy to provide added pressure in the air inlet. Diesel engines are particularly well suited for turbocharging. Gasoline engines may not have the inlet pressure raised too much because the air and fuel mixture may subsequently self-ignite when it is not supposed to, and instead of burning controllably, detonate. In a diesel such a situation is not possible because the fuel is injected only when combustion should actually happen in the first place. As a result, relatively high inlet pressures can be used, considerably improving the power output of a diesel engine, and with proper attention to the subtleties of the design, engine efficiency and fuel consumption.

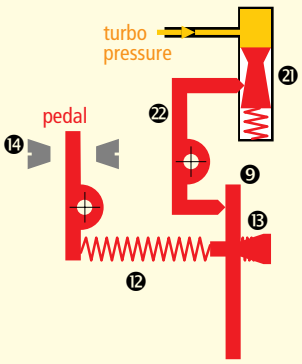
On its own, once the amount and pressure in the exhaust manifold reaches a level high enough to power it, with the engine fully loaded, the turbine would spin proportionally to engine speed squared, because both the pressure and the volume of the air pumped into the engine are increasing.

Because the engine is required to deliver as much torque as possible at the widest possible range of engine revolution, the requirements on the turbine are somewhat contradictory. If the turbo is made very small and light, it will spin up very quickly due to its low mass and inertia, ensuring its full benefit already at low rpms. However, with a moderate increase in engine speed, the rotational speed of the turbine (note the quadratic relationship) would become excessively high. When the turbine blade speed approaches the speed of sound, a supersonic wave effect occurs that can abruptly leave it without any load, at which point runaway would occur, resulting in severe damage to the turbine.

On the other hand, if the turbine was dimensioned so that even at the highest engine speed it is still operating within safe limits, it would not be useful at all in the middle range where the engine is most often used. A compromise can be achieved using an overpressure valve, the **wastegate** valve ❺. The turbo pressure is constantly monitored by this valve opening above a set pressure limit, letting the exhaust escape through a bypass. This avoids turbo runaway by making the turbo rotational speed proportional to that of the engine, once the limit pressure is reached. This way the quick spin-up resulting from the quadratic relationship can be preserved while the turbocharging effect is extended over a significant percentage of the usable engine speed range—typically the higher 70-80%. But it comes at a price: because of the simplicity of such a regulation, the limit pressure is dictated by the maximum turbine speed, which is usually calculated for maximum engine speed plus a safety margin. The maximum pressure is already reached at lower engine and turbine speeds, where the turbine could conceivably still provide more pressure because of a lesser demand for air volume. Although with a simple wastegate a certain amount of the turbocharging potential is lost, the increase in power output is still substantial.

Citroën is a pioneer in implementing variable wastegate limit pressure using a controllable wastegate valve, to tap into this previously unused turbo potential.

Essentially, a turbocharged diesel engine runs in two different modes: atmospheric pressure or turbo-charged. The atmospheric pressure mode prevails while the exhaust gas produced is not yet sufficient to power the turbine (below a given engine speed and load). Once this limit is crossed and the turbine starts generating higher than atmospheric pressure, the engine is running in turbocharged mode.



The injection pump regulator needs to know about the changes in the inlet pressure, because those changes mean differences in the amount of air entering the engine. And this also means that the upper limit of fuel injected needs to be changed correspondingly. These injection systems are tuned for the turbo producing the rated waste pressure (also known as full boost). However, the amount of fuel injected during the atmospheric mode of the engine—before the turbo kicks in—has to be reduced in order to avoid crossing the smoke limit. The turbo pressure drives a limiter in the injection pump: with the increasing pressure the piston ❷❶ moves down. Its varying diameter forces the lever ❷❷ rotate around its pivot, which then acts as a stop to limit the allowed range of operation of the regulator lever ❾, limiting the amount of fuel to be injected.

Intercooler

Towards a cleaner world

Exhaust Gas Recycling (EGR) systems were used—depending on the market—as add-on units. An electronic unit measuring the coolant temperature and the position of the gas pedal control on the pump (with a potentiometer fitted to the top of the control lever) controls a valve which lets part of the exhaust gas get back into the inlet.

Post-glowing is also used as a pollution reducing mechanism. A definite post-glow phase, lasting for up to minutes is usually controlled by a combination of a timer and the engine coolant temperature: either the timeout of 4 minutes runs out or the engine reaches 50 °C. An additional mechanism prevents post-glowing if the engine was not actually started.

Electronic Diesel Control

Just like it is the case with gasoline engines and carburetors, a mechanical device—even one as complicated as a diesel injection pump—cannot match the versatility and sensibility of a microcomputer coupled with various sensors, applying sophisticated rules to regulate the whole process of fuel injection.

The only input a mechanical pump can measure is the engine speed. The amount of air entering into the engine, unfortunately, is far from being proportional to engine speed, and the turbo or the intercooler disturbs this relationship even further. As the injection always has to inject less fuel than the amount which would already generate smoke, the mechanical pump—capable only of a crude approximation of what is actually going on in the engine—wastes a significant amount of air, just to be of the safe side.

The satisfactory combustion in diesel engines relies on the exhaust as well—if this is plugged up, more of the exhaust gases stay in the cylinder, allowing less fresh air to enter. A mechanically controlled injection pump has no feedback from the engine (except for the engine speed)—it will simply pump too much fuel into the engine, resulting in black smoke. An electronically controlled injection pump, on the other hand, can tell how much air has actually entered by using a sensor (although only the latest systems use such a sensor).

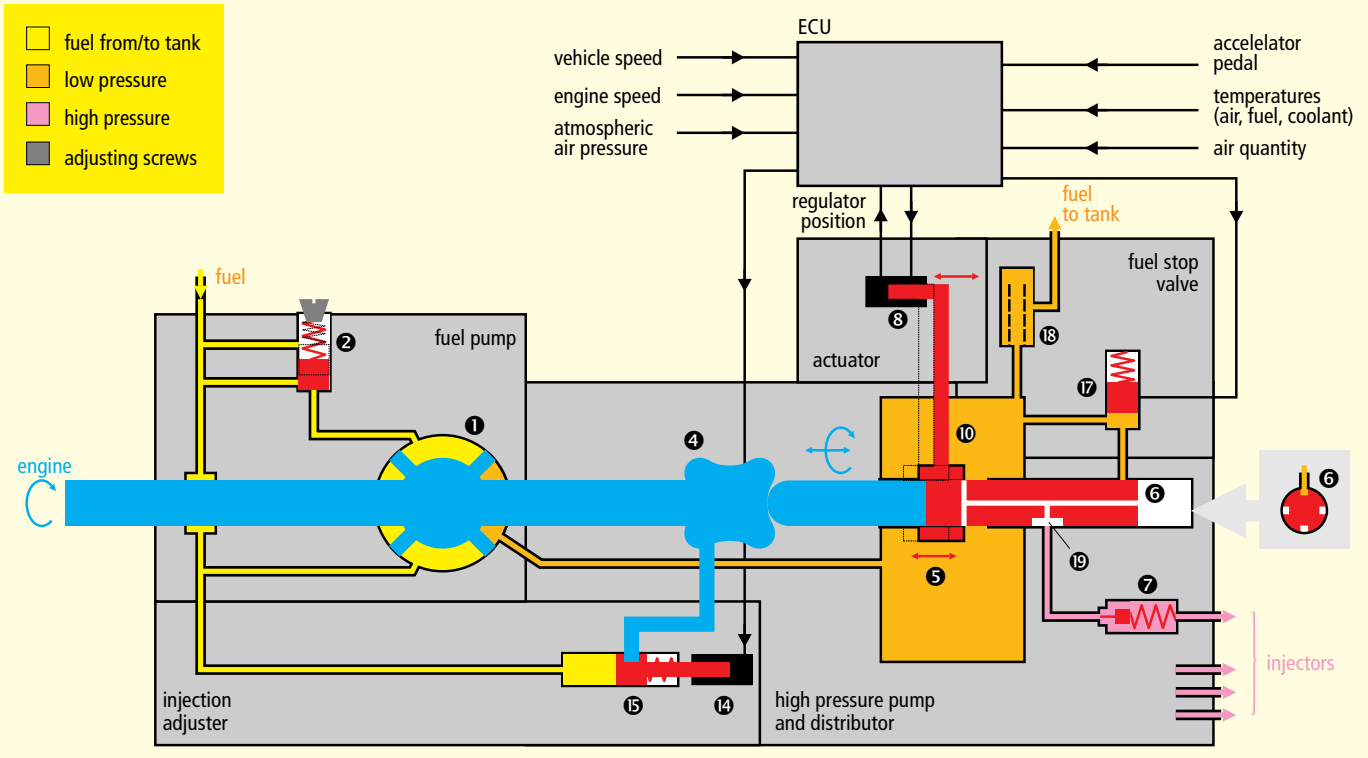
There are also other factors never considered by a mechanical system. The details of the combustion process depend heavily on the chemical characteristics of the fuel. The ignition delay, as we have already seen, depends on the cetane number of the diesel oil. In spite of the fact that correct timing has a paramount influence on the performance and the low pollutant level of a diesel engine, the mechanical system can have no information about this very important input factor. Less essential but still important is the temperature of the incoming air. With measuring all the circumstances and conditions in and around the engine (air, engine and fuel temperatures), the injection system can achieve better characteristics, lower fuel consumption and less pollution.

All in all, the electronically controlled injection pump not only adds precision to the injection process as its gasoline counterpart does but introduces completely new methods of regulation; therefore it represents a much larger leap forwards than fuel injection in gasoline engines. In spite of this, it is quite similar to its mechanical predecessor. From the five subparts, four remain practically the same, only the **regulator** is replaced with a simple electromagnetic actuator that changes the position of the same regulator collar ❺ as in the mechanical pump, in order to regulate the amount of fuel to be injected.

The real advantage over the former, mechanical pumps is that an electronic device, a small microcomputer can handle any complex relationship between the input values and the required output. With mechanical systems, only simple correction rules are possible, and as the rules get more complicated, the mechanics quickly becomes unfeasible. In contrast to this, the ECU just have to store a set of characteristic curves digitized into lookup tables, describing the amount of fuel to be injected using three parameters: **engine speed** (measured by a flywheel inductive magnet), **coolant temperature** (measured by a sensor protruding into the coolant liquid), **air temperature** (measured by a sensor in the air inlet).

The newer HDi engines use an **air mass sensor** using a heated platinum wire (as that mentioned on page 6). Having the exact amount of air to enter the engine, these latest EDC systems can deliver true closed loop regulation.

A potentiometer attached to the **accelerator pedal** sends information about the pedal position to the computer. This signal is used as the main input, conveying the in-



tentions of the driver. The ECU uses this sensor to learn about special conditions like idle speed or full load as well.

Air temperature is measured by a sensor in the inlet manifold (but if the air mass is measured by a heated platinum wire sensor, this already provides the necessary air temperature correction, thus there is no need for an additional sensor).

The ECU stores the basic engine characteristics, the intrinsic relationship between the air intake and the engine speed (plus the manifold pressure if a turbo is fitted). The values obtained from this table are corrected according to the inputs of the various sensors, in order to arrive at a basic timing and smoke limit value. The actual amount of fuel injected and the accurate timing are a function of these results and the position of the accelerator pedal.

The final amount of fuel calculated will be used to control the electric **actuator** ❽ which—by moving a lever ❿—changes the position of the regulating collar ❺. To ensure the necessary precision, the factual position is reported back to the computer using a potentiometer.

As we have already mentioned, the exact timing of the injection is of utmost importance in a diesel engine. The electronic system uses a **needle movement sensor** built into one of the injectors (the other are assumed to work completely simultaneously) notifying the computer about the precise time of the beginning of the injection. Should there be any time difference between the factual and designated opening times, the electro-valve ⓮ of the **injection adjuster** ⓯ will receive a correction signal until the difference disappears. If the electro-valve is completely open, the injection start will be delayed, if it is closed, the start time will be advanced. To achieve the timing required, the valve is driven with a modulated pulse signal, with the duty cycle (on-off ratio) determined by the ECU.

The input from this sensor is also used for compensating calculations on the amount of fuel injected, and to provide the on-board computer with the exact amount of fuel used up so that it can calculate the momentary and average consumption.

The computer has extensive self-diagnostic functionality. Many sensors can be substituted with standard input values in case of a failure (serious errors will light up the diagnostic warning light on the dashboard). Some sensors can even be simulated using other sensors—for instance, the role of a failing engine speed sensor might be filled in by the signal generated from the needle movement sensor.

As there is no standalone ignition in a diesel engine, the only way to stop it is to cut off the fuel supply. The mechanical default position of the actuator ❽ is the position where no fuel enters the injectors at all; this is where it returns when the computer receives no more voltage from the battery, the ignition switch having turned off.

As it has already been mentioned, the inlet pressure is one of the principal EDC parameters for a turbocharged engine. Later Citroën turbocharged diesels—starting with the 2.5 TD engine of the XM—pioneered variable turbo pressure technology. The wastegate on these turbines has several actuators, fed with the turbo pressure through electric valves. The ECU, based on the relevant engine operation parameters obtained from the sensors, controls these actuators in various combinations, providing a selection of two or three different wastegate limit pressures. This lets the system ease the compromise between the turbo pressure and turbine speed: the pressure is kept at the usual value for higher engine speeds (limited by the maximum turbine speed) but is allowed to go higher than that in the middle rpm ranges, adding a significant amount of torque in the range where it is most needed.

Green versus Black

Diesel oil, just like gasoline, is a mixture of various hydrocarbons (C_nH_m), and burned together with the oxygen (O_2) of the air, transforms to carbon-dioxide (CO_2) and water vapor (H_2O). However, as the combustion is never ideal, the exhaust gas also contains various byproduct gases: carbon-monoxide (CO), various unburned hydrocarbons (C_nH_m), nitrogen-oxides (NO_x). The relatively high lambda value a diesel engine is operating with reduces the hydrocarbon and carbon-monoxide content to 10–15%, and the amount of nitrogen-oxides to 30–35% of the corresponding figures measured in gasoline engines without a catalytic converter. The sulphur content of the fuel—drastically reduced during the recent decades—is responsible for the emission of sulphur-dioxide (SO_2) and sulphuric acid (H_2SO_4).

Conversely, these engines emit 10–20 times more particulates—or black soot—than gasoline engines. These are unburned or incompletely burned hydrocarbons attached to large particles of carbon. These substances are mainly aldehydes and aromatic hydrocarbons; while the first only smells bad, the second is highly carcinogenic.

The much higher amount of particulates is due to the different combustion process. The various aspects of mixture formation, ignition and burning occur simultaneously, they are not independent but influence each other. The distribution of fuel is not homogenous inside the cylinder, in zones where the fuel is richer the combustion only takes place near the outer perimeter of the tiny fuel droplets, producing elemental carbon. If this carbon will not be burned later because of insufficient mixing, local oxygen shortage (large fuel droplets due to insufficient fuel atomization, caused by worn injectors) or the combustion stopping in cooler zones inside the cylinder, it will appear as soot in the exhaust. The diameter of these small particles is between 0.01 and 10 µm, the majority being under 1 µm. Keeping the amount of fuel injected below the *smoke limit*—the lambda value where the particulate generation starts to rise extremely—is essential.

Similarly to gasoline engines, the exhaust gas can be post-processed to reduce the amount of pollutants even further. There are two different devices that can be used:

- **Soot burning filter:** as the diesel engine always operates with excess air (its lambda is above 1), there is enough oxygen in the exhaust gas to simply burn the carbon soot present. The burning filter is manufactured from ceramic materials that can withstand the resulting high temperatures (up to 1200 °C). As the diesel engine is very sensitive to excessive back pressure, the filter has to be able to self-regenerate. This is solved by the addition of organic metal substances.
- **Catalytic converter,** identical to the simpler ones used on gasoline engines before the proliferation of three-way, controlled converters. It reduces the carbon-monoxide and hydrocarbon content of the exhaust gas.

I think that at this point, soot burning filters will have to be cut out of the PDF and put in at a similar ecological section under DI/HDI—since that is the only system that actually makes soot burning practical, and the only system that implements it.

Soot burning was experimented with a lot but was never made practical before HDI due to a too low exhaust temperature. The particle filter would need heating to a very high temperature and that was deemed to be too dangerous. Even with cerine additives, essentially, there would have to be a separate small burner to heat up the filter, which is again another system that can go wrong. HDI essentially integrates a burner by alowing post-injection, something that is simply impossible for injection systems derived from a classical pump due to teh timing required. I think that for soot management it is enough to write that the smoke limit control is *vastly* improved by the better regulation of the EDC.

Other things like controlled swirl and multi-valve technology, also pioneered by Citroën (XM 2.1 TD!) should be mentioned. The catalytic converter section remains unchanged.

And, of course, there should be an "In addition to the pollution management implemented on mechanical injection systems" sentence somewhere in there, since proper cold start corrections and EGR are implemented in EDC units by default.

Suspension

A Suspension Primer

From the early days of the automobile—and even before, in the time of horse-drawn carts—it was already well known that the body of the car, housing both the passengers and the load, has to be decoupled from the unevenness of the road surface.

This isolation is much more than a question of comfort. The vertical force of the jolts caused by the repeating bumps and holes of the road surface are proportional to the square of the vehicle speed. With the high speeds we drive at today, this would result in unbearable shock to both people and the mechanical parts of the car. Jolts in the body also make it more difficult to control the vehicle.

Consequently, there has to be an elastic medium between the body and the wheels, however, the elasticity and other features of this suspension medium are governed by many, mostly contradicting factors.

The softer, more elastic the spring, the less the suspended body will be shaken by various jolts. For the sake of comfort, we would thus need the softest spring possible. Unfortunately, too soft a spring will collapse under a given weight, losing all its elasticity. The elasticity of the spring would need to be determined as a function of the weight carried but the weight is never constant: there is a wide range of possible load requirements for any car. On one hand, a hard suspension will not be sensitive to load variations but being hard, will not fulfill its designated purpose, either. A soft suspension, on the other hand, is comfortable but its behavior will change significantly on any load variation. To cope with this contradicting requirements, an elastic medium of decreasing flexibility would be required: such a spring will become harder as the weight to be carried increases.

When the spring is compressed under the weight of the load, it's not only its flexibility that changes. The spring deflects, causing the clearance between the car and the road surface decrease, although a constant clearance would be a prerequisite of stable handling and roadholding. At first sight, this pushes us towards harder springs: soft springs would result in excessive variations of vertical position — unless, of course, we can use some other mechanism to ensure a constant ground clearance.

In addition to the static change caused by load variations, the deflection of the spring is changing constantly and dynamically when the wheels roll on the road surface. The body of the vehicle dives, squats, rolls to left and right as the car goes over slopes, holes and bumps in the road, corners, accelerates or decelerates.

When a deflected spring is released again, the energy stored in it will be released but as there is no actual load for this energy, the elastic element, the mass of the suspension and the vehicle form an oscillatory system, causing a series of oscillations to occur instead of the spring simply returning to its neutral position.

Any vertical jolt would thus cause such oscillations: the upward ones are transmitted to the car body while the downward ones make the wheels bounce, losing contact with and adhesion to the road surface. The first is only discomforting, but the second is plainly dangerous. In addition, it's not only the spring that oscillates; the tires contain air which is a highly elastic spring medium. Oscillation in itself causes unwanted motion but when the corrugation of the road surface happens to coincide with the period of the suspension oscillations, it might lead to synchronous resonance, a detrimental situation leading to serious damages in the suspension elements.

Mass in motion can also be viewed as a source for kinetic energy; because of this, moving parts of the suspension are often reduced in weight to decrease this portion of the stored energy, and this in turn eases the requirements on the dampers as they have to dissipate less unwanted energy as heat. This solution, however, often shifts the frequency of the self-oscillation of the suspension upwards. Unfortunately, occupants are more sensitive to higher frequencies reducing comfort (mostly adding noise), so this is an area where compromise is needed.

Conventional suspension systems use a second element, a shock absorber to dampen these oscillations. The absorber uses friction to drain some of the energy stored in the spring in order to decrease the oscillations. Being an additional element presents new challenges: the characteristics of both the spring and the absorber have to be matched carefully to obtain any acceptable results. The absorber ought to be both soft and hard at the same time: a soft absorber suppresses the bumps of the road but does not decrease the oscillations satisfactorily while a hard absorber reduces the oscillations but lets the passengers feel the unevenness of the road too much. Due to this contradiction, conventionally suspended cars have no alternative but to find a compromise between the two, according to the intended purpose of the car: sport versions are harder but offer better roadholding, luxurious models sacrifice roadholding for increased comfort. This contradiction clearly calls for a unified component serving both as a spring and an absorber, harmonizing the requirements.

Hydropneumatic Suspension

As we saw, the ideal suspension would require elasticity decreasing with the load, constant ground clearance, shock absorbers integrated into the suspension—all these beyond the obvious independent suspension for all wheels. And this is exactly what Citroën's unique hydropneumatic suspension offers.

According to the Boyle–Mariotte formula defined in the 17th century, the pressure and the volume of a mass of gas are inversely proportional at a constant temperature. Therefore, by keeping the mass of the gas constant and changing the volume of its container, its pressure can be controlled (the usual pneumatic suspensions operate on the opposite principle: air is admitted or withdrawn from the system by compressors and exhaust valves, modifying its mass while keeping the volume constant).

The volume changes are controlled by hydraulics, a technology in widespread use in every branch of the industry. As liquids are non-compressible, any amount of liquid introduced at one end of a hydraulic line will appear immediately at the other end (this phenomenon was first formulated by Blaise Pascal). Using this principle, motion can be transmitted, multiplied or divided (according to the relative sizes of the operation cylinders), with velocity increased or decreased (using varying cross sections in the tubing), to any distance desired, over lines routed freely.

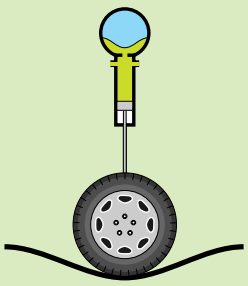
Hydraulics are immensely useful, very efficient, reliable, simple to use, and—due to their widespread deployment—relatively cheap. It is no wonder that it is used for many purposes even in the most conventional vehicles: shock absorbers, brake circuit and power assisted steering being the most trivial examples; however, Citroën is the only one to use it for the suspension.

The First Embodiment

DS ID GS GSA

The Citroën DS, introduced at the 1955 Paris Motor Show, was radically different from any of its competitors on the market at that time: suspension, running gear, steering, brakes, clutch, body, aerodynamics were all unique, not only in details but in the main operating principles as well.

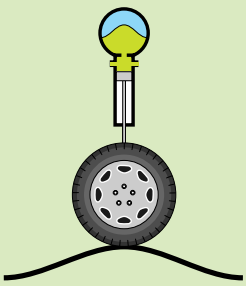
The hydropneumatic spring-absorber unit uses an inert gas, nitrogen (colored blue on the illustrations) as its spring medium, resulting in very soft springing. The flexibility of the gas decreases as the increasing load compresses the suspension pistons, reducing the volume of the gas and adding to its pressure. The damping effect is obtained by forcing the fluid (colored in green) pass through a two-way restrictor unit between the cylinder and the sphere. This effect provides a very sensitive, fast and progressive damping to reduce any unwanted oscillations.



There are many great advantages to this hydropneumatic suspension. First, by adding or removing fluid from the suspension units (practically, by adjusting the length of the hydraulic strut), **ground clearance** can be kept **constant under any load variations.** Although this might not seem very important at first sight, it means that the suspension geometry is also constant—in other words, the handling of the car does not depend on the load.

The compressed gas has a variable spring effect, becoming harder as the load increases. This compensation for the increasing load keeps the **resonance frequency** of the suspension nearly constant. As a consequence, the same excitation in the suspension moves the same amount of fluid through the dampers regardless of load (which is not the case with conventional springs). The working range of the dampers becomes much smaller and this fact makes the use of a simple damper element very effective.

This basically constant suspension resonance frequency also contributes to the consistent behaviour independent of the load. In essence, it ensures that both the road contact and the feeling transmitted to the driver remains always the same. This is something absolutely unique: all conventional suspensions have an optimum point around average load; when carrying more or fewer passengers or load than this average value, the handling characteristics change, not seldom so radically that the car becomes utterly dangerous to drive.



Another advantage is the limited but very useful **anti-dive behavior:** this is essential for efficient braking with a basically very soft suspension. The center of mass of the car moves much less than usual, hence the braking force is distributed more evenly. Manufacturers of cars with conventional suspension and braking only start to add brake force distributors to their vehicles these days. The first DS did have a force distributor but Citroën later realized that the suspension, with the addition of a single pipe, can fulfill its role entirely.

The height correction and the constant connection between the left and right side of the suspension has another important implication: lower difference in forces on the wheels. Coupled with variable damping this keeps the wheels **in contact with the road at all times,** which in turn maximizes the tractive forces on the tires—braking while turning still leaves the vehicle with the grip of all four wheels: this is essential for security in low adherence conditions, such as ice, snow, rain, mud.

The steady connection between the sides requires an external management of body roll. Ideally, for any vertical movement of the car body, the two sides of the suspension should be connected, while for any movement that results in different displacements of each wheel, they should ideally be separate. This second movement can be viewed as a rotation around the longitudinal or transversal axis.

For instance, if the front wheels run into a pothole and the rear wheels go over a bump, the car will rotate around its transversal axis. The angle of rotation remains relatively small as the length of the car is its largest dimension; the higher weights like the engine bay are far from the centre of mass, resulting in a large inertial torque to counter outside forces. If all suspension elements of the wheels were connected hydraulically, the vehicle would absorb the bumps very efficiently (the rear struts compressed by the bump would deliver fluid into the front struts, resulting in immediate compensation: the rear would sink, the front would rise, restoring the horizontal position of the car). Unfortunately, this would also lead to slow transversal (dive and squat) oscillations, made even worse by acceleration, deceleration and varying distribution of weight inside the cabin.

As the inertia of the car body around its transversal axis is basically sufficient to counter the effect of longitudinal bumps, the front and rear suspension circuits are separated. The active height correction of the system acts as a further a non-linear stabilizer both countering dive and squat, and solving weight distribution problems.

On the other hand, if the bumps are transversal—for instance, a pothole under the right wheel and a bump under the left one—, the car will rotate around its longitudinal axis. Being much less wide than long, the angle of rotation will be higher and the inertial torque is considerably lower to counter this kind of rotation. Completely independent sides would result in very little damping of roll movements: the low inertia provided by the body would find the reaction of the suspension too stiff. Hence, the two sides in the hydropneumatic suspension are interconnected, providing a push-pull operation of the two sides. The interconnection has special damping elements which react differently to different fluid movements between the sides: to quick suspension movements caused by potholes and bumps, or to slower changes occuring when driving in a curve.

To counter body roll resulting from the second, an additional element, an **anti-roll bar** is also needed. The effects of roll could be eliminated if the center of the roll could be identical to the center of the mass. As this is not possible, the opposite approach of moving the center of roll away from the center of mass could also help overcome body roll by increasing the opposing torque. This is the role of the anti-roll bar: similarly to a bike leaning into a curve, it lifts the inner side of the wheel, using the force on the outer edge, and this moves the center of roll outwards. In other words, the wheels and suspension elements do have roll, the role of the anti-roll bar is to isolate this roll from the body which should remain, ideally, horizontal. To accomplish this, the bar cannot be completely rigid (it has to absorb the road undulations without transfering them to the body), a torsion spring is the usual solution.

Such anti-roll bars are used on conventional spring suspension systems as well, however, there are substantial differences in the way the bar interacts with the rest of the suspension on Citroëns. In a spring system, there is a considerable amount of interaction, a significant flow of energy in both directions between the suspension and the bar. The shock absorbers have to provide the damping for the anti-roll bar, introducing yet another interaction (in the hydraulic setup this is catered for by the damping inside the connection line between the sides).

Consequently, the hydropneumatic suspension has much less interdependence and compromise between damping, countering roll, squat and dive. In addition, it can provide solutions which are simply unfeasible mechanically in a conventional suspension. Cars with steel springs always have roll, including diagonal one, induced by undulations of the road—their anti-roll bar represent a constant mechanical connection between the sides, unable to differentiate between bumps and curves. Citroëns, on the other hand, have a varying interconnection depending on fluid movement—this is very easy to accomplish with hydraulics but extremely complicated with springs.

The only disavantage is that damping occurs further from the source of the disturbance, and due to the good conductivity of sound via the hydraulic lines, this results in slightly more noise. The same effect makes the hydropneumatic suspension somewhat noisier than a conventional one. However, good sound insulation inside the cabin can help overcome this small annoyance.

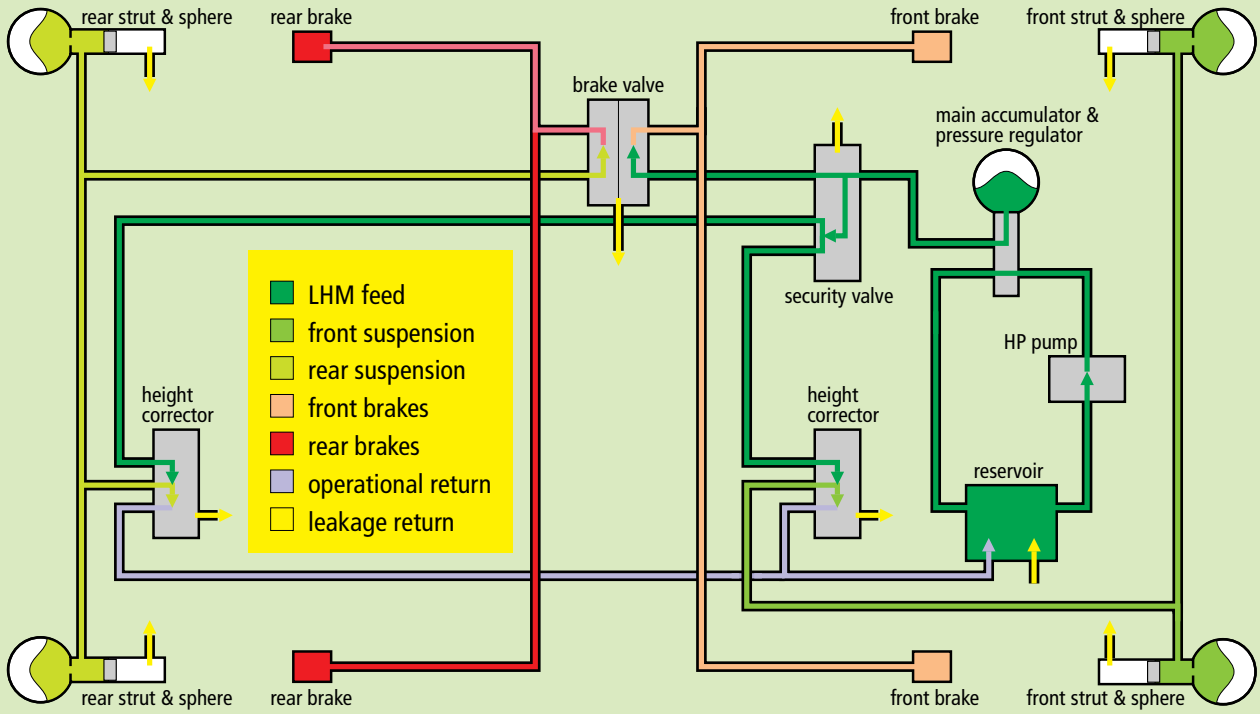
This suspension layout reduces the **sensitivity** to underinflated or blown tires and cross-wind. Even with largely uneven braking forces on the two sides the car will not pull to either side.

Although the hydropneumatic spring-absorber unit is an integrated unit from a technical point of view, hydraulics make it possible to place some hydraulic parts (for instance, the center spheres on Hydractive systems) in different locations, **reducing the amount of sprung mass.** Conventional springs have a considerable mass of their own while the mass of the nitrogen in the spheres is practically negligible. Even adding the mass of the fluid moving around in the system, the sum remains much below that of a steel spring. Hydropneumatic struts can be kept relatively small by increasing the operating pressure, which decreases the diameter of the struts. The automatic height correction reduces the mass further because the basic suspension mechanics can be simpler, without requiring multilinks and similar components.

The brakes share the mineral fluid with the suspension. This fluid boils at a very high temperature, therefore it provides great **resistance to vapor lock.** Due to the proportional regulation a hydropneumatical Citroën can keep braking as long as there is anything left of the brake pad. Even if the liquid starts to boil, there will be no vapor lock as the pressure is automatically released and remains proportional to the braking effort applied by the driver.

This system is often criticized for being overly complicated and prone to error, none of which accusations is true. The suspension is actually quite simple when considering its extra services in comparison to a conventional system and experience shows that the whole system is very reliable. The perfect functioning of the system relies mainly on the prescribed cleaning of the system and the change of the hydraulic fluid—adhering to these simple prescriptions can make the system very reliable.

A typical example: the BX

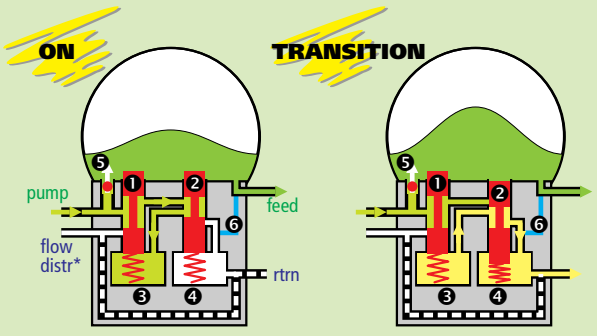


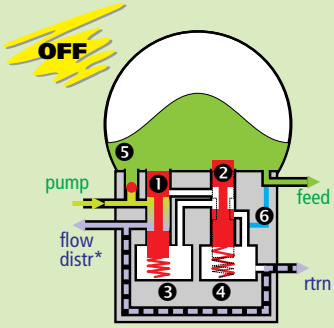
Finally, there are no forces in the suspension when the circuit is depressurised, allowing very **easy and safe servicing** of the relevant suspension and transmission parts.

Modern spring suspension systems are in fact capable of achieving some of these results. For instance, variable diameter or pitch springs coupled with hydraulic shock absorbers (incidentally, with a similar internal geometry as the damper elements used in Citroën spheres) behave similarly to these hydropneumatic units. The main difference is that even if these elements would be practically identical, all other functionality that comes either for free or at a small additional cost in Citroën systems—constant height, anti-dive, brake force regulation and so on—, require complex and expensive additional systems.

The illustration shows the basic layout of the suspension (differences on models fitted with power steering or ABS will be described in the corresponding chapters). Most components have an output line to collect leakage (which is intentional to keep the elements lubricated) and return it to the reservoir—although the outputs are indicated, the lines themselves are omitted for the sake of clarity. In reality, they are grouped together and go back to the reservoir.

The *high pressure supply subsystem* consists of a five-piston volumetric **high pressure pump** drawing the mineral suspension liquid called LHM from the **reservoir.** The fluid under pressure is stored in the **main accumulator.** It is the task of a **pressure regulator**—built into the same unit with the accumulator—to admit fluid into the accumulator as soon as the pressure drops below the minimum value of 145 bar; as soon as the pressure reaches 170 bar, the regulator closes and the fluid continues its idle circulation from the pump, immediately back to the reservoir.





On simpler models the output marked with an asterisk is omitted and it goes to the return ouput inside the regulator unit instead, as shown by the dashed line. On models fitted with power assisted steering (DIRASS) this interconnecting line is missing and both outputs are used independently.

The spring below the piston ❶ is calibrated so that it will collapse only when pushed down with a pressure exceeding the cut-in threshold (145 bar). While the pressure in the main accumulator remains inferior, the piston stays in the upper position, allowing the pump to deliver fluid into the accumulator through the ball valve ❺: the unit is *switched on.* The piston ❷ also remains in the upper position (its spring is calibrated to the cut-out pressure, 170 bar), letting the entering fluid fill up the chamber ❸ as well. This, in turn, ensures that the piston ❶ stays in the upper position: the fluid pressure in this chamber plus the force of the spring counters the downward pressing force even if the pressure in the accumulator rises well above 145 bar.

The fluid supplied by the pump raises the pressure in the accumulator; as soon as it reaches 170 bar, its pressing force will exceed the retaining force of the spring under the piston ❷, forcing it to the lower position. In this moment, the high pressure line coming from the another piston will be cut off and the fluid from the chamber ❸ can escape back to the reservoir (yellow in the illustration).

BX

CX

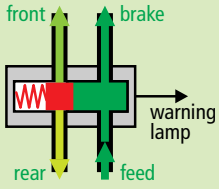
With the back pressure now vanished from behind the piston ❶, the pressing force of the accumulator fluid drives it down at once: the regulator is *switched off* now. The fluid supplied by the pump returns back immediately: on PAS-equipped cars, to the flow distributor, on other vehicles, straight back to the LHM reservoir through the internal connection (dashed line).

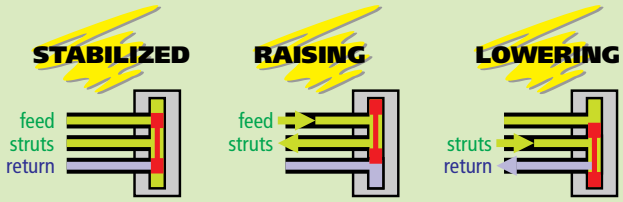
Shortly, as the suspension and braking circuits start to use up the pressure in the main accumulator, the piston ❷ will return to its original position. Once there, the regulator is ready to start a new cycle.

The characteristic ticking which can be heard in Citroëns is the sound of the regulator pistons quickly moving one after the other, in quick succession: ❷ down, ❶ down, ❷ up. The opposite tick—❶ up, when the regulator is switched on to replenish the accumulator—is much softer.

The interconnection ❻ is normally closed. Opening it lets all the fluid stored under pressure return back to the LHM reservoir—this is the way the system is depressurized when any of the suspension elements need servicing.

The liquid—supplied to the rest of the system from the main accumulator—passes through a **security valve** whose task is to ensure safety by feeding the brake circuits first. The *front brake circuit* is always open but the other two outputs are blocked by a piston. If the pressure in the main circuit exceeds 100 bar, the fluid pushes the piston back against the force of the spring, opening up the suspension outputs as well. The electrical switch for the low hydraulic pressure warning lamp on the dashboard is built into this valve as well. This way, a sudden failure of the pump or the belt driving it will not leave the car without sufficient braking power.





The second circuit fed from the security valve is the *front suspension.* The fluid goes to the **front height corrector.** When the vehicle height is stabilized, the piston inside the corrector blocks the inlet of fluid, isolating the struts from the rest of the suspension. Body roll is limited by the damping effect of the restrictors built into the sphere supports and by forcing the fluid to run from the left to the right strut through a connection line. If the movement of the front anti-roll bar dictates that the front of the vehicle should be raised, the connecting linkage moves the piston upward, opening the inlet and letting additional fluid enter the front struts. When an opposite movement is required, the piston moves downward, letting the fluid at residual pressure flow back from the struts to the LHM reservoir. Both directions of flow are stopped and blocked when the height corrector piston resumes its middle position.

The mechanical connection between the anti-roll bar and the height corrector is not a rigid linkage but has some free play. Just before the height corrector, the connecting rod coming from the anti-roll bar hooks into a small window on the corrector side. Small movements of the control rod do not change the position of the height corrector, only those are large enough to exceed this free play. In addition, the corrector has its internal (albeit low) resistance, besides, all rods are somewhat elastic, so in the end, all these factors make the height correction system filter out the higher frequency components of the suspension movement.

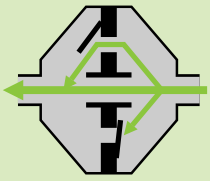
Observing an initial threshold which has to be crossed before any correction occurs not only reduces the strain and wear on the correctors but also prevents the system from developing self-oscillation. A powered system provides amplification and any feedback mechanism with a delay—such as the height correction—could potentially result in oscillations. The initial threshold ensures that there is no feedback, and consequently, no oscillation when the required correction is too small.

The next circuit is the *rear suspension.* Its layout and operation is identical to the front one, having its own height corrector.

The first circuit, as already mentioned, feeds the *front brakes.* The liquid under pressure flows into the **brake compensator valve,** operated by the brake pedal. In its neutral position, the brake circuits are connected to the return lines to ensure that the brakes are not under pressure. When the driver pushes on the pedal, this moves the first piston, closing the return output and opening up the outlet going to the **front brake cylinders.**

This piston and a spring behind it pushes the second piston which works similarly for the *rear brakes,* although those are not fed directly from the security valve but receive their supply from the rear suspension (later brake valves have three pistons but their method of operation is practically the same). In consequence, the braking force at the rear depends on the load: the more the back of the car is loaded, the stronger the rear brakes work. Actually, on a Citroën mostly used to carry only its driver, without much load in the trunk, the rear brake pads and disks wear much slower than those in the front.

The **damping elements** in the sphere supports consist of a central hole which is always open and additional small holes closed and opened by a spring as the flow of the hydraulic liquid dictates. Slower suspension movements like body roll, squat or dive result in a slower flow of the liquid and the smaller dynamic pressure differences are not sufficient to bend the spring cover open over the additional holes. The damping effect is therefore only determined by the diameter of the center hole.



The abrupt jolts caused by road irregularities, in contrast, cause faster flow. With the increasing pressure difference the fluid will open the spring cover and use the additional holes as well. This increased cross section results in a lower damping effect.

The additional holes are located in a circle around the center hole. There are two spring covers, one on each side, but they do not cover all the holes equally. Half of the holes (actually, every second one) are slightly enlarged on one side, the remaining half on the other side. By carefully adjusting the size of the holes, the designers could fine tune the damping factors independently for both directions of strut travel.

Hydractive I

The Hydractive I suspension system appeared with the XM. Unlike the simpler hydropneumatic suspension used on the DS, GS/GSA, CX, BX and some XMs, this one has two modes of operation, soft and hard. The suspension functions in soft mode but it will be switched to the hard mode when the computer deems this necessary for the sake of roadholding and safety.

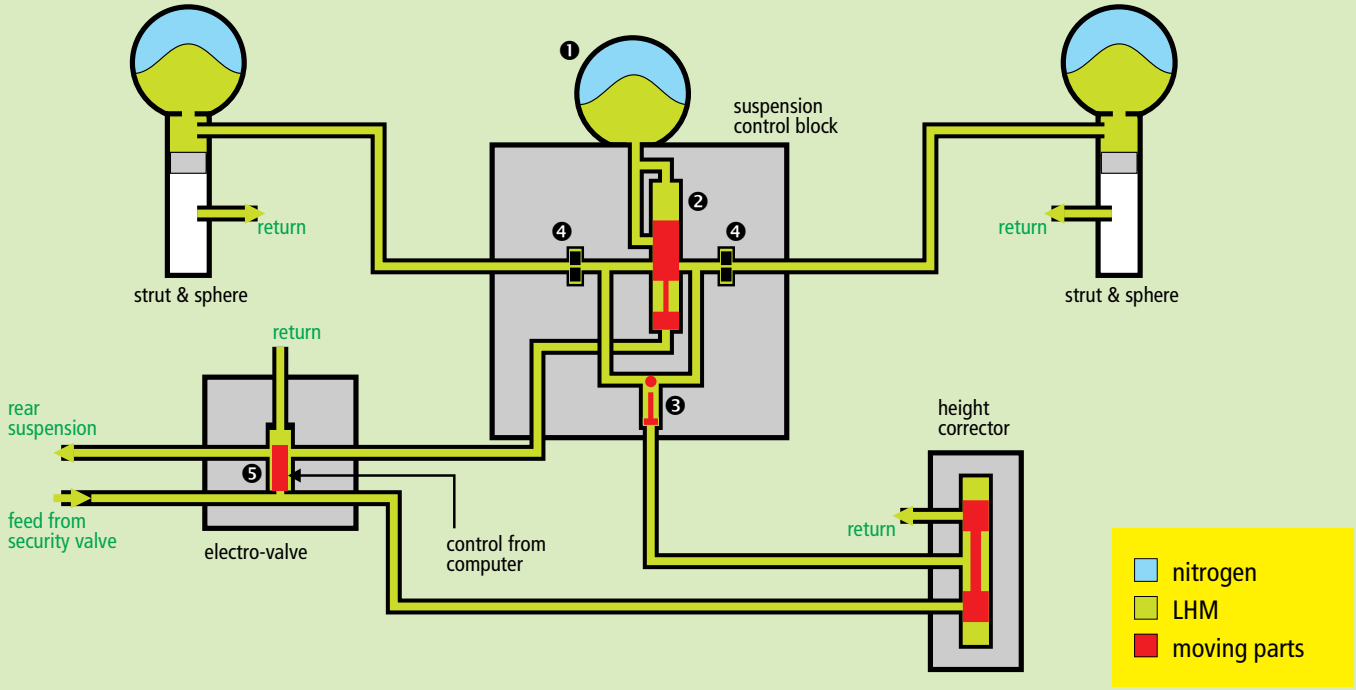
XM

To achieve this, the first hydractive system adds two spheres (one for each axle) and an electric valve to the struts and spheres of the standard hydropneumatic setup.

During normal driving, the computer keeps the suspension in soft mode most of the time but—based on the input provided by many sensors (steering wheel, accelerator pedal, body movement, road speed and brake), including the *Sport*/*Comfort* switch on the dashboard—the suspension ECU decides when to switch to hard mode; in other words, when to deactivate the additional spheres for extra roadholding and safety.

When the driver selects the *Sport* setting, the suspension is switched to hard mode constantly. This setting is not what any Citroën driver would call comfortable… The successor system, Hydractive II overcomes this limitation.

The layout of the system (front suspension)



The illustration only depicts the differences to the standard hydropneumatic layout already presented in the previous section:

❶ A standard Citroën **sphere base** which fits a sphere without a damper block. The sphere volume and pressure differ for the front and rear, as well as according to the model of the car;

❷ A **hydraulically controlled isolation valve** that connects or isolates the sphere from the rest of the suspension, modifying the string constant of the suspension;

❸ A **ball and piston valve** arrangement that limits fluid cross-flow between the left and right suspension struts in case of body roll. This valve is disabled for suspension height corrections, in order to guarantee that the fluid pressure in the corner struts remains equalized;

❹ Two **damping elements** similar to those used on the corner spheres, acting as dampers for the center one;

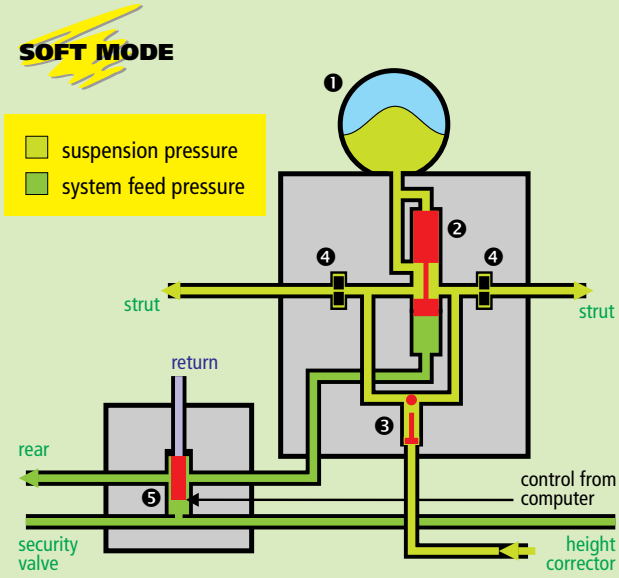
❺ An **electrically controlled valve** driven by the suspension ECU. In order to reduce heat build-up, the computer uses pulse width modulation to achieve a constant current through the coil. The initial voltage is higher to make the valve react quicker but it is reduced to a smaller value once the inductive effects have been overcome, should the valve stay on for a long enough time. The valve is capable of being on indefinitely when driven with this sustained current.

The front and rear suspension circuits are identical and the same electrovalve serves both subsystems.

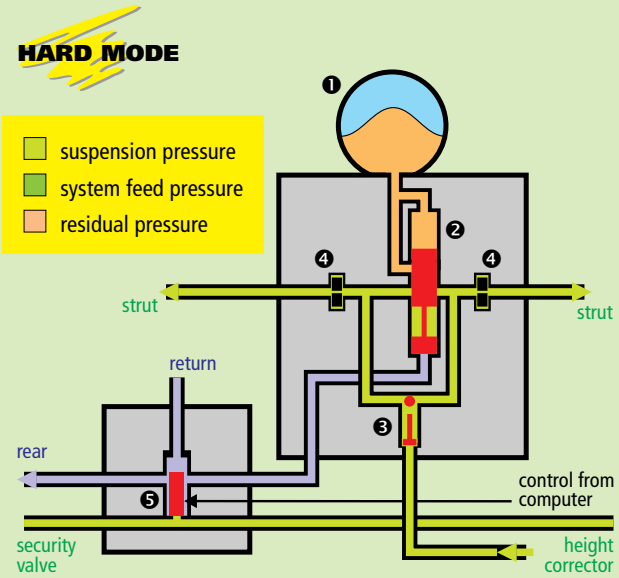
Soft, hard, soft, hard...

The default electrical mode of the suspension, when the electro-valve ❺ is not energized, is *hard.*

???



While the computer keeps the suspension in **soft mode,** the electro-valve ❺ is energized by the ECU, opening the feed pressure onto the isolation valve piston ❷ and by moving it, connecting the center sphere ❶ to the rest of the suspension. The fluid in the suspension has to pass through two damping elements ❹ (one for each strut connection). When both struts move in unison, the center sphere behaves as a standard sphere with a damper hole twice as large as a single damper element, but when the car starts to roll, the fluid has to move from one strut to the other, passing through both damper elements consecutively. In addition to this double damping, the sphere ❶ itself acts as a damping string, absorbing quick changes in pressure between the two dampers. This dampens the body roll to some extent even in soft mode.

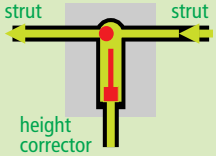


Whenever the computer feels it necessary to switch to **hard mode,** it closes the electro-valve ❺, not allowing the main feed pressure to move the isolation piston ❷. The pressure inside the center sphere ❶, always higher than that of the return path under normal operating conditions, will move the control piston into a position which closes off the center sphere completely. The remaining pressure in this sphere remains unknown but as the main circuit pressure might change while the suspension is in hard mode (due to either the dynamics of the suspension—acceleration, braking, movement due to uneven surface—or the vehicle height altered by the driver), the computer equalizes the pressure periodically by enabling the control block to assume the soft position for a short period of time.

Hard mode serves three reasons. First, it provides higher resistance to body roll. The cross-flow of LHM from one strut to the other has to pass through both damper blocks as in soft mode, but it is additionally limited using the piston and ball valve ❸, now switched into the hydraulic circuit between the damper elements instead of the center sphere. The ball is positioned in the fluid so that any cross-flow moves the ball and thus limits the flow, dampening the body roll as well.

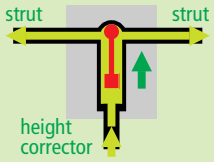
Second, it limits dive and squat by helping out the height correctors. A stiffer suspension damps the vertical motion and therefore reduces the amount of correction required.

Third, hard mode not only limits the suspension travel between the body to the road but between the suspension elements and the body. Its aim is to reduce suspension movement at the cost of comfort but to gain safety, limiting the influence of the body movement to steering, very important in extreme situations like a flat tire.

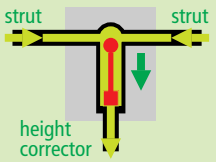


When the vehicle is making a sharp left turn, tending to roll to the right, the right strut will be compressed and the left one expanded. The fluid is then forced from the compressed strut to the expanded one, moving the ball in the valve towards the outlet of the left strut; as soon as it reaches and covers the outlet orifice, it closes off any further cross-flow. The corner spheres are now isolated and has to provide all the damping themselves.

At the same time when the body roll is present, the car might need to change the ground clearance as well: for instance, when braking in a curve. The valve ❸ therefore has an additional piston which lets the LHM flow between the circuits of the struts and of the height corrector. If the body has to be raised, the pressure in the height correctors will be higher than that in the suspension. This higher pressure pushes the piston, which in turn dislodges the ball and the pressure will raise equally in both struts (without dislodging the ball, only one of the struts would receive the fluid, resulting in incorrect operation).



If the body has to be lowered, the higher pressure in the struts will dislodge the ball again, opening the piston towards the return line ad the fluid will escape from both struts, lowering the vehicle.



Sensory perceptions

The computer of the suspension system takes its input signals from the various sensors and based on a set of rules, dynamically activates the electric valve.

There are eleven inputs to the ECU. First, the **Comfort/ Sport switch** on the dashboard, enabling the driver to choose between the two settings. The status light on the in-

strument panel informs about the setting selected (it *does not* indicate the mode the suspension is currently in).

The second input comes from a **vehicle speed sensor.** This inductive magnet tachogenerator generates 4 pulses per rotation, that is approximately 5 pulses per meter traveled (although this depends somewhat on tire size). It is located on the gearbox where the speedometer cable attaches, or in some versions, on the cable itself. The ECU determines the **acceleration** of the car by evaluating changes in vehicle speed for the duration of one second.

Another input arrives from the **steering wheel angle and speed sensor,** an optoelectronic device consisting of two infrared light beams, interrupted by a rotating disc with 28 holes. The ECU senses the quadrature signal changes of both sensors to effectively increase the resolution of the sensor (28 pulses per steering wheel revolution) by a factor of four. This produces one edge change every 3.214 degrees of steering wheel rotation. The direction of turning can be determined by the sequence of the edge changes.

To make decisions, the computer needs to know the straight ahead position of the steering wheel. The sensor does not have a built-in zero position (as it would not always work, due to misalignment and wear in the mechanical components). The computer uses heuristics instead:

First, the straight line position is assumed if the vehicle speed is above 30 km/h and the steering wheel position was not changed (an error margin of up to 4 pulses is allowed) for the last 90 seconds. Second, we know the maximum number of pulses in both directions from the center (lock to lock angle divided by two). If the steering wheel is found to turn more than this value (an error of up to 4 pulses is accepted here, too), this is a clear indication of an incorrect center reference: in this case the center position will be adjusted by the surplus.

The rotational speed of the steering wheel is determined by measuring the time elapsed between the individual pulse edges coming from the sensors.

A similar sensor informs the computer about the **movement of the car body.** Two infrared beams, the disc having 45 notches, similarly quadrupled by the ECU. Excessively long intervals are considered coming from slow height changes resulting from the driver selecting a different height setting, and are consequently discarded.

The sensor is connected to the front anti-roll bar, to the right of the height corrector linkage. Due to its location, it is capable of detecting both squat and dive, and to some extent, body roll. But as the sensor is mounted off-center, its sensitivity to roll is about three times less than the sensitivity to squat and dive. In all directions, it can measure both movement amplitude and speed of movement, using the same process as the steering wheel sensor does.

The **throttle pedal position sensor** is located below the dashboard, right next to the pedal mechanism, where the pedal can operate its sprung lever as it moves. The sensor is a potentiometer with an integrated serial resistor in the wiper's circuit.

The entire travel of the potentiometer is quantized into 256 steps by the analog-digital converter inside the ECU. The 5 V reference is supplied by the ECU itself. Due to the gas pedal initial position and maximum travel, about 160 to 220 steps out of 256 are being actually used.

The **brake pressure sensor** is a simple pressure activated switch located on a hydraulic conduit connector block, right next to the ABS block, at the bottom of the left front wing, in front of the wheelarch, under the battery. The switch makes contact at 35 bars of braking pressure.

The **door/tailgate open switches** are located on the door frame and in the boot latch. The door switches are all wired together in parallel and connected to one input line (and routed to the interior light dimmer and timer as well). The tailgate switch is connected to the other input line (and routed to the boot light and the tailgate opened detection input for the status display on the dashboard, too; the door open and bonnet open signals for the status display are generated by a separate set of switches, independent of the ones used for the suspension).

The usual **ignition switch** provides a power-on signal, triggering and internal reset and self diagnostic run in the ECU. Turning the ignition on and off also triggers internal events that guarantee proper pressure equalization between the center and corner spheres.

The brain behind the suspension

The ECU is a small microcomputer sensing the input signals coming from the various sensors. A very interesting and important aspect of the system is that it uses the driver of the car as a major part of its intelligence, making the operation very simple but effective. To achieve this, most of the sensors read the controls the driver operates.

The software contains the description of various conditions (status of the input lines and internal timers) governing when to activate-deactivate the electrovalve switching the suspension to either hard or soft mode. These conditions can be formulated as rules.

Every main input sensor has an associated rule: when the value collected from the sensor exceeds a specific threshold, the suspension is put into hard mode and the computer starts a timeout counter. For the suspension to return to soft mode at the end of the timeout period, the threshold must not be exceeded again during this time. If it was exceeded, the suspension stays in hard mode and the timeout starts all over again.

There are four additional rules overriding the normal operation—even if the sensor inputs call for a generic rule to be applied, these four conditions are checked first:

- the computer puts the suspension into soft mode when the ignition is turned on or off. This setting prevails until 30 seconds elapse or the vehicle speed exceeds 30 km/h, whichever comes first;
- if the computer determines any problem with its own operation or any of the input or output devices (including inconsistent values like no body movement but a vehicle speed above 30 km/h), the suspension will be switched to hard mode and stay there until the ignition is turned off or the doors are opened with the vehicle speed below 30 km/h. The ECU does run a self-diagnostic routine when the ignition is turned on but some sensors cannot be tested at this time, only during normal use;
- whenever the suspension stays in hard mode for more than one minute, the computer switches to soft mode momentarily to assure the equalization of pressures in the corner and center spheres. If the circumstances still

call for hard mode, the suspension will revert within 50 ms and restart the one-minute timeout period;
- below 30 km/h opening the doors or tailgate overrides any other rules and puts the suspension into soft mode to equalize the pressures in the spheres.

As already mentioned, the **steering wheel sensor** is used to derive two inputs values: steering wheel speed and angle. These values are treated separately with the purpose of calculating the lateral acceleration of the vehicle (vehicle speed, steering angle) and the potential change in this acceleration (vehicle speed, steering wheel speed). It is seemingly done this way to save memory which would otherwise be required for a full three-parameter lookup (based on vehicle speed, steering wheel angle, steering wheel speed). The steering wheel sensor rules actually give a measure of potential body roll. Body roll is significantly reduced in hard mode, consequently, the rules were set up to ensure that the body roll is minimized when there is potential for it, still the suspension stays soft to absorb bumps when there is no body roll caused by the vehicle changing direction.

If the **acceleration** or **deceleration** (braking) of the vehicle exceeds 0,3 g (approximately 3 m/s²) while the actual speed is above 30 km/h, the suspension will be switched to hard mode and a timeout of 1.2 seconds begin.

The table below shows the thresholds of **steering wheel angle** and **rotating speed.** If any of these values exceed the threshold for the actual vehicle speed, the suspension will switch to hard mode; it will revert to soft when the corresponding value drops below the threshold for at least 1 second if the switching was triggered by the steering wheel angle and 2 seconds if triggered by the rotational speed:

Vehicle speed (km/h)	Steering wheel angle (deg)
< 30	always soft
31–40	130
41–60	100
61–80	52
81–100	40
101–120	18
121–140	15
141 >	8

Vehicle speed (km/h)	Steering wheel speed (deg/s)
< 30	always soft
31–60	196
61–100	167
101–120	139
121 >	128

The body movement amplitude and speed is derived from the output of the **body movement sensor,** although the two values are used in a different way.

The body movement speed is used as the parameter for the activation of two types of corrections:
- *Flat tire correction:* if the body movement speed exceeds 300 mm/s, the suspension switches to hard mode, and all thresholds are modified to 60 mm. The timeout of the correction will be 0.4 s.
- *Excessive body movement correction:* if the body movement exceeds 60 mm more than three times within three seconds, the suspension will switch to hard mode, and all thresholds are modified to 60 mm. The timeout of this correction will be 0.4 s.

The previous corrections stay enforced until one or more of the following conditions are satisfied:
- body movement amplitude remains under the modified threshold until the correction timeout elapses;
- suspension selector is set to the *Sport* setting;
- the vehicle accelerates above 159 km/h;
- the steering wheel angle exceeds the threshold value dependent on vehicle speed as specified in the following table.

Once any of these conditions are met, the suspension will revert to normal operation, with thresholds restored according to the table. Exceeding any of these thresholds will force the suspension into hard more. The computer checks every 0.8 seconds whether the conditions forcing the suspension into hard mode are still present, and if so, the system stays in hard mode.

Suspension down > 13 pulses, timeout 1 sec
Suspension up > 9 pulses, timeout 1 sec
Suspension change speed between 30 and 50 ms AND Durchfederung > 3 pulses, timeout 1 sec

Vehicle speed (km/h)	Dive (mm)	Squat (mm)	Steering wh pos (deg)
< 30	—	—	—

Vehicle speed (km/h)	Dive (mm)	Squat (mm)	Steering wh pos (deg)
< 30	—	—	—

The values delivered by the **throttle pedal sensor** are used with reference to the vehicle speed in order to anticipate the vehicle dynamics as a result of acceleration or deceleration. The rules for this sensor represent a reaction to probable vehicle squat (on acceleration) or dive (on deceleration). Both are significantly reduced when the suspension is in hard mode.

The suspension ECU quantizes the pedal position into five discrete steps: 0, 30, 40, 50 and 60 percent of the complete pedal travel. The computer measures the time elapsed as the pedal travels from one step to the next in either direction. If this time is inside the intervals shown in the table, the suspension will switch to hard mode. It will revert to soft if the pedal movement becomes slower for at least the duration of the timeout specified:

Pedal press speed (ms)	Timeout (s)
< 100	1
101–150	2

Pedal release speed (ms)	Timeout (s)
< 100	1
101–200	2

The **brake pressure sensor** detects the pressure in the front brake hydraulic circuit. Since this is a fixed threshold sensor, the suspension setting rule is simple: if the vehicle speed exceeds 30 km/h and the pressure is above 35 bar in the brake circuit, the suspension switches to hard mode. The system stays so to prevent excessive dive when brakes are applied while any of these two conditions are met (the timeout value is one second).

Without ignition and electrical feed to the suspension computer, the electro-valve would immediately return to hard mode. Loading or unloading the car, people getting in or out would induce pressure differences in the hydraulic system. These differences would equalize abruptly when the system is started again, causing the car to jump or sink vehemently. In order to avoid this, the computer allows an additional 30 seconds of timeout starting when any of the doors is opened or closed (as communicated by the **door**

and tailgate open sensors) , leaving the electro-valve energized for the duration of the timeout.

It is important to note that the suspension will switch to soft mode even with the ignition switch turned off. Early cars did not have this feature built directly into the computer but used an additional relay and circuits. On those models, the constantly energized electro-valve can drain the battery if the doors remain open for a long time. Starting with the H2 suspension computer (from ORGA 4860, February 28, 1990) the door sensors are observed by the ECU itself and the operation is enhanced with a 10-minute timeout period. After this interval, the electro-valves will always return to the hard, non-energized state.

Changing the state of the **ignition switch** provokes a transition to soft mode for a maximum of 30 seconds; reaching a vehicle speed of 30 km/h will cancel this mode prematurely. When the ignition is turned on, the ECU also runs a self-test diagnostic sequence lasting three seconds.

When the **suspension selector switch** is set to the *Sport* setting, all sensor inputs except for the vehicle speed sensor are ignored. Below 30 km/h the car stays in soft mode and switches to permanent hard mode above this speed. The **suspension status light** in the instrument panel has two functions:

- when the ignition switch is turned on and the suspension set to *Comfort,* it will light up for the duration of the ECU self test. If the computer detects any malfunction in the course of this test, the light will flicker one or more times during this period;
- when the suspension is set to *Sport,* the status light will remain lit to inform the driver of the setting chosen. The status light actually lights up or extinguishes only when the suspension rules have been changed in response to the mode select switch. This takes a short while because the internal timeouts are reset and some of the sensors are recalibrated. Because of this the light changing state is slightly delayed from the mode switch changing state.

Hydractive II

The second incarnation of the hydractive suspension appeared at February 1, 1993 (ORGA 5929). It was designed to overcome the biggest problem of the previous system, the very uncomfortable hard mode.

XM

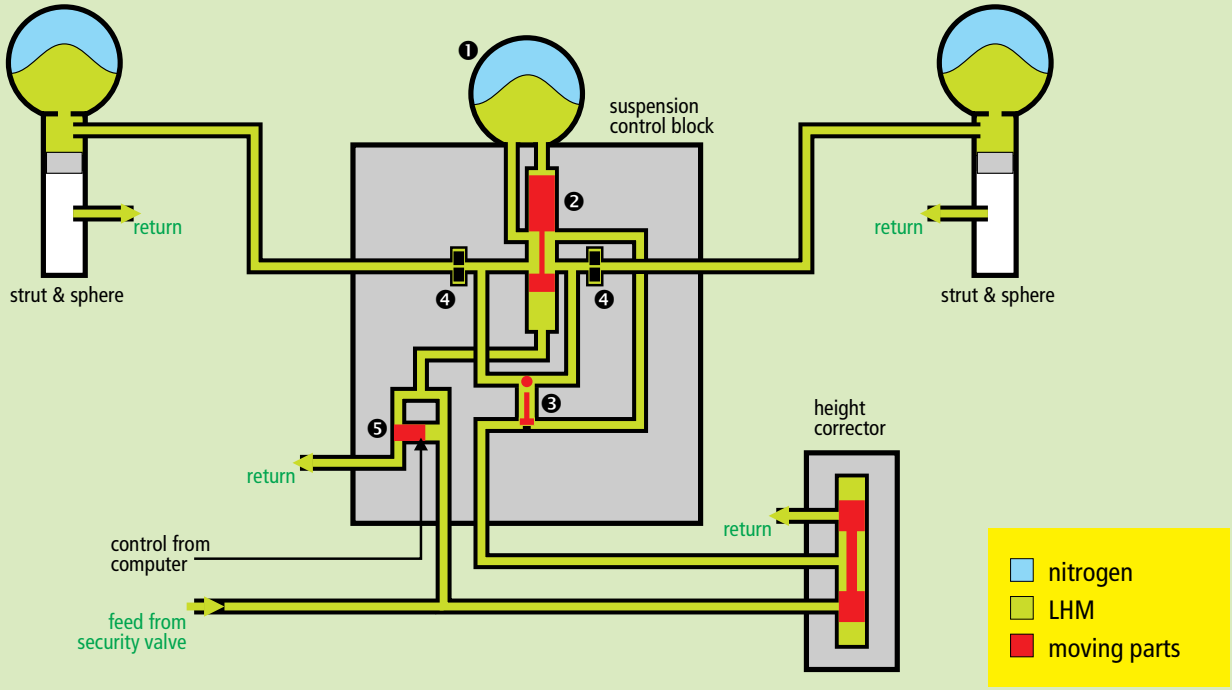
Xan

Switching to *Sport* does not mean sticking to a hard, uncomfortable ride any more. On the Hydractive II, the relation between suspension modes and dashboard switch settings became more complicated: in both settings—*Normal* (the new name of *Comfort)* and *Sport*—the computer can switch to both hard and soft mode as it finds it necessary, however, when set to *Sport,* the suspension becomes more sensitive and will sooner and more often switch to the hard mode.

1
2
3
4

Many models were also fitted with an anti-sink system that locks the system when the car is not running, using yet another sphere. Its only purpose is to keep the car from sinking when not used, it does not influence the functioning of the suspension system in any way.

The layout of the system (front suspension)



The center sphere circuits and supports were redesigned: they now house the electrovalves and the internal conduits serving the sphere were modified as well; the new control blocks connect, as previously, to the left and right corner spheres, the height corrector, and—depending on the control signal coming from the suspension computer—the center sphere. The elements are practically the same as on Hydractive I:

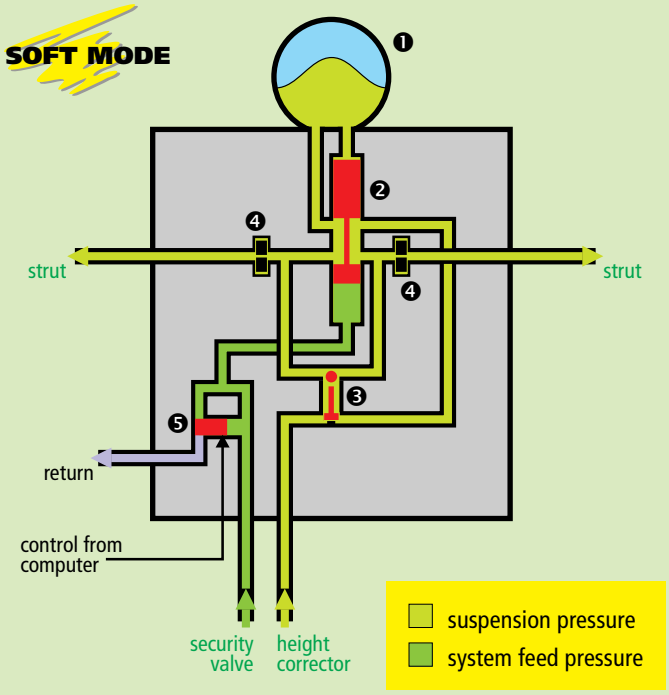
❶ A **sphere base**;
❷ A **hydraulically controlled isolation valve;**
❸ A **ball and piston valve**;
❹ Two **damping elements**;
❺ An **electrically controlled valve** driven by the suspension computer.

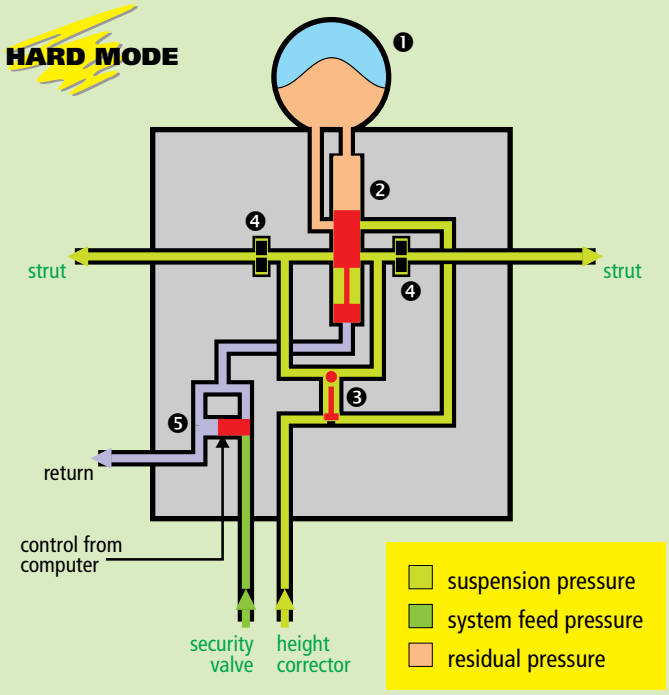
The front and rear suspension circuits are identical but hydraulically independent. The electro-valves are driven simultaneously, in parallel.

Trapped among pistons

The electro-valve ❺ is energized when the suspension is in its *soft* mode, hence, the default electrical position is *hard.* However, due to the indirect coupling between this valve and the isolation piston ❷ inside the control block, the hydraulics can stay in either position for extended periods of time with the electric valve disconnected, depending on the pressure differences between the strut and the main circuits. If the main suspension circuit has nominal pressure, the system stays in hard mode with the electric valve off or disconnected.

The two modes are practically the same as on the previous Hydractive system: in **soft mode** the electro-valve ❺ opens the feed pressure onto the isolation piston ❷ and by moving it, connects the center sphere ❶ to the rest of the suspension. In **hard mode**, the electro-valve ❺ closes and





lets the pressure inside the center sphere ❶ move the control piston into a position which closes off the center sphere completely.

The center sphere ❶ is now supplied directly from the height corrector in soft mode. This simplifies the ball valve arrangement with respect to Hydractive I.

Higher intelligence

The computer uses the same set of sensors as Hydractive I, the only difference is the **vehicle speed sensor** which is a Hall-effect sensor now. Its resolution have been doubled to 8 pulses generated per rotation, that is approximately 5 pulses per meter traveled (although this depends somewhat on tire size). It is located on the gearbox where the speedometer cable attaches, or in some versions, on the cable itself.

The internal algorithm of the computer became more sophisticated. While the Hydractive I had only one computer controlled mode (*Sport* switched the suspension to constant hard mode above 30 km/h of vehicle speed), the newer system has two such regimes of operation: in both *Normal* and *Sport* it dynamically activates the electro-valves of the suspension control blocks whenever it decides that the driving circumstances call for a firmer suspension. The difference is in the set of rules the computer uses to evaluate those circumstances: the rules are stricter for the *Sport* setting, with most of the thresholds reduced, thus the suspension will switch to hard mode much more readily.

The following table shows the thresholds of **steering wheel angle.** If the value observed by the sensor exceeds the threshold for the actual vehicle speed and the suspension setting, the suspension will switch to hard mode; it will revert to soft when the corresponding value drops below the threshold for at least 1.5 seconds:

Vehicle speed (km/h)	Steering wheel angle (deg)	
	Normal	Sport
< 34	—	—
34–39	174	119
40–49	100	67
50–59	84	56
60–68	68	45
69–78	55	37
79–89	42	28

Vehicle speed (km/h)	Steering wheel angle (deg)	
	Normal	Sport
90–99	33	22
100–119	26	27
120–139	23	15
140–158	20	13
159–179	13	9
179 >	10	7

There is a similar table for the thresholds of the **steering wheel rotational speed** as well:

Vehicle speed (km/h)	Steering wheel speed (deg/s)	
	Normal	Sport
< 24	—	—
24–29	535	357
30–39	401	267
40–49	246	164
50–59	178	119
60–68	110	73
69–78	82	55

Vehicle speed (km/h)	Steering wheel speed (deg/s)	
	Normal	Sport
79–89	62	41
90–99	53	35
100–119	42	28
120–139	30	20
140–158	22	15
158 >	20	13

The thresholds for **body movement** are:

Vehicle speed (km/h)	Dive (mm)	Squat (mm)	Steering wh pos (deg)
< 10	—	—	—
10–33	84	60	—
34–39	84	60	87
40–49	54	48	50
50–59	54	48	42
60–68	54	48	34
69–78	54	48	27.5
79–89	54	48	21
90–99	48	48	16.5

Vehicle speed (km/h)	Dive (mm)	Squat (mm)	Steering wh pos (deg)
100–109	48	48	13
110–119	48	42	13
120–129	48	42	11.5
130–139	42	42	11.5
140–149	42	42	10
150–158	42	36	10
159–179	42	36	6.5
179 >	36	36	5

Note that the thresholds are the same for both *Normal* and *Sport* suspension settings

The thresholds of the **gas pedal sensor** are:

Vehicle speed (km/h)	Pedal press rate (steps/25 ms)	
	Normal	Sport
< 14	2	1.3
15–49	3	2
50–99	4	2.6
100–134	5	3.3
135–199	6	4
199 >	7	4.6

Vehicle speed (km/h)	Pedal release rate (steps/25 ms)	
	Normal	Sport
< 19	10	6.6
20–78	5	3.3
79–168	6	4
168 >	7	4.6

With the improved resolution of the vehicle speed sensor, the rules formerly referencing to 30 km/h are changed to 24 km/h. Thus, the suspension switches to hard mode if the **brake pressure sensor** detects a pressure above 30 bar and a vehicle speed in excess of 24 km/h.

Similarly, the suspension will switch to soft mode if the **ignition switch** is turned on, for a maximum of 30 seconds, but reaching a vehicle speed of 24 km/h will cancel this mode prematurely. It will switch to soft also if any **door** or the **tailgate** is opened but the vehicle speed is below 24 km/h. The reason for this is to equalize the pressure between all three spheres of an axle. Without it, the center sphere would retain its former pressure and once the vehicle exceeds the speed of 24 km/h, opening it would make the car jump or drop, depending on the actual pressure.

It is important to note that the suspension will switch to soft mode even with the ignition switch turned off. Should the doors remain open with the ignition switch in the off position, the suspension soft mode will be subjected to a 10-minute timeout period to avoid draining the battery as the soft mode requires the electric valves to be energized.

Anti-sink system

Many contemporary Citroëns—including both regular hydropneumatic and Hydractive Xantiae and XMs—have an anti-sink system (SC/MAC) fitted, to keep the car from lowering when not used. The system does not interfere with the normal functioning while in use. It attempts to minimize leaks inside the system by having only one element that can leak, the anti-sink valve itself.

The introduction of this anti-sink valve coincided with the appearance 6+2 piston high pressure pump. As the suspension is fed from the smaller, two-piston side of the pump, pumping the car up from the low position would require a lot of time (although its performance is perfectly sufficient for the normal operation once the car is already running).

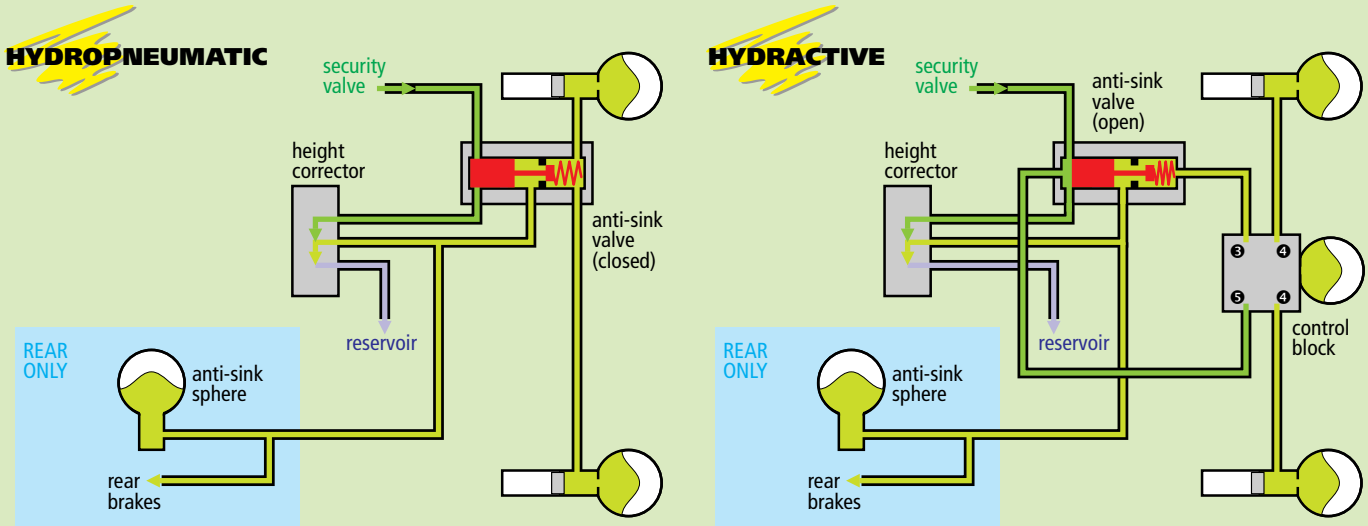
To avoid this scenario, the anti-sink valves fitted for each axle between the height corrector system and the suspension struts (or the hydraulic control block on Hydractive systems) keeps the car body from lowering when the engine is switched off. The valves operate on the pressure differences in the system, without any electrical control: when there is significant pressure in their control circuit, they keep their work circuit constantly open.

Under normal circumstances, the high pressure pump supplies the pressure regulator and the main accumulator with fluid. The output from these two feeds the whole system with high pressure, going through the security valve which keeps the brake circuit constantly under pressure, for obvious reasons of security. If there is enough pressure in the system, the security valve feeds the rest of the suspension via the anti-sink valves and the height correctors.

This pressure coming from the security valve appears in the control circuit of the anti-sink valves. When the car runs, the valves are constantly open, connecting the height correctors to the rest of the suspension and brake subsystems—everything functions exactly as in cars not equipped with this anti-sink system. Even when the engine is turned off, the valves remain open as long as the feed from the accumulator remains at a higher pressure than that of the suspension. But as soon as the leakage in the struts, height regulators and the brake valve reduces the pressure in the main accumulator below the suspension pressure, the closing anti-sink valves isolate the suspension struts from the rest of the system. It is usually the front valve that closes first as the front of an unladen car is much heavier due to the engine and gearbox. Compared to a non-anti-sink car, the leakage is quite drastically reduced. For instance, a standard XM with its suspension in prime condition takes about 20-30 hours to sink completely, while with the anti-sink system this would take as much as ten days.

The rear anti-sink valve is connected slightly differently: in addition to feeding the rear suspension and the brake circuit, as usual, it connects to an additional anti-sink sphere as well. The function of this sphere is to maintain pressure in the braking circuit. As the brake valve is the most leaky element, it could exhaust the pressure between the piston and the plunger while the remaining pressure behind the piston (provided the high pressure and the front suspension circuits do not leak that much) stays rather high. In this case the anti-sink valve might open again in error—this additional sphere ensures that this will not happen.

This system maintains the car height by counteracting the internal leakage of the various suspension element that would make the pressure escape back to the reservoir. Elements that are in constant motion—height correctors, for instance—leak past their seals on purpose to lubricate themselves. The anti-sink valves—which move very rarely, need no intensive lubrication, thus are manufactured with very close tolerances and hardly leak themselves—isolate all the struts from the rest of the system to prevent any possible leakage to reduce the pressure in the struts, allowing the car to sink.



Activa Suspension

The Activa suspension—used only on some Xantia models—creates mixed feelings. Drivers requiring sporty handling and roadholding praise it because this car turns into curves without turning a hair: it stays completely horizontal and neutral. However, this comes at the expense of ride comfort.

Xan

The Activa system operates in two distinct steps. The first one is controlled mechanically by a **roll corrector** (the component is identical to the height correctors used in the suspension, see the details on page 26).

The corrector is connected by an L-shaped spring to the bottom wishbone. When the car takes a sharp left turn, its front left wheel will be forced down by the body roll caused by centrifugal force. As the wheel moves down, so does the end of its wishbone, pulling the linkage to the corrector. The piston inside the roll corrector moves upwards, opening the pressure feed into the stabilizing cylinders. These two cylinders are attached to the wheel suspension differently: in the front, the piston pushes the left wheel upwards while in the rear, the right wheel will be forced downwards. This diagonal correction counteracts the roll of the body.

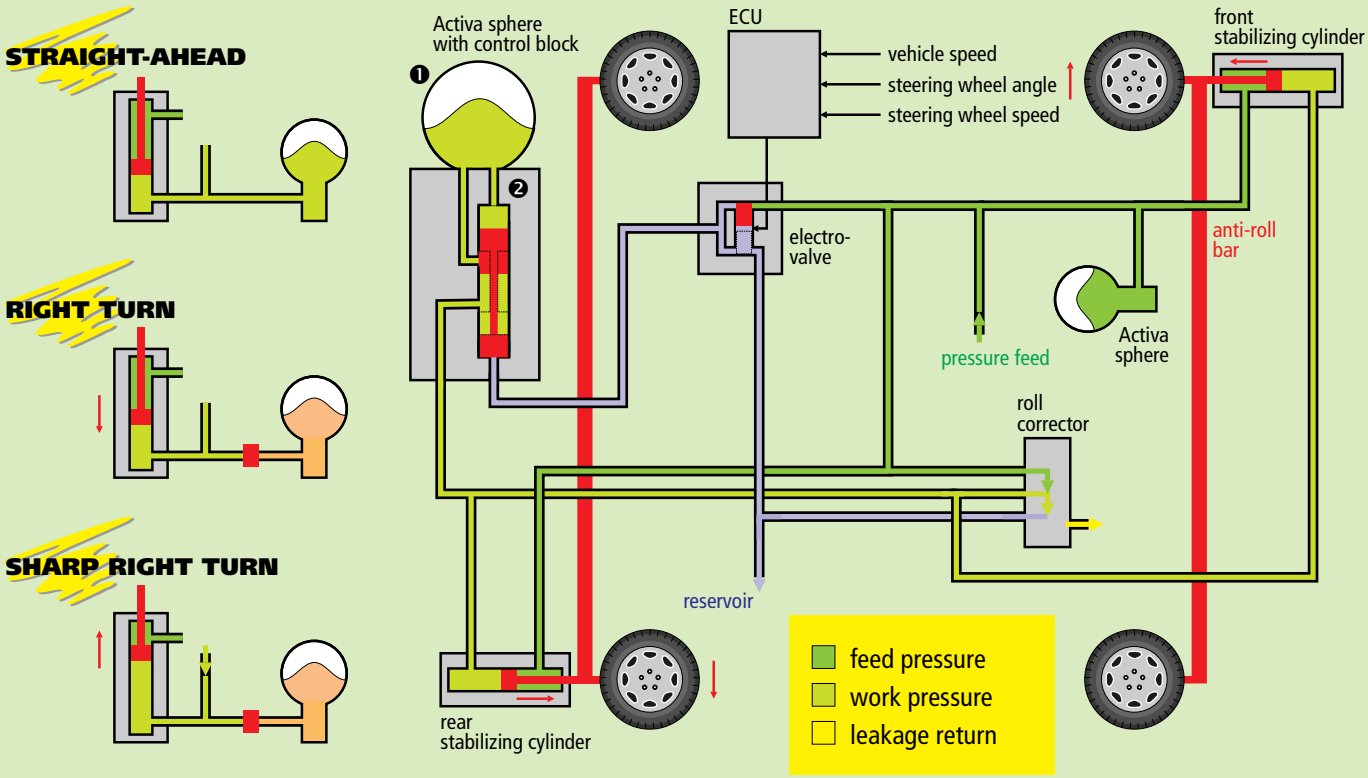
Turning to the other side result in an inverse operation: the roll corrector opens the connection from the stabilizing cylinders back to the reservoir. The front left wheel moves downwards, the rear right one upwards, once again countering the effect of body roll.

An additional Activa sphere in the front acts as an extra accumulator but the rear sphere can be connected or decoupled electrically. Depending on the position of the piston inside the **electro-valve,** the high pressure feed is either allowed to reach the piston ❷ inside the control block, pushing it up and connecting the sphere ❶ to the rest of the circuit (dashed line on the illustration), or the residual pressure in the sphere moves the piston ❷ down, isolating the sphere ❶.

When the Activa sphere is open to the rest of the system, roll correction is applied through a spring element formed by the accumulator and the Activa sphere. The supply side of the **stabilizing cylinder** pistons have half the area of the other side, connected to the Activa sphere ❶ with the valve ❷ open. Changes in the length of the linkage is therefore not transmitted directly to the roll bar. Upon the influence of external forces like body roll, the movement of the piston compresses the gas content in one sphere and at the same time, expands it in the other.

The stabilizing cylinder works as a spring with asymmetrical characteristics: its effective hardness is smaller around the corrected position, but it hardens progressively as the piston is forced out of that position.

The Activa system has two operating modes, depending on the position of the electro-valve ❷. In the first mode roll correction is always active because the roll corrector is upset. The resulting flow of fluid will tend to move the active linkage upsetting the balance of presssure in the two extra



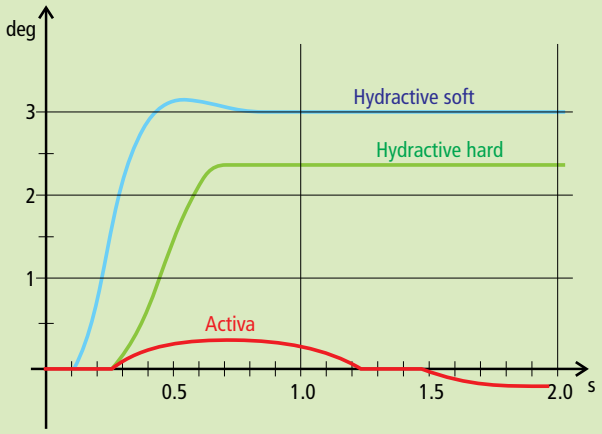
spheres, and making the coercive force be applied through a spring element which becomes progressively stiffer the more correction is needed.

The **ECU** controling the electro-valve uses sensors identical to the Hydractive system. The values of vehicle speed, steering wheel rotation angle and speed determine when the second mode of anti-roll behavior has to be enforced. Similary to the operation of the suspension computer, the Activa ECU also uses the driver as the input to determine the motion of the vehicle body: if the roll is caused by the unevenness of the road surface, the steering wheel will not be rotated. In curves, the computer calculates the maximum potential lateral acceleration (vehicle speed is measured by its sensor, the turning radius is communicated by the steering wheel angle sensor, the mass of the car is a known constant—the centrifugal force can be calculated from these values) and decides wether the spring element formed by the two spheres needs to become rigid to make the system compensate for the body roll.

In this mode the Activa sphere is isolated from the rest of the system, the fluid line between the roll corrector and the active linkage is blocked at both ends, making the linkage completely rigid. Even if the roll collector end is open, the linkage remains quite rigid (providing for a very hard spring coupled with high damping); only half of the displacement escapes from the additional accumulator sphere through a restrictive regulator.

The additional damping of the Activa sphere is now switched off, the correction is applied only through the very hard roll-bar. When the possible range of correction is exhausted (strut linkage extends or contracts as far as it can), at about 0.6 g lateral acceleration, only the very hard roll-bar remains functional.

The diagrams showing the kinetic characteristics of an Activa car reveal the details. The first diagram shows the relationship between time and roll angle for a constant lateral acceleration. It can be observed clearly that the Hydractive system can only limit roll damping, not roll angle. Note that the initial slope of both Hydractive curves—the section up to 0.4–0.6 seconds— is practically the same in both soft and hard mode. This slope represents the combined hardness of the roll bar and the associated hydraulic components. Yet, the reaction time is longer in the soft mode (0.8 seconds versus 0.6, indicated by the last bend when the curve turns into a horizontal line). As the corner spheres are isolated and their combined gas volume is less in hard



mode, the maximum roll angle stabilizes around 2.5 degrees while in soft mode it reaches 3 degrees.

The second diagram depicts the relation between the lateral acceleration and the roll angle. The hydraulical-mechanical roll bar of the Activa starts the same as the Hydractive system with minimum lateral acceleration. But, while the Hydractive stays almost linear—the sharper you turn, the bigger the body roll angle will be—, the Activa compensates by keeping the body roll angle at a constant below 0.5 degree up to a lateral acceleration of 0.6 g (by providing an effectively infinitely stiff roll bar setup). But even when the limits of the roll bar are reached, having contracted or extended it as far as it can go, the effective roll bar remains quite stiff: the roll angle will increase only moderately, up to a maximum of 1 degree.

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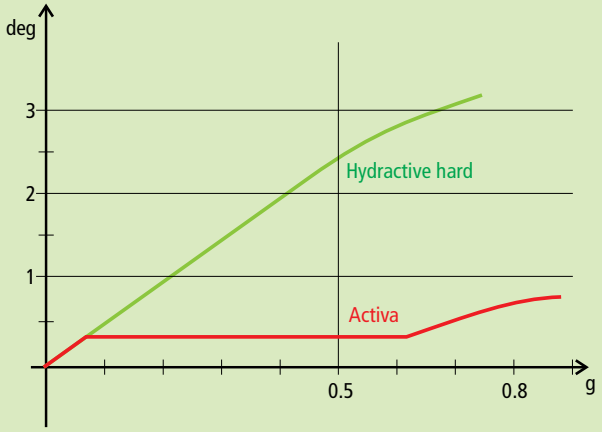


Hydractive 3

The new C5 has a new suspension system, doing away with many solutions used on Citroëns for several decades, yet offering the same or even better comfort than before. Recent developments in electronics and computics made it possible to delegate many functions previously solved by mechanical-hydraulical components to electronic units.

C5

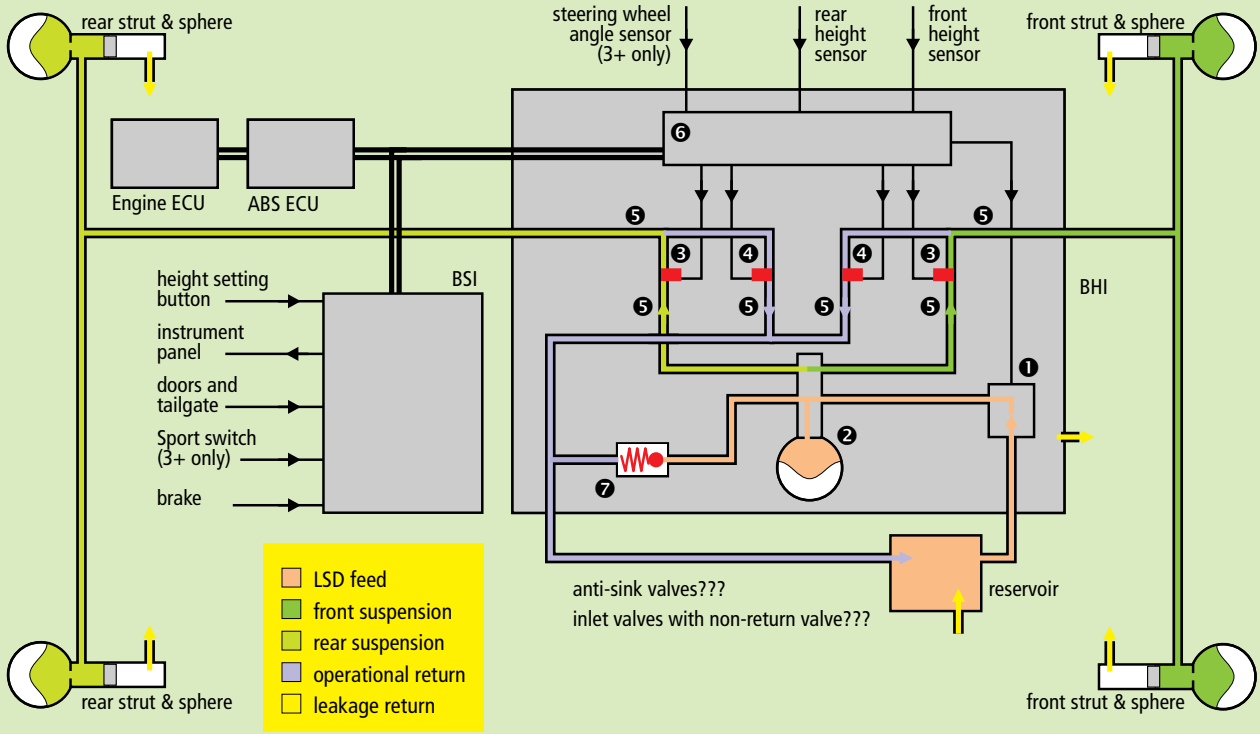
This third generation suspension system retains the same basic functioning as the previous systems. It also comes in two flavors: a simpler **Hydractive 3** reminiscent of the original hydropneumatic suspension of the DS–GS–BX–CX and a slightly more complicated **Hydractive 3+,** building upon the former Hydractive I and II (actually, Hydractive 3 is not hydractive in the sense we used this term before, its only special activity is to adjust the road clearance depending on speed and road condition).

Although the basic functioning is practically the same, the actual layout underwent significant changes. Most importantly, the previously mechanically operated height correctors became electronically controlled hydraulic units. And all hydraulic units except for the spheres—which were redesigned to give unlimited life expectancy—are now housed in a single unit, the **Built-in Hydroelectronic Interface** (**BHI**). This compact unit has three main parts:

- the high pressure for the new synthetic fluid (called LDS, orange in color) is generated by a five-piston hydraulic pump ❶, driven by an electric motor (rotating at 2,300 rpm) operating independently of the engine, running only when necessary;
- the hydraulic units, including an accumulator ❷ to even out the pressure pulsations of the pump, four electrovalves ❸ and ❹ and two hydraulic valves ❽ serving the height regulation and anti-sink behavior, some in-line filters ❺ and an overpressure valve ❼ (taking the role of the pressure regulator of previous systems).
- the electronic computer ❻, communicating with other computers across the multiplex network to read the inputs of various sensors and to control both the HP pump motor and the electrovalves.

In contrast to the height correctors of previous systems, operated mechanically via a linkage coupled to the anti-roll bars, the new system used electronic sensors to learn the actual height of the suspension and electric actuators to modify the ground clearance whenever needed. The main advantage of using them is that the ECU can implement very sophisticated algorithms to derive and apply height correction, what were impossible with the mechanically linked feedback with simple thresholds.

The computer ❻ is connected to the CAN multiplex network, providing access to the messages sent by the BSI and its fellow computers controlling the engine and the ABS. The inputs the suspension ECU uses comprise of rear and front body height, brake pedal, vehicle speed and acceleration, open-closed status of the doors (including the tailgate), plus the steering steering wheel angle and rotating speed on the Hydractive 3+.



As usual with Citroëns, the driver can select from four height settings (although the selector is no longer mechanically coupled with the hydraulics, it is a simple electronic switch sending signals to the computer): *high, track* (plus 40 mm), *normal* and *low.* The selected setting is displayed on the multifunction screen in the dashboard. The computer also prevents unsuitable settings being selected. The *high* option is not available when the car is traveling faster than 10 km/h and neither *track* nor *low* mode can be selected above 40 km/h.

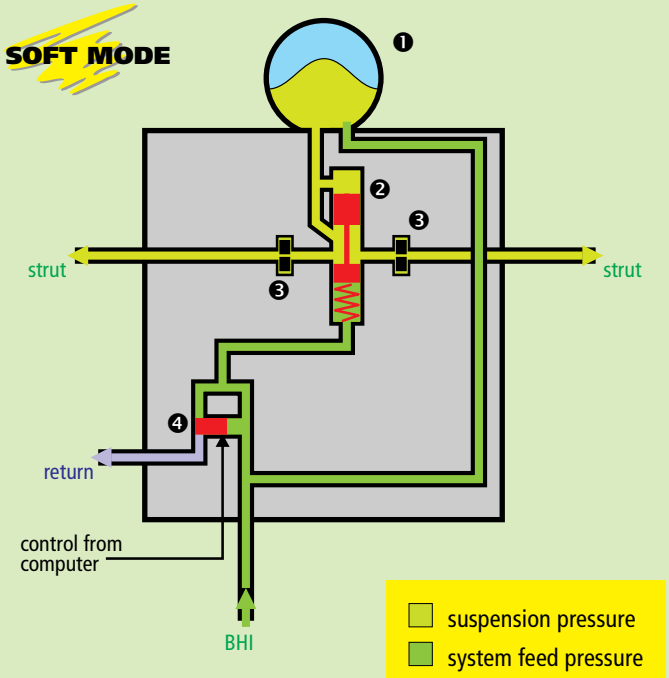
In addition to the manual settings, the system adjusts the ground clearance automatically. Below 110 km/h on well surfaced roads the ride height remains standard but as soon as this speed is exceeded, the vehicle will be lowered by 15 mm at the front and 11 mm at the rear. This change lowers the center of gravity, improving stability, lowering fuel consumption (by reducing drag) and reducing the sensibility to crosswinds. The car resumes the standard ride height when its speed drops below 90 km/h.

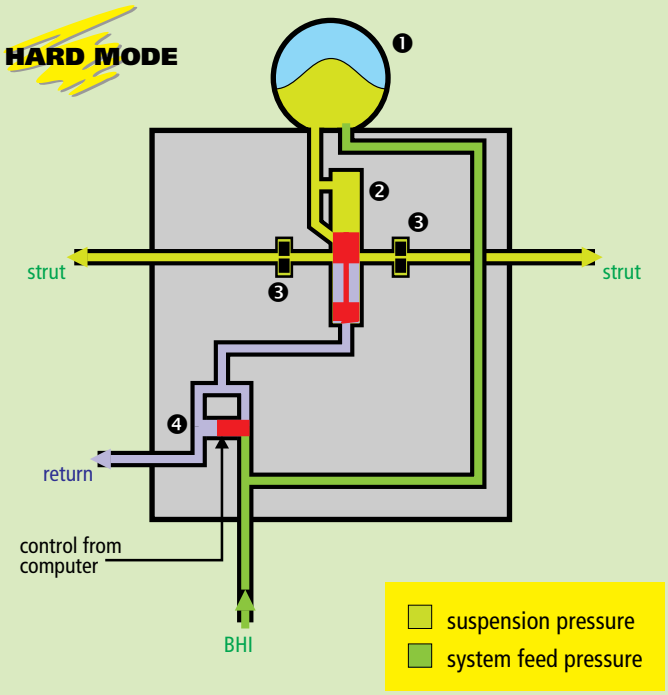
On poorly surfaced roads (the computer learns about the road quality by monitoring data on vehicle speed, height and movement of the suspension) the ride height will be increased. The maximum increase would be 20 mm but this setting is only used on very poor roads and with the vehicle traveling below 60 km/h.

The general height of the vehicle (filtering out rapid movements due to suspension travel) is checked, and if necessary, adjusted every 10 seconds and when any of the doors is opened or closed (even with the ignition switched off).

Hydractive 3+

Just like its predecessor, this system also has two modes, *firm* and *soft*. A **stiffness regulator**—an additional sphere and a hydraulic control block per axle—isolates or connects the corner and center spheres. Its functioning is practically equivalent to the similar control block of the Hydractive II: the computer controlled electro-valve ❹





opens the feed pressure onto the isolation piston ❷ and by moving it, connects the center sphere ❶ to the rest of the suspension, switching the suspension to **soft mode**. of the suspension. Closing the electro-valve ❹ obstructs the hydraulic supply coming from the BHI; the residual pressure in the center sphere ❶ moves the isolation piston ❷ downwards into a position which closes off the center sphere completely: the suspension switches to **hard mode.**

The suspension has two settings the driver can choose from, *Normal* and *Sport.* The new stiffness regulators together with the center spheres are isolated in hard mode and re-activated in soft mode in response to the various inputs received and processed by the suspension ECU. The functioning of the computer is basically similar to the Hydractive II ECU: it uses tables and rules to set up thresholds on the value on many sensor inputs to determine when to switch to hard mode. Just like on its predecessor, the *Sport* setting does not mean constant hard mode, just lowered, more sensitive thresholds for the switching.

The computer observes the following input parameters: the **height** and **sport settings** specified by the driver (communicated by the BSI); the **vehicle speed** and the **longitudinal-lateral acceleration** of the body (communicated on the CAN), the **angle** and **speed of rotation of the steering wheel** (the type of the sensor depends on whether the car is equipped with ESP, in this case the sensor connects to the multiplex network instead of directly to the suspension ECU), the speed of **suspension travel** (using the values of the front and rear height sensors), the open-closed status of the **doors** (communicated by the BSI) and the movement of the **accelerator pedal or butterfly.**

Steering

Power Assisted Steering

The PAS steering (DIRASS, Direction Assistée) used on Citroëns is not radically different from similar systems on other cars. Naturally, having a high pressure hydraulic system at disposal influences the layout.

BX

The fluid requirements of the various hydraulics subsystems differ significantly: while the brakes require only a very little amount of LHM and the suspension somewhat more, the power steering cannot work without large amounts of mineral fluid provided at a moment's notice. A **flow distributor** built into the first hydraulic circuit—that of the hydraulic pump, the main accumulator and the pressure regulator—controls the hydraulic pressure between the steering circuit and the suspension-brake circuits on PAS cars.

The rest is rather simple. A hydraulic **ram cylinder** is mounted on the rack of a traditional rack-and-pinion steering gear unit. The pressure of the hydraulic fluid supplied to assist the driver in turning the steering wheel is controlled by the flow distributor and a **control valve.** The flow distributor has the following components:

- ❶ a **slide valve** to divide the amount of fluid;
- ❷ another **slide valve** to limit the amount of fluid;
- ❸ a **pressure limiting valve** to limit the pressure of the LHM when the steering wheel is turned completely to lock;

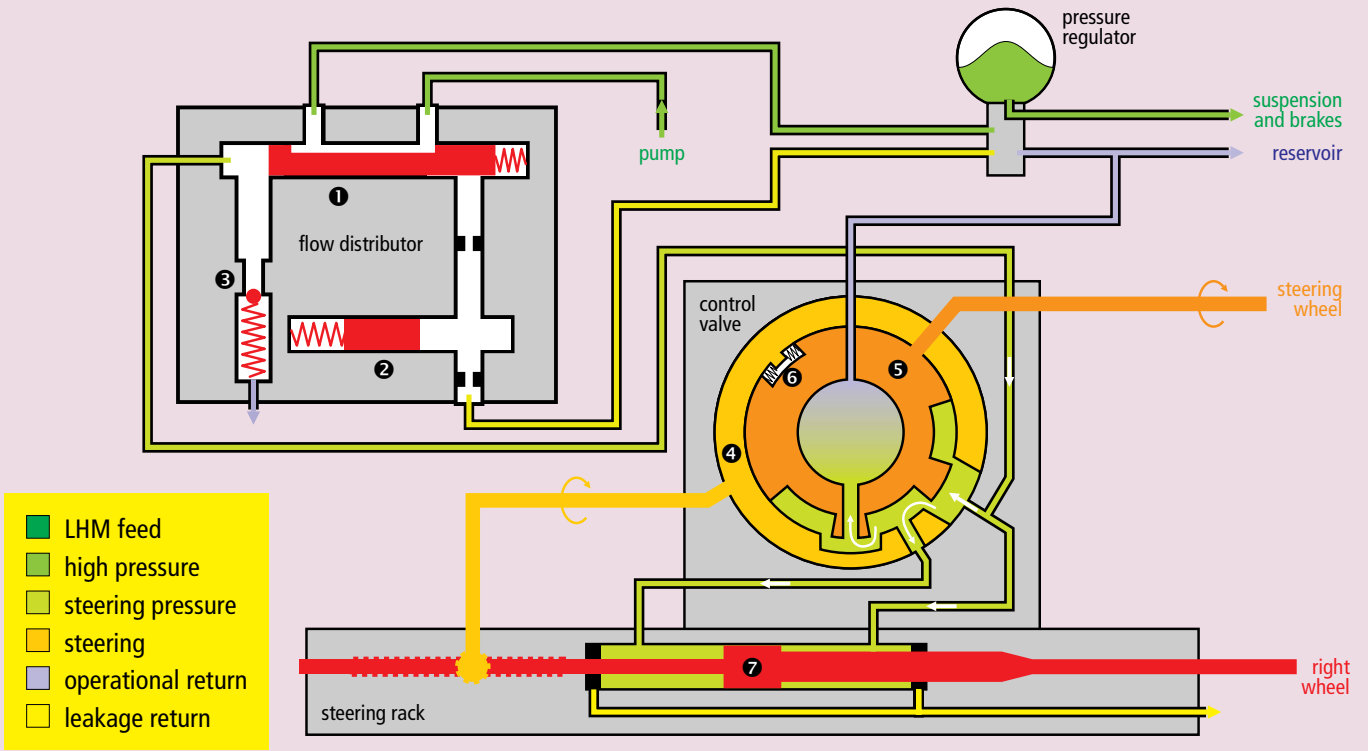
The steering control valve has three important elements:

- ❹ a **distributor** mounted to the pinion;
- ❺ a **rotor** fixed on the end of the steering rack;
- ❻ a **torsion bar** between the distributor and the rotor.

On the main illustration, the power assisted steering system is shown when it operates with the steering wheel in the straight-ahead position and the **pressure regulator** is switched on. The slide valve ❶ inside the flow distributor divides the mineral fluid coming from the high pressure pump between the main and the steering hydraulic circuits (the main circuit having priority). Both the distributor ❹ and the rotor ❺ are in neutral position—the torsion bar between the two is not functioning). Both chambers of the ram cylinder are fed without pressure. All the fluid arriving through the distributor flows back to the LHM reservoir.

When the pressure regulator switches off while the steering wheel still is in its straight-ahead position, the pressure starts to rise until it reaches 170 bar again and disconnects the feed to the **main accumulator.** The main slide valve of the pressure regulator is connected to the second feeding channel of the flow distributor. All the fluid supplied by the HP pump now feeds the flow distributor where the slide valve ❷ is responsible for limiting the amount of fluid transported by the control valve. The whole amount of fluid still returns to the reservoir.

Now let's assume the driver starts to steer to the right. The rotor ❺ starts to rotate with reference to the distributor ❹. The control valve closes the path of the fluid coming from the flow distributor which no longer is allowed to enter the valve. The pressure begins to rise in the circuit between the control valve and the flow distributor, moving the slide valve ❶, which in turn modifies the ratio of fluid, favoring the PAS circuit. The fluid will enter the right chamber of the ram cylinder while the left chamber can be emptied

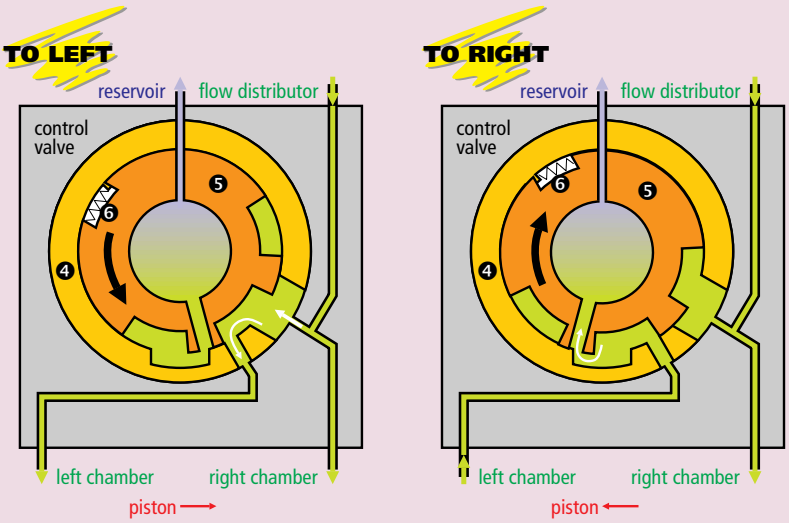


into the reservoir via the rotor of the control valve. This pressure difference moves the piston ❼ to the left inside the cylinder, helping the car to make a right turn. If the steering wheel stays at the right lock, the pressure limiting valve ❸ inside the flow distributor maintains a maximum pressure of 140 bar—when the pressure rises above this value, the fluid pushes the ball of the valve backwards, sending the excess fluid back to the reservoir..

When the steering wheel is turned to the left, the rotor ❺ rotates in the opposite direction. It starts by cutting of the return of fluid to the main reservoir. The pressure will rise again in the circuit between the flow distributor and the control valve. The rotor allows the LHM to enter both chambers of the steering ram, however, the pressed area of the left chamber is twice as large as that of the right chamber, thus the piston will move to the right, helping the car turn to the left.

The hydraulic assistance is only needed while the driver is actually turning the steering wheel. When the rotating force on the steering wheel ceases—the driver has finished turning the wheel—, the angle difference between the distributor ❹ and the rotor ❺, made possible by the flexibility of the torsion bar ❻ disappears, reverting the system to the neutral position, stopping the power assistance. When the driver releases the steering wheel back to the straight-ahead position, an opposite operation will start.

Later XMs and Xantiae omit this distributor and use a two-section high pressure pump with two independent outputs instead: six pistons provide LHM for the power steering, two pistons for the rest of the hydraulics.



DIRAVI Steering

Another gem of engineering, the DIRAVI steering, made its debut on the SM, excelled in many CXs and the flagship, V6 XMs (left hand only, the small amount sold in the UK never justified the expenses of the conversion to RHD).

CX

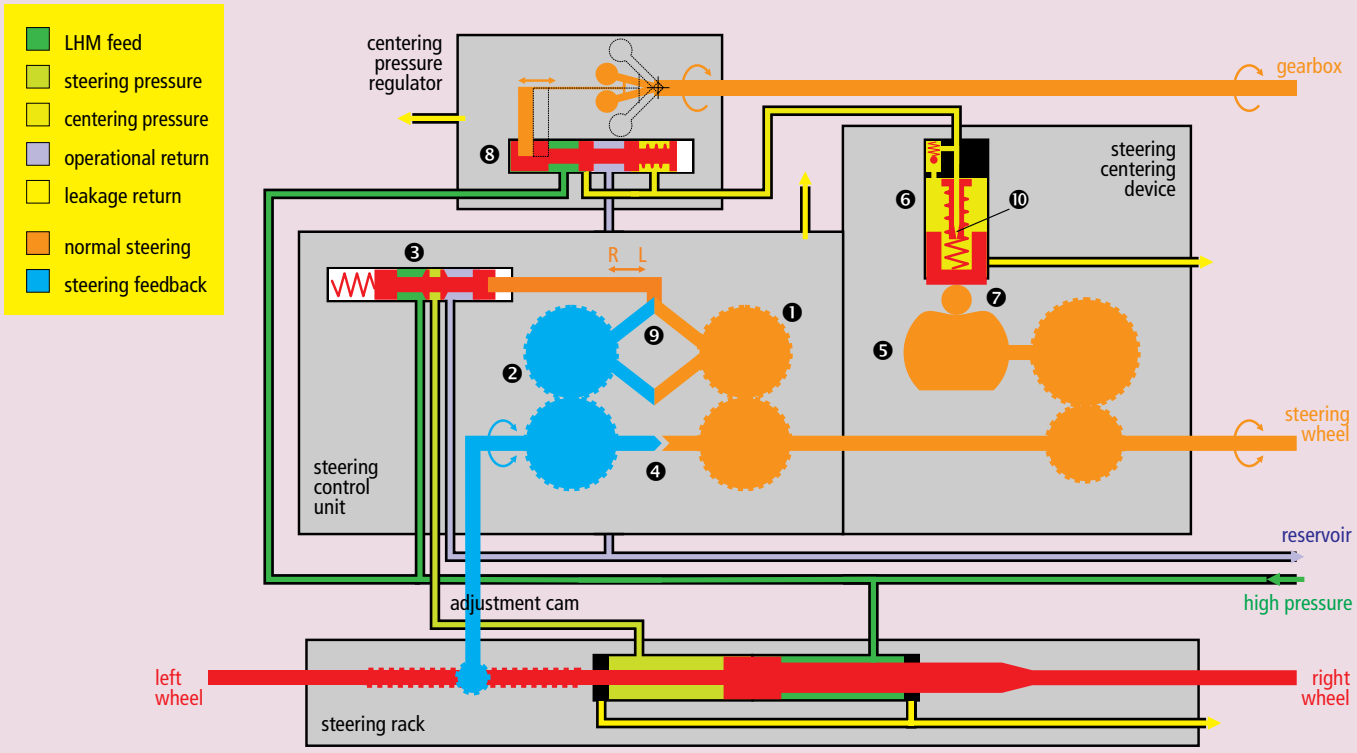
SM

The DIRAVI (Direction Rappel Asservi, Steering with Limiting Counterforce) steering is as unique as the hydropneumatic suspension—it was never used by any other manufacturer, although its excellence over conventional power assisted systems speaks for itself.

As usual, it has some quirks confusing the average driver during their first meeting. First of all, it is geared very high: it only took two turns of the steering wheel from lock to lock (one turn for each side) to steer on the SM. Later models, the CX and the XM retained this feature although the number of turns was larger (2.5 and 3.3). The gear ratio could have been much higher, the engineers themselves insisted on a single turn lock to lock for the SM (which would, interestingly, void the need for a circular steering wheel completely). The final solution was a compromise to reduce the initial strangeness of the steering for the drivers already accustomed to traditional systems.

Certainly, making the gearing so high is not complicated in itself but a conventional (even power assisted) system with such rapid a response would be unusable. As the car obviously has to have a similar turning circle as other cars, too responsive a steering would mean that even the slightest movement of the steering wheel would induce excessive deviation of the car from the straight line. To avoid this, it uses an opposing force, increasing with the vehicle speed. With this setup, in spite of the very high gearing, it is very easy to use it during parking, yet it offers exceptional stability at high speeds: it actually runs like a train on its rails, requiring a sensible amount of force on the steering wheel to deviate it from the straight line. And an additional feature: the steering wheel (and the roadwheels, naturally) center themselves even if the car is stationary.

Second, there is no feeling of feedback from the road through the steering wheel. Other steering systems have a constant mechanical connection between the steering wheel and the roadwheels, the DIRASS only adds some force to the one exerted by the driver. DIRAVI is different: simply put, the usual path between the steering wheel and the steering rack is divided into two halves, with a hydraulic unit in the middle. When the driver turns the steering wheel, this only operates the gears and valves in the hydraulic unit. The hydraulic pressure then moves the steering cylinder and the roadwheels. The lower half of the mechanics works in the opposite direction, as a negative feedback, returning the hydraulic system to the neutral position as soon as the wheels reach the required direction. The hydraulic cylinder and the wheels become locked, no bump or pothole can deviate them from their determined direction. Note that this neutral position is not always the straight-ahead direction, the hydraulics return to neutral whenever the steering wheel is held at a given angle for any longer period of time. Letting the steering wheel rotate back or turning it further in the previous direction will initiate a new mechanical-hydraulical cycle as described above.

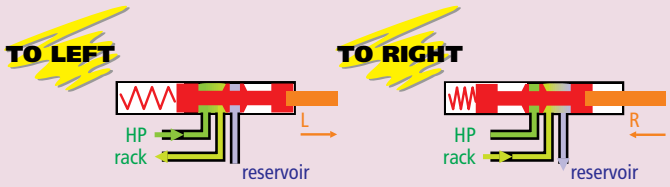


Thus, the lower mechanical link, the feedback from the roadwheels does not extend beyond the hydraulic unit. Everything the driver feels is generated artificially. One drawback for uninitiated drivers is the lack of noticeable feedback indicating that the wheels are skidding or driving in a ditch. The driver has to learn to feel the behavior of the car via other sensory means and this is probably the main reason why anyone not prepared for a period of learning will immediately dislike DIRAVI. But once accustomed to the system, it is more ergonomic and stress-free than any other steering system.

The DIRAVI system uses four main components:

The **steering rack and hydraulic ram cylinder** with a piston inside. The areas on which the pressure acts on the left and right sides of the piston are different—the left one is twice as large as the right one—, thus to keep the piston in neutral position, the right hand side must have twice as much hydraulic pressure than the left hand side. As this side is fed from the high pressure of the hydraulic system, a control unit manipulates the pressure on the other side.

This **steering control unit** is connected to the steering column. It has a coupling ❹ inside which is very loosely connected, with a significant amount of free play (nearly 30 degrees). Under normal circumstances this coupling stays in the middle, so the free play is irrelevant but it serves as a mechanical backup for safety if there would be any failure in the hydraulic system. In this case, the car can be steered mechanically, although much heavier and with a large free play on the steering wheel.



The main illustration shows the steering system with the steering wheel in the straight-ahead position. When the driver rotates the steering wheel, the steering column turns the gear ❶ inside the control unit. The set of levers ❾ attached to this wheel transform the relative rotation (relative to the previous hydraulically stabilized steering wheel position) of the steering wheel into a horizontal motion: turning the steering wheel to the left pulls the slide valve ❸, letting the high pressure fluid enter the left chamber of the cylinder. The right chamber is constantly at this same pressure, however, the area on the left side of the piston is twice as large as on the other side, thus the resulting higher force will move the steering rack to the right, turning the roadwheels to the left.

If the driver rotates the steering wheel to the right, the levers ❾ push the slide valve ❸, draining the LHM from the left chamber of the cylinder back to the reservoir. As the right chamber is still under the constant pressure, the resulting force moves the rack to the left, thus the car starts to turn to the right.

As we have already mentioned, the moving steering rack rotates the pinion and—through the steering feedback—the cogwheel ❷. The levers linking this gear to the valve ❸ now work in the opposite direction, returning the valve to its neutral position, cutting off the LHM supply to the steering rack. The roadwheels stay in the angled position corresponding to the position of the steering wheel; due to the closed valve ❸, the steering gear and the roadwheels are hydraulically locked, resulting in high turning stability.

To make the steering progressively heavier as the speed of the vehicle increases, the **steering centering pressure regulator**—a centrifugal device—is driven by a cable from the gearbox. Its spinning weights open up a slide valve ❽ admitting some fluid from the high pressure circuit into the centering device, or closes it to drain the extra fluid back to the reservoir.

The faster the car runs, the bigger is this hydraulic pressure sent to the **steering wheel centering device.** This consists of an eccentric cam ❺ geared to the steering wheel side of the unit, with a ratio making it turn less than a full turn while the steering wheel is rotated from lock to lock. A piston ❻ forced down by the mentioned hydraulic pressure pushes a roller ❼ against this cam. Being eccentric, the only stable position is when the cam is centered. The centering force can be regulated by changing the hydraulic pressure behind the piston.

The hydraulic pressure behind the piston ❻—being dependent on the vehicle speed—represents the progressive counter-force needed to make the steering gradually heavier at highway speeds. In addition, it returns the steering gear to the neutral, straight-ahead position when the driver releases the steering wheel. While the wheels of a DIRASS car return to the center themselves, forcing the rack and steering wheel as well, on DIRAVI the opposite is true: the force on the angled wheels is attenuated infinitely, having no influence whatsoever on the steering wheel. This additional device returns the steering wheel to the center instead, just as if you have turned it back yourself.

During the rotation of the steering wheel, the lower piston was pushed up by the roller ❼ and the eccentric cam ❺. The fluid leaves the chamber through the ball valve now opened. While this piston moves upwards, it compresses the spring, which in turn pushes the upper piston slightly up, freeing the calibrated bore ❿.

As soon as the driver releases the steering wheel, the opposite of the previous operation takes place. The ball valve will be closed by the entering fluid, thus the LHM has to go through the center bore of the upper piston, leaving via the calibrated bore ❿. Due to this resistance, it carries the upper piston down slightly, compressing the spring. This downward force pushes the lower piston together with the roller ❼ down, and the torque exerted on the eccentric cam ❺ forces that to rotate back into its neutral position, returning the complete steering gear to the straight-ahead position. At the end, the spring will return the upper piston to its original position inside the centering device. The restriction of the bore ❿ keeps the steering wheel from returning to the center position too fast.

The last component is an **adjustment cam** allowing the adjustment of the pinion relative to the disk on the pinion end of the steering column.

Self-steering Rear

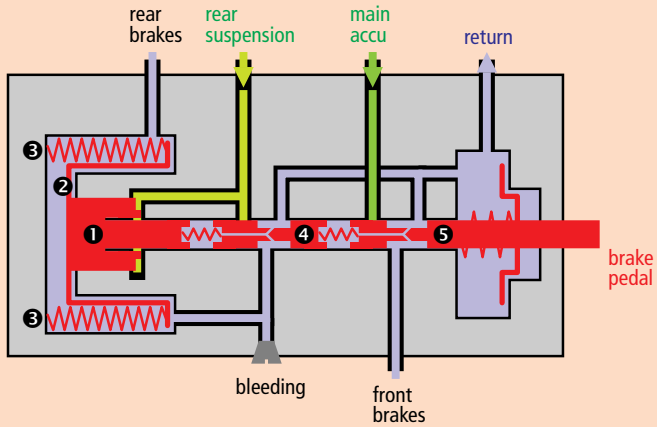
sasasa

Brakes

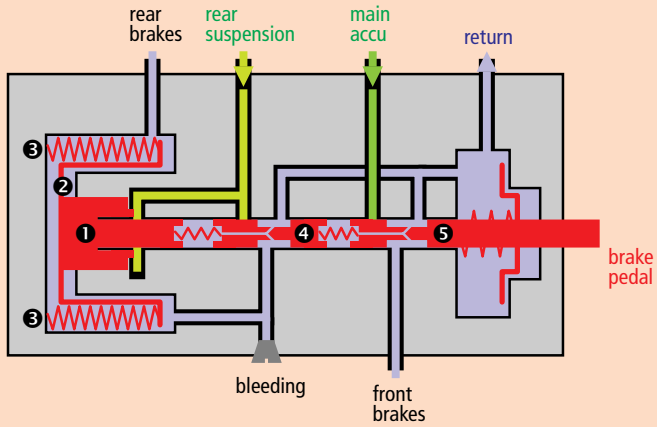
Standard braking system

The brake compensator valve is the most complicated part of the hydropneumatic suspension. This component is not only responsible for the operation of the brakes but forms a central part of the whole system.

With no pressure applied on the pedal, the brake valve connects both the front and the rear brake circuits to the operational return, ensuring that the brake pads retract from the disks. Note that both braking pistons (❹ and ❺) have internal conduits (drawn as Y-shaped lines) offering a passage for the brake pressure to escape into the return line:

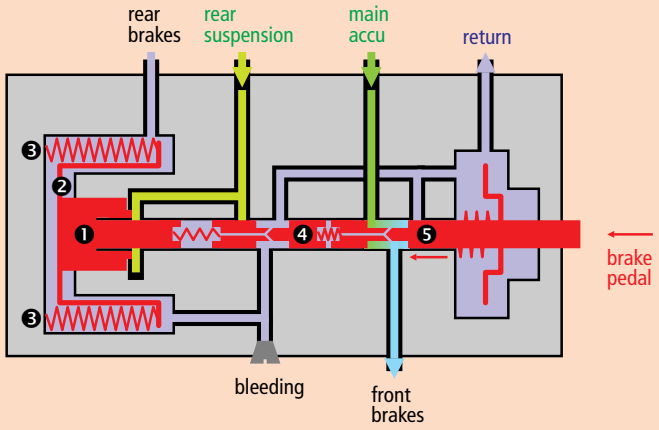


At the same time, the pressure coming from the rear suspension exerts pressure on the right hand side of the piston ❶. As soon as this pressure exceeds a given (albeit quite low) level, the piston will be forced to the left. The cup ❷ will be forced to the left as well which, in turn, will compress the spring ❸. As soon as the piston ❶ starts to move, the lip on its the face will move away from the edge of the housing, effectively increasing the area the hydraulic liquid can exert its pressure upon. This setup introduces some hysteresis in order to prevent unwanted oscillations in the system: although the piston ❶ and the cup ❷ moves as soon as the pressure exceeds the threshold level, it stays in that position even if the pressure drops a little:

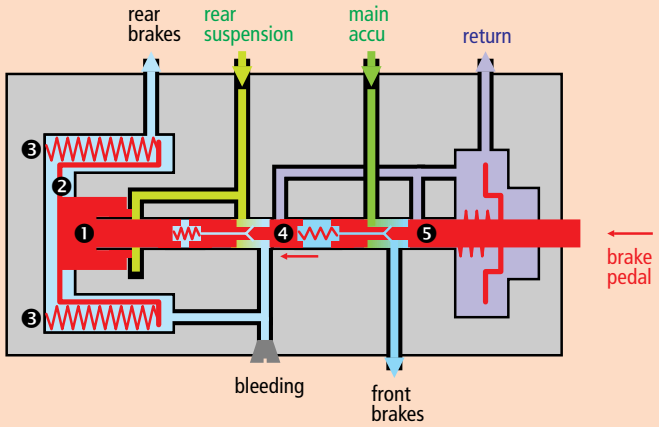


The reason for this is to lower the counter force on piston ❹, forming the valve for the rear brakes. This makes the rear brakes extremely sensitive at the very beginning of braking, minimize their delay in order to allow the anti-dive behavior of the rear trailing arm suspension to take effect.

As soon as the driver starts to brake by pressing on the brake pedal, which in turn presses the front piston ❺ behind the rubber boot at the end of the unit, the feed from the main accumulator becomes connected to the front brake circuit:



In addition, the high pressure liquid will also pass through the channel in the middle of the front piston ❺ and enters the chamber between the front ❺ and rear ❹ pistons. The pressure of the LHM will push the rear piston ❹ to the left, too, which in turn activates the rear brakes:



The presence of pressure in the rear suspension has kept the piston ❶ and cup ❷ pushed back to the left (against the force of the spring ❸) until now. But the increasing pressure in the rear brake circuit, being present on the left side of the piston ❶ as well, will exert a counter-force, forcing the piston ❶ to the right. Via the passage in the rear piston ❹, the pressurized LHM of the rear suspension enters the chamber between that and the piston ❶ (all these pistons have lipped faces to prevent unwanted oscillations by introducing hysteresis action, as described above).

We have discussed piston ❶ as a single component so far but in reality, it is made of two parts. We introduce part ❻ here so that we can refer to its right side (forming a chamber with the left side of the rear piston ❹). In the following

formulae, piston ❶ will only denote the part in direct touch with the pressure coming from the rear suspension. Thus, the force on the left side of the piston ❶ comes from both the spring ❸ and the braking pressure (blue) exerted on the left side of piston ❶:

$$F_{left} = F_{❸} + p_{brake} A_{❶left}$$

As we can see from the cross section of the valve, the combined areas of ❻ and ❶ right are equal to that of ❶ left:

$$F_{left} = F_{❸} + p_{brake} \left(A_{❶right} + A_{❻right} \right)$$

Similarly, the force on the right comes from the suspension pressure (green) on the right side of piston ❶ as well as the braking pressure (blue) on the right side of piston ❻ (arriving via the channel in the rear piston ❹):

$$F_{right} = p_{rear} A_{❶right} + p_{brake} A_{❻right}$$

Brake force regulation is performed by the movement of pistons ❶❻ until an equilibrium of forces is obtained on their two sides, and the consequent influence on pistons ❹ and ❺. Limiting of rear brake pressure with respect to rear suspension pressure is insured by the force generated from the pressure in the rear brake circuit being assisted by the spring ❸. Because of this spring, that pressure is always smaller by an amount proportional to the spring tension:

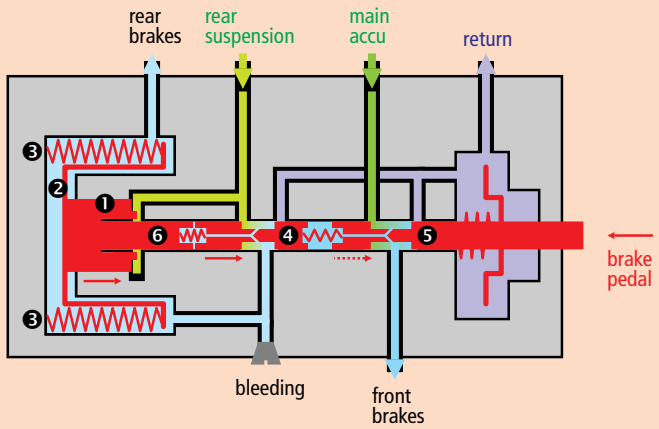
$$F_{left} = F_{right}$$

$$F_{❸} + p_{brake} A_{❶right} + p_{brake} A_{❻right} = p_{rear} A_{❶right} + p_{brake} A_{❻right}$$

$$p_{brake} A_{❶right} = p_{rear} A_{❶right} - F_{❸}$$

$$p_{brake} = p_{rear} - \frac{F_{❸}}{A_{❶right}}$$

The balance of forces depend on the spring, as well as the suspension and brake pressures. Limiting occurs whenever the rise in rear brake pressure causes the pistons ❶❻ move to the right:



As the LHM trapped between the rear ❹ and front ❺ pistons is not compressible, the second one will also move to the right, providing a counter-force to the pressure of the driver's foot. As this movement will partially close the passage between the main pressure feed and the front brakes, the pressure in the front circuit is also forced to reach an equilibrium between the force applied to the brake pedal and that of pushing the piston ❺ to the right.

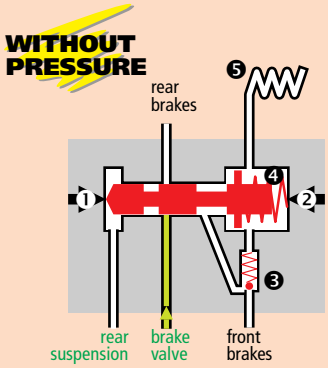
The springs between the pistons ❻, ❹ and ❺ are not taking part in this process. They are small, soft springs, aiming only to center the rear piston ❹ between the other two but their effect is otherwise negligible.

From this description, we can draw a few conclusions. First of all, the maximum rear brake pressure can never exceed that of the rear suspension. Consequently, if there is no rear suspension pressure, the rear wheels do not brake.

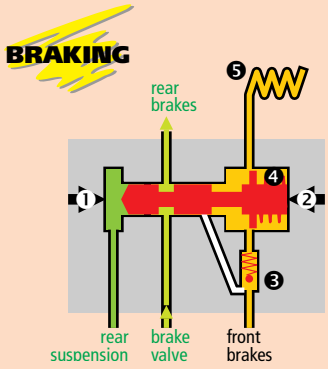
When the driver starts to brake, the rear brakes will bite immediately as the suspension pressure overpowers the spring ❸, pushing the pistons ❶❻ to the left and allowing the rear piston ❹ to open quickly and completely. This piston will also balance the forces in the front and rear brake circuit, so, during this initial braking period, the rear brakes operate just like the front ones. As the rear brake pressure builds up, it will always be dynamically limited with respect to the rear suspension pressure, as described by the formula above.

Stop breaking, please...

The brake compensator valve used on early CXs was slightly different from the one described above, withouth the built-in brake force limiting effect of the piston ❶ and the cup ❷. These CX Break models had a separate rear **brake force limiter** to provide this functionality.



When there is no pressure in the rear suspension (for instance, the suspension is set to low), the force of the spring ❹ keeps the piston in the neutral position, completely closing the feed to the rear brakes from the brake compensator valve.



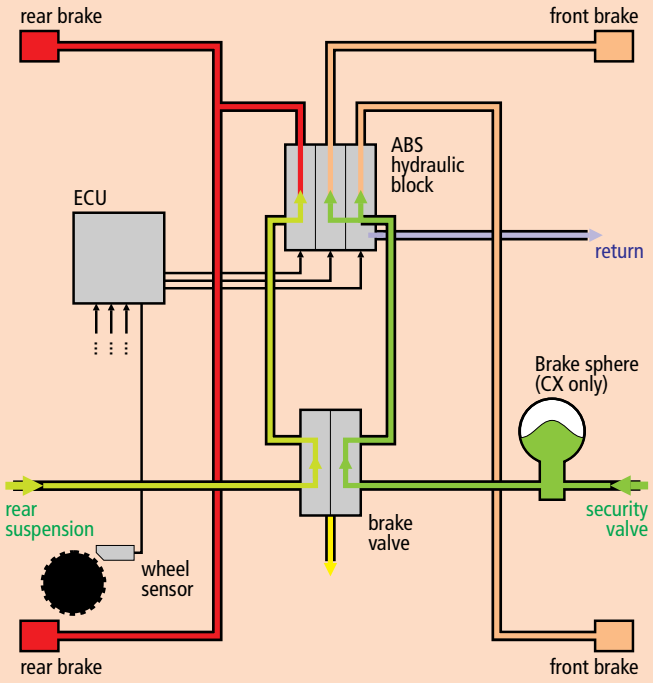
When the suspension is under normal pressure, the force ❶ supplied by the rear suspension fluid exceeds the counter force ❷ provided by the spring. The piston stays in the open position, letting the fluid pass to the rear brakes. As soon as the driver starts braking, the force ❷ increases by the additional pressure coming from the front brakes, via the LHM entering through the ball valve ❸.

As soon as the incoming front brake pressure exceeds the rear suspension pressure by more than 28 bar (in other words, the coymbined force of front pressure and that of the calibrated spring ❹ becomes larger than the rear suspension pressure), the piston moves again to the left, cutting out the additional pressure to the rear brakes, which will then continue to brake with this constant pressure.

To avoid a sudden cut-off of pressure, the ball valve ❸ is combined with a damping element ❺ to smoothen the changes. This element is a coil made of hydraulic piping, closed at the far end. The elasticity of the pipe and the coil acts as a small hydraulic spring capable of lowering the resonance of the chamber, hindering unwanted oscillations.

Anti-lock Braking System

Models with higher performance level came fitted with ABS.



The principle of operation is the same as on cars with conventional braking systems but the layout is much simpler as all we need to control the operating pressure of the brakes are a few electro-valves.

During breaking, the **ABS computer** monitors the changes in the rotational speed of each roadwheel, communicated by inductive magnetic **sensors** reading the individual cogs of a toothed wheel fitted inside the cavity of the brake discs. The computer does not interfere with the braking if the vehicle speed (as measured with the same sensors) is below 5 km/h.

If any of the wheels begins to slow at a faster rate than the others, the ABS reduces the hydraulic pressure fed to the brake caliper of the wheel in question to avoid the wheel being locked. Although every wheel has its own sensor, the rear brake calipers receive the same pressure, only the front ones are fed separately. As soon as road grip is regained, the hydraulic pressure to the brake will be restored. The computer is capable of cycling the pressure with a frequency of several times a second.

To actually control the pressure, the system uses a three-unit hydraulic block (one block each for the front brakes, one for both rear brakes). All three units comprise two electro-valves, an inlet ❶ and a return ❷ valve.

During the rising period of normal braking, without the need for the intervention of the ABS computer, the brakes operate in **phase 1:** the inlet valve ❶ is open but the return valve ❷ is closed. The braking functions as in a system without ABS: the incoming hydraulic pressure is directly routed to the brake caliper.

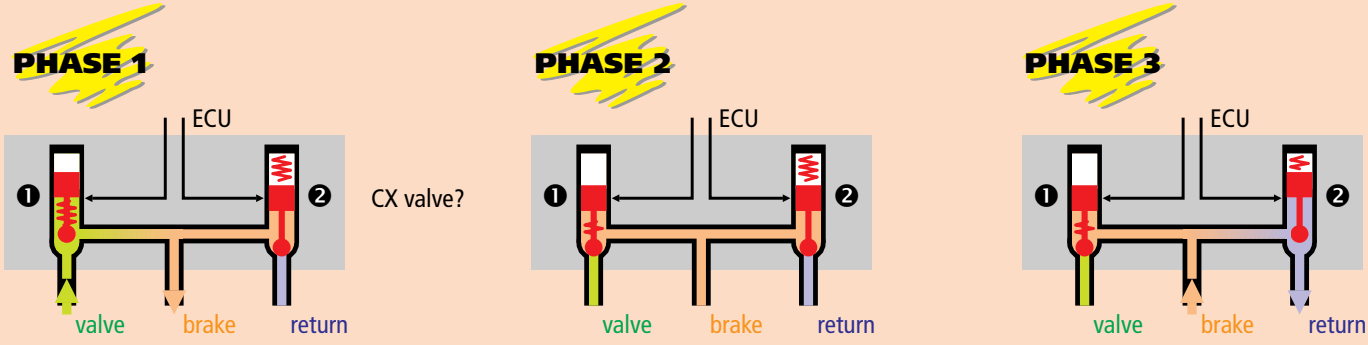
Under constant breaking **(phase 2)** both valves close to maintain a steady hydraulic pressure in the brake calipers.

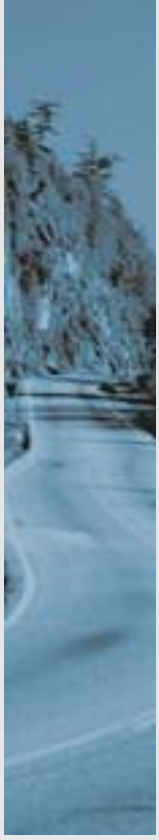
When the ECU senses the need for intervention, the electro-valves proceed to **phase 3:** the inlet valve ❶ closes while the return valve ❷ closes. Hydraulic pressure will be released from the brake caliper, reducing the braking force. To restore the braking effort, the ECU will return to phase 1 in a short while.

The ABS computer has a built-in diagnostic feature, checking the components both when the ignition is turned on and during braking. Any failure will be reported by a warning lamp or a warning message of the board computer. As you can see from the illustration, the springs inside the valves are located in such a way that the mechanical default mode is phase 1—the normal braking—for all three hydraulic blocks. Any failure in the ABS system will therefore revert it to the usual, non-assisted braking.

Early CXs has a slightly different ABS system. The general layout is the same, but the hydraulic block only has three valves, one for each brake circuit, however, they have three positions. Without energizing current, they route the fluid coming from the brake accumulator to the brakes. In phase 2, a medium current switches them to isolate the brake calipers, while a larger current opens it completely to let the pressure escape from the brakes into the return lines.

On XM the hydraulic block has five electro-valves only. I am not sure how they connect internally, but I suspect that the valve that closes supply for the front brakes is common for the left and right wheel ???





Electrical Systems

Multiplex network

Circuit layouts already universally adopted in computers finally made their way into contemporary cars. Although their functioning might be frighteningly complex for people used to traditional circuits, they actually make the cabling very simple and the addition of component interactions possible in ways never experienced before.

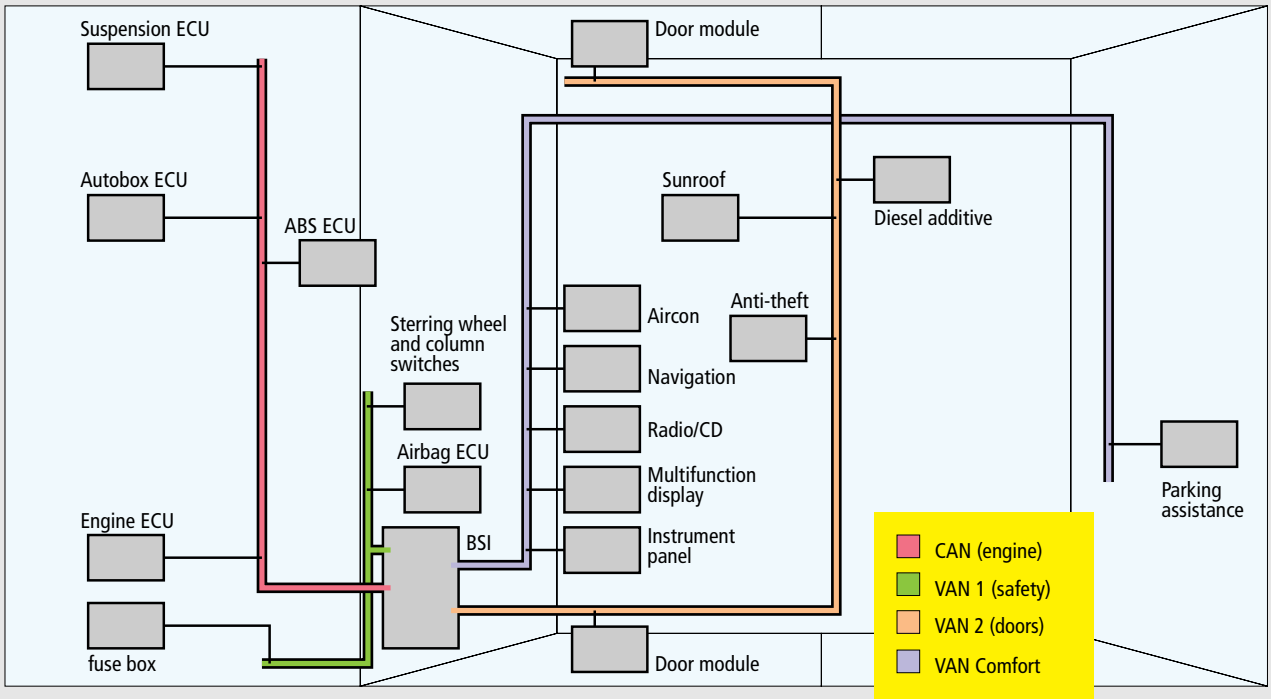
Conventionally, cars used individual wires connecting the various elements—steadily increasing in number—on board. The huge amount of wires, connectors, wiring harnesses were a constant source of connection problems. The various circuits were largely independent (sharing only the feed and the ground), although some components had to interact (for instance, fog lights should work only when the headlights are switched on), necessitating connections between the various components (usually using some kind of a switching logic, relays for simpler tasks and small electronic modules for more complicated ones).

As various subsystems (engine management, suspension, ABS, etc.) came from different manufacturers, some functions were even built in parallel. Several subsystems might rely on the signal sent by a coolant temperature or a vehicle speed sensor but it was simpler for the manufacturers to fit two or three such sensors into various places, using every one of them only by their respective subsystem, than to find ways to share the sensors, introducing interconnecting wires and the danger of one failing subsystem to influence the others.

The multiplex wiring first seen on late XMs and later used on newer models like the Xsara Picasso or the C5 introduces a radically different concept: just like in the computer used to read this book, there is a central backbone circuit called *bus* which goes around the whole car—actually, there are four of them, a **Controller Area Network (CAN)** and three **Vehicle Area Networks (VANs),** dealing with different areas: the CAN is only responsible for the connection between the central unit and the engine, gearbox and suspension computers, the VANs for the rest of the systems: the first serves the safety systems like the airbag, the second the various doors (including the sunroof) and the anti-theft system, the third everything else: the instrumentation and the comfort gadgets.

The bus—in contrast to the traditional wiring harnesses hosting many individual wires running side by side to serve different components—is a common channel of information flow for all components connecting to it. It uses only two wires which all associated components connect to in parallel (in addition to this, the devices are connected to the ground as usual; the two input wires serve as a safety measure, using them both makes the system resistant to any outside interference, and the whole system remains functional even if one of the bus wires becomes broken, shorted to ground or positive feed). There is no special controller or owner of this bus, each device connecting to it is free to send or receive messages and commands to the others, at a rather high speed (approximately ??? messages per second).

Buses in the C5



Each **message** or command is a sequence of a few numbers, specifying:

- the sender and the intended recipient of the message (every device connecting to the multiplex bus has its own address, a unique numerical identifier—for instance, the fuel level sensor has the address 4315, the instrument panel is 0004);
- whether the recipient should acknowledge the message as it processes it;
- the actual data the message transmits;
- some additional values to check the integrity and validity of the message at the receiving end.

Each major unit sends its own data into the network at predetermined intervals, marking the message with its own address as a sender (some simpler sensors are connected directly to a computer which sends the messages relating to their measured values on their behalf). With our example, the fuel level sensor sends the amount of fuel it measures, specifying the central unit (BSI) as the intended recipient. As soon as the BSI sees this message circulating on the network, it processes it by retrieving the data—the value of fuel level—from the message and comparing it to the previously known value. As the amount of fuel is not supposed to change drastically from one moment to the other, it discards the new value if it differs too much from the previous one.

If the new value is acceptable, the BSI emits another message of its own, addressed to the instrument panel this time. As the instrument panel receives this second message, it extracts the data representing the amount of fuel left in the tank and turns this signal into the physical rotation of the gauge needle.

All devices are constantly observing the bus for messages addressed to them, ignoring the ones sent to other recipients (although there are special broadcast messages sent to all devices, without specifying a single addressee)—actually, the instrument panel saw the original message coming from the level sensor as well but ignored it, it only acted when the second message, sent by the BSI and addressed specifically to it, arrived.

All components work in a similar way. Some are simple enough to send a few simple messages (like sensors or switches) or to receive only a few ones (like electric window motors). Others are complex subsystems themselves, like the suspension, observing the input from a large number of sensors and performing complex operations. But as they are all connected to a common bus, the possibility of interaction is already there. Whether the headlights light up, the electric windows close and the wiper starts to work in case of rain, or whether the passenger side external rear view mirror folds down when engaging reverse gear have all become simple questions of software written for the central unit. Adding a new feature does not require building a single extra wire or connection, just to add a few lines to the software.

Center of Attention

The four networks all connect to the central unit, the **Built-in Systems Interface (BSI).** This control unit manages the flow of information between the networks (many of the messages generated in one network has to be relayed to another, just one example is the suspension computer—connected to CAN—being interested in messages about the open or closed position of the doors—communicated on VAN 2).

In addition to that, the BSI offers an interface to the outside world as well, a diagnostic socket which can be used to check, test and configure the whole system.

The multiplex system switches to an energy-saving low power mode whenever possible.

Air Conditioning

Air conditioning

Once considered pure luxury, air conditioning and other forms of climate control have became standard items on today's car. After all, creating an acceptable environment for the driver is more than a mere question of comfort, it contributes to safety to a great extent.

XM

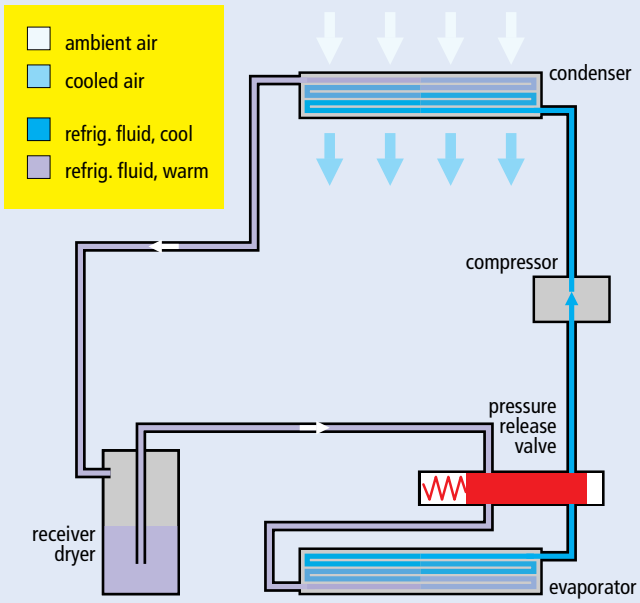
There were several **climate control** systems fitted to our Citroëns, offering various degrees of automation of keeping the climatic conditions inside the car. The system can be **manual, semi-automatic** or **automatic.** The manual version also came with separate settings for driver and passenger.

The semi-automatic system is rather similar to the manual one, the visible difference is that the operating knob on the dashboard is marked in degrees instead of just blue and red. The direction and recirculation controls are indentical to the manual system. The automatic climate control looks radically different, with a controlling panel using buttons and a digital temperature display.

The AC system in the XM is fairly simple. If it is on, the air is always cooled to about 8–10 °C on the inlet side (this is varied between the air intake from outside and recirculation from the inside) and then if you set a higher temperature, it's reheated. The heater also always works, its effect is only regulated by allowing air to flow or not to flow through it (this is what the flap valve does). The air always flows through the AC heat exchanger. As a result, the AC also dries out the air whenever it is on. Once the air passes out of the temperature regulating flap valve, another flap valve regulates where it goes inside the cabin. That's really all there is to it.

The AC system itself is almost self-sufficient. It has a radiator, compressor, heat exchanger with evaporator, and a condenser—and the connecting pipes. The climate control ECU actually only provides a signal to a relay that switches the AC system on by operating the electric clutch on the compressor. This same signal switches the radiator fans on to the low speed. The AC system in turn sends a 'fans to full speed' signal to the fan controller, when the coolant temperature reaches a trip point (this is handled by a different switch section in the same pressure sensitive switch that prevents the AC going on without any coolant in the system, described above).

As far as I know (unless it changed in later versions), the AC itself (as oposed to climate control) never had an ECU.



The **evaporator** has an integrated pressure/temperature valve, opening up the pressure line to the return line.

After coming through the evaporator, the temperature of the fluid (more precisely, a mixture of liquid and vapor) suddenly drops because of the drop in pressure. It enters the **heat exchanger** which operates like a radiator, cooling the air and heating itself up. The fluid then goes back to the drier-radiator-compressor end of the loop. The condensed moisture is collected from the heat exchanger and let out through to floor of the cabin via a plastic tube.

As the air always enters through the heat exchanger, and whether it gets cooled at this point, depends only on whether the compressor is working or not. The temperature flap only decides which part of the air is going to be taken before or after the heater radiator. This is how the temperature is regulated.

When the **compressor** is on, is to condense the moisture out of the air, and then re-heat it as necessary to the temperature set on the controls. Since the temperature is regulated by the temperature flap, it has really nothing to do with the compressor at all—the only consequence of the compressor not working (for any reason) is that the system will obviously not be able to produce a temperature lower than ambient.

There are four sensors providing input. The first one is at the entrance of the air, before the heat exchanger, the second one after the temperature flap, the third one on the roof, and the last one in the heat exchanger. They have very different but sometimes overlapping roles.

The first three collectively influence temperature regulation. In particular, the sensors after the temperature flap and on the roof determine what the actual temperature is. The sensors before the heat exchanger and after the temperature flap decide how fast the temperature flap will be moved to prevent extremely fast changes in temperature in the cabin. This does not alway work very well, which is why you get a blast of air when the system is set on auto and you leave the car in the sun in summer. Both of these parameters (temperature and temperature difference) influence the fan speed.

The sensor before and in the heat exchanger as well as the teperature selection, influence the AC part, i.e. the operation of the compressor. For instance, the compressor will not operate below a certain external temperature. Also, it will not operate if the temperature is set to maximum.

When the system is cooling the incoming air, it needs to have the exchanger at a temperature which is lower than the ambient air temperature, obviously. As the compressor either runs or not, it cannot cool just a little bit—it always either runs on full or does not run. When it starts, it will start cooling the heat exchanger. How cold it will get, depends on how hot the incoming air is and how much air is coming in. In any case, when it gets significantly colder than the incoming air, the moisture from the air will start to condense on the heat exchanger, which is why there is a collector underneath it and a drip outlet. If the compressor keeps on working, while the heat that needs to be taken from the air is lower from the heat transfer ability of the whole system, the heat exchanger will continue to progressively get colder. If nothing is done, it will get well below freezing (it can go as low as –40 °C given proper fluid, and of course construction designed for this). What will happen then is that the condensed water from the air will start freezing on the heat exchanger fins, and eventually, the whole thing will become a solid block of ice (usually there will be a crackling noise to acompany the event), preventing actual air flow. If the condition persists, the pressure in the system will build up until the valve in the evaporator opens, and by this time it is possible that the fluid actually gets heated up enough that the remaining part going through the heat exchanger will actually melt the ice producing a fog (I've seen it happen!). All of this will be the lucky turn of events, asuming the ice has not cracked the heat exchanger and that there is no fluid leak.

So, obviously, there is a sensor, and that's the fourth one in this story, which detects the temperature of the heat exchanger becoming too low. When that happens, the compressor is cut out, until the heat exchanger temperature rises to an acceptable level. The thermal inertia and different cut out and cut in temperatures insure that the compressor doesn't keep switching on and off too quickly, which would place an undue strain on the electromagnetic clutch.

The logic in the ECU is done very simply, if the fourth sensor detects that the heat exchanger is too cold, the compressor will switch off, regardless of the AC switch and temperature set. The only thing it will do, as I said in the earlier mail, is that it will switch on for about 1 second whenever the AC switch is turned on, this is probably some ECU feature. The compressor will never turn on if the gas pressure is insufficient, and this part is handled by the pressure switch on the drier, and has nothing to do with the ECU. In fact, the ECU only gives the whole system a 'go-ahead'.

Appendix

ORGA number

This number shows the day when your car was actually assembled on the production line. The dealers and parts stores use this number (often called ORGA or RP number, the second stands for Replacement Parts) to identify the various parts and components fitted to your car.

On various models, the ORGA number can be found in different locations. It is on the top of the left hand suspension turret on **Visas, C15s, AXs** and **CXs** (often hidden by the wiring harness). **BXs** and **XMs** have it stamped on the left hand front door A-pillar, above the courtesy light switch. On the **GSA** you find it on the inner right front wing. **Xantiae** switched to the other side: the number can be found on the bulkhead just in front of the right suspension sphere. C5 ?????????????

Calculating the production date is very easy using the following table. Locate the largest number in the table still less than or equal to your organization number. To see an example, let's assume the number is **4859.** Then the largest number will be **4832** in the cell **February 1990.** Just subtract this number from your organization number to get the day of the month of the production of your car (in our example, **4859 – 4832=27** yields ***February 27, 1990).***

If you receive the non-existent date zero (this happens when your organization number is not greater than but equal to the number in the table), simply take the last day of the previous month. For instance, for the organization number **5013** the largest number in the table is **5013** in the cell **August 1990,** subtraction results in **zero,** hence the production date is ***July 31, 1990.***

Years	Months											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1982	1879	1910	1938	1969	1999	2030	2060	2091	2122	2152	2183	2213
1983	2244	2275	2303	2334	2364	2395	2425	2456	2487	2517	2548	2578
1984	2609	2640	2669	2700	2730	2761	2791	2822	2853	2883	2914	2944
1985	2975	3006	3034	3065	3095	3126	3156	3187	3218	3248	3279	3309
1986	3340	3371	3399	3430	3460	3491	3521	3552	3583	3613	3644	3674
1987	3705	3736	3764	3795	3825	3856	3886	3917	3948	3978	4009	4039
1988	4070	4101	4130	4161	4191	4222	4252	4283	4314	4344	4375	4405
1989	4436	4467	4495	4526	4556	4587	4617	4648	4679	4709	4740	4770
1990	4801	4832	4860	4891	4921	4952	4982	5013	5044	5074	5105	5135
1991	5166	5197	5225	5256	5286	5317	5347	5378	5409	5439	5470	5500
1992	5531	5562	5591	5622	5652	5683	5713	5744	5775	5805	5836	5866
1993	5897	5928	5956	5987	6017	6048	6078	6109	6140	6170	6201	6231
1994	6262	6293	6321	6352	6382	6413	6443	6474	6505	6535	6566	6596
1995	6627	6658	6686	6717	6747	6778	6808	6839	6870	6900	6931	6961
1996	6992	7023	7052	7083	7113	7144	7174	7205	7236	7266	7297	7327
1997	7358	7389	7417	7448	7478	7509	7539	7570	7601	7631	7662	7692
1998	7723	7754	7782	7813	7843	7874	7904	7935	7966	7996	8027	8057
1999	8088	8119	8147	8178	8208	8239	8269	8300	8331	8361	8392	8422
2000	8453	8484	8512	8543	8573	8604	8634	8665	8696	8726	8757	8787
2001	8819	8850	8878	8909	8939	8970	9000	9031	9062	9092	9123	9153
2002	9184	9215	9243	9274	9304	9335	9365	9396	9427	9457	9488	9518

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Key to symbols

Bulb

Item no. 7

Switch

Pump/motor (M)

Multiple contact switch (ganged)

Earth

Pin and socket contact

Fuse/ fusible link (F10)

Gauge/meter

Resistor

Diode

Variable resistor

Line connector

Connecting wires

Solenoid actuator

Wire colour (Grey) — G

Connections to other circuits (e.g. diagram 3/grid location B2. Direction of arrow denotes current flow.) 3/B2 3/B2

Wire - permanent positive supply (double line)

Wire - permanent direct earth (thick line)

Wire - interconnecting (thin line)

Denotes alternative wiring variation (brackets)

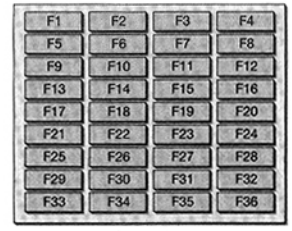
Screened cable

Denotes black connector, terminal no 3. N/3

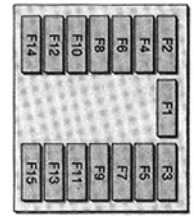
Typical passenger fusebox

Fuse	Rating	Circuit protected
F1	10A	ABS
F2	10A	Stop lights
F3	10A	Heated rear window, A/C, heated seats
F4	5A	Language display
F5	30A	Radio, instrument panel, language display, heater temperature sensor
F6	5A	Rear foglights
F7	10A	Hydractive suspension
F8	5A	Language display
F9	30A	Controls for: heated rear window, front/ rear wiper, A/C, electric windows, lights-on warning buzzer, flasher unit
F10	10A	Interior lighting
F11	10A	Interior lighting
F12	5A	Language display
F13	10A	Hazard warning lights, diagnostic socket
F14	5A	RH tail light, lighting rheostat
F15	5A	Temperature interface
F16	5A	Coolant temp. warning light, display supply
F17	20A	Heated rear seat
F18	5A	LH tail light
F19	15A	Reversing lights, instruments, diagnostic socket, compressor cut-off relay, lighting timer, temperature interface
F20	5A	Spare
F21	15A	Front foglights
F22/23	Shunt	Transit shunt (supply cut-off)
F24	20A	Heated front seats
F25	20A	Opening roof
F26	30A	Electric rear windows
F27	15A	Instruments, interior lighting, trip computer, clock, radio, alarm
F28	30A	RH electric front seat
F29	15A	Spare
F30	30A	LH electric front seat
F31	10A	Temperature interface - injection
F32	30A	Headlight washer, horn
F33	30A	Heated screen, heated mirrors
F34	30A	Central locking, Hydractive suspension
F35	30A	Front windows
F36	30A	Front/rear cigar lighters

Typical passenger fusebox (in passenger compartment)



Typical Engine fusebox (in engine compartment)



Typical engine fusebox

Fuse	Rating	Circuit protected
F1	10A	Supply to EGR control unit
F2	30A	Supply to air conditioning
F3	30A	ABS
F4	-	Not used
F5	-	Not used
F6	-	Not used
F7	-	Not used
F8	-	Not used
F9	10A	RH main beam
F10	-	Not used
F11	10A	LH main beam
F12	-	Not used
F13	10A	LH dipped beam
F14	-	Not used
F15	10A	RH dipped beam

H29648
T.M.Marke

Diagram 1 : Information for wiring diagrams

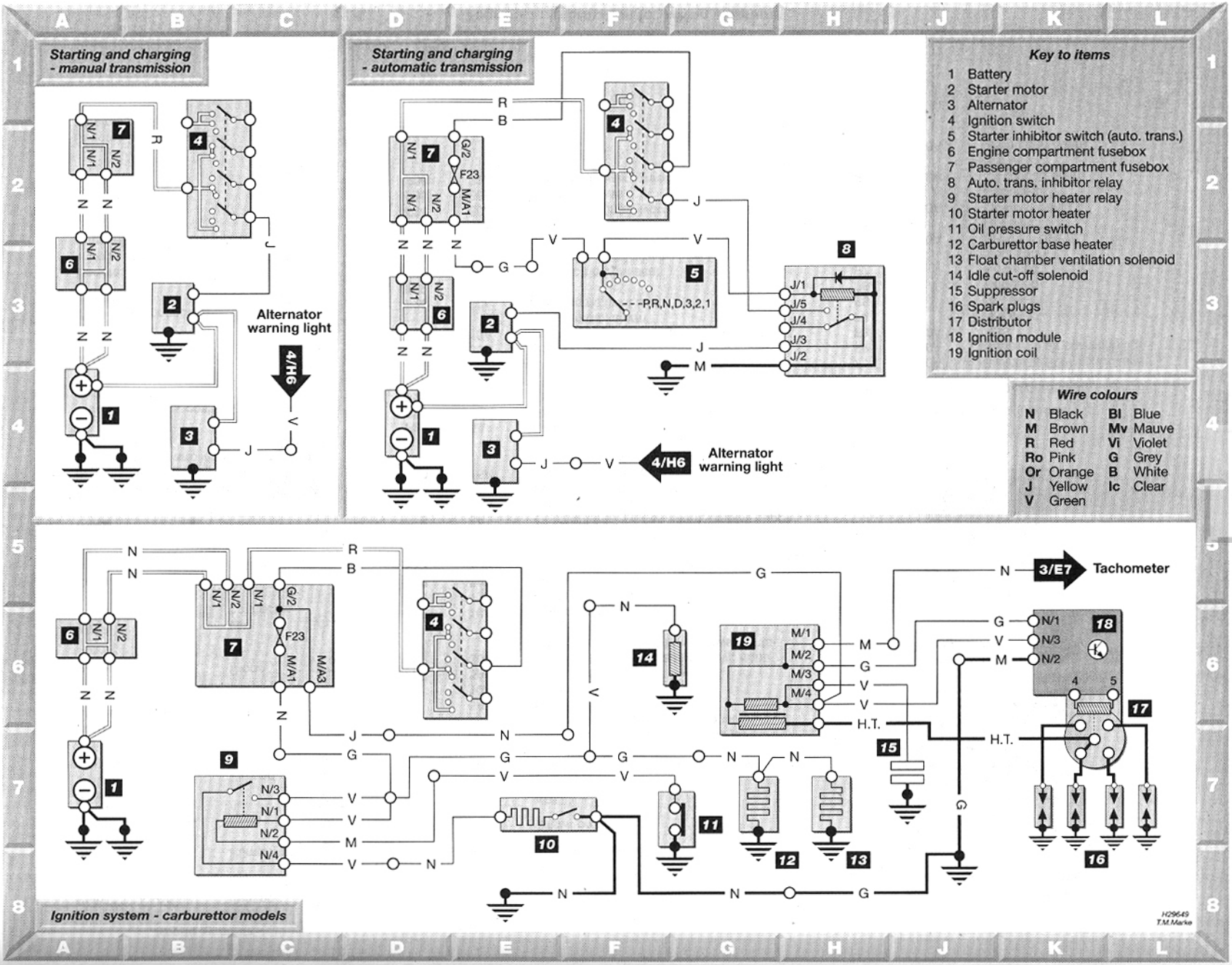


Diagram 2 : Typical starting, charging and ignition system (carburettor models)

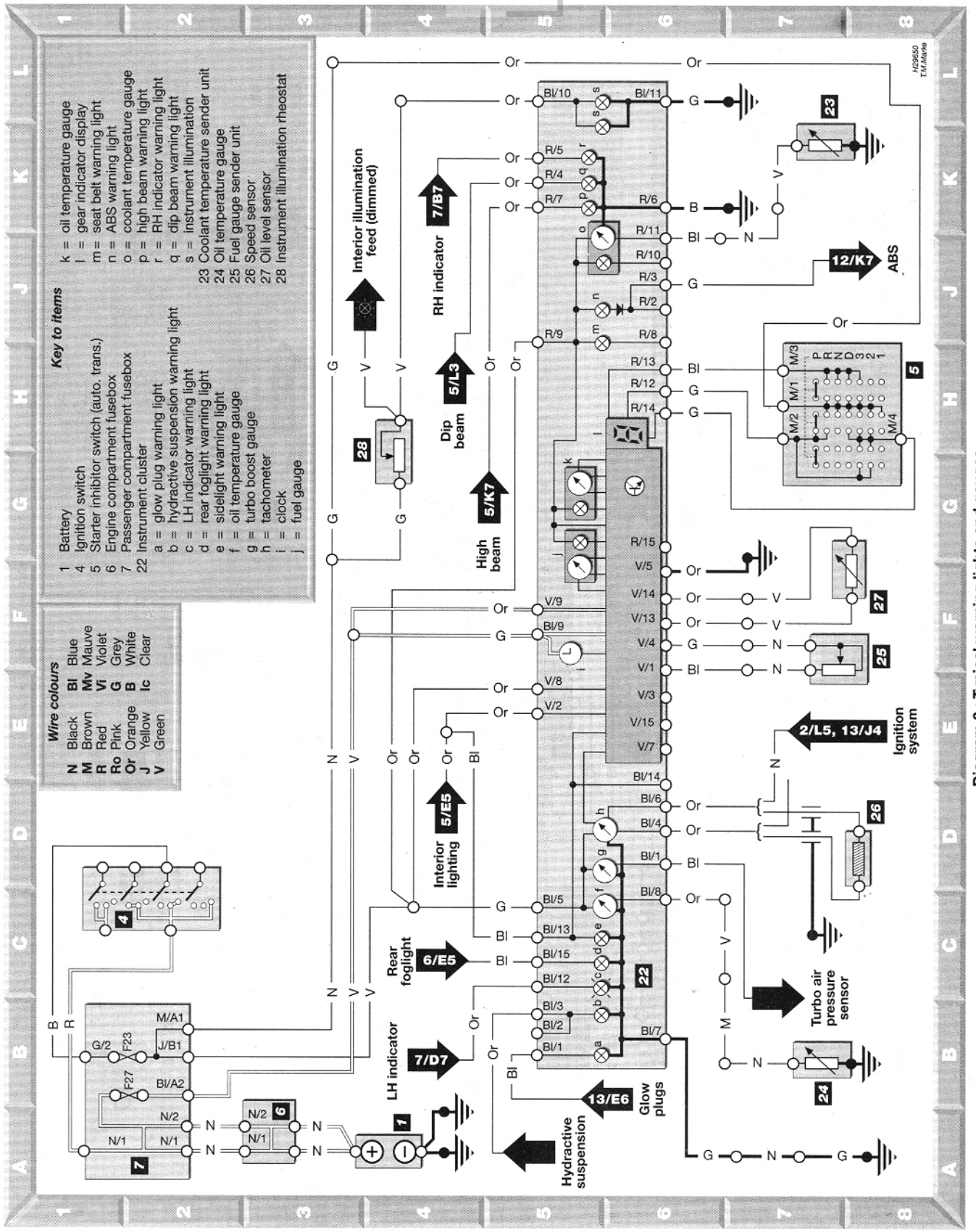


Diagram 3 : Typical warning lights and gauges

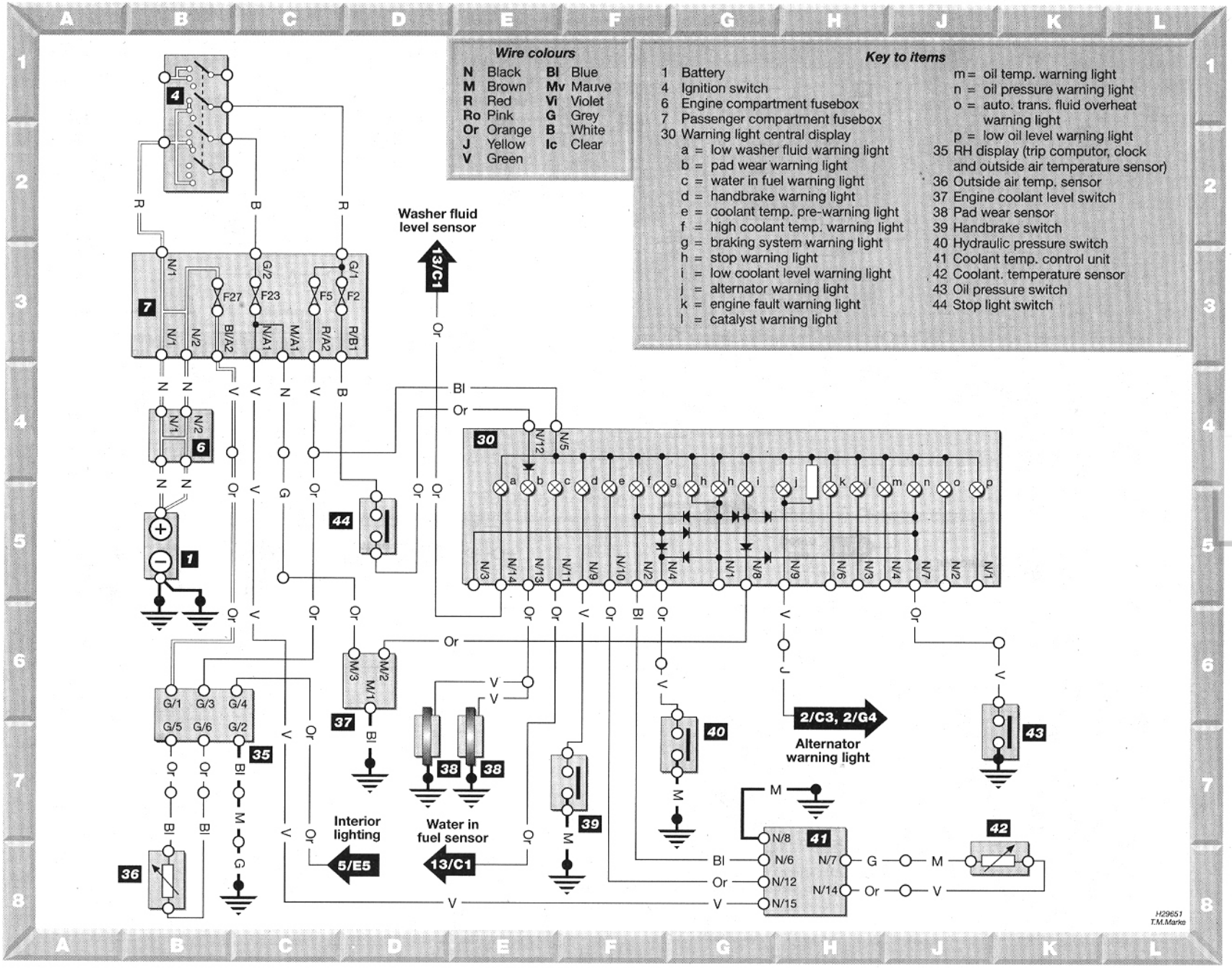


Diagram 4 : Typical central display unit

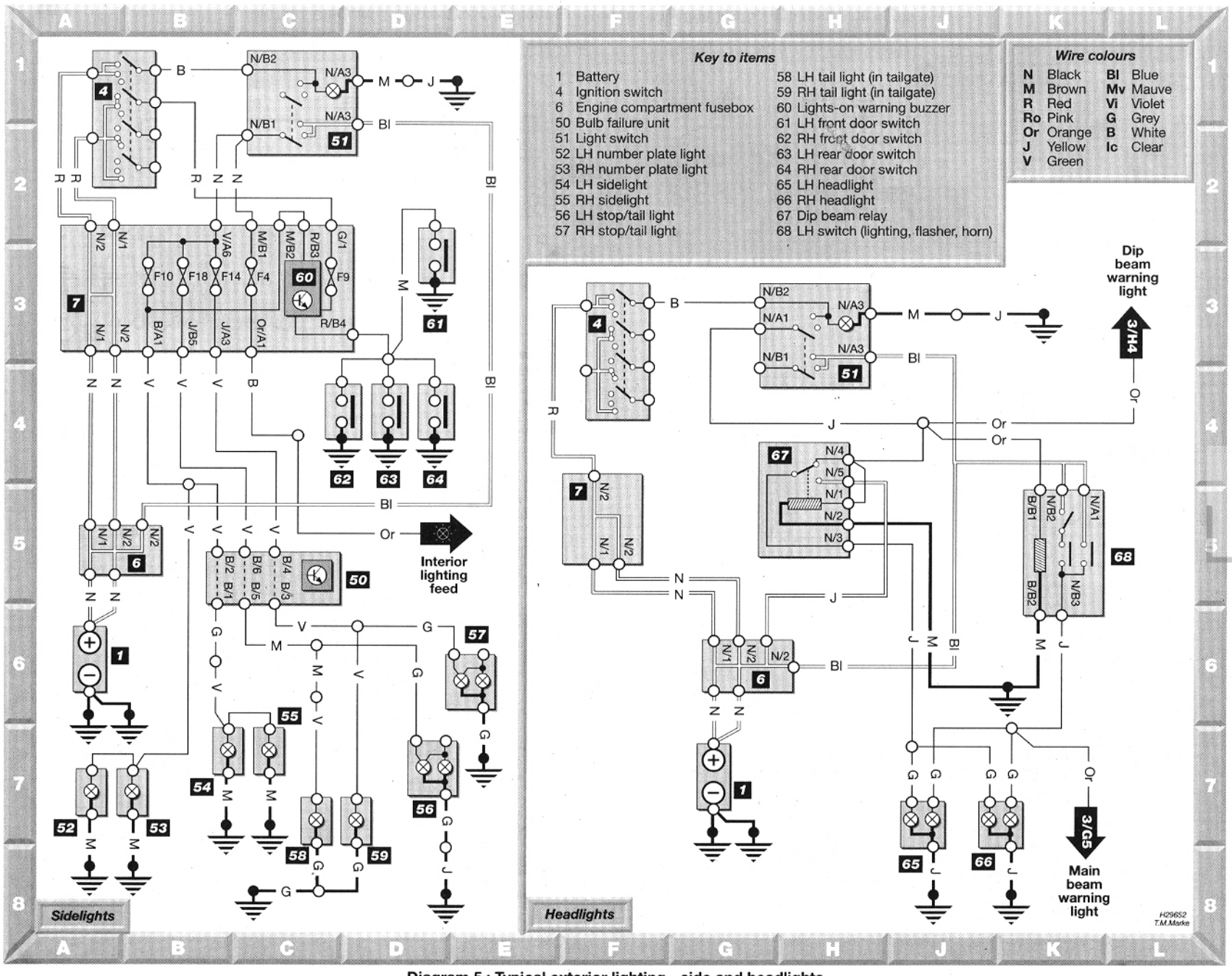


Diagram 5 : Typical exterior lighting - side and headlights

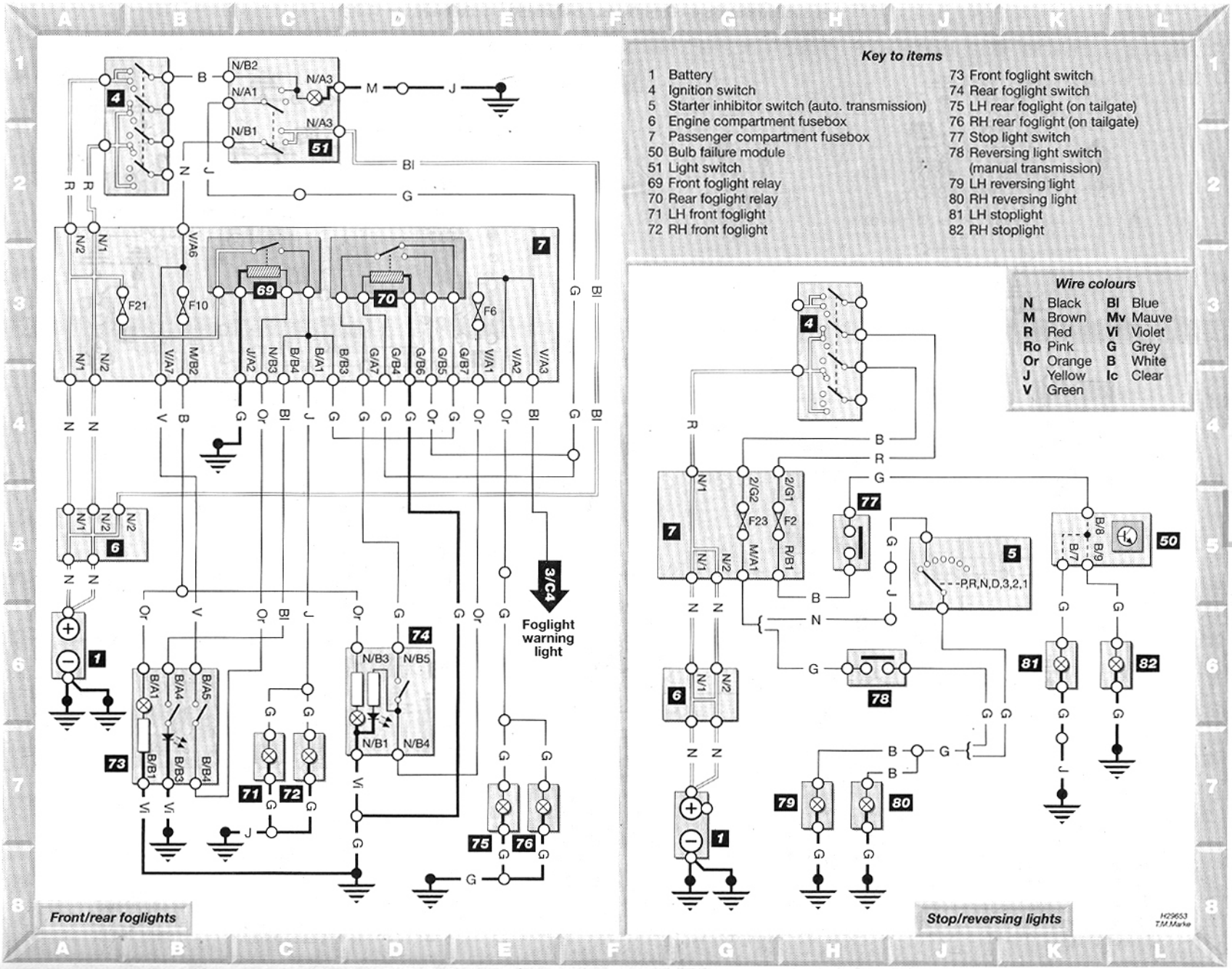


Diagram 6 : Typical exterior lighting - front/rear foglights, stop and reversing lights

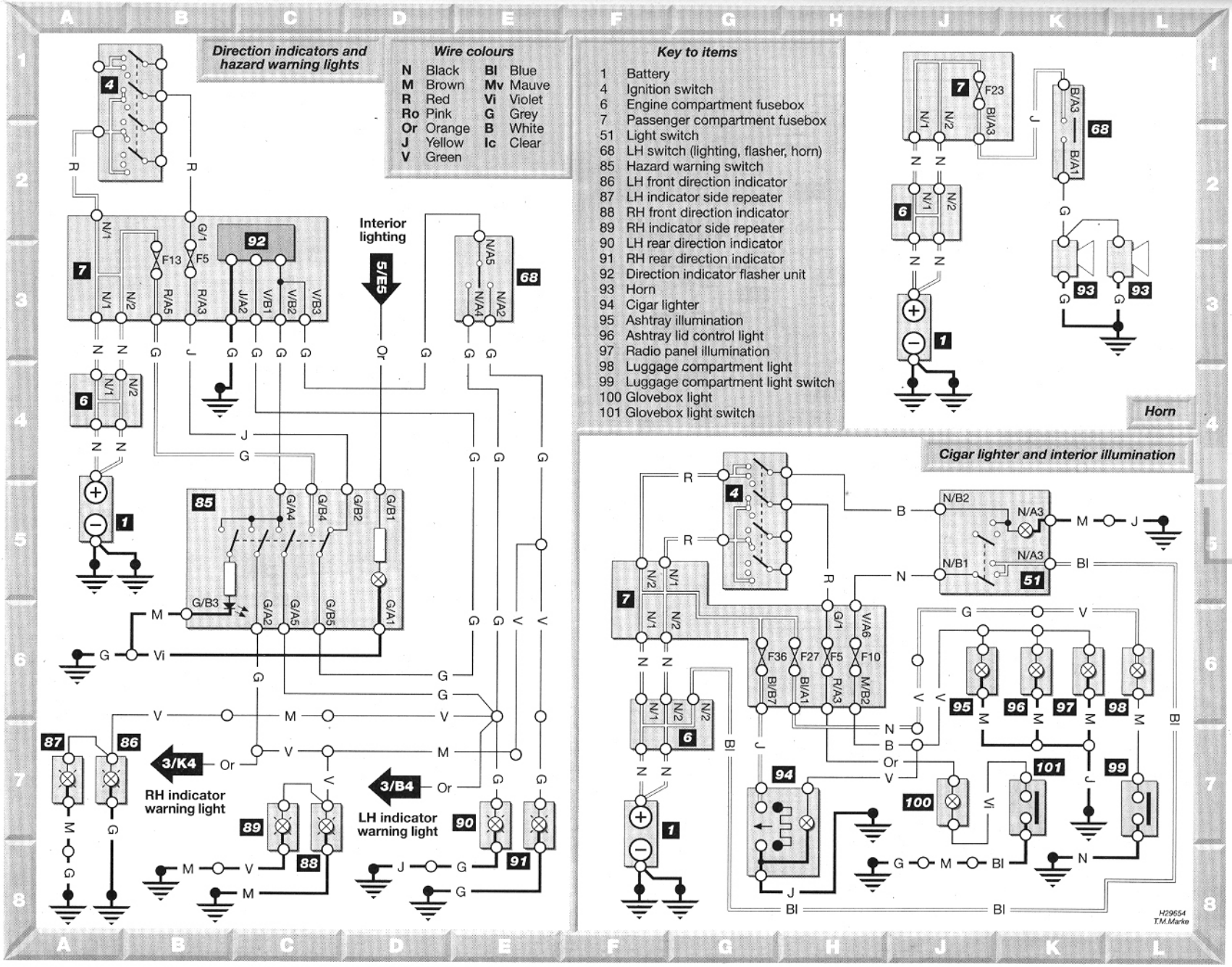


Diagram 7 : Typical exterior lighting - direction indicators, hazard warning and typical interior lighting

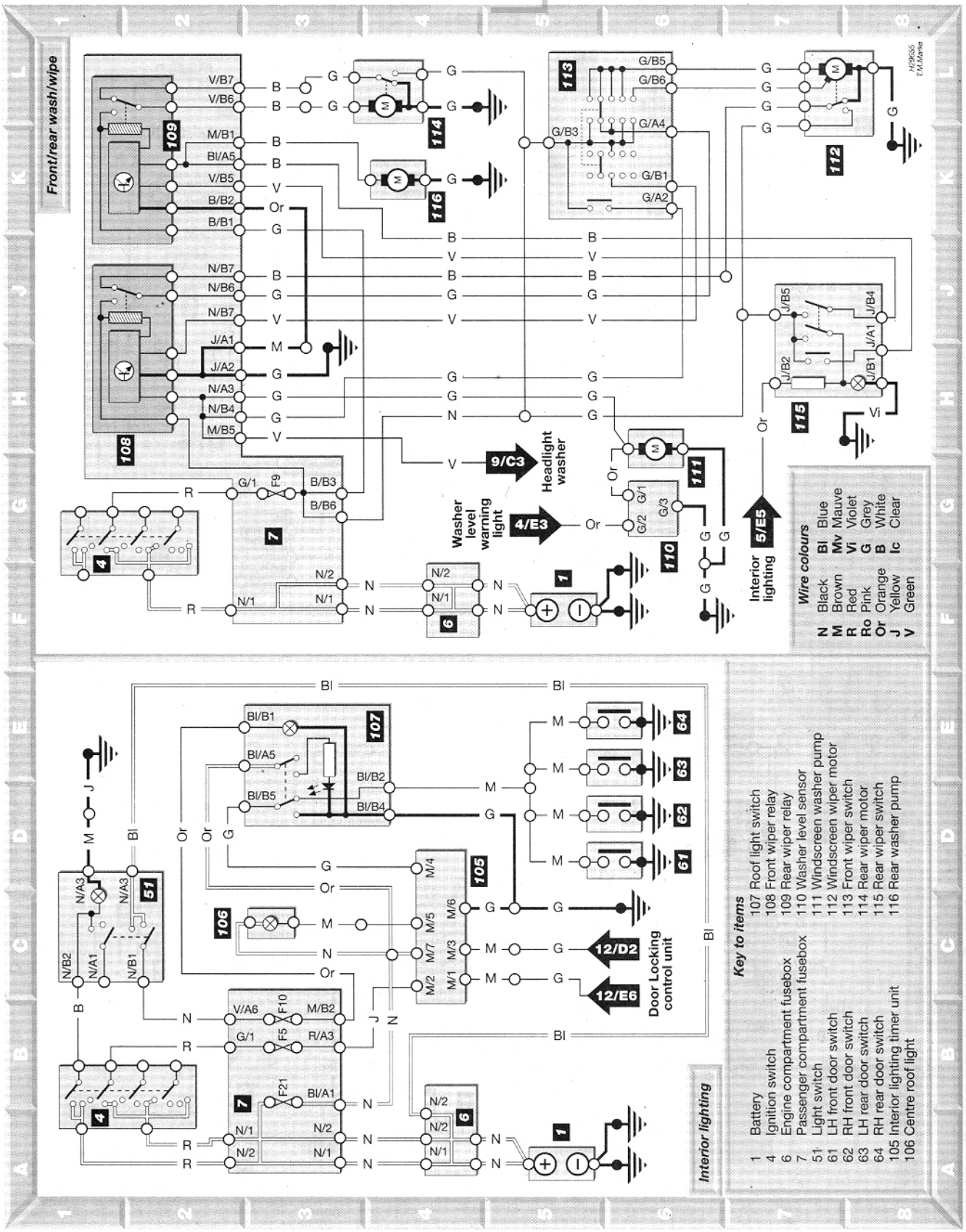


Diagram 8 : Typical interior lighting continued, front and rear wash/wipe

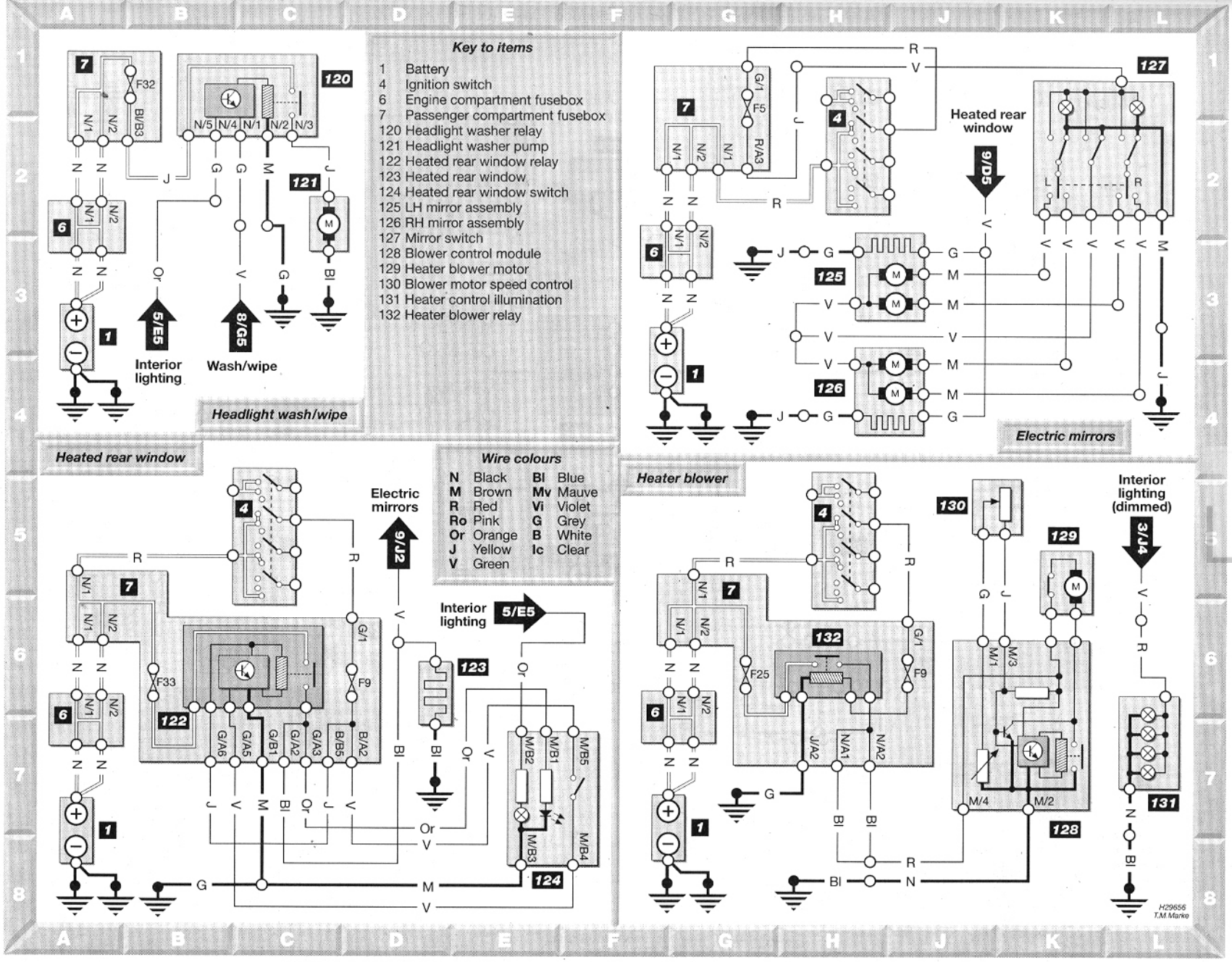


Diagram 9 : Typical headlight washer, heater blower, heated rear window and electric mirrors

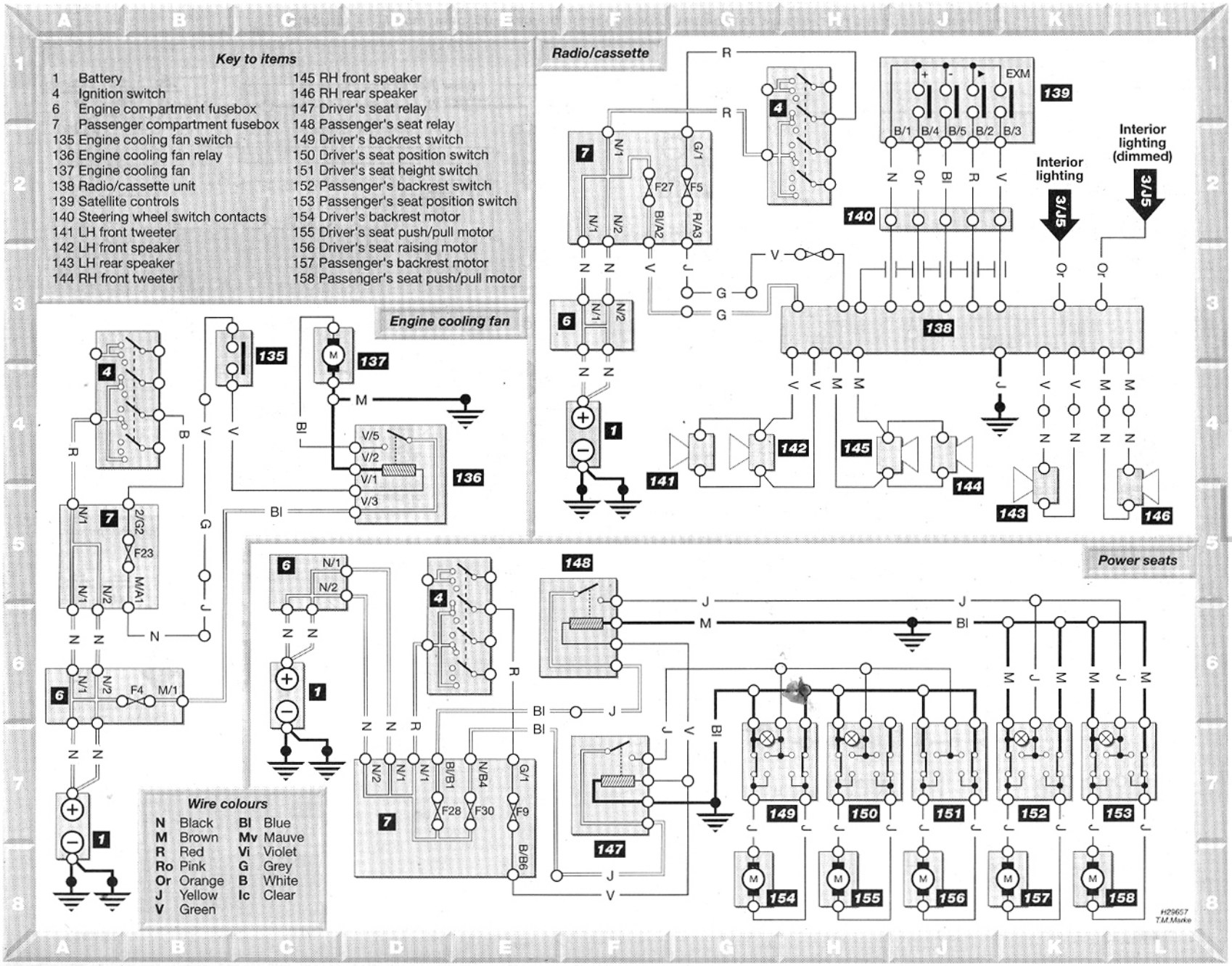


Diagram 10 : Typical engine cooling fan, radio/cassette and power seats

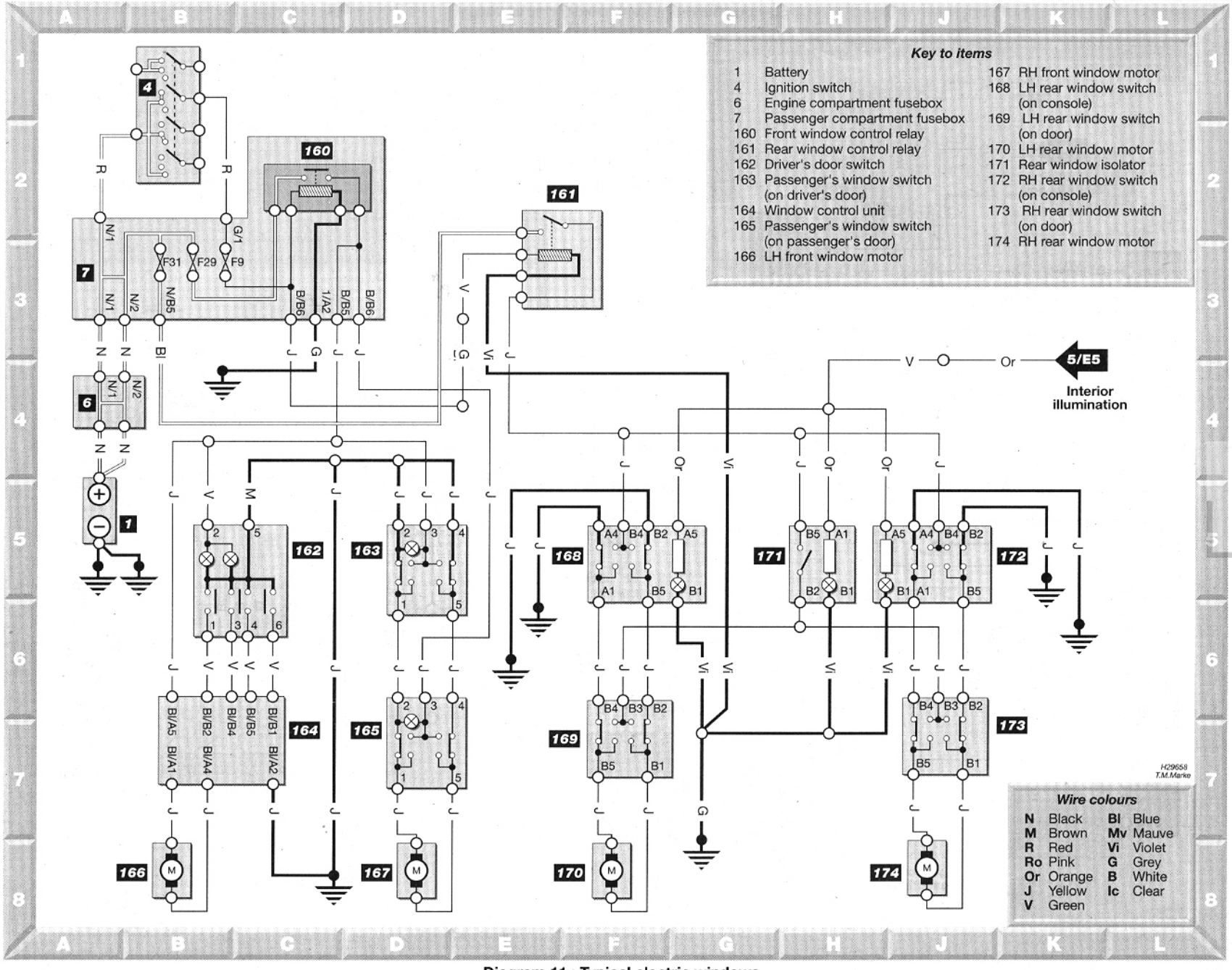
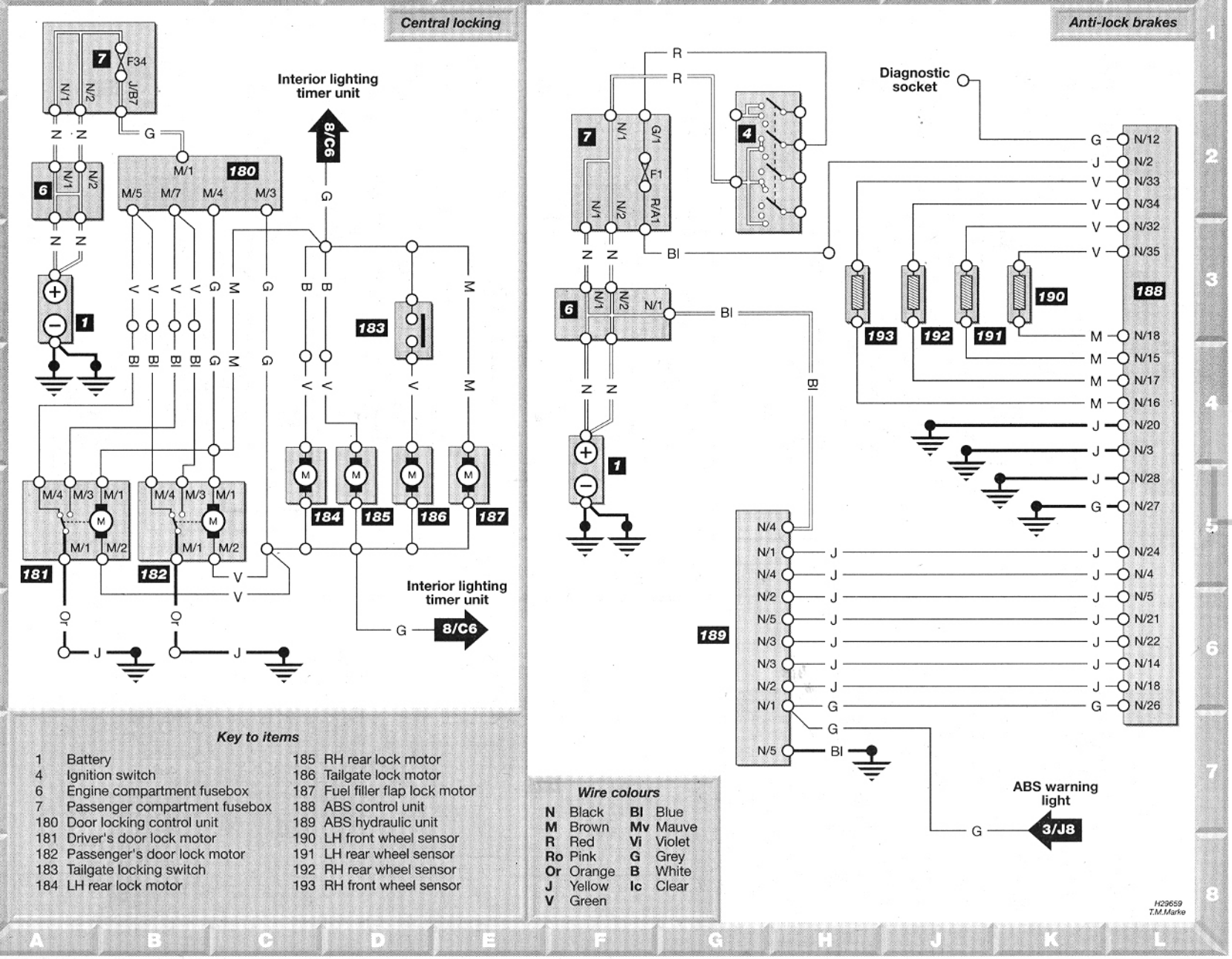


Diagram 11 : Typical electric windows



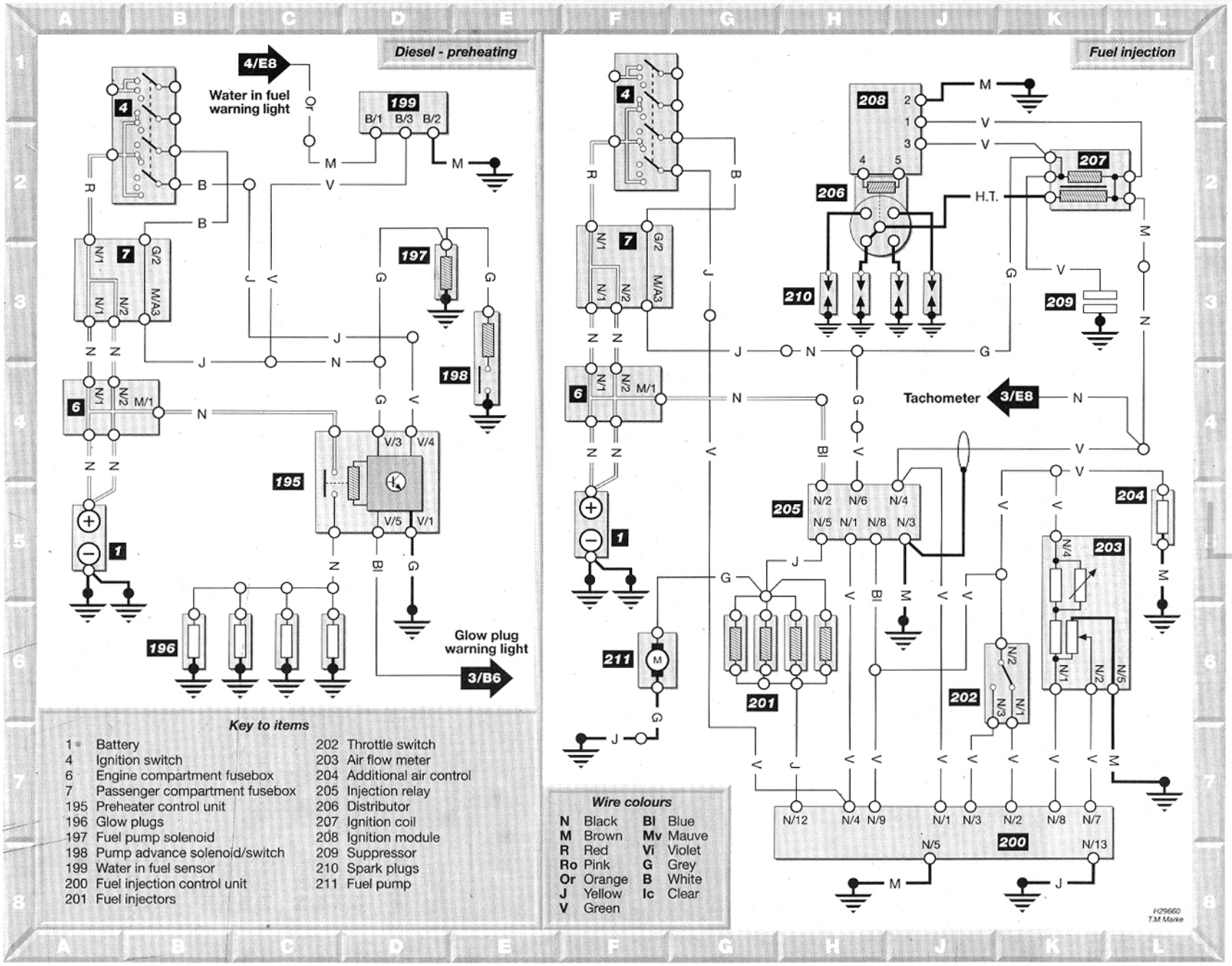
Key to items

1	Battery	185	RH rear lock motor
4	Ignition switch	186	Tailgate lock motor
6	Engine compartment fusebox	187	Fuel filler flap lock motor
7	Passenger compartment fusebox	188	ABS control unit
180	Door locking control unit	189	ABS hydraulic unit
181	Driver's door lock motor	190	LH front wheel sensor
182	Passenger's door lock motor	191	LH rear wheel sensor
183	Tailgate locking switch	192	RH rear wheel sensor
184	LH rear lock motor	193	RH front wheel sensor

Wire colours

N	Black	**Bl**	Blue
M	Brown	**Mv**	Mauve
R	Red	**Vi**	Violet
Ro	Pink	**G**	Grey
Or	Orange	**B**	White
J	Yellow	**Ic**	Clear
V	Green		

Diagram 12 : Typical central locking and ABS



Key to items

1	Battery	202	Throttle switch
4	Ignition switch	203	Air flow meter
6	Engine compartment fusebox	204	Additional air control
7	Passenger compartment fusebox	205	Injection relay
195	Preheater control unit	206	Distributor
196	Glow plugs	207	Ignition coil
197	Fuel pump solenoid	208	Ignition module
198	Pump advance solenoid/switch	209	Suppressor
199	Water in fuel sensor	210	Spark plugs
200	Fuel injection control unit	211	Fuel pump
201	Fuel injectors		

Wire colours

N	Black	Bl	Blue
M	Brown	Mv	Mauve
R	Red	Vi	Violet
Ro	Pink	G	Grey
Or	Orange	B	White
J	Yellow	Ic	Clear
V	Green		

Diagram 13 : Typical preheating (Diesel) and fuel injection (petrol)

PRIVATE CARS

XANTIA-XM-SYNERGIE 2001

«The technical information contained in this document is intended for the exclusive use of the trained personnel of the motor vehicle repair trade. In some instances, this information could concern the security and safety of the vehicle. The information is to be used by the professional vehicle repairers for whom it is intended and they alone would assume full responsibility to the exclusion of that of the manufacturer».
"The technical information appearing in this brochure is subject to updating as the characteristics of each model in the range evolve. Motor vehicle repairers are invited to contact the CITROËN network periodically for further information and to obtain any possible updates».

CAR 050008
Book 2

PRESENTATION

THIS HANDBOOK summarises the characteristics, adjustments, checks and special features of **CITROEN** vehicles, not including COMMERCIAL vehicles for which there exists a separate handbook.

The handbook is divided into the following groups representing the main functions :

GENERAL - ENGINE - INJECTION - IGNITION - CLUTCH, GEARBOX, DRIVESHAFTS - AXLES, SUSPENSION, STEERING - BRAKES - HYDRAULICS - ELECTRICAL - AIR CONDITIONING.

In each section, the vehicles are dealt with in the following order : XANTIA-XM-SYNERGIE and all models where applicable.

The information given in this handbook is based on vehicles marketed in **EUROPE**.

IMPORTANT

If you find that this handbook does not always meet your requirements, **we invite you to send us your suggestions** which we will take into account when preparing future publications. For example :

– INSUFFICIENT INFORMATION
– SUPERFLUOUS INFORMATION
– NEED FOR MORE DETAILS

Please send your comments and suggestions to :

CITROEN U.K. Ltd.
221, Bath Road,
SLOUGH,
SL1 4BA.
U.K.

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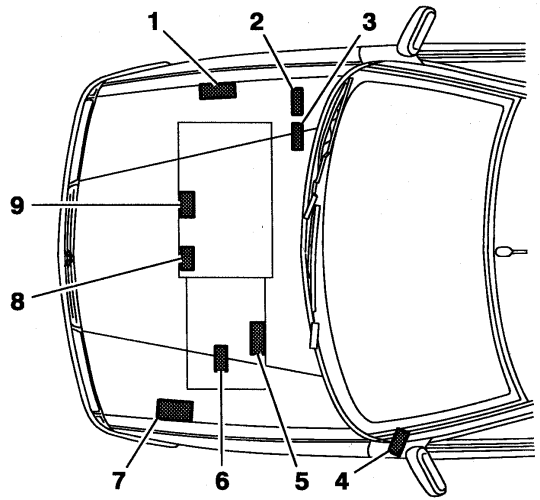


E1AP07ED

(1) Manufacturer's cold stamp.

(2) R.P. organisation N°.

(3) Paint code.

(4) 01/02/99 ➔ Label :
- Pression de gonflage.
- N° organisation P.R.
- Code peinture

(5) Automatic gearbox identification ref.

(6) Manual gearbox identification ref.

(7) Manufacturer's name plate.

(8) XU5 - XU7 - ES9J4 engine plate.

(9) XU10 - XUD engine plate.

XANTIA - All Types	IDENTIFICATION OF VEHICLES					
	PETROL SALOON					
	1.6 i	1.8 i	1.8 i 16 V			
			Auto.		Auto.	
	SX	SX	SX			
Emission standard	L3				L4	
Type code	X1 BFZF	X1 BFXF	X1 LFYM	X1 LFYF	X1 LFYN	X1 LFYB
Engine type	BFZ	BFX	LFY			
Cubic capacity (cc)	1580	1761				
Fiscal rating (hp)	7		8			
Gearbox type	BE3/5		AL4	BE3/5	AL4	BE3/5
Gearbox ident. plate	20 TE 00	20 TE 35	20 TP 52	20 TE 35 (*)	20 TP 52	20 TE 36

(*) = Long gearbox.

IDENTIFICATION OF VEHICLES			XANTIA - All Types			
	PETROL SALOON					
	1.8i 16 V		2.0i 16 V		30.i V6	
	SX		SX	Exclusive	Activa	SX Exclusive
Emission standard	L4		L3			
Type code	X1 LFYN/IF (*)	X1 LFYB/IF (*)	X1 RFVM	X1 RFVF	X7 XFZF	X7 XFZM
Engine type	LFY		RFV		XFZ	
Cubic capacity (cc)	1761		1998		2946	
Fiscal rating (hp)			9		13	14
Gearbox type	AL4	BE3/5	AL4	BE3/5	ML/5	4HP20
Gearbox ident. plate	20 TP 52	20 TE 36	20 TE 53	20 TE 37	20 LE 89	20 HZ XX

(*) = IF = Fiscal incentive.

XANTIA - All Types	IDENTIFICATION OF VEHICLES				
	DIESEL SALOON				
	1.9 D	2.0 HDi (1)			
	Auto.				
	SX SX Aircon Pack	SX SX Aircon Pack	SX - SX Aircon Pack Exclusive Activa	SX Exclusive	SX Activa
Emission standard	L3	L3		L4	
Type code	X1 DHXM	X1 RFYF	X1 RHZF	X1 RHZB	X7 RHZB
Engine type	DHX	RHY	RHZ		
Cubic capacity (cc)	1905	1997			
Fiscal rating (hp)	7	6			
Gearbox type	AL4	BE3/5	ML/5		
Gearbox ident. plate	20 TP 50	20 TE 40	20 LE 84		

(1) HDi = High pressure Diesel injection

IDENTIFICATION OF VEHICLES					XANTIA - All Types
	PETROL ESTATE				
	1.8i	1.8i 16V			
	SX	SX - SX Aircon Pack		SX	
Emission standard	L3	L3		L4	
Type code	X2 LFXF	X2 LFYF	X2 LFYC	X2 LFYB/IF (*)	X2 LFYB
Engine type	LFX	LFY			
Cubic capacity (cc)	1761				
Fiscal rating (hp)	7	8	7		
Gearbox type	BE3/5				
Gearbox ident. plate	20TE 35	20 TE 36	20 TE 35	20 TE 36	

(*) = IF = Fiscal incentive.

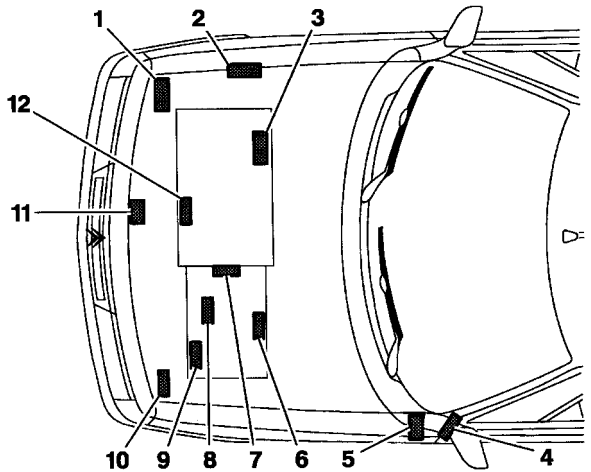
XANTIA - All Types	IDENTIFICATION OF VEHICLES					
	PETROL ESTATE					
	2.0i 16V				3.0i V6	
	Auto.				Auto.	
	SX	SX Aircon Pack Exclusive	SX	SX Aircon Pack Exclusive	Exclusive	
Emission standard	L3					
Type code	X2 RFVM		X2 RFVF	X2 RFVM	X2 XFZF	X7 XFZM
Engine type	RFV				XFZ	
Cubic capacity (cc)	1998				2946	
Fiscal rating (hp)		9		9	14	13
Gearbox type	AL4		BE3/5		4HP20	ML/5
Gearbox ident. plate	20 TP 53		20 TE 37		20 HZ XX	20 LE 89

IDENTIFICATION OF VEHICLES	XANTIA - All Types			
	DIESEL ESTATE			
	1.9 TD Auto.	2.0 HDi (*)		
	SX SX Aircon Pack	SX SX Aircon Pack	SX - SX Aircon Pack Exclusive	SX Exclusive
Emission standard	**L3**	**L3**	**L4**	
Type code	**X2 DHXM**	**X2 RHYF**	**X2 RHZF**	**X2 RHZB**
Engine type	DHX	RHY	RHZ	
Cubic capacity (cc)	1905	1997		
Fiscal rating (hp)	7	6		
Gearbox type	AL4	BE3/5	ML/5	
Gearbox ident. plate	20 TP 50	20 TE 40	20 LE 84	

(1) HDi = High pressure Diesel injection

XANTIA - All Types	IDENTIFICATION OF VEHICLES					
	COMMERCIAL VERSIONS ALL TYPES			DUAL FUEL PETROL/LPG (1)		
	Diesel			Petrol		
	Saloon		Estate	Saloon		Estate
	2.0HDi (2)			1.8i 16V		
	SX Ambulance X - SX Company	SX Company	SX Entreprise	SX	SX SX Aircon Pack	
Emission standard	L3			L3		
Type code	X1 RHYF	X1 RHZF	X2 RHYF/T (3)	X1 LFYC/GPL	X1 LFYC/GPL	X2 LFYC/GPL
Engine type	RHY	RHZ	RHY	LFY/GPL		
Cubic capacity (cc)	1997			1761		
Fiscal rating (hp)	6				7	
Gearbox type	BE3/5	ML/5	BE3/5	BE3/5		
Gearbox ident. plate	20 TE 40	20 LE 84	20 TE 40	20 TE 36	20 TE 35	

(1) = Liquid Petroleum Gas.
(2) HDi = High pressure Diesel injection.
(3) /T = Can be converted.



(*) : Applicable only to 1999 model year saloons

E1AP07FD

(1) Bodyshell N°

(2) Manufacturer's cold stamp

(3) 6 cyl. engine plate

(4) R.P. organisation N°. (*) 01/02/1999 ➔ Label :
- Tyre pressures.
- R.P. organisation N°.
- Paint code

(5) R.P. organisation N°. ➔ 01/02/99

(6) BE3 gearbox ident.

(7) 4HP 18 gearbox ident.

(8) MG gearbox ident.

(9) ME5T gearbox ident.

(10) Paint code ➔ 01/02/99 (*)

(11) Manufacturer's plate

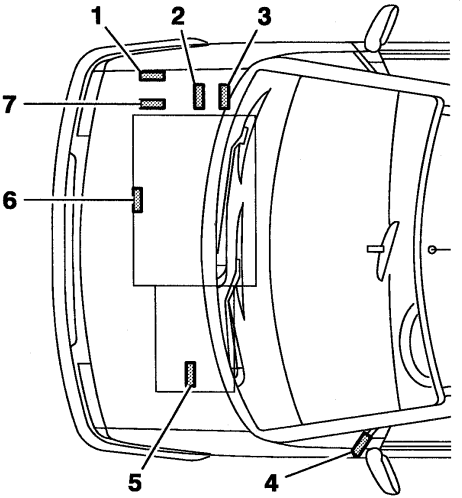
(12) 4 cyl. engine plate

XM - All Types	IDENTIFICATION OF VEHICLES					
	PETROL SALOON					
	2.0i 16 V		2.0i Turbo CT		3.0i V6	
		Auto.		Auto.		Auto.
	SX		SX		SX - Exclusive	
Emission standard	L3					
Type code	Y4-CZ	Y4-TV	Y4-GG	Y4-TT	Y4-WG	Y4-WH
Engine type	RFV		RGX		XFZ	
Cubic capacity (cc)	1998				2946	
Fiscal rating (hp)	9	10		11	13	14
Gearbox type	BE3/5	4 HP 18	ME/5	4 HP 18	ML/5	4 HP20
Gearbox ident. plate	20 TD 01	20 GZ 5G	20 GM 32	20 GZ 1G	20 LE 59	20 HZ YY

	DIESEL SALOON			
	2.1 TD Auto. SX			2.5 TD SX - Exclusive
Emission standard	**L3**		**L4**	**L3**
Type code	**Y4-GZ**	**Y4-RN**	**Y4-WE**	**Y4-NZ**
Engine type	P8C			THY
Cubic capacity (cc)	2088			2446
Fiscal rating (hp)	7	8	7	9
Gearbox type	ME/5	4 HP 18	ME/5	MG/5
Gearbox ident. plate	20 GM 31	20 GZ 5D	20 GM 31	20 KM 70

XM - All Types	IDENTIFICATION OF VEHICLES					
	PETROL ESTATE					
	2.0i		2.0i Turbo CT		3.0i V6	
		Auto.		Auto.		Auto.
	SX		SX-Commerce	SX	SX	
Emission standard	L3					
Type code	Y4-GB	Y4-TU	Y4-GM	Y4-TS	Y4-WJ	Y4-TN
Engine type	RFV		RGX		XFZ	
Cubic capacity (cc)	1998				2946	
Fiscal rating (hp)	9	10	9	10	13	14
Gearbox type	BE3/5	4 HP 18	ME/5	4 HP 18	ML/5	4 HP 20
Gearbox ident. plate	20 GM 36	20 GZ 5G	20 GM 33	20 GZ 1G	20 LE 59	20 HZ YY

IDENTIFICATION OF VEHICLES					XM - All Types
	DIESEL ESTATE				Commercial Estate
	2.1 TD			2.5 TD	2.1 TD
	Auto.				
	SX Commerce		SX	SX Commerce	SX Ambulance
Emission standard	L3		L4	L3	
Type code	Y4-MZ	Y4-CW	Y4-WF	Y4-RM	Y4-GZ
Engine type	P8C			THY	P8C
Cubic capacity (cc)	2088			2446	2088
Fiscal rating (hp)	7	8	7	9	7
Gearbox type	ME/5	4 HP 18	ME/5	MG/5	ME/5
Gearbox ident. plate	20 GM 31	20 GZ 5D	20 GM 31	20 KM 70	20 GM 31



E1AP07GD

(1) Manufacturer's cold stamp

(2) R.P. organisation No.

(3) Paint code

(4) 01/02/99 → Label :
- Tyre pressures.
- R.P. Organisation No.
- Paint code.

(5) Gearbox ident.

(6) Engine plate

(7) Manufacturer's plate

IDENTIFICATION OF VEHICLES			SYNERGIE - All Types		
	PETROL		DIESEL		
	2.0i 16 V		2.0 HDi		2.0 16 V HDi
		Auto.			
	X – SX Exclusive		X – SX	X Taxi – SX Exclusive	
Emission standard	IF L5 (*)		L3		L4
Type code	AF RFNC/IF	AF RFNF/IF	AF RHZA/T	AF RHZA	AF RHWB
Engine type	RFN		RHZ		RHW
Cubic capacity (cc)	1997				
Fiscal rating (hp)	9	10	6		
Gearbox type	BE4/5	AL4	ML5		
Gearbox ident. plate	DL26 - DL27	20 TP 31	20 LE 91		

Draining method.

The oil capacities are defined according to the following methods.

1) - Vehicle on level surface (in high position, if equipped with hydropneumatic suspension).

2) - Engine warm (oil temperature **80°C**).

3) - Draining of the oil sump + removal of the cartridge (duration of draining + dripping = **15 mm**).

4) - Refit plug + cartridge.

5) - Engine filling.

6) - Engine starting (allowing the cartridge to be filled).

7) - Engine stopped (stationary for **5 mm**).

ESSENTIAL : Systematically check the oil level using the oil dipstick.

CAPACITIES (in litres)										XANTIA - All Types
	XANTIA									
	Petrol									
	1.6i	1.8i		1.8i 16V		2.0i 16V		3.0i 6V		
					Auto.		Auto.		Auto.	
Engine type	BFZ	BFX	LFX	LFY		RFV		XFZ		
Engine angle									30°	
Engine with filter change	4.75			4.75 - 4.25 **(1)**		4.25		5.25		
Between Min. and Max.	1.3			1				2		
5-speed gearbox	1.8					1.8		1.8		
Automatic gearbox				6			6		8.3	
after oil change				3			3		5.3	
Hydraulic or brake circuit	5.8									
Cooling system	7 - 8.3 (2)			7.5		7.5 - 8.5 (2)		10		
Fuel tank capacity	65									

(1) Air conditioning **(2)** Depending on equipment - **NOTE : Engine, systematically check the oil level using the oil dipstick.**

XANTIA - All	CAPACITIES (in litres)		
	XANTIA		
	Diesel		
	1.9 D Auto.	2.0 HDi	
Engine type	DHX	RHY	RHZ
Engine angle			30°
Engine with filter change	4.25 - 4 **(1)**	4.5 - 4.25 **(1)**	
Between Min. and Max.	1.5		
5-speed gearbox		1.8	
Automatic gearbox	8		
after oil change	3		
Hydraulic or brake circuit	5.8		
Cooling system	9		8.5 - 11 **(1)**
Fuel tank capacity	65		

(1) Air conditioning - **NOTE : Engine, systematically check the oil level using the oil dipstick.**

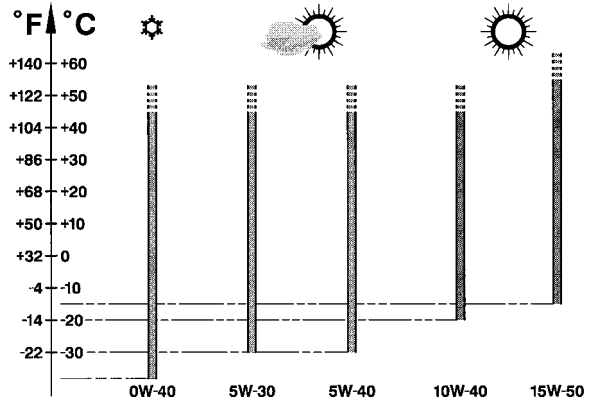
CAPACITIES (in litres)	XM - All Types									
	XM									
	Petrol						Diesel			
	2.0i Turbo CT		2.0i 16 V		3.0i		2.1 TD		2.5 TD	
		Auto.		Auto.		Auto.		Auto.		
Engine type	**RGX**		**RFV**		**XFZ**		**P8C**		**THY**	
Engine with filter change (a)	4.75 - 4.5 **(1)**		4.25		5.25		5 - 4.5 **(1)**		8	
Between Min. and Max. (b)	1.4 - 1.2 **(1)**		1		2		1.45 - 1.25 **(1)**		3	
5-speed gearbox	1.9		1.9		1.8		1.85		2.2	
Automatic gearbox		7.5		7.5		8.3		7.5		
after oil change		2.4		2.4		5.3		2.4		
Hydraulic or brake circuit	5.4				5		5.4			
Cooling system	10.8 - 11.3 **(2)**		8 - 11.5 **(2)**		9.4		11.4 - 12 **(2)**	13.2		
Fuel tank capacity	80						80			

(1) Air conditioning **(2)** Depending on equipment - **NOTE : Engine, systematically check the oil level using the oil dipstick**.

SYNERGIE - All Types	CAPACITIES (in litres)			
	SYNERGIE			
	Petrol		Diesel	
	2.0i 16V	Auto.	2.0 HDi	2.0 HDi 16V
Engine type	RFN		RHZ	RHW
Engine angle			21°	
Engine with filter change	4.25		4.5	4.75
Between Min. and Max.	1.7		1.4	1.9
5-speed gearbox	1.8		1.8	
Automatic gearbox		8		
after oil change		3		
Hydraulic or brake circuit	Sans ABR : 0.47 - Avec ABR : 0.52			
Cooling system	7		8.5	
Fuel tank capacity	80		80	

(1) Air conditioning - **NOTE : Engine, systematically check the oil level using the oil dipstick.**

S.A.E. Norm - Table for selection of engine oil grade



E4AP006D

Factory evolutions in 2000 model year

CITROËN engines are lubricated at the factory with **TOTAL** oil of grade **S.A.E.5W-30**.
TOTAL oil of grade **S.A.E.5W-30** allows improved fuel economies *(approx. 2.5%).*

This oil is not used in the following engines :

- **XU10 4 RS – XSARA VTS 2.0i 16V** *(3-door)*
- **SOFIM – RELAY 2.8 D** and **2.8 TD.**

Engine oil norms

These engine oils have been classified by the following recognised organisations:
SAE : Society of Automotive Engineers.
API : American Petroleum Institute.
ACEA : Association des Constructeurs Européens d'Automobiles

ALL TYPES	LUBRICANTS - TOTAL recommended oils

Selection of engine oil grades recommended for climatic conditions in countries of distribution

ACEA Norms

The first letter corresponds to the type of engine concerned :
- **A : petrol** and **dual fuel petrol / LPG** engines.
- **B : diesel** engines.

The figure following the first letter corresponds to the type of oil.
- **1 :** highly fluid oils, for reducing friction and lowering fuel onsumption.
- **3 :** high performance oils.

The number after that (**96** or **98**) corresponds to the year of creation of the norm.

NOTE : From **01/03/2000,** all engine oils must comply with **ACEA-98 norms.**

Example :
ACEA A1-98 / B1-98 : Blended oils for all engines, permetting fuel economy *(complying with **ACEA 98** norms).*

API Norms

The first letter corresponds to the type of fuel used by the engine :
- **S : petrol** and **dual fuel petrol / LPG** engines.
- **C : diesel** engines.

The second letter corresponds to the degree of evolution, in ascending order.
Example : The norm **SJ** is more severe than the norm **SH** and corresponds to a higher level of performance.
The adding of the letters **EC** indicates that the engine oil concerned is an oil which permits fuel economy.
EC : Energy Conserving, reduction in fuel consumption.

Examples :

API SJ / CF : Blended oils for **diesel and dual fuel petrol / LPG** engines
API CF / EC : Oils specifically for **diesel** engines, permitting fuel economy.

API SJ / CF / EC : Blended oils for all engines, permetting fuel economy.

LUBRICANTS - TOTAL recommended oils | ALL TYPES

Recommendations.

Denominations of **TOTAL** oils, according to country of marketing :

TOTAL ACTIVA (France only).
TOTAL QUARTZ (outside France).

IMPERATIVE : From 1999 model year, to preserve engine performance, all engines fitted in CITROEN vehicles must be lubricated with high quality oils (synthetic or semi-synthetic)

These oils must comply with the following norms :

Petrol and **dual fuel petrol / LPG** engines: **ACEA A3-98** and **API SJ**.
Diesel engines: **ACEA B3-98** and **API CF**.

ATTENTION : Engines fitted in CITROEN vehicles prior to 2000 model year must not be lubricated with oil complying with standards ACEA A1-98 / B1-98 and API SJ/CF EC.

Summary

Model year	Types of engine	ACEA norms	API norms
2001 model year	Petrol and dual fuel petrol / LPG engines	**A3-98 or A1-98 (*)**	**SJ or SJ / EC (*)**
	Diesel engines	**B3-98 or B1-98 (*)**	**CF or CF / EC (*)**

Engine oil norms to be respected in **2001 model year**.

ALL TYPES	LUBRICANTS - TOTAL recommended oils		
	S.A.E. grades	**SPI norms**	**ACEA norms**
Blended oils for all engines (petrol, dual-fuel petrol / LPG and diesel)			
TOTAL ACTIVA 9000 TOTAL QUARTZ 9000	**5W-40**	**SJ / CF**	**A3-98 / B3-98**
TOTAL ACTIVA 9000 (*) TOTAL QUARTZ 9000 (*)	**5W-30**	**SJ / CF EC**	**A1-98 / B1-98**
TOTAL ACTIVRAC	**10W-40**	**SJ / CF**	**A3-98 / B3-98**
(*) = Blended oils for all engines, permitting fuel economy.			
Oils specifically for petrol and dual-fuel petrol / LPG engines			
TOTAL ACTIVA 7000 TOTAL QUARTZ 7000	**10W-40**	**SJ**	**A3-98**
TOTAL QUARTZ 9000	**0W-40**		
TOTAL ACTIVA 7000 TOTAL QUARTZ 7000	**15W-50**		
Oils specifically for diesel engines			
TOTAL ACTIVA DIESEL 7000 TOTAL QUARTZ DIESEL 7000	**10W-40**	**CF**	**B3-98**
TOTAL ACTIVA DIESEL 7000 TOTAL QUARTZ DIESEL 7000	**15W-50**		
TOTAL ACTIVA 9000	**5W-40**		

LUBRICANTS - TOTAL recommended oils			ALL TYPES
	FRANCE		
	Blended oils for all engines		
Metropolitan FRANCE	TOTAL ACTIVRAC		S.A.E : 10W-40 Norms
	TOTAL ACTIVA		TOTAL ACTIVA DIESEL
	Blended oils for all engines	Oils specifically for petrol and dual-fuel petrol / LPG engines	Oils specifically for diesel engines
Metropolitan FRANCE	900 5W-40 9000 5W-30 (*)	7000 10 W-40	7000 10 W-40 9000 5W-40
New Caledonia Guadeloupe Saint-Martin La Réunion Martinique Guyana Tahiti Mauritius Mayotte	9000 5W-40	7000 15W-50	7000 15W-50

(*) = Blended oils for all engines, permitting fuel economy.

ALL TYPES	LUBRICANTS - TOTAL recommended oils		
	EUROPE		
	TOTAL QUARTZ		TOTAL QUARTZ DIESEL
(*) = Blended oils for all engines, permitting fuel economy	**Blended oils for all engines**	**Oils specifically for petrol and dual-fuel petrol / LPG engines**	**Oils specifically for diesel engines**
Germany	**9000 5W-40 9000 5W-30 (*)**	**7000 10W-40 9000 0W-40**	**7000 10W-40**
Austria		**7000 10W-40**	
Belgium		**7000 10W-40 9000 0W-40**	
Bulgaria		**7000 10W-40**	
Cyprus		**7000 15W-50**	**7000 10W-40 7000 15W-50**
Croatia		**7000 10W-40**	**7000 10W-40**
Denmark		**7000 10W-40 9000 0W-40**	
Spain		**7000 10W-40 7000 15W-50**	**7000 10W-40 7000 15W-50**
Finland		**7000 10W-40 9000 0W-40**	**7000 10W-40**
Great Britain		**7000 10W-40**	

LUBRICANTS - TOTAL recommended oils			ALL TYPES
	EUROPE (continued)		
	TOTAL QUARTZ		TOTAL QUARTZ DIESEL
(*) = Blended oils for all engines, permitting fuel economy	**Blended oils for all engines**	**Oils specifically for petrol and dual-fuel petrol / LPG engines**	**Oils specifically for diesel engines**
Greece	**9000 5W-40 9000 5W-30 (*)**	**7000 10W-40 7000 15W-50**	**7000 10W-40 7000 15W-50**
Holland		**7000 10W-40**	**7000 10W-40**
Hungary		**9000 0W-40**	
Italy		**7000 10W-40**	
Latvia		**7000 10W-40**	
Lithuania		**9000 0W-40**	
Macedonia		**7000 10W-40**	
Malta		**7000 10W-40 7000 15W-50**	**7000 10W-40 7000 15W-50**
Norway		**7000 10W-40 9000 0W-40**	**7000 10W-40**
Poland		**7000 10W-40**	
Portugal			
Slovak Republic			

ALL TYPES	LUBRICANTS - TOTAL recommended oils		
	EUROPE (continued)		
	TOTAL QUARTZ		TOTAL QUARTZ DIESEL
(*) = Blended oils for all engines, permitting fuel economy	**Blended oils for all engines**	**Oils specifically for petrol and dual-fuel petrol / LPG engines**	**Oils specifically for diesel engines**
Czech Republic	**9000 5W-40 9000 5W-30 (*)**	**7000 10W-40 9000 0W-40**	**7000 10W-40**
Romania		**7000 10W-40 7000 15W-50**	**7000 10W-40 7000 15W-50**
Russia		**7000 10W-40 9000 0W-40**	**7000 10W-40**
Slovenia		**7000 10W-40**	
Sweden		**7000 10W-40 9000 0W-40**	
Switzerland		**7000 10W-40**	
Turkey		**7000 10W-40 7000 15W-50 9000 0W-40**	**7000 10W-40 7000 15W-50**
Ukraine		**7000 10W-40 9000 0W-40**	**7000 10W-40**

LUBRICANTS - TOTAL recommended oils				ALL TYPES
		TOTAL QUARTZ		TOTAL QUARTZ DIESEL
		Blended oils for all engines	Oils specifically for petrol and dual-fuel petrol / LPG engines	Oils specifically for diesel engines
Australia New Zealand	OCEANIA	9000 5W-40	7000 10W-40	7000 10W-40
Angola - Ivory Coast Egypt - Ecuador - Gabon Madagascar - Morocco Dominican Republic Senegal - Tunisia	AFRICA	9000 5W-40	7000 15W-50	7000 15W-50
Argentina - Brazil - Chile Colombia - Cuba Guatemala - Paraguay Peru - El Salvador Uruguay	SOUTH AMERICA	9000 5W-40	7000 15W-50	7000 15W-50

ALL TYPES		LUBRICANTS - TOTAL recommended oils		
		TOTAL QUARTZ		TOTAL QUARTZ DIESEL
		Blended oils for all engines	Oils specifically for petrol and dual-fuel petrol / LPG engines	Oils specifically for diesel engines
China	SOUTH & EAST ASIA	9000 5W-40	7000 10W-40 7000 15W-50	7000 15W-50
South Korea			7000 10W-40	
Hong Kong - India Indonesia			7000 15W-50	
Japan			7000 10W-40 7000 15W-50	
Malaysia			7000 15W-50	
Singapore				
Taiwan			7000 10W-40 7000 15W-50	
Thaïland			7000 15W-50	
Vietnam				

LUBRICANTS - TOTAL recommended oils		ALL TYPES		
		TOTAL QUARTZ		TOTAL QUARTZ DIESEL
		Blended oils for all engines	Oils specifically for petrol and dual-fuel petrol / LPG engines	Oils specifically for diesel engines
Saudi Arabia Bahrain Dubai United Arab Emirates Israel Jordan Kuwaït Lebanon Qatar Yemen	MIDDLE EAST	9000 5W-40	7000 15W-50	7000 15W-50

ALL TYPES	LUBRICANTS - TOTAL recommended oils	
Gearbox oils		
Manual gearbox	Europe Overseas France Asia	TOTAL TRANSMISSION (new formula) Norms S.A.E 75W-80
Automatic gearbox MB3	All countries	TOTAL FLUIDE ATX ou TOTAL FLUIDE AT 42. Special oil distributed by CITROEN (Part No. : 9730 94).
Automatic gearbox 4 HP 14 et 4 HP 18		TOTAL FLUIDE AT 42 ou Special oil distributed by CITROEN (Part No. : 9730 94).
Automatic gearbox 4 HP 20 et AL4		Special oil distributed by CITROEN (Part No. : 9736 22).
Transfer box and differential		TOTAL TRANSMISSION X 4
C MATIC gearbox		TOTAL FLUIDE T
Oils for power-assisted steering		
Power-assisted steering	All countries	TOTAL FLUIDE ATX

LUBRICANTS - TOTAL recommended oils				ALL TYPES
Engine coolant				
All countries	CITROEN Fluid Protection : - 35°C	**Packs**	**CITROEN Reference**	
			GLYSANTIN G 33	**REVCOGEL 2000**
		2 litres	**9979 70**	**9979 72**
		5 litres	**9979 71**	**9979 73**
		20 litres	**9979 76**	**9979 74**
		210 litres	**9979 77**	**9979 75**
Synthetic brake fluid				
All countries	CITROEN Fluid	**Packs**	**CITROEN Reference**	
		0.5 litre	**9979 05**	
		1 litre	**9979 06**	
		5litres	**9979 07**	
CITROEN hydraulic circuit fluid				
All countries	**Mineral fluid for hydraulic circuit – green colour**			
	TOTAL LHM PLUS **Norms ISO 7308-7309**	**Packs**	**CITROEN Reference**	
		1 litre	**ZCP 830 095**	
	Hydraulic circuit rinsing fluid – green colour			
	TOTAL HYDRAURINCAGE			

ALL TYPES	LUBRICANTS - TOTAL recommended oils			
Wash / wipe fluid				
		CITROEN Reference		
All countries	Concentrate : 250 ml	**9980 33**	**ZC 9875 953 U**	**9980 56**
	Liquid ready to use : 1 litre	**9980 06**	**ZC 9875 784 U**	
	Liquid ready to use : 5 litres	**9980 05**	**ZC 9885 077 U**	**ZC 9875 279 U**
Grease				
All countries			**Norms NLGI (1)**	
	TOTAL MULTIS EP2		**2**	
	TOTAL MULTIS COMPLEX EP2		**2**	
	TOTAL MULTIS N4128		**1**	
	TOTAL SMALL MECHANISMS			

(1) NLGI = National Lubrificating Grease Institute.

ENGINE OIL CONSUMPTION — ALL TYPES

I - Oil consumption depends on :
- the engine type.
- how run-in or worn it is.
- the type of oil used.
- the driving conditions.

II - An engine can be considered **RUN-IN** after:

- **3,000 miles** (5,000 km) for a **PETROL** engine.
- **6,000 miles** (10,000 km) for a **DIESEL** engine.

III - **MAXIMUM PERMISSIBLE** oil consumption for a **RUN-IN** engine.

- **0.5 litres** per **600 miles** (1,000 km) for a **PETROL** engine
- **1 litre** per **600 miles** (1,000 km) for a **DIESEL** engine.

DO NOT WORK BELOW THESE VALUES.

IV - **OIL LEVEL :** The level should **NEVER** be above the **MAX.** mark on the dipstick after changing or topping up the oil.
- This excess oil will be used up rapidly.
- It will reduce the engine output and adversely affect the operation of the air circuits and gas recycling.

ALL TYPES	ENGINE SPECIFICATIONS				
	Engines : BFZ BFX LFX LFY				
	Petrol				
	All Types				
	1.6i	1.8 i		1.8 i 16 V	Dual fuel
Engine type	**BFZ**	**BFX**	**LFX**	**LFY**	**LFY/GPL**
Cubic capacity (cc)	1580	1761			
Bore / Stroke	83/73	83/81.4			
Compression ratio	9.25/1	9.5/1		10.4/1	
Power ISO or EEC KW-rpm	65-6000	66-5000		81-5500	79-5500
Power DIN (HP-rpm)	89-6000	90-5000		112-5500	109-5500
Torque ISO or EEC (m.daN-rpm)	13-2600	14.7-2600		15.5-4250	
Torque DIN (mkg-rpm)	13.5-2600	15.3-2600		16.1-4250	
Max. speed (rpm)	6800	6300		6400	

ENGINE SPECIFICATIONS				ALL TYPES
	Engines : RGX RFN RFV XFZ			
	Petrol			
	2.0I TURBO CT	2.0i 16V		3.0i V6
Engine type	**RGX**	**RFN**	**RFV**	**XFZ**
Cubic capacity (cc)	1998	1997	1998	2946
Bore / Stroke	86/86	85/88	86/86	87/82.6
Compression ratio	7.9/1	10.8/1	10.4/1	10.5/1
Power ISO or EEC KW-rpm	108-5300	99-6000	97.4-5500	140-5750
Power DIN (HP-rpm)	150-5300	136-6000	135-5500	194-5750
Torque ISO or EEC (m.daN-rpm)	23.5-2500	19-4600	18-4200	26.7-4000
Torque DIN (mkg-rpm)	24.5-2500	19.8-4600	18.7-4200	27.7-4000
Max. speed (rpm)	6300		6800	6520

ALL TYPES	ENGINE SPECIFICATIONS					
	Engines : DHX - RHZ – RHY - RFW - P8C - THY					
	Diesel					
	All Types					
	1.9 TD	2.0 HDi		2.0 HDi 16V	2.1 TD	2.5 TD
Engine type	**DHX**	**RHZ**	**RHY**	**RHW**	**P8C**	**THY**
Cubic capacity (cc)	1905	1997			2088	2445
Bore / Stroke	83/88	85/88		85/88	95/92	92/92
Compression ratio	21.8/1	17.6/1		18/1	21.5/1	22/1
Power ISO or EEC KW-rpm	66-4000	80-4000	66-4000	80-4000	80-4300	94.5-4300
Power DIN (HP-rpm)	90-4000	110-4000	90-4000	110-4000	110-4300	130-4300
Torque ISO or EEC (m.daN-rpm)	19.6-2250	25-1750	20.5-1750	27-1750	25-2000	28.5-2000
Torque DIN (mkg-rpm)	20.5-2250	26-1750	21.3-1750	-1750	26-2000	30-2000
Max. speed (rpm)	4500	5300			4300	5100

COMPRESSION RATIO - DIESEL ENGINES | ALL TYPES

ENGINE	COMPRESSION RATIO	MINIMUM VALUE (- 20 ‰)	MAX. SPACING BETWEEN CYLINDERS
	in Bars		
XUD 7 / 9	25 to 30	20	5
XUD 11	19 to 21	15	
DW10	30 ± 5		
DK5	25 to 30	20	

XANTIA - XM	SPECIAL FEATURES - TIGHTENING TORQUES (m.daN)					
Engines : BFZ – BFX - LFX - LFY - RFV - RGX						
	CYLINDER HEAD (mm)					
Engine type	**BFZ**	**BFX**	**LFX**	**LFY**	**RFV**	**RGX**
Maximum permissible bow	0.05					
Gasket surface regrinding	- 0.20					
	TIGHTENING TORQUES (m.daN)					
Crankshaft bearing screws : **- Pre-tightening** **- Tightening** **- Angular tightening**	- 5.5 ± 0.5 -				- 7 ± 0.7 -	
Connecting rod screws **- Pre-tightening** **- Tightening** **- Angular tightening**	4±0.4 2±0.2 70°±7°					
Flywheel screw	5					
Crankshaft pulley screw	12					
Pulley screw at end of camshaft	5.5±0.5			7.5±0.7	5.5±0.5	

WARNING : After removing the crankshaft pulley, carry out the following operations :
- Clean the thread (Tap 14X150)
- Fit a NEW screw.
- Fit a NEW washer
- Tighten (see table above)

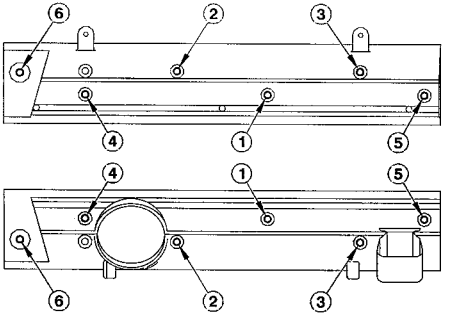
SPECIAL FEATURES - TIGHTENING TORQUES (m.daN)			SYNERGIE
	Engine : RFN		
Maximum permissible bow	**0.05**		
Gasket surface regrinding	**- 0.20**		
Crankshaft			
Bearing cap screws. - Pre-tightening - Angular tightening	 2 ± 0.1 60° ± 6°	**Camshaft pulley hubs**	7.5 ± 0.7
Con-rod cap screws. - Tightening - Untightening - Tightening - Angular tightening	 2.3 ± 0.2 46° + 2° - 4°	**Engine flywheel** - Pre-tightening - Tightening	 2 ± 0.2 21° ± 3°
Con-rod nuts. - Pre-tightening - Angular tightening		**Clutch plate**	2 ± 0.2
Accessories drive pulley - Tightening - Angular tightening	2.1 ± 0.1		
Accessories drive pulley hub - Pre-tightening - Angular tightening *(Sintered washer)* - Angular tightening *(Steel washer)*	 4 ± 0.4 40° ± 4° 53° ± 5°		

XANTIA - XM	SPECIAL FEATURES - TIGHTENING TORQUES (m.daN)

Engines : LFY - RFV

CYLINDER HEAD COVER

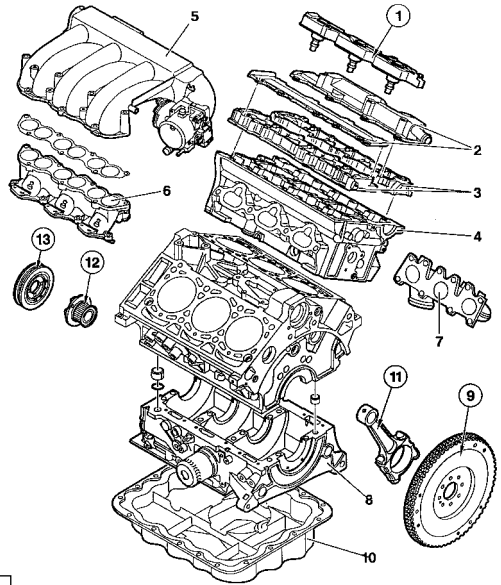
XM - XANTIA
LFY - RFV
- Pre-tighten : **0.5** - Tighten : **1±0.1**



B1DP01YD

SPECIAL FEATURES - TIGHTENING TORQUES (m.daN)

XANTIA - XM - V6



B1BP1HAP

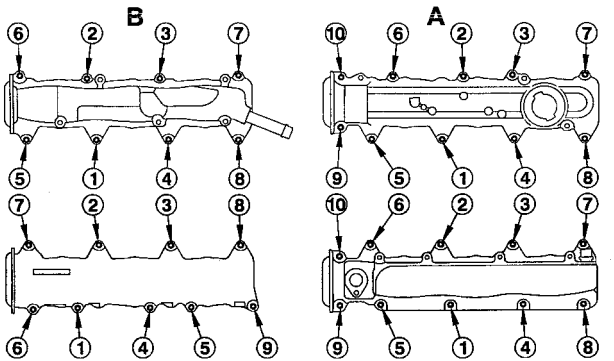
Engine : XFZ

(1) Compact coil unit	**1 ± 0.1**
(**9**) Flywheel	
- Tightening	**1**
- Angular tightening	**60°± 6°**
(11) Connecting rod caps	
- Tightening	**2 ±**
- Angular tightening	**74° ± 7**
(12) Crankshaft hub	
- Tightening	**4 ± 0.4**
- Angular tightening	**80° ± 8°**
(13) Crankshaft pulley	**2.5 ± 0.2**

XANTIA - XM - V6	SPECIAL FEATURES - TIGHTENING TORQUES (m.daN)

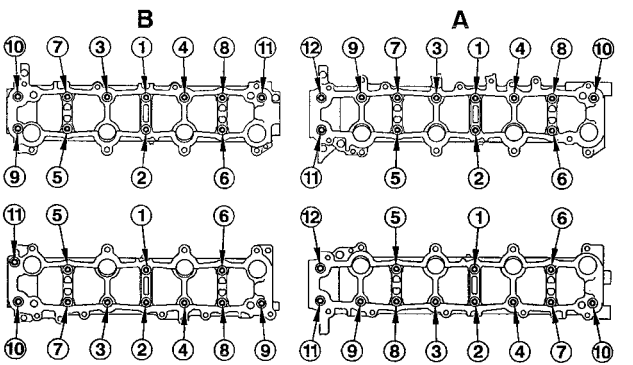
Engine : XFZ

- 2 Cylinder head cover (A) Front cyl. head - (B) Rear cyl. head



B1DP08UD

- 3 Bearing caps housing (A) Front cyl. head - (B) Rear cyl. head



B1DP08TD

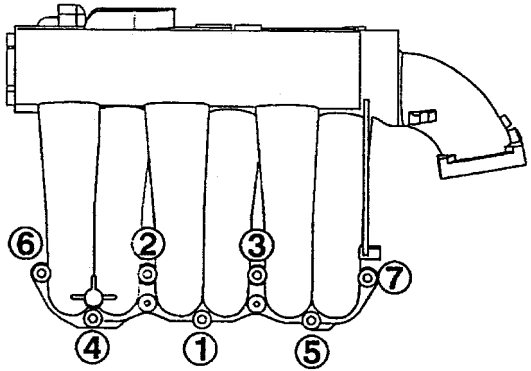
WARNING : Tighten screw by screw in the order shown.

- Pre-tighten	**0.5**	- Pre-tighten	**0.2**
- Tighten	**1 ± 0.1**	- Tighten	**0.8**

SPECIAL FEATURES - TIGHTENING TORQUES (m.daN)	XANTIA - XM - V6

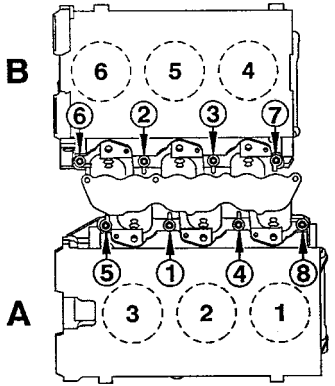
Engine : XFZ

- 5 Air inlet manifold



B1HPOLJC

- 6 Lower manifold (A) Front cyl. head - (B) Rear cyl. head



B1DP097C

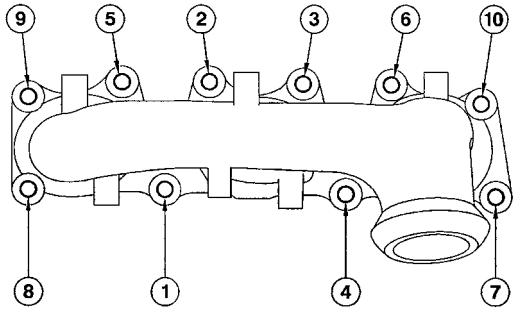
WARNING : Tighten screw by screw in the order shown.

- Pre-tighten	**1 ± 0.1**	- Pre-tighten	**1 ± 0.1**
- Tighten	**2 ± 0.2**	- Tighten	**2.5 ± 0.2**

XANTIA - XM - V6	SPECIAL FEATURES - TIGHTENING TORQUES (m.daN)

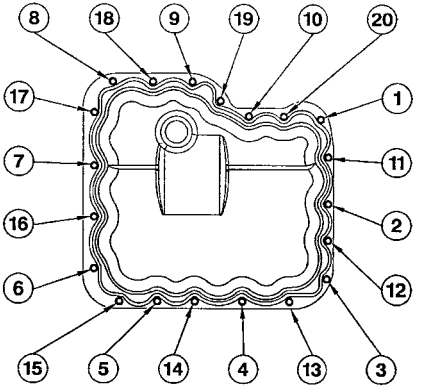
Engine : XFZ

- 7 Exhaust manifold (NEW seal)



B1BP1GXD

- 10 Oil sump



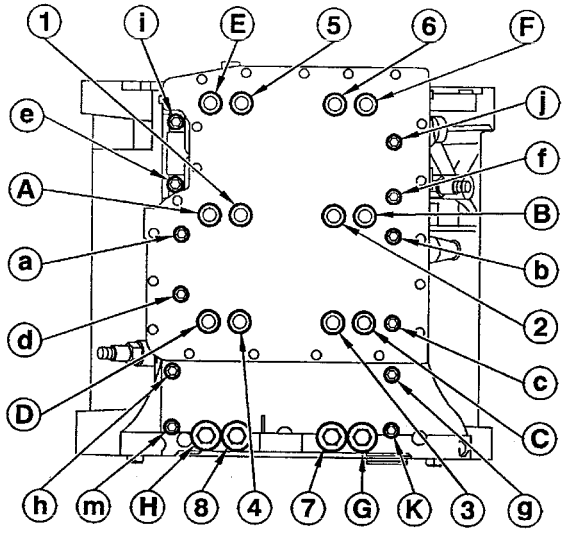
B1BP1GZD

WARNING : Tighten screw by screw in the order shown.

- Pre-tighten	**1 ± 0.1**
- Tighten	**3 ± 0.3**

- Pre-tighten	**0.5 ±**
- Tighten	**0.8 ±**

SPECIAL FEATURES - TIGHTENING TORQUES (m.daN) | XANTIA - XM - V6



B1BP1GYD

Engine : XFZ

- 8 Crankshaft bearing

- Clean the threads of the screws with a brush.
- Refit the screws with a coating of grease (MOLYKOTE G RAPID PLUS).
- Check that the 8 centring pins are in place.

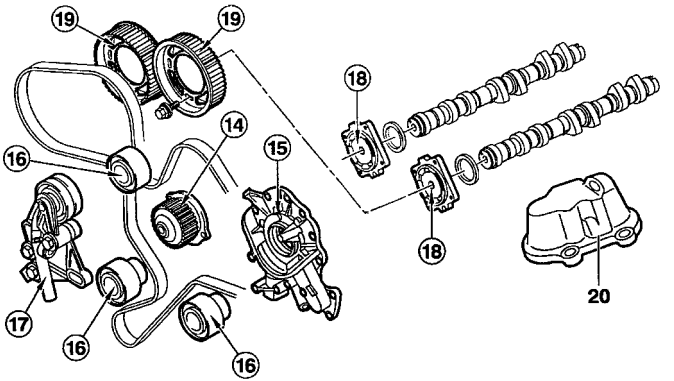
Maximum length under the heads of the screws :

- M11 = 131.5 mm.

- M8 = 119 mm.

- Pre-tighten the M11 screws to **3 m.daN ± 0,3** (1 to 8).
- Pre-tighten the M8 screws to **1 m.daN ± 0,1** (A to H).
- Tighten the M6 screws to **1 m.daN ± 0,1** (a to m).
- Slacken the M11 and M8 screws (screw by screw).
- Tighten the M11 screws to **3 m.daN ± 0,3** (1 to 8).
- Tighten the M8 screws to **1 m.daN ± 0,1** (A to H).

XANTIA - XM - V6	SPECIAL FEATURES - TIGHTENING TORQUES (m.daN)



B1BP1HBD

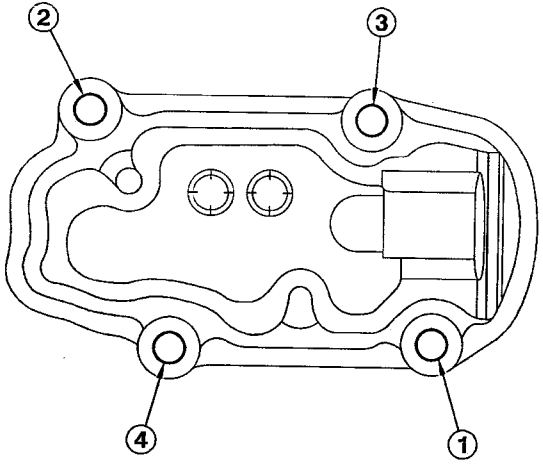
Engine : XFZ

(14)	Water pump	
	- Pre-tighten	**0.5**
	- Tightening	**0.8**
(15)	Oil pump	
	- Pre-tighten	**0.5**
	- Tightening	**0.8**
(16)	Guide roller	**8 ± 0.8**
(17)	Tensioner roller	**8 ± 0.8**
(18)	Camshaft hubs	
	- Pre-tighten	**2 ± 0.2**
	- Tightening	**57° ± 5°**
(19)	Camshaft pulley	**1 ± 0.1**

SPECIAL FEATURES - TIGHTENING TORQUES (m.daN)	XANTIA - XM - V6

Engine : XFZ

- 20 Oil fumes recovery unit.



B1BP1H1D

WARNING : Tighten screw by screw in the order shown.

- Pre-tighten **0.5 ±**

- Tightening **1 ± 0.1**

DIESEL - All Types	SPECIAL FEATURES - TIGHTENING TORQUES (m.daN)					
Engines : DHX - P8C - RHY - RHZ - RHW - THY						
	CYLINDER HEAD (mm)					
Engine type	**DHX**	**P8C**	**RHY**	**RHZ**	**RHW**	**THY**
Maximum permissible bow	0.07	0.05	0.03			0.05
Gasket surface regrinding	- 0.20		- 0.40			
	TIGHTENING TORQUES (m.daN)					
Crankshaft bearing screws : **- Pre-tightening** **- Tightening** **- Angular tightening**	1.5 ± 0.1 - 60° ± 6°		2.5 ± 0.2 - 60 ± 6°			2 ± 0.2 - 60°±6°
Connecting rod screws : **- Pre-tightening** **- Angular tightening**	2 ± 0.2 70° ± 7°					2 ± 0.2 65° ± 6°
Flywheel screw	5 ± 0.5					
Crankshaft pulley screw : **- Pre-tightening** **- Angular tightening**	4 ± 0.4 51° ± 5°	7 ± 0.7 60° ± 6°	4 ± 0.4 51° ± 5°			7 ± 0.7 51° ± 5°
Pulley screw at end of camshaft	4.5 ± 0.4	4.3 ± 0.4				

WARNING : After removing the crankshaft pulley, carry out the following operations : **(Except for THY engines).**

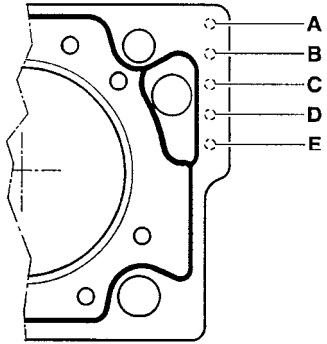
- Clean the thread (Tap 14X150)
- Fit a NEW washer
-Fit a NEW screw.
- Tighten (see table above)

CYLINDER HEAD — XANTIA - XM

Engines : BFZ – BFX - LFX - LFY - RGX - RFV

IDENTIFICATION OF THE CYLINDER HEAD GASKET

Engine types			BFZ	BFX	LFX	LFY	RGX	RFV
Identification marks			(Notch on cylinder head gasket) *					
Suppliers	CURTY	A	1					
		B	0					
		C	0					
		D	0					
		E	0					
	MEILLOR	A	0			0	0	1
		B	1			0	0	0
		C	0			1	0	1
		D	0			0	0	0
		E	0			0	1	0



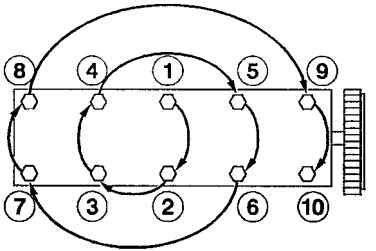
* 0 = Without notch
1 = One notch

B1BP004C

XANTIA - XM	CYLINDER HEAD (continued)

Engines : BFZ – BFX - LFX - LFY - RGX - RFV

Cylinder head tightening (m.daN)



B1DP05BC

BFZ – BFX - LFX – LFY

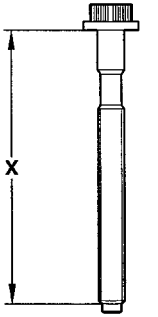
- Pre-tightening	**6**
- Loosening	**YES**
- Tightening	**2**
- Angular tightening	**300°**

RGX – RFV

- Pre-tightening	**3.5**
- Loosening	**NO**
- Tightening	**7**
- Angular tightening	**160°**

Cylinder head bolts

Note : Oil the threads and under the heads of the cylinder head bolts. (Use engine oil or Molykote G Rapid Plus).



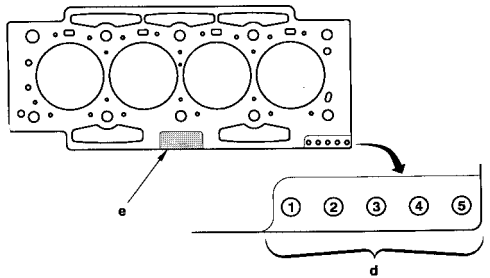
B1DP13PC

X = MAXIMUM reusable length

BFZ - BFX LFX	LFY	RGX	RFV
171.5 mm	160.5 mm	122 mm	112 mm

CYLINDER HEAD			SYNERGIE
Engine : RFN			
Identification of the cylinder head gasket			
	Nominal dimension	Repair dimension	
Marking zone "d"	4 - 5	2 - 4 - 5	
Marking zone "e"		R1	R2
Gasket thickness (mm)	0.8	1.1	1.4
Supplier	MEILLOR		

Multilayer metallic gasket

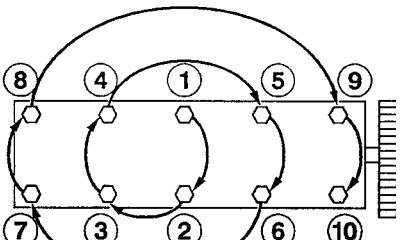


B1DP183D

SYNERGIE	CYLINDER HEAD (continued)

Engine : RFN

Cylinder head tightening (m.daN)

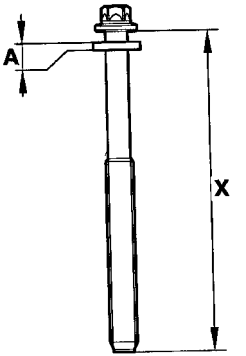


B1DP05BC

RFN	
Pre-tightening	**1.5 ± 0.1**
Tightening	**5 ± 0.1**
Loosening	**360° ± 2°**
Tightening	**2 ± 0.75**
Angular tightening	**285° ± 5°**

Note : Oil the threads and under the heads of the cylinder head bolts. (Use engine oil or Molykote G Rapid Plus).

Cylinder head bolts



B1DP16FC

A = Washer thickness : **4 ± 0.2 mm**.
X = Length under heads of new bolts = **144.5 ± 0.5 mm**.

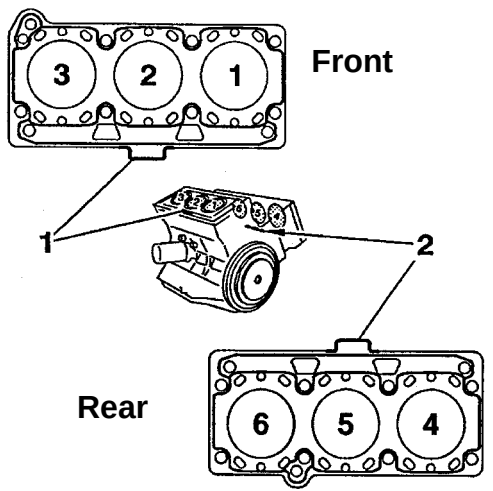
X = MAXIMUM reusable length
RFN
X = 147 mm

CYLINDER HEAD	XANTIA - XM

Engine : XFZ

IDENTIFICATION OF THE CYLINDER HEAD GASKET

Supplier	Thickness (mm)	Ident. marks (1) and (2)
ERLING	1.45 ± 0.04	Centre tab

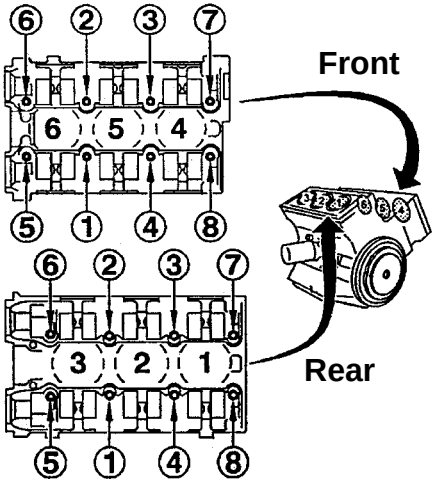


B1DP09TC

XANTIA - XM	CYLINDER HEAD (continued)

Engine : XFZ

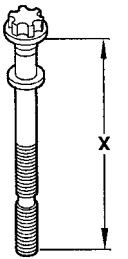
Cylinder head tightening (m.daN)



- Pre-tighten	**2**
- Loosen	**YES**
- Tightening	**1.5**
- Angular tightening	**225°**

B1DP09UC | **B1DP09VC**

Cylinder head bolt



Note : Oil the threads and under the heads of the cylinder head bolts. (Use engine oil or Molykote G Rapid Plus).

X = MAXIMUM reusable length
XFZ
149.5 mm

CYLINDER HEAD — XANTIA

Engine : DHX

IDENTIFICATION OF THE CYLINDER HEAD GASKET

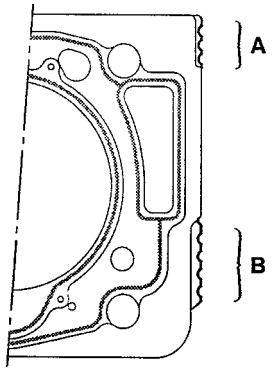
Engine type	Piston stand-proud (mm)	Thickness (mm) ± 0.06	Marking (B)
DHX	0.56 to 0.67	1.36	
	0.68 to 0.71	1.40	
	0.72 to 0.75	1.44	
	0.76 to 0.79	1.48	
	0.80 to 0.83	1.52	

(A) = Engine identification.

(B) = Thickness identification.

B1BP10TC

DHX



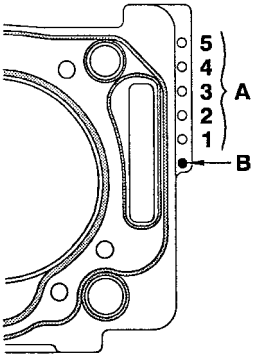
Engine	Ident. (A)	Ident. (B)
DHX	3 notches	1 to 5 notches

XM	CYLINDER HEAD (continued)

Engine : P8C

IDENTIFICATION OF THE CYLINDER HEAD GASKET

Engine type	Piston stand-proud (mm)	Thickness (mm)	Position of hole(s)	Ident.
P8C	0.65 to 0.76	1.52	B - A1	(A) and (B)
	0.77 to 0.81	1.57	B - A2	
	0.82 to 0.86	1.62	B - A3	
	0.87 to 0.91	1.67	B - A4	
	0.92 to 0.96	1.72	B - A5	
	Reconditioning		B - A1 - A5	



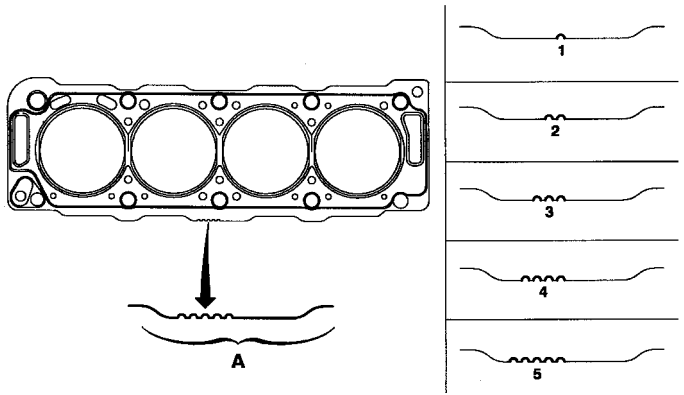
B1BP1DTC

CYLINDER HEAD — XANTIA - SYNERGIE

Engine : RHZ - RHY

IDENTIFICATION OF THE CYLINDER HEAD GASKET

Engine type	Piston stand-proud (mm)	Thickness (mm)	No. of notches at A
RHZ RHY	0.47 to 0.605	1.30 ± 0.06	1
	0.605 to 0.655	1.35 ± 0.06	2
	0.655 to 0.705	1.40 ± 0.06	3
	0.705 to 0.755	1.45 ± 0.06	4
	0.755 to 0.83	1.50 ± 0.06	5

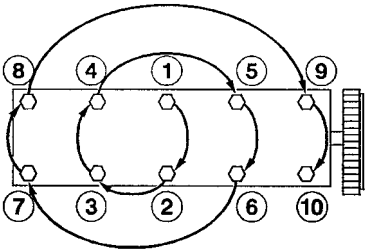


B1DP15AD

XANTIA - XM - SYNERGIE	CYLINDER HEAD

Engines : DHX - RHZ - RHY - P8C

Cylinder head tightening (m.daN)



P8C

- Pre-tightening	**2**
- Tightening	**6**
- Angular tightening	**180°**

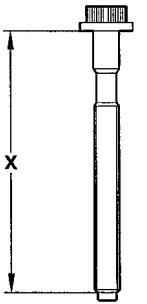
DHX - RHZ - RHY

- Pre-tightening	**2**
- Tightening	**6**
- Angular tightening	**220°**

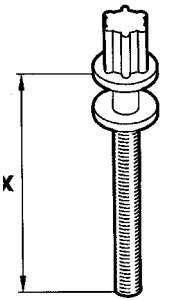
B1DP05BC | B1DP13PC | B1DP15EC

Cylinder head bolts

DHX - P8C



RHZ - RHY



Note : Oil the threads and under the heads of the cylinder head bolts. (Use engine oil or Molykote G Rapid Plus).

X = MAXIMUM reusable length

DHX	P8C	RHZ - RHY
150.5 mm	**151.5 mm**	**133.3 mm**

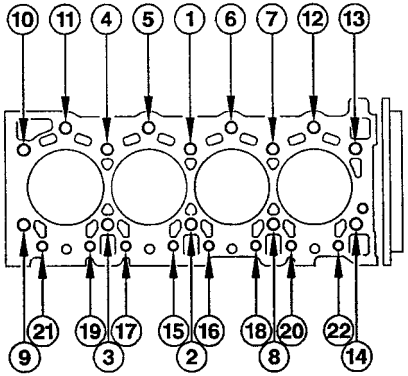
CYLINDER HEAD

XM

Engine : THY

Identification of the cylinder head gasket

Engine type	Thickness (mm)	Ident.
THY	1.6	None



Cylinder head tightening (m.daN)

Pre-tightening the bolts :

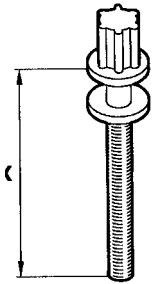
- **1 à 14** (Bolt Ø 12) **5**
- **15 à 22** (Bolt Ø 10) **3.5**

Angular tightening :

- **1 à 22** (Bolt Ø 12 and 10) **120° ± 5°**

B1DP03XC

Cylinder head bolts



Note : Oil the threads and under the heads of the cylinder head bolts. (Use engine oil or Molykote G Rapid Plus).

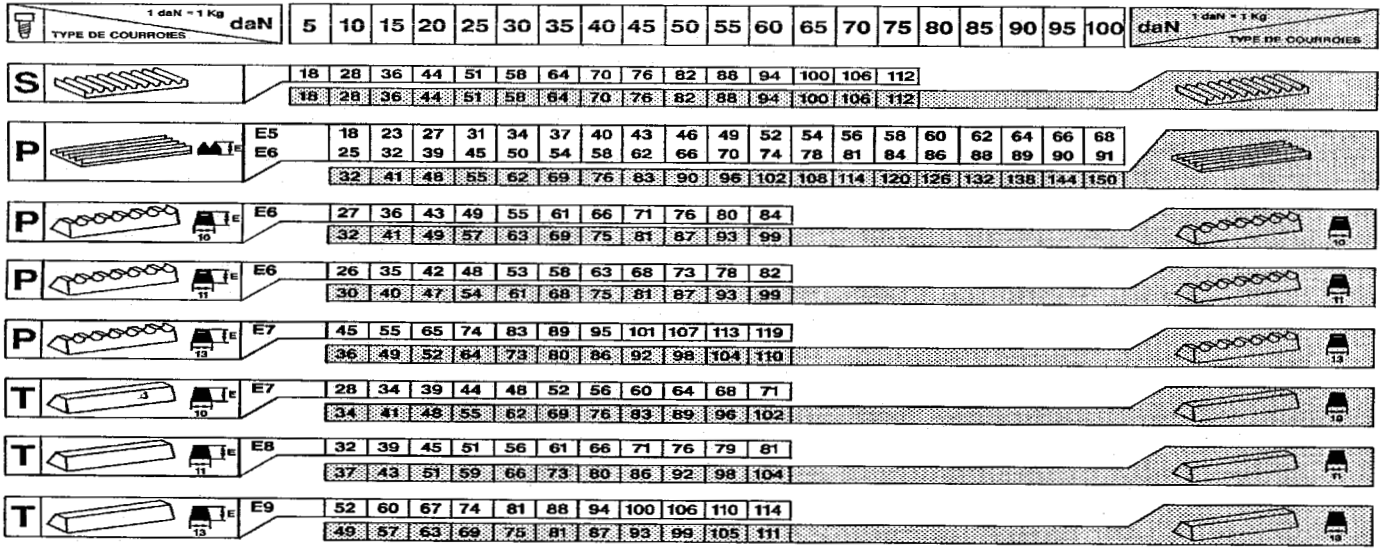
B1DP15EC

X = MAXIMUM reusable length

Bolt Ø 12	Bolt Ø 10
153.5 mm	162.5 mm

ALL TYPES — BELT TENSION/SEEM UNITS CORRESPONDENCE TABLE

4099-T (C.TRONIC.105) ← Tools → **4122-T** (C.TRONIC.105.5)



B1EP135D

AUXILIARY EQUIPMENT DRIVE BELT | ALL TYPES

Engines : All Types Petrol and Diesel

TOOL

- Belt tension measuring instrument : **4122 - T.** (C.TRONIC 105.5)

- **WARNING : If using tool 4099-T** (C.TRONIC 105) refer to the correspondence table on page 62.

ESSENTIAL

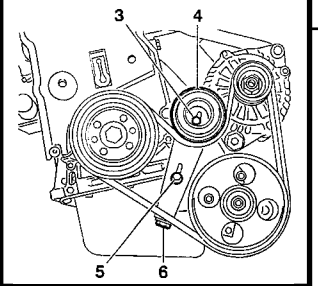
- Before refitting the auxiliary equipment drive belt, check that :

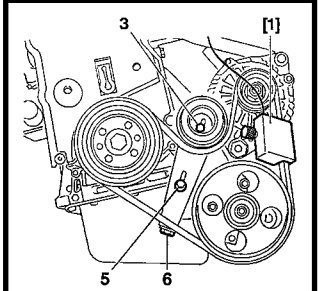
1) The roller(s) rotate freely (no play or stiffness)

2) The belt is correctly engaged in the grooves of the various pulleys.

XANTIA - XM	AUXILIARY EQUIPMENT DRIVE BELT

Engines : BFZ - LFX - LFY - RFV - RGX





Without air conditioning

[1] Belt tension measuring instrument : **4122-T**

- (3) and **(5)** Roller support fixing screws.

- (6) Tensioning screw.

- Tighten the belt, by loosening the screw **(6)** to : In **SEEM units**

BFZ-LFX	LFY	RFV-RGX
100 ± 10	120 ± 10	100 ± 10

- Tighten the screws **(3)** and **(5)**.
- Rotate the crankshaft by **4 turns** (direction of rotation).
- Loosen the screws (3) and **(5)**.
- Tension the belt, by slackening the screws **(6)** to : In **SEEM units**.

BFZ-LFX	LFY	RFV-RGX
115 ± 5	120 ± 10	105 ± 10

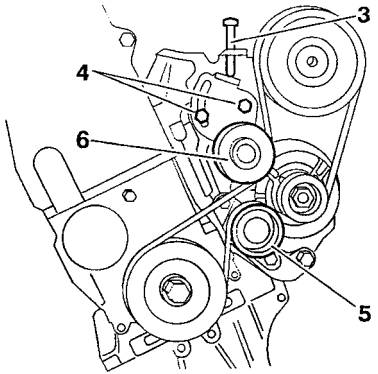
- Tighten the screws **(3)** and **(5)** to **2 m.daN.**

B1BP00HC | B1BP00IC

AUXILIARY EQUIPMENT DRIVE BELT

Engines : BFZ - LFX - LFY - RFV - RGX (Continued)

With air conditioning



B1EP05FC

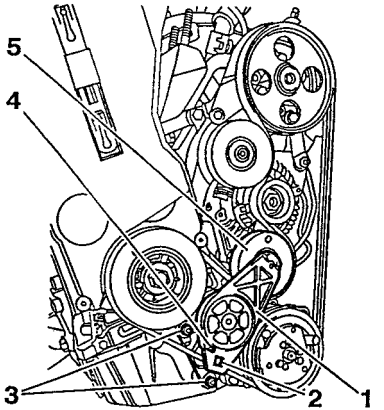
- Loosen :
- The screws **(4)** of the tensioner roller (**13 mm** angle spanner).
- The screw **(3)**.

- Tension the belt using the screw **(3)** to obtain :
- New belt : **120 SEEM units**.
- Reused belt : **90 SEEM units**.

- Tighten the screws **(4)** to **2 m.daN**.

- Rotate the crankshaft by **4 turns** (direction of rotation).

- Adjust the belt tension (if necessary).



B1BP1HJC

With air conditioning

- Fit the drive belt.

- The tensioner roller **(1)**.

- Tighten the screws **(3)** to **2 m.daN**.

- Turn the tensioner roller **(1)** using the tool (**9.52 mm square drive (3/8)**) at **(2)**, in order to remove the tool or locking peg **(Ø 4 mm)** at **(4)**.

- Slowly release the tensioner roller **(1)** so that the roller **(5)** presses against the belt

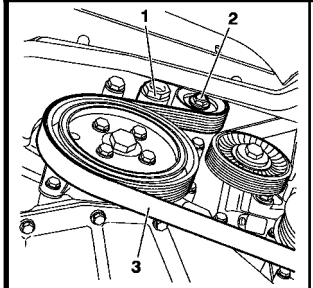
AUXILIARY EQUIPMENT DRIVE BELT

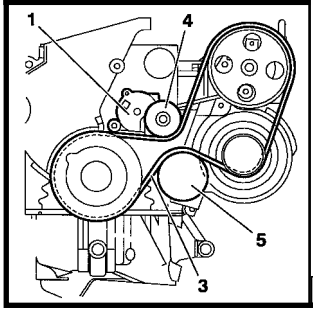
SYNERGIE

Without air conditioning

Engine : RFN

With air conditioning





Tools

[1] Plyers for removing plastic pegs **7504-T**

Remove the belt.

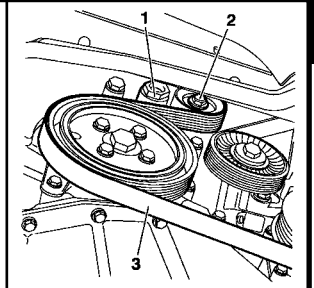
- Detension the belt **(3)** by turning the screw **(2)** of the tensioner roller **(1)** *(anti-clockwise).*

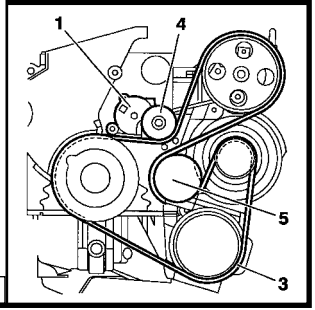
- The screw **(2)** ***(WARNING** : not left hand screw).*
- Remove the belt **(3)**, while keeping the tensioner roller **(1)** tight.

Refit the belt.

- Refit the belt **(3)**, while keeping the tensioner roller **(1)** tight.
- Release the tensioner roller **(1)**.

B1BP23PC **B1BP23QC**



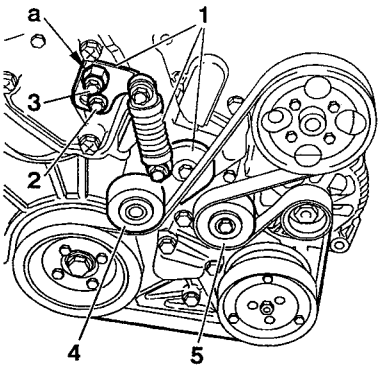


B1BP23PC **B1BP23RC**

XANTIA - XM	AUXILIARY EQUIPMENT DRIVE BELT

Engine : XFZ

With air conditioning



B1BP1EXC

Removal :

- Release the bolt **(3)**.
- Keep the dynamic tensioner **(1)** tensioned by holding the hexagonal fixture «a».
- Release the shoulder of the screw **(2)** from the oblong hole of the dynamic tensioner.
- Release the dynamic tensioner **(1)** using the hexagonal fixture **«a»**.
- Remove the belt.

Refitting :

- Locate the dynamic tensioner **(1)** in its operating position using the hexagonal fixture **«a»**.

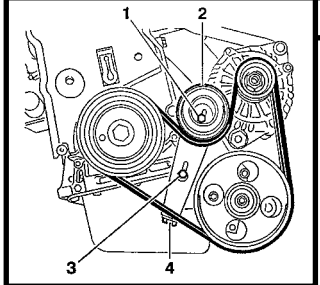
(The tensioner **(1)** will automatically tension it).

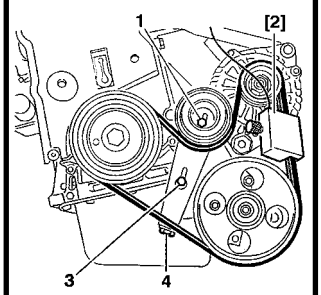
- Tighten the screws **(2)** and **(3)** to **2.5 m.daN**.

AUXILIARY EQUIPMENT DRIVE BELT

XANTIA - XM

Engines : DHX - P8C





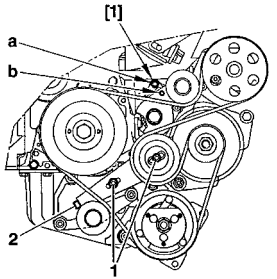
Without air conditioning

[2] Belt tension measuring instrument **4122-T**

- Tighten the belt, by loosening the screw **(4)** to obtain:
- **115 ± 10 SEEM units.**
- Tighten the screws **(1)** and **(3)**.
- Rotate the crankshaft by **4 turns** (Direction of rotation).
- Loosen the screws **(1)** and **(3)**.
- Tighten the belt to :
- **115 ± 10 SEEM units** (if necessary).
- Tighten the screws **(1)** and **(3)** to **2 m.daN.**

Engines : DHX

With air conditioning



- Loosen the screws **(1)**.

- Tighten or loosen the screw **(2)** until holes **«a»** and **«b»** are superimposed.

- Locate the peg **[1]** : (in the hole **«a»**).

DHX peg **7019-T.**

- Tighten the screw **(2)** until it stops..

- Loosen the screw **(2)**, so the peg **[1]** can be removed.

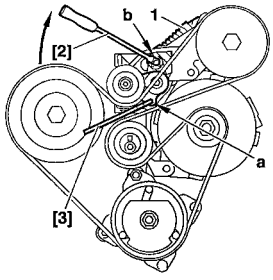
- Tighten the screws **(1)** to **2 m.daN**.

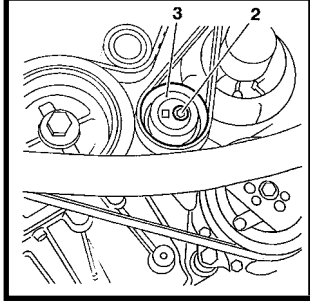
B1BP1HHC

AUXILIARY EQUIPMENT DRIVE BELT

XM

Engines : P8C





With air conditioning

- Engage the square drive tool **[2] (9.52 mm - 3/8)**, in its location in the tensioner arm **(b)**.
- Compress the damper **(1)** using the tool **[2]**.
- Peg the damper **(1)** at **«a»** using the tool **[3] 7019- T**.

(Tensioner in locking position).

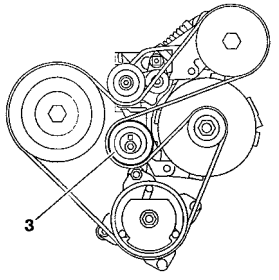
- Remove the tool **[2]** and loosen the screw **(2)** of the roller **(3)**.
- Position the belt on :

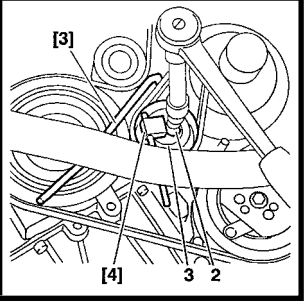
The crankshaft, the tensioner roller, the high pressure pump, the eccentric roller, the air conditioning compressor.

- Tighten the belt, roller **(3)** tool **[4] 5711- T.E**.

NOTE : Tighten the screw **(2)** of the roller **(3)** when the tool **[3]** slides freely into its pegging location.

- Tighten the screw **(2)** to **5 m.daN**.

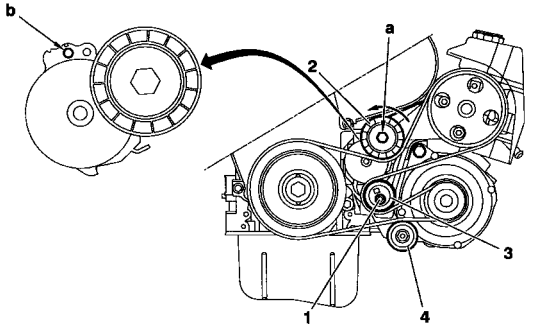




B1BP1HFC | B1BP1HEC | B1BP1HDC | B1BP1HCC

XANTIA - SYNERGIE | AUXILIARY EQUIPMENT DRIVE BELT

Engine : RHY - RHZ



Without air conditioning

Tools

[1] Belt tension adjusting square	: **(-).0188 J2**
[2] Ø 4 mm peg	: **(-).0188.Q1**
[3] Ø 2 mm peg	: **(-).0188.Q2**
[4] Dynamic tensioner compression lever	: **(-).0188.Z**

Removal.
Re-use of belt

WARNING : Mark the direction the belt was fiited in case of re-use of the same belt.

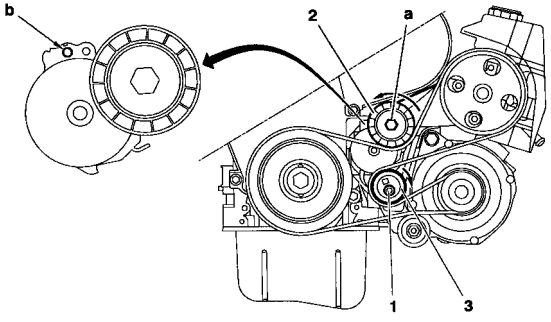
- Compress the tensioner roller **(2)** by action at **«a»** (in anti-clockwise direction), tool **[4]**.
- Keep the tensioner roller **(2)** compressed and remove the belt.

No re-use of belt.
- Compress the tensioner roller **(2)** by action at **«a»** (in anti-clockwise direction), tool **[4]**.
- Peg using tool **[2]**, at **«b»**.
- Hold the tensioner roller **(2)** compress and remove the belt.
- Loosen the screw **(1)**.

B1BP1YKD

AUXILIARY EQUIPMENT DRIVE BELT

Engine : RHY - RHZ



Without air conditioning (continued)

Refit.
Re-used belt.

- Compress the tensioner roller **(2)** by action at **«a»** (in anti-clockwise direction), tool **[4]**.
- Refit the belt.

WARNING : Respect the direction belt was fitted.

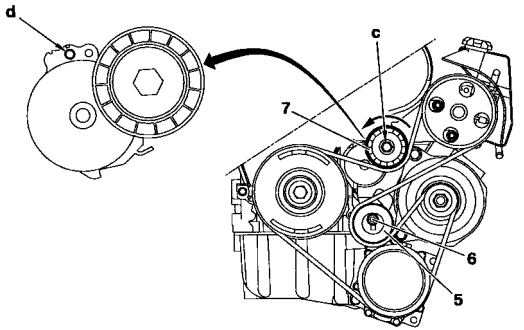
- Remove the tool **[4].**

New belt.

- Refit the belt.
- Turn the eccentric roller **(3)**, tool **[1]** (clockwise) to free the tool **[2]** from its pegging at **«b»**.
- Hold the eccentric roller **(3)**, tool **[1]**, and tighten the screw **(1)** to **4.3 m.daN**.
- Remove the tool **[2]**.
- Rotate the crankshaft **4 times** in the direction of rotation.
- Check that it is possible to peg at **«b»**, tool **[3]**.
- If not possible to peg, restart the adjustment.

B1BP1YMD

Engine : RHY - RHZ



With air conditioning

Tools

[1] Belt tension adjusting square	: **(-).0188 J2**
[2] Ø 4 mm peg	: **(-).0188.Q1**
[3] Ø 2 mm peg	: **(-).0188.Q2**
[4] Dynamic tensioner compression lever	: **(-).0188.Z**

Remove

Re-use of belt

WARNING : Mark the direction the belt was fitted in case of re-use of the same belt.

- Compress the tensioner roller **(7)** by moving it at **«c»** (in anti-clockwise direction), tool **[4]**.
- Hold the tensioner roller **(7)** compressed and remove the belt.

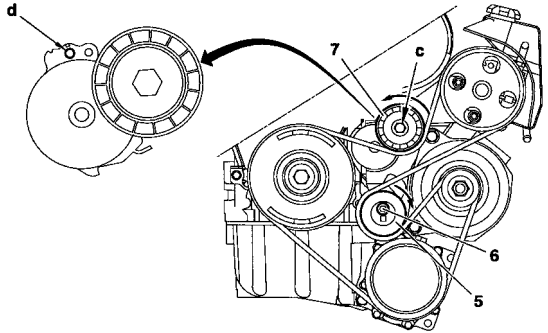
No re-use of belt.

- Compress the tensioner roller **(7)** by moving it at **«c»** (in anti-clockwise direction), tool **[4]**.
- Peg using tool **[2]**, at **«d»**.
- Loosen the screw **(6)**.
- Bring the eccentric roller **(5)** towards the rear.
- Tighten the screw **(6)** by hand.
- Remove the belt.

B1BP1YLD

AUXILIARY EQUIPMENT DRIVE BELT | XANTIA - SYNERGIE

Engine : RHY - RHZ



With air conditioning (continued)

Refit.

Re-used belt.
- Compress the tensioner roller **(7)** by action at **«c»** (in anti-clockwise direction), tool **[4]**.
- Refit the belt.

WARNING : Respect the direction belt was fitted.
Remove the tool **[4]**.

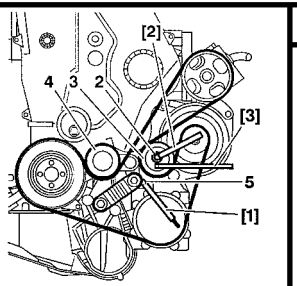
New belt.
- Refit the belt.
- Turn the eccentric roller **(5)**, tool **[1]** (clockwise) to free the tool **[2]** from its pegging at **«d»**.
- Hold the eccentric roller **(5)**, tool **[1]**, and tighten the screw **(6)** to **4.3 m.daN**.
- Remove the tool **[2]**.
- Rotate the crankshaft **4 times** in the direction of rotation.
- Check that it is possible to peg at **«d»**, tool **[3]**.
- If not possible to peg, restart the adjustment.

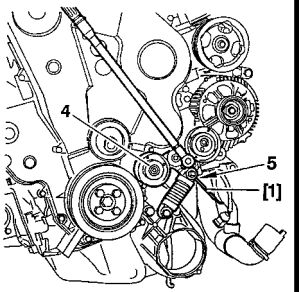
B1BP1YND

XM	AUXILIARY EQUIPMENT DRIVE BELT

Engine : THY

With air conditioning





WORN BELT.

- Loosen the screw **(2)** using tool **[2] 5714-T.R** (**6 mm** across the flats).

- Move the roller **(3)**, using tool **[3] 5714-T.S** (**6 mm** across the flats) until tool **[1] 5714 - T.Q**. **(Ø 4 mm)** fits in the hole **(5)** of the automatic tensioner **(4)**.

NOTE :If there is insufficient roller movement **(3)**, move the tensioner **(4)** using a ratchet wrench **(9.52 mm)** plus extension, so that the tool **[1] (Ø 4 mm)** fits in the hole **(5)**.

- Remove the belt.

BROKEN BELT.

- Move the tensioner **(4)** using a ratchet wrench **(9.52 mm)** plus extension so that the tool **[1] 5714-T.Q (Ø 4 mm)** fits in the hole **(5)**.

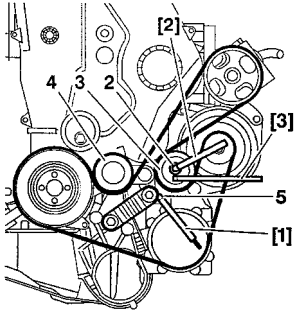
B1BP051C | **B1BP052C**

AUXILIARY EQUIPMENT DRIVE BELT

XM

Engine : THY

With air conditioning (continued)



B1BP051C

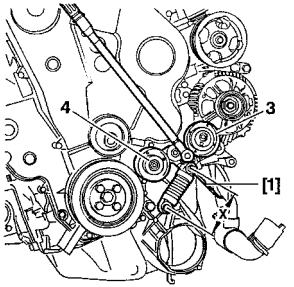
NEW BELT.

- ove the roller **(3)**, with tool **[3] 5714-T.S** (**6 mm** across the flats) until tool **[1] 5714-T.Q (Ø 4 mm)** is released.
- Hold the roller **(3)** in this position and tighten the screw **(2)** using tool **[2]**. Tighten to **3.2 m.daN**.
- Rotate the crankshaft by **5 turns** (Direction of rotation) = **1 turn** of the belt.
- Check the tension by inserting the tool **[1] (Ø 2 mm)** in the hole **(5)** of the automatic tensioner **(4)**.
- If the tension is not correct, repeat the tensioning procedure.

XM	AUXILIARY EQUIPMENT DRIVE BELT

Engine : THY

With air conditioning (continued)



B1BP054C

REUSED BELT

- Continue in the same way as for a new belt.

NOTE : In certain cases the roller **(3)** is in its maximum stop position, and it is not possible to remove the tool **[1] 5714-T.Q (Ø 4 mm)** .

- Move the roller **(4)** using a ratchet wrench **(9.52 mm)** plus extension to release the tool **[1]**.

- Rotate the crankshaft by **5 turns** (Direction of rotation) = **1 turn** of the belt.

Measure distance X :

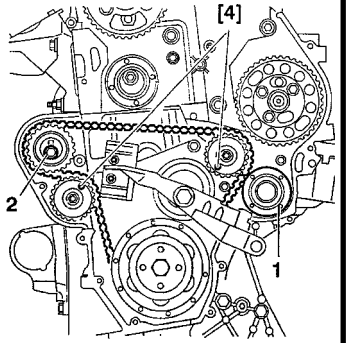
- If measurement **X** is less than **98 mm**, the belt is correctly tensioned.

- If measurement **X** is more than **98 mm**, the belt must be replaced.

BALANCE SHAFT BELT

XM

Engine : THY



B1BP04QC

TOOLS

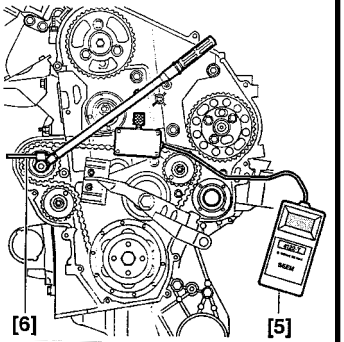
- **[5]** Belt tension measuring instrument	: **4122-T**	
- **[1]** Flywheel locating peg	: **7014-T.J.**	**Tool kit 7004-T**
- **[2]** Camshaft pinion locating peg	: **5711-T.A.**	
- **[3]** Injection pump peg	: **5711-T.B.**	**Tool kit 5711-T**
- **[4]** Balance shaft peg	: **5711-T.D.**	
- **[6]** Tensioning lever	: **5711-T.E.**	

Removal

- The auxiliary equipment and timing belt (See pages **76** to **78** and **115** to **117**).
- Peg the balance shafts using the tools **[4]**.
- Remove the guide roller **(1)**.
- Loosen the screw **(2)** (freeing the roller).
- Remove the balance shaft belt.

XM	BALANCE SHAFT BELT

Engine : THY (continued)



B1BP04RC

Refitting

- Check that the rollers work properly.
- The balance shaft belt.
- Remove the tool **[4]**.
- Fit the tool **[5]** to the belt.
- Pre-adjust the tension using the tool **[6]**. (Placed in the square locating hole of the tensioner roller).

Adjust the tension to :

- New belt **70 SEEM units**.
- Reused belt **51 SEEM units**.
- Tighten the roller to **4.5 m.daN**.

Checking the fitting pre-tensioning.

- Remove and refit the tool **[5]**. (Make any necessary corrections).

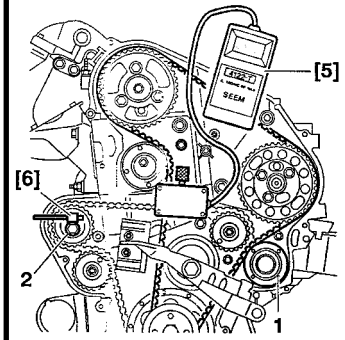
Fit :

- The guide roller **(1)**, tighten to **4.5 m.daN**.
- The timing belt (See pages **115** to **117**).
- Pre-tension, then tension the timing belt (See pages **115** to **117**).

BALANCE SHAFT BELT

DK5 - All Types

Engine : THY (continued)



B1BP04SC

NOTE : Rotate the crankshaft by **10 turns** (if this wasn't carried ort when refitting the timing belt).
- Loosen the screw **(2)** to release the tensioner roller.
- Fit the tool **[5]**.
- Adjust the belt tension using the tool **[6]**. (Inserted in the square hole in the tensioner roller).

Adjust the tension to :
- New belt **31 SEEM units**.
- Reused belt **26 SEEM units**.
- Tighten the tensioner roller to **4.5 m.daN**.

CHECKING THE FITTING TENSION

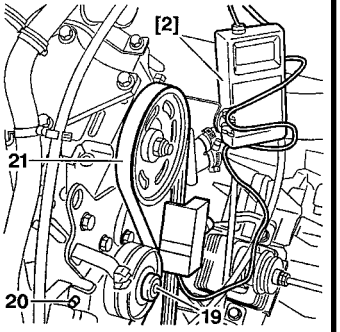
- Remove and refit the tool **[5]**. (Make any necessary corrections).
- Remove the tool **[5]**.

CHECKS

- Rotate the crankshaft by **2 turns**.
- Peg the flywheel, (behind the engine) using the tool **[1]**.
- To check that a tooth hasn't been missed, visually check the pegging of the following components :
- the injection pump.
- the camshaft.
- the balance shafts.
- Remove the tool **[1]**.

XM	WATER PUMP BELT

Engine : THY



B1GP016C

Removal

- Loosen the screw **(19)**.
- Turn the screw **(20)** in the same direction as if tightening in order to slacken the belt.
- Remove the belt **(21)**.

Refitting

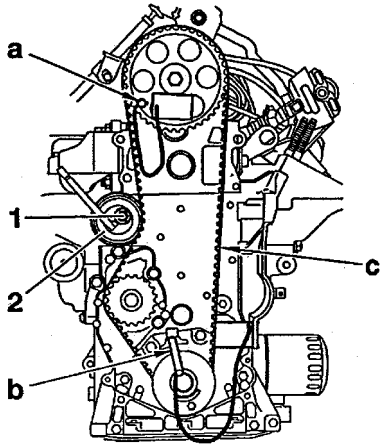
- Refit the belt **(21)**.
- Fit the measuring instrument **[2] 4122-T** to the belt.
- Loosen the screw **(20)** to tighten the belt.
- **NEW belt = 46 SEEM units.**
- **Reused belt = 38 SEEM units.**
- Remove the tool **[2]**.
- Rotate the crankshaft by **3 turns** (direction of rotation).
- Fit the tool **[2]**.
- Check the belt tension:
- **NEW belt = 46 SEEM units.**
- **Reused belt = 38 SEEM units.**
- Retighten the screw **(19)**.
- Remove the tool **[2]**.

CHECKING AND SETTING THE VALVE TIMING								ALL TYPES	
	XU							EW	ES
	5	7			10				9
	JP	JB	JP	JP4	J2TE	J4R		J4	
	1.6 i	1.8 i	1.8 i 16 V		2.0 i Turbo CT	2.0 i 16 V			3.0 i
Engine type	**BFZ**	**LFX**	**LFY → 11/97**	**LFY 11/97 →**	**RGX**	**RFV → 11/97**	**RFV 11/97 →**	**RFN**	**XFZ**
XANTIA	X	X	X	X		X	X		X
XM					X	X	X		X
SYNERGIE								X	
See pages :	85 to 86		87 to 91	82 to 96	85 to 86	87 to 91	92 to 96	97 to 101	102 to 106

ALL TYPES	CHECKING AND SETTING THE VALVE TIMING (continued)					
	XUD	DW			XUD	DK
	9	10			11	5
	BTF	TD	ATED	ATED4	BTE	ATE
	1.9 TD	2.0 HDi		2.0 HDi 16V	2.1 TD	2.5 TD
Engine type	DHX	RHY	RHZ	RHW	P8C	THY
XANTIA	X	X	X			
XM					X	X
SYNERGIE			X	X		
See pages :	107	108 to 112			113 to 114	115 to 117

CHECKING AND SETTING THE VALVE TIMING

Engine : BFZ - LFX - RGX



B1EP07RC

TOOLS

- Belt tension measuring instrument : **4099-T** or **4122-T**
- Camshaft pulley locating peg : **7004-T.G.**
- Crankshaft locating peg : **7014-T.N.**
- Square drive : **7017-T.W.**

} **Tool kit 7004-T**

CHECKING THE VALVE TIMING

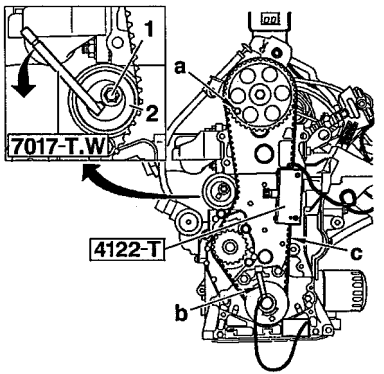
- Remove the protective covers.
- Peg the camshaft pulley at **«a»** using the tool **7004 - T.G**.
- Peg the crankshaft at **«b»** using the tool **7014 - T.N**.

SETTING THE VALVE TIMING

- Check that the pegs can be engaged correctly at **«a»** and **«b»**.
- Fit the belt in the following order : camshaft pulley, crankshaft pinion, water pump pinion, tensioner roller.
- Peg the camshaft pulley at **«a»** and the crankshaft at **«b»**.
- Remove the peg at **«b»** only.
- Bring the tensioner roller **(2)** into contact with the belt.

CHECKING AND SETTING THE VALVE TIMING

Engines : BFZ - LFX - RGX (continued)



B1EP07SC

SETTING THE VALVE TIMING

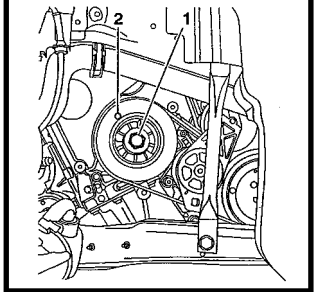
- Fit the tension measuring tool to the middle of the belt strip **«c»**.
- Turn the tensioner roller **(2)** *(anti-clockwise direction)* using the tool **7017-T.W** to obtain the following measurements :
- Engines : **LFZ - LFW : 30 ± 2 SEEM units**.
- Engines : **RGX - RFU : 16 ± 2 SEEM units**.
- Tighten the screw **(1)** to **2m.daN**.
- Remove the tools.
- Rotate the crankshaft by two turns *(do not turn backwards).*
- Check the setting by positioning the pegs at **«a»** and **«b»**.
- Remove the pegs.

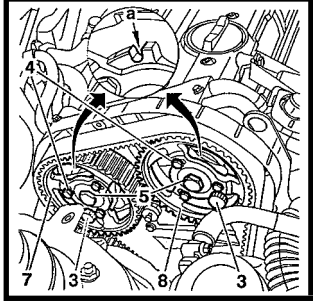
CHECKING THE TENSION

- Rotate the crankshaft by two turns *(do not turn backwards).*
- Peg the camshaft pulley at **«a»**.
- Fit the tension measuring tool on the belt strip at **«c»**.
- The tension measurement should be **44 ± 2 SEEM units**.
  (If the measurement is not correct, repeat the tensioning procedure).
- Remove the tools.

CHECKING AND SETTING THE VALVE TIMING

Engine : LFY - RFV ➔ 11/97





TOOLS

- Belt tension measuring instrument. : **4099-T** or **4122-T**
- Crankshaft locating peg : **7014-T.N.**
- Camshaft pulley locating peg. : **9041-T.Z.** } **Tool kit 7004-T**
- Tensioning tool : **7017-T.W.** }
- Toothed sector for locking the flywheel **XM** : **6012-T**
- Toothed sector for locking the flywheel **XANTIA** : **9044-T**

CHECKING THE SETTING

- Turn the engine by the crankshaft screw **(1)**.
- Ensure that the slot **(a)** for pegging the camshaft hubs can be seen *(Conformity of hubs).*
- Turn the engine by the screw **(1)** and peg the crankshaft at **(2)**.

ESSENTIAL : Check that the crankshaft DAMPERS pulley is in good condition.
If the hub/pulley markings do not line up, the crankshaft pulley must be replaced.

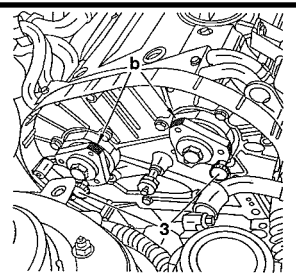
- Peg the camshaft pulleys at **(3)**. *(The locating pegs should slide in easily).*

If this is not the case :

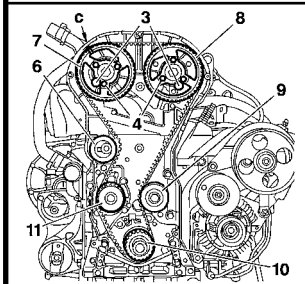
- Check that the crankshaft pegs can be engaged correctly.
-Slacken the six screws **(4)** of pulleys **(7)** and **(8)**.
-Peg the hubs at **(3)**. *(If necessary, turn the camshaft by the screw **(5)**).*
-Tighten the screws **(4)** to **1 m.daN**.
-Remove the pegs.

CHECKING AND SETTING THE VALVE TIMING

Engines : LFY - RFV → 11/97 (continued)



LFY



SETTING THE VALVE TIMING

- Peg the crankshaft at **(2)**.
- Peg the camshaft pulleys at **(3)**.
- Loosen the tensioner roller **(6)**.
- Remove the belt..

PREPARATION

- Loosen the three screws **(4)** of pulleys **(7)** and **(8)**.
- Ensure that the pulleys **(7)** and **(8)** move freely on the hubs.

If this is not the case :

- Remove the pulleys **(7)** and **(8)**.
- Clean the contact faces of pulleys **(7)** and **(8)** and of the camshaft hubs at **(b)**.
- Fit the pulleys **(7)** and **(8)** onto the hubs, without tightening them.

NOTE : Pulleys **(7)** and **(8)** are identical.

(Timing angles, see pages: 118 **(LFY)** - 119 **(RFV)**

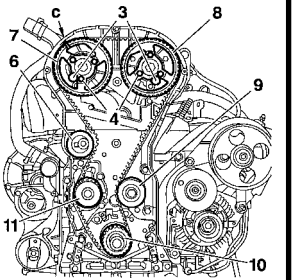
LFY and **RFV** engines = The camshaft hubs are different.

REFITTING THE TIMING BELT

- Fit the belt on the pulley **(7)**.
- Fit a plastic clamping collar **(c)** to hold it in place.
- Wind the belt around the : pulley **(8)**, roller **(9)**, pinion **(10)**, water pump **(11)** and tensioner roller **(6)**.

B1EP08LC | B1EP11UC

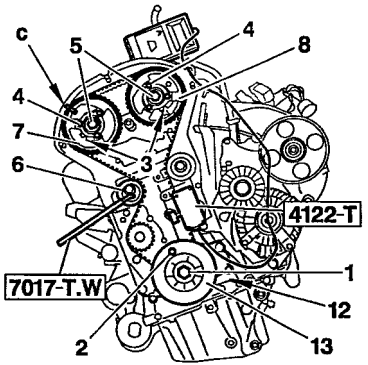
RFV



B1EP08UC

CHECKING AND SETTING THE VALVE TIMING

LFY



B1EP11VC

Engines : LFY - RFV → 11/97 (continued)

PRE-TENSIONING THE TIMING BELT

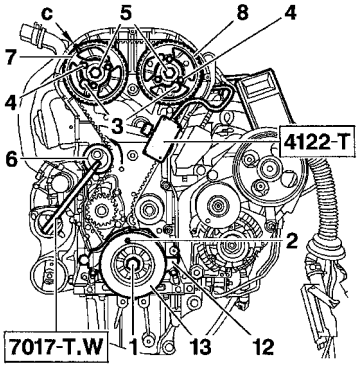
- Fit the tool **4122-T**.
- Turn the roller **(6)** with the tool **7017-T.W**.

Pre-tension to :

Engines	LFY - RFV
New belt	45 SEEM units

- Tighten the roller **(6) to 2 m.daN**, and the **six screws (4)** to **1 m.daN**.
- Remove the too**l 4122-T**, the pegs **(3)** and the plastic clamp at **"c"**.
- Fit the timing cover **(12)**, the pulley **(13)**, the screw **(1)** *(LOCTITE E6 on the threading, tighten to **12 m.daN**).*

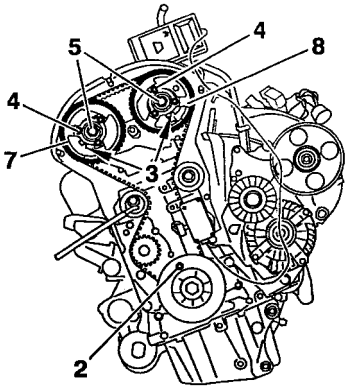
RFV



B1EP08VC

CHECKING AND SETTING THE VALVE TIMING

LFY



B1EP11WC

Engines : LFY - RFV → 11/97 (continued)

TENSIONING THE TIMING BELT

- Rotate :

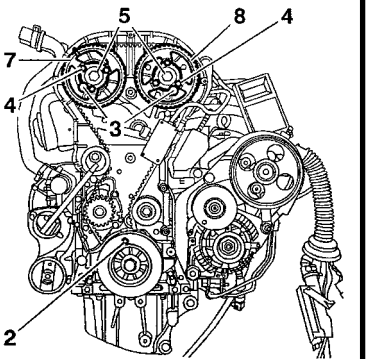
Engines **LFY - RFV** = **2 turns** of the crankshaft.

- Peg the crankshaft at **(2)**.
- Loosen the six screws **(4)** of pulleys **(7)** and **(8)**.
- Peg the hubs at **(3)**.
  *(If necessary, turn the camshaft by the screw **(5)**).*
- Desserrer le galet **(6)**.
- Poser l'ortil **4122-T**.
- Effectuer une tension de :

Engines	LFY - RFV
New belt	26 SEEM units

- Tighten the roller **(6)** to **2 m.daN**.
- Remove the tools.

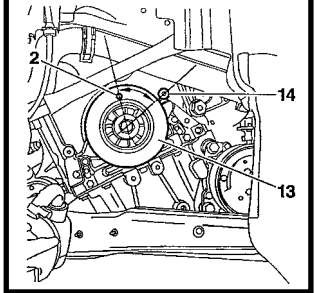
RFV

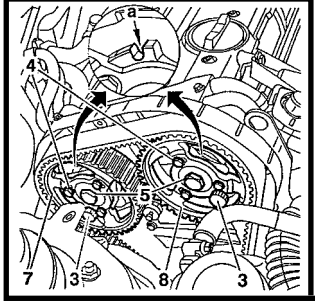


B1EP08WC

CHECKING AND SETTING THE VALVE TIMING

Engines : LFY - RFV ➔ 11/97 (continued)





SETTING THE VALVE TIMING (Cont.)

- Rotate the crankshaft by **2 turns**.
- Peg the crankshaft at **(2)**.
- Loosen the screws **(4)**.
- Peg the hubs of pulleys **(7)** et **(8)** at **(3)**.
  (If necessary, turn the camshaft using the screw **(5)**).
- Tighten the screws **(4)** to **1 m.daN**.
- Remove the pegs.

CHECKING THE BELT TENSION

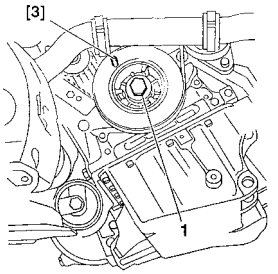
- Rotate the crankshaft by **1/4** turn to align the locating peg hole **(2)** of the pulley **(13)**, with the screw **(14)**.
  (Do not turn backwards).
- The tension measurements must be between:

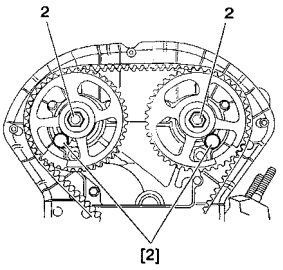
Engines	LFY - RFV
New belt	36 ± 4 SEEM units

If the measurements are different, repeat the tensioning procedure.

CHECKING AND SETTING THE VALVE TIMING

Engine : LFY - RFV 11/97 ➔





TOOLS

- **[1]** Belt tension measuring instrument	: **4122-T**	**Tool kit 7004-T**
- **[2]** Camshaft locating peg	: **9041-T.Z**	
- **[3]** Crankshaft locating peg	: **7014-T.N**	
- **[4]** Camshaft pulley locking peg	: **4200-T.G**	
- **[5]** Tensioning tool	: **7017-T.W**	
- **[6]** Toothed sector for locking the flywheel	: **9044-T**	

CHECKING THE SETTING

- Turn the engine using the crankshaft screw **(1)**.
- Peg the crankshaft using the tool **[3]**.

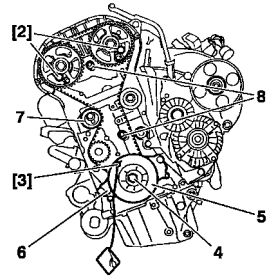
ESSENTIAL : Check that the crankshaft DAMPERS pulley is in good condition. If the hub/pulley markings do not line up, the crankshaft pulley must be replaced.

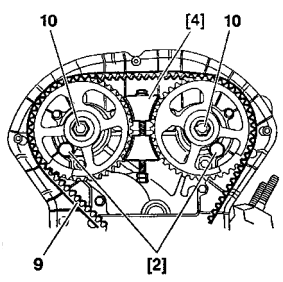
- Peg the camshafts using the tool **[2]**.
  *(The locating pegs **[2]** should slide in easily).*
- If this is not the case, set the timing.

NOTE : Camshaft hubs (See page **120**).

CHECKING AND SETTING THE VALVE TIMING

LFY





Engines : LFY - RFV 11/97 → (continued)

SETTING THE VALVE TIMING.

- Peg the crankshaft using tool **[3]**.
- Peg the camshaft pulleys using tool **[2]**.
- Lock the flywheel using the tool **[6]**.

REMOVE :

- The peg **[3]**.
- The screw **(4)** *(Brush the screw thread).*
- The pulley **(5)**.
- The lower cover **(6)**.

REFIT :

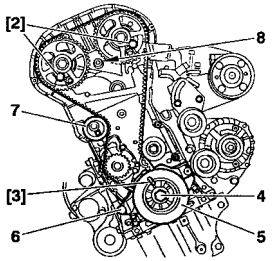
- The pulley **(5)**.
- The screw **(4)** *(Tighten moderately).*
- The peg **[3]**.

REMOVE :

- The tool **[6]**.
- The studs **(8)**.
- Fit the tool **[4]**.
- Loosen the screws **(10)**.
- Remove the tool **[4]**.
- Slacken the tensioner roller **(7)**.
- Remove the belt **(9)**.

B1EP11XC | B1EP120C

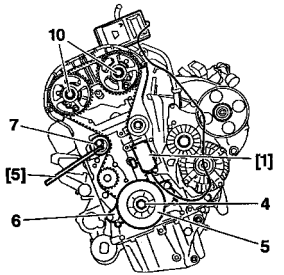
RFV

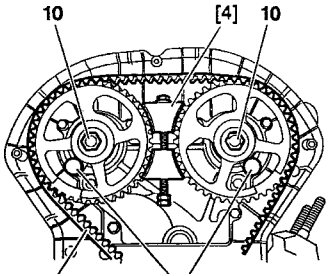


B1EP11ZC

CHECKING AND SETTING THE VALVE TIMING

LFY





Engines : LFY - RFV 11/97 → (continued)

PRETENSIONING THE TIMING BELT.

- Peg the crankshaft using the tool **[3]**.
- Peg the camshaft pulleys using the tool **[2]**.

NOTE : Ensure that the camshaft pulleys rotate freely on the hubs. Clean the contact faces of the pulleys and hubs.

Turn the camshaft pulleys in a clockwise direction to bring them to the end of the slots.

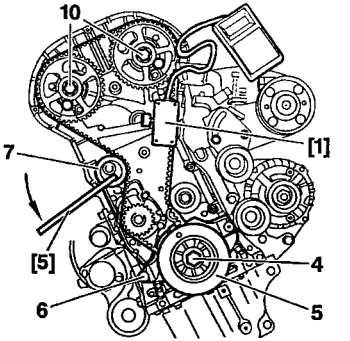
- Fit the belt **(9)**.
- Fit the tool **[1]**.
- Turn the roller **(7)** using the tool **[5]**.
- Pre-tension to : *(Pulleys slackened).*

Engines	LFY - RFV
New belt	55 SEEM units

- Tighten the screws of the roller **(7)** to **2 m.daN**.
- Fit the tool **[4]**.
- Tighten the screws **(10)** to **4 m.daN**.
- Remove the tools.
- Rotate the crankshaft by **six turns** *(normal direction of rotation).*

B1EP11YC | B1EP120C

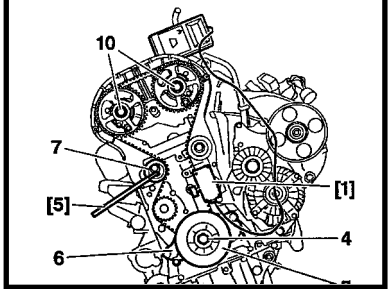
RFV

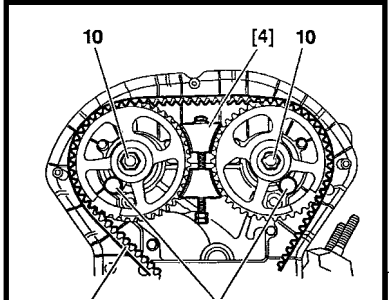


B1EP121C

CHECKING AND SETTING THE VALVE TIMING

LFY





Engines : LFY - RFV 11/97 → (continued)

TENSIONING THE TIMING BELT.

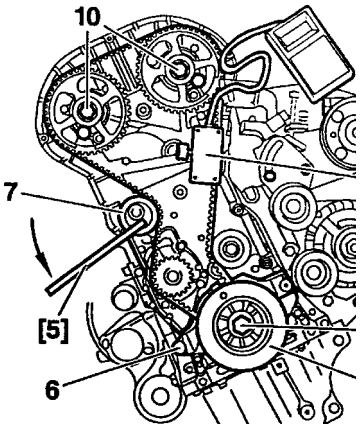
- Peg the crankshaft using the tool **[3]**.
- Peg the camshaft pulleys using the tool **[2]**.

NOTE : If it is not easy to peg the camshaft hubs, loosen the tensioner roller **(7)**, and turn the camshafts using the screw **(10)**.

- Fit the tool **[4]**.
- Loosen the screws **(10)**.
- Remove the tool **[4]**.
- Loosen the tensioner roller **(7)**.
- Fit the tool **[1]** to the belt.
- Turn the roller **(7)** using the tool **[5]**.

B1EP11YC B1EP120C

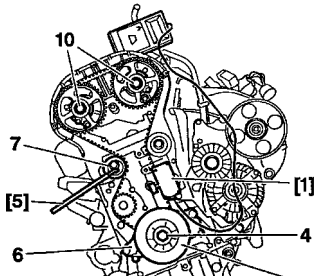
RFV

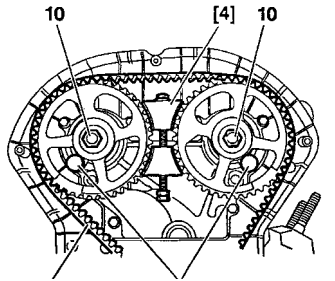


B1EP121C

CHECKING AND SETTING THE VALVE TIMING

LFY





Engines : LFY - RFV 11/97 → (continued)

- Tension to : *(Pulleys slackened).*

Engines	LFY - RFV
New belt	35 SEEM units

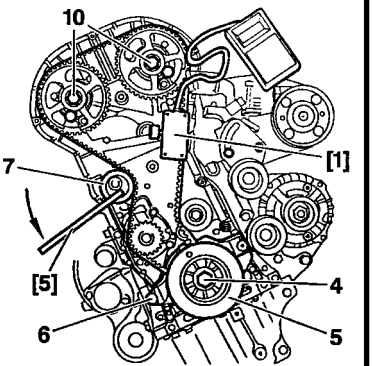
- Tighten the screw of the roller **(7)** to **2 m.daN**.
- Fit the tool **[4]**.
- Tighten the screws **(10)** to **7.5 m.daN**.
- Remove the tools.
- Rotate the crankshaft by two turns *(Normal direction of rotation)*.
- Check the pegging of the crankshaft/camshaft using tools **[2]** and **[3]**.

NOTE : Tools **[2]** and **[3]** should slide in easily.

- Remove the tools.

B1EP11YC | B1EP120C

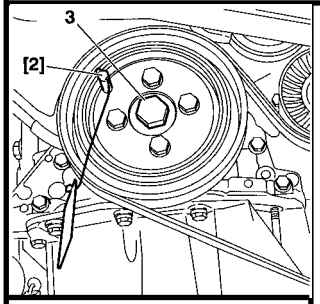
RFV

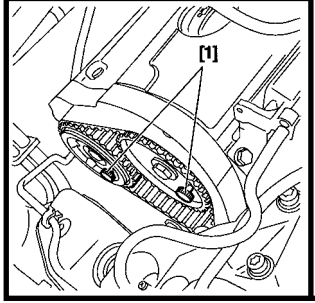


B1EP121C

CHECKING AND SETTING THE VALVE TIMING

Engine : RFN





TOOLS

[1] Camshaft setting pegs	**: (-).0189.B**	
[2] Crankshaft setting peg	**: (-).0189.B**	**Tool kit C.0189.**
[3] Belt locking pin	**: (-).0189.K**	
[4] Angular tightening adaptor	**: 4069-T.**	
[5] Hub immobilising tool	**: 6310-T**	

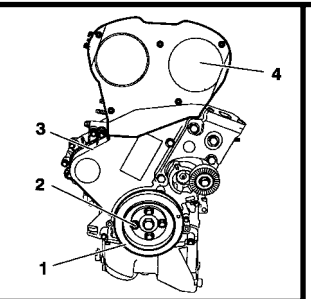
CHECKING THE VALVE TIMING

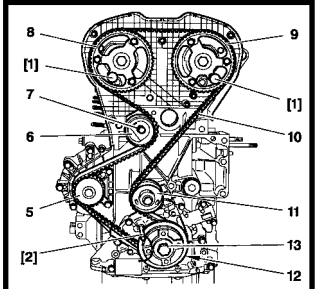
- Turn the engine by the crankshaft pinion screw **(3)** to bring it to pegging position.
- Peg the crankshaft, using tool **[2]**.
- Peg the camshaft pulleys, using tools **[1]**.

NOTE : The pegs **[1]** must go in without effort.

CHECKING AND SETTING THE VALVE TIMING

Engine : RFN





Checking the valve timing (continued)

WARNING : If the pegs do not engage without effort, restart the fitting and tensioning of the timing belt (see below).

Setting the valve timing

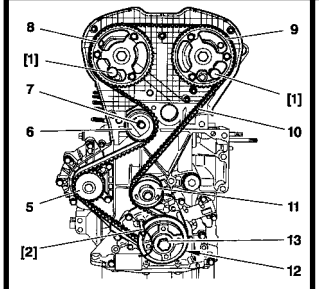
Remove

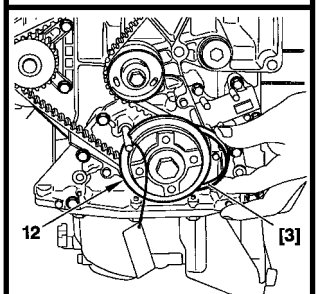
- Remove the screws **(2)**, the pulley **(1)**, upper valve cover **(4)**, lower valve cover **(3)**.
- Turn the engine by the screw **(13)** of the pinion **(12)** to bring it to pegging position.
- Peg the pulleys **(8)** and **(9)** using tools **[1]**.
- Peg the pinion **(12**) using tool **[2]**.
- Loosen the screw **(7)** of the tensioner roller **(6)**.
- Turn the tensioner roller **(6)** *(clockwise).*
- Remove the timing belt **(10)**.

B1BP23XC | **B1EP14JD**

CHECKING AND SETTING THE VALVE TIMING

Engine : RFN





Refit (continued)

- Refit the belt **(10)** on the pinion **(12)**.
- Hold the belt **(10)** with tool **[3]**.
- Position the belt **(10)** in the following order :
- The guide roller **(11)**, the inlet camshaft pinion **(9)**, the exhaust camshaft pinion **(8)**, the water pump **(5)**, the tensioner roller **(6)**.

NOTE : Make sure that the belt **(10)** is as flush as possilble with the outer face of the various pinions and rollers.

- Remove the tools **[3]** and **[1]**.

Timing belt tension

Adjusting the tension

- Turn the roller **(6)** in the direction of the arrow **«b»** ; using an Allen key at **«a»**.
- Position the index **«c»** in its maximum setting at **«d»**.

IMPERATIVE : The index «c» must stand proud of the notch «f» by an angular value of 10°. If it does not, replace the tensioner roller (6) or the timing belt and the tensioner roller (6)

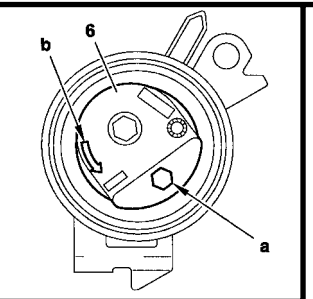
- Bring the index **«c»** to its adjusting position **«f»** by turning the tensioner roller **(6)** in the direction of the arrow **«e»**.

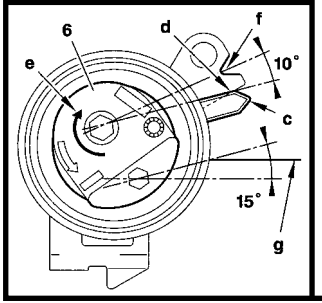
WARNING : The index **«c»** must not stand proud of the notch **«f»** : if it does, restart the timing belt tensioning operation.

IMPERATIVE : The tensioner roller (6) must not turn while its fixing is being tightened up. If it does, recommence the adjusting operation.

CHECKING AND SETTING THE VALVE TIMING

Engine : RFN





Adjusting the tension (continued)

- Tighten the screw **(7)** of the the tensioner roller **(6)** to **2.1 ± 0.2 m.daN**.

IMPERATIVE : The hexagonal drive of the tensioner roller (6) must be at 15° below the level of the cylinder head gasket «g». If not, replace the tensioner roller (6) or the timing belt and the tensioner roller (6).

Refit (continued)

- Remove the tools **[1]** et **[2]**.
-Turn the crankshaft **10 times** in the normal direction of rotation

IMPERATIVE : No pressure or outside action must be brought to bear on the timing belt.

- Peg the inlet camshaft pulley, using the tool **[1]**.

Checks

Timing belt tension

IMPERATIVE : Check the position of the index «c», it should be facing the notch «f». If the position of index «c» is not correct, restart the adjustment of its position.

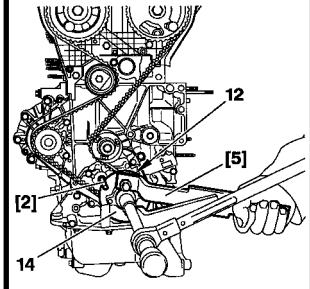
Positioning of the crankshaft

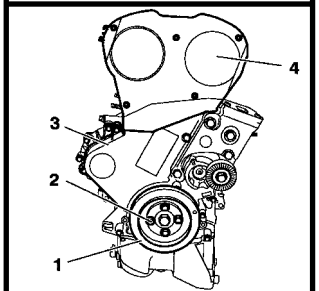
- Fit tool **[2]**.
-As long as it is possible to fit tool **[2]**, continue with the refit operations.

IMPERATIVE : If it is not possible to fit tool [2], reposition the flange (14).

CHECKING AND SETTING THE VALVE TIMING

Engine : RFN





Checks (continued)

Repositioning the flange

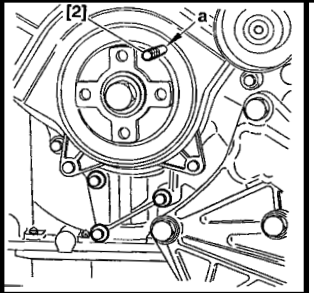
- Immobilise the crankshaft using tool **[5]**.
- Loosen the screw **(13)**.
- Release the pinion **(12)** of the crankshaft.
- Bring the flange **(14)** to the pegging position; using tool **[5]**.
- Fit the tool **[2]**.
- Immobilise the crankshaft using tool **[5]**.
- Tighten screw **(13)** to **4 ± 0.4 m.daN**, then angular tighten **53° ± 4°** with tool **[4]**.
- Remove tools **[1]**, **[2]** and **[5]**.

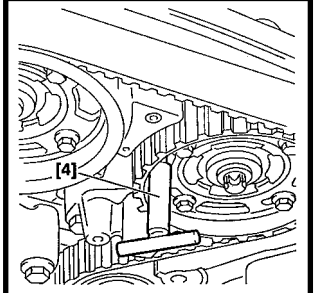
Refit :

- The lower valve cover **(3)**.
- The upper valve cover **(4)**.
- The crankshaft pulley **(1)**.
- The screws **(2)**.
- Pretighten the screws **(2)** to **1.5 m.daN**.
- Tighten the screws **(2)** to **2.1 ± 0.5 m.daN**.

CHECKING AND SETTING THE VALVE TIMING

Engine : XFZ





TOOLS

- **[1]** Belt tension measuring instrument : **4122-T**
- **[2]** Crankshaft locating peg : **(-).0187 A**
- **[3]** Camshaft pulley locating peg : **(-).0187 B**
- **[4]** Timing checking peg : **(-).0187 C.Z.**
- **[5]** Dynamic tensioner calibration shim : **(-).0187 E.Z.**
- **[6]** Camshaft locking lever : **(-).0187 F**
- **[7]** Belt retaining pin : **(-).0187 J.**

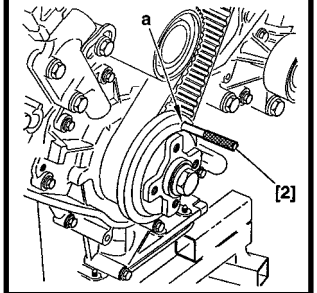
} **Tool kit (-).0187**

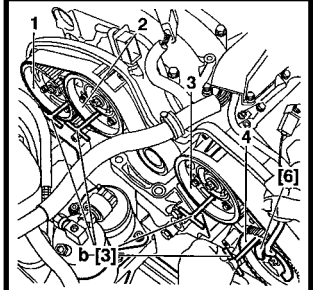
CHECKS

- Rotate the crankshaft by **2 turns** *(clockwise)*.
- Peg the crankshaft at **(a)**, using tool **[2]**.
- Check that the peg **[4]** can be freely engaged in the cylinder heads at the camshaft pulleys at **(b)**.

CHECKING AND SETTING THE VALVE TIMING

Engine : XFZ (continued)





SETTING THE VALVE TIMING

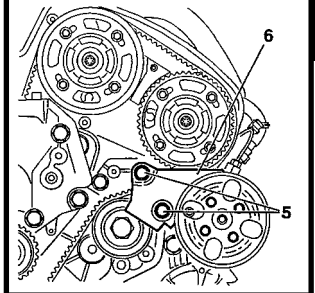
- Peg the crankshaft at **(a)** using tool **[2]**.
- Loosen the camshaft pulley screws.
- Peg the camshaft pulleys at **(b)** using tool **[3]** in the following order :
- Camshaft pulley **(1)**,**(2)**,**(3)** and **(4)**.

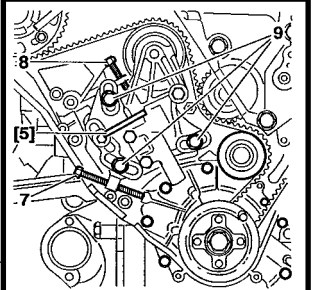
NOTE : If necessary use tool **[6]**.

Preparation

- Remove the screws **(5)** and the plate **(6)**.
- Screw in a **M8x75** screw **(7)** to its stop.
- Fit a **M8x40** screw **(8)**.
- Fit the tool **[5]** by loosening the screw **(7)** if necessary.
- Tighten the screw **(8)** until it locks the tool **[5]**.
- Loosen the screws **(9)**.
- Loosen the screws **(7)** to slacken the belt.
- Mark the direction of fitting of the belt *(if being reused).*
- Remove the belt.

B1EP09CC | B1EP09EC





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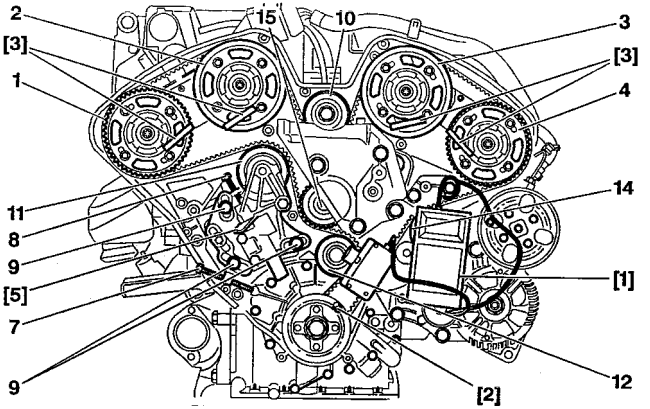
CHECKING AND SETTING THE VALVE TIMING



B1EP09GD

Engine : XFZ (continued)

SETTING THE VALVE TIMING

Refitting the belt.

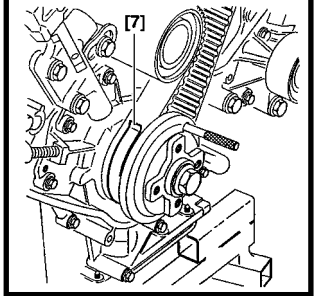
- Check that the rollers **(10)**, **(11)**, **(14)** and **(12)** rotate freely.
- Rotate the camshaft pulleys *(anti-clockwise)* as far as the slots allow.
- Tighten the camshaft pulley screws to **0.5 m.daN**.
- Loosen the camshaft pulley screws by **45°**.
- Tighten the screws **(9)** to **1 m.daN**.
- Loosen the screws **(9)** by **45°**.

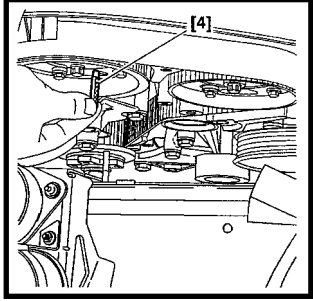
WARNING :Ensure that the belt is fitted in the right direction :
Facing the timing side, it should be possible to read the writing on the belt.

- Put the belt in place in the following order :
- Crankshaft pinion *(hold the belt using the tool **[7]**),* the guide roller **(14)** camshaft pulleys **(4)** and **(3)**, guide roller **(10)**, camshaft pulleys **(2)** and **(1)**, tensioner roller **(11)**, water pump pulley **(15)**, guide roller **(12)**.

CHECKING AND SETTING THE VALVE TIMING

Engine : XFZ (continued)





SETTING THE VALVE TIMING

NOTE : When positioning the belt on the camshaft pulleys, rotate it in an anti-clockwise direction in order to engage the nearest tooth.
The angular displacement of the pulleys must not exceed one tooth.

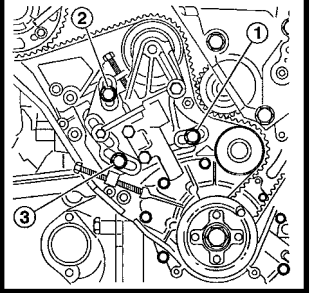
- Lightly tighten the screw **(7)** so that the belt is lightly tensioned.
- Remove the tool **[7]**.
- Fit the tool **[1]**.
- Tighten the belt using the screw **(7)** to obtain a tension of : **83 ± 2 SEEM units = 50 daN**.

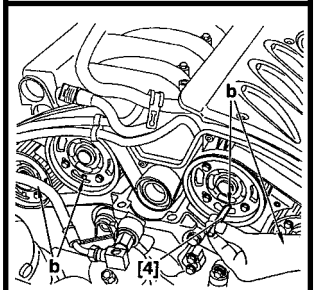
ESSENTIAL : Check that the camshaft pulleys are not against the end of the slots.
(Otherwise, repeat the belt fitting operation).

- Remove the tools.
- Tighten the camshaft pulley screws in the following order: **(1)**, **(2)**, **(3)** and **(4)** Tighten to **1 m.daN**.
- Tighten the screws **(9)** to **2.5 m.daN** in the order indicated.
- Rotate the crankshaft by **2 turns** *(clockwise).* Do not turn backwards.
- Peg the crankshaft using the tool **[2]**.
- Loosen the camshaft pulley screws and the screws **(9)**.

CHECKING AND SETTING THE VALVE TIMING

Engine : XFZ (continued)





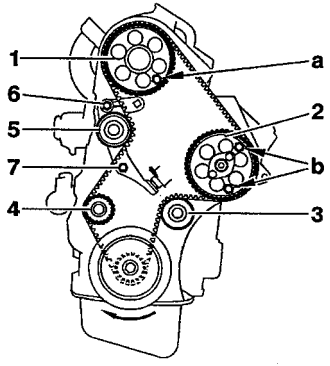
SETTING THE VALVE TIMING

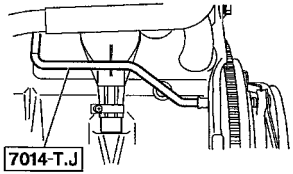
- Remove the screw **(8)**.
- Loosen the screw **(7)** so that the tool **[5]** can move without any play**..**
- Wait for 1 minute *(Damper action).*
- Check that the tool **[5]** can move without any play.
- Remove the tool **[5]**.
- Tighten the screws **(9)** to **2.5 m.daN** *(In the order indicated).*
- Remove the screw **(7)** and the tool **[2]**.
- Rotate the crankshaft by **2 turns** *(clockwise). (Do not turn backwards).*
- Peg the camshafts in the order **4, 3, 2** and **1** as follows :
- Peg **[3] ENGAGES :** Loosen the camshaft pulley screws by **45°**.
- Peg **[3**] **DOES NOT ENGAGE :** Loosen the camshaft pulley screws by **45°** and turn the hub using the tool **[6]** until the peg engages.
- The camshaft pulley screws must not be against the end of the slots.
  (Otherwise, repeat the belt fitting operation).
- Tighten the camshaft pulley screws in the following order : **4, 3, 2** and **1**. Tighten to **1 m.daN**.
- Remove the tools.
- Rotate the engine by **2 turns**.
- Check the timing.

B1EP102C | **B1EP09BC**

CHECKING AND SETTING THE VALVE TIMING

Engines : DHX





TOOLS

- Crankshaft locating peg : **7014-T.J.** or **7014-T.R.**
- Camshaft and injection pump locating peg : **7004-T.G.** **Tool kit 7004-T**

CHECKS

- Peg the crankshaft.
- Peg the pulleys **(1)** and **(2)** at **«a»** and **«b»**.

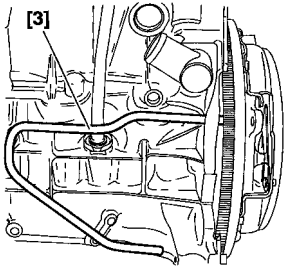
SETTING THE VALVE TIMING.

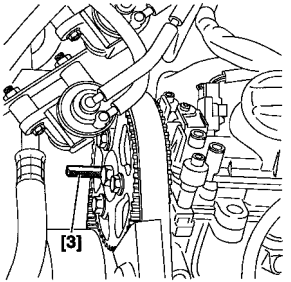
- Peg the crankshaft.
- Peg the pulleys **(1)** at **«a»** and **(2)** at **«b»**.
- Fit the belt in the following order :
  Crankshaft pinion, guide roller **(3)**, injection pump pulley **(2)**, camshaft pulley **(1)**, tensioner roller **(5)**, water pump **(4)**.
- Remove the pegs.
- Free the tensioner roller **(5)** (nut **(6)** and screw **(7)**), retighten the screw **(7)**.
- Rotate the crankshaft by **2 turns**. Do not turn backwards.
- Loosen the tensioner roller **(5)**, allow the tensioner to operate.
- Retighten the screw **(7)** and the nut **(6)**. **Tighten to 1.8 m.daN**.
- Check the setting.

NOTE : The injection pump is removed without changing the valve timing.
*(immobilise the injection pump pulley using the screws **(8x125)** at **«b»**).*

B1EP09KC **B1EP080C**

CHECKING AND SETTING THE VALVE TIMING





Engine : RHY - RHZ

Tools

[1] Belt tension measuring instrument	: **4122-T**
[2] Tension lever	: **(-).188.J2**
[3] Engine flywheel peg	: **(-).0288.D**
[4] Belt compression spring	: **(-).0188.K**
[5] Camshaft pinion peg	: **(-).0188.M**
[6] Engine flywheel lock	: **(-).0188.F**
[7] Set of blocking plugs	: **(-).0188.T**
[8] Crankshaft pulley extractor	: **(-).0188.P**

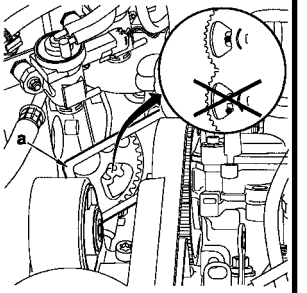
Checking the setting of the valve timing.

Peg :

- The engine flywheel, tool **[3].**
- The camshaft, tool **[5]**.

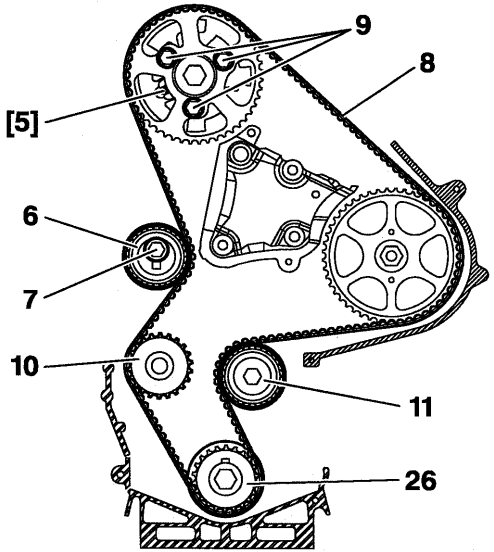
WARNING : Should it be impossible to peg the camshaft, check that the offset between the camshaft pinion hole and the pegging hole is not more than 1 mm, with the help of a mirror « a » and a Ø 7 mm screw.

IMPERATIVE : If pegging is impossible, restart the adjusting.
(See corresponding operation).



B1CP04CC | B1BP1TSC | B1BP1TTC

CHECKING AND SETTING THE VALVE TIMING



Engine : RHY - RHZ

Setting the valve timing.

Peg :

- The engine flywheel, tool **[3]**.
- The camshaft, tool **[5]**.

Loosen :

- The three screws **(9)**.
- The screw **(7)** of the tensioner roller **(6)**.

Remove the timing belt.

Checks.

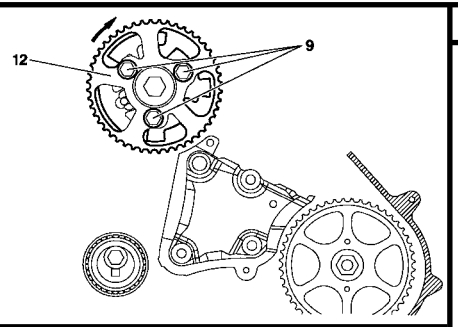
IMPERATIVE : Just before refitting, carry out the checks below :

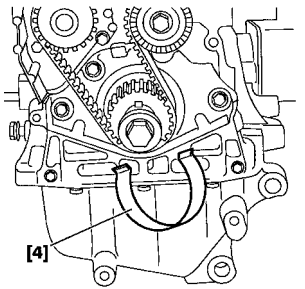
Check that :

- The rollers **(6), (11)** and the water pump **(10)** turn freely *(without play or tightness).*
- There are no traces of oil *(on camshaft or crankshaft).*

B1EP13DD

CHECKING AND SETTING THE VALVE TIMING





Engine : RHY- RHZ

Setting the valve timing (continued).

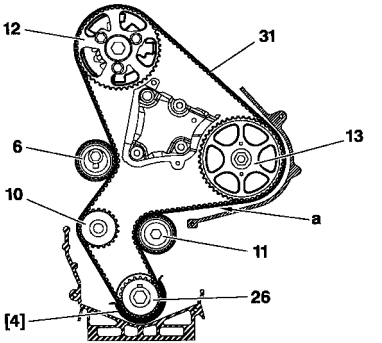
- Retighten screws **(9)** by hand.
- Turn the pinion **(12)** (clockwise) to the bottom of the buttonhole.
- Refit the belt on the crankshaft, in the following order, using the tool **[4]** to keep the belt tight at **«a»**.

- Guide roller **(11)**.
- Fuel high pressure pump pinion **(13)**.
- Camshaft pinion **(12)**.
- Water pump pinion **(10)**.
- Tensioner roller **(6)**.

NOTE : If needed, slightly turn the pinion **(12)** anti-clockwise *(not by more than one tooth).*

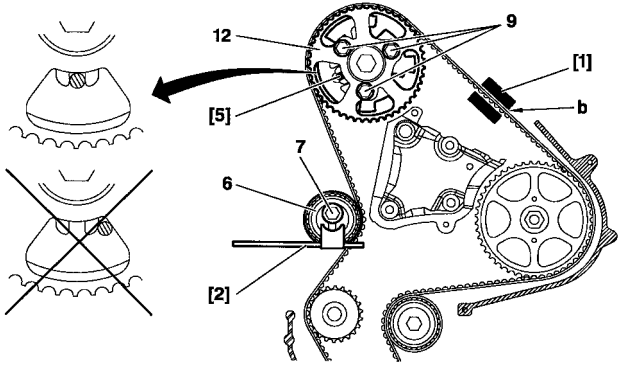
- Remove the tool **[4].**

B1EP13ED | B1EP13FC



B1EP13GD

CHECKING AND SETTING THE VALVE TIMING



Engine : RHY - RHZ

Setting the valve timing (continued).

- Position tool **[1]** on the belt at **«b»**.
- Turn the roller **(6)** *(anti-clockwise)* using tool **[2]** to attain a tension of :

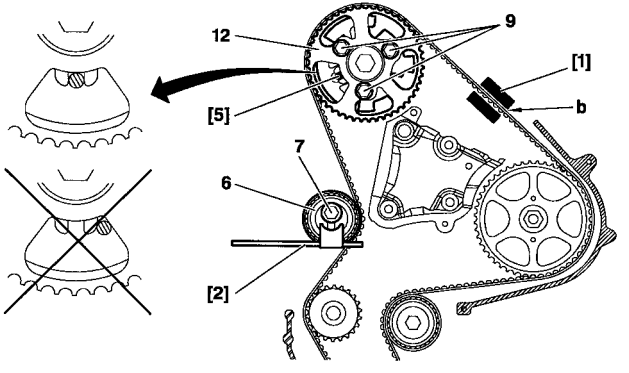
98 ± 2 SEEM units

- Tighten screw **(7)** of the roller **(6)**, tighten to **2.5 m.daN**.
- Remove one screw **(9)** from the pinion **(12)**.
  (to check that the screws are not against the end of the buttonhole).
- Tighten the screws **(9)** to **2 m daN**.
- Remove tools **[1],[2],[3]** and **[5]**.
- Rotate the crankshaft **8 times** *(normal direction of rotation).*
- Fit the tool **[3]**.
- Loosen screws **(9)**.
- Fit tool **[5]**.
- Loosen screw **(7)** *(to free the roller **(6)**).*
- Fit tool **[1]**.
- Turn the roller **(6)** *(anti-clockwise)*, tool **[2]**, to attain a tension of :

54 ± 2 SEEM units .

B1EP13HD

CHECKING AND SETTING THE VALVE TIMING



Engine : RHY - RHZ

Setting the valve timing (continued).

Tighten :
- The screw **(7)** of the roller **(6)** to **2.5 m.daN**.
- The screw **(9)** to **2.m.daN**.
- Remove the tool **[1]**.
- Refit the tool **[1]**.
- Tension value should be : **54 ± 3 SEEM units**.

IMPERATIVE : If value is incorrect, restart the operation

- Remove tools **[1], [3]** and **[5]**.
- Rotate the crankshaft **2 times** *(normal direction of rotation).*
- Fit the tool **[3]**.

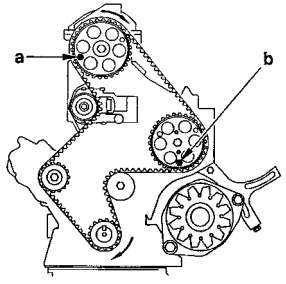
WARNING : Should it be impossible to peg the camshaft, check that the offset between the camshaft pinion hole and the pegging hole is not more than 1 mm..
In the case of an incorrect value, recommence the operation.

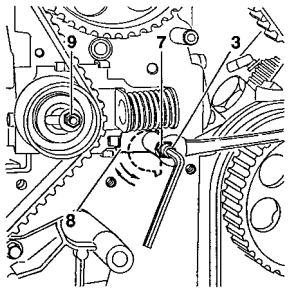
- Remove the tool **[3]**.

B1EP13HD

CHECKING AND SETTING THE VALVE TIMING

Engine : P8C





TOOLS

- Crankshaft peg : **7014-J** or **7017-T.R.**
- Camshaft pulley and injection pump peg : **7004-T.G**. **Tool kit 7004-T**

CHECKS

- Peg the crankshaft.
- Peg the camshaft pulley at **«a»** and the injection pump pulley at **«b»**.

SETTING THE VALVE TIMING

- Peg the crankshaft.
- Peg the camshaft pulley at **«a»**.
- Peg the injection pump pulley at **«b»**.

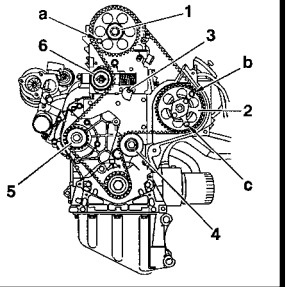
To slacken the belt.

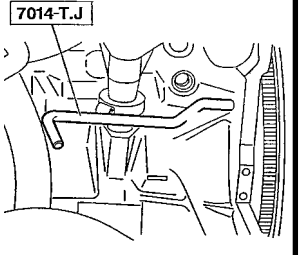
- Loosen the nut **(9)**.
- Loosen the nut **(3)** and the screw **(7)** *(**5 mm** six-sided spanner, **10 mm** flat spanner).*
- Move the tensioner roller eccentric **(8)**.
- Retighten the nut **(9)**.
- Remove the belt.

B1EP09LC | **B1EP09MC**

CHECKING AND SETTING THE VALVE TIMING

Engine : P8C (continued)





SETTING THE VALVE TIMING

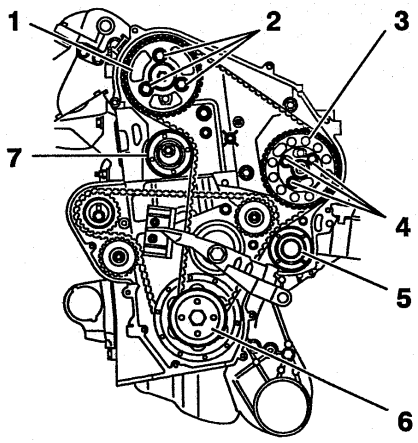
- Fit the belt in the following order :
  Injection pump pulley **(2)** *(strap tensioned),* engage half the width of the belt on :
  the guide roller **(4)**, the crankshaft pinion, the water pump pinion **(5)**, the camshaft pulley **(1)**,
  the tensioner roller **(6)**.
- Align the belt.
- Remove the three pegs.
- Loosen the nut **(9)**.
- Rotate the crankshaft by **2 turns** until the pegs can be engaged *(without refitting the pegs).*
- **ESSENTIAL : Never turn the crankshaft backwards.**
- Tighten the nut **(9)** Tighten to **1 m.daN**.
- Rotate the crankshaft by **2 turns** to reach the pegging point *(without refitting the pegs).*
- **ESSENTIAL : Never turn the crankshaft backwards.**
- Loosen the nut **(9)** by one turn and allow the spring to operate.
- Tighten the nut **(9)** and the screw **(3)**. Tighten to **1 m.daN**.
- Refit the three pegs.

NOTE : If it is impossible to refit one of the pegs, restart the belt fitting operation.
- Remove the pegs.

B1EP081C | B1EP082C

CHECKING AND SETTING THE VALVE TIMING

Engine : THY



B1EP11HC

TOOLS

- Belt tension measuring instrument : **4099-T** or **4122-T.**
- Crankshaft locating peg : **7014-T.J.** **Tool kit 7004-T**
- Camshaft pulley locating peg : **5711-T.A.**
- Injection pump pulley locating peg : **5711-T.B.** } **Tool kit 5711-T**
- Tensioner lever : **5711-T.E.**

CHECKS

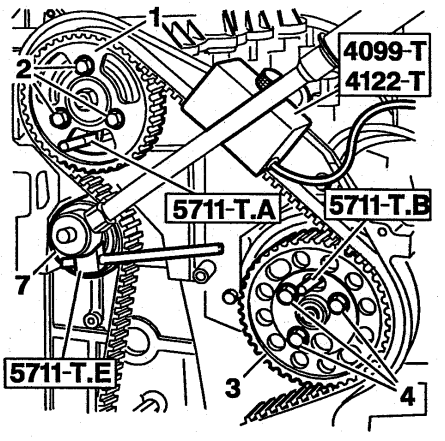
- Peg the flywheel *(behind the engine)*.
- Visually check the pegging of the following components :
- The camshaft pulley **(1)**.
- The injection pump pulley **(3)**.

SETTING THE VALVE TIMING

- Peg the flywheel *(behind the engine).*
- Peg the camshaft pulley **(1)**.
- Peg the injection pump pulley **(3)**.
- Loosen the screws **(2)** and **(4)**, then manually retighten, then loosen again by **1/6 of a tur**n.
- Turn the pulleys **(1)** and **(3)** to the end of the slots *(clockwise)*.

CHECKING AND SETTING THE VALVE TIMING

Engine : THY (continued)



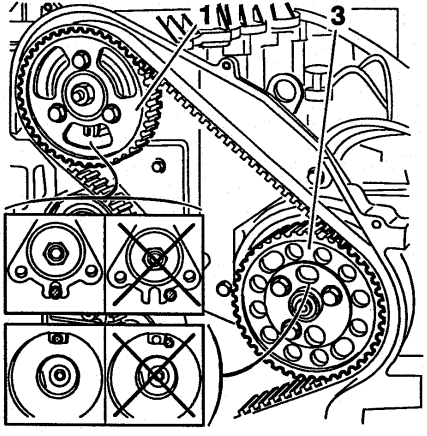
B1EP11JC

SETTING THE VALVE TIMING (continued)

- Fit the belt in the following order :
  The crankshaft pinion **(6)**,the guide roller **(5)**, the injection pump pulley **(3)**, the camshaft pulley (1),the tensioner roller **(7)**.
- If necessary, turn the pulleys **(1)** and **(3)** to make it easier to fit the belt.
- Fit the tool **4099-T** or **4122-T**.
- Pre-tension using the tool **5711-T.E** to obtain a value of :
  - **New belt : 107 SEEM units**
  - **Reused belt : 80 SEEM units**
- Tighten the tensioner roller **(7)** to **4.5 m.daN**.
- Tighten the screws **(2)** and **(4)** to **2.5 m.daN**.
- Remove the tools.
- Rotate the engine by **10 turns**.
- Peg the flywheel.
- Loosen the screws **(2)** and **(4)** then manually retighten, then tighten again by **1/6 turn**.
- Loosen the tensioner roller **(7)**.

CHECKING AND SETTING THE VALVE TIMING

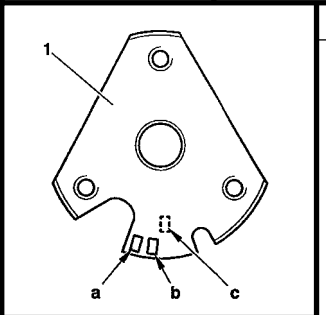
Engine : THY (continued)

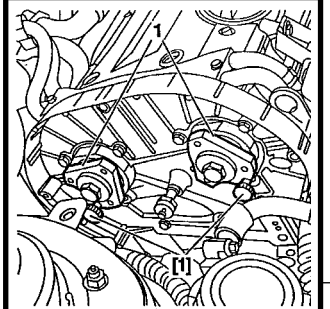


B1EP11KC

CHECKING THE VALVE TIMING

- Peg the camshaft pulley **(1)**.
- Peg the injection pump pulley **(3)**.
- Fit the tool **4099-T** or **4122-T**.
- Tension using the tool **5711-T.E** to obtain a value of :
  - **New belt : 58 SEEM units**
  - **Reused belt : 51 SEEM units**
- Tighten the tensioner roller **(7)** to **4.5 m.daN**.
- Tighten the screws **(2)** and **(4)** to **2.5 m.daN**.
- Remove the tools.
- Rotate the engine by **2 turns**.
- Check the setting.





Camshaft hub marking ➔ 11/97 | **LFY**

	Identification marks a - b
Inlet camshaft	«a»
Exhaust camshaft	«b»
	Number in mark c
Inlet camshaft	N° 1
Exhaust camshaft	N°2

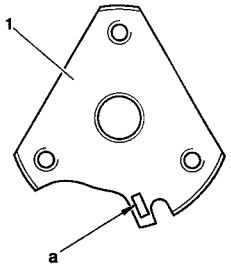
Note : The identification marks are visible next to the pegging slot. Mark **«c»**, bearing the number, is engraved on the rear side of the hub **(1)**.

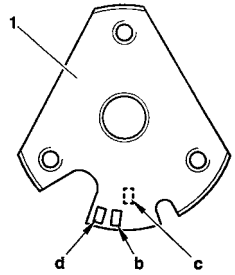
B1EP11LC | B1EP11MC

SPECIAL FEATURES OF THE TIMING

Camshaft hub marking → 11/97

RFV





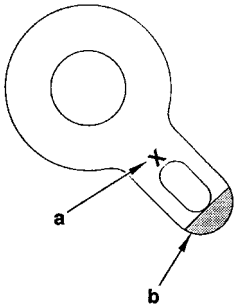
	1st possibility	2nd possibility
	Identification marks a - b - c	
Inlet camshaft	No mark	«b»
Exhaust camshaft	«a»	«c»
		Mark number d
Inlet camshaft		N° 3
Exhaust camshaft		N° 4

Note : The identification marks are visible next to the pegging slot. Mark **«c»**, bearing the number, is engraved on the rear side of the hub **(1)**.

B1EP11NC B1EP11PC

SPECIAL FEATURES OF THE TIMING

Camshaft hub marking 11/97 → | **LFY - RFV**



B1EP122C

Engines	Hubs	"a" Marking	"b" Paint marking
LFY	Inlet	C	BLUE
	Exhaust	D	BROWN
RFV	Inlet	A	GREEN
	Exhaust	B	BLUE

VALVE CLEARANCE SETTING

ALL TYPES

The valve clearances must be checked with the engine cold

	● Inlet	⊗ Exhaust
Petrol all types (except 2.0i 16V and 3.0i)	0.20 mm ± 0.05	0.40 mm ± 0.05
Petrol 2.0i 16V, 3.0i Diesel, 2.0HDi	Hydraulic adjustment	
XM Diesel		
Diesel All types (except XM and 2.0 HDi)	0.15 mm ± 0.08	0.30 mm ± 0.08

POSSIBLE PROCEDURES
For engines with 4 cylinders in a line (1-3-4-2)

Rocking

Rocking	Adjust
1 ● ⊗ 1	4 ● ⊗ 4
3 ● ⊗ 3	2 ● ⊗ 2
4 ● ⊗ 4	1 ● ⊗ 1
2 ● ⊗ 2	3 ● ⊗ 3

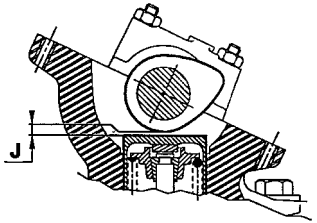
⊗ Exhaust

● Inlet

Fully open (Exhaust)

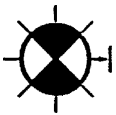
Valves fully open	Adjust
⊗ 1	3 ● ⊗ 4
⊗ 3	4 ● ⊗ 2
⊗ 4	2 ● ⊗ 1
⊗ 2	1 ● ⊗ 3

Engines without hydraulic adjustment : the clearance **(J)** should be checked opposite the cam.

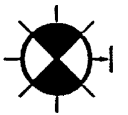


B1DP13QC

ALL TYPES	CHECKING THE OIL PRESSURE						
Tool kit 4103-T	To be read with the Petrol and Diesel correspondence tables						
	XU All Types				EW	XU	V6
	1.6 i	1.8 i	1.8 i 16 V	2.0 i 16V		2.0 i Turbo CT	3.0 i
Engine type	**BFZ**	**LFX**	**LFY**	**RFV**	**RFN**	**RGX**	**XFZ**
Temperature (°C)	80°				90°	80°	90°
Pressure (Bars)	5.3		6	6.4	4	5.5	5
Rpm	4 000						3 000
	XUD	**DW**			**XUD**	**DK**	
	1.9 TD	2.0 HDi		2.0 HDi 16V	2.1 TD	2.5 TD	
Engine type	**DHX**	**RHY**	**RHZ**	**RFW**	**P8C**	**THY**	
Temperature (°C)	80°				100°	90°	
Pressure (Bars)	5	4			2.5	3	
Rpm	4 000				4 000	2 000	

ENGINE OIL PRESSURE SWITCH							ALL TYPES
Engine type			Location	Tightening torque (m.daN)	Warning lamp goes out at : (Bars)		
XU All Types	1.6 i	BFZ	Above the oil filter	2.8		0.5	
	1.8 i	LFX					
	1.8 i 16 V	LFY					
	2.0 i Turbo CT	RGX					
EW	2.0 i 16 V	RFN					
XU TT	2.0 i 16 V	RFV	Above the starter motor	3.4			
V6 TT	3.0 i V6	XFZ	Near the oil filter	3.5			

D6AP01MB | D6AP01ND

ALL TYPES			ENGINE OIL PRESSURE SWITCH				
Engine type			Location	Tightening torque (m.daN)	Warning lamp goes out at : (Bars)		
XUD All Types	1.9 TD	DHX	Above the oil filter	3.4	 D6AP01MB	0.5	D6AP01ND
	2.0 TD	P8C	Near the oil filter	2.8			
DW10 All Types	20 HDi	RHY					
		RHZ					
	2.0 HDi 16V	RHW					
DK5	2.5 TD	THY	Above the starter motor	2.3			

OIL FILTERS — ALL TYPES

To be read with the Petrol and Diesel correspondence tables

Type of oil filters to be fitted after the 1st revision		XU All Types						ES9J4
		1.6 i	1.8 i	1.8 i 16 V	2.0 i 16 V	2.0 i T.CT	2.0HDi 16V	3.0 i V6
		BFZ	LFX	LFY	RFV	RGX	RFN	XFZ
PURFLUX	LS 867	●	●	●	●	●		
	LS 304	●	●	●	●	●	●	
	LS 880							●

Type of oil filters to be fitted after the 1st revision		XUD	DW			XUD	KD
		1.9 TD	2.0 HDi		2.0 HDi 16V	2.1 TD	2.5 TD
		DHX	RHY	RHZ	RHW	P8C	THY
PURFLUX	LS 867	●				●	●
	LS 304	●	●	●		●	●

		Ø (mm)	Height (mm)
SPECIFICATION	LS 867	76	89
	LS 304		
	LS 880	86	97

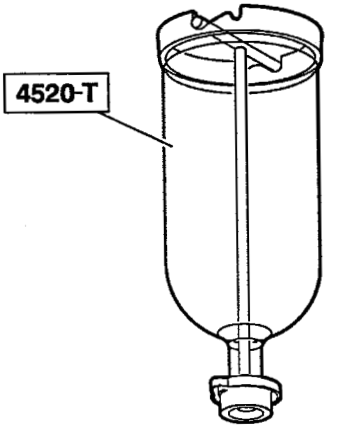
FILLING AND BLEEDING THE COOLING CIRCUIT

FILLING AND BLEEDING

- Fit the filling cylinder **4520-T** to the filler orifice.
- Use the coolant to ensure protection between **- 15° C** and **- 37° C**.
- Slowly fill the system.

NOTE : Keep the cylinder filled up *(visible level)*.

- Close each bleed screw as soon as the coolant flows without air bubbles.
- Start the engine : Engine speed **1500 rpm**.
- Maintain this speed until the cooling fans have cut in and cut out.
- Stop the engine and allow it to cool down.
- Remove the filling cylinder **4520-T**.
- Top up the system to the **max.** mark, with the engine cold.
- Refit the filler cap.



E5AP141C

IDLING - ANTI-POLLUTION							XANTIA - XM - SYNERGIE	
Vehicles		Engine type	Emission standard	Make - Injection type	Idling speed (± 50 rpm)		% Content	
					Manual gearbox	Auto. Gbox : N gear engaged	CO	CO2
XANTIA	1.6 i	BFZ	L3	M. MARELLI 8P13	850	800	< 0.5	> 9
	1.8 i	LFX		M. MARELLI 1AP20				
	1.8 i 16V	LFY		SAGEM SL96 (Manual)/ BOSCH MP7.2 (Automatic)				
	1.8 i 16V Dual fuel	LFY		SAGEM SL96 (Petrol)/ NEKAM KOLTEC (LPG)				
	1.8 i 16V	LFY	L4	BOSCH MP7.3				
	2.0 i 16V	RFV	L3	BOSCH MP5.2	800			
	3.0 i V6	XFZ		BOSCH MP7.0	650 *	650		
XM	2.0 i 16V	RFV		BOSCH MP5.2	800	800		
	2.0 i Turbo CT	RGX		BOSCH MP3.2				
	3.0 i V6	XFZ		BOSCH MP7.0	650 (*)	650		
SYNERGIE	2.0 i 16V	RFN	IF L5	M. MARELLI 48P2	800		< 0.5	> 9

*Variable speed depending on : Battery voltage, parking manoeuvre, temperature.

XANTIA	PETROL INJECTION						
	XANTIA						
	1.6 i	1.8 i	1.8 i 16 V Dual fuel		1.8 i 16 V	2.0 i 16 V	3.0 i V6
Engine type	**BFZ**	**LFX**	**LFY**		**LFY**	**RFV**	**XFZ**
Emission standard	L3				L4	L3	
Make Injection type	M. MARLELLI 8P13	M. MARELLI 1AP20	SAGEM SL96		BOSCH MP 7.3	BOSCH MP5.2	BOSCH MP7.0
Fuel pressure (bars)	2.5	3		/	3		3
Overspeed cut-off (rpm)	6 300	6400	6500	M. MARELLI 1AP40	6500	6530	6520
Injection cut-in during deceleration (rpm)	1 500	1400	1500	3	1500	1200	1100
Résistance injecteurs (en ohms)	16	14.5	16	6 500	14.5	14.5	12
Engine coolant temperature sensor resistive value (ohms)	3800 at 10° C		2 500 at 20° C		800 at 50° C	230 at 90° C	
Idling actuator or stepper motor resistive value (ohms)	Stepper motor : 53						
Air temperature sensor resistive value (ohms)	3800 at 10° C		2 500 at 20° C		800 at 50° C	230 at 90° C	

PETROL INJECTION				XM - SYNERGIE
	XM			SYNERGIE
	2.0 i 16 V	2.0 i Turbo CT	3.0 i V6	2.0 i 16 V
Engine type	**RFV**	**RGX**	**XFZ**	**RFN**
Emission standard	L3			IF L5
Make Injection type	BOSCH MP5.2	BOSCH MP3.2	BOSCH MP7.0	M. MARELLI 48P2
Fuel pressure (bars)	3			
Overspeed cut-off (rpm)	6 530	6 400	6 520	
Injection cut-in during deceleration (rpm)	1 200	1 400	1 100	
Injector resistive value (ohms)	14.5	16	12	
Engine coolant temperature sensor resistive value (ohms	3 800 at 10°C	2 500 at 20° C	800 at 50°C	230 at 90° C
Idling actuator or stepper motor resistive value (ohms)	Stepper motor : 53	E.V. : 22	E.V. : 11	Stepper motor : 53
Air temperature sensor resistive value (ohms)	3 800 at 10°C	2 500 at 20° C	800 at 50°C	230 at 90° C

ALL TYPES	ANTI-POLLUTION TECHNICAL CHECKS (FRANCE)

All Types Petrol CO Corrected (In %)

Conditions : At idle, engine warm.

➔ 01/96

Less than **4.5 %** for vehicles registered before **10/86**.

Less than **3.5 %** for vehicles registered after **10/86**.

With catalytic converter

Greater than 2.0i 89 M.Y.

All Types 93 M.Y.

CO less than **0.5 % at idle speed.**

CO less than **0.3 % at fast idle speed** between **2500** and **3000 rpm (*)**

(*) Except :

TU5 JP : 2200 rpm ± 100.

XU5JP : 1500 rpm or 3100 rpm (± 100).

XU7JP : 1500 rpm or 3100 rpm (± 100).

NOTE : On **XU5JP** and **XU7JP** engines at 1500 rpm, the check should be carried out with main beams, rear heated screen and cabin ventilation switched on and with the front wheels on maximum lock (if the vhicle has power-assisted steering).

Lambda Probe value **0.97** to **1.03**.

All Types Diesel (m^{-1})

Features :

Xantia, MMDCM injection **on 1.6i** (BFZ) engine, **1.8i** (LFZ) engine and **2.0i** (RFX) engine.
Should the check reveal excessive **CO**, make sure that the ECU channel **25** is not connected to earth in error.

(See Info-rapid N° 77)

01/96 ➔

Atmospheric engine.

Less than 2.5 m^{-1}

Turbocharged engine.

Less than 3.0 m^{-1}

EMISSION STANDARDS							ALL TYPES
STANDARD				APPLICATION		NOTES	CHARACTERISTICS
E.E.C.	PSA		Engines	Vehicles	Applicable		
	A-S	RP					
ECE R 15.04	K K'	15.04 15.04	Petrol Diesel	Private vehicles : > 2 litres • new cyl. < 2 litres • existing cyl. < 2 litres	→ 06/89 → 06/92 → 12/92	Brussels directive 83/351 → except special derogations for certain private vehicles cyl. > 2 litres	With oxygen sensor, without catalytic converter
				Utility vehicles : All Types	→ 10/89 imminent	→ Utility vehicle limits = private vehicle limits increased by 25 % → For private vehicles and utility vehicles in major export	
ECE R 15.05	W vp	15.05	Petrol	Private vehicles : > 2 litres • new models • existing models	01/10/88 → 01/10/89 →	Brussels directive 88/76 " Luxembourg Accords " → Replaced by 89/458 + 91/441	

ALL TYPES			EMISSION STANDARDS				
STANDARD				APPLICATION		NOTES	CHARACTERISTICS
E.E.C.	PSA		Engines	Vehicles	Applicable		
	A-S	RP					
ECE R 15.05	W vu	15.05	Petrol Diesel	Utility vehicles : All Types • new models • existing models	01/10/88 → 01/10/89 → → 10/94	Brussels directives 88/76 and 88/436 → Utility vehicle limits private vehicle limits of Brussels directive 88/436 7 classes of limits by vehicle weight	
US 83	Z	US 83	Petrol Diesel	Private vehicles : • certain non-EEC European countries • certain Export countries	Current	→ Adoption of the U.S.	With oxygen sensor and catalytic converter for petrol vehicles

EMISSION STANDARDS						ALL TYPES
STANDARD				APPLICATION		NOTES	CHARACTERISTICS
E.E.C.	PSA		Engines	Vehicles	Applicable		
	A-S	RP					
US 87	Y	US 87	Diesel	Private vehicles : • certain non-EEC European countries • certain Export countries	Current	→ Adoption of the U.S. standard	With catalytic converter and EGR
US 93	Y2	US 93	Petrol Diesel	Private vehicles : • certain Export countries	Current	→ Adoption of the U.S. standard	
US 84 LDT	X1	US 84	Petrol Diesel	Utility vehicles : • certain non-EEC European countries • certain Export countries	Current	→ Adoption of the U.S. standard for light utility vehicles	
US 87 LDT	X2	US 87	Petrol Diesel	Utility vehicles : • certain non-EEC European countries • certain Export countries	Current	→ Adoption of the U.S. standard for light utility vehicles	

ALL TYPES	EMISSION STANDARDS						
STANDARD				APPLICATION		NOTES	CHARACTERISTICS
E.E.C.	PSA		Engines	Vehicles	Applicable		
	A-S	RP					
US 90 LDT	X3	US 90	Petrol Diesel	Private vehicles : • certain non-EEC European countries • certain Export countries	Current	→ Adoption of the U.S. standard for light utility vehicles	
EURO 1 (EURO 93)	L1	CEE 19.5	Petrol Diesel	Private vehicles : < 1.4 litres • new models • existing models	07/92 → → 01/07/93 → 31/12/94	Brussels directive 89/458 → Possible alternative to emission standard L from 1992 to 1994	
EURO 1 (EURO 93)	L	CEE 19.5	Petrol Diesel	Private vehicles : All Types • new models • existing models • new models • existing models	07/92 → 01/93 → → 01/96 → 01/97	EU Brussels Directive 93/59 (91/441)	With oxygen sensor and catalytic converter for petrol vehicles. With catalytic converter and EGR for diesel vehicles.

EMISSION STANDARDS							ALL TYPES
STANDARD				APPLICATION		NOTES	CHARACTERISTICS
E.E.C.	PSA		Engines	Vehicles	Applicable		
	A-S	RP					
EURO 1 **(EURO 93)**	W2	CEE W2	Petrol Diesel	Utility vehicles : < 3.5 tonnes • new models • existing models Class 1 : • new models • existing models Class 2/3 : • new models • existing models	 01/10/93 → 01/10/94 → → 01/97 → 10/97 → 01/98 → 10/98	Brussels directive 93/59 → 3 classes depending on vehicle weight : Class 1 < 1250 kg Class 2 : 1250/1700 kg Class 3 > 1700 kg	With oxygen sensor and catalytic converter for petrol vehicles
EURO2 **(EURO 96)**	L3	CEE 95	Petrol Diesel	Private vehicles : < 6 seats and < 2.5 tonnes • new models • existing models	 01/96 → 01/97 →	Brussels directive 94/12 → EURO 93 standard made stricter	With oxygen sensor and reinforced catalytic converter for petrol vehicles. With catalytic converter and EGR for diesel vehicles.

ALL TYPES			EMISSION STANDARDS				
STANDARD				APPLICATION		NOTES	CHARACTERISTICS
E.E.C.	PSA		Engines	Vehicles	Applicable		
	A-S	RP					
EURO 2 **(EURO 96)**	W3	CEE 95	Petrol Diesel Gas	Utility vehicles : < 3.5 tonnes Class 1 : • new models • existing models Class 2/3 : • new models • existing models	 01/97 → 10/97 → 01/98 → 10/98 →	Brussels directive 96/69 → 3 classes depending on vehicle weight : Class 1 < 1250 kg Class 2 : 1250/1700 kg Class 2 : 1 700 kg	With oxygen sensor and reinforced catalytic converter for petrol vehicles. With catalytic converter and EGR for diesel vehicles.
EURO 3 **(EURO 2000)**	L4	CEE 2000	Petrol Diesel Gas	Private vehicles : All Types • new models • existing models	→ 01/2000 → 01/2001	Brussels directive 98/69 → EURO 2 standard (L3) made stricter → Fiscal incentives	With 2 oxygen sensors and catalytic converter for petrol vehicles. With catalytic converter and EGR for diesel vehicles.With EOBD on-board diagnosis.

EMISSION STANDARDS							ALL TYPES
STANDARD				APPLICATION		NOTES	CHARACTERISTICS
E.E.C.	PSA		Engines	Vehicles	Applicable		
	A-S	RP					
EURO 3 **(EURO 2000)**	W3		Petrol Diesel Gas	Utility vehicles : < 3.5 tonnes Class 1 : • new models • existing models Class 2/3 : • new models • existing models	 → 01/2000 → 01/2001 → 01/2001 → 01/2002	Brussels directive 98/69 → EURO 2 standard (L3 made stricter → Fiscal incentives → 3 classes depending on vehicle weight : Class 1 < 1305 kg Class 2 : 1305/1760 kg Class 2 : 1760 kg	With 2 oxygen sensors and catalytic converter for petrol vehicles. With catalytic converter and EGR for diesel vehicles. With EOBD on-board diagnosis.
EURO 4	IF/ L5 EOBD		Petrol	Private vehicles : All Types • new models • existing models diagnostic embarqué	 → 01/2001 → 01/2003	Brussels directive 98/69 → EURO 3 standard (L4)) made stricter → Fiscal incentives	With 2 oxygen sensors and catalytic converter for petrol vehicles. With EOBD on-board diagnosis.

SAFETY REQUIREMENTS : PETROL/LPG DUAL FUEL SYSTEM

ESSENTIAL : Special precautions should be taken when dealing with gas powered systems

SAFETY REQUIREMENTS.

Only personnel who have been specially trained to work with **petrol/LPG DUAL FUEL** vehicles are authorised to carry out repairs to the **DUAL FUEL** system.

- Ensure that these qualified personnel are provided with acrylic-free overalls *(risk of static electricity).*

In the event of a major gas leak

- Isolate the vehicle in the open air, away from any buildings.

- Call the emergency services *(police and fire brigade)* should the situation get out of hand.

SAFETY REQUIREMENTS : PETROL/LPG DUAL FUEL SYSTEM | ALL TYPES

PRECAUTIONS TO BE TAKEN BEFORE CARRYING OUT ANY REPAIR WORK

Any work on a gas powered vehicle must be carried out in a ventilated area.
Disconnect the battery negative terminal.
Ensure the vehicle is connected to earth.

Ensure the vehicle is kept away from the following hazards :
- Sparks.
- Flames.
- Slow combustion *(lit cigarette).*

Drain the fuel tank using "flare" type material (following the instructions for this material) before performing one of the following operations :
- Remove the gauge valve.
- Working on the fuel tank.

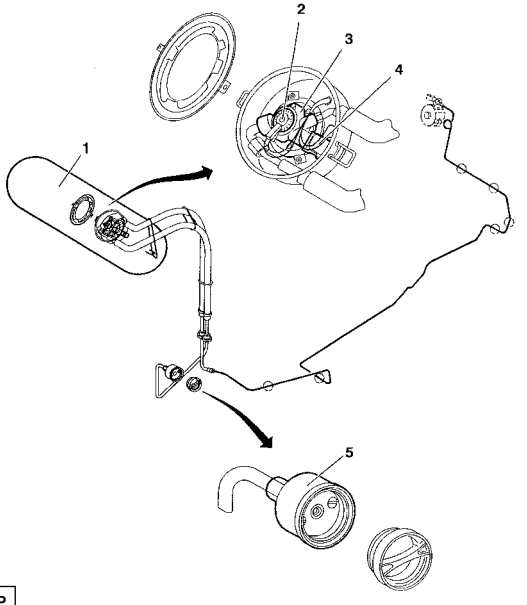
Before removing the fuel tank or working on the gas circuit located downstream of the safety electrovalve (on the gauge valve), perform the following operations :
- Close the safety electrovalve.
- Switch the engine to use gas.
- Wait for the engine to stop due to lack of fuel.

After each operation, check that the circuit is sealed using one of the following systems :

- Electronic detector .
- Soapy water.
- Any other leak detection product.

Remove the fuel tank when the vehicle is to be subject to high temperatures (above 50oC) (spray booth).
Do not clean the engine compartment with a high pressure device and do not use detergents.

ALL TYPES	SPECIFICATIONS : PETROL/LPG DUAL FUEL SYSTEM



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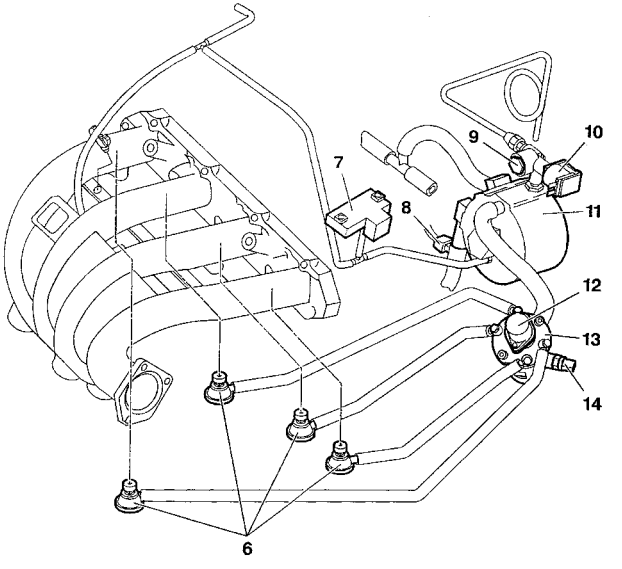


B1HPOQ5P

SPECIFICATIONS : PETROL/LPG DUAL FUEL SYSTEM — ALL TYPES

1) Fuel tank
- Capacity : **70 litres.**
- Max. pressure : during tests / in operation : **30 bars / 20 bars**.
- Max. operating temperature : **50°C**.
- *Location : in the boot.*

2) Fuel gauge
- Supply voltage : **12 volts**.
- Resistance : **0 to 15** ohms empty, **280 to 315 ohms** full.
- *Location : on the gauge valve.*

3) LPG gauge valve.
- *Location : on the fuel tank.*

4) Safety electrovalve.
- Supply voltage : **12 volts**.
- Power : **8W**.
- resistance : **18 ohms**.
- *Location : on the gauge valve.*

5) Filler orifice with safety valve.
- *Location : on the rear right wing.*

6) Injectors and valves.
- *Location : in the engine compartment, under the air manifold.*

7) Pressure sensor.
- Ssupply voltage : **5 volts**.
- *Location : on the evaporator control valve support.*

8) Temperature sensor 15°C.
- *Location : on the control valve reheating circuit.*

9) LPG filter.
- Type : paper.
- Replacement intervals: every **37,500 miles**.
- *Location : on the evaporator control valve inlet union.*

10) Supply electrovalve.
- Supply voltage : **12 volts**.
- Power : **8W**.
- Resistance : **18 ohms**.
- *Location : on the evaporator control valve inlet union.*

ALL TYPES	SPECIFICATIONS : PETROL/LPG DUAL FUEL SYSTEM

11) Evaporator control valve.
- Make : **NECAM**.
- Typt : **MEGA**.

ESSENTIAL :

Before checking and setting the pressure, it is essential that you read through and follow closely BROCHURE : BRE 0332.

Setting pressure - 1st stage.

- Pression de réglage vaporisateur-détendeur neuf :

● **1450 ± 50 mb.**

- Pression de réglage vaporisateur-détendeur ayant déjto servi :

● **1400 ± 50 mb**.

Setting pressure - 2nd stage.

- Setting pressure for a new evaporator control valve :

● **- 970 ± 10 mb**

- Setting pressure for a used evaporator control valve :

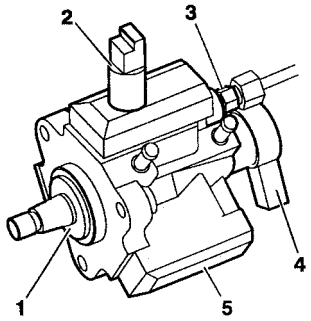
● **- 960 ± 10 mb**

12) Stepper motor
- Location : on the distributor.

13) Distributor.
- Location : on the evaporator control valve support.

14) Distributor electrovalve.
- Supply voltage : **12 volts**.
- Resistance : **25 ohms**.

Engines : RHZ - RHY



B1HP12CC

Cleaning.
- The use of high pressure cleaners is prohibited.
- Do not use compressed air.

Fuel supply circuit.
- Required fuel : diesel.

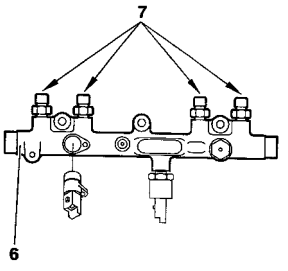
WARNING : Do not use other fuels.

Electric circuit.
- Swapping injection ECUs between two vehicles will render it impossible to start either vehicle.
- It is forbidden to supply a diesel injector with **12 volts**.

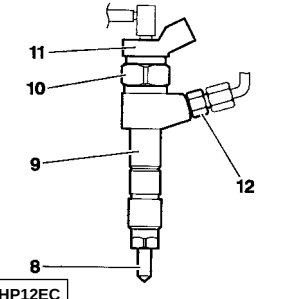
High pressure fuel pump.

Do not separate the following components from the high pressure fuel pump **(5)** :
- High pressure fuel pump third piston deactivator **(3)** *(no replacement parts).*
- High pressure fuel regulateur **(4)** *(no replacement parts).*
- Sealing ring **(1)** *(no replacement parts).*
- High pressure outlet connector **(3)** *(will cause a malfunction).*

PROHIBITED OPERATIONS: HDI DIRECT INJECTION SYSTEM



B1HP12DC



B1HP12EC

Engines : RHZ - RHY

High pressure fuel injection common rail.

- Do not separate the connectors **(7)** from the common injection rail **(6)** *(malfunction).*

Diesel injectors.

WARNING: Diesel and ultrasonic cleaners are prohibited.

Do not separate the following components from the diesel injector carrier **(9)** :

- Diesel injector **(8)** *(no replacement parts).*
- Electromagnetic element **(11)** *(destruction)*.
- Do not alter the position of the nut **(10)** *(malfunction).*
- Do not separate the connector **(12)** from a diesel injector.
- It is forbidden to clean the carbon deposits from the diesel injector nozzle.
- Identification : Injector carrier.

There are **2 types** of diesel injector carrier classed according to fuel flow.

Identification by engraving or paint mark

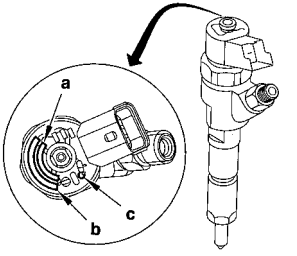
Injector carrier	Engraving	Paint mark	Location
Class 1	**1**	**Blue**	On the upper part of the coil near to the fuel return aperture
Class 2	**2**	**Green**	

Identification markings:

- **"a"** : Supplier identification.
- **"b"** : PSA identification number.
- **"c"** : Class identification.

IMPERATIVE: When replacing a diesel injector carrier, order a component of the same class.

(See repair manual).



B1HP16PC

SAFETY REQUIREMENTS

Preamble.

All interventions on the injection system must be carried out to conform with the following requirements and regulations :

- Competent health authorities.
- Accident prevention.
- Environmental protection.

WARNING : Repairs must be carried out by specialised personnel informed of the safety requirements and of the precautions to be taken.

Safety requirements.

IMPERATIVE : Take into account the very high pressures in the high pressure fuel circuit (1350 bars), and respect the requirements below :

- No smoking in proximity to the high pressure circuit when work is being carried out.
- Avoid working close to flame or sparks.

Engine running :

- Do not work on the high pressure fuel circuit.
- Always stay clear of the trajectory of any possible jet of fuel, which could cause serious injuries.
- Do not place your hand close to any leak in the high pressure fuel circuit.

After the engine has stopped, wait 30 seconds before any intervention.

NOTE : This waiting time is necessary in order to allow the high pressure fuel circuit to return to atmospheric pressure.

CLEANLINESS REQUIREMENTS.

Preliminary operations

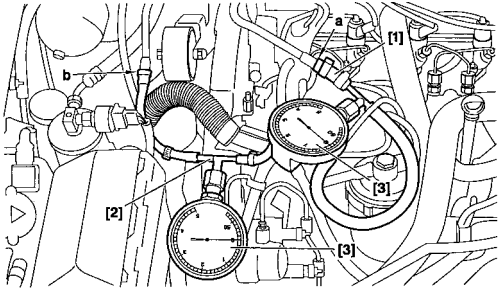
IMPERATIVE : The technician should wear clean overalls.

Before working on the injection system, it may be necessary to clean the apertures of the following sensitive components : *(refer to corresponding procedures).*
- Fuel filter.- High pressure fuel pump.
- High pressure fuel injection common rail.
- High pressure fuel pipes.
- Diesel injector carriers.

IMPERATIVE : After dismantling, immediately block the apertures of the sensitive components with plugs, to avoid the entry of impurities.

Work area.
- The work area must be clean and free of clutter.
- Components being worked on must be protected from dust contamination.

Engines : RHZ - RHY



B1BP1TWD

TOOLS

[1] Ø 10 mm low pressure connector : **4215-T**
[2] Ø 8 mm low pressure connector : **4218-T**
[3] Pressure gauge for testing boost pressure : **4073-T** **Kit 4073-T**

Connect the tool **[1]** between the booster pump and the fuel filter *(white mark at **"a"** on the fuel supply pipe).*
Connect the tool **[2]** downstream of the diesel injectors, between the high pressure fuel pump and the fuel filter *(green mark at **"b"** on the fuel return pipe).*

WARNING : Any check of pressure downstream of the fuel filter is

PROHIBITED.Checks on pressure : static.

- Switch on ignition

For **3 seconds** *(normal functioning)* :
- Fuel supply pressure shown by the pressure gauge **[3] = 1.8 ± 0.4 Bar**.
- Fuel return pressure shown by the pressure gauge **[3] = 0.5 ± 0.4 Bar**.

XANTIA - SYNERGIE	CHECKS : LOW PRESSURE FUEL SUPPLY CIRCUIT

Engines : RHZ - RHY (continued)

Checks on pressure : dynamic.
Engine running, at idle **(normal functioning):**
- Fuel supply pressure shown by the pressure gauge **[3] = 2 ± 0.4 Bar.**
- Fuel return pressure shown by the pressure gauge **[3] = 0.7 ± 0.4 Bar.**

Abnormal functioning

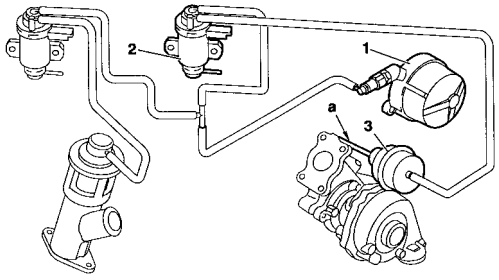
Fuel supply pressure	Fuel return pressure	Checks
Between **3** and **3.5 Bar**	**0.7 ± 0.2 Bar**	Check the condition of the diesel filter
More than **3.5 Bar**	Less than **0.7 Bar**	Check the low pressure regulator incorporated in the filter *(locked shut)* : replace.
More than **3.5 Bar**	More than **0.7 Bar**	Check the fuel return circuit *(pipe pinched or trapped...).*
Between **0.8** and **1.5 Bar**	Less than **0.7 Bar**	Check the fuel suppy circuit : - Booster pump *(low pressure)*, piping.

Impossible to start the engine :
Fuel supply pressure less than **0.8 Bar** :
- Check the low pressure regulator incorporated in the filter (locked open).
- Check the high pressure pump distribution valve *(locked shut)*.

Check : diesel injector return flow. *(Table below)*

Uncouple the diesel injector return pipe.

Check :	Observe :
The flow should be drop by drop.	Diesel injector functioning correctly.
Excessive fuel return.	Diesel injector locked shut.



B1HP12FD

Engines : RHZ - RHY

TOOLS

[1] Manual vacuum pump : FACOMM DA 16.

IMPERATIVE : Respect the safety and cleanliness requirements.

Vacuum pump.

- Connect the tool **[1]** on the vacuum pump **(1)**.
- Start the engine.
- Pressure should be **0.8 bar** at **780 rpm**.

Boost pressure regulator electrovalve.

- Connect the tool **[1]** between the electrovalve **(2)** and the valve **(3)** of the boost pressure regulator.

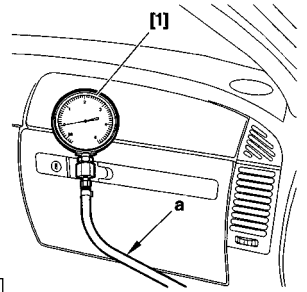
Compare readings with the values in the table below.

Engine speed (rpm)	Pressure (Bar)
780	0.6
4000	0.25

Pressure regulator valve.

- Connect the tool **[1]** on the valve **(3)**.
- Appy a pressure of **0.5 bar** to activate the rod **"a"** :
- Rod **"a"** should be moved **12 mm**.

CHECKS : TURBO PRESSURE



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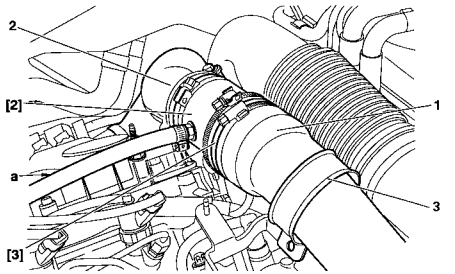


B1HP12JD

Engine : RHZ

TOOLS

[1] Pressure gauge for checking boost pressure **: 4073-T.A Kit 4073-T**
[2] Sleeve for checking boost pressure **: 4185-T**
[3] Adaptor sleeve **: 4229-T**

Checks.

IMPERATIVE : respect the following checking requirements : Engine at running temperature. Vehicle in running order at full load.

Preparation.

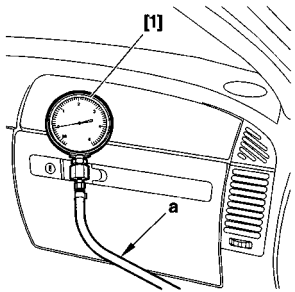
- Remove the collar fixing **(3)**.
- Insert the tool **[2]** connected with tool **[3]**, between the pipe **(1)** and the duct **(2)**.
- Position tool **[1]** in the vehicle.
- Connect the sleeve [**2]** to the tool **[1]** with its tube **"a"**.

Procedure.

- Start the engine.
- Engage first gear and start the engine.
- Engage the gears up to third gear.
- Decelerate to **1000 rpm**.
- Accelerate hard, and check the pressure : **0.6 ± 0.05 Bar *(1500 rpm)***.
- Accelerate freely in kick-down, *(changing from fourth to third gear).*
- Check the pressure : **0.95 ± 0.05 Bar** *(between **2500** and **3500 rpm**).*
- Remove the tools, reposition the pipe **(1)** and refit the collar **(3)**.

CHECKS : TURBO PRESSURE

XANTIA



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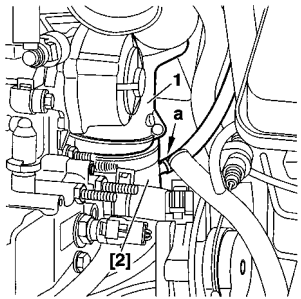


B1BP20MC

Engine : RHY

TOOLS

[1] Pressure gauge for checking boost pressure **: 4073-T.A Kit 4073-T**
[2] Sleeve for checking boost pressure **: 4185-T**

Checks.

IMPERATIVE : respect the following checking requirements : Engine at running temperature. Vehicle running at full load.

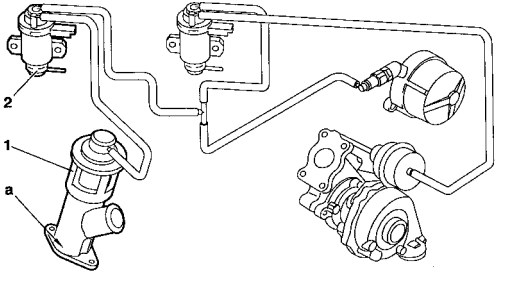
Preparation.

- Remove the collar **(3)** and the sleeve.
- Insert the tool **[2]** between the pipe **(1)** and the duct **(2)**.
- Position tool **[1]** in the vehicle.
- Connect the pressure gauge **[1]** to the tool **[2]** with its tube **"a"** long enough for the gauge to be positioned inside the vehicle.

Procedure.

- Start the engine.
- Engage first gear and start the engine.
- Engage the gears up to third gear.
- Decelerate to **2000 rpm**.
- Gradually accelerate.
- Check the pressure : **0.95 ± 0.05 Bar.**
- Remove the tools.

CHECKS : EXHAUST GASES RECYCLING CIRCUIT



B1HP12GD

Engines : RHZ - RHY

TOOLS

[1]] Manual vacuum pump : FACOMM DA 16.

IMPERATIVE : Respect the safety and cleanliness requirements.

EGR valve

- Connect the tool **[1]** to the capsule union **(1)**.
- Apply, several times in succession, a vacuum of approx. **0.6 bar** to activate the rod **"a"**.
- In abrupt reaction to the vacuum, the valve should close on its seating with a clicking noise.

Exhaust gas reycling (EGR) electrovalve.

- Check, not under load, between the electrovalve **(2)** and the EGR valve **(1)**.
- Connect the tool **[1]** between the electrovalve **(2)** and the capsule **(1)**.
- Compare readings with the values in the table below.

Engine speed (rpm)	Pressure (Bar)
780	0.5
2500	0

SPECIFICATIONS OF THE DELPHI DIESEL INJECTION PUMP								ALL TYPES
				PUMP - TYPE - REFERENCE				
Emission standards				L3				
Equipment							Compacted (1)	Acoustic (2)
XM	X U D	11 BTE	P8C				XUDLP01 R 8640 A 051 A	
SYNERGIE								XUDLP01 R 8640 A 102 A

(1) = Without acoustic bonnet.
(2) = With acoustic bonnet and foam.

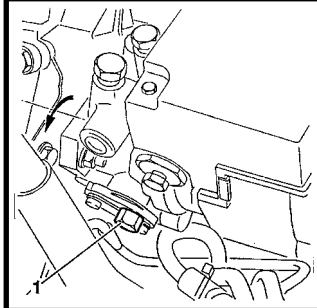
ALL TYPES	SPECIFICATIONS OF THE DELPHI DIESEL INJECTION PUMP												
Engine type	Pump Type Reference	Static timing Initial advance Compression Time (cylinder N° 4)	Dynamic timing checking (at idle)	Reference		Colour code	Injector needle lift pressure Bar)	Adjustments (rpm)			Max. speed	
				Injector	Injector holder + injector			Fast idling	Anti-stall	Idling	Unladen rpm	Laden rpm
P8C	XUDLP01 R 8640A/*	Crankshaft TDC hole pump pre-positioned by pegging		6751 H	002R01AE2 6734 302H	ORANGE	163.5±3.5	NOT ADJUSTABLE				

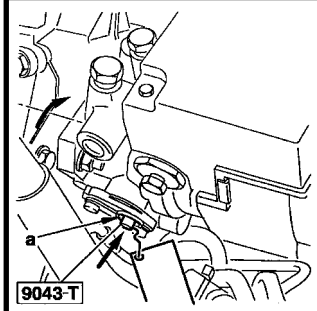
(a) : 850^{+0}_{-50} with aircon - (*) See table on page : **153**.

SETTING THE DELPHI ELECTRONIC INJECTION PUMP

XM

Engine : P8C





TOOLS

- Flywheel locating peg	: **7017-T.J**	**Kit 7004-T**
- EPIC injection pump setting rod	: **9043-T**	**Kit 4123-T**

SETTING THE PUMP

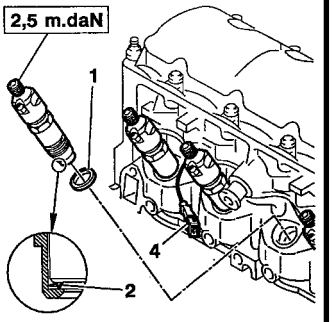
NOTE : This operation is a pre-positioning of the injection pump.

- Peg the flywheel.
- Tilt the pump towards the outer section of the engine.
- Remove the plug **(1)**.
- Introduce the peg **9043-T** into the orifice **"a"**.
- Turn the pump towards the inner section of the engine, pushing locating peg **9043-T** fully home.
- Tighten the front and rear nuts of the pump to **2 m.daN**.
- Remove the tools.
- Refit the plug **(1)**. Tighten to **0.5 m.da**N.

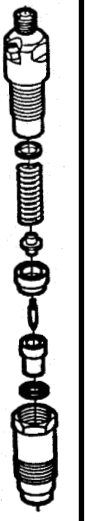
NOTE : No adjustment of the pump controls *(managed by the ECU).*

XM	FITTING DELPHI DIESEL INJECTORS

Engine : P8C



B1HPOYHC



B1HPOYJC

Fitting an injector

The copper seal **(1)** and the fire seal washer **(2)** are to be replaced each time they are removed.

NOTE : Fitting parts of different makes is **PROHIBITED**.

WARNING : Ensure that the fire seal washer **(2)** is fitted the right way round.

- The needle-lift injector **(4)** is positioned on the cylinder **No. 3**.

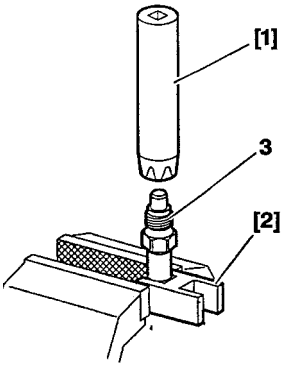
WARNING : Should the needle lift sensor fail to operate, the complete injector holder must be replaced.

IMPERATIVE : Do not reset the injector holder **(4).**

Tighten the injector holder on the cylinder head to :

9 m.daN

[1] Tool to remove/refit injectors **(2) 7007-T**
[2] 7008-T.A Tool kit 4123-T



(3) Tighten lightly to prevent any distortion: **1 m.daN + 20°** or **6 m.daN**.

B1HPOYGC

SPECIFICATIONS OF THE BOSCH INJECTION PUMP				ALL TYPES							
				PUMP - TYPE - REFERENCE							
Emission standards				L3							
Equipment				Automatic gearbox	ADC 7 keys	Transponder	ADC II	Damper	ADC Damper	Aircon Damper	
XANTIA SYNERGIE	XUD9	BTF	DHX	XUDBP02 R 601/3	XUDBP02 R 601/2	XUDBP02 R 601/5	XUDBP02 R 601/5				
XM	DK5	ATE	THY								VP36535 VER 520
XANTIA SYNERGIE	DW10	TD	RHY	CP1 (*)							
		ATED	RHZ								

(*) = The fuel high pressure is driven by the timing belt.

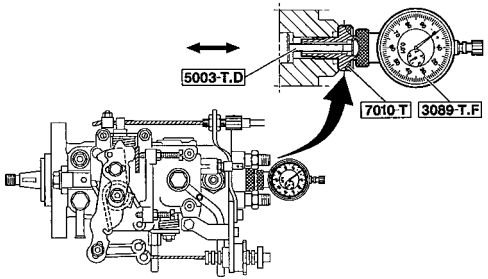
ALL TYPES	SPECIFICATIONS OF THE BOSCH INJECTION PUMP											
Engine type	Pump Type Reference	Static timing (1) Initial advance Compression Time (cylinder N° 4)	Dynamic timing checking (at idle)	Reference Injector	Reference Injector holder + injector	Colour code	Injector needle lift pressure (Bar)	Adjustments (rpm) Fast idling	Anti-stall	Idling	Max. speed Unladen rpm	Laden rpm
DHX	**XUDBP02 VE R 601 / ***	Pump 0.57 mm ABDC		299C	KCA 17S92	GREEN	175 +50 - 0	**(2)** 950 ± 50	1500 ± 100 + 3 mm shim	**(3)** 800 +0 -50	5100 ± 80	
RHY RHZ	**CP1**	Non adjustable		96255 42580								
THY	**VP 36 535 VE R 520 / ***	No setting : managed by ECU		KCE 30S5	312	YELLOW	170 +5 -0					
				Cylinder N° 3				ADJUSTABLE WITH DIAGNOSTIC TOOL				
				KCE 30S5	316	NONE						

(1) Engine : Trou de Pige **P.M.H** - **(2)** Clearance at the fast idle control **1 mm**

(3) 850 = +0-50 with air conditioning**.** - *****See table on page : **157**

NOTE : For all pumps on 1.9TD engines with a "B" index : the static timing is 0.82 mm (instead of 0.66 mm)

SETTING THE BOSCH MECHANICAL INJECTION PUMP



B1HPOYKD

Engine : DHX

TOOLS

- Flywheel locating peg	: **7017-T.R.**	**Kit 7004-T**
- Ring spanner	: **4132-T.**	
- Crescent spanner **FACOM 57**	: **11 X 13**	
- Dial gauge	: **3089-T.H.**	**Kit 4123-T.**
- Dial gauge bracket	: **7010.T.**	
- 31 mm lever	: **5003-T.D.**	

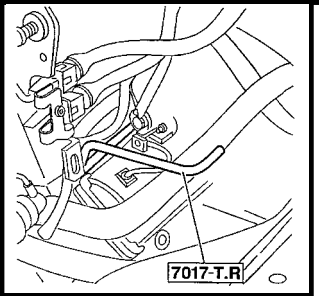
SETTING THE INJECTION PUMP

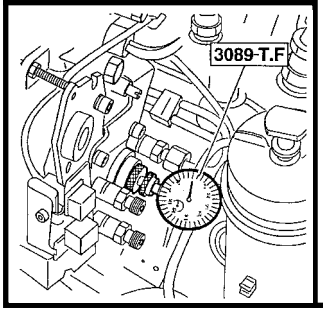
-Tilt the pump in the retarded direction *(away from the engine).*
- Fit the timing tool.
- Turn the engine (direction of engine rotation) until the peg engages in the flywheel.
- Ensure that the pump pinion can be pegged *(if not, rotate the crankshaft by **1 turn**).*
- Remove the tool **7017-T.R**.
- Find the **B.D.C.** position of the pump *(by turning the crankshaft backwards)* and set the dial gauge to **"0"**.
- Turn the crankshaft *(direction of engine rotation)* until locating peg **7017-T.R** engages.
- Turn the pump, in the advance direction *(towards the engine)* until the dial gauge shows (See the table on page : **158**).

NOTE : The dial gauge needle must not move when tightening.

XANTIA	SETTING THE BOSCH MECHANICAL INJECTION PUMP

Engine : DHX (continued)





CHECKING THE INJECTION PUMP SETTING

- Remove the tool **7017-T.R**.

- Rotate the crankshaft by **1/4 of a turn** *(opposite direction of rotation).*

- Rotate the crankshaft *(direction of rotation)*.

- Peg the flywheel.

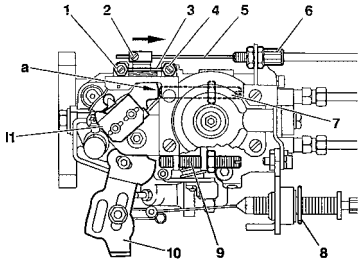
- In this position, the dial gauge should show the value **"X"** (See the table on page : **158**).

- The value **"X"** corresponds to the travel of the pump piston in relation to the **B.D.C**.

- Remove the tool.

B1HP0NQC | **B1HP0NPC**

Engine : DHY



B1HP0YLD

Engine cold.
- Check the fast idle speed.
- Ensure that the lever **(3)** is against its screw stop **(1)** by pushing it in the direction of the arrow ➔ .
If not, adjust with the cable clamp **(2)**, and then the cable tightener **(6)**.

Engine hot.
- Ensure that the cable **(9)** is slack.
- Engine stopped : fully depress the accelerator pedal, check that the lever **(8)** is against its stop **(7)**.
If not, move the position of the spring clip **(B)**.

Adjusting the idle speed.
- Loosen the screw **(5)** until there is no longer any contact with the end of the screw.
- Move the screw **(4)** to obtain an engine speed of (see the table on page: **158**).

Adjusting the residual output.
- Insert a shim **"A"** of (see the table on pages **158**), between the lever **(8)** and the screw **(5)**. Adjust the screw **(5)** to obtain a speed of (see the table on page **158**).

Adjusting the fast idle speed.
- Place the lever **(3)** against the screw **(1)** and turn the screw to obtain an engine speed of (see table on page **158**) .
- Check the operation of the manually-operated **"STOP"** control.

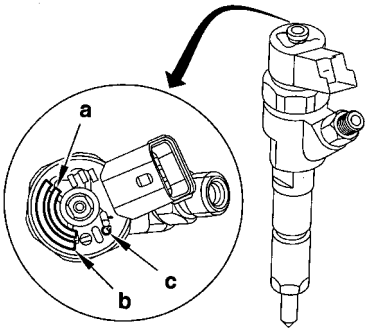
Adjusting the throttle lever switch (C).
- The contacts will open for an accelerator cable travel of **11 mm** or a clearance of **8.5 mm** at **A".**

XANTIA - SYNERGIE	FITTING BOSCH INJECTORS

Engines : RHY - RHZ

Evolution : Classification of diesel injector carriers

16/11/98 →



B1HP16PC

Reminder : RHY and **RHZ** are equipped with **4** diesel injector carriers marked according to their injection duct diameters *(flow of diesel fuel)*.

Identification.
The injector carriers have an engraving or paint mark on the upper part of the coil, close to the diesel fuel return aperture

Mark **1 = BLUE** paint mark = Injector class **1.**
Mark **2 = GREEN** paint mark = Injector class **2.**

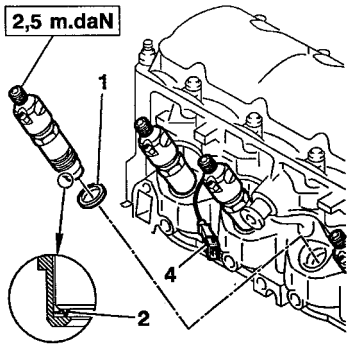
Identification marking:
a : Supplier identification.
b : PSA identification no.
c : Identification of class.

After Sales operations.

ESSENTIAL : When changing a diesel injector carrier, order a component of the same class.

→ **15/11/98** (RPO No.) *(injector carrier without marking)*, **always order a class 2 injector carrier.**

Engine : THY



B1HPOYHC

B1HPOYJC

Fitting an injector.

The copper seal **(1)** and the fire seal washer **(2)** are to be replaced each time they are removed.

NOTE : Fitting parts of different makes is **PROHIBITED**.

WARNING : Ensure that the fire seal washer **(2)** is fitted the right way round

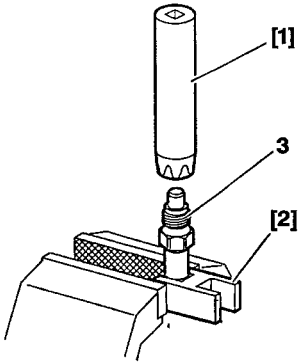
The needle lift type injector **(4)** is located on **cylinder No. 3.**

WARNING : Should the needle lift sensor fail, the injector holder assembly must be replaced.

IMPERATIVE: Do not reset the pressure of the injector holder **(4).**

Tighten the injector holder on the cylinder head to : 4.5 m.daN.

[1] Injector spanner **77510-T**
[2] 7008-T **Kit 4123-T**



(3) Tighten lightly to avoid distortion.
Tighten to: **7 m.daN**.

B1HPOYGC

INJECTION

ALL TYPES		SPARKING PLUGS					
Vehicles - Models		Engine type	BOSCH	CHAMPION	SAGEM	Electrode gap setting	Tightening torque
XANTIA	1.6i	BFZ	FR7DE	RC8YCL	RFC58 LZ	0.9 mm	**2.5 mdaN**
	1.8i	LFX					
	1.8i 16v	LFY					
	2.0i 16v	RFV					
	3.0i V6	XFZ	FR 8 KDC	PFR 6 E -10		1 mm	**10 Nm+90° (*)**
XM	2.0i 16v	RFV	FR7DE	RC8YCL	RFC58 LZ	0.9 mm	**2.5 mdaN**
	2.0i TcT	RGX					
	3.0i V6	XFZ	FR 8 KDC	PFR 6 E -10		1 mm	**10 Nm+90°***
SYNERGIE	2.0i 16v	RFN	FR7DE	RC8YCL	RFC58 LZ	0.9 mm	**2.5 mdaN**

***** : Retightening => 2.5 mdaN

An E.E.C. decree of **25 June 1976,** regulates the speed displayed by the speedmeter in relation to the actual speed travelled.

This decree stipulates :

- The speed indicated by a speedometer must never be lower than the actual vehicle speed.
- Between the speed displayed **«SD»** and the speed travelled **«ST»**, there must always be the following relationship :

ST < SD < 1.10 ST + 4 Kph

Example : For an actual speed of **100 Kph** the speed displayed by the speedometer may be between **100** and **114 Kph**.
The speed indicated by the speedometer may be influenced by :

- The speedometer.
- The tyres fitted to the vehicle.
- The final drive ratio.
- The speedometer drive ratio.

Any of these components can be checked without removing them from the vehicle. (See information note **N° 78-85 TT of 19 October 1978**.

NOTE : Before replacing the speedometer, check the conformity of the following points :
- The tyres fitted to the vehicle.
- The gearbox final drive ratio.
- The speedometer drive ratio.

ALL TYPES	CLUTCH SPECIFICATIONS					
	XU					
	5	7				10
	JP	JB		JP4		J4R
	All Types					XM Saloon
	1.6i	1.8i		1.8i 16V		2.0i 16V
Engine type	BFZ	LFX		LFY		RFV
Gearbox type	BE3/5					ME/5
Make	LUK	VALEO	LUK	VALEO	LUK	VALEO
Mechanism/Type	200 P 4100	200 CP 4250	200 P 4100	200 CP 4250	200 P 4100	215 DT5250
Clutch disc	200	200 B (D73) 33 AX	200	200 B (D73) 33 AX	200	215 F (D93) 22 BX
Ext./Int. lining Ø	200/134	200/137	200/134	200/137	200/134	215/147
Disc lining type	F 408					F 808

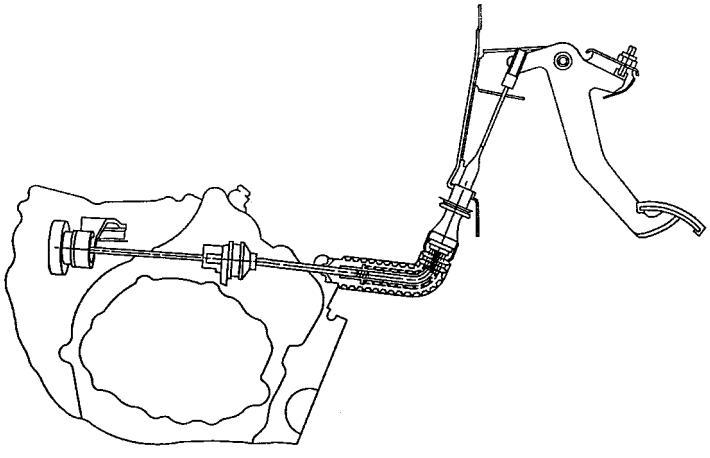
CLUTCH SPECIFICATIONS							ALL TYPES
	EW	XU					ES
	10						9
	J4	J4R		J2TE			J4
	Synergie	XM Estate	Synergie	Xantia	XM	Synergie	All Types
	2.0i 16V			2.0i Turbo CT			3.0i V6
Engine type	RFN	RFV		RGX			XFZ
Gearbox type	BE3/5	ME/5 – ML/5		ML/5	ME/5 – ML/5		ML/5
Make	VALEO			LUK	VALEO		
Mécanisme/Type	230 DING 4700	235 CP 5650		235 T 5700	235 CP 5650		242 DT 6500
Clutch disc	228 D 73 12 R 14 X	228 SH 11 A 15X		228 D	228 D 62 32 BX		242 SH (D31) 11 A 15 X
Ext./Int. lining Ø		235/155		228/155			242/162
Disc lining type	F 808 DS	F 202					F 808

ALL TYPES	CLUTCH SPECIFICATIONS					
	XUD		DW			DK
	11		10			5
	BTF		TD	ATED		ATE
	XM- Synergie RHD	XM LHD	All Types	Xantia	Synergie	All Types
	2.1 TD		2.0 HDi			2.5 TDi
Engine type	P8C		RHY	RHZ		THY
Gearbox type	ME/5-ML/5	ME/5	BE3/5	BE3/5-ML/5	ML/5	MG/5
Make	VALEO		LUK			VALEO
Mechanism/Type	235 CP 5650		230 P 4700	235 T 5700	225 T 5700 **(1)**	242 DT 6500
Clutch disc	228 SH 11 A 15X	228 F (D95) 32 AX	228	228D	225	242 SH (D95) 31 Q
Ext./Int. lining Ø	235/155		230/	235/155	225/	242/162
Disc lining type	F 202		F 408	F 202	F 808	F 206

(1) DVA = Damped double flywheel.

Push-action clutch with automatic adjustment (Non-adjustable) (*)

Engines	**BFZ - LFX - LFY – RFN – RHY**	Gearbox	**BE3/5**



Refitting the clutch cable.

- Set the pedal to the high position (contact at **A**).
- Attach the cable end-piece to the pedal.
- Refit a new clip **(3)** to the pedal.
- Fit the end-piece **(4)** to the bulkhead (**G6** grease).
- Clip the end-piece **(5)** to the gearbox.
- Refit the cable to the lever **(1)**.
- Depress the clutch cable several times to set the assembly in place.
- Check that the end-piece **(4)** is properly fitted to the bulkhead.
- Check the operation of the automatic adjusting device.

1) - Pull the lever *(in direction **F**)*, the lever must move when pulled by hand.

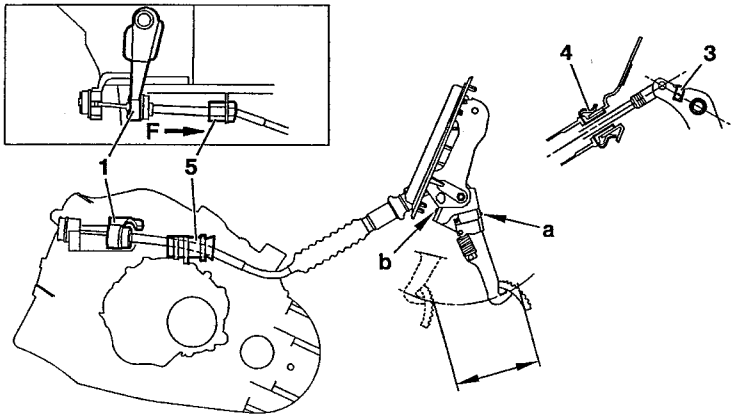
2) - Press the clutch pedal very lightly and repeat the same operation. The lever should not move back.

(*) See pages : **172** to **173**).

XANTIA - XM - SYNERGIE	CLUTCH : CHECKS AND ADJUSTMENTS

Pull-action clutch with automatic adjustment (Non-adjustable) (*)

Engines	**Xantia - XM : RFV - DHX**	Gearboxes	**BE3/5**
	XM : RGX		**ME/5**
	Synergie : RFV		**ML/5**



Refitting the clutch cable.

- Set the pedal to the high position (contact at **A**).
- Attach the cable end-piece to the pedal.
- Refit a new clip **(3)** to the pedal.
- Fit the end-piece **(4)** to the bulkhead (**G6** Grease).
- Clip the end-piece **(5)** to the gearbox.
- Refit the cable to the lever **(1)**.
- Depress the clutch cable several times to set the assembly in place.
- Check that the end-piece **(4)** is properly fitted to the bulkhead.
- Check the operation of the automatic adjusting device.

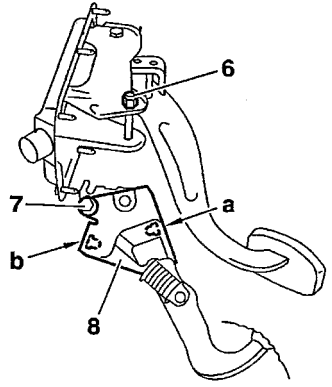
1) Pull the lever (in direction **F**), the lever must move when pulled by hand.

2) Press the clutch pedal very lightly and repeat the same operation. The lever should not move back.

(*) See pages : **172** to **173**).

B2BP03DD

Adjustment of push and pull action clutch with automatic compensation (adjustment of compensation system)



B2BP03EC

Engines : BFZ - LFX - LFY - RFV – RGX - RFN - DHX - RHY - RHZ

WARNING : If a system blockage is detected when checking, or if the pedal has been removed, the pedal position must be adjusted. This position is obtained by the angular displacement of the stop supports **"a"** and **"b"**.

Procedure

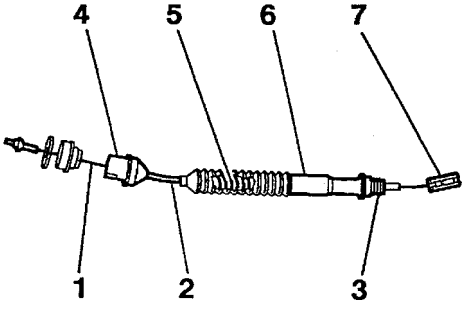
- Loosen the nut **(6)** and the screw **(7)**.
- Using a lever, raise the stop support (8) to its highest position.
- In this position, there must be a substantial free play in the pedal.
- Lower the support until there is a free play of **2 ± 1 mm**.
- Tighten the screw **(7)** and the nut **(6)**.
- Check that the outer cable slides freely (at rest, the pedal is against its upper stop **«A»**, the outer cable length should be variable).

Characteristics

- The automatic adjusting device requires no manual adjustment.
- Pedal travel remains constant for all models **145 ± 5 mm**.
- Automatic adjustment is achieved by modifying the curvature of the outer cable.
- Take extra care with the routing of the outer cable, and do not add any supplementary fixing points.

CLUTCH : CHECKS AND ADJUSTMENTS

Engines : BFZ - LFX - LFY - RFV – RGX - RFN - DHX - RHY - RHZ



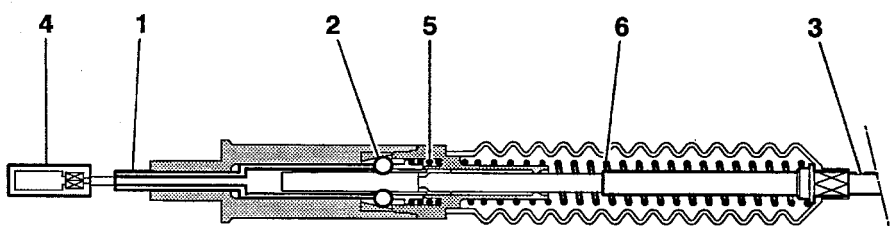
B2BP02SC

NOTE : This cable has an automatic adjusting device which takes up the clutch disc wear and makes up for the compression of the outer cable.

DESCRIPTION

1 - Metallic cable, crimped on both ends.
2 - Outer cable or telescopic duct.
3 - Outer cable stop, bulkhead side *(fixed point on the bodyshell).*
4 - Outer cable stop, gearbox side *(fixed point on the gearbox).*
5 - Tensioning spring ensuring the maximum length of the outer cable.
6 - Wear take up device.
7 - Attaching end-piece.

Engines : BFZ - LFX - LFY - RFV - RGX - RFN - DHX - RHY - RHZ (Continued)



B2BP03QD

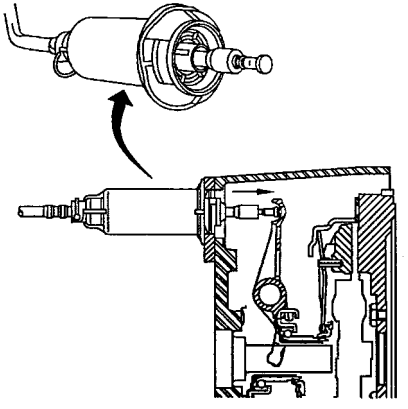
Operation	Clutch disengagement phase	Engagement / adjustment phase
For the adjusting device to operate correctly, it is necessary that : The pedal is at rest *(against its upper stop)* The locking sleeve **(1)** is slightly compressed, the rollers **(2)** are free, the outer cable **(3)** length may vary.	As soon as the pedal is applied, the attaching end-piece **(4)** leaves the sleeve **(1)** which moves back. The rollers, pushed by spring **(5)** jam the system. The cable behaves like a conventional cable.	The pedal returns to rest on its upper stop. Attaching end-piece **(4)** pushes sleeve **(1)** which frees the rollers. Outer cable **(3)**, kept extended by the spring **(6)** becomes : - Shorter if the clutch disc is worn. - Longer if the outer cable has been compressed.

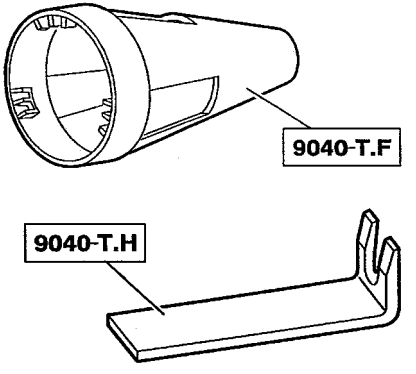
NOTE : The pedal gear has a non-adjustable assisting device

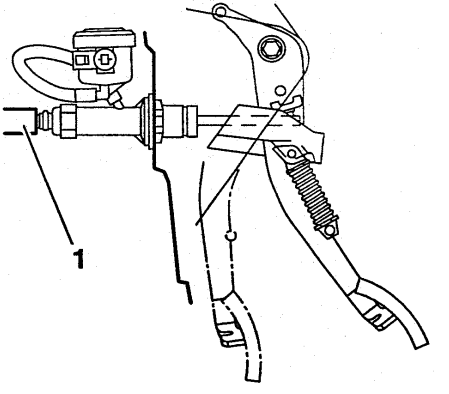
XANTIA - XM - SYNERGIE	CLUTCH : CHECKS AND ADJUSTMENTS

Hydraulically operated pull-action clutch (Non-adjustable)

Engines		Gearboxes	
	XM : RGX -P8C		**ME/5**
	Xantia - XM - Synergie : RGX - XFZ - RHZ		**ML/5**
	XM : THY		**MG/5**





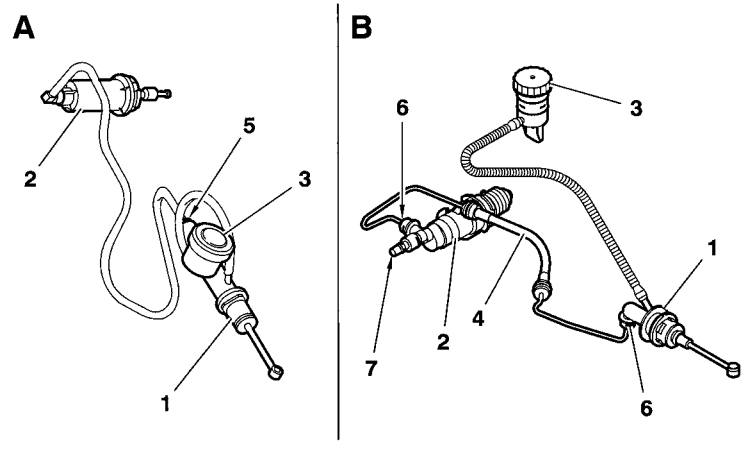


(1) Quick-fit union Tool **9040-T.H.**

B2BP03RC | E5AP14VC | B2BP03SC

Hydraulically operated pull-action clutch (Non-adjustable)

Engines : RGX - XFZ – RHZ - P8C - THY



B2BP03ZD

A / Old assembly, supplied complete and filled with hydraulic fluid.
B / New assembly :
- The components supplied separately.
- The circuit is filled with fluid after being fitted to the vehicle.

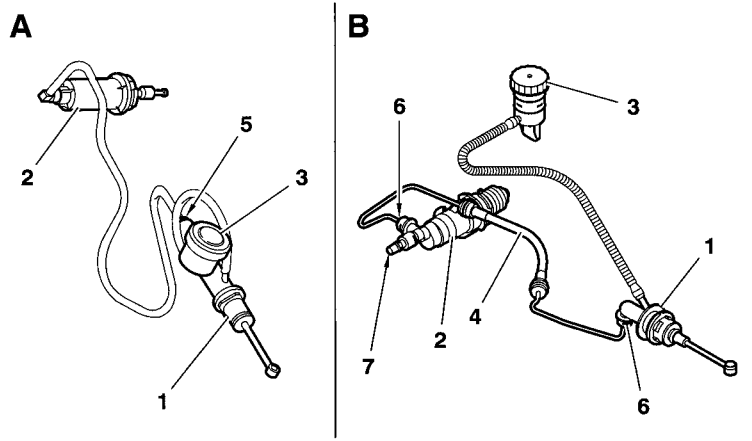
(1) Clutch transmitter.
(2) Clutch receiver.
(3) Hydraulic clutch control reservoir.
(4) Link pipe.
(5) Click-fit union, sealed (after dismantling).
(6) Click-fit union, non-sealed (after dismantling).
(7) Bleed screw.

Le nouveau montage est composé des pièces suivantes :
The new assembly consists of the the following parts :
- Clutch transmitter, anchored in place after a 1/4 turn.
- Clutch receiver, with push-rod.
- Hydraulic clutch control reservoir, with feed pipe.
- Link pipe, between clutch transmitter and receiver.

CLUTCH : CHECKS AND ADJUSTMENTS

Hydraulically operated pull-action clutch (Non-adjustable)

Engines : RGX - XFZ – RHZ - P8C - THY



B2BP03ZD

After fitting on the vehicle, the circuit should be filled with a **«DOT 4»** type brake fluid.
Clutch control reservoir capacity **120 cc.**
(Bleeding is carried out not under pressure).

Repair

The new clutch control components are not compatible with the old parts.
Both the old and the new components are marketed by **«Replacement Parts»**.

Draining-Filling - Top-up

- Check the level after each repair visit.
- Fill the circuit *(after drainage)*, using a filling cylinder specifically designed for this operation.
- Use the circuit's bleed screw **(7)**.
- The level of fluid inside the clutch control reservoir should be between the min. and max. marks.

NOTE : Wear on the clutch causes a slight increase in the level of fluid inside the control reservoir.

GEARBOX AND TYRE SPECIFICATIONS								XANTIA
(*) = Long gearbox.	**Petrol**							
	1.6i	**1.8i**	**1.8i 16V**			**2.0i 16V**		
					Auto.		**Auto.**	
Engine type	**BFZ**	**LFX**	**LFY**			**RFV**		
Tyres-Rolling circumference	175/70R14 1.85 m	185/65 R14 - 1.815 m			185/65R15 1.895 m	205/55R15 1.85 m	185/65R15 1.895 m	
Gearbox type	BE3/5				AL4	BE3/5	AL4	
Gearbox ident. plate	20 TD 00	20 TB 94	20 TB 95	20 TB 95 **(*)**	20 TP 52	20 TB 97	20 TP 53	
Reduction box torque	15X64	19X75	19X79		23X73	19X79	23X73	
Speedometer ratio	22X18			28X18	20X16	22X18	20X16	

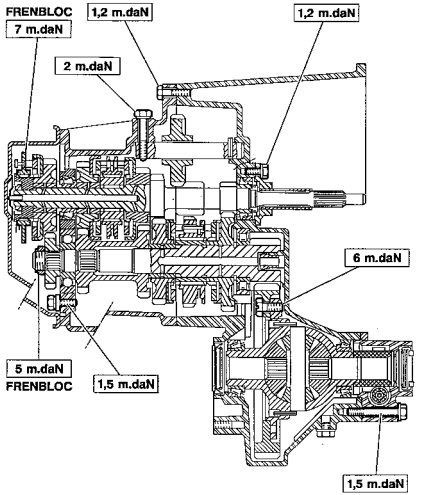
(1) = Plastic pinion	**Petrol**			**Diesel**		
	2.0i Turbo CT	**3.0i V6**		**1.9 TD**	**2.0 HDi**	
			Auto.	**Auto.**		
Engine type	**RGX**	**XFZ**		**DHX**	**RHY**	**RHZ**
Tyres-Rolling circumference	205/60 R15 - 1.92 m			205/60R15 - 1.92m	205/60 R15 - 1.92 m	
Gearbox type	ML/5		4 HP 20	AL4	BE3/5	ML/5
Gearbox ident. plate	20 LE 90	20 LE 89	20 HZ XX	20 TP 50	20 TB 53	20 LE 84
Reduction box torque	15X67	16X69	20X69	25x71	19X75	16X65
Speedometer ratio	25X20 (1)		20X16	20x16	22X18	25X20 (1)

XM	GEARBOX AND TYRE SPECIFICATIONS					
	Petrol					
	2.0i 16V		3.0i V6		2.0i Turbo CT	
		Auto.		Auto.		Auto.
Engine type	RFV		XFZ		RGX	
Tyres-Rolling circumference	195/65R15 - 1.93 m		205/65R15 - 1.97 m			
Gearbox type	BE3/5	4 HP 18	ML/5	4 HP 20	ME/5	4 HP 18
Gearbox ident. plate	20 TD 01	20 GZ 5G	20 LE 59	20 HZ YY	20 GM 33	20 GZ 1G
Reduction box torque	14X62	18X77	17X71	20X69	14X59	18X77
Speedometer ratio	22X18	25X20	25X20	20X16	21X26 **(1)**	25X20
(1) = Plastic pinion	Diesel					
	2.1 TD		2.5 TD			
		Auto.				
Engine type	P8C		THY			
Tyres-Rolling circumference	195/65R15 - 1.93 m		205/65R15 - 1.97 m			
Gearbox type	ME/5	4 HP 18	MG/5			
Gearbox ident. plate	20 GM 31	20 GZ 5D	20 KM 70			
Reduction box torque	15X59	18X77	16X65			
Speedometer ratio	21X26 **(1)**	25X20	16X20 **(1)**			

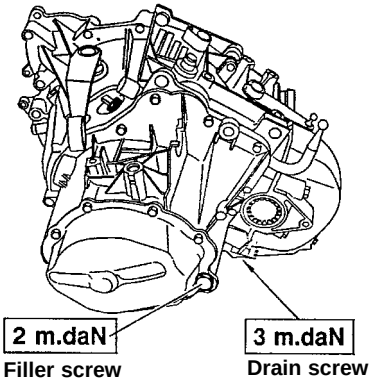
GEARBOX AND TYRE SPECIFICATIONS				SYNERGIE
	Petrol			Diesel
	2.0i 16V		Auto.	2.0 HDi
Engine type	RFN			RHY
Tyres-Rolling circumference	205/65 R15 - 1.97 m			
Gearbox type	BE4/5		AL4	ML/5
Gearbox ident. plate	20 DL 26	20 DL 27	20 TP 31	20 LE 91 **(*)**
Reduction box torque	14x62		21x73	15x67
Speedometer ratio	18x14		20x16	25x20

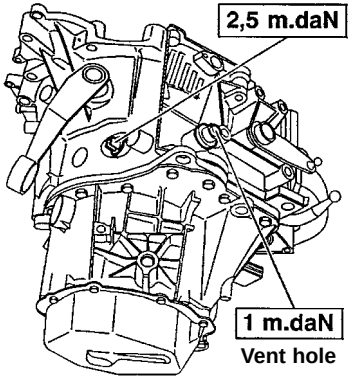
(*) DVA = Double damped flywheel

Engines : BFZ - LFX - LFY - RFV 03 - RHY



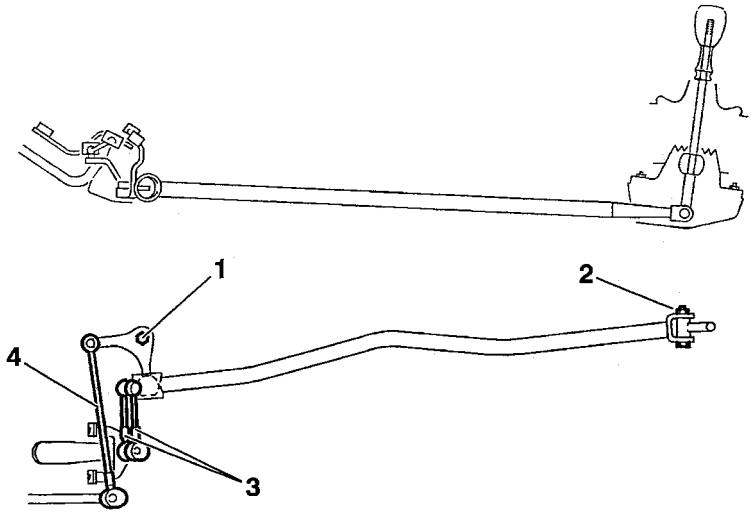
B2CP34JP





B2CP20HC | B2CP20JC

Engines : BFZ - LFX – LFY – RFV - RHY



B2BP005D

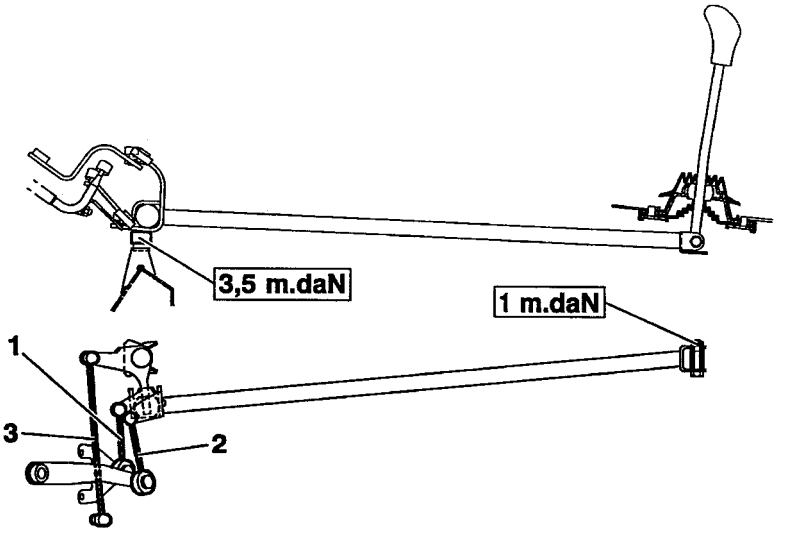
Tightening torques m.daN.

(1) Pinion/subframe fixing	**2.7 ± 0.2**
(2) Bar /lever fixing	**1 ± 0.1**

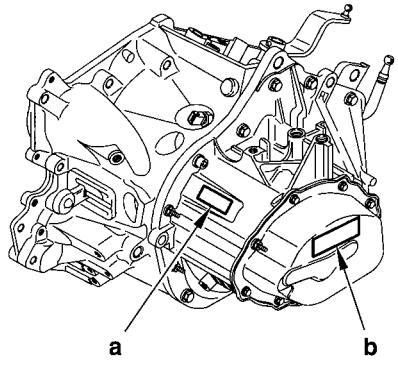
Adjustment of the control rods

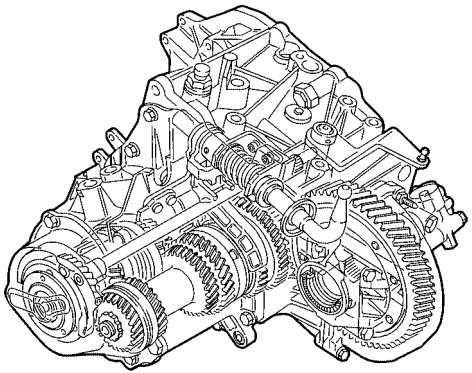
(3) Length selection rod	**100 ± 1 mm**
(4) Length engagement rod	**245 ± 1 mm**

Note : The adjustment dimensions are the distances between ball-joint centres.



(1)	100 ± 1 mm.
(2)	100 ± 1 mm.
(3)	246 ± 1 mm.



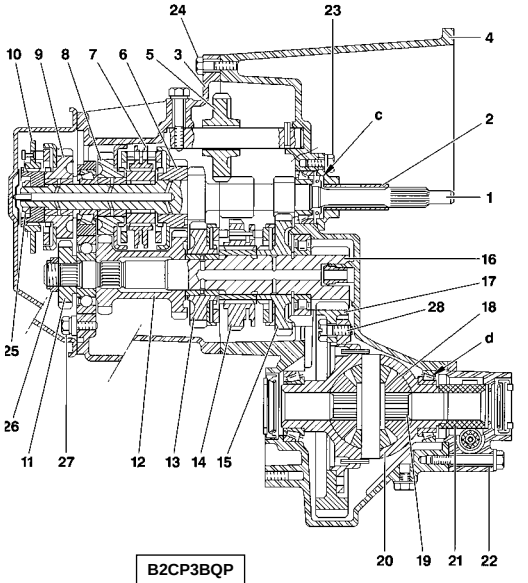


(a) = Marking zone *(Sequence and serial no.).*
(b) = Location of identification label.

B2CP3BNC | B2CP3BPD

SYNERGIE	BE4/5 GEARBOX SPECIFICATIONS

Engines : RFN



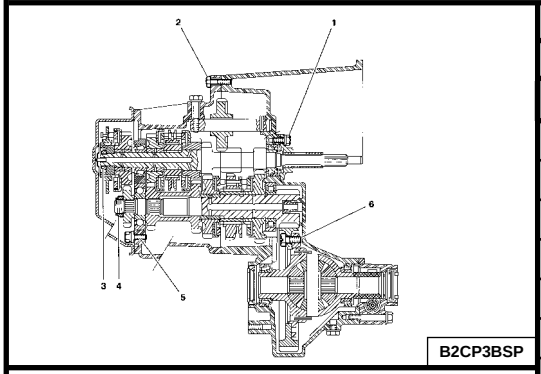
Description (Continued)

(1) Primary shaft.
(2) Clutch bearing guide.
(3) Gearbox casing.
(4) Clutch housing.
(5) Reverse idle.
(6) Drive gear (3rd gear).
(7) 3rd /4th gear synchroniser
(8) Drive gear (4th gear).
(9) Drive gear (5th gear).
(10) 5th gear synchroniser.
(11) Driven gear (5th gear).
(12) Driven gear (2nd / 4th gear)
(13) Driven gear (2nd gear).

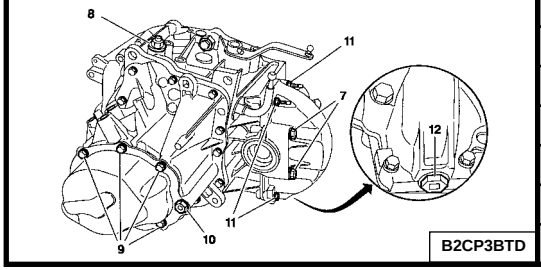
(14) 1st / 2nd gear synchroniser
(15) Driven gear (1st gear)
(16) Secondary shaft.
(17) Differential gear.
(18) Satellite gears
(19) Planet gears.
(20) Boîtier de différentiel.
(21) Differential housing.
(22) Extension.

«d» Adjusting shims : **0.7 to 2.4 mm**
(0.10 mm and increasing by 0.10 mm).

"c" Adjusting shims : **1.4 to 1.6 mm**
(0.10 mm and increasing by 0.10 mm).



B2CP3BSP



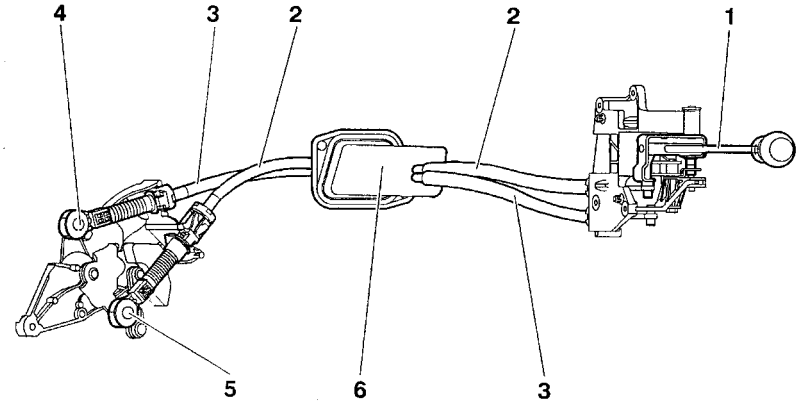
B2CP3BTD

Engine : RFN

Tightening torques

Ref.	Description	Number of screws	m.daN
1	End guide	3	1.2 ± 0.1
2	Clutch housing	13	1.3 ± 0.1
3	Primary shaft nut	1	7.2 ± 0.7
4	Secondary shaft nut	1	6.5 ± 0.7
5	Yoke holding screw	2	1.5 ± 0.1
6	Differential gearwheel screw	2	6.5 ± 0.7
	Reverse gear contact	1	2.5 ± 0.3
7	Differential housing	4	5 ± 0.5
8	Breather pipe	1	1.7 ± 0.2
9	Rear housing cover screw	7	1.2 ± 0.1
10	Top-up plug	1	2.2 ± 0.2
11	Differential housing screw	4	1.2 ± 0.1
12	Drain plug screw	1	3.5 ± 0.4

Engines : RFN



B2CP3BWD

(1) Gear control lever

(2) Gear engagement control cable **(*)**

(3) Gear selection control cable **(*)**

(4) Gear selection ball-joint **Ø 10 mm.**

(5) Gear engagement ball-joint **Ø 10 mm.**

(6) Flexible insulating grommet through the bulkhead

(*) = These two cables cannot be separated.

Principles of adjusting the gear controls.

WARNING : Cables should be adjusted each time the gearbox, gear controls or power unit are removed.

Principles.

Lock the gear lever in neutral position, using tool: **9607-T**.

Place the gearbox in neutral.

Couple the cables on the lever.

Fit the ball-joints on the gearbox lever.

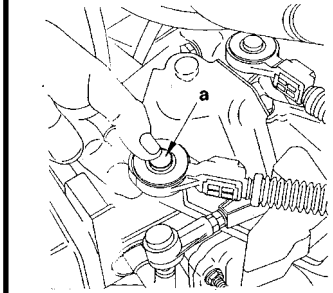
Lock the cable lengths with the ball-joint locking keys.

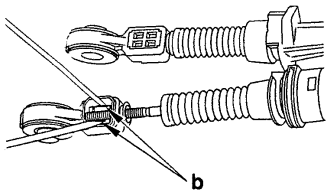
WARNING : Do not use any tool to unclip the ball-joints.

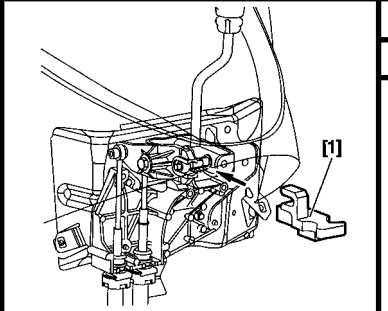
To unlock the ball-joint, press at the centre **«a»**, then pull the ball-joint upwards.

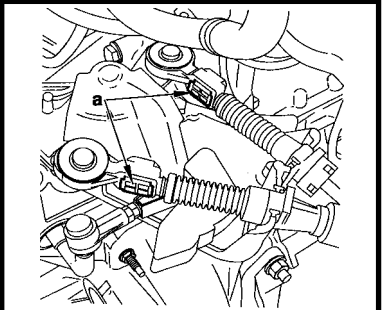
Note : Changing an individual ball-joint is possible as long as the locking key is removed.

Unclip at **«b»**, using two small screwdrivers.









Engines : RFN

Adjusting the gear controls.

TOOL

[1] Tool for positioning the gear lever **: 9607-T.**

ADJUSTMENTS

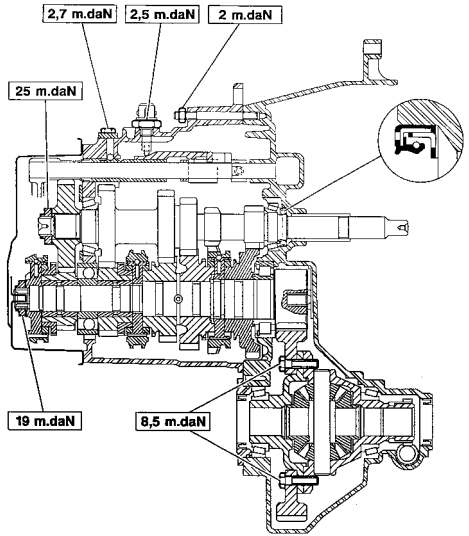
WARNING : Cables should be adjusted each time the gearbox, gear controls or power unit are removed.

Inside the vehicle
- Remove the trim under the gear lever.
- Lock the gear lever in neutral position,using tool **[1]**.

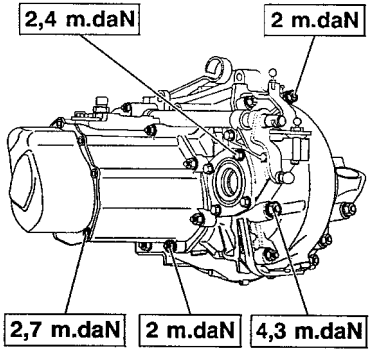
Under the bonnet
- Remove the air filter assembly.
- Unlock the ball-joint keys at **«a»**.
- Place the gear selection and control levers neutral.
- Lock the cable lengths with the ball-joint locking keys.

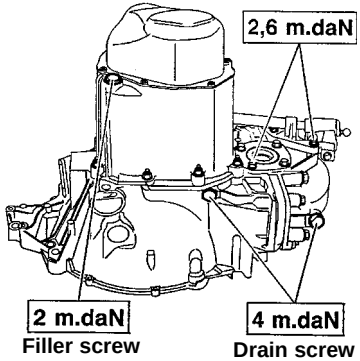
CHECKS

- Remove the tool **[1]**.
- Check that all the gears engage without **«tightness »**.
- Check that the gear lever moves identically forwards and backwards and to right and left. If it does not, repeat the adjustment.
- Refit the trim under the gear lever.
- Refit the air filter assembly.



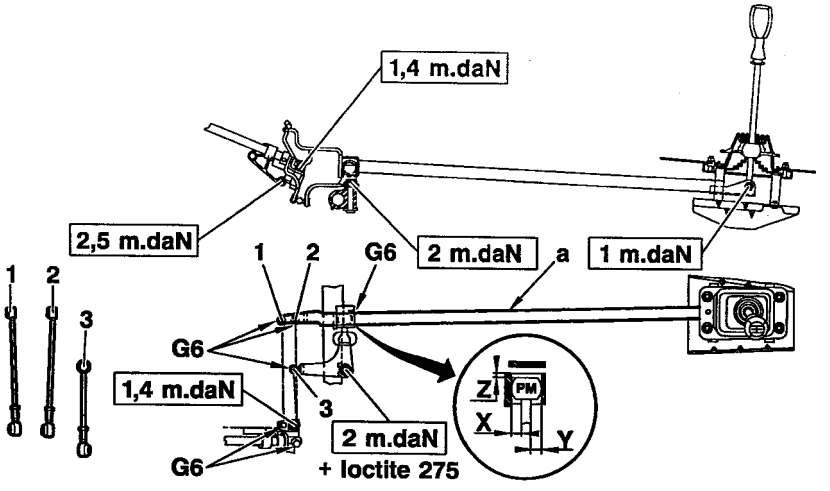
B2CP34KP





B2CP20KC | B2CP20LC

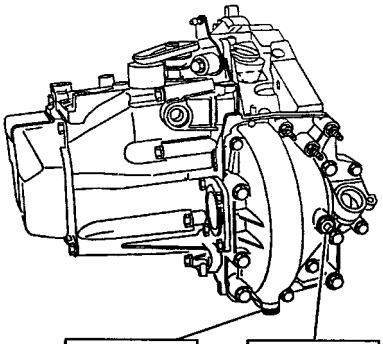
Engines : RGX - P8C



B2CP351D

(1)	Z	3 ± 2 mm
(2)	Z	3 ± 2 mm
(3)	X	8.5 mm
	Y	8.5 mm

Engines : XFZ - RHZ -

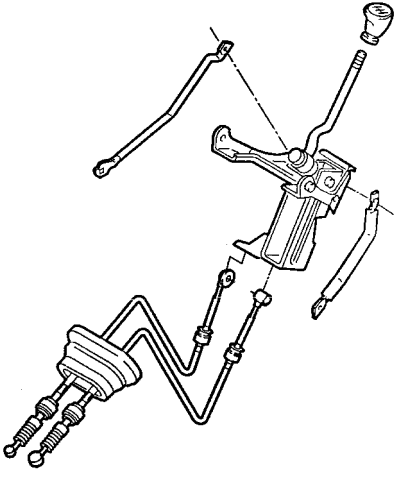


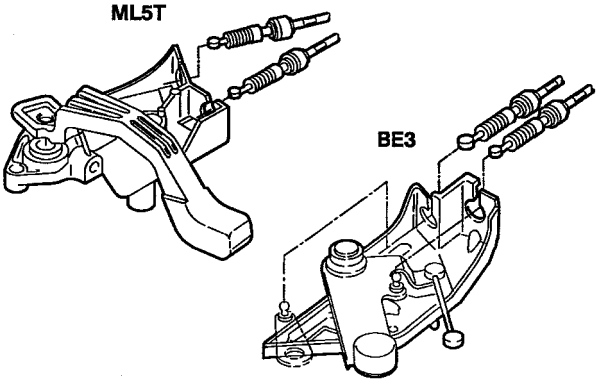
B2CP34LC

Tightening torque : m.daN.

- Gearbox casing/clutch bell housing fixing	**1.8**
- Speedometer cable housing/engine fixing	**1.5**
- Clutch bell housing/engine fixing :	
• Screws H10 x 150 L 75	**6**
• Screws M12 x 175 L 70	**8.5**

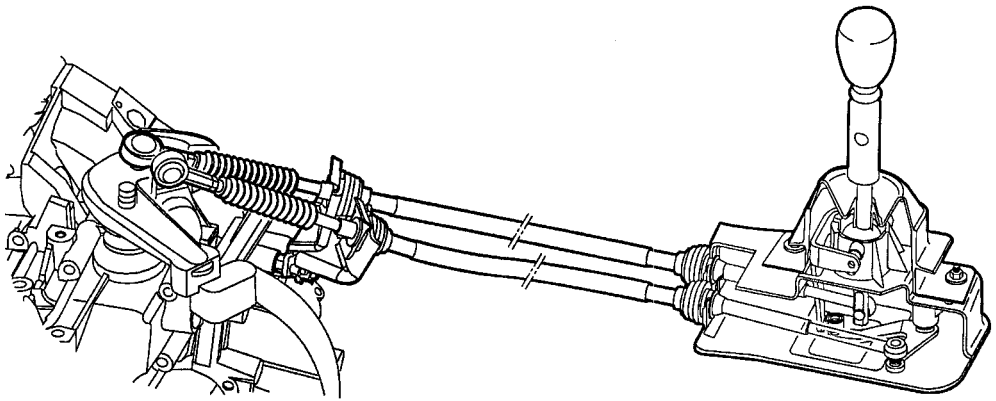
Engines : XFZ - RHZ





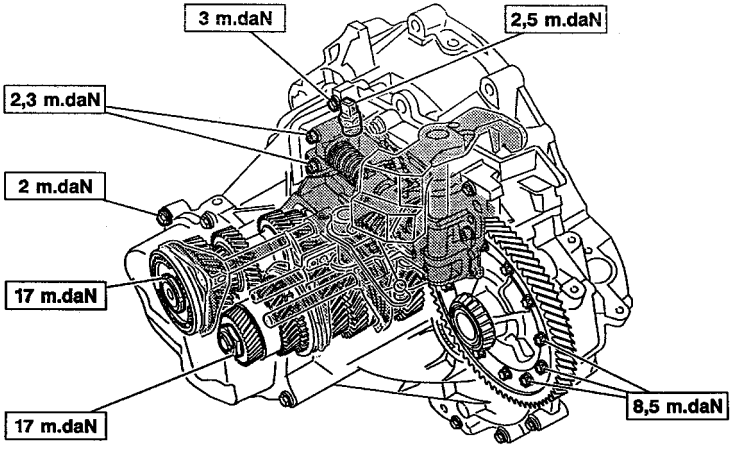
B2CP0350P

Engines : XFZ - RHZ



B2CP16FP

Engine : THY



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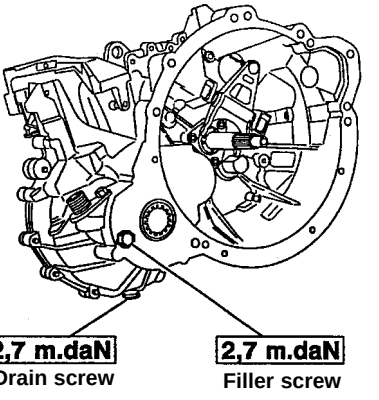
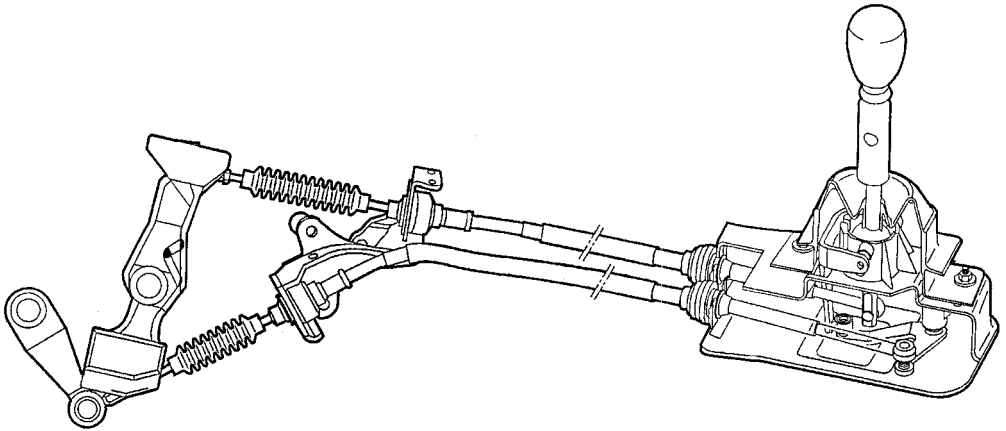


B2CP34NC

Engines : THY



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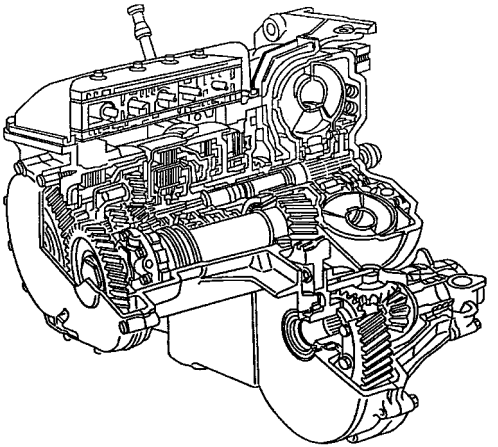

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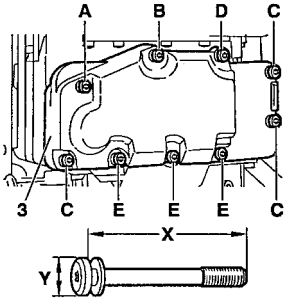
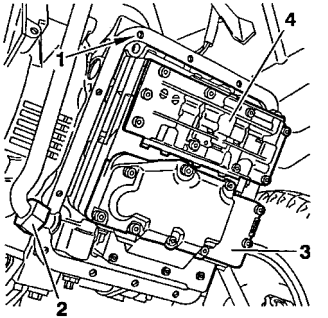


Ref. letter	X (mm)	Y (mm)	Torque m.daN
A	80	12	0.8
B	80	10	0.6
C	75	12	0.8
D	65	10	0.6
E	60	10	0.6

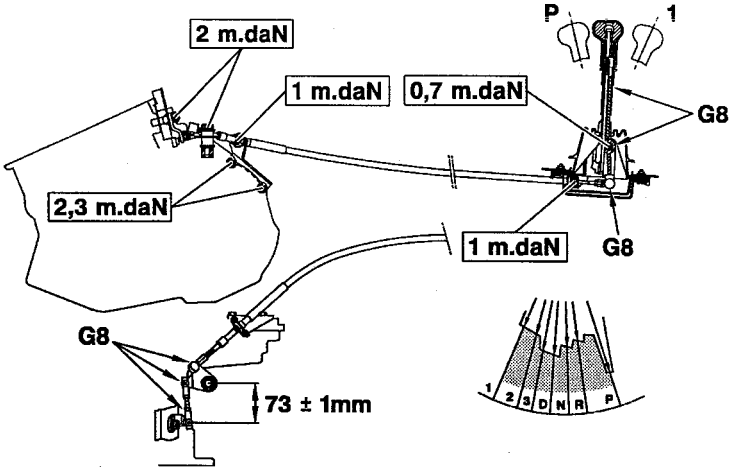


Tightening torques m.daN

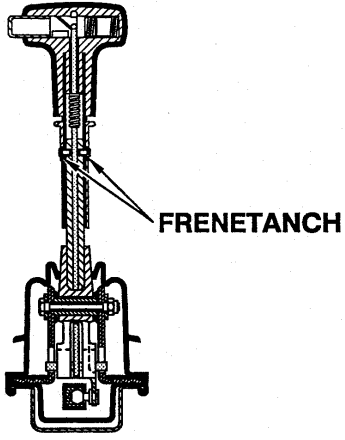
(1) Gearbox casing screw	**1 ± 0.1**
(2) Oil dipstick tube nut	**4.5± 0.4**
(3) Strainer cover	
(4) Hydraulic valve block	**0.8**

Note : When replacing an automatic gearbox, it is **ESSENTIAL** to replace the heat exchanger, as well as the oil.

B2CP34SC B2CP34TC



B2CP35AD



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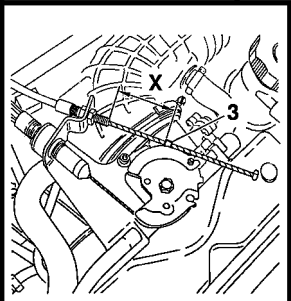
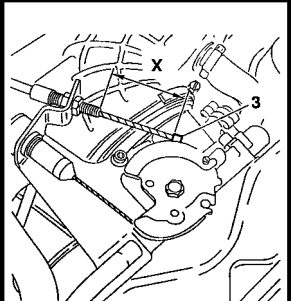




Engines : RFV - RGX - P8C

Checks - Adjustments : Kick down cable

Preliminary conditions :

- Engine hot.
- Idling speed correct.
- Cable routing correct

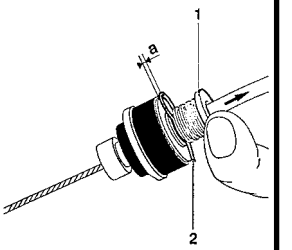
Accelerator cable adjustment :

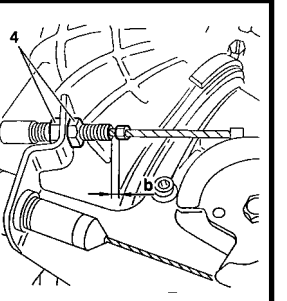
- Remove the kick down cable from the drum.
- Pull out the sleeve stop **(1)** and fit the spring clip **(2)** so as to obtain a small clearance at **«a»**.

Kick down cable adjustment :

- Pull out the cable until the start of the kick down command, the lug **(3)** should be at: **X = 39 mm** from the end of the sleeve.
- The lug **(3)** should then be positioned and crimped on the cable.
- Refit the kick down cable on the drum.
- Adjust the clearance **(B)** from **0.5 mm** to **1 mm** max. by tightening the nuts **(4)**.

B2CP35CC | B2CP35DC





B2CP013C | B2CP35EC

PRECAUTIONS TO BE TAKEN

Towing
The front of the vehicle must be raised in order to be towed.
If the front of the vehicle cannot be raised :

IMPERATIVE : - Put gear lever in position «N»..
- Do not add any oil.
- Do not exceed 50 kph over a distance of 50 km.

Driving

- Never drive with the ignition switched off.
- Never push the vehicle to try to start it;
  (impossible with an automatic gearbox).

Lubrication

The automatic gearbox is only lubricated when the engine is running.

REMOVING - REFITTING. *(Automatic gearbox).*

WARNING : Never place the gearbox on its lower casing *(risk of deforming the tray and damaging the hydraulic valve block).* Never use the connections as handles for raising, turning, holding or pushing the gearbox.

ESSENTIAL :
- Fit the converter retaining peg while the gearbox is removed.
- Fit the centring peg to locate the gearbox on the engine:
(remove the converter retaining peg just before locating)

WARNING : With the safety programme selected, a snatching can be felt when changing from **"P"** → **"R"** or **"N"** → **"R"**.

PROCEDURE BEFORE REPAIRS

AL 4 gearbox

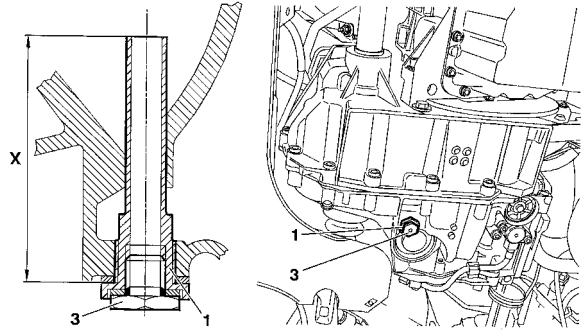
Oil Quality

If the gearbox has suffered a serious fault resulting in a malfunction or the destruction of a clutch, the oil will overheat and become contaminated with impurities :

the oil is said to be **«burnt»**.

This is characterised by a black colour and the presence of an unpleasant smell.

ESSENTIAL : The gearbox must be replaced.



B2CP31FD

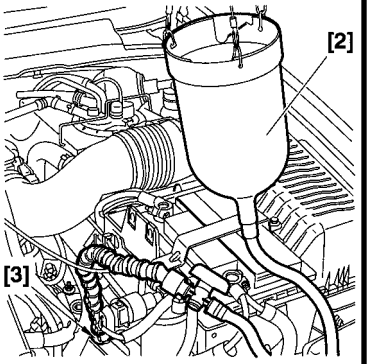
Engines : LFY - RFV - RFN - DHX

PROCEDURE BEFORE REPAIRS

Oil level AL 4 *(prior conditions).*
- Vehicle in horizontal position.
- Check gearbox is not in back-up mode.
- Remove the oil filler plug **(2)**.
- Add **0.5 litres** extra oil into the gearbox.
- Foot on the brake, change through all the gears.
- Selection lever in position **"P**".
- Engine running, at idle.
- Oil temperature : **60°C *(+8°C; -2°C)***, measured with the aid of a diagnostic tool.
- Remove the oil level plug **(3)**.
- Thread of oil then **"drip-drip"** : refit plug **(3)**.Tighten **2.4 m.daN**.
- **"Drip-drip"** or nothing : refit the plug **(3)**.
- Stop the engine.
- Add **0.5 litres** extra oil into the gearbox.
- Repeat the oil level procedure.

NOTE : The level is correct at the moment the thread of oil becomes **drip-drip**.
- Refit the oil filler plug **(3)**. Tighten to **2.4 m.daN**.
- Initialise the oil usage counter (open the diagnostic tool procedure).

Engine : XFZ



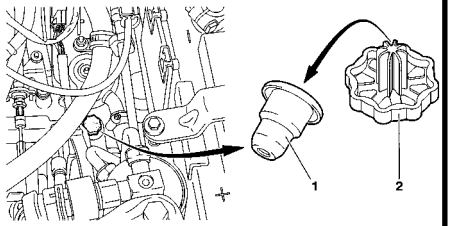
Tools

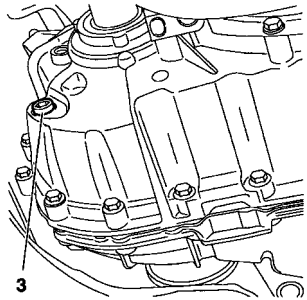
[1] Hose clamp pliers	**: 4517-T**	**Tool kit 4507-T**
[2] Filling cylinder	**: (-).0341.**	
[3] Specific end-piece	**: (-).0341.B.**	

Checking the oil level.

Preliminary conditions

- Vehicle in horizontal position, handbrake released.
- Engine idling, without using power *(headlamps, heated rear screen etc.)*.
- Check absence of gearbox back-up mode; using a diagnostic tool.
- Apply the brake, change through all the gears.
- Gear selection lever at position **P**.
- The check is to be carried out when the oil has reached a temperature of **55°C ± 1°C**; using a diagnostic tool.
- Remove the oil filler plug **(3)**.





Engine : XFZ

Checking the oil level (continued)

Flowing of oil from the oil filler aperture.

- As soon as the oil temperature reaches **60°C ± 1°C**, refit the oil filler plug **(*)**.

Note : The oil level is correct.

No flowing of oil from the oil filler aperture.

- Refit the oil filler plug **(3)**.
- Stop the engine.
- Remove the air vent assembly **(1)** and **(2)** from the gearbox; using tool **[1]**.
- Add 0.5 litre of additional oil into the gearbox; using tool **[2]**.
- Repeat the procedure of topping up the oil.
- Remove the tools **[2]** and **[3]**.
- Refit the metallic part **(1)** of the air vent assembly, using a **Ø 18 mm** drift and a mallet.
- Clip on the plastic part **(2)** of the air vent assembly.
- Refit the air filter housing.

(*) Note : The method of topping up gearbox oil with an oil gauge remains unchanged.

PROCEDURE BEFORE REPAIRS (continued)

When the ECU detects an erroneous or non-existent value on input or output :

- It writes the fault in memory.
- For each associated context, it writes the context of the oldest fault in memory.
- It initiates a back-up mode strategy.

There are two types of back-up modes :

- The ECU makes replacement values available *(relating to comfort, gear selection quality, loss of functions).*

- Access to emergency programme *(only 3rd ratio and reverse are available).*

Note : 4 HP 20 : A snatching may be felt when changing :
P/R - N/R - N/D.

Reading the fault codes.

- Read the fault codes.

No fault codes present :
Carry out a measure of parameters.

Anomalies present :

- **YES :** Carry out the necessary repairs.
- **NO :** Read the fault codes – engine ECU

- Carry out a road test.

Following an initialisation of the ECU, for a certain period of time there may be an inconsistent gear selection quality *(while ECU parameters are adapted to the gearbox).*
To achieve a consistent standard, it will be necessary to carry out a road test taking in frequent gear changes *(auto-adaptive laws).*

ECU : Downloading, Configuration, Initialisation *(Pedal).*

Downloading *(4 HP 20)*
Updating the gearbox ECU by downloading :
- Follow the procedure using the diagnostic equipment

The operation of downloading is used to update the automatic gearbox ECU or to adapt it to the engine ECU.

After downloading, carry out the following :

Following the diagnostic tool procedure.

- A reinitialisation of the auto adaptor ***(4 HP 20)***.
- A road test ***(4 HP 20)***.

IMPERATIVE : Every update of the automatic gearbox ECU must be accompanied by an update of the engine ECU.

Engines : LFY-RFV-DHX-RFN

ECU : Downloading

Updating the gearbox ECU by downloading :

- SFollow the procedure using the diagnostic tool.

The downloading operation enables the automatic gearbox to be updated, or adapted to an evolution of the engine ECU.
Before commencing the downloading, take the value of the oil usage counter present in the automatic gearbox ECU.

After the downloading operation, carry out the following:

A clearing of faults.
A pedal initialisation.
An initialisation of the auto-adaptives.
A recording of the value of the oil usage counter previously read.
A road test.

ESSENTIAL : Every update of the automatic gearbox ECU should be accompanied by an update of the engine ECU.

Updating the value of the oil usage counter.

Using PROXIA

Access to reading and recording of the oil counter is via the menu : **«Configuration (integrated circuit button) / Oil counter».**
Adjustment of the oil counter value is done in incremental steps of **2750 units.**

Using LEXIA or ELIT.

Access to reading and recording of the oil counter is via the menu : **«Oil counter»**.
Adjustment of the oil counter value is done by entering directly the **5 figures** of the oil counter.

ECU : Downloading, Configuration, Initialisation (pedal) (continued)

Downloading

ECU downloading procedure :
- Follow the diagnostic tooling procedure.

A new ECU or downloaded update is always configured with the following options :
- SHIFT LOCK gear selection lever position.
- OBD outlet (emission standard L4).

If the ECU is to be fitted to a vehicle without one or both of these options:
- Carry out a configuration which inhibits the diagnosis of the option(s) concerned.

Pedal initialisation

A pedal initialisation must be carried out in the following cases :

- Replacement of the automatic gearbox ECU.

- Replacement of the automatic gearbox.

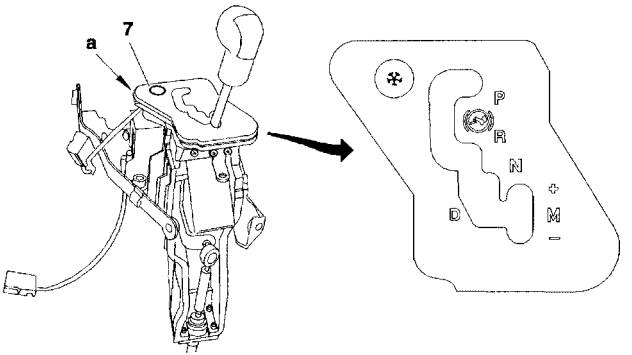
- Downloading of the ECU configuration.

- Adjustment or replacement of the accelerator cable.

- Replacement of the throttle potentiometer.

IMPERATIVE : For a certain period of time, while the ECU parameters are adapted to the gearbox, there may be an inconsistent gear selection quality. To achieve a consistent standard, it will be necessary to carry out a road test taking in frequent gear changes *(auto-adaptive laws).*

Engine : RFN



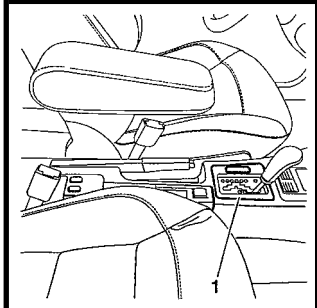
B2CP3CFD

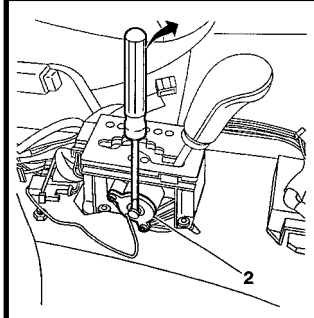
Gear control is by a cable linked to the selection lever located on the dashboard.
The gear selection control has 5 positions :

«P» Park *(immobilisation of the vehicle, whatever the slope).*
«R» Reverse gear.
«N» Neutral.
«D» Drive *(autoadaptative mode, eco-law).*
«M» Manual mode **(M+, M-).**
The vehicle can only be started when the selection lever is in position **«P»** or **«N».**

Shift-Lock

The «shift-lock» is a system which locks the gear selection lever in position **«P»**.
To unlock the gear selection lever from position **«P»**, switch on the ignition and press the brake pedal.
During a repair, the shift-lock can be unlocked by pressing the locking finger **«a»** *(see corresponding operation).*





Engine : XFZ

SHIFT LOCK

- The **shift lock** is a system which locks the selection lever in the park position **«P»**.

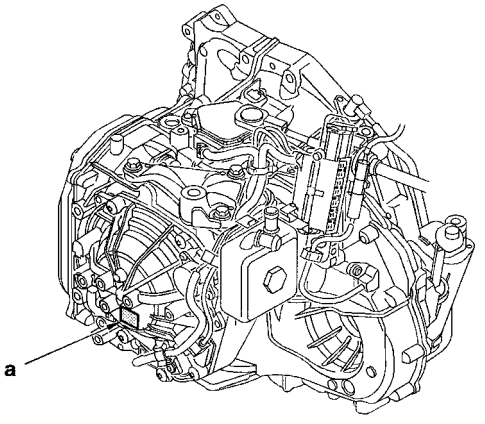
Unlocking the SHIFT LOCK *(in normal operation)*

- Switch on the ignition.
- Press and hold down the brake pedal.
- Using the selection lever, disengage from position **«P»**.

NOTE : It is IMPERATIVE to disengage the gear selection lever from position "P" the minute you start applying the brake pedal. Otherwise, release pressure on the brake pedal and then try again.

Unlocking the SHIFT LOCK *(In the event of a malfunction)*

- Remove the cover **(1)**.
- Unlock the shift lock **(2)** using a screwdriver.
- Using the selection lever, disengage from position **«P»**.

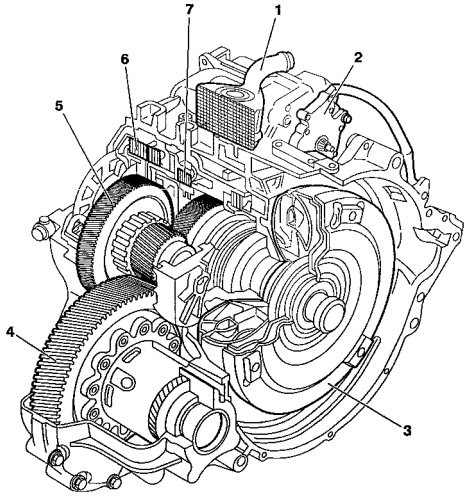


B2CP30ZD

WARNING : CITROEN special semi-synthetic oil cannot be mixed with other oils. The gearbox is lubricated for life.

(a) Component reference.

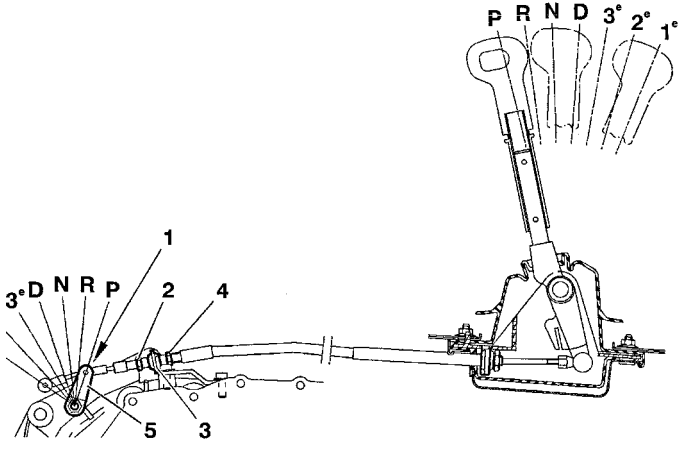
Engine : XFZ



B2CP34VP

(1) Oil/water exchanger.
(2) Selection lever position switch.
(3) Torque converter.
(4) Differential.
(5) Secondary shaft.
(6) Clutch.
(7) Brake.

4 HP 20



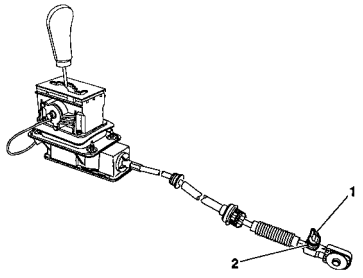
B2CP37FD

Adjusting the selection mechanism.

- Put selection lever **(5)** in position : parking.
- Untighten nut **(2)** and the lock nut **(4)** on either side of the linkage **(3)** so as to connect the ball-joint **(1)** to the selector.
- Apply grease **G9**.
- Tighten the nut **(2)** and the lock nut **(4)** to **1 m.daN**.

Engines : LFY - RFV - DHX - XFZ

4 HP 20



B2CP35FD

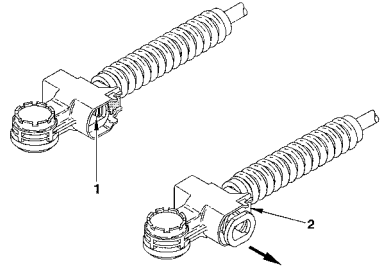
Adjusting the selection mechanism

- If the selection mechanism is **NEW**, pull out the locking key **(1)** 1/4 of a turn.

If the selection mechanism is **OLD** and not set correctly, press on component **(2)**, without flexing the cable, then release.

- Check the passage through all the gears.

AL 4



B2CP37ED

Adjusting the selection mechanism.

- If the selection mechanism is NEW or removed from the vehicle, component **(1)** is locked..

When fitting the selection mechanism, press on component **(2)**, without flexing the cable, then release. *(Component **(1)** unlocks).*

- Check the passage through all the gears.

ALL TYPES	TRANSMISSION - GEARBOX					
		Tightening torque (m.daN)		Gearbox oil seal mandrels		
Gearbox	**Engines**	**Driveshaft bearing**	**Driveshaft nut**	**Right**	**Left**	**Tool kit**
BE3/5	BFZ-LFX-LFY-RFV-RHY	**1**	**32.5**	7114-T.W	7114-T.X	7116-T
BE4/5	RFN					
ME/5	RGX-P8C		**34.5**	9017.T.B	9017-TC	9017-T
ML/5	RGX-XFZ-RHZ		**32.5**	9017.T.C	5701-T.A	**NO**
	RFV-RGX DHX-RHZ-P8C (Synergie)		**10 + 60°**			
MG/5	THY	**1.9**	**34.5**	5708-T.J	5708-T.H	5708-T
4 HP 18	RGX - RFV - P8C	**1**				
AL 4	LFY - RFV - DHX		**32.5**	Seal extractor Right/Left (-) 0338 C		(-) 0338
				(-) 0338 J1 + (-) 0338 J2	(-) 0338 H1 + (-) 0338 H2	
4 HP 20	XFZ			8010-T.K2 + 8010-T.J. Rep. : rouge	8010-T.K1 + 8010-T.J. Rep. : noir	8010-T

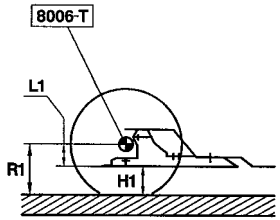
Tightening torque (m da.N) of the wheel bolts : XANTIA - XM = 9 - SYNERGIE = 10.

General conditions required for adjustment

- Check the tyre pressures.
- Parking brake released.
- Manually set the height to the «NORMAL DRIVING» position.
- Engine running

NOTE : After each body movement, and before each measurement :
- Move the vehicle backwards and forwards slightly by pushing the road wheel by hand.

Front height



B3BP12XC

H1 = R1 - L1

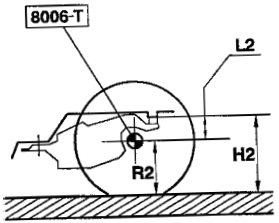
H1 = Front height
All Types **(+ 7 - 10 mm)**
SC CAR **(± 3.5 mm)**
R1 = Wheel radius in mm.
L1 = Theoretical dimension between the front subframe contact surface and the wheel axis.

Example : front height
- Measure dimension **R1** *(centre of the wheel)* on the vehicle.
- Subtract **L1** from **R1** (See the table on page **214**) and calculate **H1**.
- Measure **H1** on the vehicle.
- The measured dimension H1 should be the same as the calculated dimension **H1 (+ 7 - 10 mm)**.
- Adjust the heights if necessary.

Rear height

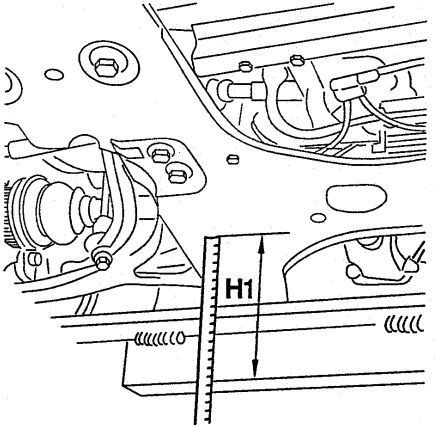
H2 = R2 - L2

H1 = Rear height
All Types **(+ 7 - 10 mm)**
SC CAR **(± 3.5 mm)**
R2 = Wheel radius in mm.
L2 = Theoretical dimension between the bearing surface of the bodyshell and the wheel axis.



B3BP12YC

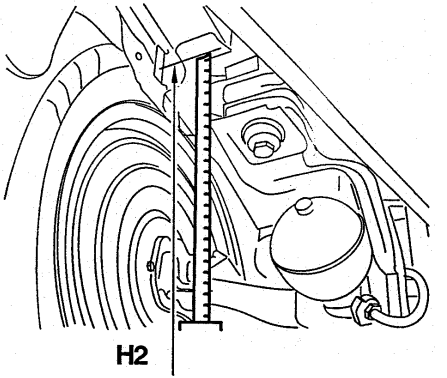
Measuring the front height



B3BP04EC

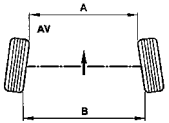
Vehicles	L1 (mm)
All types	121

Measuring the rear height



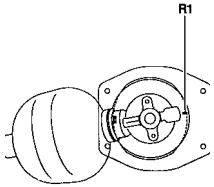
B3BP04GC

Vehicles	L2 (mm)
All types	136



	NOTE	
A < B = Positive figure :	+ =	TOE-IN
A > B = Negative figure :	- =	TOE-OUT

Front axle					Rear axle	
Vehicle	**Tracking**	**Castor**	**Camber**	**King pin inclination**	**Tracking**	**Camber**
		(Non adjustable)			*(Non adjustable)*	
All Types	**0 to - 3 mm** **0° à - 0° 25'**	**3° ± 30'**	**0° ± 30'**	**13° 15' ± 35'**	**+ 1 to + 6 mm** **+ 0°10' to + 0°50'**	**– 1°15' ± 20'**

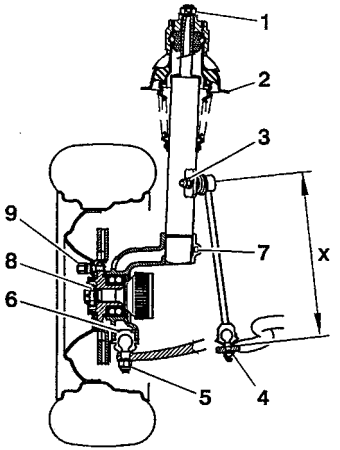


B3CP04LC B3BP00ZC

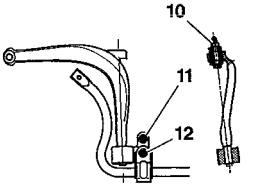
WARNING : The castor angle is determined by the direction of fitting of the pneumatic unit support.

Power-assisted steering

R1 towards the rear of the vehicle.



Hauteur de la biellette :
X = 323 ± 1 mm

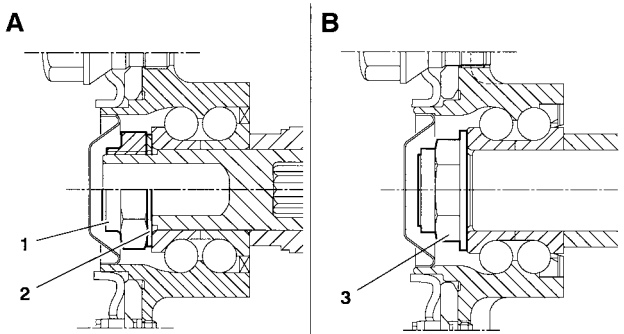


Tightening torques (m.daN)

1 -	Suspension leg upper fixing *(coat with **LOCTITE FRENETANCH**)*	**6.5**
2 -	Suspension leg fixing on bodyshell	**2.5**
3 -	Link rod upper fixing : up to **RPO N° 6615** ball joint stem **Ø 10mm**	**4**
3 -	Link rod upper fixing : from **RPO N° 6616** ball joint stem **Ø 12mm**	**7**
3 -	SC.CAR ram upper fixing	**7**
4 -	Link rod lower fixing : up to **RPO N° 6615** ball joint stem **Ø 10mm**	**4**
4 -	Link rod lower fixing : from **RPO N° 6616** ball joint stem **Ø 12mm**	**7**
4 -	SC.CAR ram lower fixing	**7**
5 -	Ball joint fixing	**4.5**
6 -	Ball joint/swivel fixing	**25**
7 -	Suspension leg fixing on swivel	**5.5**
8 -	Driveshaft fixing on hub	**32**
9 -	Wheel fixing	**9**
10 -	Arm front fixing	**8.5**
11 -	Arm rear fixing	**8.5**
12 -	Arm rear fixing/anti-roll bar rear fixing	**8.5**

Evolution : Rear hub nut

Old → 15/12/1999 (A)	New 15/12/1999 → (B)



B3DP08AD

Evolution :

- New rear hub nut **(3)**.
- Washer discontinued **(2)**.

Old fitting (A)

(1) Rear hub nut.
(2) Thrust washer.
IESSENTIAL : Tighten to : 27.5 ± 2.7 m.daN

New fitting (B)

(3) Rear hub nut.
ESSENTIAL : Tighten to : 25 ± 2.5 m.daN.

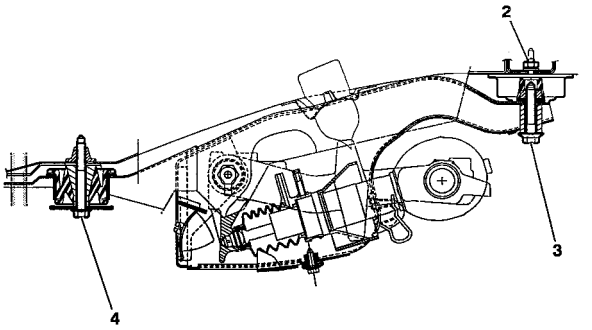
NOTE : It is possible to have both types of fitting on the same axle.

The old nut **(1)** requires the fitting of the thrust washer **(2)**.

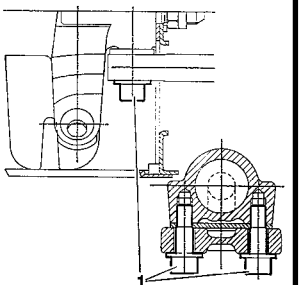
WARNING : do not fit a thrust washer **(2)** with a new nut **(3)**.

ESSENTIAL: Respect the tightening torque to be applied when fitting.

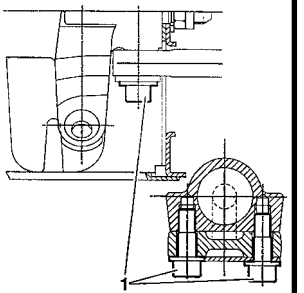
WARNING: Identify the type of fitting, before starting a repair.



Saloon



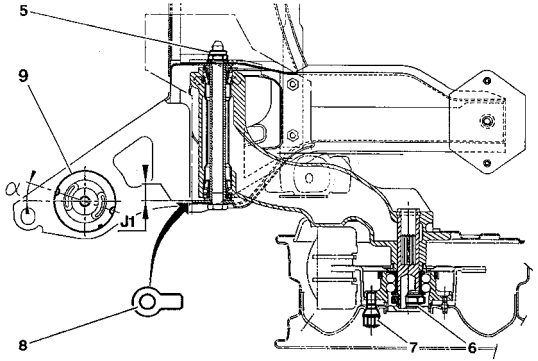
Estate

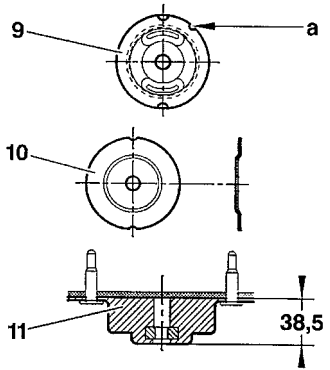


Tightening torques (m.daN)

1 - Anti-roll bar fixing	**9.5**
2 - Rear silentblock/bodyshell fixing	**3.4**
3 - Subframe rear fixing	**11**
4 - Subframe/bodyshell front fixing	**8**

NOTE : (3) and **(4)** Face and threads not lubricated





Tightening torques (m.daN)

5 - Arm/shaft fixing	**13**	**9** - Front runner mountings oriented at 18° (marking: notch at **"a"**).	
6 - Hub/stub fixing	**28**	**10** - Washer	
7 - Wheel fixing	**9**	**11** - Rubber mounting	

Adjustment of a suspension arm

ESSENTIAL :

The clearance «J1» should be equal to or less than 0.5 mm.

It must be obtained using a single shim **(8)**.

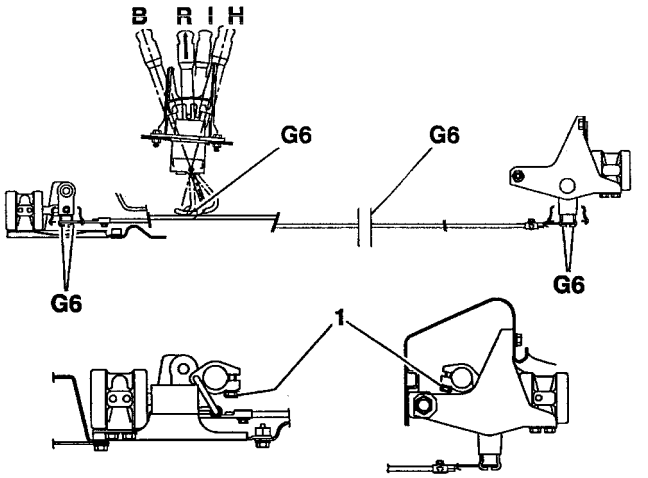
Thickness of available shims :
0.5 - 1 - 1.5 mm.

Selecting the shim thickness (8)

- **J1** less than or equal to **0.5 mm** (No shim **(8)** required).
- **J1> 0.5 mm ;** less than or equal to **1 mm :** (Fit a **0.5 mm** shim)**.**
- **J1> 1 mm** less than or equal to **1.5 mm** (Fit a **1 mm** shim).
- **J1> 1.5 mm**, fit a **1.5 mm** shim.

B3DP02GD B3DP02HC

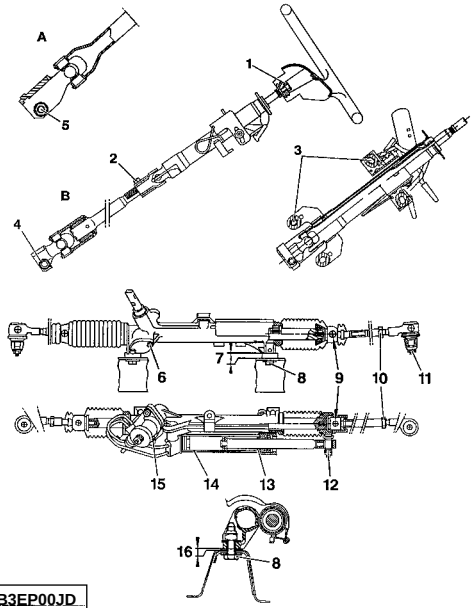
Height control : Saloon and Estate



B3BP12ZD

Engines	Ø Anti-roll bars (mm)	
	Saloons	
	Front	Rear
BFZ - LFX - LFY RFV - DHX - RHY	22	21
RGX - RFN - XFZ - P8C - RHZ	22	22
ACTIVA	28	25
Engines	**Estate**	
	Front	Rear
All Types	23	23

(1) Automatic control clamp
Tighten to **1,5m.daN**
Grease **G6** *(TOTAL MULTIS)*



B3EP001D B3EP00JD

	All Types
Steering	Power-assisted
Pinion (no. of teeth)	8
Rack (no. of teeth)	34
Steering rack travel	74.3

Tightening torques (m.daN)

1	Steering wheel fixing	**3**	**11**	Swivel ball joint fixing	**3.5**
2	Cardan joint fixing	**2**	**12**	Steering rack/ram fixing	**6**
4			**14**	Steering/ram fixing	**9**
5			**15**	Valve/casing fixing	**1.2**
3	Steering column fixing	**1.5**	**13**	Travel limiting stop, fitted to the power- steering : **74.3 mm**	
6	Flange/push-rod fixing	**1**			
7	**9 mm** spacer *(mechanical steering)*				
8	Steering/crossmember fixing	**8**	**16**	**3 mm** spacer *(Power- steering)*	
9	Steering rack ball-joint fixing	**6**			
10	Link-rod lock nuts	**4.5**			

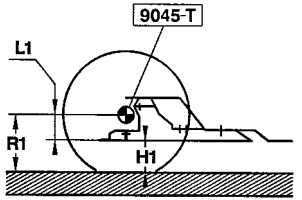
AXLE GEOMETRY — XM

General conditions required for adjustment

- Check the tyre pressures.
- Parking brake released.
- Manually set the height to the «NORMAL DRIVING» position.
- Engine running.

Note : After each body movement, and before each measurement : Move the vehicle backwards and forwards slightly by pushing the road wheel by hand.

Front height



B3BP130C

H1 = R1 – L1

H1 : Front height ***(+7. – 10 mm)***
R1 : Wheel radius in mm.
L1 : Theoretical dimension between the front subframe contact surface and the wheel axis

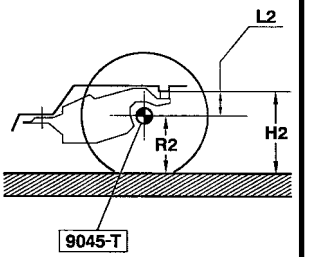
Example : front height

- Measure dimension **R1** *(centre of the wheel)* on the vehicle.
- Subtract **L1** from **R1** (See the table on page **223**) and calculate **H1**.
- Measure **H1** on the vehicle.
- The measured dimension H1 should be the same as the calculated dimension **H1** ***(+ 7. – 10 mm)***
- Adjust the heights if necessary.

Rear height

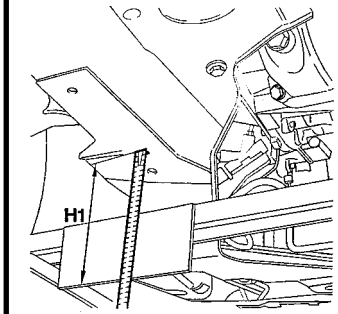
H2 = R2 + L2

H2 : Rear height ***(+7. – 10 mm)***
R2 : Wheel radius in mm.
L2 : heoretical dimension between the bearing surface of the bodyshell and the wheel axis

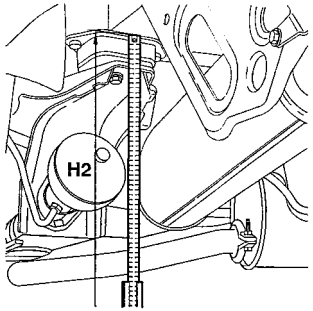


B3BP131C

Front height

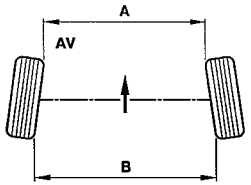


Rear height



All Types (mm)			
L1	141.5	1.2	H2

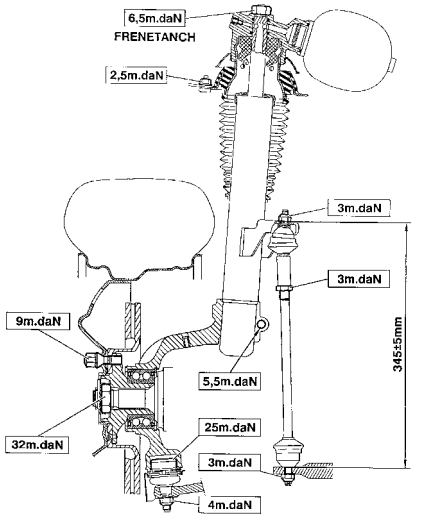
B3BP132C B3BP133C

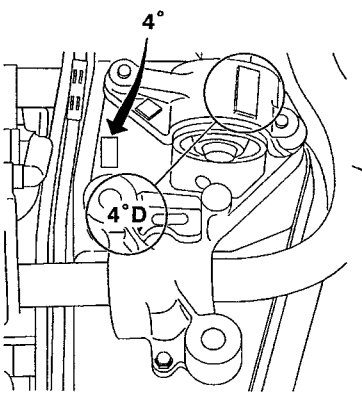


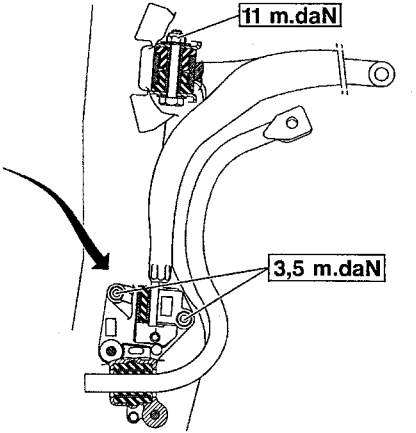
	NOTE	
A < B = Positive figure :	+ =	TOE-IN
A > B = Negative figure :	- =	TOE-OUT

B3BP051D

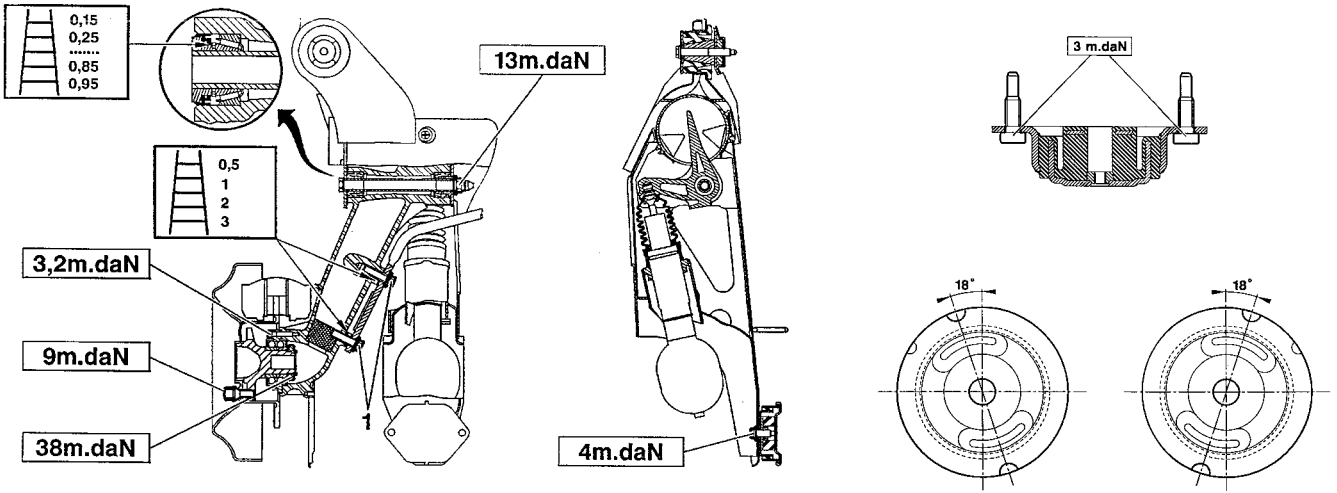
		Front	Rear
Anti-rearing device		4°	
Tracking (Toe in/out)	0°	0° to - 0°27’	+ 0°5’ to + 1°
	mm	0 to - 3	+ 0.5 to + 6.5
Castor angle *(max. left-right difference 30’)*		2°30’ ± 30’	
Camber angle		0° ± 30’	- 0°50’ ± 20’
King pin inclination		13° 15’	



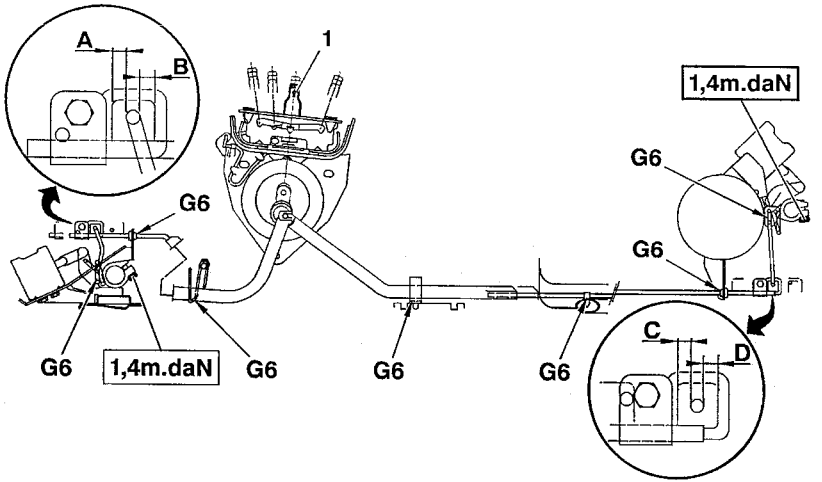


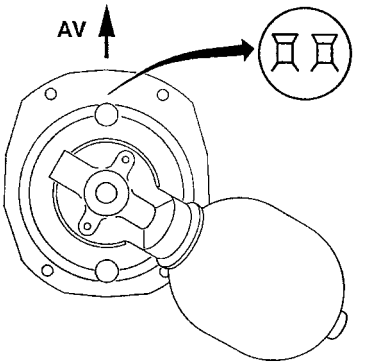


B3CP04NP | B3CP044D



B3DP06MD | B3DP06NC | B3DP06PD





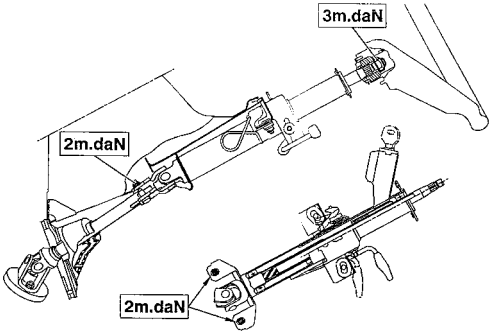
B3BP135D | B3BP134C

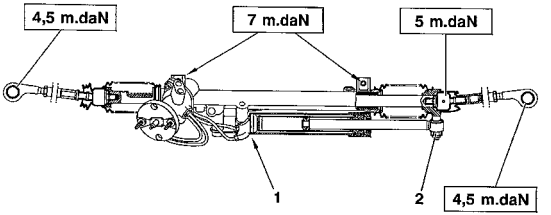
Engines	Ø Anti-roll bars (mm)	
	Saloons	
	Front	Rear
RGX	23	22
RFV	23	21
XFZ - P8C - THY	24	22
Ambulance (P8C)	24	22.5
Engines	Estate	
All Types	Front	Rear
	25	22.5

Engines	Front suspension units	
	Saloons and Estate	
	Ø piston rods	Ø pistons
RFV	22	40
RGX	25	
XFZ		
P8C - THY		

Rear suspension cylinders

Saloons : **Ø 37 mm**.
Estate : **Ø 42.5 mm**





	All Types
Steering	Assistée
Pinion (teeth)	8
Steering rack (teeth)	34
Rack travel	83

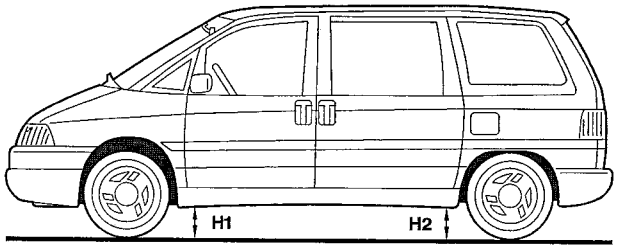
(1) 4 and **6 cm³** rams :
- Tighten to **9 m.daN.**

(2) 4 cm³ ram :
- Tighten to **6 m.daN.**

6 cm³ ram
- Tighten to **9 m.daN.**

B3EP09XD | B3EP09YD

Reference height

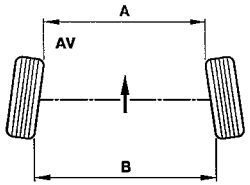


CONDITIONS FOR ADJUSTING THE HEIGHTS
(Tyre pressures correctly set.)

Front	Heights (mm)	Rear
H1	**Tyres**	**H2**
158	195/70R 14	163
161	195/65R 15	166
166	205/65R 15	171

The reference heights must be checked between the jacking points and the ground.

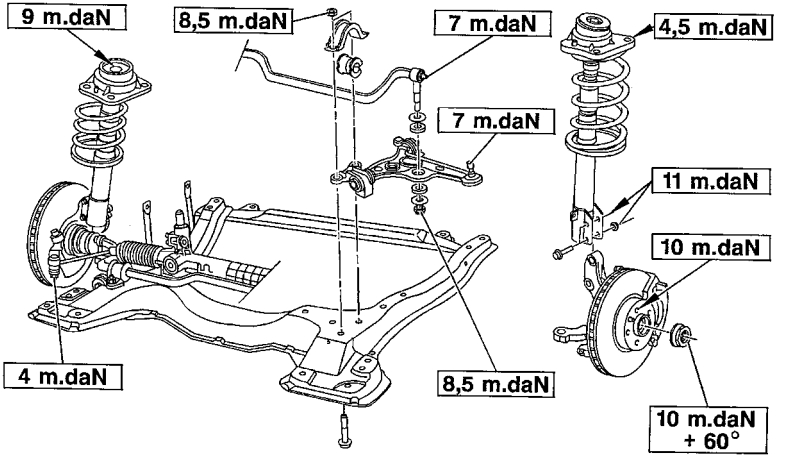
B3BP051D

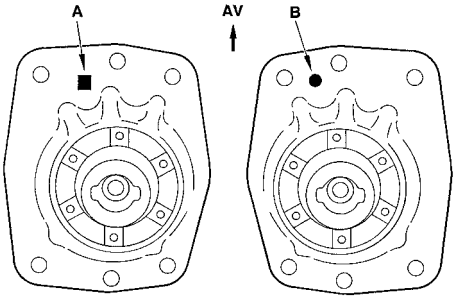


	NOTE	
A < B = Positive figure :	+ =	PINCEMENT
A > B = Negative figure :	- =	TOE-OUT

B3BP051D

		Front	Rear
Tracking *(Toe-in/toe-out)*	0°	+0°8' to +0°25'	
	mm	+1 to +3	
Castor angle max. *(left-right difference : 30')*		3°30' to ± 30'	
Camber angle		0° ± 30'	-1° ± 30'
King pin *(inclination)*		11°28' ± 40'	

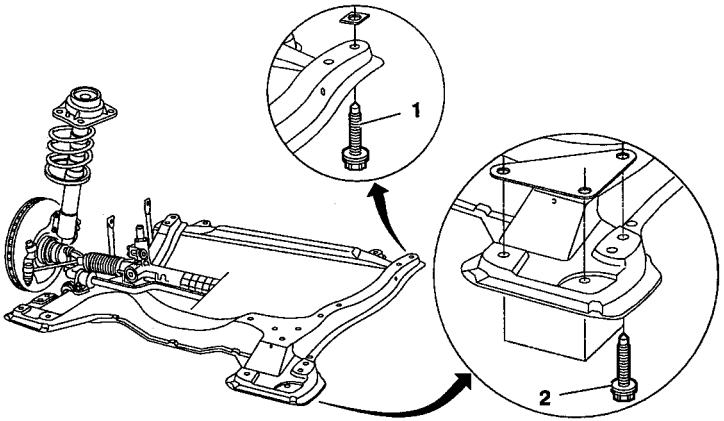




B3CP04PD | B3CP04QD

Evolution : Tightening torque on front subframe

28/05/1999 ➔



B3CP055D

(1) Fixing screw *(front)*.
(2) Fixing screw *(rear)*.

Tightening torque

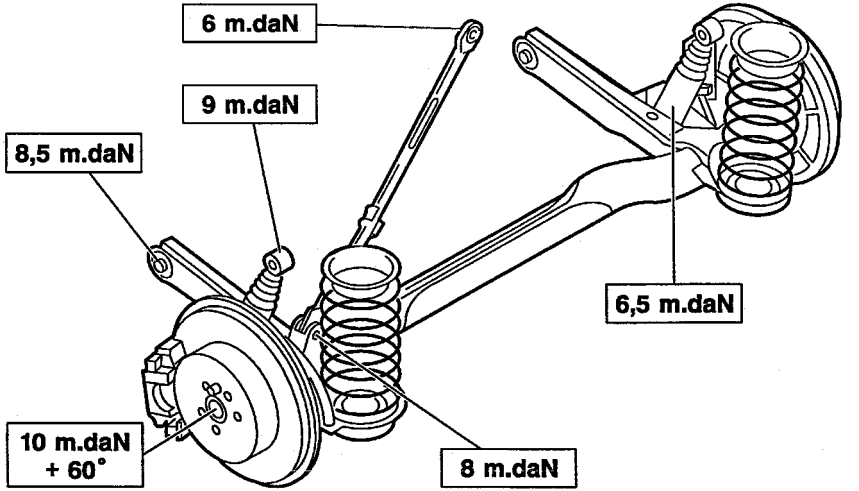
Old fitting

Tighten the screw **(1)** to **13.5 m.daN.**
Tighten the screw **(2)** to **13.5 m.daN.**

New fitting.

Tighten the screw **(1)** to **10.7 m.daN.**
Tighten the screw **(2)** to **10.7 m.daN.**

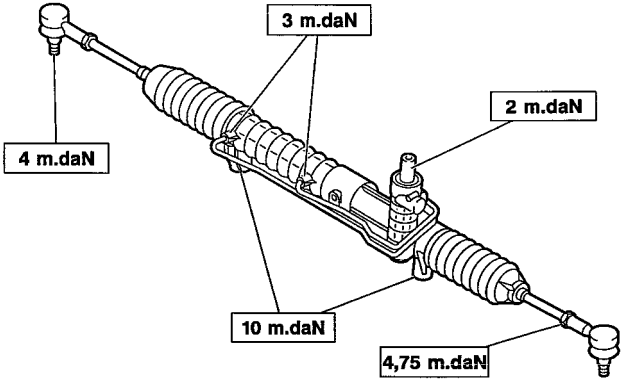
NOTE : Replacement Parts markets the old as well as the new components.



B3DP06QD

			All Types
Shock absorber (ref.)		Ft	F 23
		Rr	F 254
Anti-roll bar Ø (mm)		Ft	25
		Rr	30
Spring (ref.)	Withoutair-con	Ft	1 grey+ 1 yellow
	With air-con		2 grey+ 1 yellow
		Rr	3 yellow

SYNERGIE	STEERING					
	Steering	Steering rack travel (mm)	Number of teeth		Number of turns of the steering wheel	Steering ratio
			Pinion	Steering rack		
All Types	Assisted	152	9	33	2.98	15.75



B3EP09ZD

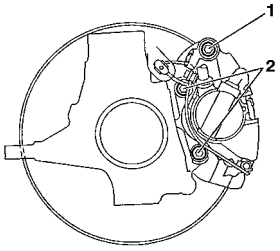
BRAKE SPECIFICATIONS											XANTIA
			2.0i CT	3.0i V6	1.9 TD Auto.	2.0 HDi	1.6i	1.8i	1.8i16V	1.9D	2.0HDi	.0i16V
Ft	Ø mm	Caliper/piston makes	BENDIX SVG-Z0 60				BENDIX 5G 54					
		Disc	288				266					283
	Disc thickness		28				20.4					22
	Minimum disc thickness		26				18.4					20
	Brake pad grade		FERF 949									
Rr	Ø mm	Caliper/piston makes	CITROEN 33									
		Disc	224									
	Disc thickness		9									
	Minimum disc thickness		7									
	Brake pad grade		FERF 949									

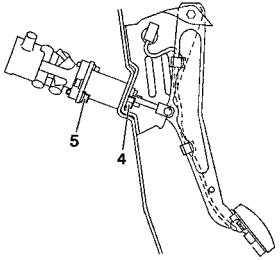
(1) With active anti-roll

XANTIA			BRAKE SPECIFICATIONS							
			2.0i CT	3.0i V6	1.9 TD Auto.	2.0 HDi	1.8i	1.8i 16V	2.0i 16V	2.0 HDi
Ft	Ø mm	Caliper/piston makes	BENDIX SVG-Z0 60				BENDIX 5G 54		BENDIX 5G 57	
		Disc	288				266		283	
	Disc thickness		28				20.4		22	
	Minimum disc thickness		26				18.4		20	
	Brake pad grade		FERF 949							
Rr	Ø mm	Caliper/piston makes	CITROEN 33							
		Disc	224							
	Disc thickness		9							
	Minimum disc thickness		7							
	Brake pad grade		FERF 949							

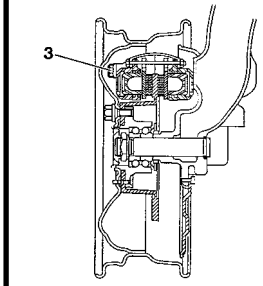
BRAKES — XANTIA

Front





Rear



Tightening torques (m.daN)

- Stud **(1)** = **5**
- Caliper fixing **(2)** = **10.5**

B3FP00QC

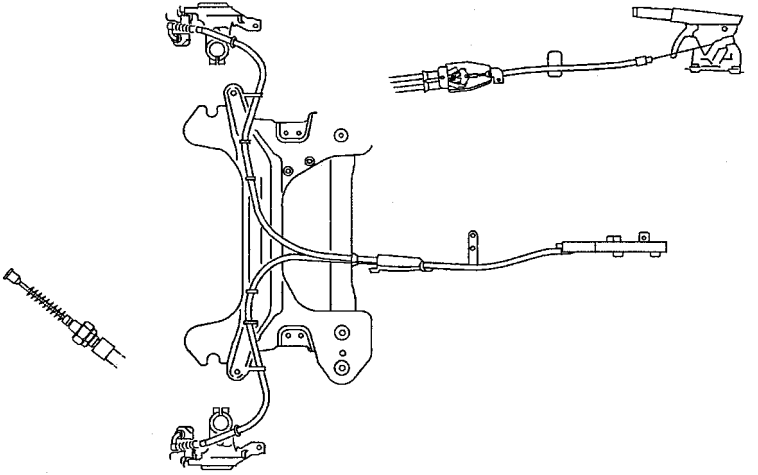
- Fixing to bodyshell **(4)** = **1.5**
- Control valve fixing **(5)** = **2**

B3FP00TC

- Caliper fixing **(3)** = **4.7**

B3FP00SC

XANTIA	HANDBRAKE



B3FP00WD

- The calipers have a handbrake travel self-adjusting mechanism.

NOTE : The handbrake operates on the front wheels.

HANDBRAKE (continued) — XANTIA

Automatic wear adjustment.

Engine running.
Handbrake in the fully released position.
Press the brake pedal **10 times** with an effort of **20 m daN**.
Release the brake pedal.

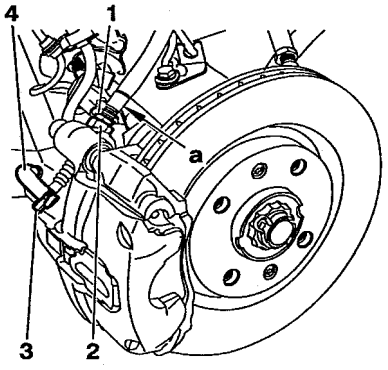
Adjusting the parking brake sheaths.

NOTE : Before carrying out this operation, ensure that the parking brake sheaths are properly bedded-in.

Operate the handbrake lever **10 times** with an effort of **40 m daN**.
- Set the steering in the straight-ahead position.
- Put the handbrake in the fully released position.
- Carry out the following operations on each side of the vehicle :
- Slacken the lock nut **(1)**.
- Put the lock nut **(1)** against its stop at **«a»**.
- Slacken the nut **(2)**.

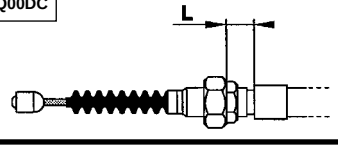
Start adjusting with the right side.
Pull the end-piece **(3)** of the parking brake cable by hand.
Slightly tighten, by hand, the nut **(2)** so that it is against the brake caliper (the end-piece **(3)** should be in contact with the lever **(4)**.
Mark one face of the nut **(2)** using a felt-tip marker pen.
RHD vehicles up to **RPO N° 6375** : Slacken the nut **(2)** by **3 turns**.
LHD vehicles all types, RHD vehicles from **RPO N° 6376** : Slacken the nut **(2)** by **1/2 turn**.
Tighten the lock nut to **3 m.daN**.
Dimension **«L»** should be the same on both sides to within **1.5 mm** *(correct balance of the parking brake equaliser).*

NOTE : With the brake lever at rest, the levers **(4)** must not be pulled by the cables, whatever the steering lock angle and the vehicle height.



B3FP10RC

B3AQ00DC



XANTIA	BLEEDING THE BRAKES

- Bleed the brakes with the suspension in the high position, after having operated the suspension as follows..

Position : **LOW → HIGH → LOW → HIGH.**

- Jack up the vehicle with the road wheels hanging free.

- Remove the wheels.

XANTIA fitted with ABS.

- The circuit bleeding operation can be made easier by activating the hydraulic valve block using the **LEXIA** or **PROXIA** diagnostic stations or the **ELIT** test unit.

- Bleed the brakes in the following order : **- Rear right.**
  - Rear left.
  - Front right.
  - Front left.

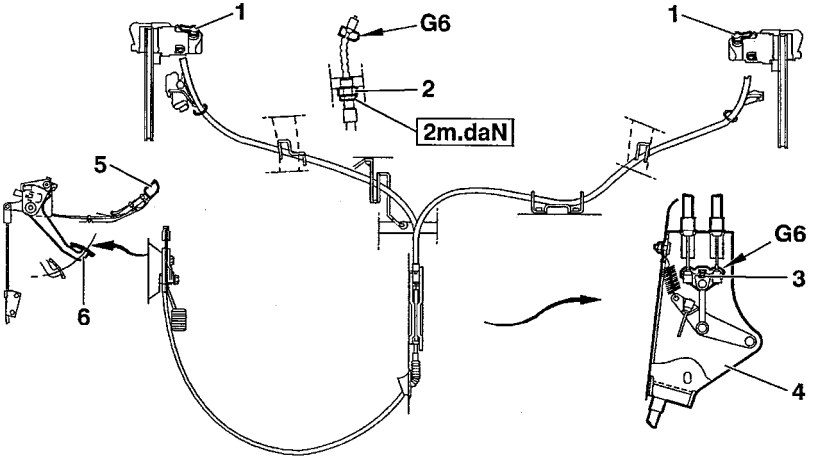
- Engine running.
- Connect the bleed screw to a receptacle using a transparent pipe.
- Press the brake pedal lightly, or load the pedal with a weight of **5** to **6 kg**.
- Slacken the bleed screw, let the fluid escape until it is free of air bubbles.
- Retighten the screw.
- Top up the LHM reservoir

BRAKE SPECIFICATIONS (continued) — XM

			Petrol				Diesel	
			2.0 i Turbo CT 2.0 i 16 V		3.0 i V6		2.1 TD	2.5 TD
			Saloon	Estate	Saloon	Estate	Saloon	
Ft	Ø mm	Caliper/piston makes	BENDIX Série S5G 57		BENDIX Série 5ZO 60		BENDIX Série S5G 57	BENDIX Série 5ZO 60
		Disc	283		288		283	288
	Disc thickness		26		28		26	28
	Minimum disc thickness		24		26		24	26
	Brake pad grade		ABEX-FERF 949					
Rr	Ø mm	Caliper/piston makes	CITROEN 33		CITROEN 33	CITROEN 40	CITROEN 33	CITROEN 40
		Disc	224		232	251	224	251
	Disc thickness		9		9	12	9	12
	Minimum disc thickness		7		7	10	7	10
	Brake pad grade		ABEX-FERF 949					

adjustment

- Apply the main brake pedal so that the brake pads are in contact with the brake discs, release the pressure.
- Set the handle **(5)** to the locked position.
- Press the pedal **(6)** to the **4th notch** of the quadrant.
- Turn the nuts **(2)** to obtain an equaliser **(3)** balance to within **1.5 mm**.
- Unlock the handle **(5)**, the pedal should return to its rest position.
- The levers **(1)**, should not be pulled by the cables, whatever the steering angle and height of the vehicle.
- Tighten the lock nuts to **2 m.daN**.
- Apply the parking brake several times, ensuring it returns to its rest position.
- The pedal should be between the **6th** and **12th notch** of the quadrant.



B3FP10SD

BLEEDING THE BRAKES

XM

All Types

- Bleed the brakes with the suspension in the high position, after having operated the suspension as follows.

Position : **LOW → HIGH → LOW → HIGH.**

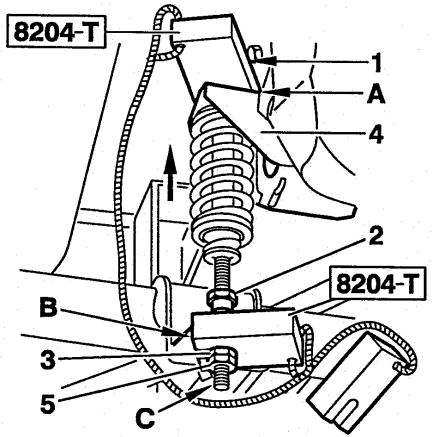
- Bleed the brakes in the following order : **- Rear right.**
  - Rear left.
  - Front right.
  - Front left.

- Engine running.
- Connect the bleed screw to a receptacle using a transparent pipe.
- Press the brake pedal lightly, or load the pedal with a weight of **5** to **6 kg**.
- Slacken the bleed screw, let the fluid escape until it is free of air bubbles.
- Tighten the screw.
- Top up the LHM reservoir.

XM equipped with ABS.

- The circuit bleeding operation can be made easier by activating the hydraulic valve block using the **LEXIA** or **PROXIA** stations or **ELI**T test unit.

SYNERGIE			BRAKE SPECIFICATIONS	
			2 0 HDi	**2.0i 16V**
Ft	**Ø mm**	**Master cylinder**	23.8	
		Master-vac	279	203 + 230 (Tandem)
		Caliper/piston makes	GIRLING C57 57	
		Disc	281 (Ventilated)	
	Disc thickness		26	
	Minimum disc thickness		24	
	Brake pad grade		GALFER 3314	
Rr	**Ø mm**	**Cylinder or caliper**	20.6	36
		Drum	255	
		Disc		295
	x./ min. thickness			10/8
	Make		BENDIX FN 36	
	Brake lining grade		DON 7124	GALFER 36212
	Compensator cut-off in Bars		**Front** 65 - **Rear** brake 65	**Front** brake 85 - **Rear** brake 85



B3FP10TC

Mechanical adjustment of the compensator

- Set the vehicle at reference height (see page **229**).

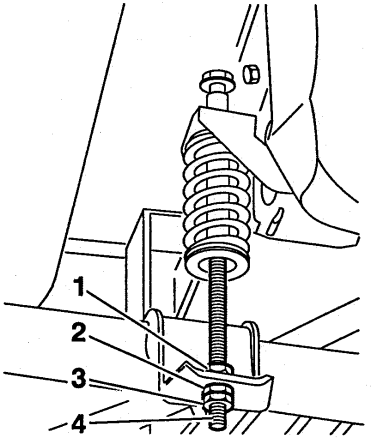
ESSENTIAL : Never alter the position of the upper nut (1).

- Refit the flanged nut **(2)**.
- Fit the tool **8204-T**.

	Drum	Disc
At shim A	Yellow	Blue
At shim B	Red	

- Adjust the nut **(3)** to allow the free passage, without play, of the red shim **(B)**, without moving the lever **(4)** downwards.
- Tighten the lock nut **(5)** without modifying the adjustment.
- Remove the threaded rod at **C**.
- Tighten the flanged nut **(2)** over the nut **(3)**.

BRAKES (continued)



B3FP10UC

Checks and hydraulic adjustment of the compensator

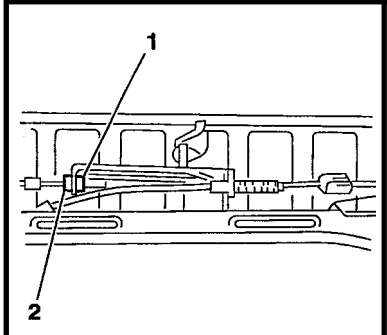
- Use the brake pressure checking equipment **4104-T**, connect diagonally and bleed: **Ø bleed screw :** caliper **8x125** - Wheel cylinder **7x100**.
- Set the vehicle at setting height (See the table on page **229**).

Engines : RFU - DHX P8C		Engine : RGX	
Disc	Drum	Disc	
Front	Rear	Front	Rear
40	40	50	50
65	65	85	85
135	86	135	100

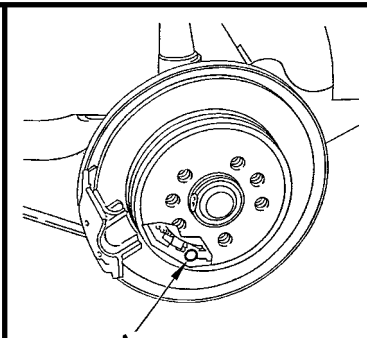
- If the pressures are not correct, adjust as follows :
- Refit the nut **(1)**.
- Adjust using the nut **(2)** to obtain the braking pressure.
- Tighten the lock nut **(3)**.
- Hold the threaded rod **(4)**.
- Tighten the flanged nut **(1)** over the nut **(2)**.

HANDBRAKE

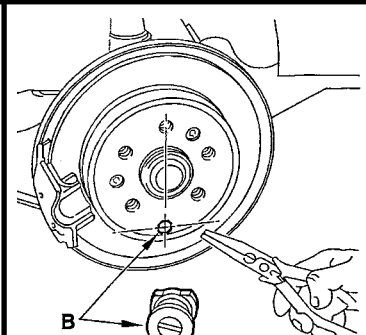
SYNERGIE



B3FP10VC



B3FP10WC



B3FP10XC

- Slacken the cables using the nut **(1)**.
- Remove the blanking plug from hole **A**.
- Position hole **A** opposite the toothed wheel *(adjusting mechanism)*.
- Turn the toothed wheel using a flat screwdriver until the disc locks.
- LH side upwards.
- RH side downwards.
- Unlock the disc by turning in the opposite direction by **6 notches**.
- Position the blade **B** of the blanking plug perpendicular to the line passing through the centre of the disc and the centre of the hole. Tighten the nut **(1)** to obtain a handbrake lever travel of **4** to **5 notches**.
- Tighten the lock nut **(2)**.

ALL TYPES	DE-PRESSURISING THE SUSPENSION CIRCUITS	
	Carry out the following operations	**Consequences**
	Vehicle without hydractive suspension (Without SC.MAC valve)	
1	Height control set to «LOW» position.	The suspension spheres are de-pressurised, wait for the vehicle to lower fully.
2	Unscrew the pressure regulator release screw by 1 turn	The main accumulator is de-pressurised.
	Vehicle without hydractive suspension in running order (With SC.MAC valve)	
1	Start the engine.	Open the SC.MAC valves.
2	Height control set to «LOW» position if the vehicle is on stands : raise the wheel(s) concerned.	The suspension spheres + SC.MAC accumulator are de-pressurised.
3	Unscrew the pressure regulator release screw by 1 turn	The main accumulator is de-pressurised
	Vehicle with hydractive suspension in running order (With or without SC.MAC valve)	
1	Start the engine.	The electrovalves of the hydractive regulators are energised. Open the SC.MAC valves.

DE-PRESSURISING THE SUSPENSION CIRCUITS (continued)		ALL TYPES
	Carry out the following operations	**Consequences**
2	Height control set to «LOW» position if the vehicle is on stands : raise the wheel(s) concerned.	The suspension spheres + hydractive regulator accumulators + SC.MAC regulator are de-pressurised.
3	Unscrew the pressure regulator release screw by 1 turn	The main accumulator is de-pressurised.
	Vehicle with hydractive suspension not in running order (With or without SC.MAC valve)	
1	Unscrew the pressure regulator release screw by 1 turn	The main accumulator is de-pressurised.
2	Height control set to «LOW» position.	The SC.MAC accumulator is de-pressurised.
3	Uncouple the pressure regulator outlet pipe. Couple the outlet pipe with the pump **4135-T** + union(s) or **4034-T** + union **(S)** and **(O)** from tool kit **4146-T**.	
4	Switch on the ignition.	The electrovalves of the hydractive regulators are energised.

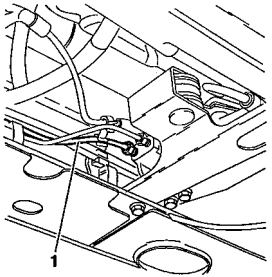
ALL TYPES	DE-PRESSURISING THE SUSPENSION CIRCUITS (continued)	
	Carry out the following operations	**Consequences**
5	Establish a pressure of **150** to **180 Bars** if the vehicle is on stands : raise the wheel(s) concerned.	The suspension spheres + hydractive regulator accumulators are de-pressurised.
6	Open the bleed screw of the pump **4135-T** or **4034-T**, remove the tools.	The supply circuit is de-pressurised.
	Vehicle with SC.CAR, Citroën Active Roll Control, in running order	
1	Start the engine	The electrovalves of the hydractive regulators are energised, and the SC.MAC valves are opened.
2	Height control set to «LOW» position.	The suspension spheres + hydractive regulator accumulators + SC.MAC regulator are de-pressurised.
3	Stop the engine.	
4	Unscrew the pressure regulator release screw by 1 turn.	The main accumulator is de-pressurised.
5	Open the SC.CAR regulator bleed screw.	The SC.CAR regulator accumulator is de-pressurised.

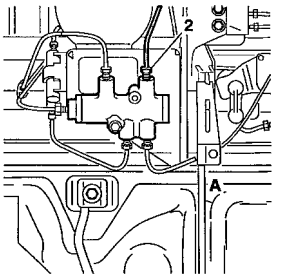
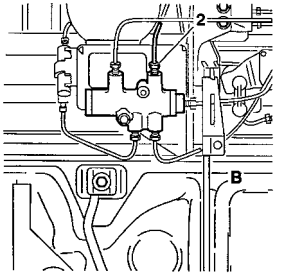
DE-PRESSURISING THE SUSPENSION CIRCUITS (continued)		ALL TYPES
	Carry out the following operations	**Consequences**
6	Activate **4** to **5** times alternately the two SC.CAR corrector link rods.	The SC.CAR accumulator is de-pressurised.
	Vehicle with SC.CAR, Citroën Active Roll Control, not in running order	
1	Unscrew the pressure regulator release screw by 1 turn.	The main accumulator is de-pressurised.
2	Height control set to «LOW» position.	The SC.MAC accumulator is de-pressurised.
3	Open the SC.CAR regulator bleed screw.	The SC.CAR regulator accumulator is de-pressurised.
4	Activate **4** to **5** times alternately the two SC.CAR corrector link rods.	The SC.CAR accumulator is de-pressurised.
5	Uncouple the SC.CAR accumulator supply pipe, plug the pipe using the unions **4146-T (M)** and **(V)**.	
6	Uncouple the pressure regulator outlet pipe, couple the pipe to the pump **4135-T** + **4146-T.S** or **4034-T** + **4136-T (S)** and **(O)**.	

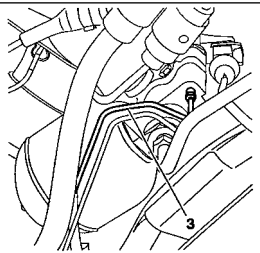
ALL TYPES	DE-PRESSURISING THE SUSPENSION CIRCUITS (continued)	
	Carry out the following operations	**Consequences**
7	Switch on the ignition.	The electrovalves of the hydractive regulators are energised.
8	Establish a pressure of **150** to **180 Bars** if the vehicle is on stands : raise the wheel(s) concerned.	The suspension spheres + hydractive regulator accumulators are de-pressurised.
9	Open the bleed screw of the pump **4135-T** or **4034-T**, remove the tools.	The supply circuit is de-pressurised.

DE-PRESSURISING THE SUSPENSION CIRCUITS (continued) — ALL TYPES

SPECIFIC CASES
The suspension can be de-pressurised on each axle individually.
ESSENTIAL : The height corrector must be operated in the «LOW» position.

	Carry out the following operations	Consequences
	Vehicle with or without hydractive suspension - Front axle (With SC.MAC valves)	
1	Unscrew the pressure regulator release screw by **1 turn**.	The main accumulator is de-pressurised.
2	Uncouple the pressure inlet pipe **(1)** from the height corrector. Connect the pump **4135-T** or **4034-T - 4146-T.O.**	 B3BP136C
3	Hydractive Vehicle : Switch on the ignition.	The electrovalves of the hydractive regulators are energised.

ALL TYPES	DE-PRESSURISING THE SUSPENSION CIRCUITS (continued)		
	Carry out the following operations	**Consequences**	
4	Establish a pressure (**100** to **180 Bars**) to control the slide valves of the SC.MAC valve and hydractive regulator.	The suspension spheres + hydractive regulator accumulators + SC.MAC accumulator (front suspension settling) are de-pressurised.	
5	Open the bleed screw of the pump **4135-T** or **4034-T**, remove the tools.	The supply circuit is de-pressurised.	
	Vehicle with or without hydractive suspension - Rear axle (With SC.MAC valves)		
1	Unscrew the pressure regulator release screw by 1 turn.	The main accumulator is de-pressurised.	
2	Uncouple the pipe **(2)** of the SC.MAC valve. Couple the pump **4135-T** or **4034-T.O + 4146-T.O** to the SC/MAC valve.	 **A =** Without hydractive	 **B =** With hydractive
	B3BP137C B3BP138C		

DE-PRESSURISING THE SUSPENSION CIRCUITS (continued)		ALL TYPES
	Carry out the following operations	**Consequences**
3	Vehicle with hydractive suspension : switch on the ignition	The electrovalves of the hydractive regulators are energised.
4	Establish a pressure (**80** to **180 Bars)** to control the slide valves of the SC.MAC valve and hydractive regulator.	The suspension spheres + hydractive regulator accumulators + SC.MAC accumulator (front suspension settling) are de-pressurised.
5	Open the bleed screw of the pump **4135-T** or **4034-T**, remove the tools.	The supply circuit is de-pressurised.
	Vehicle with hydractive suspension (without SC.MAC valve) Work on the hydractive regulator which controls the axle to be repaired.	
1	Unscrew the pressure regulator release screw by 1 turn.	The main accumulator is de-pressurised.
2	Uncouple the pipe **(3)** of the hydractive regulator. Couple the pump **4135-T** or **4034-T** + **4146-T.O.**	 B3BP139C

ALL TYPES	DE-PRESSURISING THE SUSPENSION CIRCUITS (continued)	
	Carry out the following operations	**Consequences**
3	Switch on the ignition.	The electrovalves of the hydractive regulators are energised.
4	Establish a pressure (**80** to **180 Bars**) to control the slide valves of the hydractive regulator.	The suspension spheres + hydractive regulator accumulators (suspension settling) are de-pressurised.
5	Open the bleed screw of the pump **4135-T** or **4034-T**, remove the tools.	The supply circuit is de-pressurised.
	Vehicle with SC.CAR: Citroën Active Roll Control	
1	Unscrew the pressure regulator release screw by 1 turn.	The main accumulator is de-pressurised
2	Height control set to «LOW» position.	The SC.MAC accumulator is de-pressurised.
3	Open the SC.CAR regulator bleed screw.	The SC.CAR regulator accumulator is de-pressurised.
4	Activate **4** to **5** times alternately the two SC.CAR corrector link rods.	The SC.CAR accumulator is de-pressurised

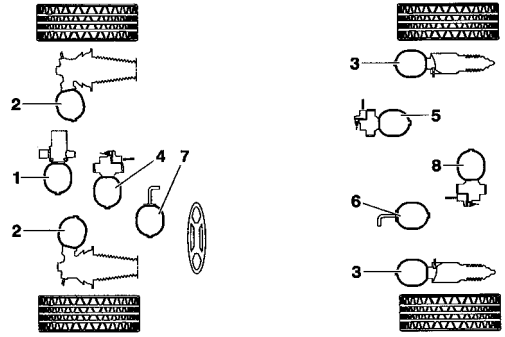
DE-PRESSURISING THE SUSPENSION CIRCUITS (continued)		ALL TYPES
	Carry out the following operations	**Consequences**
5	Uncouple the SC.CAR accumulator supply pipe, plug the pipe with the unions **4146-T.M** and **V**.	
	Front suspension : special case (without SC.MAC valve) (See page 242)	
	Rear suspsion : special case (without SC.MAC valve) (See page 240)	

FILLING AND BLEEDING THE SUSPENSION CIRCUITS (continued)

	Carry out the following operations	Consequences
1	LHM fluid level to the max. mark.	
2	Loosen the pressure regulator release screw.	
3	Start the engine.	
4	Tighten and slacken the pressure regulator release screw several times, then retighten it.	Priming of the high pressure (HP) pump.
5	Height control set to «HIGH» position.	Wait for the vehicle to rise fully.
6	Top up the level : engine running, vehicle in the high position.	LHM fluid topped up.

PNEUMATIC UNITS – DAMPERS

XANTIA



B4BP017D

(1) Main accumulator.
(2) Front suspension sphere
(3) Rear suspension sphere
(4) Front hydractive regulator accumulator
(5) Rear hydractive regulator accumulator.
(6) SC..MAC accumulator
(7) SC.CAR accumulator.
(8) SC.CAR regulator accumulator

Diaphragm types :
- **D** = Desmopan
- **U** = Urepan
- **M** = Multi-layer

WARNING : The pneumatic unit nos. shown in the tables ARE NOT REPLACEMENT PART NOS.

	MAIN ACCUMULATOR (1)				
Vehicle	**Pneumatic unit nos.**		**Volume (cc)**	**Pressure (bars)**	**Damper**
All types accept SC.CAR	96 154 588	D	400	62 (+5 ; – 32)	None
	95 451 376	U			
SC.CAR	95 437 354	D			

(*) SC.CAR : Citroen Active Roll Control - SC.MAC : Citroen Anti-Sink

XANTIA	PNEUMATIC UNITS – DAMPERS

NON-HYDRACTIVE SUSPENSION

Front suspension sphere (2)

Vehicle type	Pneumatic unit nos.		Volume (cc)	Pressure (bars)	Damper hole diameter mm
All Types	96 178 589	D	400	55 (+5 ; – 20)	1.5
	96 194 444	U			
	96 199 318	M	450	50	

Rear suspension sphere (3)

Vehicle type	Pneumatic unit nos.		Volume (cc)	Pressure (bars)	Damper hole diameter mm
Saloon	96 238 977	D	400	30 (+5 ; – 10)	1.2
	96 239 023	U			
Estate	96 239 029	D		40 (+5 ; – 10)	1.25
	96 239 028	U			

SC.MAC accumulator (6) **NOTE :** This pneumatic unit is located at the rear of the vehicle.

Vehicle type	Pneumatic unit nos.		Volume (cc)	Pressure (bars)	Damper
All Types	96 145 672	D	400	50 (+5 ; – 20)	None
	96 198 613	U			

SC.MAC : Citroen Anti-Sink

PNEUMATIC UNITS – DAMPERS — XANTIA

HYDRACTIVE SUSPENSION

Front suspension sphere (2)

Vehicle type	Pneumatic unit nos.		Volume (cc)	Pressure (bars)	Damper hole diameter mm
All Types	96 238 949	M	450	45	0.7

Rear suspension sphere (3)

Vehicle type	Pneumatic unit nos.		Volume (cc)	Pressure (bars)	Damper hole diameter mm
Saloon	96 238 951	D	400	30 (+5 ; – 10)	0.6
	96 238 950	U			
Estate	96 239 027	D	500	40 (+5 ; – 10)	0.8
	96 239 026	U	400		

Hydractive regulator accumulator. **NOTE: (*)** The dampers are incorporated in the hydractive regulator.

Vehicle	Hydractive regulator (Axle)	Pneumatic unit nos.		Volume (cc)	Pressure (bars)	* Damper hole diameter (mm)
All types (except V6)	**Front (4)**	96 181 131	M	450	75	1.1
V6		96 281 798			70	1.2
All Types	**Rear (5)**	96 045 530	U	400	50 (+5 ; – 20)	1.3

XANTIA	PNEUMATIC UNITS – DAMPERS

HYDRACTIVE SUSPENSION (Continued)

SC.MAC accumulator (6) **NOTE :** This pneumatic unit is located at the rear of the vehicle.

Vehicle type	Pneumatic unit nos.		Volume (cc)	Pressure (bars)	Amortisseur
All Types	96 145 672	D	400	50 (+5 ; – 20)	None
	96 198 613	U			

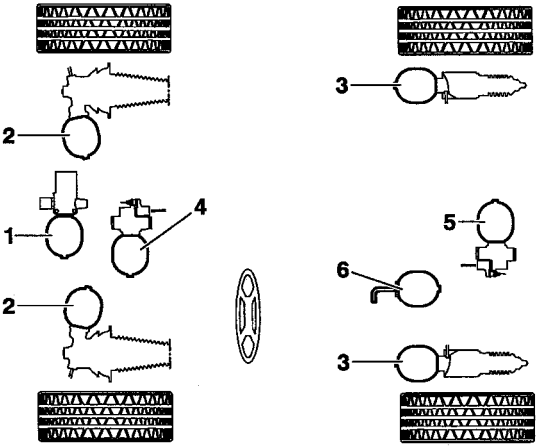
SUSPENSION SC.CAR (*)

Suspension sphere. **NOTE : (*) SC.CAR : Citroen Active Roll Control**

Vehicle ACTIVA	Cylinder	Pneumatic unit nos.		Volume (cc)	Pressure (bars)	* Damper hole diameter (mm)
All types (except V6)	Front (2)	96 221 189	M	450	45	0.7
V6 Manual Gearbox		96 289 689			40	
All types (except V6)	Rear (3)	96 222 870	U	400	30 (+5 ; – 10)	0.7
V6 Manual Gearbox		96 289 687				0.6

PNEUMATIC UNITS – DAMPERS						XANTIA
	SUSPENSION SC.CAR (*)					
Hydractive regulator accumulator. **NOTE: (*)** The dampers are incorporated in the hydractive regulator.						
Hydractive regulator	**Pneumatic unit nos.**	**Volume (cc)**	**Pressure (bars)**	**Damper hole diameter mm**		
Vehicle ACTIVA	**Hydractive regulator (Axle)**	**Pneumatic unit nos.**		**Volume (cm^3)**	**Pressure (bars)**	*** Damper hole diameter (mm)**
All Types (Except V6)	**Front (4)**	96 181 131	M	450	75	1.1
V6 Manual gearbox		96 281 798			70	1.2
All Types	**Rear (5)**	96 221 207	U	400	55 (+5 ; – 10)	1.1
Additional accumulator						
Type	**Pneumatic unit nos.**			**Volume (cc)**	**Pressure (bars)**	
SC.MAC accumulator **(6)**	96 198 613	D		400	50 (+5 ; – 20)	
SC.CAR accumulator **(7)**	96 212 198	U			62 (+5 ; – 32)	
SC.CAR accumulator regulator						
Regulator	**Pneumatic unit nos.**			**Volume (cc)**	**Pressure (bars)**	
SC.CAR **(8)**	96 208 710	U		400	30 (+5 ; – 10)	

XM	PNEUMATIC UNITS – DAMPERS



B4BP018D

(1) Main accumulator.
(2) Front suspension sphere
(3) Rear suspension sphere
(4) Front hydractive regulator accumulator
(5) Rear hydractive regulator accumulato
(6) SC.MAC accumulator

Diaphragm types :
- **D** = Desmopan
- **U** = Urepan
- **M** = Multi-layer

NOTA : SC.MAC : Citroen Anti-Sink

WARNING : |The pneumatic unit nos. shown in the tables ARE NOT REPLACEMENT PART NOS.

	MAIN ACCUMULATOR (1)				
Vehicle	**Pneumatic unit nos.**		**Volume (cc)**	**Pressure (bars)**	**Damper**
All Types	95 451 376	U	400	62 (+5 ; – 32)	None

PNEUMATIC UNITS – DAMPERS — XM

NON-HYDRACTIVE SUSPENSION

Front suspension sphere (2)

Vehicle type	Pneumatic unit nos.		Volume (cc)	Pressure (bars)	Damper hole diameter mm
Saloon and Estate (Except 2.1 DT)	96 051 819	D	400	70 (+5 ; – 25)	1.65
	96 222 864	M	450	65	
Estate All Types (Except 2.1TD)	96 069 918	D	400	70 (+5 ; – 25)	1.4
	96 212 110	M	450	65	
Saloon and Estate 2.1 TD	96 222 866	D	400	70 (+5 ; – 25)	1.65
	96 222 865	M	450	65	

Rear suspension sphere (3)

Vehicle type	Pneumatic unit nos.		Volume (cc)	Pressure (bars)	Damper hole diameter mm
Saloon All Types	96 222 874	D	400	40 (+5 ; – 15)	1.25
	96 222 873	U			
Estate All Types	96 120 324	U	500		1.5

SC.MAC accumulator (6) **NOTE :** This pneumatic unit is located at the rear of the vehicle..

Vehicle type	Pneumatic unit nos.		Volume (cc)	Pressure (bars)	Damper
Saloon and Estate	96 198 613	U	400	50 (+5 ; – 20)	None

HYDRACTIVE SUSPENSION

Front suspension sphere (2)

Vehicle type	Pneumatic unit nos.		Volume (cc)	Pressure (bars)	Damper hole diameter mm
Saloon/Estate TT (Except V6)	96 222 867	M	450	50 (+5 ; – 20)	0.8
Saloon/Estate V6	96 290 048			40 (+5 ; –15)	0.7

Rear suspension sphere (3)

Vehicle type	Pneumatic unit nos.		Volume (cc)	Pressure (bars)	Damper hole diameter mm
Saloon All Types Except V6)	96 222 871	D	400	30 (+5 ; – 15)	0.7
	96 222 870	U			
Saloon/Estate V6	96 238 950				0.6
Estate All Types (Except : V6 2.5 TD)	96 222 872	U		40 (+5 ; – 15)	0.7

HYDRACTIVE SUSPENSION (continued)

Hydractive regulator accumulator. **NOTE : The dampers are incorporated in the hydractive regulator.**

Vehicle type	Pneumatic unit nos.		Volume (cc)	Pressure (bars)	Damper hole diameter mm
Saloon/Estate 2.0 i 16 V	96 181 131	M	450	75	1.25
Saloon/Estate **(4)** (Except 2.0 i 16 V)	96 281 798			70	
Saloon **(5)**	96 045 530	U	400	50 (+5 ; – 20)	
Estate **(5)**	96 468 115		500	40 (+5 ; – 15)	

SC.MAC accumulator (6) **NOTE : This pneumatic unit is located at the rear of the vehicle**

Vehicle type	Pneumatic unit nos.		Volume (cc)	Pressure (bars)	Damper
2.0 i - 2.5 TD - 2.1 TD 2.0 i Turbo - CT	96 198 613	U	400	50 (+5 ; – 20)	None

XANTIA		STARTER MOTORS		
Vehicles / models		**Manufacturer and Ref.**	**Class**	**Climate**
XANTIA	1.6i / 1.8i 1.8i 16v	VALEO D6 RA 661	3	H,T
		BOSCH 107019		C
		BOSCH 1108084	4	VC
	1.8i 16v (Auto.) 2.0i 16v	VALEO D6 RA 661	3	H,T
		BOSCH 107019		
		BOSCH 1108084	4	C,VC
	3.0i V6	VALEO D7 R17		H,T,C,VC
	1.9TD 2.0i HDi	VALEO D7 R8	5	H,T
		MELCO M001T80082		
		VALEO D7 R12	6	C,VC

CLIMATE : T (Temperate), **H** (Hot), **C** (Cold), **VC** (Very Cold)

STARTER MOTORS				XM
Vehicles / models		**Manufacturer and Ref.**	**Class**	**Climate**
XM	**2.0i 16v** **2.0i Turbo CT (Auto.)**	VALEO D6 RA 661	3	H,T
		BOSCH 107019		
		BOSCH 1108084	4	C,VC
	2.0i Turbo CT	VALEO D6 RA 661	3	H,T
		BOSCH 107019		C
		BOSCH 1108084	4	VC
	3.0i V6	VALEO D7 R17		H,T,C,VC
	2.1 TD	VALEO D7 R8	5	H,T
		MELCO M001T80082		
		VALEO D7 R12	6	C,VC
	2.5 TD	MELCO M002T84771		H,T,C,VC

CLIMATE : T (Temperate), **H** (Hot), **C** (Cold), **VC** (Very Cold)

SYNERGIE	STARTER MOTORS			
Vehicles / models		**Manufacturer and Ref.**	**Class**	**Climate**
SYNERGIE	**2.0i 16v**	VALEO D6 RA 661	3	H,T
		BOSCH 107019		C
		BOSCH 1108084	4	VC
	2.0 Hdi **2.0 16v Hdi**	VALEO D7 R26	5	H,T
		MELCO M001T80082		
		VALEO D7 R27	6	C,VC

Classes of starter motors

CLASS	CLASS 2	CLASS 3	CLASS 4	CLASS 5	CLASS 6
Torque C	5.5 Nm	6 Nm	10 Nm	11.5 Nm	11.5 Nm
Maximum current for a speed of 1200 rpm	I £ 275 A	I ≤ 300 A	I ≤ 430 A	I ≤ 470 A	I ≤ 500 A

CLIMATE : T (Temperate), **H** (Hot), **C** (Cold), **VC** (Very Cold)

ALTERNATORS								ALL TYPES
		Classes and types						
Engine	Gbox.	Without air con.		Climate	With air con.			Climate
1.6i	M	7	VALEO A11 VI 57	H	9	VALEO A13 VI 191		H
			BOSCH A120310104			MELCO A003TA0591		
		8	MELCO A002TA0291	T,C	8	MELCO A002TA0291		T,C,VC
			VALEO A13 VI 189			VALEO A13 VI 189		
		9	VALEO A13 VI 191	VC				
			MELCO A003TA0591					
1.8i 2.0i 16v	M	7	BOSCH A120411525	H	9	VALEO A13 VI 101+		H,T,C
		8	BOSCH A120411523	T,C		MELCO A002TA2091		VC
			MELCO A002TA1991					
			VALEO A13 VI 102					
		9	VALEO A13 VI 101+	VC				
			MELCO A002TA2091					

CLIMATE : T (Temperate), **H** (Hot), **C** (Cold), **VC** (Very Cold)

ALL TYPES	ALTERNATORS						
	Classes and types						
Engine	Gbox.	Without air con.		Climate	With air con.		Climate
1.8i 16v	M	7	BOSCH A120411525	H	9	VALEO A13 VI 101+	H,T,VC
		8	BOSCH A120411523	T,C		MELCO A002TA2091	
			MELCO A002TA1991		8	BOSCH A120411523	C
			VALEO A13 VI 102			MELCO A002TA1991	
		9	VALEO A13 VI 101+	VC		VALEO A13 VI 102	
			MELCO A002TA2091				
1.8i 16v 2.0i 16v	A	9	VALEO A13 VI 101+	T	12	VALEO A14 VI 14	H
			MELCO A002TA2091	C,VC	9	VALEO A13 VI 101+	T,C,VC
		8	BOSCH A120411523	H		MELCO A002TA2091	
			MELCO A002TA1991				
			VALEO A13 VI 102				

CLIMATE : T (Temperate), **H** (Hot), **C** (Cold), **VC** (Very Cold)

ALTERNATORS								ALL TYPES
		Classes and types						
Engine	Gbox.	Without air con.		Climate	With air con.			Climate
3.0i V6	M				12	VALEO A14 VI 24		H,T,C VC
1.9 TD	M	8	BOSCH A120411513	H,T	9	VALEO A13 VI 94+		H,T
			VALEO A13 VI 95			MELCO A002TA2094		C,VC
			MELCO A002TA1994					
		9	VALEO A13 VI 94+	C,VC				
			MELCO A002TA2094					
	A		VALEO A13 VI 94+	H,T	12	VALEO A13 VI 13		C,VC
			MELCO A002TA2094	C,VC		MELCO A003TA5591		
					9	VALEO A13 VI 94+		T
						MELCO A002TA2094		
					15	VALEO A14 VI 27+		H
						BOSCH A12051611		
						MELCO A004TF0091		

CLIMATE : T (Temperate), **H** (Hot), **C** (Cold), **VC** (Very Cold)

ALL TYPES	ALTERNATORS						
	Classes and types						
Engine	Gbox.	Without air con.		Climate	With air con.		Climate
2.0 HDi	M	15	VALEO A14 VI 27+	H,T,C,VC	15	VALEO A14 VI 27+	H,T,C VC
			BOSCH A12051611			BOSCH A12051611	
			MELCO A004TF0091			MELCO A004TF0091	

CLIMATE : T (Temperate), **H** (Hot), **C** (Cold), **VC** (Very Cold)

ALTERNATORS							ALL TYPES
		Classes and types					
Engine	Gbox.	Without air con.		Climate	With air con.		Climate
2.0i Turbo CT	M	9	VALEO A13 VI 191	H,T	15	VALEO A14 VI 15+	H
			MELCO A003TA0591	C,VC	12	MELCO A004TA0091	T
					9	VALEO A13 VI 191	C,VC
						MELCO A003TA0591	
	A	9	VALEO A13 VI 191	H,T	15	VALEO A14 VI 15+	H,T
			MELCO A003TA0591	C,VC	9	VALEO A13 VI 191	C,VC
						MELCO A003TA0591	
2.0i 16v	M	9	VALEO A13 VI 101+	H,T	12	VALEO A14 VI 14	H,T
			MELCO A002TA2091	C,VC	9	VALEO A13 VI 101+	C,VC
						MELCO A002TA2091	
	A	9	VALEO A13 VI 101+	H,T	15	VALEO A14 VI 15+	H,T
			MELCO A002TA2091	C,VC	9	VALEO A13 VI 101+	C,VC
						MELCO A002TA2091	
3.0i V6	M/A				15	VALEO A14 VI 25+	H,T,C VC

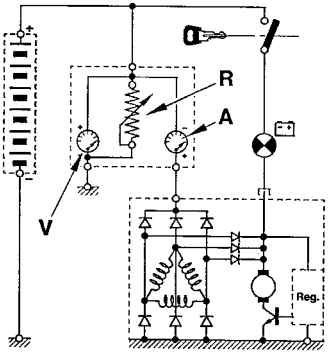
CLIMATE : T (Temperate), **H** (Hot), **C** (Cold), **VC** (Very Cold)

ALL TYPES	ALTERNATORS						
	Classes and types						
Engine	Gbox.	Without air con.		Climate	With air con.		Climate
2.1 TD	M	12	VALEO A14 VI 13	H,T	15	VALEO A14 VI 16+	T
				C,VC	12	VALEO A14 VI 13	C,VC
	A	12	VALEO A14 VI 13	H,T	12	VALEO A14 VI 13	T
				C,VC			C,VC
2.5 TD	M	12	VALEO A14 VI 13	H,T	12	VALEO A14 VI 13	T
				C,VC			C,VC

CLIMATE : T (Temperate), **H** (Hot), **C** (Cold), **VC** (Very Cold)

ALTERNATORS								ALL TYPES
		Classes and types						
Engine	Gbox.	Without air con.		Climate	With air con.			Climate
2.0i 16v	M	8	BOSCH 0123310011	H,T	12	VALEO A14 VI 10		H,T
			MELCO A002TA0291			MELCO A004TA0091		
		9	VALEO A13 VI 81	C,VC	9	VALEO A13 VI 81		C,VC
			MELCO A003TA0591			MELCO A003TA0591		
	A	8	BOSCH 0123310011	|H	15			H
			MELCO A002TA0291					
		9	VALEO A13 VI 81	T,C,VC	12	VALEO A14 VI 10		T,C,VC
			MELCO A003TA0591			MELCO A004TA0091		
2.0 HDi		15	VALEO A14 VI 27+	H,T,C,VC	15	VALEO A14 VI 27+		H,T,C VC
			MELCO A004TF0091			MELCO A004TF0091		
			BOSCH A12051611			BOSCH A12051611		

CLIMATE : T (Temperate), **H** (Hot), **C** (Cold), **VC** (Very Cold)



CHECKING THE ALTERNATOR OUTPUT

Connect as shown in the diagram opposite, using an ammeter **(A)**, a voltmeter **(V)** and a rheostat **(R)**, or a Voltmeter/Ammeter/Rheostat combination.
Adjust the engine speed (table opposite) and rheostat charge according to the vehicle's equipment specification in order to obtain U = 13.5 V.

Reminder : The excitation energising current will flow through the warning lamp - check that the warning lamp comes on when the ignition is switched on. It must go out when the engine has started (accelerate slightly).

CHECKING THE VOLTAGE REGULATOR

Set the rheostat to zero and disconnect all the electrical consumers.Display 5000 alternator rpm. If **U** alternator is > 14.7 V, the regulator is faulty.

Note : These tests should be performed with the engine hot and the battery fully charged.

Output under 13.5 VCurrent (A) / Alternator speed

Speed / Class	2000 rpm	3000 rpm	4000 rpm
5	29 A	39 A	43 A
7	42 A	54 A	59 A
8	49 A	62 A	68 A
9	62 A	76 A	83 A
12	72 A	90 A	100 A
15	99 A	128 A	140 A

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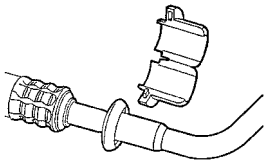
PRE-HEATING AND STARTING SYSTEMS				ALL TYPES
Vehicles / models		**Pre-heater plugs**	**Pre-heater control unit**	**Pre / Post heating (pre-heating duration at 20°C)**
XANTIA	**1.9TD**	BERU 0 100 226 186	BOSCH 0 281 003 005	6s / 180s
		BOSCH 0 250 201 039	VALEO 73507212	
	2.0 HDi	CHAMPION CH170	NAGARES 735068	Controlled by diesel injection ECU
		BOSCH 0250202032	CARTIER 960411-P	
XM	**2.1TD**	BERU 0 100 226 186	VALEO 73506802	
		BOSCH 0 250 201 039		
	2.5TD	BERU 0 100 226 186	VALEO 73506802	
		BOSCH 0 250 201 039		
SYNERGIE	**2.0 Hdi**	CHAMPION CH170	NAGARES 735068	
	2.0 16v HDi	BOSCH 0250202032	CARTIER 960411-P	

Preheater plug resistance : 0.4 Ω ≤ R ≤ 0.6 W

ALL TYPES	AIR CONDITIONING R 134 a (HFC)					
Vehicle	Engine	Date	Refrigerant refill (± 25 gr)	Compressor		
				Capacity Variable	Oil quantity cc	Oil reference
XANTIA	XU All types	10/94 >	**875 gr**	**SD 7 V 16**	135	**SP 10**
	3.0 i V6	01/97 >	**825 gr**			
	XUD All types DW 10 All types (Except 2.1 TD)	02/96 >		**DELPHI V5 (1)**	265 ± 15	**PLANETELF 488**
	2.1 TD	05/97 >	**850 gr**			
XM	XU All types	10/93 >	**725 gr**	**SD 7 V 16**	135	**SP 10**
	3.0 I V6	05/97 >	**825 gr**			
	XUD All types (Except 2.5 TD)	10/93 >	**725 gr**			
	2.5 TD	07/94 >	**825 gr**			
SYNERGIE	All types	06/94 >	**1000 ± 50 gr**			

(1) HARRISON Division

SPECIAL FEATURES : AIR CONDITIONING SYSTEM (R 134.a) — ALL TYPES



C5HP073C

Vehicle		Click-fit union removal/fitting tool		
		Ø Inch	Ring colour	Tool kit 4164-T
XANTIA SYNERGIE	All types	5/8	Black	8005-T.A.
XM	3.0 i V6			
XM	All types (except V6)	1/2	Blue	8005-T.B.

	Tightening torques (m.daN).	
	Unions	
Ø Pipes	Steel/Steel	Aluminium/Steel
M 06	1.7 ± 0.3	1.3 ± 0.3
M 08	3.8 ± 0.3	2 ± 0.2
M 10	4 ± 0.3	2.5 ± 0.3

REMINDER : Refilling the air conditioning system should be done through the **LOW PRESSURE** valve whenever possible.
NOTE : The diameters of the High Pressure and Low Pressure valves are different, to avoid mixing them up.

NOTE : For operations concerning draining, drying (empty), checking and recharging of a system: (refer to **BRE 0290)**
WARNING : For R 134.a quantities: (See table on page**: 280)**

ALL TYPES	SPECIAL FEATURES : AIR CONDITIONING SYSTEM (R 134.a)

Compressor lubricant.

ESSENTIAL: The compressor lubricant is extremely hygroscopic; always use FRESH oil.

Checking the compressor oil level.

There are three specific cases :
1) Repairs to a system without leaks.
2) Slow leak.
3) Fast leak.

1) Repairing a system without leaks.

a) Using draining/recovery equipment not fitted with an oil decanter.
- Drain the system as slowly as possible via the **LOW PRESSURE** valve, so as not to lose any oil.
- No more oil should be added when filling the system with **R 134.a** fluid.

b) Using draining/filling equipment fitted with an oil decanter.
- Drain the **R 134.a** fluid from the system in accordance with the instructions in the equipment handbook.
- Measure the amount of oil recovered.
- Add the same amount of **NEW** oil when filling the system with **R 134.a** fluid.

c) Replacing a compressor.
- Remove the old compressor, drain it and measure the oil quantity.
- Drain the new compressor (supplied full), so that the same amount of **NEW** oil is left in the compressor as was in the old compressor.
- No more oil should be added when filling the system with **R 134.a** fluid.

SPECIAL FEATURES : AIR CONDITIONING SYSTEM (R 134.a) | ALL TYPES

Checking the compressor oil level (continued)

2) Slow leak.

- Slow leaks do not lead to oil loss, therefore the same procedure should be followed as if there was no leak at all.

3) Fast leak.

- This type of leak causes both oil loss as well as allowing air to enter the system.It is therefore necessary to :

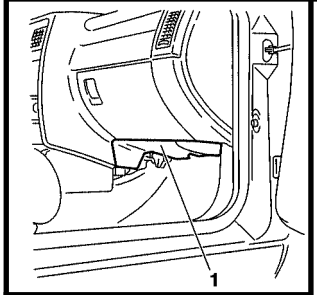
- Replace the dehydrator.
- Drain as much oil as possible (when replacing the faulty component).

Either before or during filling of the system with **R 134.a** fluid, introduce **80 cc** of **NEW** oil into the system

ALL TYPES	SPECIAL FEATURES : AIR CONDITIONING SYSTEM (R 134.a)			
	Presence of pollen filter			
Vehicle	**Equipment**	**RPO No.**	**Presence of filter**	**Observations**
AX-SAXO-ZX-BX-C15	All Types		**NO**	
XSARA **XSARA PICASSO**	Without aircon		**YES** (Behr)	Exc. driving school
	Base aircon		**YES** (Larger)	
	Regulated aircon		**YES** (Valeo)	
XANTIA I and II	Without aircon		**NO**	
	Regulated aircon		**YES**	Except Brazil
XM I and II	All Types		**NO**	
SYNERGIE	Without aircon		**NO**	
	Base aircon		**NO**	
	Automatic aircon	→ 8148	**Do not fit**	Ingress of water
		8148 → 8421	**YES** (Behr)	Body modification
		8421 →	**YES** if Exclusive	2 blowers
			NO if X and SX	1 blower
BERLINGO	Without aircon		**NO** (Valeo)	
	Base aircon		**YES** (Valeo)	
DISPATCH	All Types		**NO**	
	Base aircon		**NO**	
RELAY	Without aircon		**NO**	
	Base or double aircon		**YES**	

SPECIAL FEATURES : AIR CONDITIONING SYSTEM (R 134.a)

Removing/refitting the pollen filter

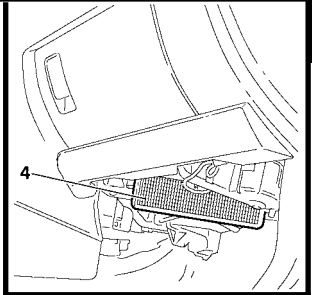


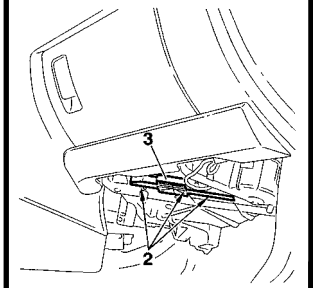
Remove.

- Access from below the dashboard on passenger's side, remove the sound-deadening **(1)**.

- Remove the three screws **(2)** and the cover **(3)**.

Remove the filter **(4)**.





Refit.

- Proceed in the opposite order to removal.

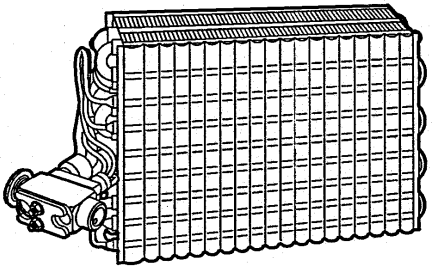
C5HP00UC | C5HP00VC

C5HP00WC

XANTIA	POINTS PARTICULIERS : CIRCUIT DE REFRIGERATION (R 134.a)

Evaporator.

OLD → 01/97



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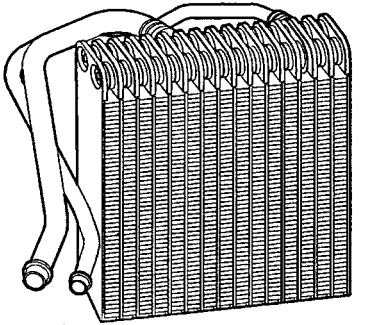
NEW 01/97 →



C5HP062C

The evaporator makes use of new technology and is called a **"plate evaporator"**.

The coils around which the **R 134.a** fluid flowed previously, are replaced by plates which offer a greater area of contact with the air, thus increasing evaporator efficiency.

CHECKING THE EFFICIENCY OF THE AIR CONDITIONING SYSTEM — ALL TYPES

CHECKING TEMPERATURES.

TOOLS

Two thermometers.

Preliminary conditions.

Position of the air conditioning controls :
- Maximum cold air.
- Air blower in maximum position.
- Air distributor in "ventilation" position, with the dashboard vents open.
- Air intake flap in "exterior air" position.

Conditions and vehicle equipment.

- Bonnet closed.
- Doors and windows shut.
- Ensure the vehicle is in a sheltered area *(away from wind, sun, etc..).*

CHECKS.

If all these conditions are met, take the following action :

- Start the engine, with the air conditioning off, and wait for the cooling fan first speed to cut in.
- Operate the air conditioning and set the engine speed to **2500 rpm**.

NOTE : If the exterior temperature reaches **40 °C**, the engine speed will return to **2000 rpm** in order to prevent the compressor from being cut off by the High Pressure safety device *(Pressostat).*

After the air conditioning has been on for three minutes, measure :
- the exterior temperature in the workshop,
- the temperature of the air coming out of the central vents.

Compare the two values using the table overleaf.

ALL TYPES	CHECKING THE EFFICIENCY OF THE AIR CONDITIONING SYSTEM

CHECKING TEMPERATURES. (continued)

		Vehicle using R134.a fluid (Compressor with variable capacity)					
Exterior temperature in °C		**40**	**35**	**30**	**25**	**20**	**15**
Temperature in °Cat the central vents	**Vehicles**						
	XANTIA	20 ± 3	16 ± 3	13 ± 3	11 ± 3	9 ± 3 **(*)**	8 ± 3
	XM	24 ± 3	18 ± 3	15 ± 3	13 ± 3	10 ± 3	8 ± 3
	SYNERGIE				12 ± 3	8 ± 3	

(*) At exterior temperature **20°C**, air temperature from the central vents is for second speed of the ventilator fan.
If fan operates at first speed, then air temperature from the central vents becomes **8.4 ± 3 °C**.
NOTE : In general, the temperature of the air being blown from the central vents should be around **5°C** to **8°C**.

CHECKING THE EFFICIENCY OF THE AIR CONDITIONING SYSTEM — ALL TYPES

CHECKING PRESSURES

TOOLS : 1 Charging station and **2** Thermometers.Observing the preliminary conditions, as well as vehicle equipment and checks (see page **287**) :After the air conditioning has been operating for three minutes, record the following parameters :

- The temperature of the air coming out of the central vents See the table on page **290**).
- The High Pressure.
- The Low Pressure.Compare the values recorded with the table below, or the graphs.

		Vehicle using R134.a fluid (Compressor with variable capacity)					
Exterior temperature in °C		**40**	**35**	**30**	**25**	**20**	**15**
	Vehicles						
High pressure (Bars)	**XANTIA (1)**	24 ± 3		21 ± 3		18 ± 3	14 ± 3
Low pressure (Bars)		4 ± 3	2.5 ± 3				4 ± 0.3
High pressure (Bars)	**XANTIA (2)**	21 ± 3			16 ± 3	14 ± 3	
Low pressure (Bars)		1.9 ± 3			1.4 ± 0.3		
High pressure (Bars)	**XM**	24 ± 0;3			19 ± 3	17 ± 3	15 ± 3
Low pressure (Bars)		4 ± 0.3	3 ± 0.3	2.5 ± 0.3			1.8 ± 0.3
High pressure (Bars)	**SYNERGIE**				16 ± 3	13 ± 3	
Low pressure (Bars)					2.1 ± 0.3		1.8 ± 0.3

(1) SANDEN Compressor *(Petrol engines : all types)* - **(2) = HARRISON** Compressor *(Diesel engines : all types).*
If the parameters recorded do not correspond to those in the above table, refer to the table (see page **290**).

ALL TYPES	CHECKING THE EFFICIENCY OF THE AIR CONDITIONING SYSTEM

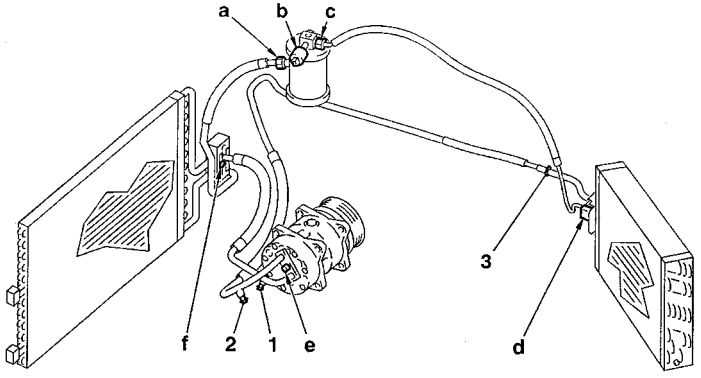
CHECKING PRESSURES (continued)

	Low pressuretoo low	Low pressurenormal	Low pressuretoo high
High pressuretoo low	- Insufficient fluid charge. - Constriction of the HP system. - Dirty pressure control valve.	- Cooling fan speed unsuitable. - Faulty compressor.	- Faulty pressure control valve. - Faulty compressor.
High pressurenormal	- Faulty compressor. - Dirty evaporator.	- Circuit normal.	- Cooling fan speed unsuitable
High pressuretoo high	- Faulty pressure control valve. - System blocked. - Water in the system.	- Presence of solid matter in the system. - Dirty condenser.	- Excessive fluid charge. - Dirty condenser. - Faulty pressure control valve. - Cooling fan speed unsuitable.

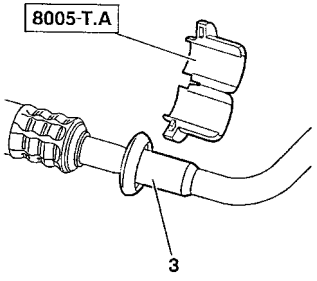
Checking the pressure at temperatures between 15°C and 35°C for information only.
In general, the pressure should be approximately :
- for **R134.a** fluid, less than **2 Bar**s (Low pressure), and between **13** and **24 Bars** (High pressure).

AIR CONDITIONING SYSTEM R134.a

XANTIA All Types (Except V6 - XUD)



C5HP12GD

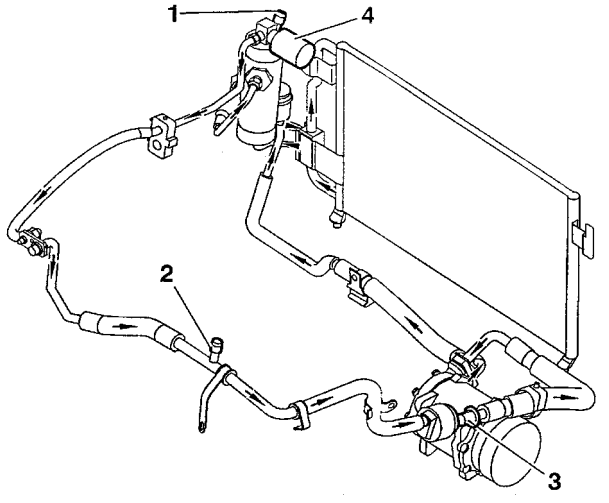


C5HP12EC

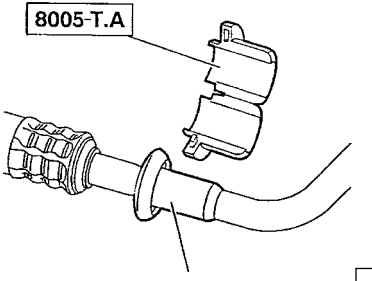
Tightening torques (m.daN).

a - **1.8**
b - **1.8**
c - **1.8**
d - **1**
e - **3.5**
f - **0.7**

(1) High pressure valve
(2) Low pressure valve
(3) Clickfit union



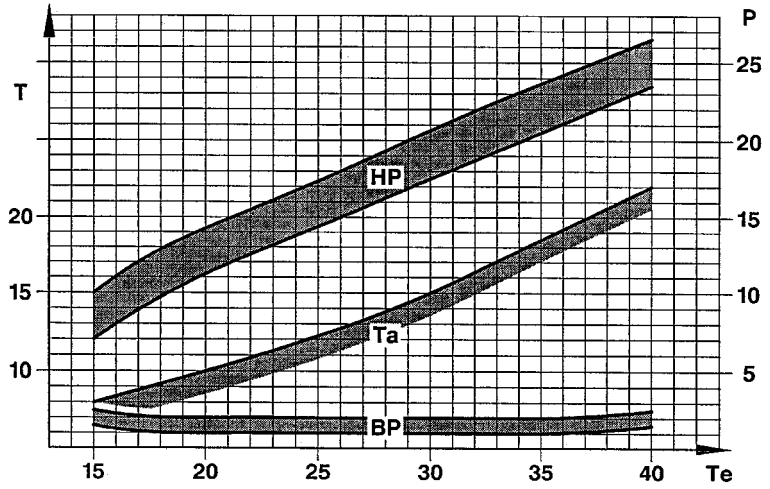
C5HP12HD



C5HP12EC

(1) High pressure valve
(2) Low pressure valve
(3) Clickfit union
(4) Pressostat

Checking the air conditioning circuit



Key

T = Temperature **(C°)** and High Pressure **(Bars)**.

P = Low pressure **(Bars)**.

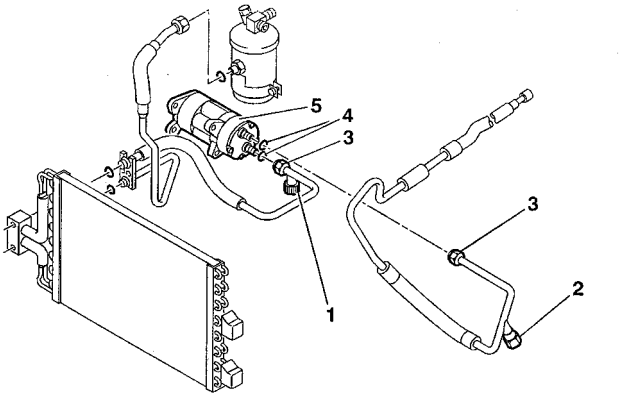
Te = Exterior temperature **(C°)**.

HP = Pressure at compressor outlet **(Bars)**.

Ta = Temperature of air blown from the central air vents **(C°)**.

BP = Pressure at compressor inlet **(Bars)**.

C5HP01ZD



C5HP05XD

(1) - High pressure valve

(2) - Low pressure valve

Air conditioned **XANTIA XUD All Types** are equipped with a new **"HARRISON"** refrigeration compressor, with variable capacity.

All other models are fitted with a **"SANDEN"** compressor.

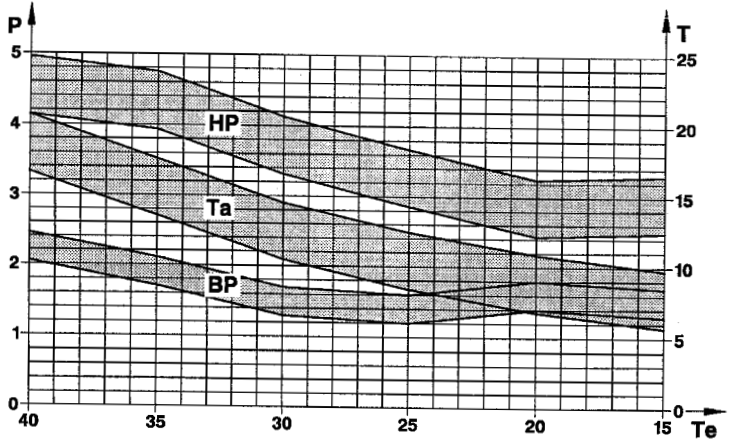
Parts modified.

(5) - **"HARRISON"** variable capacity compressor, reference **"DELPHI V5"**.

(3) - Air conditioning pipes, secured to the compressor with nuts instead of clamps.

(4) - Modified seals to suit the new attachments.Belt length : **1710 mm** instead of **1700 mm**.

Checking the air conditioning circuit



Key

T = Temperature **(C°)** and High Pressure **(Bars)**.

P = Low pressure **(Bars)**.

Te = Exterior temperature **(C°)**.

HP = Pressure at compressor outlet **(Bars)**.

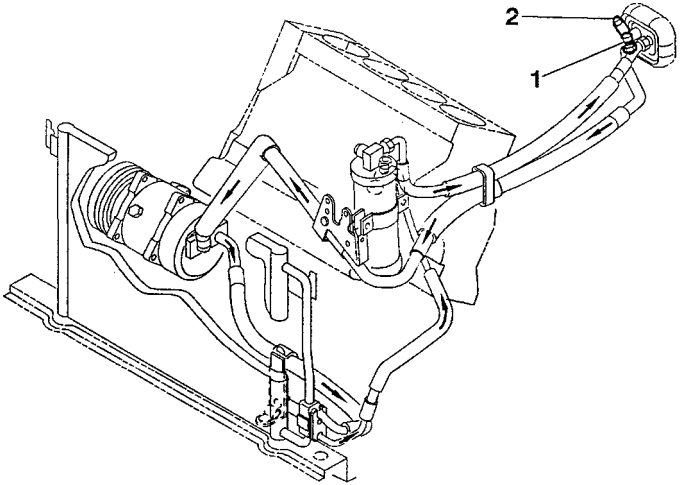
Ta = Temperature of air blown from the central air vents **(C°)**.

BP = Pressure at compressor inlet **(Bars)**.

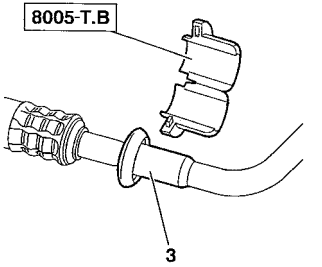
C5HP122D

XM - All Types (Except V6 - 2.5 TD)

AIR CONDITIONING SYSTEM R134.a



C5HP12JD

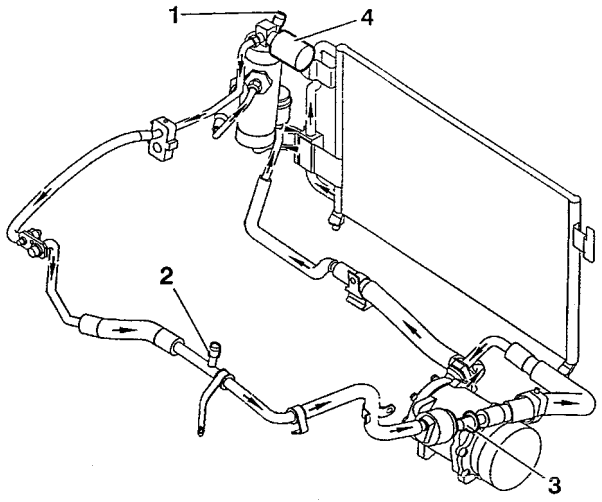


C5HP12KC

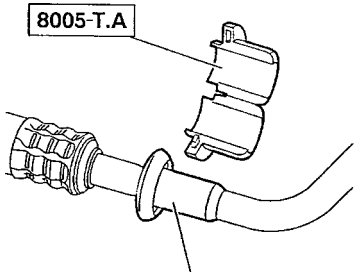
(1) High pressure valve
(2) Low pressure valve
(3) Clickfit union.

AIR CONDITIONING SYSTEM R134.a

XM - V6

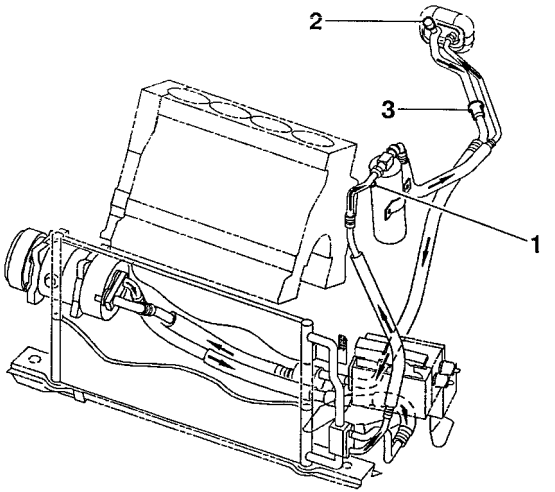


C5HP12HD

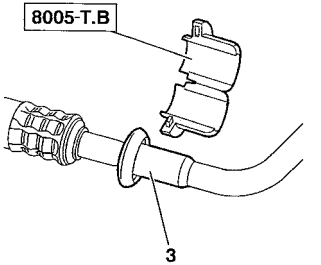


C5HP12EC

(1) High pressure valve
(2) Low pressure valve
(3) Clickfit union.



C5HP12LD



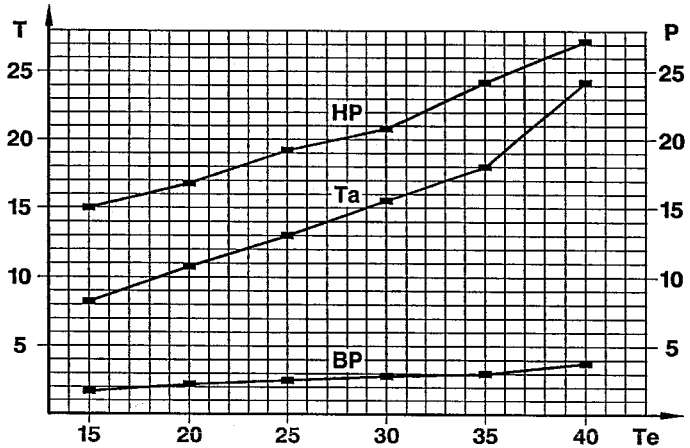
C5HP12KC

(1) High pressure valve
(2) Low pressure valve
(3) Clickfit union.

AIR CONDITIONING SYSTEM R134.a

XM - All Types

Checking the air conditioning circuit



Key

T = Temperature **(C°)** and High Pressure **(Bars)**.

P = Low pressure **(Bars)**.

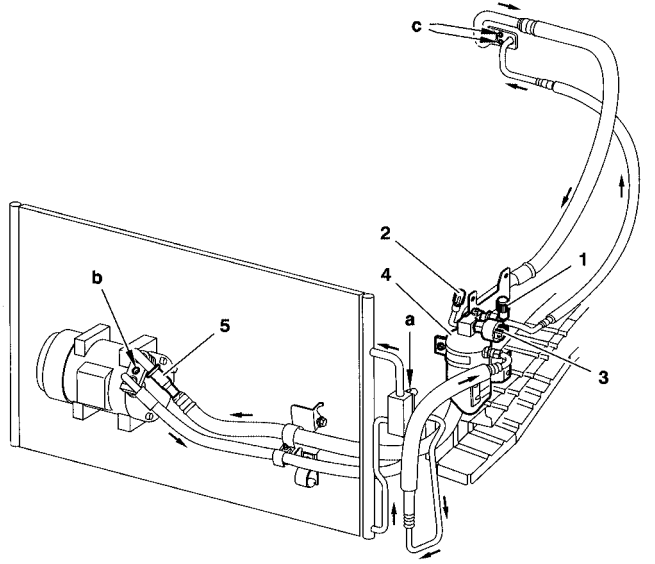
Te = Exterior temperature **(C°)**.

HP = Pressure at compressor outlet **(Bars)**.

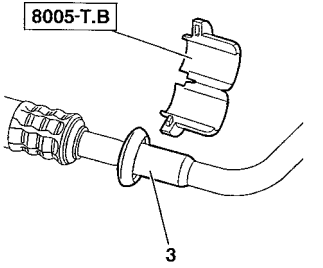
Ta = Temperature of air blown from the central air vents **(C°)**.

BP = Pressure at compressor inlet **(Bars)**.

C5HP068D



C5HP15PP

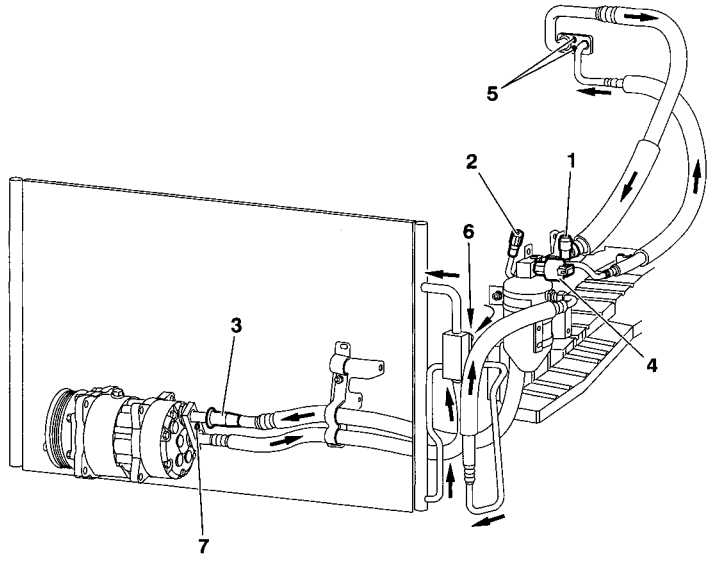


C5HP12EC

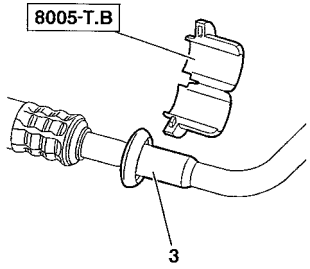
Tightening torques.

(1) High pressure valve
(2) Low pressure valve
(3) Pressostat, tighten to **1.8 m.daN**
(4) Dryer
(5) Clickfit union

a	**0.8 m.daN**
b	**4 m.daN**
c	**0.8 m.daN**



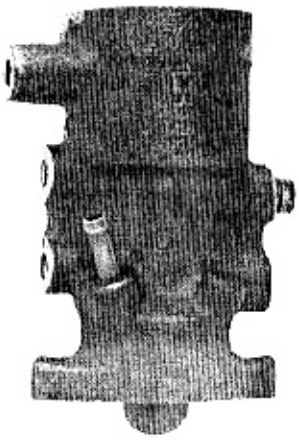
C5HP15EP



C5HP12EC

Tightening torques.

(1) High pressure valve
(2) Low pressure valve
(3) Clickfit union
(4) Pressostat, tighten to **1,8 m.daN**
(5) Flange fixing, tighten to **0,8 m.daN.**
(6) Flange fixing, tighten to **0,8 m.daN.**
(7) Flange fixing, tighten to **4 m.daN**.



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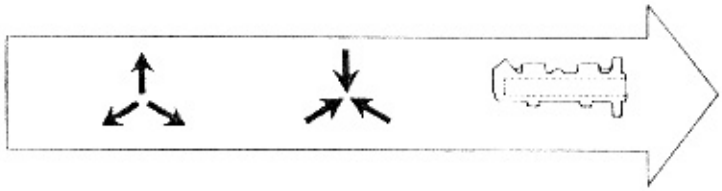

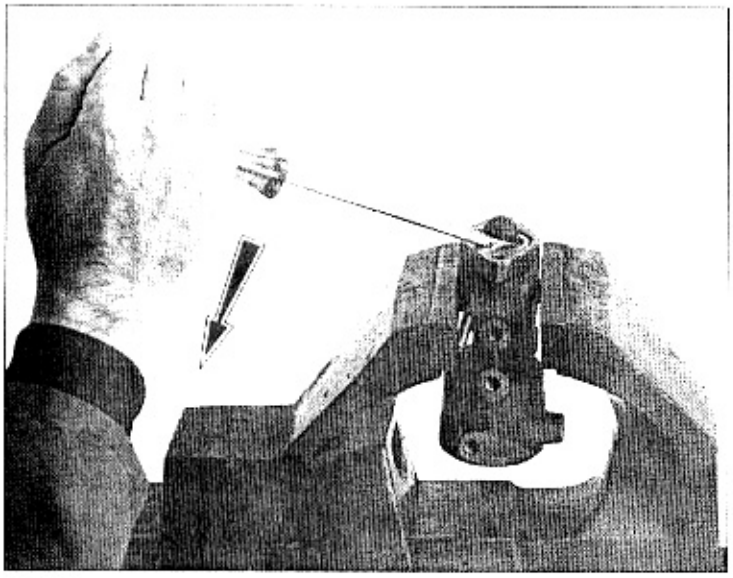

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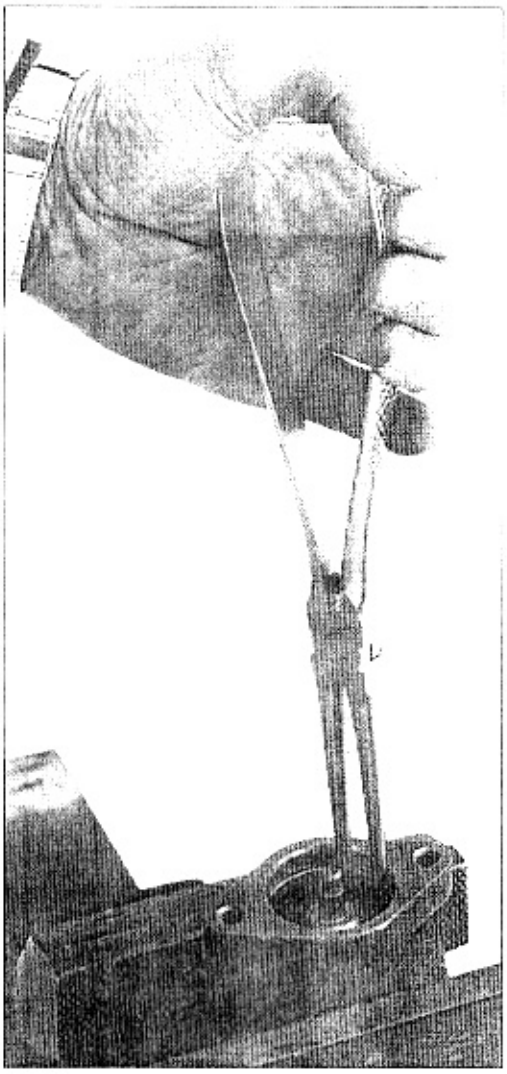

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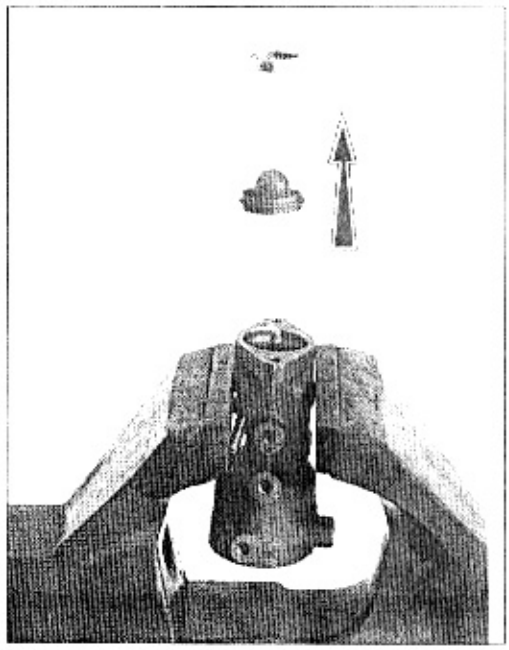

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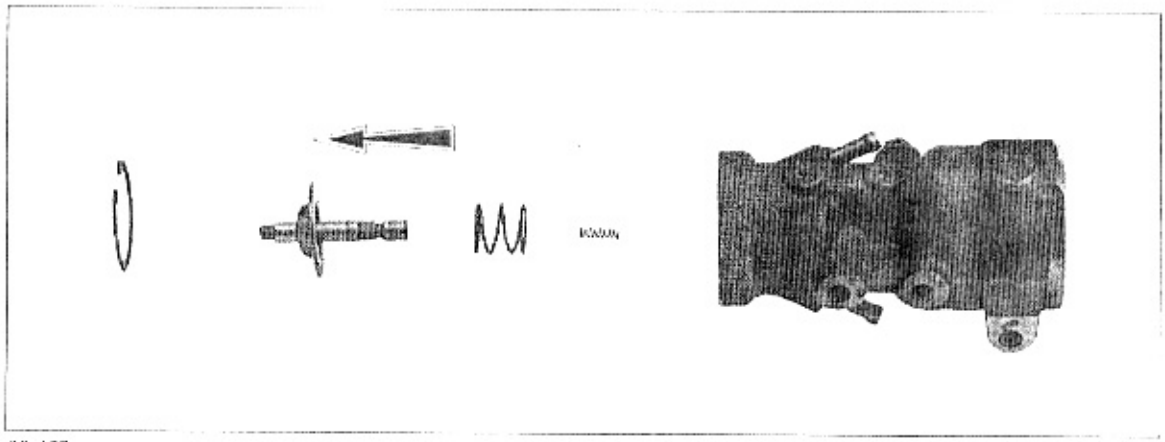

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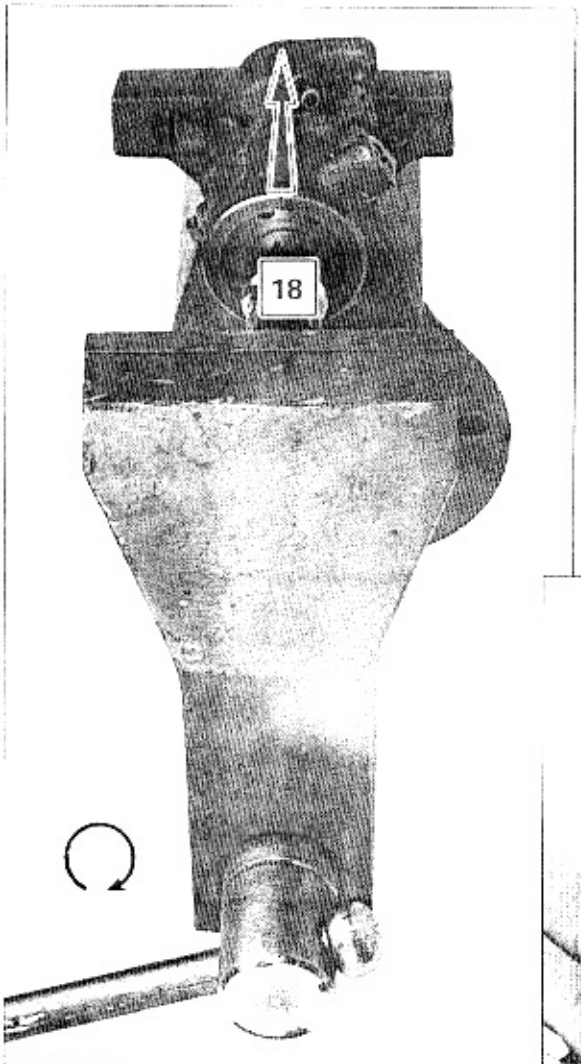

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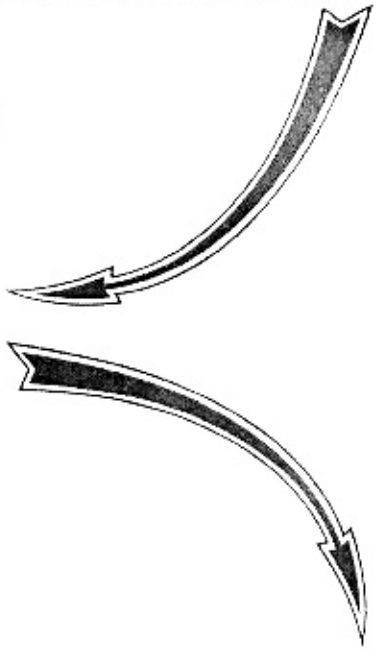

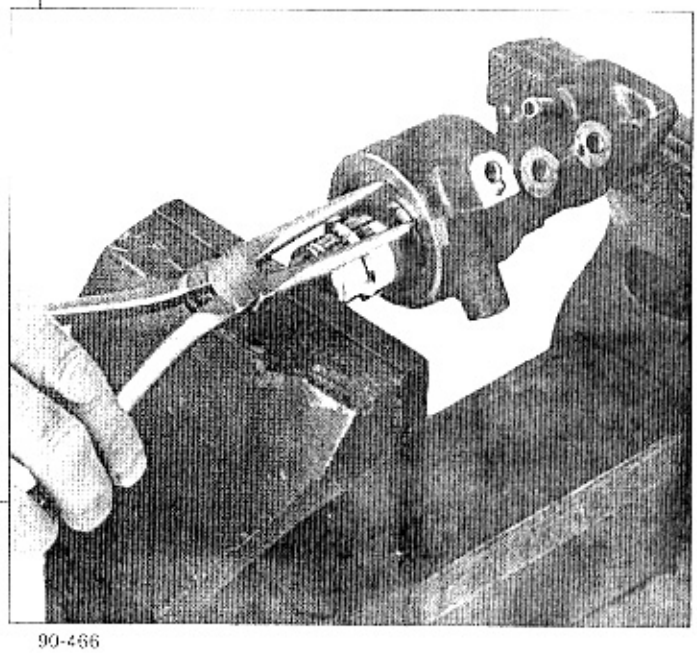

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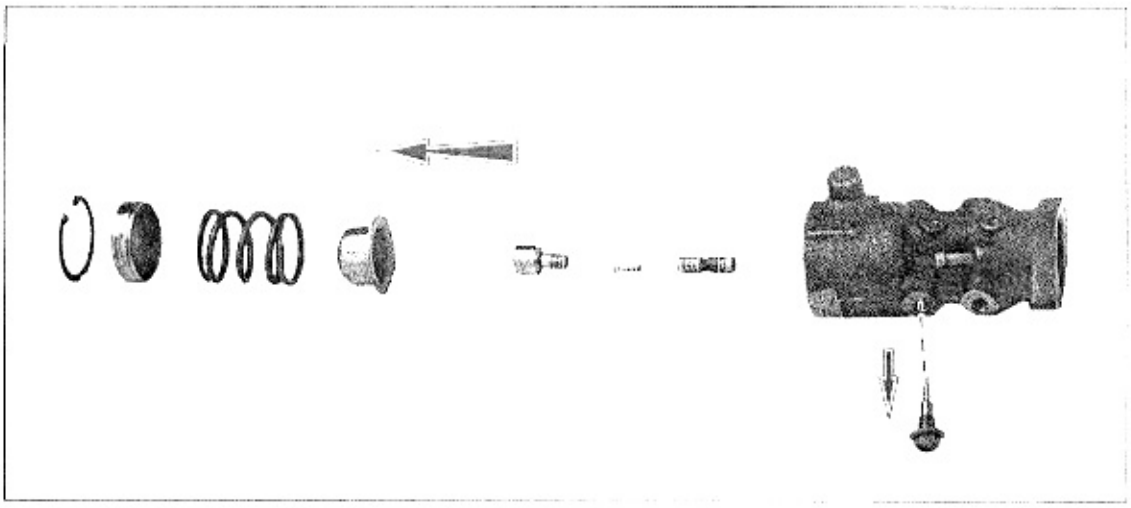

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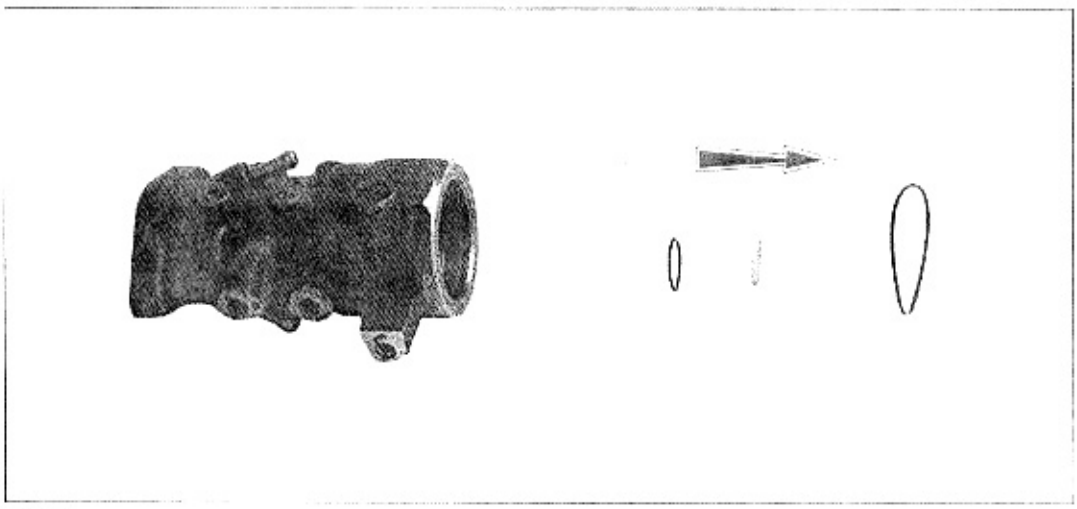

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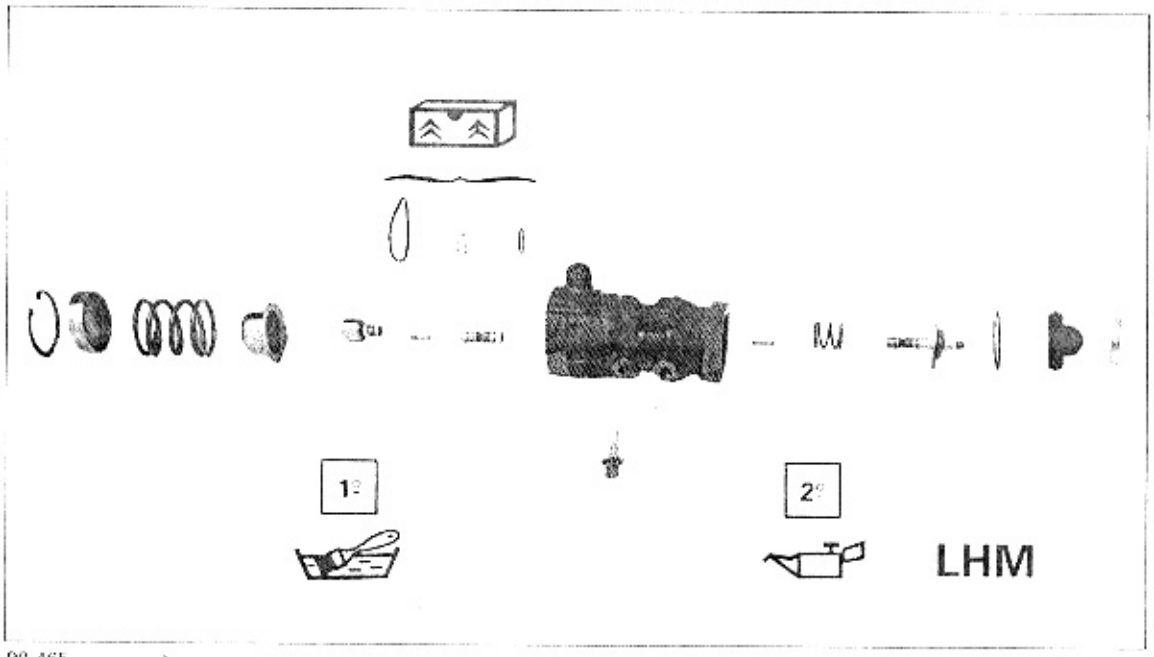

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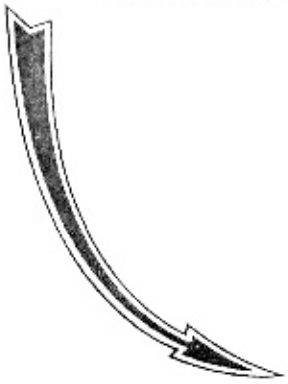
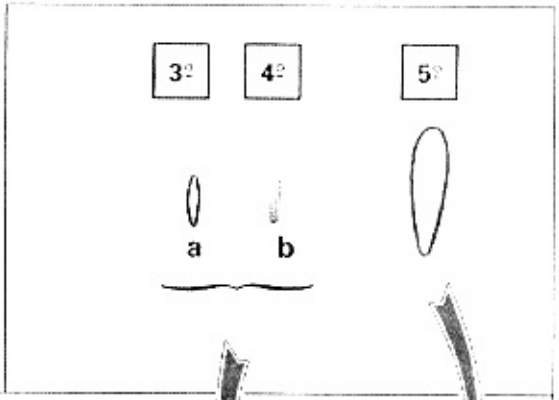
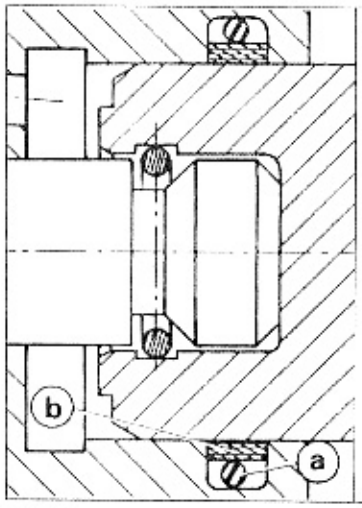
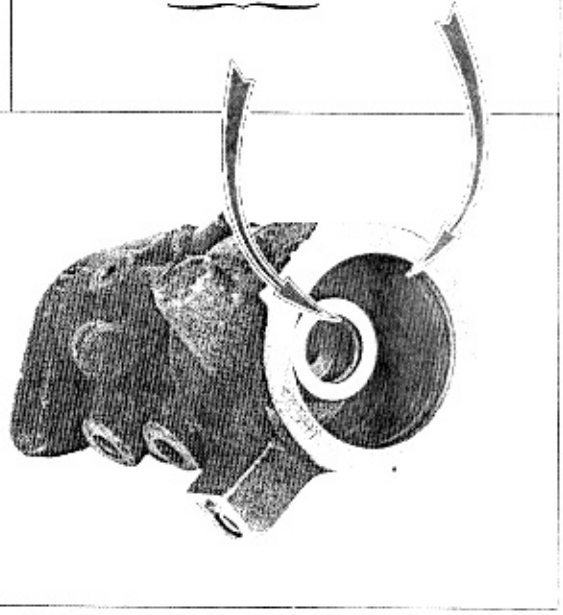


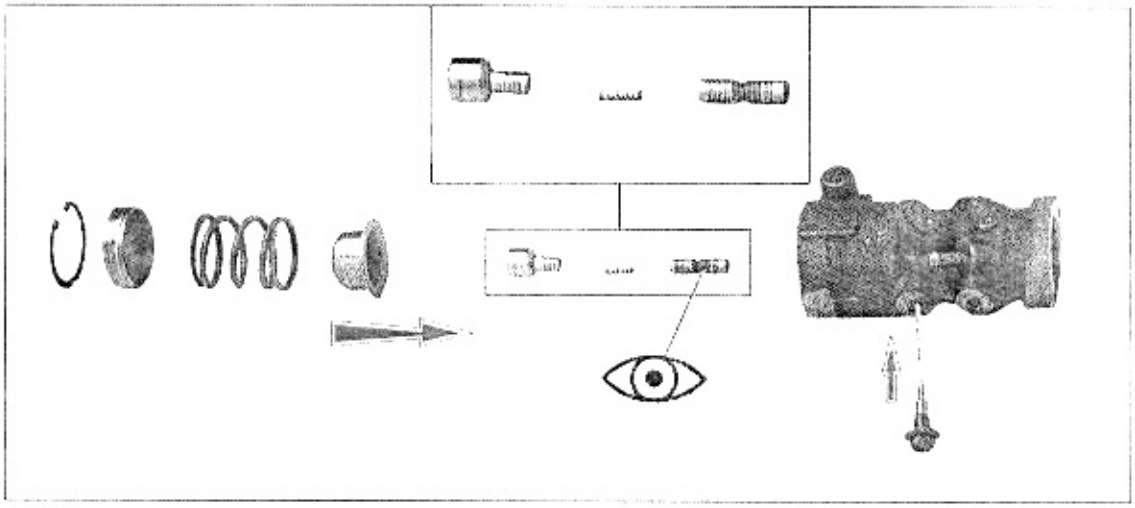




Y.45-20



90-504 — 90-461



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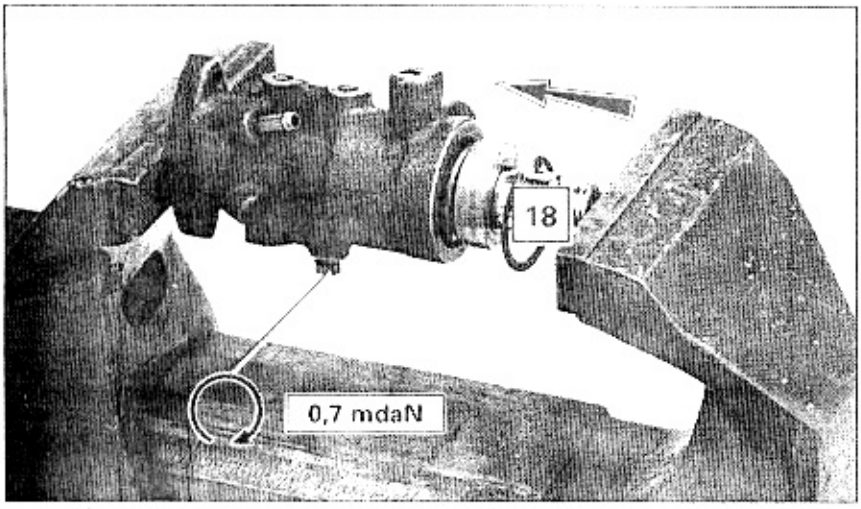

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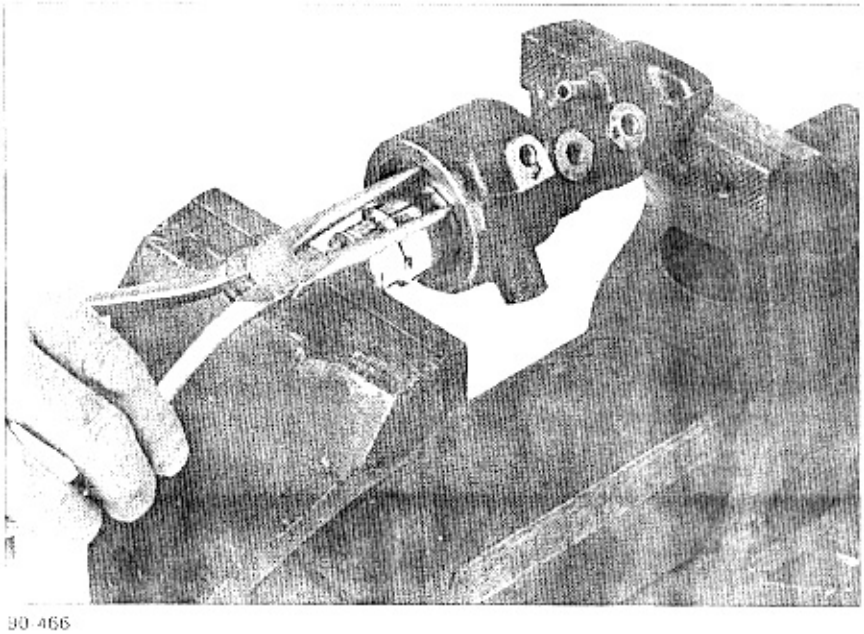

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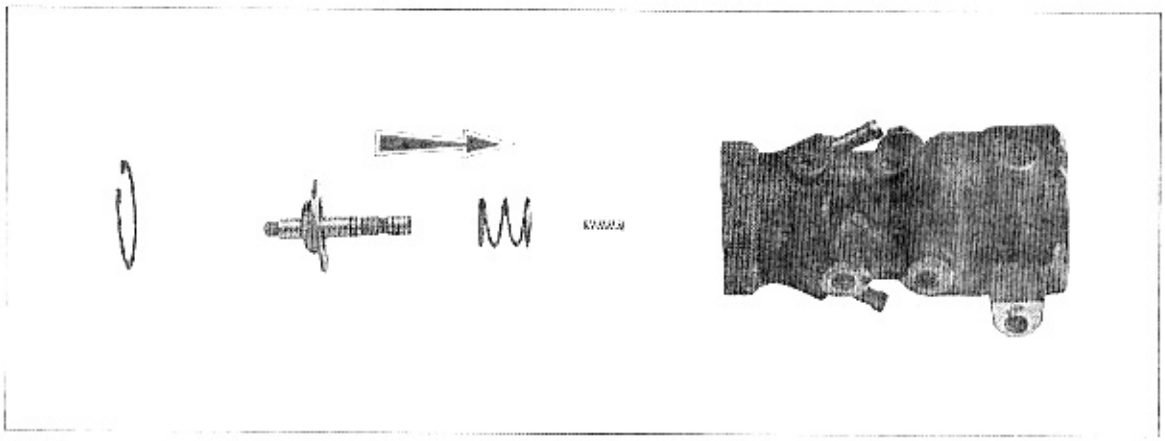

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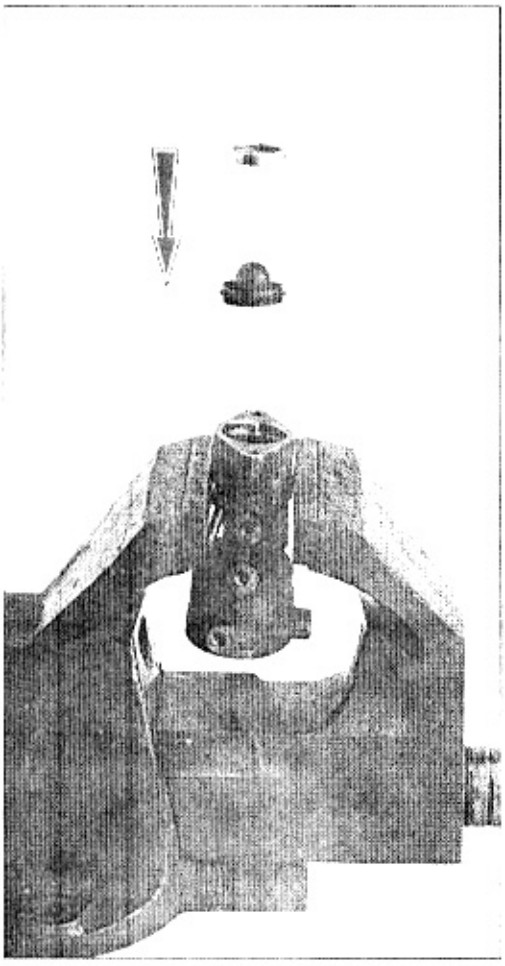
90-459



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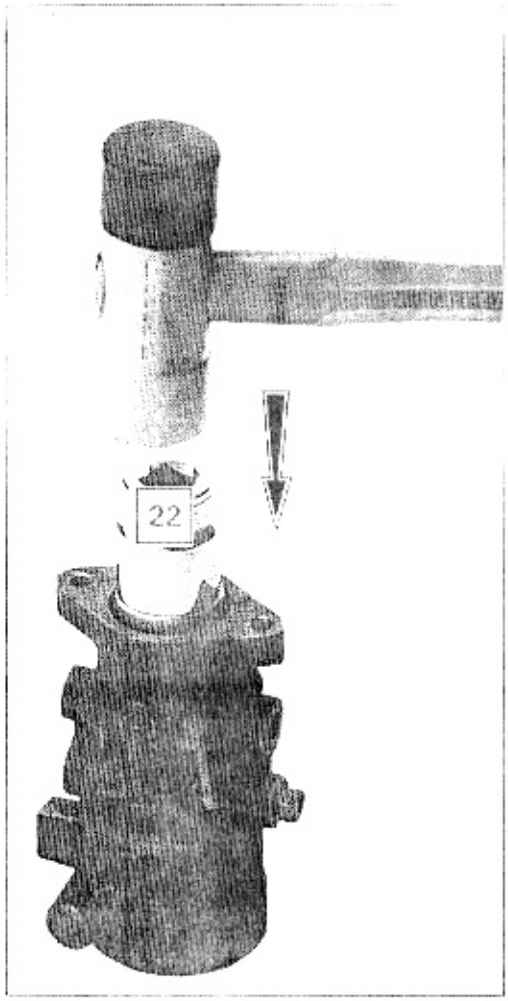


90-462

XM-GB-5001

CITROËN XM

OWNER'S HANDBOOK

Welcome aboard your new CITROËN XM

We thank you for and congratulate you on your choice and wish you every satisfaction with your CITROËN XM.

Read this handbook carefully; it will allow you to discover the features of your XM and familiarise yourself with them in the interest of your enjoyment and safety.

Follow the service schedule.

Remember. *The CITROËN Dealer Network is at your disposal.*

Introducing Your Car 5

Driving 31

Comfort 41

Maintenance 65

Practical Advice 83

Characteristics 103

Alphabetical Index 110

Warning

This vehicle incorporates components containing asbestos (in particular: brake linings, clutch facings, heat shields, gaskets.)
Breathing asbestos dust is dangerous to health.
Follow safety instructions:
If you carry out work on or adjacent to these components: operate if possible out of doors or in a well ventilated place; preferably use hand tools or low speed tools equipped, if necessary, with an appropriate dust extraction facility. If high speed tools are used, they should always be so equipped; this applies particularly to linings which have to be drilled or ground.
If possible dampen before cutting or drilling; dampen dust and place in a properly closed receptacle and dispose of it safely.
(For example brake dust in wheels, drums or calipers; clutch dust in bell-housings.)

[Extended extract from the Asbestos Products (Safety) Regulations 1985 no. 2042.]

	Pages
Keys, remote control	6
Child safety locks, doors	7
Bonnet, tailgate	8
Refuelling	9
Front seats	10
Rear seats, parcel shelf	11
Seat belts	12 - 13
Rearview mirrors	14
Steering column adjustment, power steering	15
Driving position, instruments	16 - 17
Electric windows and central armrest	18
Lighting, signalling	19 - 20
Visibility	21
Instrument panel	22 - 23
Warning lamps, rheostat	24 - 25
Warning lamp display	26 - 27
Trip computer	28 - 29
Dot-Matrix display	30

All locks on the vehicle have an additional 'anti-theft' feature. It is therefore **essential** to engage the key fully and press in, while turning the lock.

1 - Main key

Operates steering, tailgate, glovebox and door locks as well as ignition and starter.

Central electric locking

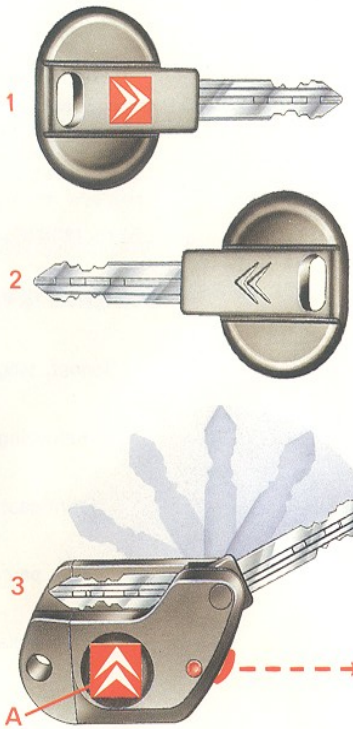
The key enables you to lock or unlock all four doors, the tailgate and the fuel tank flap from either front door. If one of the front doors is open, the central locking will not work.

2 - Garage key

Operates as main key with the exception of tailgate and glovebox.

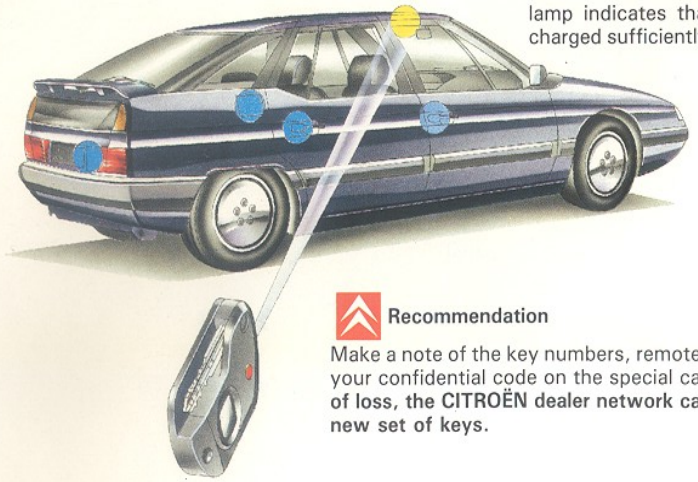
3 - Combined remote control and folding master key

Operates the locking and unlocking of the doors, tailgate and fuel filler flap.
Direct the beam of the remote control towards the receiver which is located in the roof console.
Press once on the button **A**. If the central locking fails to operate, press again on button **A**.



Note: A single push on the button activates the remote control. It serves no purpose to keep the button depressed.

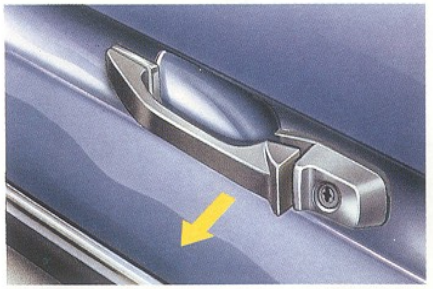
Illumination of the small red warning lamp indicates that the batteries are charged sufficiently (Refer to page 88).



Recommendation

Make a note of the key numbers, remote control number and your confidential code on the special card provided. **In case of loss, the CITROËN dealer network can supply you with a new set of keys.**

* According to model.



Opening from the outside

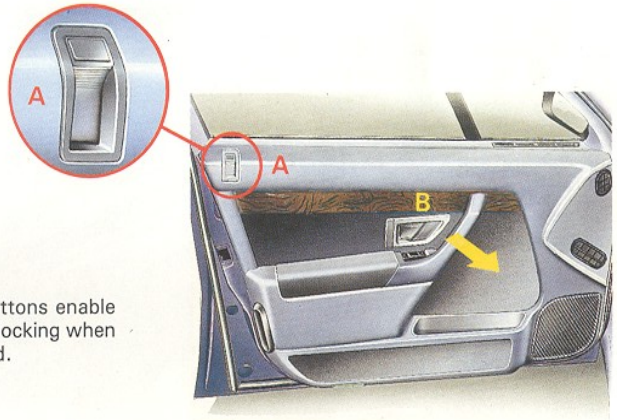
To unlock one of the front doors from the outside, **turn, while pressing in, the key** or unlock with the remote control.

Pull the door handle towards you.

Opening from the inside

Raise locking button **A** to unlock.

Pull lever **B** towards you.



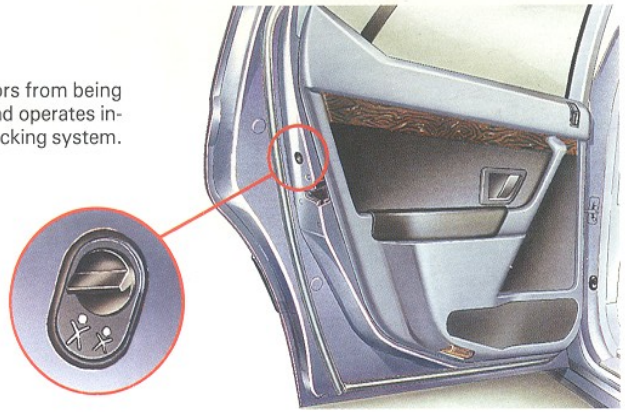
Locking from the inside

The front door locking buttons enable you to operate the central locking when the front doors are closed.

Child safety feature

This prevents the rear doors from being opened from the inside, and operates independently of the main locking system.

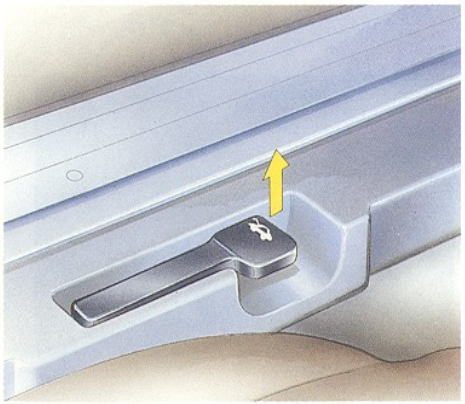
Align the knob with the symbol to engage the lock.



Opening the bonnet

Can only be done with the left-hand front door open.

Pull the release lever situated to the left of the front passenger seat.



Lift the latch situated under the forward edge of the bonnet and pull up.

Closing

Lower the bonnet to waist height then slam it shut without using excessive force.

Make sure that it has locked securely.

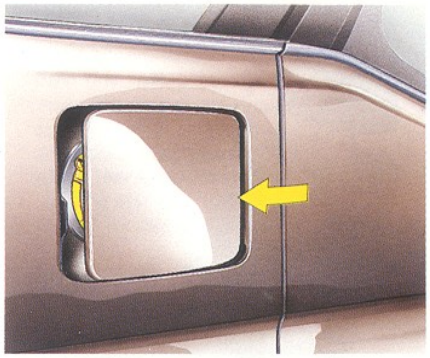
The under-bonnet lamp works when the sidelamps are on.*

Opening the tailgate

Unlock with the remote control or the key.
Push the lever upwards and lift the tailgate.
To close, pull down the tailgate using the grips located in the tailgate internal trim moulding and then push down.

* According to model.

The fuel filler flap lock is operated by the central locking.
To open the flap, press on its forward edge.



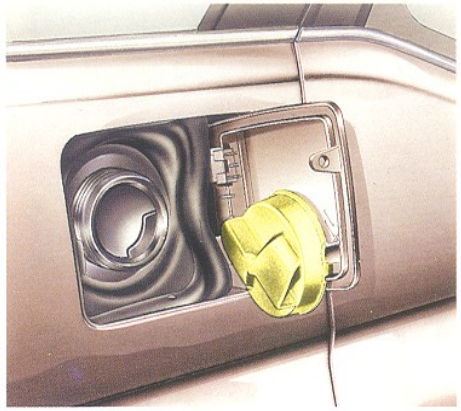
If the central locking fails to operate, unlock the flap by pushing the bolt towards the rear, gaining access through the opening in the boot.

Fuel tank capacity: 80 litres (17.6 gals.).

The threaded filler cap is specific. In case of loss, replace it **only** with a cap of the same type.
When replacing, turn fully home.
When refuelling, place the cap in the support provided on the inside of the filler flap.

Models with catalytic converter : unleaded fuel compulsory. The reduced diameter filler neck has a smaller orifice to avoid choosing the wrong fuel. Refuel from a dedicated unleaded pump with a small diameter delivery nozzle.

Use of leaded petrol will destroy the catalytic converter.



Manual adjustments

Reach
Lift the control bar and adjust to the desired position.

Backrest
Lift the control lever and adjust to the desired position.

Height (Driver's seat)
Operated by a telescopic lever.
By pulling the handle forward, the lever extends to reduce the operating effort.

Lateral support
Turn control knob **4** to adjust to the desired position.

Head rests
To remove, turn the guides **5** by a quarter of a turn and pull the headrest upwards.

Electrically operated adjustments

Reach
Operate the switch **1** situated on the inner edge of the seat to adjust for reach.

Backrest
Operate the switch **2** situated on the outer edge of the seat to adjust the angle of the backrest.

Height
Operate switch **3**.

Heated seats
The controls are situated on the centre console.

* According to model or country.

Split rear seat
The seat can be either partially or fully folded.*
Attention: Irrespective of which portion of the rear seat is folded down, the remaining rear seat (60% or 40%) is intended for use by only one passenger.

Seat cushion
Pull the strap(s) then swing the cushion forward against the front seat backrests.

Backrest
Release by pulling one of the two control levers **1** and swing completely forward.

If the headrests are in the raised position, lower them before proceeding.

To reinstate seating, proceed in the reverse order.

Rear heated seats*
The controls are situated on the rear door armrests.

If the seat is not put back into place correctly, the rear seat belts will not work effectively.

Parcel shelf
To remove : lift its folding section. Raise the front edge of the shelf and pull.

To refit: proceed in the reverse order.

Models fitted with inner rear glass screen
To remove the parcel shelf: fasten the glass screen to the tailgate. (Refer to page 63).

* According to model or country.

For optimum protection in the event of an accident, however minor, adults and children of all ages must wear a seat belt or restraint appropriate to their size.

The seat belts can only be effective if:

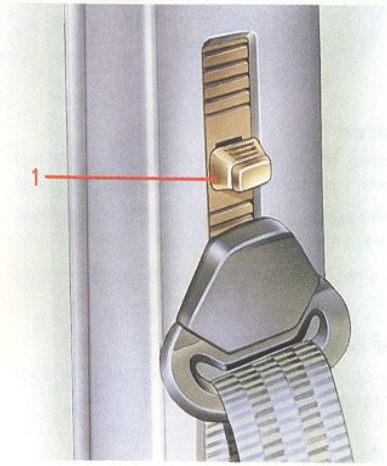
The front seats are properly adjusted.

The rear seats are properly latched in position.

The belt is not twisted or allowed to rub against any sharp edges.

The buckle is securely fastened.

The belt is correctly positioned across the chest and over the shoulder. If necessary adjust the height by placing the adjustment button **1** where needed.



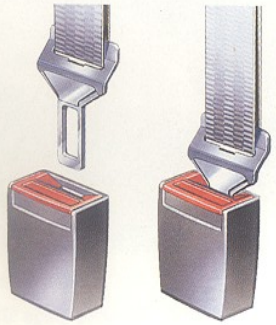
Attention: When adjusting the height of the front seat belt upper anchorage point, it is imperative to ensure that it latches securely in the desired position.

The lower part of the belt lies across the top of the thighs.

The belt is correctly tensioned and nothing interferes with the operation of the reel.

Readjust the seat belt after any change of seating position.

Any movement of the belt, fastening and unlocking, should be carried out smoothly.



Do not:

Leave any slack in the belt.

Pass the seat belt under arms.

Use the same belt for two people at a time, nor carry a child on your lap.

Recline the seat excessively.

Pretensioner

The front seat belts are fitted with a pretensioning device which,in the event of an accident,will automatically provide a greater level of support for the front seat passengers.

After an accident,check that the seat belt mountings are in the normal position. If not consult your CITROËN dealer to have the pretensioner device reset and the seat belts replaced if necessary.

Important advice

Before removing or working on the front seats,the pretensioner device must be disarmed. Only a CITROËN dealer can carry out this procedure. As a safety precaution, the pretensioner device **must be disarmed** before carrying out any work on the front seats.

Children

Children under 10 years of age should use the rear seats; in fact it is a legal requirement in some countries to do so. They should also use an approved restraint appropriate for their age and size.

As a guide :

From 9 months to 4 years of age - use a child seat and harness.

From 4 to 14 years of age - use a booster cushion and the existing rear seat belts.

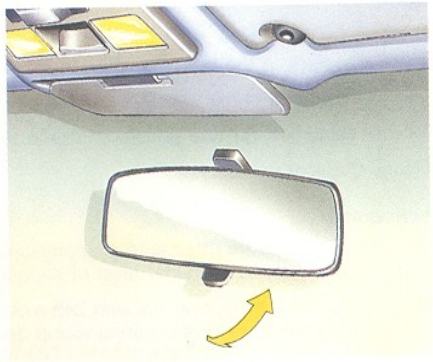
Only approved safety equipment should be used and it must be fitted according to the manufacturer's instructions.

Maintenance

After an accident, have the seat belts changed and the anchorage points checked.

When stationary, a sharp tug on the seat belt should cause the reel to lock. If the reel fails to lock, the seat belt should be replaced immediately.

Only warm soapy water should be used to clean the seat belts. Do not allow water to enter the reel



Interior rear view mirror

Night position - anti-dazzle.
Push the lever back.

Exterior rear view mirrors

Manually operated rear view mirrors.
Adjust in 4 directions.

Electrical adjustment*

A - Select LH or RH rear view mirror.

B - Adjustment in 4 directions using the directional rocker switch.

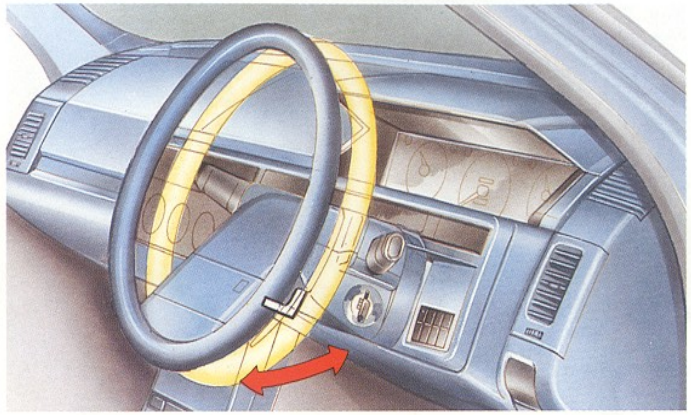
The defrosting of the rear view mirrors is linked to the electrical demisting of the rear window.*

* According to model.

The steering wheel is adjustable for both height and reach.

First adjust the seat position.

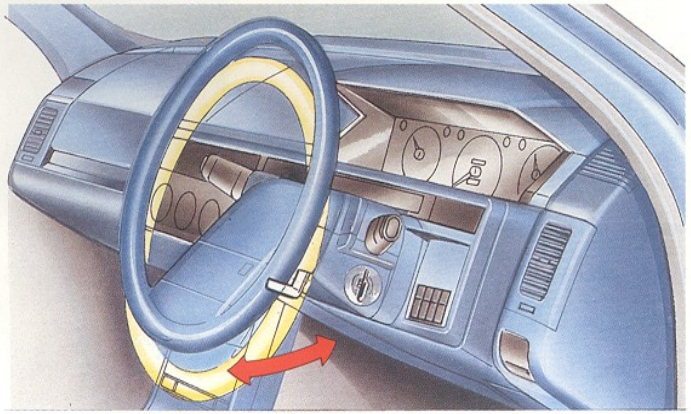
The steering release lever is located on the left hand side of the column.



Adjustment

Push the lever to release the steering column.

Raise or lower the steering wheel.



Pull or push the steering wheel to the desired position.

Pull the lever towards you to lock the steering wheel in the new position. Do **not** release the steering column adjusting mechanism while the vehicle is in motion. Make all steering column adjustments when stationary.

Power steering

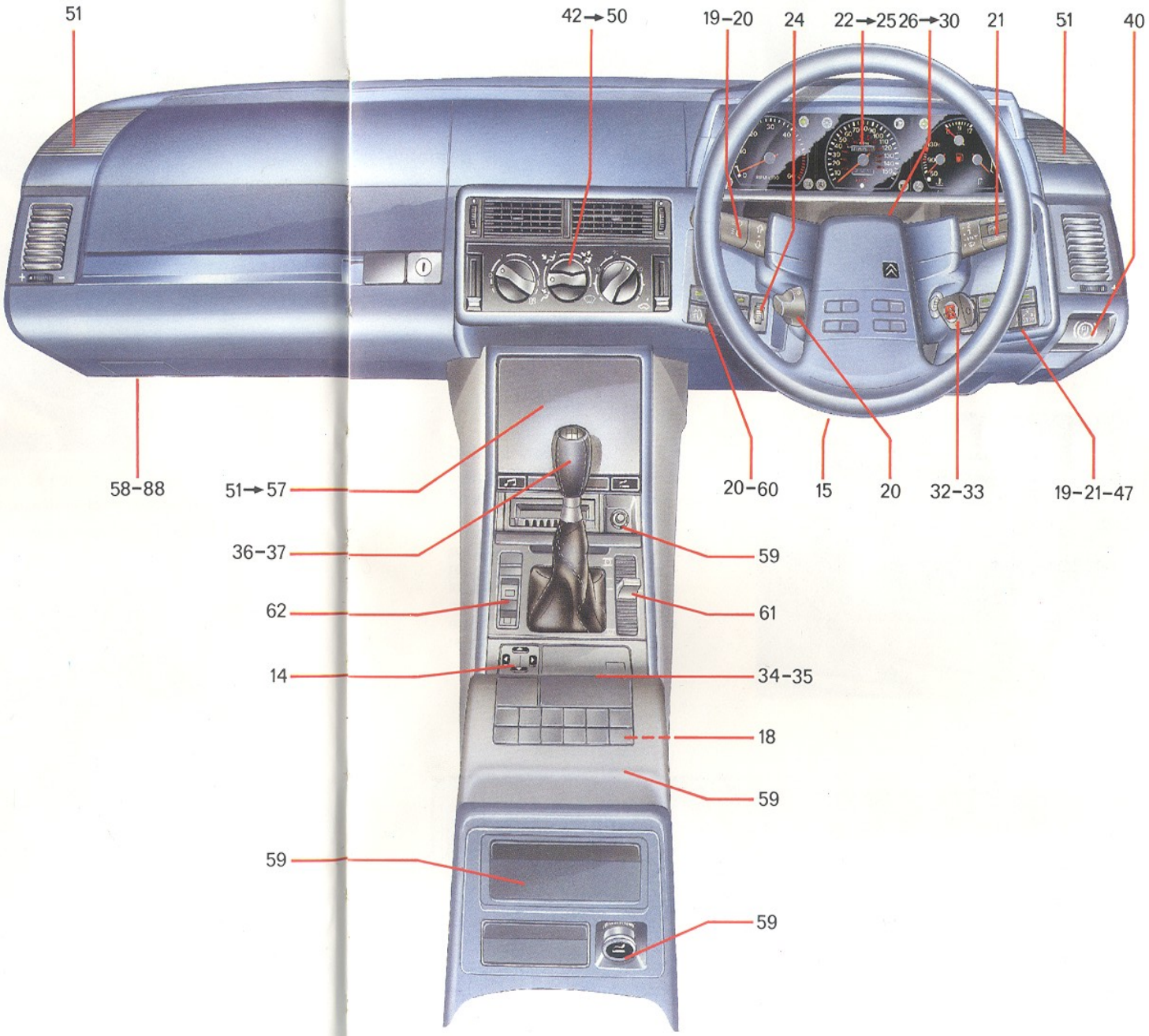
Never turn the ignition off when moving.

* According to model.

Pages

14 Electric rear view mirror control
15 Steering column adjustments
18 Electric windows and centre armrest
19 - 20 Lighting, signalling
21 Visibility
22 - 25 Instrument panel and warning lamps
24 Rheostat
26 - 27 Warning lamp display
28 Trip computer
29 Matrix display
32 - 33 Steering lock, ignition switch, starter motor
34 - 35 Coded anti-theft device
36 - 37 Gear lever
38 Used engine oil
39 Dim-Dip lighting
40 Parking brake
42 - 50 Heating and ventilation
47 Air conditioning
51 - 57 Radio equipment
58 Document pack holder
59 Oddment boxes, ashtrays, cigar lighter
60 Interior lighting
61 Ground clearance
62 Hydractive suspension
88 Fuses

The layout may vary slightly from one model to another.

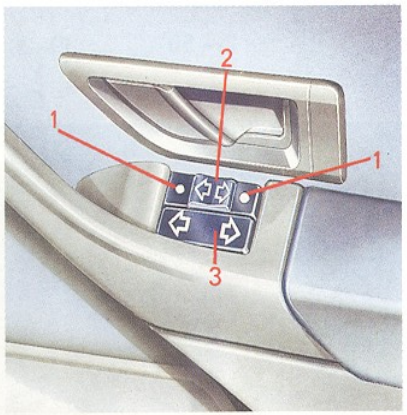


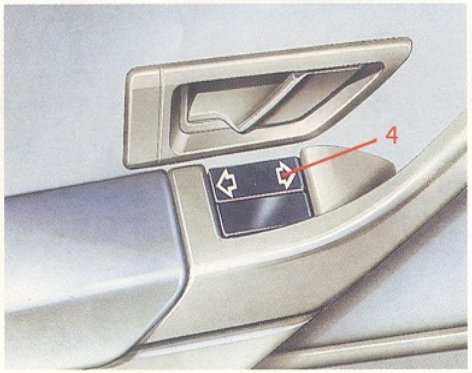
* According to model.

The switches situated on the door or on the centre console allow control of the vehicle windows.

1 - One touch on the switch opens or closes fully the driver's window.

2 - Controlled operation of the driver's window.





3 - Switch for the passenger's window.

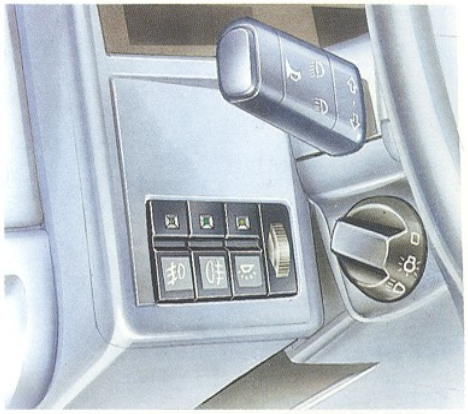
4/5 - Switches for the rear windows are situated on the centre console and the rear door armrests.

6 - Isolator switch preventing operation of the rear windows, rear cigar lighter and electric power accessory socket.

7 - Control switch for the electric armrest adjustment.

The position of the switches may vary according to model.

* According to model.



Horn

Press the end of the stalk.

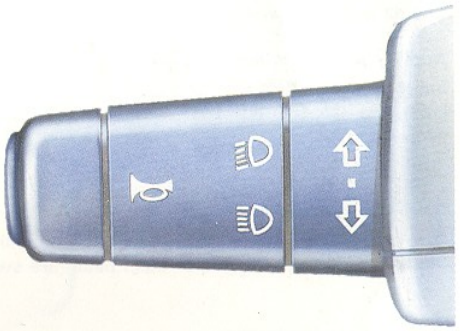
Headlamp warning flash

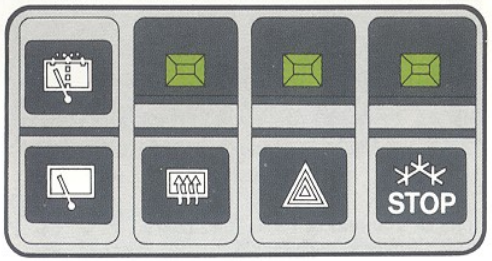
Pull stalk towards you (operates even with the ignition off).

Direction indicators

Left: down.
Right: up.

When indicating, move the stalk past the resistance; automatic return and stop with the steering wheel. On motorways, when overtaking or changing lane, move the stalk against the resistance.





Hazard warning lights

Operates the four direction indicators and two side repeaters simultaneously.

Use only in case of danger, emergency stop or breakdown.

Lighting control switch
Turn knob **1** forward.

0 Lamps off.

Sidelamps (Dim-Dip with ignition).

Headlamps.

Dipswitch

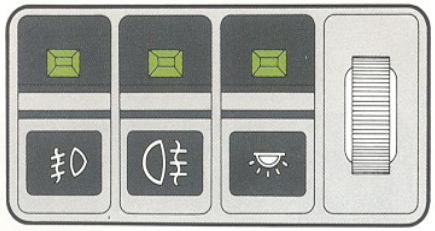
Turn knob **1** to position
Pull lever **2** towards you to change from dipped beam to main beam and vice-versa.

When using main beam
The dipped beam will remain on.

Audible warning when lamps on
Indicates that the lamps have been left on, when a front or rear door* is opened and the ignition is off. This warning will stop on closing the door, on turning the lamps off, or on switching on the ignition.

Front fog lamps
Press the switch, the warning lamp will light. Front fog lamps will only operate if sidelamps, dipped or main beam are switched on.

Rear fog lamps
Press the switch, the warning lamp will light. Rear fog lamps will only operate if front fog lamps, dipped or main beams are switched on.



In clear weather, the rear fog lamps are dazzling. Do not forget to switch them off when not needed.

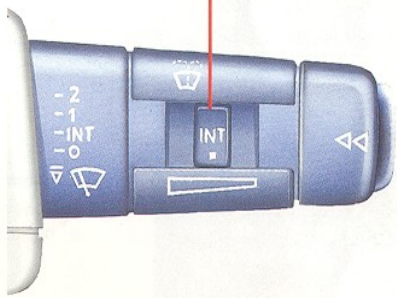
Headlamp adjustment
Incorrectly adjusted headlamps are dangerous to you and to other road users.
The headlamp alignment is achieved by turning the adjuster wheels.
These adjustments have to be precise, therefore, they must be carried out by a CITROËN dealer with the necessary alignment equipment.
After replacing a bulb, have the headlamp alignment checked.

* According to model.

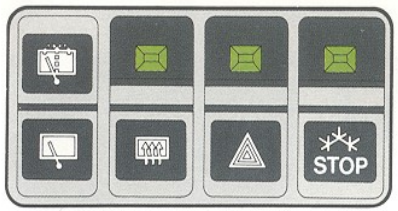
Windscreen wiper

2	fast speed.
1	normal speed.
INT	intermittent wipe with adjustable frequency.
0	stop.
	Single operation of the wiper. Press the stalk down.

The frequency of the intermittent wipe can be adjusted by moving the slider.



Windscreen washer
Pull the stalk towards you. The wiper also operates, then parks.



Rear screen wiper
Push the switch in: intermittent operation of the wiper.

Rear screen washer
While holding in: screen wash and wipe.
On release: about 3 wipes then parks.

Electric demisting
Rear window (and rear view mirrors) demisting switch.

Demist warning lamp.
(timed operation-12 minutes duration)*.

On models without the timed function, switch off as soon as possible to avoid excessive current consumption.

* According to model.

Tachometer (Petrol engine)
Do not exceed 6,200 rpm (4,500 rpm during the running in period).

Engine oil temperature.

Tachometer (Diesel engine)
Do not exceed 5,000 rpm (4,000 rpm during the running in period).

Turbo overpressure
The function is correct when the needle is in the white zone. If, during periods of sustained acceleration, the needle enters the red zone, drive at reduced speed to the nearest CITROËN dealer.

Total mileage recorder.

Trip mileage recorder with reset
Press the button.

* According to model.

Automatic gear selection display
See pages 36 - 37.

Fuel gauge
When the low level warning lamp comes on continuously, there are approximately 8 litres left in the tank.

Water temperature
Above normal operating temperature, the pre-warning and main warning lamps will light up. Refer to page 26.

Oil level gauge
The oil level gauge will operate approximately 2 seconds after the ignition is switched on. The level is correct provided the needle is between the min. and max. level marks. The gauge does not function with the engine running.

Analogue clock
To reset: Turn the button.

Fuel gauge
When the low level warning lamp comes on continuously, there are approximately 8 litres left in the tank.

* According to model.

Sidelamps
Refer to page 20.

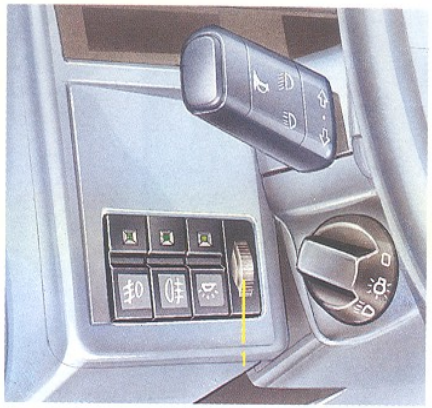
Dipped beam
Refer to page 20.

Main beam
Refer to page 20.

Rear fog lamps
Refer to page 20.

Rheostat
The brightness of the dashboard illumination can be adjusted.

Turn the dimmer wheel **1** situated on the lower left hand side of the warning lamp display.



LH direction indicator
Refer to page 19.

RH direction indicator
Refer to page 19.

'Hydractive' suspension
Lights up when 'Sport' mode is selected.

Antilock Braking System
It will light up for a few seconds when the ignition is turned on. If it stays on or lights up when driving, this indicates that the ABS is faulty, **but does not affect the normal braking system.**

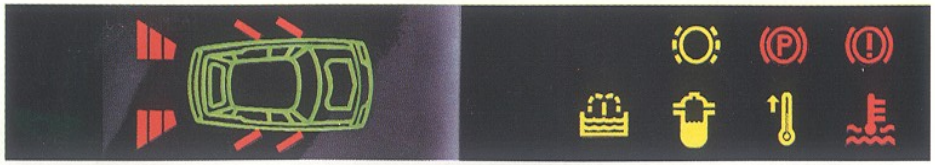
Nevertheless, it is recommended that the vehicle be taken to a CITROËN dealer as soon as possible.

On slippery roads (loose stones, snow, ice, etc.), it is imperative to drive with caution, since while ABS minimises stopping distances it cannot compensate for the reduced grip afforded by such surfaces. Stopping distances will therefore increase significantly on slippery surfaces.

Low level fuel warning
When it comes on continuously, there are approximately 8 litres left in the tank.

Not used.

Preheaters (Diesel)
Will light up with the ignition key in position **M.**
Refer to pages 32 - 33.



Electronic visual information (Dot-Matrix display: refer to page 30).

Vehicle silhouette*

Indicates the following: - Doors are not properly closed.
- Failure of the rear sidelamps.
- Failure of the stop lamps (left or right).

Upon switching on the ignition, the bulb failure warning lamps will light. After the first application of the brake pedal, the failure warning lamps will go out provided that the stop lamp circuit is in working order.

Low level screen wash
Refill the reservoir.
Capacity: 4.5 litres (1 gal.).

Front brake pad wear
If it lights up when pressing the brake pedal, have them checked and replaced if necessary.

Water in fuel filter
Drain the water from the fuel filter as soon as possible.

Parking brake
Indicates that the parking brake is applied or is not fully released.

Water temperature pre-warning lamp
If it lights up, slow down.

Hydraulic pressure and level
If it lights up, stop immediately and call the nearest CITROËN dealer.

Water temperature
If it lights up together with the STOP warning, stop immediately but let the engine idle. Check the coolant level, taking the precautions detailed on pages 66 to 77. Contact the nearest CITROËN dealer.

* According to model.

Clock and external temperature* (Trip computer: refer to page 28 - 29)
Clock reset: using a pointed object, press in one of the two buttons to the right of the clock.

1 Setting of hours.

2 Setting of minutes.

Stop command
Will come on together with another warning lamp; vehicle must be stopped as quickly as possible with due regard to safety.

Battery charge
Should not come on when the engine is running. May light up when the engine idles but should go out with slight acceleration. If it remains on, go to the nearest CITROËN dealer.

Coolant level
Check the level taking the precautions detailed on pages 66 to 77.

Engine oil pressure
If it lights up while driving, stop the engine. Check the oil level, refer to pages 66 to 77.
If the warning lamp remains on with a correct oil level, contact the nearest CITROËN dealer.

Engine auto-diagnosis
If it flashes or lights, it indicates a fault within the fuel injection or ignition systems; engine performance and running may be impaired. Prolonged running under these conditions will lead to damage to the catalytic converter. Consult a CITROËN dealer as soon as possible.

* According to model.

Four types of information appear on the display to the right of the instrument panel:

Ambient temperature. (°F)
Instantaneous fuel consumption. (MPG)
Average fuel consumption. (MPG)
Average speed. (MPH)

To select the desired information, press lightly on the end of the windscreen wiper stalk.

The time is displayed permanently. To reset, using a pointed object press in one of the two buttons, situated on the right of the display.

The ambient temperature is displayed whenever the ignition is switched on.When indicating temperatures of between 26 °F and 38 °F,the display flashes,warning the driver of the possibility of icy conditions.

Instantaneous fuel consumption. The fuel consumption of the last 2 second period is displayed. This function is only available at speeds above 13 m.p.h.

* According to model.

The average fuel consumption is calculated from the last reset of the computer.

The average speed is obtained, from the last reset of the computer, by dividing the distance covered by the time taken (ignition on).

To reset the computer, press continuously for more than 3 seconds on the stalk. If horizontal segments appear instead of numbers, contact a CITROËN dealer.

Each time the engine is started, the display shows ambient temperature.

If the battery has been disconnected, all the segments of the display light up upon starting the engine.

Pressure on the control stalk or one of the clock reset buttons sets the computer in operation. The ambient temperature is displayed.

* According to model.

*Electronic visual information** *(Dot-matrix display)*

A dot-matrix display (to the left of the instrument panel) gives advisory messages or urgent warnings preceded by an audible 'bip'.

Message 1	Message 2
Stop lamp test	Apply brakes to test (see page 26)
Engine oil pressure	Stop immediately
Hydraulic pressure	Warning brake pressure loss
Hydraulic level	Check fluid level
Engine water level	Stop immediately
High water temperature	Slow down
Worn out brake pads	Brake maintenance

ABS out of use
Defective right stop lamp
Defective left stop lamp
Left front door open
Right front door open
Left rear door open
Right rear door open
Boot lid open
Bonnet open

Defective right tail lamp
Defective left tail lamp
Defective side lamp
Fill windshield washer

Automatic suspension
Sport suspension

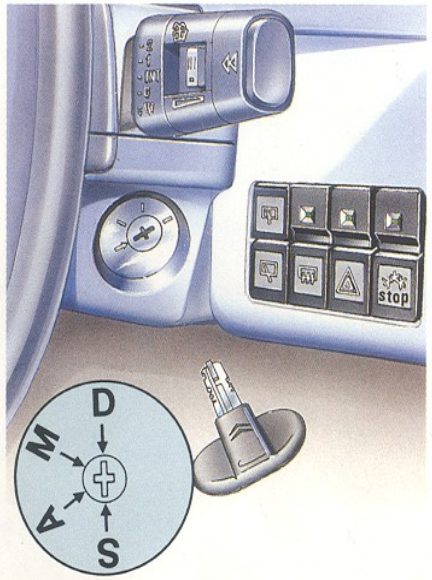
The messages can be displayed in French, English, German or Italian depending on the fitting of fuses 11 and 15.

	Fuse 11	Fuse 15
French	No	No
English	Yes	Yes
German	Yes	No
Italian	No	Yes

Refer to page 89.

* According to model.

	Pages
Steering lock, ignition, starter, preheating, catalytic converter	32
Starting the engine, running-in	33
Coded anti-theft device	34 - 35
Gear lever manual gearbox	36
Gear lever automatic gearbox	36 - 37
Used engine oils	38
Parking brake, ABS	40



• **S: Steering lock**

To unlock the steering, turn the steering wheel slightly at the same time as turning the key; avoid using undue force.

• **A: Accessories**

Allows operation of electrical accessories.

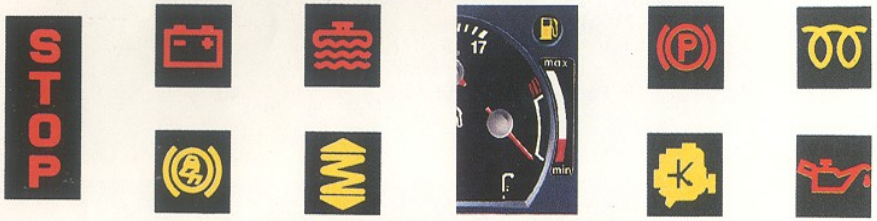
• **M: Ignition**

Upon switching on the ignition, the oil level gauge (timed) together with STOP, battery charge, ABS (timed), coolant level, hydractive suspension (timed), parking brake, auto-diagnosis, preheating and oil pressure warning lamps will all light up by way of a test function. If one of them fails to light up, a fault is indicated.

• **D: Starter**

Release the key as soon as the engine has started. Never operate with the engine running. (Refer to page 33).

These warning systems are tested in position **M**.



CATALYTIC CONVERTER

Attention: The catalytic converter is a delicate component.
Follow the advice given below.

Important information for vehicles equipped with a catalytic converter*

1 - Use only **unleaded** petrol.
2 - Do not use any additive in the unleaded petrol.
3 - Do not use any additive in the engine oil.
4 - Avoid repeated cold starts.
5 - In case of difficulty when starting a cold engine, consult your nearest CITROËN dealer.
6 - In case of misfiring, consult your nearest CITROËN dealer.
7 - Allow engine to idle before switching off the ignition.
8 - Have the vehicle serviced regularly, according to the maintenance guide.
9 - Never tow or push the vehicle to start the engine as this can cause damage to the catalytic converter.
10 - Avoid running out of petrol.
11 - Do not let the engine idle for long periods with the vehicle stationary.
12 - Never park or drive the vehicle over easily ignited materials(the catalytic converter operates at very high temperatures).

Running-in

The vehicle should be carefully run-in until the first service is carried out. Drive moderately, avoiding high engine speeds.
Do not exceed 4,500 rpm (petrol engine) or 4,000 rpm (diesel engine) in any gear.
Avoid harsh braking.
Careful running-in will improve the oil consumption throughout the life of your vehicle.
Depending on the conditions of use of your vehicle, oil consumption could reach 1/2 litre per 600 miles for a petrol engine or 1 litre per 600 miles for a diesel engine, after a running-in period of at least 3 000 miles.
Regular use of high engine speeds will significantly increase oil consumption.
When topping up with oil, do not fill above the MAX. level.

Starting (Petrol engine)

Automatic choke (according to model):

It is not necessary to depress the accelerator pedal . Turn the ignition key to position **D** to operate the starter motor (up to 10 seconds if necessary), release the key as soon as the engine starts. At temperatures below 0 °C, depress the clutch pedal to ease starting,then release it slowly.

Engine hot: it is not necessary to depress the accelerator pedal.

Operate the starter motor (for up to 10 seconds) and release the key as the engine starts. In all cases, if the engine does not start, wait a few seconds, then depress the accelerator completely while operating the starter motor (up to 10 seconds) until the engine starts.

Starting (Diesel engine)

Engine cold

Turn the ignition key to **M** (ignition, preheaters) and wait until the preheater warning lamp goes out. Operate the starter motor (up to 10 seconds) until the engine starts, then let it idle in neutral for a short time.

At temperatures below 0 °C, depress the clutch pedal to ease starting, then release it slowly.

Engine hot

Operate the starter motor. If the engine fails to start at the first attempt, then use the preheaters as in cold starting.

In all cases, if the engine does not start, wait a few seconds, then depress the throttle completely while operating the starter motor until the engine starts. If it still fails to start, consult your nearest CITROËN dealer.

Warning

Wait for the vehicle to reach its normal ride height before selecting a gear.

Do not let the engine run in a confined space.

Vehicle fitted with turbocharger

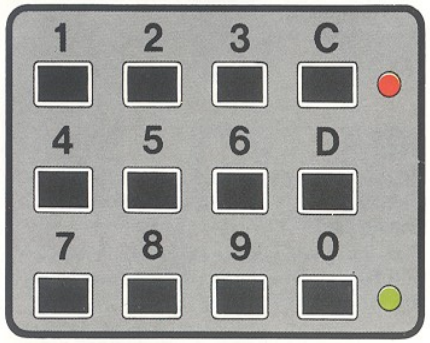
Before switching off,always let the engine idle for several seconds to allow the turbocharger to reduce speed.

This security device locks the electronic injection system when programmed with a confidential 4 figure code.

Ignition switched on

Green warning lamp on: engine can be started.
Red warning lamp on: security device engaged.
To allow the engine to be started, the 4 figure code must be entered: the red warning lamp must be off and the green lamp on.
In case of error, re-enter the code.
After 3 successive false attempts; the keyboard will be locked automatically for one minute (ignition on).
Each time a key is pressed, the green warning lamp flashes together with a 'beep' sound.
If you try to start the engine when the security device is engaged, a warning will sound while the starter motor is in operation.

1st programming of the code



Ignition on

1 - Enter the code 0001.
2 - Press key **C**.
3 - Enter your 4 figure code.
4 - Press key **C** to validate.
Four flashes of the green warning lamp and an audible 'beep' indicate that the information is recorded.

To change the code

Ignition switched on

1 - Enter your old code already in memory.
2 - Press key **C**.
3 - Enter your new confidential 4 figure code.
4 - Press key **C** to validate.
Four flashes of the green warning lamp and an audible 'beep' indicate that the information is recorded.

Security procedure

The two codes (old and new) are then valid until one is used to start the engine.
In case of non confirmation (four flashes and 'beep' sound), turn the ignition off, then turn it on and start the whole process again.
If by mistake, more than four figures have been entered before you press key **C**, only the first four will be memorised.
If both red and green warning lamps are flashing simultaneously, this indicates an incorrect entry or a malfunction. Turn the ignition off, then turn it on and start the whole process again.
If this condition persists, consult the nearest CITROËN dealer.

Neutral mode

This mode is the only one that can prevent locking. Proceed as for a change of code using as new code 0000.
To get out of this mode, enter your confidential code with the ignition on.

The device locks automatically with the ignition off:
- As soon as the doors are locked.
- One hour after the ignition has been turned off, if the doors are not locked.

Deferred locking

Press key **D** (ignition on) to delay locking of the injection system for one hour.
During this time, you need not re-enter the code to start the engine.
The deferred locking is indicated by flashing of the green warning lamp and an audible 'beep' within 30 seconds of the ignition being turned off.
To cancel the deferred locking, press key **D**.

Identification

From the outside of the vehicle, the system status can be identified:

- **Locking engaged:**
The red warning lamp lights up continuously for 10 seconds after the doors have been locked then flashes until the ignition is next turned on.

- **Locking deferred:**
The red warning lamp starts flashing after one hour and continues until the ignition is next turned on.

Recommendation

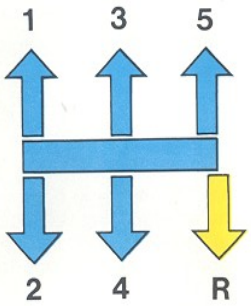
When the vehicle is taken to a CITROËN dealer for any work to be carried out, to avoid revealing your personal code, it is advisable to reprogramme the security system to the original 0000 code (see neutral code). The confidential code then stays in the memory, and can be changed only by someone who knows it.
When collecting the vehicle, with the ignition on, simply re-enter your personal code to reactivate the anti-theft device without going through the process of changing the code.

In case of breakdown or battery disconnection, the confidential code remains in the memory.

WARNING:

If the confidential code is forgotten, the fuel injection computer must be replaced.

* According to model.



Reverse gear

Never engage reverse gear while the vehicle is in motion.
Depress the clutch pedal and wait a few moments before engaging reverse gear.

Automatic gearbox gear selector

Gear selector lock

Disengage the selector lock by pressing on **B** in order to change from:

P ⇄ **R** ◄ **N** ◄ **D** **3** ► **2** **1**

The arrows indicate the selector movements that can only be made by pressing on **B**.

The engine can only be started in positions **P** and **N**.
A security interlock prevents operation of the starter in the other positions.

The position of the selector lever is displayed in the right hand dial of the instrument panel.

P **Park**

Do not engage until the vehicle is completely stationary. In this position the driving wheels are locked. To avoid any movements of the vehicle when parked, select position **P** and engage the handbrake.

R **Reverse**

Engage only when stationary and the footbrake firmly applied. To avoid any harshness, do not accelerate immediately on selection.

N **Neutral**

Recommended position when stationary in a traffic jam. **Do not select** when the vehicle is in motion.

D **Drive**

Position for normal use. The four forward gears are selected automatically.
To provide maximum acceleration (overtaking, for example) pressing the throttle pedal fully can cause the gearbox to change to a lower gear.

Suggested uses

3 **Automatic selection of the three lower gears** **1** **2** **3**

Sustained driving on winding roads, when towing a caravan or when driving in town.

2 **Automatic selection of the two lower gears** **1** **2**

Long inclines or when towing a caravan under difficult conditions.

1 **Locked in 1st gear** **1**

For use on exceptional gradients when towing a caravan.

3 **2** **1** These positions can be used for engine braking, however, **never** select a lower position when the engine speed exceeds 4,000 r.p.m.

Advice

Towing the vehicle: select position **N** (neutral).
See **Towing** page 98.

Used engine oils

Warning

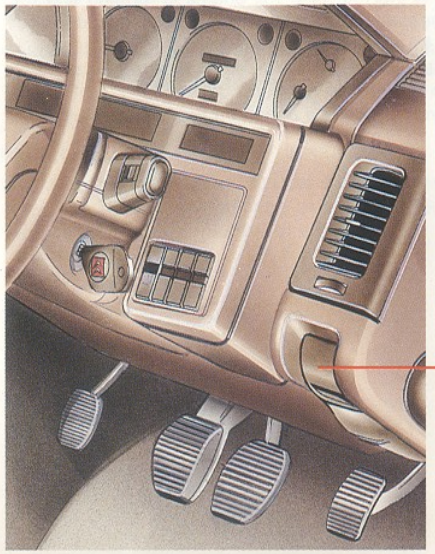
- Prolonged and repeated contact may cause serious skin disorders, including dermatitis and cancer.
- Avoid excessive contact, use a barrier cream and wash thoroughly after contact.
- Keep out of reach of children.

Protect the environment

It is illegal to pollute drains, water courses or soil. Use authorised waste disposal facilities, including civic amenity sites and garages providing facilities for receipt of used oil. If in doubt, contact your local authority for advice.

Note: 'Dim-dip' lighting (Road vehicle lighting regulations)

If the side-and-tail lamps are on and the engine is started, or if the engine is running and the side-and-tail lamps are switched on, the dipped-beams of the headlamps light at reduced output (dim-dip) to make the vehicle more easily seen by other users of the road.
When the driver switches to dipped-beams or main-beams, the dim-dip ceases to operate until side-and-tail lamps only are selected again with the engine running.
Switching the dim-dip on and off is automatic and requires no action on the part of the driver.



Emergency and parking brake

The pedal is situated to the left of the clutch pedal.

Two functions:

- Parking brake. Push in release control **1**, then depress the pedal.

  To release, pull the release control towards you gripping it from underneath.

- Emergency brake. With the release control pulled out it can be used as a conventional brake but with no power assistance.

Do not drive with the release control 1 pushed in.

The warning lamp lights up when the brake is applied or not fully released.

ABS* - Antilock Braking System

The warning lamp will light up for a few seconds when the ignition is turned on. If it stays on or lights up when driving, this indicates that the ABS is faulty, **but does not affect the normal braking system.**

Nevertheless, it is recommended that the vehicle be taken to a CITROËN dealer as soon as possible.

On slippery roads (loose stones, snow, ice, etc.), it is imperative to drive with caution, since while ABS minimises stopping distances it cannot compensate for the reduced grip afforded by such surfaces. Stopping distance will therefore increase significantly on slippery surfaces.

* According to model.

	Pages
Heating, Ventilation	42 - 44
Air temperature control	45 - 46
Air conditioning	47
Automatic heating and ventilation	48 - 50
Radio pre-equipment	51 - 52
Clarion audio system (Option)	53 - 57
Sun visors, rear blinds	58
Storage space, ashtrays, cigar lighters	59
Interior lighting	60
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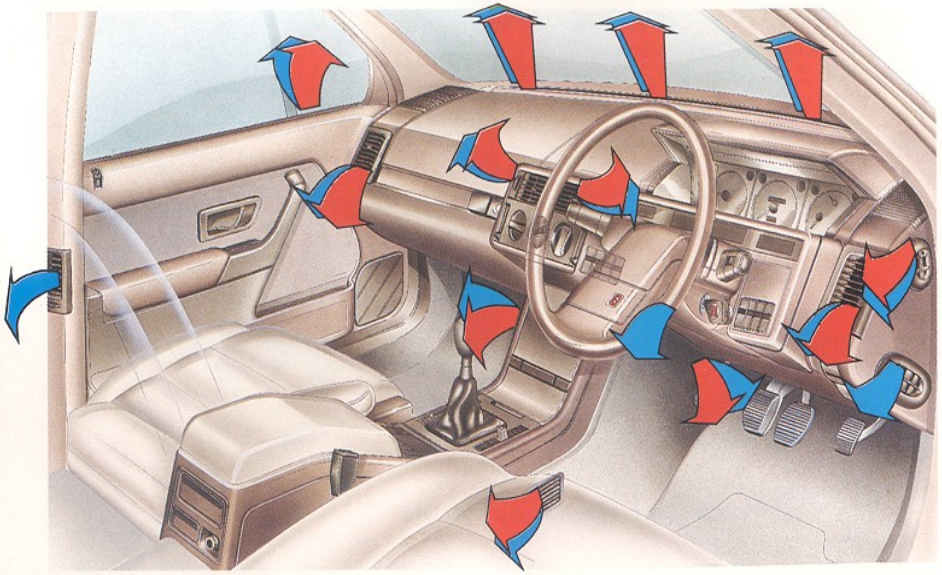
Separation screen	63
Opening roof	64



Air circulation*

Optimum comfort depends on the even distribution of the air in the passenger compartment, both at the front and at the rear.
Keep the air intake grille clear (dead leaves, snow).
Do not obstruct the following openings: passage under the front seat, space between the rear window and the shelf, recesses in the sides of the boot.

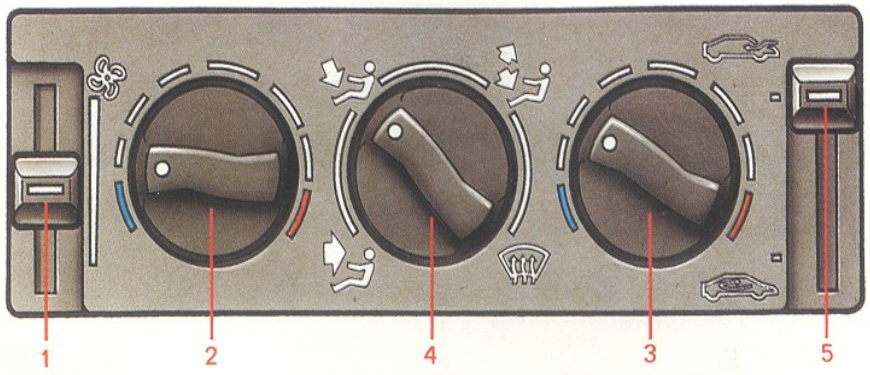
Air vents

Air vents are marked with (–) and (+) (closed or open) and have louvres to direct the airflow (high-low, right-left).

An air vent adjustable in both flow and direction situated on each centre pillar provides air for the rear passengers.

An additional adjustable air vent, situated under the steering column, provides additional air for the driver's legs.

* According to model.



Heater control panel

1 - Heater blower control slider.

2 - 3 - Air temperature controls.
The heater output temperature can be varied independently left and right.
2 - LH side. 3 - RH side.

4 - Air distribution control
4 settings plus intermediate positions possible.

Face level from the vents.

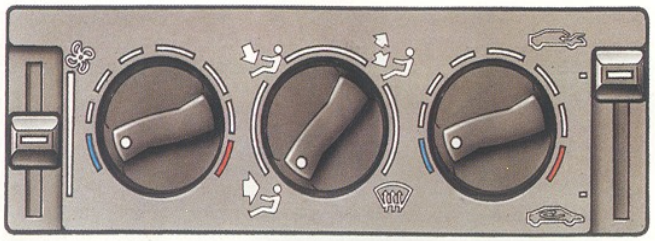
To the feet.

To screen and feet.

To screen for demisting.

5 - Recycling control
This control enables the outside air supply to be shut off and the air inside the vehicle to be recycled when passing through dusty areas or a tunnel or to avoid unpleasant odours. It will also provide quicker heating of the interior in winter or cooling by the air conditioning system(if fitted) in summer.
The control has only 2 positions and should not be left in an intermediate position.
It is recommended that the control not be left in the recycling position for longer than necessary as the normal position will provide a continuous fresh air supply to the passenger compartment.

* According to model.

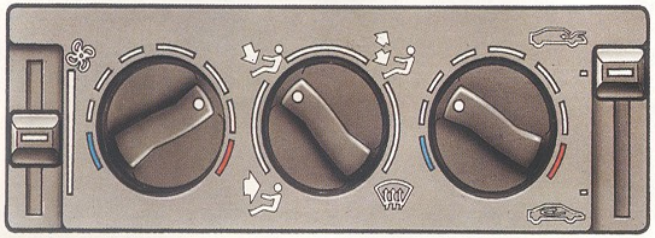


Ventilation

Cold air ventilation is obtained by setting the two temperature controls to the cold position.

Recommended position for distribution control.

The airflow is controlled by the heater blower sliding cursor.

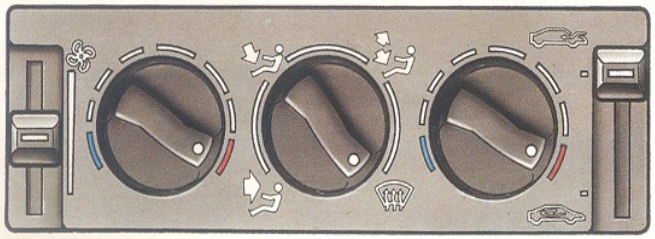


Heating

Set the two controls to the temperatures desired.
Recommended positions for distribution control:

For heating only.

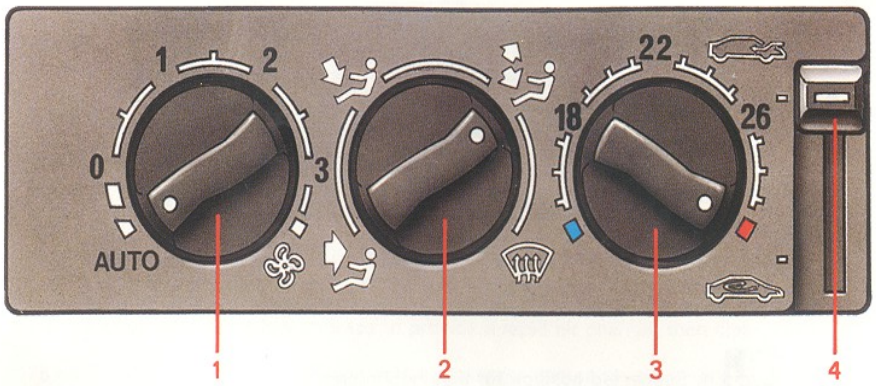
For heating and screen demisting.



Defrosting and demisting

Set the two temperature controls to 'HOT', the distribution control to , the heater blower to maximum and to clear the screen quickly, the fresh air position should be selected.
When the windows are clear, set the controls to the temperatures and levels desired.

* According to model.



Heater control panel*

1 - Heater blower speed control

5 progressive settings controlling the airflow into the passenger compartment.

Position 0: heater blower off - no air flow. ('Ram' effect air supply insignificant).

Position AUTO: automatic control of both air temperature and flow.
The air flow can be controlled manually by rotating the control **1**.

2 - Air distribution control

Face level from the vents.

To the feet.

To screen and feet.

To screen for demisting.

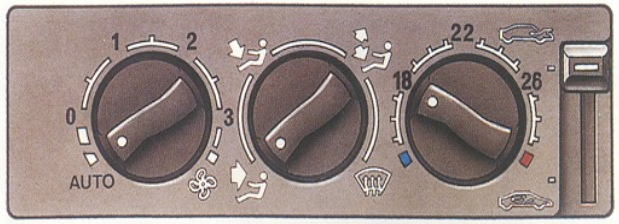
3 - Temperature selector - control by a roof-mounted sensor

4 - Recycling control

This control enables the outside air supply to be shut off and the air inside the vehicle to be recycled when passing through dusty areas or a tunnel or to avoid unpleasant odours. It will also provide quicker heating of the interior in winter or cooling by the air conditioning system(if fitted) in summer.
The control has only 2 positions and should not be left in an intermediate position.
It is recommended that the control not be left in the recycling position for longer than necessary as the normal position will provide a continuous fresh air supply to the passenger compartment.

Fresh air position

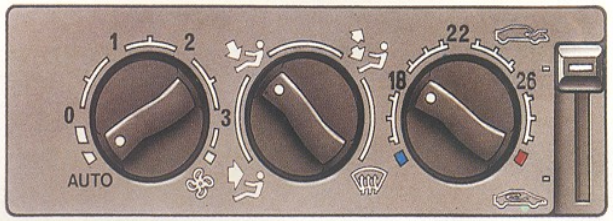
* According to model.



Ventilation

Select the desired temperature. In the AUTO position, the airflow will be controlled automatically to provide optimum ventilation.

Suggested position for distribution control.



Heating

Select the desired temperature with the control.

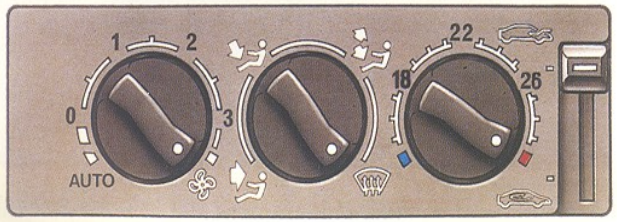
Suggested positions for distribution control:

Heating only.

Heating and screen demisting.

The AUTO** position will provide the optimum airflow.

** When starting from cold, the airflow will be slight, until the engine has reached its normal running temperature. Full heater operation will then be achieved.



Fast defrosting and demisting

Select position 3 of the heater blower control, set the distribution control to the screen position, set the temperature control to maximum and select the fresh air position on the slide control.

When the windows are clear, set the controls to the temperature and level required.

* According to model.

Air conditioning*

The system will only operate with the engine running. It is linked to the temperature controls.

It will operate if the ambient temperature is above 3 °C.

Operation of the system can be prevented by pressing the switch, the lamp will illuminate.

For the air conditioning to be fully effective, the windows should be closed.

However, if after a prolonged stop in direct sunlight, the inside of the car is hot, leave the windows open for a few minutes to provide a rapid air change, then close them.

To obtain the most effective cooling in the passenger compartment in very hot conditions or to provide rapid demisting in the winter, select the recycling position (**air conditioning in operation**).

It is normal for water (that has condensed on the surface of the air conditioner) to run out under the vehicle.

Recommendation

Set the control to the temperature desired. Optimum heating or cooling will be controlled automatically.

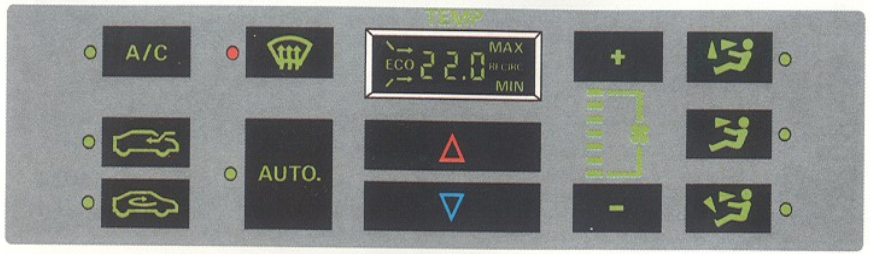
Selecting the maximum or minimum position will not speed up the process.

* According to model and equipment.

This system controls the air flow, the temperature, the air conditioning and the air distribution automatically.

It provides an optimum level of comfort regardless of the climatic conditions.

Control panel



Display
To obtain the desired temperature,press the appropriate switch:

Red
To increase.

Blue
To decrease.

Display of the selected temperature of the passenger compartment. This display is in half degree increments for temperatures between 19 °C and 25 °C and in one degree increments outside of these temperatures.

Autodiagnosis
If the decimal point **A** flashes,it is an indication that a fault has occurred in the heating system. The overall efficiency of the system may be impaired but the heating will continue to function albeit in a more simplified manner. Consult your CITROËN dealer.

These arrows indicate a significant difference between the temperature selected and the actual temperature. They confirm that the change of setting has been noted and that the system is responding. The arrows will disappear as the difference between selected temperature and actual temperature decreases.

This will appear when the air conditioning has been switched off. (See next page).

* According to model.

Appears when the recycling position has been selected.

Appears when a temperature below 15 °C has been selected.

Appears when a temperature above 30 °C has been selected.
In these two extreme positions (**Min.-Max.**), the system will provide maximum output of either cold or hot air according to setting.

Automatic operation
The switches and warning lamps are illuminated in green (except the demisting control warning which is orange).
A warning lamp will illuminate when each function has been selected.

A single press of the switch (confirmed by the illumination of the warning lamp) will automatically control 5 separate functions in achieving the temperature selected.

- Air flow
- Temperature within the passenger compartment
- Distribution of air
- Air conditioning
- Recycling of air

Note
The heater blower fan operates at reduced speed when the engine is cold and will progressively increase as the engine warms up.

Manual operation
It is possible to manually override a function whilst still maintaining automatic control of the other functions. Press one of the following switches to override the automatic control. (The **AUTO** function and warning lamp will be cancelled but not the air conditioning control.)

Air conditioning
Warning lamp illuminated: air conditioning in operation.
By pressing the switch the air conditioning will be switched off and the warning lamp will go out. '**ECO**' will appear in the display.

When the warning lamp is out, the air conditioning can be selected by pressing the switch. The warning lamp will light and the air conditioning will be available.

* According to model.

Fresh air

Warning lamp lit: fresh air is drawn into the heater system.

Recycling

Warning lamp lit: fresh air inlet is closed and air from within the vehicle is recycled.
'RECIRC' appears in the display. This function should be selected when driving in unpleasant conditions (dusty areas, unpleasant odours or in a tunnel).
It should be cancelled as soon as possible by pressing **AUTO** in order to maintain a continuous supply of fresh air.

Air flow

Press on the switches + to increase and − to decrease the heater blower speed.

Maximum heater blower speed

All segments lit.
To return to automatic control, press the **AUTO** switch.

Blower off

No segments lit. The air conditioning will be switched off automatically.

Ventilation predominantly to the screen.

Ventilation predominantly to the face vents.

Ventilation predominantly to the feet and the face vents.

These last three functions provide a choice of air distribution overriding that of the automatic control.
Pressing the **AUTO** switch will return the system to its automatic function.

Demisting

This switch provides rapid defrosting or demisting of the windscreen and effects directly the speed of the heater blower.

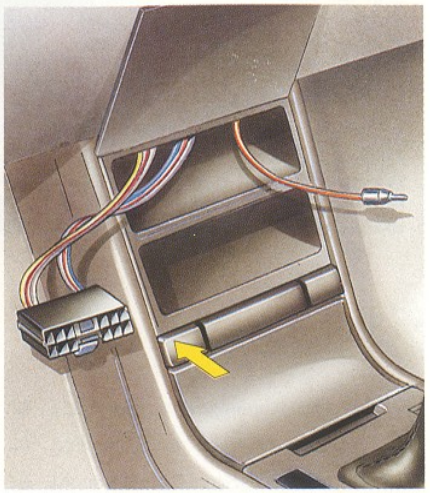
Press **AUTO** to return the system to its automatic function.

* According to model.

Comprises:

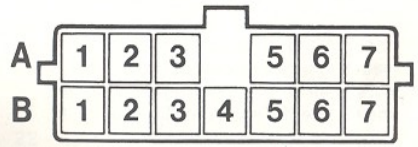
- Wiring and connections enabling the fitting of front and rear speakers and 'Tweeters' in the dashboard.
- An aerial and lead.
- A 13-way socket for connecting the radio.

A1: (−) LH Rear Speaker.
A2:(−) LH Front Speaker.
A3: Display illumination.
A5: (+) Ignition controlled.
A6: (+) RH Front Speaker.
A7: (+) RH Rear Speaker.
B1: (+) LH Rear Speaker.
B2: (+) LH Front Speaker.
B3: (+) Permanent live.
B4: Electric aerial.
B5: Earth.
B6: (−) RH Front Speaker.
B7: (−) RH Rear Speaker.



Reminder of the positions and functions of the wiring

Seen from back of connector.



Fitting tweeters to the dashboard

Remove the grilles above the air vents (see diagram), connect and secure the tweeters (72 mm diameter).

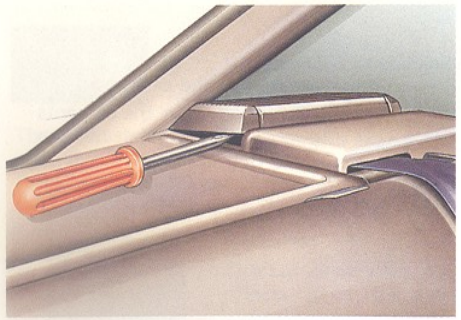
Refit the grille as shown.

* According to model or options.

Fitting speakers to the front doors*

In the lower part of the doors, speakers 165 mm diameter.

Remove the grille using a screwdriver (see diagram), cut out the panel and the lower half of the inner panel. Connect and secure the speaker. Refit the grille.



Fitting speakers to the rear shelf*

Remove the grille (see diagram) connect and secure the speakers (130 mm diameter).

Clarion radio equipment

Refer to page 53.

* According to model.

The Clarion PC 300 comprises:

1 - Volume (+)/(−)
2 - Loudness (loud control)
3 - Off/On
4 - Rewind
5 - Tape track seek (APC)
6 - Autoreverse
7 - Cassette eject
8 - Fast Forward
9 - Dolby noise reduction
10 - Frequency memorising buttons
11 - Automatic search
12 - Autostore (MA)
13 - Examining the memory (EXM)
14 - Manual search
15 - Mono-stereo function
16 - Waveband selection (BND)
17 - Bass control
18 - Treble control
19 - Front/Rear fader
20 - Right/Left balance (BAL)
21 - Coded anti-theft warning
22 - Cassette flap
23 - Function display

Clarion PC 300 Operating instructions

Connecting your PC 300

The PC 300 is security coded by the manufacturer to deter would-be thieves. Before the unit can be used, its security code must be entered:

- Press the 'ON' button.
- Using the numbered buttons, enter the unit's security code. For example if the code is 2345, press buttons 2, 3, 4 and 5 successively.

  The unit will now function normally until any such time that it becomes disconnected from its electrical supply (battery disconnected, fuse blown or unit removed from vehicle).

  Having entered the correct code, the display will show the wave band and frequency selected.

Note: If you have attempted to enter an incorrect code, the unit will lock and the incorrect code will be displayed. At this stage the unit will not operate. To enter the correct code, the incorrect code must first be erased. Press the 'BND' (**16**) button until the display clears (approximately 10 seconds). Now repeat the code entry procedure taking care to enter the correct code (see page 109).

Using the tuner

The PC300 is equipped with a 2 tuners and a 2 aerial system (the second aerial is in the rear windscreen) to give improved reproduction on FM.

Finding a radio station

Using the 'BND' button, select the desired waveband.

Selecting a station

This can be done in 2 ways:

Automatically

By pressing key **11**, the radio will retune, in the direction selected, to another frequency.

Note: Two brief successive touches on the key will cause 'DX' to be displayed. This indicates that the radio will now tune more sensitively allowing weak or distant signals to be selected. In normal operation, a single touch will allow all local stations to be found.

Remote control*

The 4 principal radio functions can be controlled remotely from the steering wheel.
The two buttons (on the right) control the volume. (Identical to key **1**.)
The button » searches all frequencies automatically as described above. (identical to key **11**.)
The 'EXM' button searches the stored frequencies. (Identical to key **13**.)

Manually

Tuning changes can be made in the appropriate direction by pressing key **14**.

Storing a station

Having selected the stations as described, they can be stored by pressing continuously one of the numbered buttons (choose which) until the sound output disappears. Sound output will return after two seconds and the station will be stored in the memory.

Using this procedure you can store:
6 FM stations on U1.
6 FM stations on U2 by autostore.
6 MW stations.
6 LW stations.

Autostore (6 FM stations) (12 - MA)

The PC 300 can 'autostore' 6 stations on band U2. To use the autostore function, press button 'MA' for 2 seconds the display will show that the frequencies are being scanned and stored in the numbered memories (1 - 6). Having stored 6 stations the display will stabilize and by pressing a numbered button, a stored station will be selected.

It is possible to limit the range of the autostore function by setting the start point of its search. To do this, select the desired start point with the manual controls and then activate the autostore function as described above. This makes it possible, for example, to select 6 stations manually from 87.6 Mhz to 97 Mhz on Band U1 and to autostore 6 stations from 97 Mhz to 108 Mhz on Band U2.

The 'MA' function (12) can also be used manually to enable 12 FM stations to be stored - 6 on Band U1 as described and 6 on Band U2, in the following way.

Select Band U1, press briefly 'MA', Band U2 will be selected.
Tune the radio to the first 6 desired stations and store them. Reselect Band U1 and select and store 6 more stations.

We advise those who travel widely to store their favourite 6 stations on Band U1 and use 'MA' Band U2 to obtain 6 stations local to their current position.

Examining the memory (EXM) (13)

By pressing the 'EXM' button, the unit will cycle through the 6 stored stations in 5 second intervals. The unit will stop automatically when all 6 stations have been displayed. The function can be stopped manually by pressing button 'EXM' again or by pressing a numbered button of your choice. The 'EXM' function can be controlled remotely from the steering wheel.

Mono-stereo function (15)

The majority of FM broadcasts are now in stereo and the stereo mode should be selected for best quality sound, however when the signal is weak and reception is poor, the reception can be improved by selecting the mono mode with the button marked ST/M.

Note: For countries with a road information network, the mono-stereo function (15) is replaced by the 'VF' function which gives access to this information network.
The mono-stereo function becomes automatic according to the quality of reception.

Cassette deck operation

Switch on the unit and insert a cassette tape (**22**), the tape will load and play automatically. The cassette deck has an autoreverse function which enables both sides of the cassette tape to be played without the need to turn the cassette tape over. At the end of the cassette tape, the cassette desk will automatically switch to play the reverse side.
The cassette will be reversed as many times as required and may be manually controlled by pressing the button (**6**).

Fast forward and rewind (4)-(8)

These two functions enable the tape to be wound rapidly in either direction. Press the right-hand button (**8**) for fast forward and the left hand button (**4**) to rewind.

Dolby (9)

The Dolby function reduces background noise from the recordings and improves the quality of reproduction. Press the button to select the Dolby function, however this will only be effective if the cassette tapes were recorded using the Dolby system (**9**).

Metal

This function operates automatically; metal cassette tapes are detected by the cassette deck itself and the display will indicate when the function is in operation, 'MTL' will appear on the display.

Tape track seek (APC) (5)

This function is used to seek rapidly the beginning of either the current track or the following track of the cassette tape. For this function to work effectively, there must be a gap of at least 4 seconds duration between the recorded tracks of the cassette tape. Press button 'APC' (**5**) (APC will appear on the display) and then the rewind (**4**) or fast forward (**8**) button to seek in the desired direction.

Cassette eject (7)

To stop the playback or to remove the cassette, press the eject button (**7**), the cassette will be ejected automatically. Do not switch the unit off without first ejecting the cassette tape. To protect the cassette tapes, they should be stored in their boxes.

Sound controls

Adjusting the volume

The volume is controlled by pressing buttons marked (+) to increase and (−) to reduce. The buttons can be pressed continously or repeatedly, and can also be controlled from the steering wheel.

Adjusting bass and treble controls (17) - (18)

To increase or reduce the bass and treble levels, press once on the appropriate button and then rotate it in the required direction. Push the buttons back in when the levels are correct. You will notice that the central position is identified by a notch. In this position no boost or suppression of the reproduction will take place.

Right/left balance (BAL) (20)

Press the balance button once. Rotate in the required direction and push back in when the desired setting is obtained.

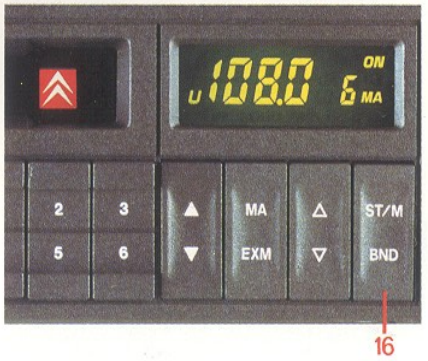
Front/rear Fader (19)

This controls the output level of the front and rear speakers and is controlled in the same way as the balance control.

Loudness (LD) (2)

This control is used when the programme sound level is low and will boost the bass and treble outputs.

Coded anti-theft function - visual indication of operation (21)



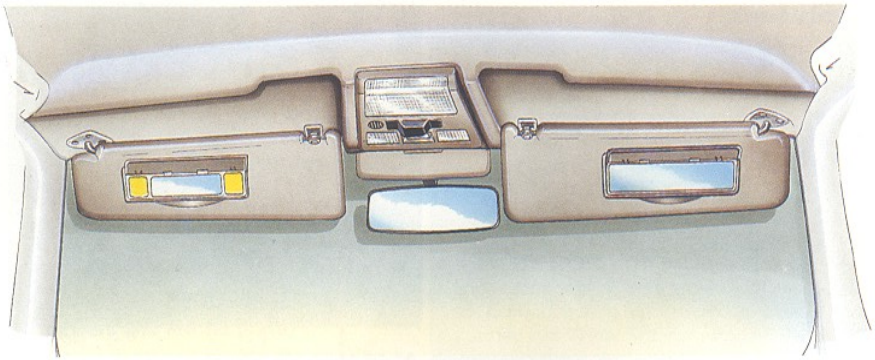
The PC 300 can flash a red warning lamp which warns that the unit is security protected. This deters the would-be thief. To initialize this function, switch off the ignition and remove the key; make sure the PC 300 is switched off and then press the button (BND) (**16**) until the red lamp lights. The lamp will then flash its warning every time the ignition is switched off. To cancel the function repeat the above operation only this time press the (BND) button until the lamp is switched off.

Note: In the event of any malfunction, please consult your nearest CITROËN dealer.

Important: Should it be necessary to remove the radio from the vehicle for repair, please advise the dealer of the security code.
If your dealer has carried out repairs or routine maintenance to your vehicle, it may have been necessary to disconnect the battery. In such circumstances the vehicle will be returned to you with the radio inoperative. Enter the security code to enable the radio to be used (see page 109).

Maintenance

It is necessary to use a tape head cleaner regularly (once every 50 hours of use of the cassette desk). Use a good quality tape head cleaner.



Sun visors *

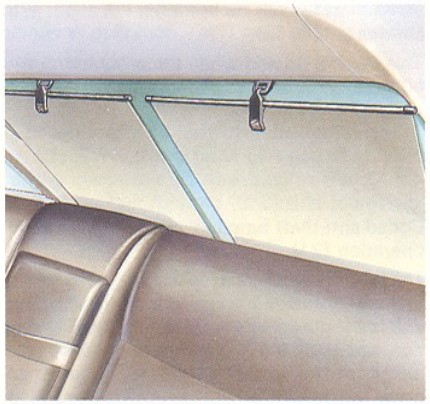
The adjustable passenger's and driver's sun visors may be fitted with a courtesy mirror and cover.

The passenger's side may be illuminated, ignition on, on opening the cover.

A third centre sun visor is provided for the space above the rear view mirror.

Rear blinds

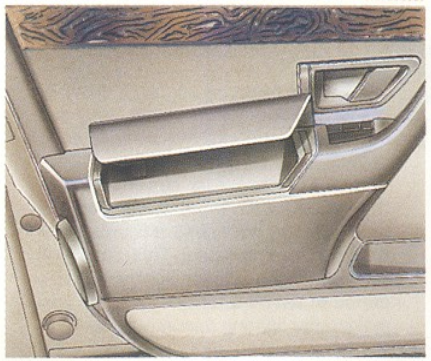
Extend the blind by pulling on the grip.
Engage in the housing in the roof.



Storage

Document pack holder: owner's handbook - maintenance and anticorrosion guide - CITROËN dealer directory.
To remove, pull down.

* According to model.



Storage space*

Raise the cover of the armrests of front or rear doors.

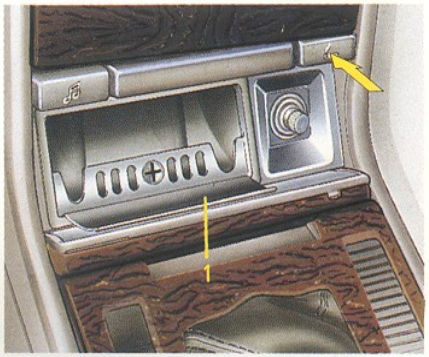
A space is provided under the centre armrest.

Map pockets in backs of front seats.

Ashtrays - Cigar-lighters

Front console

- To open, press button.
  It will open automatically.
- To empty the ashtray, push the lid at **1** to release ashtray. Lift ashtray from housing.
- To refit: locate the ashtray and push fully home. Raise the cover to close.

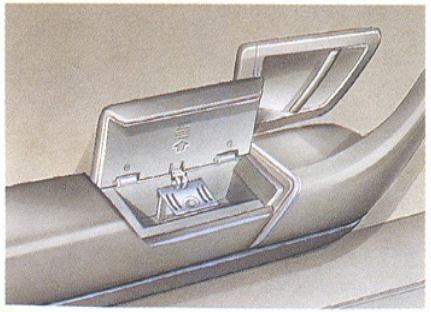


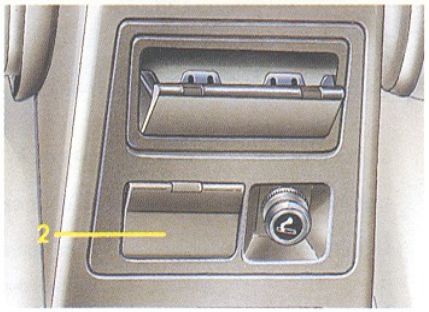
Rear door

Raise the cover.
To empty, pull the cover up.

Rear console

Lower the cover.
To empty, pull the ashtray towards you.
12 volt accessory socket **2**.

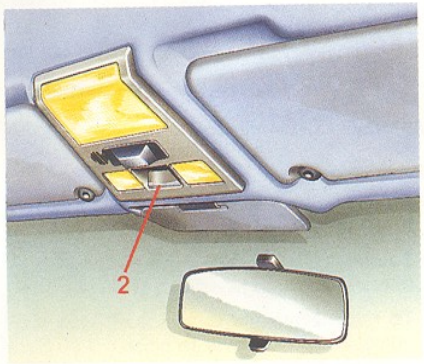




* According to model.

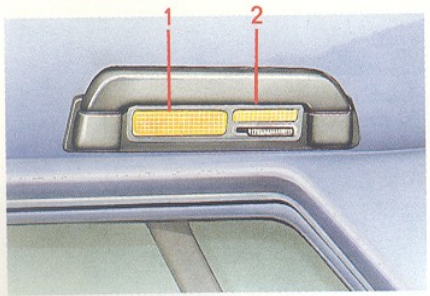
Interior lamps*

Light up by pressing switch **1** or when any of the doors are opened, they will extinguish progressively after a timed delay.
To avoid unnecessary current drain of the battery when the ignition is off (interior lamp or boot lamp left on) an automatic timer is fitted. This timer will switch off the interior lighting after a period of ten minutes. To revert to normal interior lighting operation,switch off the lamp concerned.



One interior lamp on the roof console.

Left and right front spotlights operated by switch **2**.



Two rear interior lamps **1** situated in the grab handle mountings.

Two rear spotlights **2** situated in the grab handle mountings and operated by the sliding switch.

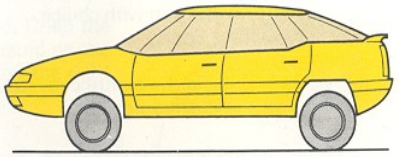
Lighting of the boot when the tailgate is open.

Lighting of the door apertures on door opening.

Lighting of the underbonnet* when opening with sidelamps switched on.

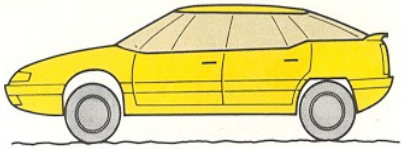
* According to model.

Adjustable ground clearance to cater for different surface conditions.
Except for certain unusual conditions, normal ride height should be used. The ride height is maintained automatically, regardless of load while the engine is running.
Lift the knob on the control lever to allow the lever to be moved from one position to another.



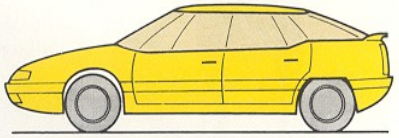
Maximum height

For wheel changes, check of hydraulic fluid. May be used to clear very difficult obstacles, but proceed carefully at very low speeds. There is no suspension movement in this position.

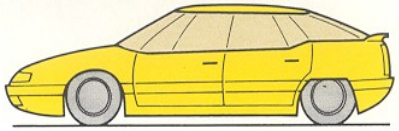


Intermediate height

For rough roads, providing increased ground clearance; proceed carefully at reduced speeds.



Normal ride height.



Minimum height

For workshop use only; do not use while driving.

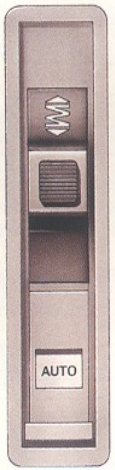
Warning

When working under the vehicle, it must be supported by axle stands.

The electronically controlled hydropneumatic suspension provides you with choice of modes: Automatic - Sport.

Press the selector slider in the centre console and move to the desired position.

The change can be made whilst driving or when stationary.



'AUTO' position

Normal driving position providing automatically the best comfort and handling.

Soft suspension, for a smooth and supple ride changing automatically to the firm SPORT mode to suit driving conditions and outside influences.

'SPORT' position

(instrument panel warning lamp on continuously)
Firm suspension.

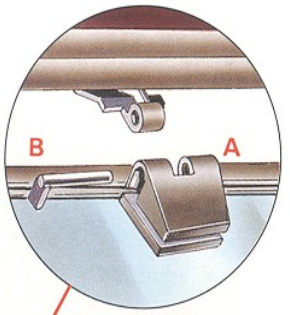
* According to model.

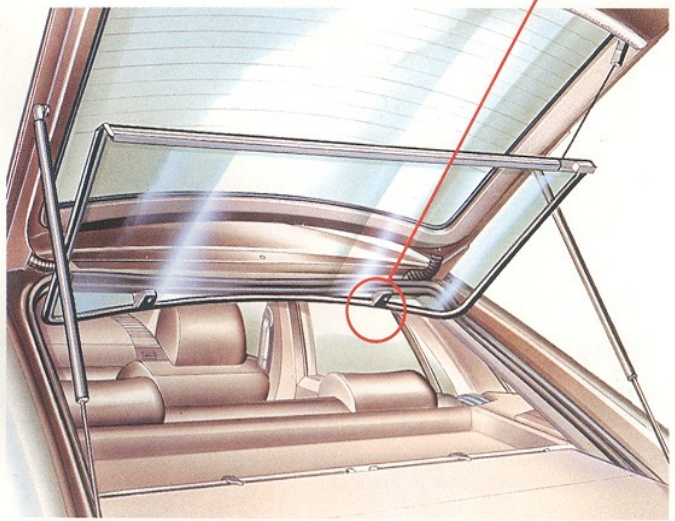
When the tailgate is open, an additional rear glass screen keeps the interior enclosed.

Three possibilities:

I - Screen fixed in position.

II - Screen rises when the tailgate is opened. Open the tailgate and attach the built-in strap situated on the bottom right of the screen, to the peg on the right hand side of the tailgate.





III - The screen can be removed to allow the loading of large objects.

To remove it, push in **A** then pull **B** to take the pins out of the hinges.

This screen is toughened glass; handle it with care when removing and avoid any knocks.

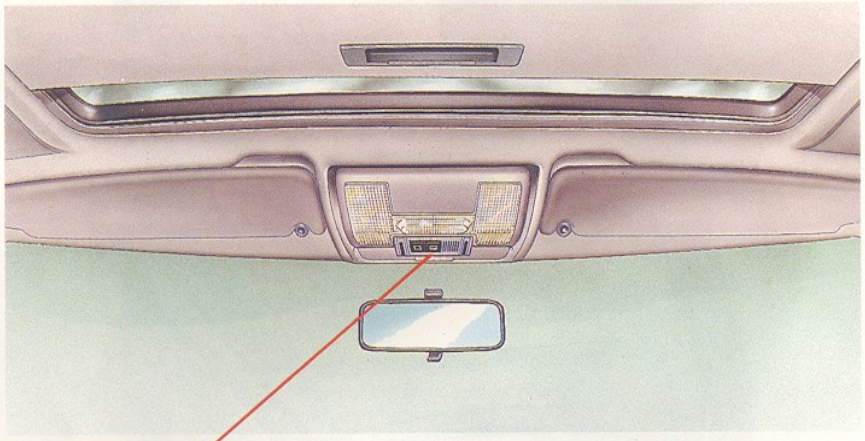
* According to model.

*Opening roof**

The opening roof has two functions: tilting up at the rear and sliding.

Interior blind

The blind can be slid forwards or backwards manually.
A deflector moves into position automatically as the roof is opened.



Press the left hand switch to raise the rear of the opening roof or to close it from the open position.

Press the right hand switch to lower the rear of the opening roof from the raised position or to open it from the closed position.

The switch should be released and then pressed again to change from one function to another.

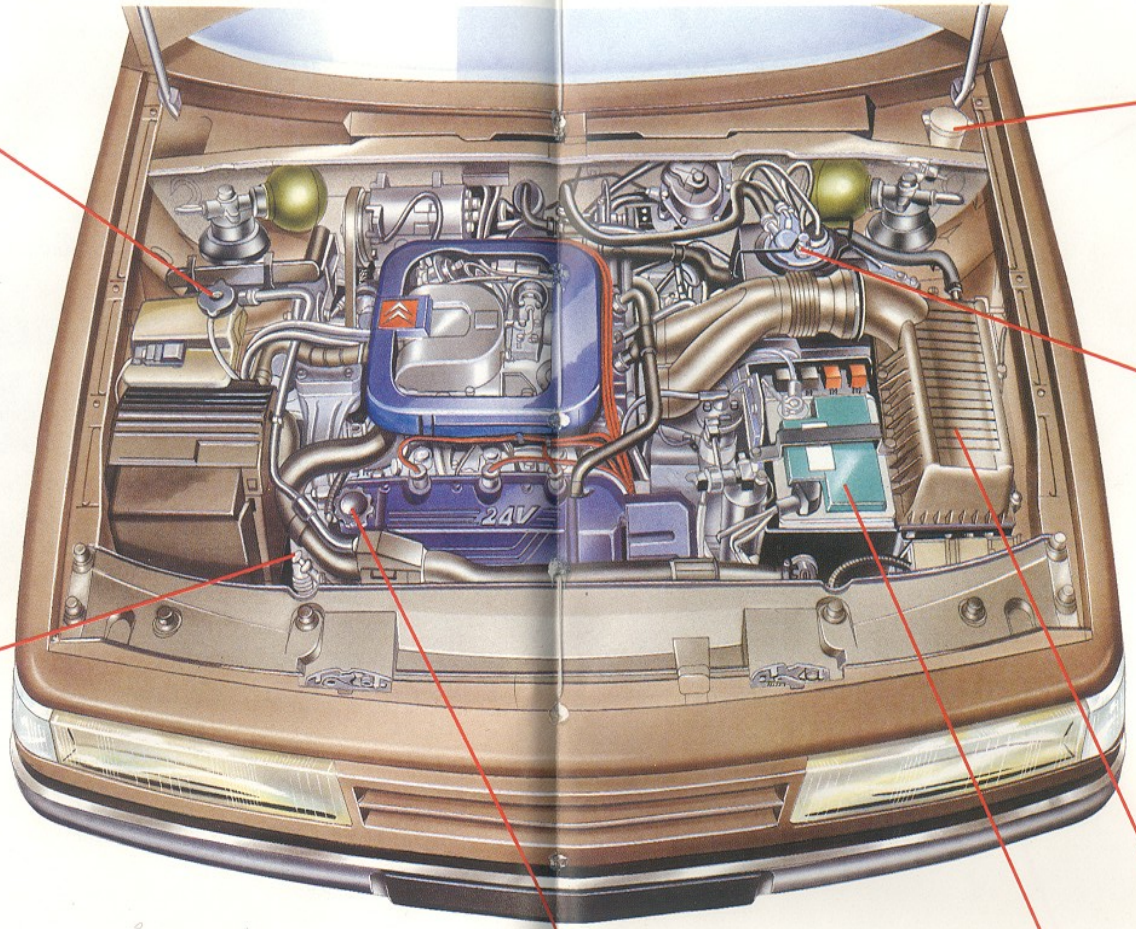
In the event of electrical failure: see page 100.

* According to model or option.

	Pages
Checks and levels, under bonnet	66 - 77
Priming the diesel fuel system, winter precautions	78 - 79
Recommended lubricants	80
Maintenance of the bodywork	81
Maintenance of the passenger compartment	82

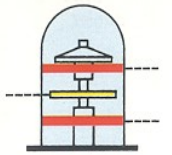
Topping up the cooling system

Engine hot: wait 15 minutes or until the temperature is below 100 °C and then unscrew the pressure cap slowly until you reach the safety stop to allow the pressure to drop. Remove the cap and top up. The water level should be 2 cm above the red level indicator inside the tank.
If adding more than 1.5 litre, have the cooling system checked by a CITROËN dealer.
Note: The need to top-up frequently indicates that something is wrong. Have the cooling system checked as soon as possible.
The antifreeze should only be changed by a CITROËN dealer.



Windscreen and rear screen wash reservoir
Capacity: 4.5 litres (8 pints).
For best results, use only the additive recommended by CITROËN.

Topping-up the hydraulic reservoir



The yellow disc must be between the two red rings. Check with the car in maximum height and with the engine running.
Use only green TOTAL LHM PLUS hydraulic fluid.
In case of emergency, engine oil SAE 10 or 20 can be used, but must be changed as soon as possible.
Consult a CITROËN dealer.

Manual engine oil dipstick

The oil level must never exceed the maximum.
Difference between min.-max.: 2 litres (3.5 pints).
Check at regular intervals.

Air filter

Follow the recommendations in the maintenance guide.

Engine oil level

STOP - check the level with the dipstick, on level ground, after the engine has been off for at least 10 minutes. After topping-up switch the ignition on and check the level on the gauge.

Engine oil filler

Oil grade (refer to page 80).

Battery

Ref: 12 V - 300 A.

Topping up the cooling system

Engine hot: wait 15 minutes or until the temperature is below 100 °C and then unscrew the pressure cap slowly until you reach the safety stop to allow the pressure to drop. Remove the cap and top up. The water level should be 2 cm above the red level indicator inside the tank.
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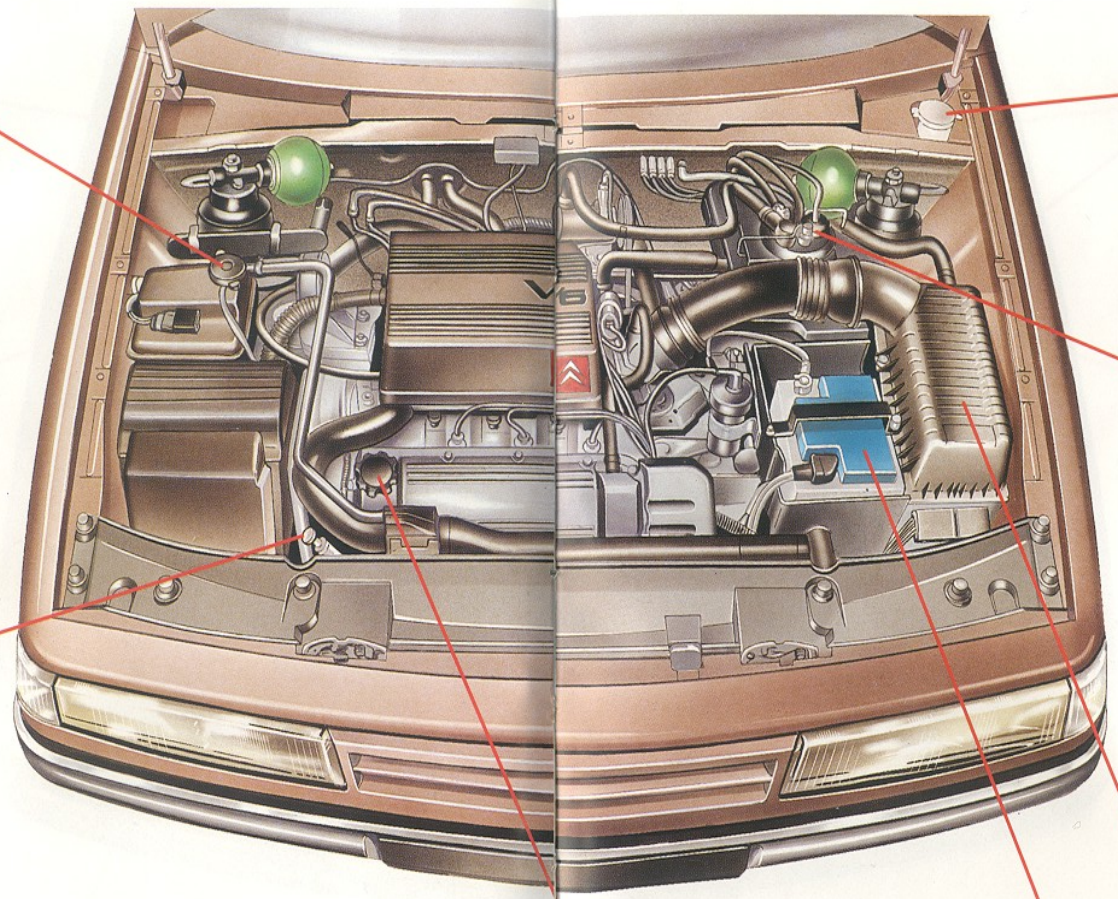

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Windscreen and rear screen wash reservoir
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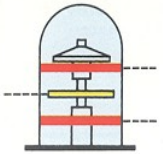
Topping-up the hydraulic reservoir



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Use only green TOTAL LHM PLUS hydraulic fluid.
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Consult a CITROËN dealer.

Air filter

Follow the recommendations in the maintenance guide.

Engine oil filler

Oil grade (refer to page 80).

Battery

Ref: 12 V - 300 A.

Topping up the cooling system
(with air conditioning option)

Engine hot: wait for 15 minutes or until the temperature is below 100 °C and then unscrew the pressure cap slowly until you reach the safety stop to allow the pressure to drop. Remove the cap and top up. The water-level should be 2 cm above the red level indicator inside the tank.
If adding more than 1 litre, have the cooling system checked by a CITROËN dealer.
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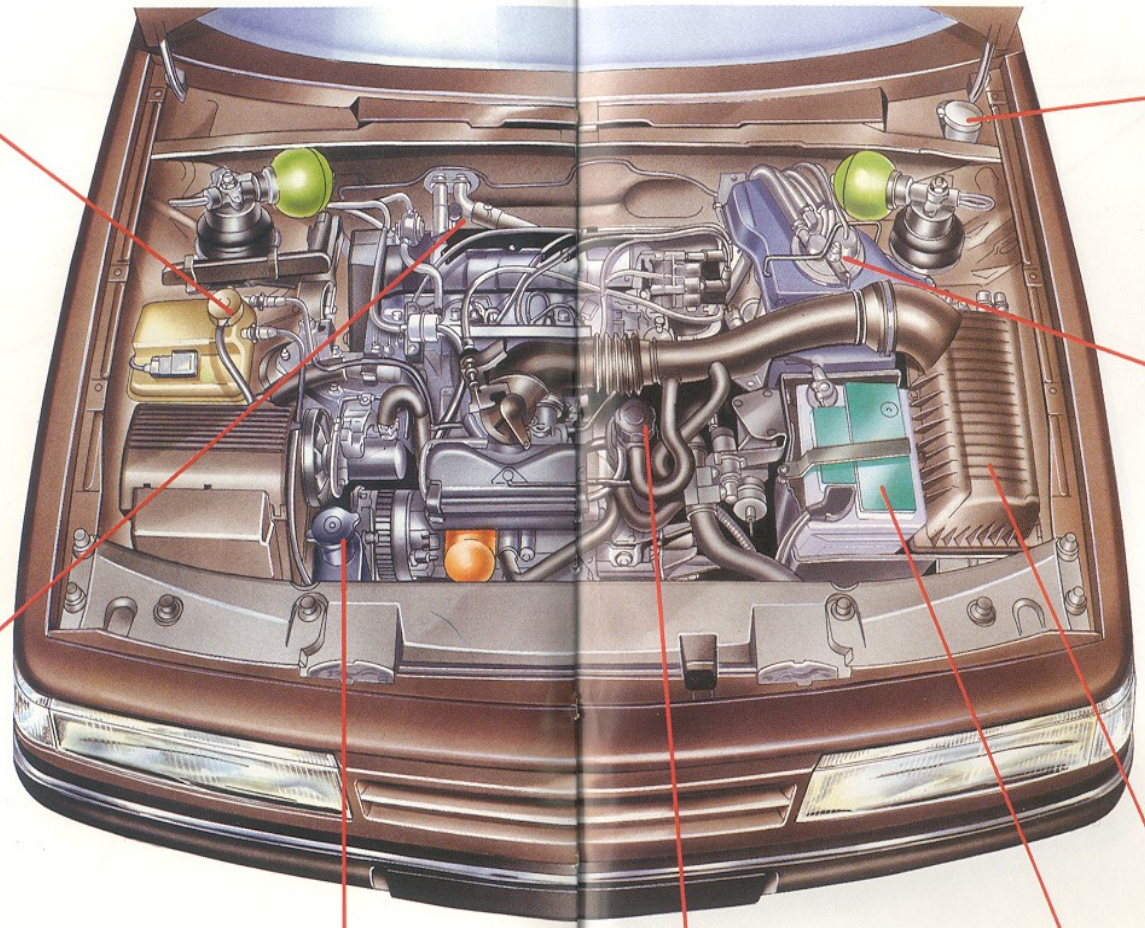

Manual engine oil dipstick

The oil level must never exceed the maximum.
Difference between min.-max.: 1.5 litre (2.5 pints).
Check at regular intervals.

Engine oil level

STOP - check the level with the dipstick, on level ground, after the engine has been off for at least 10 minutes.
After topping-up switch the ignition on and check the level on the gauge.

Topping-up the cooling system
(without air conditioning option).

Windscreen and rear screen wash reservoir
Capacity: 4.5 litres (8 pints).

For best results, use only the additive recommended by CITROËN.

Topping-up the hydraulic reservoir

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Check with the car in maximum height and with the engine running.
Use only green TOTAL LHM PLUS hydraulic fluid.
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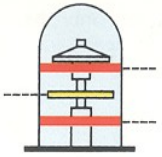

Air filter

Follow the recommendations in the maintenance guide.

Engine oil filler

Oil grade (refer to page 80).

Battery

Ref: 12 V - 300 A.

Topping-up the cooling system
(with air conditioning option)

Engine hot: wait for 15 minutes or until the temperature is below 100 °C and unscrew the pressure cap slowly until you reach the safety stop to allow the pressure to drop. Remove the cap and top up. The water level must be 2 cm above the red level indicator inside the tank.
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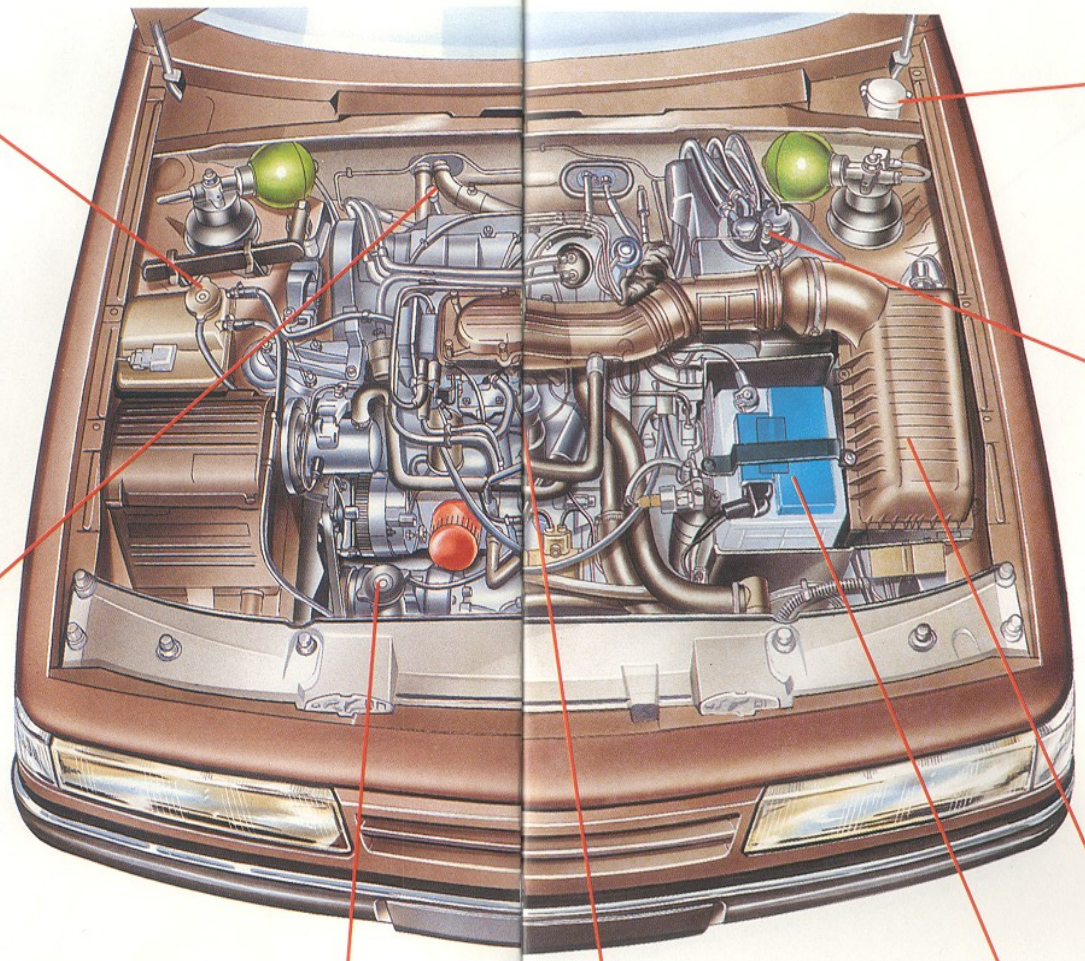
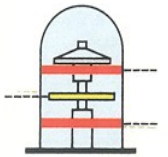
Check at regular intervals.



Topping-up the cooling system
(without air conditioning option).

Windscreen and rear screen wash reservoir
Capacity: 4.5 litres (8 pints).
For best results, use only the additive recommended by CITROËN.

Topping-up the hydraulic reservoir



The yellow disc must be between the two red rings.
Check with the car in maximum height and with the engine running.
Use only green TOTAL LHM PLUS hydraulic fluid.
In case of emergency, engine oil SAE 10 or 20 can be used,but must be changed as soon as possible.
Consult your CITROËN dealer.

Air filter
Follow the recommendations in the maintenance guide.

Engine oil filler
Oil grade (refer to page 80).

Battery
Ref: 12 V - 300 A.

Topping up the cooling system
(with air conditioning option)

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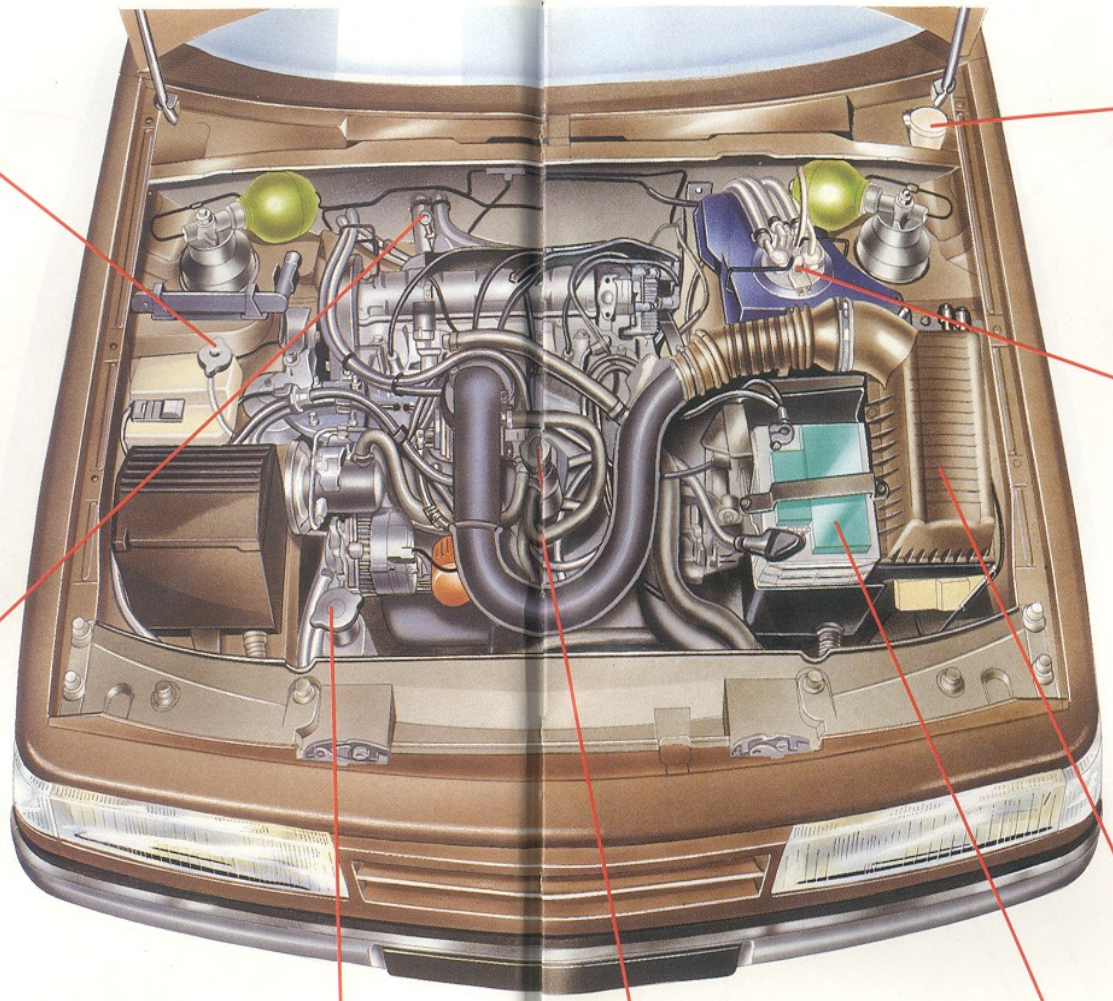
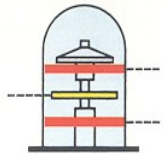
Difference between min.-max.: 1.5 litre (2.5 pints).
Check at regular intervals.



Topping-up the cooling system
(without air conditioning option).

Windscreen and rear screen wash reservoir
Capacity: 4.5 litres (8 pints).
For best results, use only the additive recommended by CITROËN.



Topping-up the hydraulic reservoir
The yellow disc must be between the two red rings.
Check with the car in maximum height and with the engine running.
Use only green TOTAL LHM PLUS hydraulic fluid.
In case of emergency, engine oil SAE 10 or 20 can be used, but must be changed as soon as possible.
Consult a CITROËN dealer.

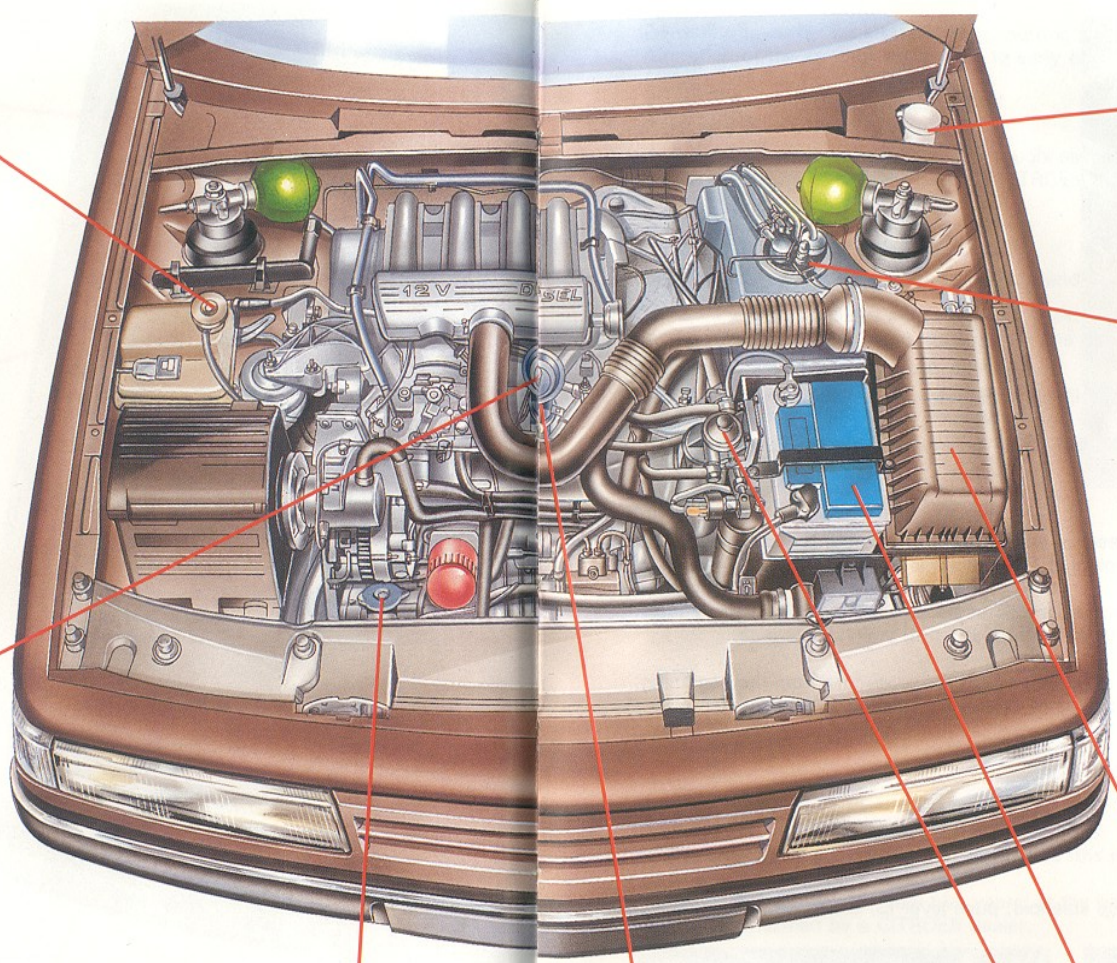
Air filter
Follow the recommendations in the maintenance guide.

Engine oil filler
Oil grade (refer to page 80).

Battery
Ref: 12 V - 300 A.

Topping-up the cooling system
(with air conditioning option)

Engine hot: wait for 15 minutes or until the temperature is below 100 °C and then slowly unscrew the pressure cap until you reach the safety stop to allow the pressure to drop. Remove the cap and top up. The water level should be 2 cm above the red level indicator inside the tank.
If adding more than 1 litre, have the cooling system checked by a CITROËN dealer.
Note: The need to top-up frequently indicates that something is wrong. Have the cooling system checked as soon as possible.
The antifreeze should only be changed by a CITROËN dealer.



Manual engine oil dipstick

The oil level must never exceed the maximum.
Difference between min.-max.: 2.8 litre (4.7 pints).
Check at regular intervals.

Engine oil level

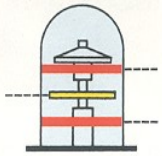
STOP - check with the dipstick, on level ground, after the engine has been off for at least 10 minutes.
After topping-up switch the ignition on and check the level on the gauge.

Topping-up the cooling system
(without air conditioning option).

Windscreen and rear screen wash reservoir
Capacity: 4.5 litres (8 pints).

For best results, use only the additive recommended by CITROËN.

Topping-up the hydraulic reservoir



The yellow disc must be between the two red rings. Check with the car in maximum height and with the engine running.
Use only green TOTAL LHM PLUS hydraulic fluid.
In case of emergency, engine oil SAE 10 or 20 can be used, but must be changed as soon as possible.
Consult a CITROËN dealer.

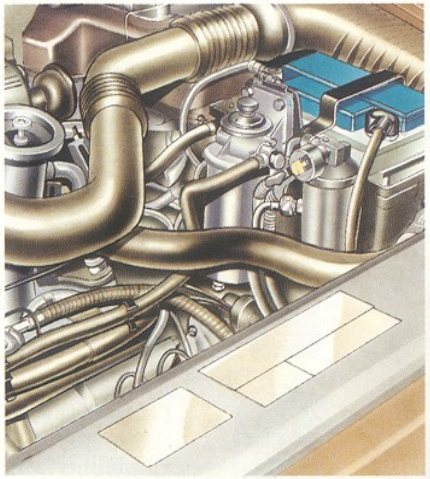
Air filter

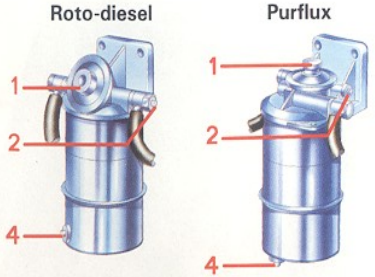
Follow the recommendations in the maintenance guide.

Battery
Ref: 12 V - 300 A.

Engine oil filler
Oil grade (refer to page 80).

Priming the fuel system
Refer to page 78.





Priming the fuel system

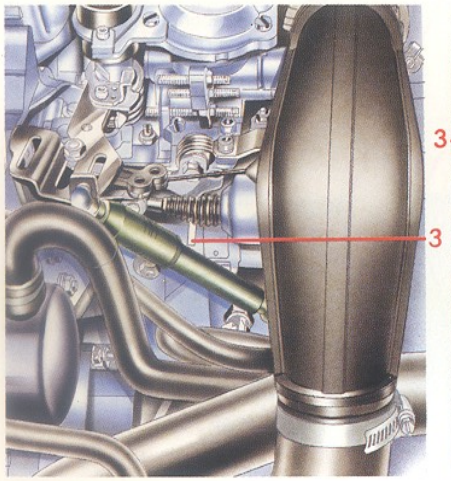
Priming after running out of fuel:
With the vehicle stationary on level ground, turn the ignition on, then pour at least 2 litres of fuel in the tank.

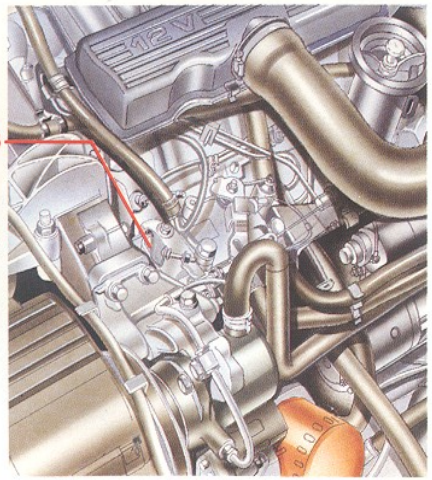
The vehicle is fitted with either a Roto-diesel or a Purflux filter, unscrew the bleed screw (**2**) a few turns and operate the head of the plunger (**1**) until some resistance is felt.

Operate the starter motor for 15 seconds while depressing the accelerator pedal by three quarters its full travel. If the engine fails to start at the first attempt, wait 15 seconds.

If the engine fails to start after about ten attempts, repeat the procedure from the beginning. When the engine is idling, accelerate slightly to complete the bleeding of the circuit.

Manual control for stopping the engine
In the event of failure of the electrical stop solenoid, push lever (**3**) to stop the engine.





Do not remove the seals on the pump setting screws under any circumstances.
Alteration of the settings might lead to early engine failure and loss of warranty cover.

Injectors

If something seems wrong - knocking, roughness, black smoke from exhaust, difficulty in starting - have the injectors checked by a CITROËN dealer.

Draining water from the fuel filter

Drain the fuel filter at every engine oil change and whenever the water-in-fuel warning lamp lights.

If the vehicle is fitted with a Roto-Diesel filter:
Loosen the drain screw (**4**) situated under the filter and pump any water out.

If the vehicle is fitted with a Purflux filter:
Unscrew the drain screw situated under the filter and pump any water out.

In both cases, keep pumping until all water has been expelled.

Winter precautions

Radiator

The original cooling liquid contains antifreeze (the minimum protection temperature is marked on a label under the bonnet).
Have the liquid changed every two years, at the beginning of the cold season. This operation must be performed by a CITROËN dealer.

Diesel fuel heater

Your vehicle is equipped with a fuel heating device in the engine compartment.

However to avoid waxing of the fuel in the tank affecting your engine:
– For temperatures below – 5 °C, use the fuel additive supplied through the CITROËN network.
– To ensure thorough mixing, the fuel additive must be poured into the tank before refuelling.

Petrol engine	TOTAL QUARTZ 10 W 40 or TOTAL GOLD 15 W 40 (all year around).
Diesel engine	All year around: TOTAL DIESEL OIL 15 W 40
Manual gearbox	TOTAL TRANSMISSION BV 75 W/80 W.
Automatic gearbox	TOTAL DEXRON II.
Hydraulic system	Use only TOTAL LHM PLUS fluid. In an emergency an SAE 10 or SAE 20 engine oil can be used, but should be changed as soon as possible. See your CITROËN dealer.
Coolant	In order to provide antifreeze and anticorrosion protection for the engine, use only antifreeze recommended by the CITROËN network. This fluid should be replaced every 60,000 km (40,000 miles) or every two years, whichever comes first. Note: The degree of protection afforded by the original coolant is given on a label forward of the radiator.

* According to model.

CITROËN prefers TOTAL

Continual technical evolution allied with constant research for better reliability requires a close collaboration between motor car manufacturers and oil companies.

Since 1964 research and tests have been carried out in common by CITROËN and TOTAL, in the laboratory and on the road.

This collaboration was symbolized in 1967 by the slogan:
"CITROËN prefers TOTAL."

It constantly offers the users of all CITROËN vehicles high quality products to fulfil the conditions required by CITROËN.

TOTAL partners CITROËN
- YOUR PARTNER -

You will find in this Owner's Handbook the description of the TOTAL products which will guarantee the best operation of your vehicle, and for its maintenance.

Never dry-wipe the bodywork.
Never use petrol, paraffin, trichlorethylene, alcohol or strong bleaches for cleaning paintwork, plastics, glass or lamp covers.

Washing the bodywork

Frequent washing is necessary to keep the paintwork in good condition. However, do not wash the car in direct sunshine or at too low a temperature. In all cases, wait until the surfaces have cooled. The body must be wetted abundantly. If you use a car-shampoo, rinse it thoroughly. Wipe dry with a chamois leather. Do not leave drops of water on the paint. When driving away, apply the brakes briefly several times to remove any water from the friction linings.

Cleaning glass

Do not use products containing silicones. To obtain the best screen-wipe, use only the screen-wash additive distributed by the CITROËN network.

Polishing paint

Polish the paint at the end of winter. The bodywork must be completely dry and clean. Use only slightly abrasive polishing liquid or cream.
Do not apply any polish on plastic parts.

External metal embellishments

Wash clean with water containing soap or a small amount of a detergent or car-shampoo, rinsing well before and after with plenty of clean water. To keep the metal bright, dry it and use a protective polish.

Tar-stains on bodywork

Remove these as soon as they appear, using a special tar-remover, do not scrape them off or use petrol.

Stains and fuel on bumpers

Remove these as soon as they appear, using a special tar-remover.

Slight paint-damage

To touch-in scratches or slight damage use aerosols of air-drying paint. Aerosols with all CITROËN colours are available (the paint-code of each car is stencilled on the left-hand front wheelarch under the bonnet).

For under-car areas

Consult your CITROËN dealer.

For the upkeep of the bodywork use the products adapted and sold by the CITROËN network.

Recommendation

When using high pressure washing equipment do not direct the jet at the rubber gaiters of the drive shafts, steering, etc., nor the exterior trim, roof joint or engine radiator.
Notwithstanding the factory applied anti-corrosion treatment, you are recommended to have the engine compartment and underbody cleaned and retreated after a winter season of driving on salted roads.

Note: Solvents can have harsh effects on the synthetic materials used in upholstery. They must therefore be used sparingly. Whenever possible, use only a solution of soap in water. Always remove dust before cleaning.

Stain-removers

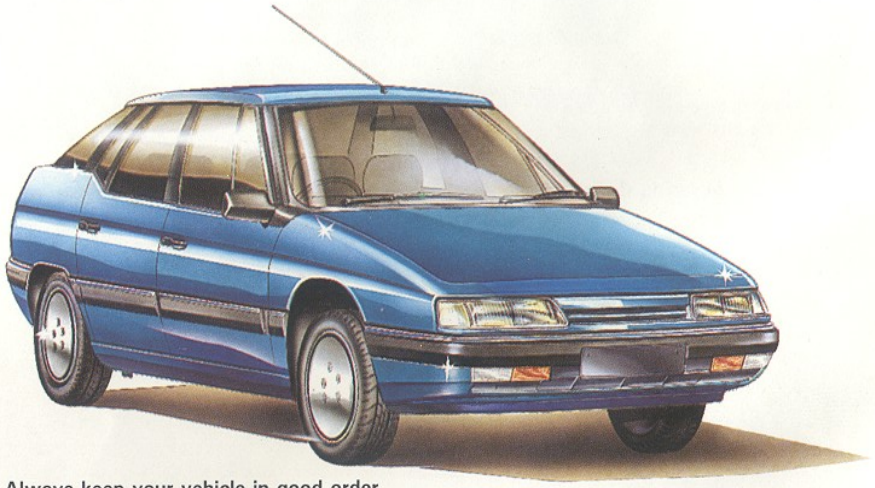
In every case follow the maker's instructions.
You are recommended to first test a hidden part or a sample cutting.
Spirits and solvents should **not** be used on leather trim.
The panels in wood should be cleaned with a solution of soap and water.
Because of the large glass area,long periods of exposure to the sun can have a detrimental effect on the trimming. In such conditions you are advised to cover the rear shelf and the top of the rear seat to protect them from the harmful ultra-violet rays.

Recommendation

Do not expose aerosol cans to temperatures above 50 °C; do not keep them in the car.

	Pages
Recommendations for saving fuel	84 - 85
Battery, replacing the batteries of the remote control	86 - 87
Fuses	88 - 89
Replacing front bulbs	90 - 91
Replacing rear bulbs	92
Replacing interior bulbs	93
Changing a wheel	94 - 95
Tyres (types and recommendations)	96 - 97
Towing, lifting the vehicle	98
Roof rack	99
Opening roof	100
Safety recommendations	101

Fuel consumption is not only tied to the conception and the technical design of a vehicle, it also depends on the driver. The following recommendations will help to improve your fuel consumption.



Always keep your vehicle in good order

Follow the maintenance guide recommendations of the manufacturer.
As well as the maintenance, checks and fluid changes, remember to check regularly the condition of the units which affect the fuel consumption.

Engine adjustments

It is recommended to check at least once a year the essential units in the ignition and fuel systems.

Ignition*

- correct spark plug gaps,
- correct ignition timing.

Air filter

A dirty filter element will reduce engine performance: replace it according to frequency indicated in the maintenance guide and if the vehicle is used in a dusty environment replace it more frequently.

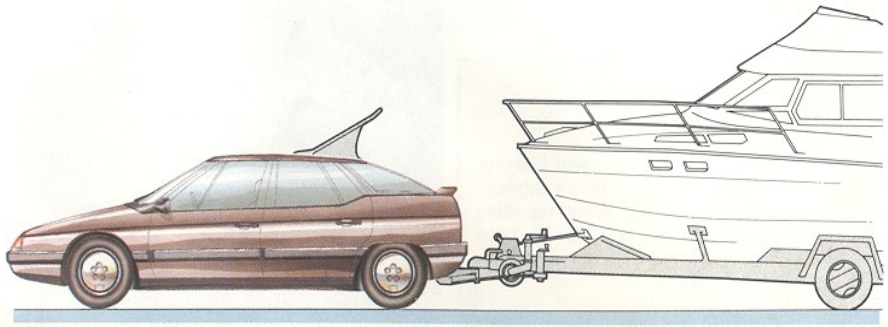
Fuel supply

- mechanical condition of the carburettor or the fuel injection pump, check for any air leaks.
- idling speed adjustment.*

Tyre pressure check

The pressures should be checked approximately every week. Tyres with low pressures will have an added resistance to forward movement and increase the fuel consumption.

* According to model.



Load your vehicle properly

Wherever possible, avoid carrying luggage on the roofrack. If you have to, balance the load and keep its volume to the minimum.
If a large load has to be carried it is advisable to use a small, low trailer. You will use less fuel. When a roof rack or bars are not used they should be removed, this also applies to caravan air deflectors. Do not leave unnecessary loads in the vehicle. They will increase your fuel consumption.

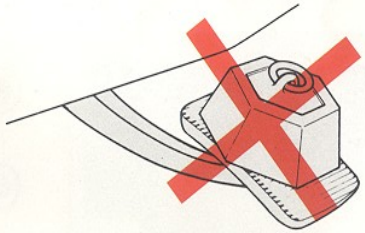
Drive with ease

Remember a few simple rules:

- **Starting,** it is not necessary to warm up the engine before starting off. Drive off slowly, accelerate gradually.

- **When driving,** use the highest gear ratio to maintain a satisfactory engine speed without the engine labouring.

Drive at an even speed. Avoid having to brake sharply. Braking and then accelerating cost fuel. Anticipate the road conditions ahead.



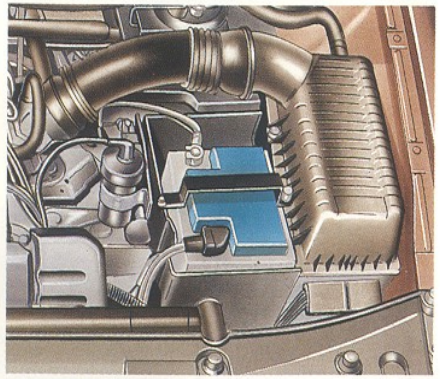
Watch your vehicle's speed

Fuel consumption increases with speed: for example, between 65 and 80 mph the consumption will increase by 25%.

Plan your journeys by car

Remember that for the first mile the fuel consumption is more than twice the normal consumption because the engine has not reached its optimum operating temperature. In town the traffic conditions are such that the fuel consumption is high. On long journeys plan your route to avoid towns and congested routes as much as possible.

Ref: 12 V.

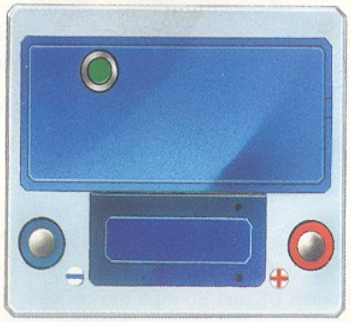


Beware
Never expose a battery to a naked flame or spark. The battery contains dilute sulphuric acid which is corrosive. When handling a battery, protect hands and face. In case of contact with the skin, rinse immediately with clean water.

Removal
Disconnect the battery leads, negative lead first.
Remove the clamp and lift out the battery.

Refitting
Connect the positive lead first. Refit the holding clamp.

Precautions
Ensure posts and terminals are clean. If they become sulphated, disconnect and clean them.
Never disconnect the leads while the engine is running.
Never recharge the battery without first disconnecting the leads.
The electrolyte level should be checked periodically using the indicator device.
In case of slight overfilling, protect the battery terminals with grease.



Green: battery charge good.

Black: battery charge low.

Clear: battery electrolyte level low.

Charging a battery
The voltage must never exceed 14.8 volts and the charging current must never exceed 20% of the rating marked on the battery casing.
The battery charge period should not exceed 24 hours. Avoid any heat build-up within the battery during the charging procedure.

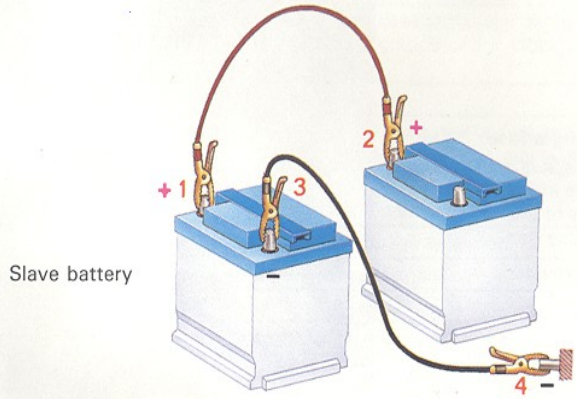
Completely discharged batteries may have to be connected for several hours before accepting a charge current.

Only battery chargers with a constant, regulated voltage output should be used.

After recharging a battery leave it for an hour before reconnecting it. A spark could cause it to explode.

If the vehicle is to be taken out of use for periods of more than one month, the battery should be disconnected.

Starting with a slave battery
A vehicle with a discharged battery can be started with either a slave battery or the battery of another vehicle.
Follow the procedure described below.

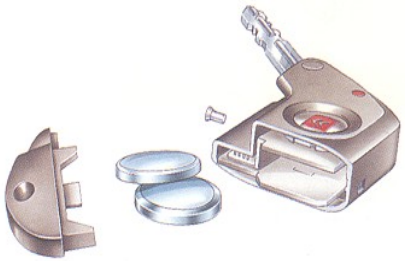


Do not use a slave battery of more than 12 volts.
When using the battery of another vehicle, the engine should be switched off. The two vehicles must not be allowed to come into contact with each other.
Connect the battery cables according to the diagram, following the same numerical sequence and ensuring a good contact is made.
Start the engine of the assisting vehicle and let it run at a fast idle for about a minute.
Then start the engine of the vehicle with the discharged battery.

Current consumption: see page 102.

Note
Do not touch the cable clamps during the procedure
Do not lean over the batteries.
Disconnect the cables in the reverse order.

Changing the remote control batteties.
Unscrew to gain access to the batteries.



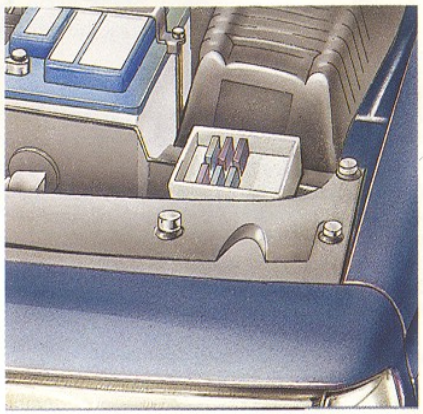
The fuse box is situated under the dashboard, left hand side.

To reach the fuses, depress the small locking tongue and pull the cover down.

Removing and replacing a fuse

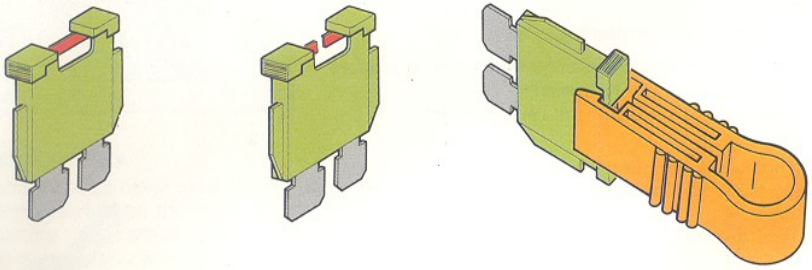
Before replacing a fuse, it is necessary to find the cause of the incident and to rectify it. The numbers of the fuses are indicated inside the fuse box.

Use the special tool provided.



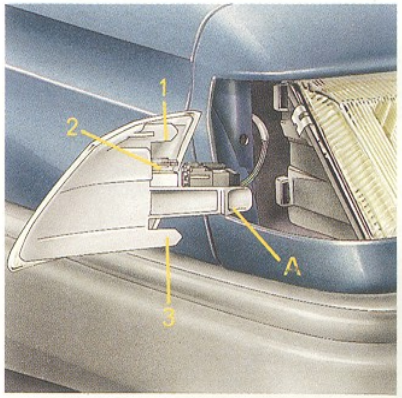
See table of fuses.

A supplementary fusebox is situated in front of the air filter under the bonnet.



Number	Rating	Functions
F 1	10 A	Antilock Braking System.
F 2	10 A	Stop,brake pad wear warning lamp.
F 3-7-8-26		Spare fuses.
F 4	10 A	Lighting for dashboard, trip-computer, dot-matrix and clock lighting.
F 5	30 A	Warning lamps, dot-matrix, electric rear view mirrors, direction indicators, trip computer (or clock), interior lighting except courtesy lamp.
F 6	5 A	Rear fog lamps.
F 9	30 A	(+ Accessories) front/rear wipers and timers, audible warning, flasher unit, heating, heated rear window timer.
F 10	5 A	Lighting for control switches, front console, under-bonnet and front sidelamps and no. plate.
F 11	5 A	Dot-matrix language selection.
F 13	10 A	Hazard warning lamps.
F 14	5 A	Rear lamp (right).
F 15	5 A	Dot-matrix language selection.
F 17	30 A	Rear heated seat, opening roof.
F 18	5 A	Rear lamp (left).
F 19	15 A	'Hydractive' suspension E.C.U.
F 21	15 A	Front fog lamps, rear fog lamps warning.
F 22	30 A	Radiotelephone.
F 23	10 A	Dashboard lighting rheostat - Reversing lamps - AC compressor - Coolant level and temperature control unit - Tachometer - Oil and water temperature sensing.
F 25	30 A	Heating - Ventilation.
F 27	20 A	Courtesy lamp/timer - Interior lighting cut-out timer - Trip computer (or clock) - Sill panel lighting - Horn.
F 28	30 A	Front electric seat (right hand side).
F 29	30 A	Front window winders.
F 30	30 A	Front electric seat (left hand side).
F 31	30 A	Rear window winders.
F 32	30 A	Headlamps wash.
F 33	30 A	Heated rear screen and rear view mirrors.
F 34	30 A	'Hydractive' suspension supply - Central door locking.
F 35	30 A	Heated front seats - electric armrest.
F 36	15 A	Cigar-lighter - 12 V socket - rear window isolator switch - Radio - Anti-theft keypad.
Under bonnet (2)		
F 1 - F 2		Not used.
F 3	30 A	RH cooling fan - high speed.
F 4	30 A	LH cooling fan - high speed - LH and RH cooling fans - slow speed.
F 5 - F 6		Not used.

* According to equipment or country.



Front sidelamps

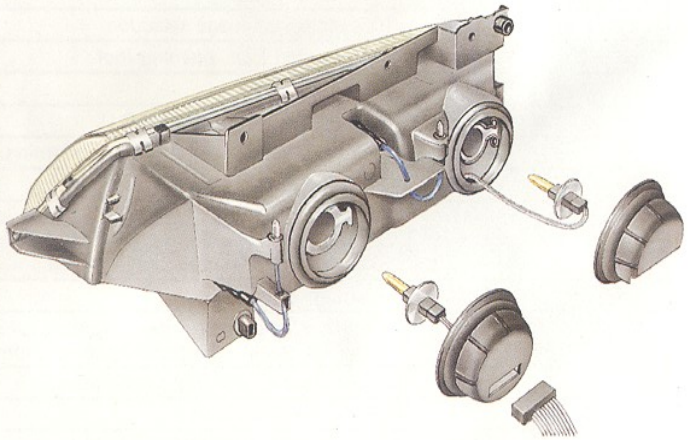
Open the bonnet.
From the inside,put your hand alongside the front light unit and press in **A** to release the lamp. To reposition, locate the guides **1-2-3** and push in.

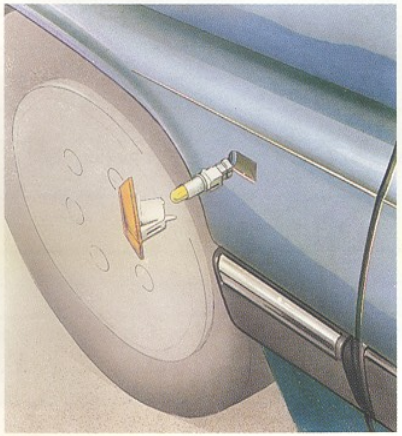
Bulb: W 5 W.

Headlamp (main and dipped beam)

Open the bonnet. Remove one of the covers by turning an eighth of a turn, disconnect the bulb, release the retaining springs. Pull the bulb out.

Bulb: H1.

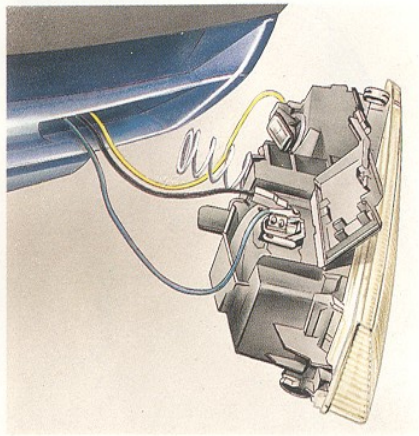




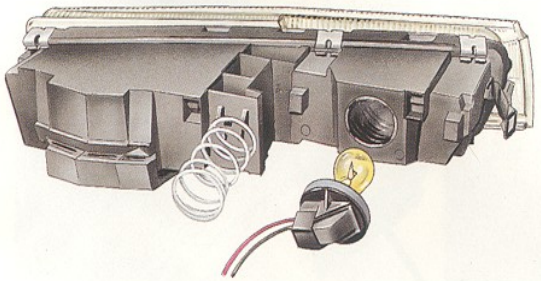
Side repeater direction indicator

Push the lamp towards the rear to unclip it and pull towards you.

Bulb: W 5 W.



Direction indicators and front fog lamps

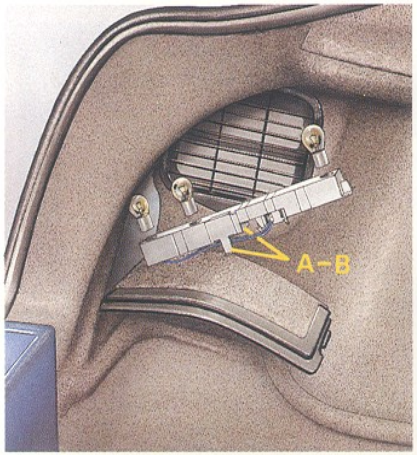


Unclip the light unit by pressing **A**. The unit will spring off.

Direction indicators: disconnect, turn the bulb holder a quarter turn then pull out.

Fog lamps: unclip the cover on the lower part of the light unit. Release the retaining springs. Remove the bulb.

Important: The halogen bulbs should not be changed until they have been off for a few minutes. Do not touch the new bulb directly with your fingers; do not use a fluffy cloth.



Rear wing lamp cluster

Unclip the boot trim by means of the grip.

Unclip the bulb holder by squeezing **A** and **B** together and pull out.

Bulbs

Direction indicators: P 21 W.
Stop lamps: P 21 W.
Sidelamps: P 21/5 W.

Rear lamps in tailgate (smoked section)

Open the boot, unclip the cover by pressing **A**.

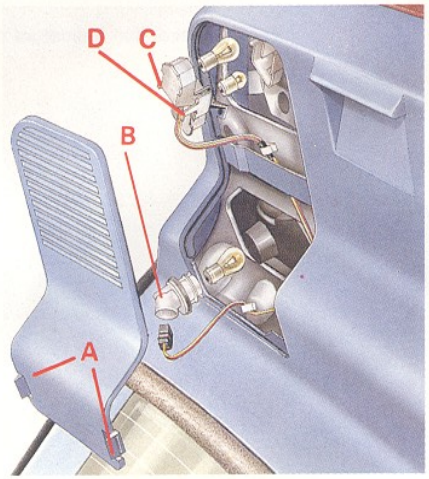
To release the bulb holder, squeeze **C** and **D** and pull.

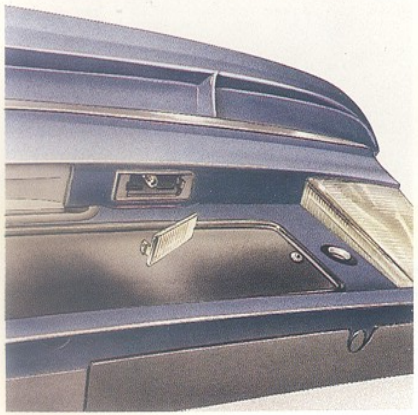
Bulbs

Sidelamps: R 5 W.
Reverse: P 21 W.

Disconnect the wires, turn the bulb holder **B** a quarter turn.
Pull out the bulb holder.

Fog lamps: P 21 W.

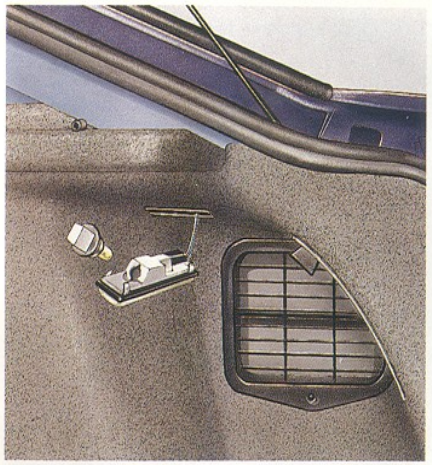




Number plate

Unclip the transparent cover.

Bulb: W 5 W.



Boot lamp

Unclip then pull the bulb holder.
Bulb: W 5 W.

Front courtesy lamp
Bulb: HT 5 W.

Sun visor
Bulb: C 3 W

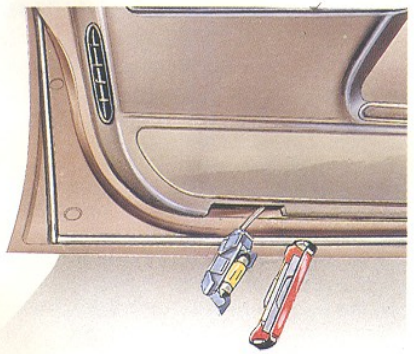
Rear courtesy lamp
Bulb: HW 5 W

Rear spot lamps
Bulb: W 3 W

Under bonnet lamp

Unclip the cover.

Bulb: R 10 W.



Door aperture lamp

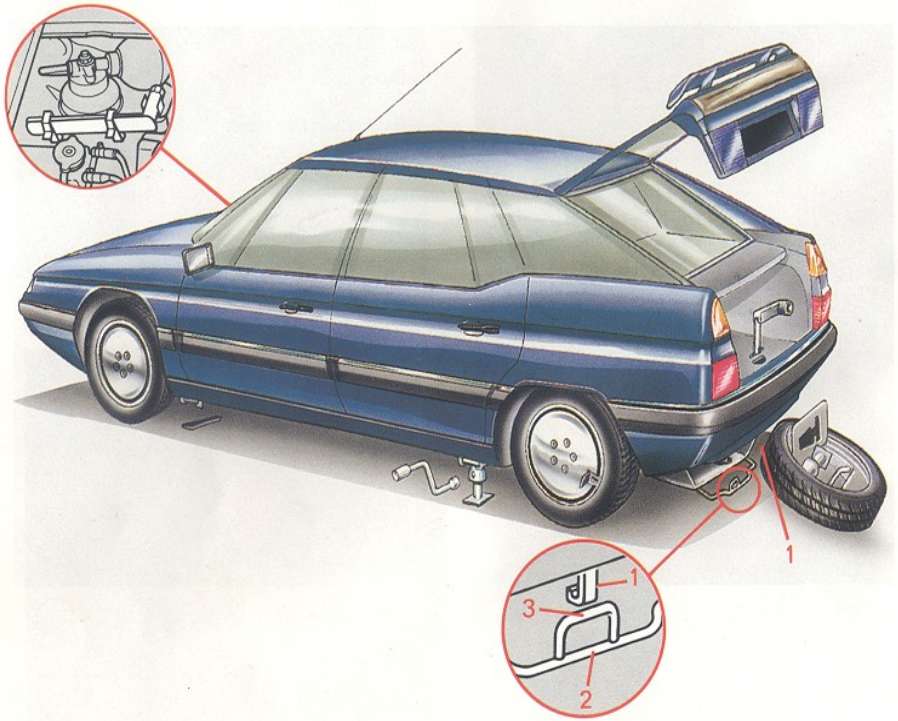
Unclip then pull the bulb holder.

Bulb: C 5 W.

Tool equipment

The jack and its handle are located in a protective holder in the spare wheel under the boot floor.

The wheel brace is located under the bonnet.



Access to the spare wheel

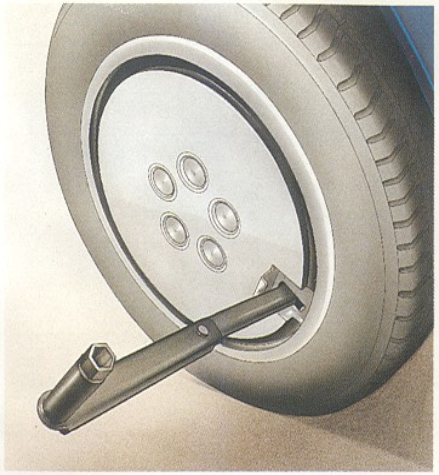
The wheel carrier retaining screw is situated under the boot carpet near the boot catch. Unscrew with the opened out end of the wheel brace.

Lift the carrier to disengage the hook and the safety catch **1**.

The hook engages in position **2** for the standard spare wheel, position **3** for 205/60 R 15 tyres.

Recommendation

Refit the repaired original wheel as soon as possible.



Removal

1 - If possible, place the car on firm, level ground. Put the handbrake on.

2 - Let the engine idle and set the suspension control lever to maximum height (refer to page 60).

3 - Remove the jacking point cover from one of the four jacking points then insert the jack. Extend the jack so that it touches the ground.

4 - Open the tyre valve flap in the wheel embellisher (steel wheels) using if necessary a screwdriver or a coin. To remove the wheel embellisher, pull on the metal ring with the T-shaped end of the wheel brace.

5 - Loosen the 5 wheel bolts using the wheel-brace (unfolded).*

6 - Operate the jack until the wheel is a few centimetres off the ground.

7 - Finish unscrewing the wheel bolts and remove the wheel.

Refitting

1 - Fit the wheel onto the hub, making sure that it is correctly positioned.

2 - Screw in the bolts, but do not fully tighten them.

3 - Lower the jack and remove it.

4 - Tighten the wheel bolts, using the wheel brace (folded).*

5 - Fit the wheel embellisher, lining up the tyre valve opening with the valve.

6 - Return the car to normal ride height (refer to page 61).

7 - Refit the repaired wheel as soon as possible.

8 - Correct the inflation pressure and have the balance checked (see the table on page 96).

Replacing the spare wheel

Replace the jack and its handle in the protective holder in the spare wheel and slide them into the carrier.
Lift the carrier up to the automatic safety catch.
Engage the hook on to the spare wheel carrier according to the tyre size (refer to the illustration on page 94).
Retighten the screw from inside the boot.
Put the wheel brace back in position under the bonnet.

* The wheel brace unfolds to facilitate the slackening of wheel bolts.
When tightening it should be used folded to avoid over-tightening the wheel bolts.

Standard tyre	XM Carburettor			XM Injection			XM V6			XM V6 24 V			XM diesel			XM diesel turbo		
Michelin tubeless	Ft.	Rr.	Sp.	Ft.	Rr.	Sp.	Ft.	Rr.	Sp.	Ft.	Rr.	Sp.	Ft.	Rr.	Sp.	Ft.	Rr.	Sp.
175/70 R15 MXL 86T			3.0			3.0				2.4	1.9	2.6						3.0
185/65 R15 MXV2 87H	2.2	1.9											2.3	1.9				
195/60 R15 MXV2 87H				2,1*	1,9													
195/65 R15 MXV2 91H																2.2	1.9	
205/60 R15 MXV2 90V							2.2	1.9	2.4									
205/60 R15 MXV2 90Z										2.2	1.9	2.4						
Approved fitting - Snow tyres																		
185/65 R15 XM+S 100 87T	2.2	1.9											2.3	1.9				
195/60 R15 XM+S 100 87T				2.1*	1.9													
195/65 R15 XM+S 100 91T										2.2	1.9					2.2	1.9	

* 2.2 with air conditioning equipment.

Advice and Recommendations

175/70 spare tyre (XM carburettor, XM Injection, XM diesel turbo): maximum speed in use 100 mph.
For your safety, make sure that the tyres are in good condition. Check the tyre pressures, including the spare, weekly and before every long journey. The pressures should only be checked when the tyres are cold. **Never reduce the pressure of a warm tyre.**

To gain access to the tyre valve, open the flap of the wheeltrim with the aid of a screwdriver or coin. Close the flap by pushing and pressing its sides.

Under-inflated tyres can overheat, leading to structural damage and the risk of a blow-out.

Impacts with kerbs, potholes or hidden obstructions in the road can cause internal damage and premature failure of the tyre.

Metric equivalent

psi	26	28	29	30	32	33	35	36	39
bars	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.7

Inspect the tyres regularly for cuts, cracks, bulges or wear.

Remove any foreign bodies (stones, pieces of metal) that may have pierced the tyre. They could cause further damage to the tyre carcass. If in doubt have the tyre inspected by a specialist.

Never fit second-hand tyres.

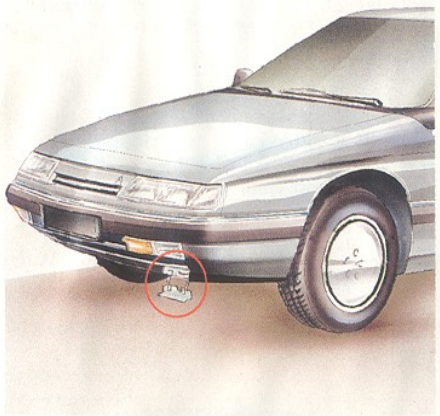
Tyres age at the same rate, whether they be in constant or occasional use. This deterioration can be seen by cracks in the tread and the wall of the tyre and in some cases, deformation of the tyre carcass. Tyres that have been fitted for 6 years or more, including the spare tyre, must be thoroughly inspected by a tyre specialist or, preferably, replaced. Tyres of this age should only be used with caution.

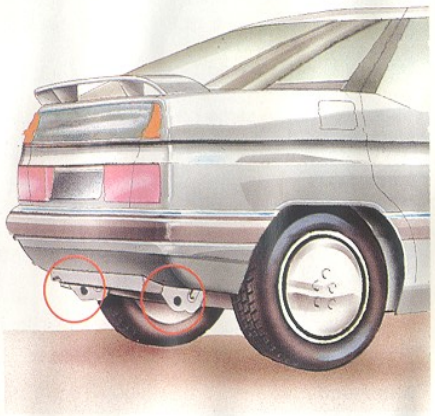
Check the wear indicators and the tread depth regularly as worn tyres have reduced grip. Worn tyres should be replaced immediately.

In the event of a puncture and to avoid damaging the tyre, the vehicle should be stopped as soon and as safely as possible.

A punctured tyre must be removed from the rim and thoroughly inspected for damage. All repairs must be carried out by a tyre specialist who could assume responsibility for the repair.

For your safety, only use the recommended tyres.





Towing with all wheels on the ground

Towing rings are situated at the front and rear of the vehicle.

Unclip the cover.

If the hydraulic system is still functioning normally, in an emergency, tow at low speed for a short distance only.

Use a bar with hooks to attach to the rings shown above.

Towing with the front end lifted

Use a special towing equipment.

Attach the hooks to each of the suspension arms; interpose a plank under the car and take the necessary precautions to protect the bumper and the front end of the vehicle.

Towing with the rear end lifted

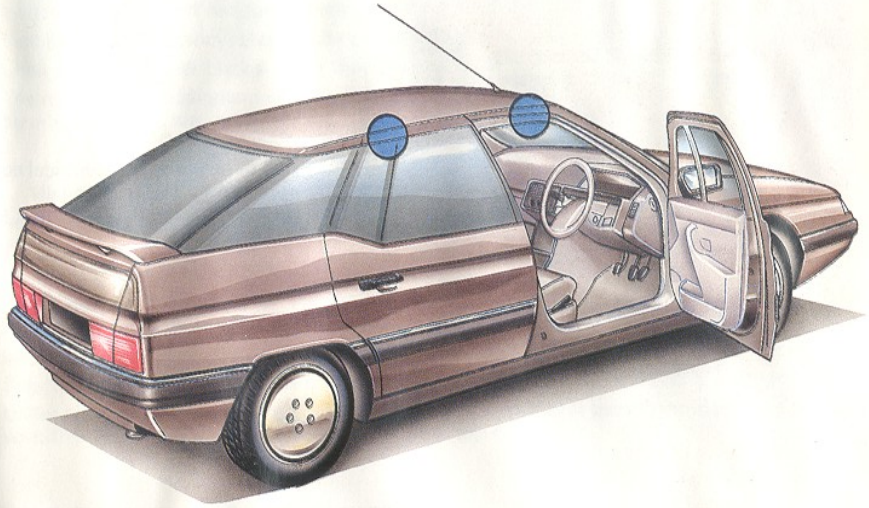
Attach the hooks to the two rings provided and take the same precautions as with the front end lifted.

Towing with front or rear end lifted at minimum suspension height.

Attach the hooks and take the same precautions as above.

Carefully lift the wheels off the ground.

Drive slowly paying special attention to the road surface condition.



Four fixing points are provided under the door seals for fitting two loading bars.

Roof bars

Only Citroen approved roof bars should be used, so as to ensure your safety.

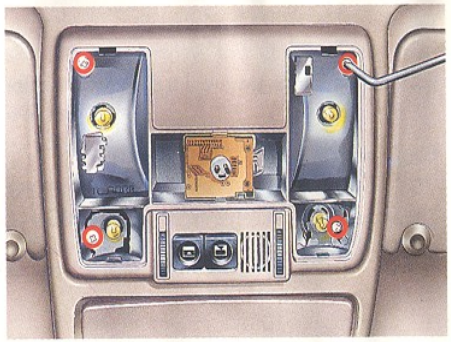
These bars are available from the CITROËN network.

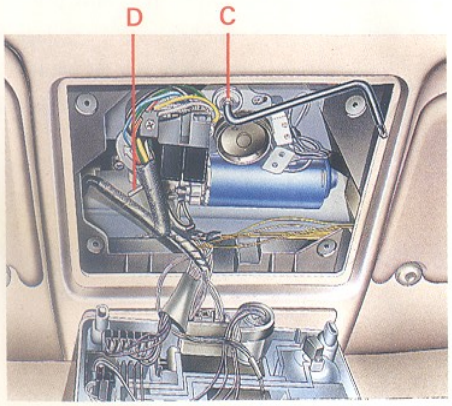
Maximum load: 80 kg.

Manual closing

In the event of failure of the electrical control,the roof can be closed manually.
Unclip the interior lamp lens at **A** and **B**.

Using the cranked handle (cruciform end) which is stowed in the glove box or in the fuse box lid (according to model), remove the four lamp securing screws. Tilt the assembly down.





Disengage the clutch of the roof motor by pushing the lever **D** toward the front,as arrowed.
Enter the hexagonal end of the cranked handle at **C** and turn the crank.

General

- In wet or foggy weather, keep your distance, slow down, braking distances are increased, switch on the dipped headlamp beam.
- Visibility and emergency, always carry a set of spare bulbs and an emergency battery lamp.
- Change screen wiper blades when they start to leave streaks on the glass.
- The road lighting equipment is designed specially for your safety and that of others. It must be in good order, well adjusted and clean.

When children are in the car

- The rear doors are fitted with a child proof locking system. When in use the doors can only be opened from the outside.
- Never leave a young child (or animal) in a car in the sun with all the windows shut.
- Children must not be allowed to stand between the backrests of the two front seats, in the back of vehicles they should be suitably restrained.
- Before opening a door make certain that this can be done without causing a danger.
- Under no condition can children travel on the lap of a front seat passenger (danger of impact with the dashboard or windscreen in case of a collision).

Caravanning

- Spread the load inside the caravan, keep heavy loads on or near the floor, respect the towing weight limits. Make sure the caravan is heavier at the front but keep within the nose weight limit.
- Drive at moderate speed (within the speed limit). Change down before hills both going up and coming down.
- When towing the fuel consumption will increase. A roof spoiler may help.
- Braking distances are increased. Use the brakes gently and progressively. Avoid harsh braking.
- Before leaving:
  - check the tyre pressures of both car and caravan,
  - check all the exterior and signalling lamps of the car and caravan,
  - practice manoeuvring, especially reversing,
  - grease regularly the towing ball hitch, remove it when not towing for a long period.

Always keep within the towing weight limits.

Roof rack

- Use approved roof bars.
- Spread the load evenly, avoid overloading one side.
- Keep heavy objects at the bottom of the load.
- Strap the load securely, and signal any overhanging load.
- Drive gently, side wind effects will be increased.
- Remove the roof rack or roof bars when not in use.

Always keep within the load capacity.

When towing in difficult conditions with a heavy trailer, XM V6 and XM Diesel models should be fitted with a second cooling fan (except on XM V6 models with air conditioning which have two fans as standard equipment).
Consult your nearest CITROËN dealer.

*Current consumption**

To avoid unnecessary current drain of the battery and to reduce the possibility of a discharged battery, the vehicle has several specific features:

- audible warning to advise of sidelamps on, (ignition off and door open).
- automatic switching of headlamps to sidelamps when the ignition is switched off.
- the radio only operates with the ignition in the **A** position.
- timed operation of the interior lighting.
- timed operation of the demisting and defrosting of rear screen.

* According to model.

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	XM Carburettor	XM Injection	XM V6	XM V6 24 V
Engine (cylinders, in line, transverse)	4	4	6	
Cubic capacity (cc)	1998	1998	2975	
Fuel tank capacity	80 litres (17.6 gals.)			
Recommended fuel — Leaded 4 Star	Vehicles without catalytic converter only		No	
Recommended fuel — Unleaded Premium	98 RON or 95 RON		98 RON or 95 RON	
Engine oil capacity [litres (pints)] with oil filter without oil filter	5.4 (9.5) 4.7 (8.2)	5.4 (9.5) 4.7 (8.2)	7.0 (12.2) 6.5 (11.4)	
Hydraulic system capacity [litres (pints)]	4.8 (8.4)			
Screen wash fluid reservoir [litres (pints)] front/rear	4.5 (7.8)			
Turning circle	12.5 m			
Calculated maximum speed [km/h (mph)] manual gearbox auto gearbox	193 (120)	205 (127) 202 (125)	222 (137) 220 (136)	235 (146)
Battery 12 V.	300 A			
Spark plugs Champion Eyquem	C 7 YCX FC 62 LS	C 7 YCX FC 58 LS	RFC 58 LS 3 FC 58 LS 3	RFC 58 LS 3 FC 58 LS 3
Weight (in kg) Unladen Laden	1 280 1 760	1 310 1 845	1 420 1 910	1 475 1 930
Max. on front axle	965	1 020	1 085	1 100
Max. on rear axle	805	825	830	840
Gross train weight	3 060	3 145	3 410	3 430
Laden trailer braked	1 300	1 300	1 500	1 500
Laden trailer unbraked	640	655	710	735
Trailer nose weight	110			
Roof rack load, max.	80			

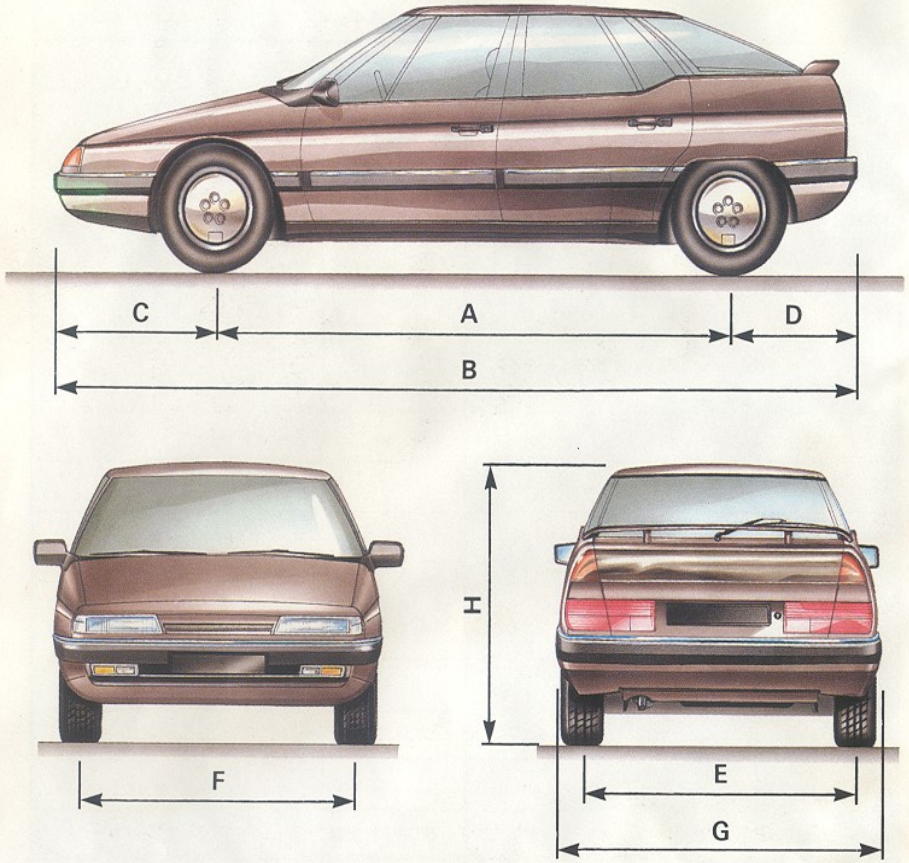
In each country, it is essential not to exceed the maximum towing loads and speeds permitted by local legislation.

To learn more about the towing capacity of your vehicle and its maximum authorised train weight, contact your CITROËN dealer.

	XM diesel	XM diesel turbo
Engine (cylinders, in line, transverse)	4	
Cubic capacity (cc)	2138	2088
Fuel tank capacity	80 litres (17.6 gals.)	
Engine oil capacity [litres (pints)] with filter without filter	6.0 (12.2) 5.5 (11.4)	
Hydraulic circuit capacity [litres (pints)]	4.8 (8.4)	
Screen wash fluid reservoir [litres (pints)] front/rear	4.5 (7.9)	
Turning circle	12.5 m	
Calculated maximum speed [km/h (mph)]	176 (109)	192 (119)
Battery 12 V.	400 A	
Weight (in kg) Unladen Laden	1 305 1 820	1 380 1 910
Max. on front axle	1 010	1 090
Max. on rear axle	820	830
Gross train weight	3 120	3 410
Laden trailer braked	1 300	1 500
Laden trailer unbraked	650	690
Trailer nose weight	110	
Roof rack load, max.	80	

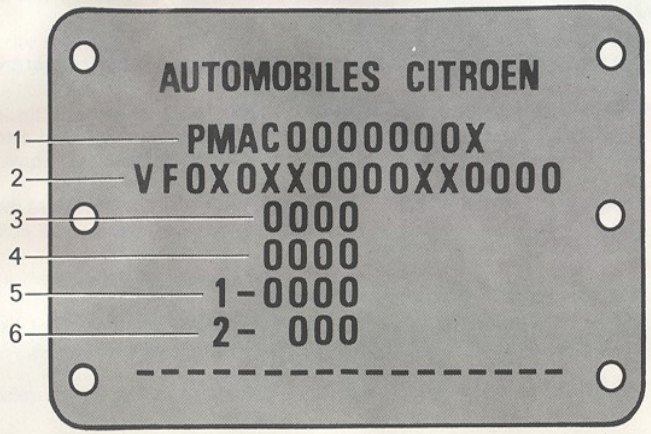
In each country, it is essential not to exceed the maximum towing loads and speeds permitted by local legislation.

To learn more about the towing capacity of your vehicle and its maximum authorised GTW, contact your CITROËN dealer.



Dimensions (in mm)

A	2 850
B	4 708
C	1 068
D	790
E	1 457 or 1 447
F	1 530 or 1 520
G	1 794
H	1 382 or 1 385



Chassis number plate: On front crossmember.

1: pMAC

2: Identification number.

3: Maximum laden weight.

4: Maximum train weight.

5: Maximum weight on front axle.

6: Maximum weight on rear axle.

Replacement parts organisation number (four figure no.).

On left hand front door pillar. Please quote this number when ordering repacement parts. All genuine CITROËN replacement parts are available from CITROËN. It is in the user's interest, for his safety and for the sake of the Warranty, to reject all other parts. Fitting parts or units not supplied by CITROËN may even result in a violation of the law, if it results in non-compliance with regulations, especially as regards safety, pollution control, interference suppression, and the noise level of the vehicle. Fitting such parts or units could also deprive the user of any recourse against the maker. This applies in particular to:

- parts of the braking system,
- lighting and signalling equipment,
- engine equipment,
- the exhaust system,
- steering system, structural and suspension parts.

Model year

On left hand front door pillar. (French market vehicles.)

Colour code

On the left hand front wheel arch.

All CITROËN accessories are designed to complement and protect the quality and style of your CITROËN XM.

They have been selected and manufactured to meet the exacting standards set by CITROËN.

Choose from the following extensive Accessoirie Range:

COMFORT: Seat covers, carpets, radio equipment, loudspeakers, etc.

SECURITY: glass marking, anti-theft alarm, wheel anti-theft device, replacement bulbs kit, etc.

CAR CARE: antifreeze fluid, screen wash, etc.

BODY STYLING: opening roof accessories, tail blazer.

LEISURE AND TRAVEL: roof bars, ski holders, bicycle carriers, tow bar.

Ask your CITROËN dealer for further details.

If your new CITROËN XM is fitted with a CLARION PC 300 radio, please note the following:

1. For security reasons, the radio will only function if the correct Radio Security Code is entered. This will have been done by the dealer and your radio should be fully operational.
2. If the electrical supply to the radio is disconnected when, for example, the battery is disconnected or a fuse blows, the radio will not function normally until the Radio Security Code is re-entered.
3. The Radio Security Code can be found on your CITROËN XM Security Card, together with the Ignition Key Number, Remote Control Number and the Anti-Theft Code.
4. Complete instructions for entering the code can be found on page 53.
5. Should the radio cease to function as a result of disconnection of the electrical supply, and the Security Code is not known, contact your CITROËN dealer for assistance.
6. Do not keep the Security Card in the car.

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PASSENGER CAR FUEL CONSUMPTION ORDER 1983
FUEL CONSUMPTION TESTS

The results recorded in official fuel economy certificates of the officially approved tests for determining fuel consumption carried out on our range of models are as follows:

"(CAT)"=Catalytic Converter
"(EGR)"=Exhaust Gas Recirculation

MODEL		Trans-mission	Imperial MPG			Metric L/100km			* 'R.U.L.E.'
			Urban	56mph	75mph	Urban	90kmh	120kmh	
AX 10E, RE & TGE		M4	50.4	72.4	50.4	5.6	3.9	5.6	E
AX 11TGE, TRS & TZX		M4	49.6	72.4	50.4	5.7	3.9	5.6	E
AX 11TGE, TRS & TZX		M5	49.6	72.4	50.4	5.7	3.9	5.6	E
AX 11TGE, TRS & TZX INJECTION	(CAT)	M4	39.8	60.1	45.6	7.1	4.7	6.2	U
AX 11TGE, TRS & TZX INJECTION	(CAT)	M5	39.2	60.1	45.6	7.2	4.7	6.2	U
AX 14TRS, TZS & TZX		M5	40.9	67.3	47.1	6.9	4.2	6.0	R
AX 14TZX INJECTION	(CAT)	M5	36.7	58.9	42.8	7.7	4.8	6.6	U
AX GT ('91 Model Year)		M5	37.2	57.6	42.8	7.6	4.9	6.6	E
AX GT (INJECTION)	(CAT)	M5	35.3	57.6	41.5	8.0	4.9	6.8	U
AX 14RD, TGD & DTR		M5	54.3	78.5	56.5	5.2	3.6	5.0	D
BX 14TE & TGE Saloon		M4	34.9	51.4	39.8	8.1	5.5	7.1	R
BX 14TE & TGE Saloon		M5	34.0	51.4	39.8	8.3	5.5	7.1	R
BX 14TGE (INJECTION) Saloon	(CAT)	M5	30.7	48.7	36.2	9.2	5.8	7.8	U
BX 16TGS & TZS Saloon		M5	31.7	51.4	40.4	8.9	5.5	7.0	E
BX 16TGS & TZS Saloon		A	32.5	48.7	37.2	8.7	5.8	7.6	E
BX 16TGI & TZI Saloon	(CAT)	M5	29.1	48.7	37.2	9.7	5.8	7.6	U
BX 19TZS Saloon		M5	29.7	47.1	37.2	9.5	6.0	7.6	E
BX 19TZS Saloon		A	29.7	46.3	37.2	9.5	6.1	7.6	E
BX 19TZI & GTi Saloon	(CAT)	M5	24.1	43.5	33.2	11.7	6.5	8.5	U
BX 19TZI & GTi Saloon	(CAT)	A	23.7	42.2	32.1	11.9	6.7	8.8	U
BX GTi Saloon		M5	27.2	46.3	34.4	10.4	6.1	8.2	E
BX GTi Saloon		A	25.4	44.1	34.4	11.1	6.4	8.2	E
BX GTi 4 x 4 Saloon		M5	23.7	39.8	31.7	11.9	7.1	8.9	E
BX 16 VALVE Saloon ('91 Model Year)		M5	25.0	42.8	34.9	11.3	6.6	8.1	E
BX 16 VALVE Saloon	(CAT)	M5	23.5	41.5	33.2	12.0	6.8	8.5	U
BX 17TGD Saloon		M5	44.1	61.4	44.1	6.4	4.6	6.4	D
BX 19TGD & TZD Saloon		M5	43.5	61.4	46.3	6.5	4.6	6.1	D
BX 19TGD & TZD Saloon		A	40.9	56.5	42.2	6.9	5.0	6.7	D
BX 19TGD & TZD Saloon	(EGR)	M5	42.2	60.1	44.1	6.7	4.7	6.4	D
BX TGD TURBO & TZD TURBO Saloon		M5	40.9	62.8	44.8	6.9	4.5	6.3	D
BX 16TGS Estate		M5	31.7	48.7	37.7	8.9	5.8	7.5	E
BX 16TGI Estate	(CAT)	M5	29.1	46.3	34.9	9.7	6.1	8.1	U
BX 19TZS Estate		M5	29.4	47.9	36.2	9.6	5.9	7.8	E
BX 19TZS Estate		A	29.7	46.3	36.2	9.5	6.1	7.8	E
BX 4 x 4 Estate		M5	26.9	42.2	32.5	10.5	6.7	8.7	E
BX 19TZI Estate		M5	26.2	44.8	33.2	10.8	6.3	8.5	E
BX 19TZI Estate		A	25.4	43.5	32.5	11.1	6.5	8.7	E
BX 19TZI Estate	(CAT)	M5	23.2	42.2	32.1	12.2	6.7	8.8	U
BX 19TZI Estate	(CAT)	A	23.7	39.8	30.7	11.9	7.1	9.2	U
BX 19TGD Estate		M5	43.5	58.9	42.8	6.5	4.8	6.6	D
BX 19TGD Estate	(EGR)	M5	42.2	58.9	42.8	6.7	4.8	6.6	D
BX TZD TURBO Estate		M5	40.9	58.9	41.5	6.9	4.8	6.8	D
CX TGE SAFARI Estate		M5	23.5	39.8	31.0	12.0	7.1	9.1	E
CX TGI SAFARI/FAMILIALE Estate		M5	20.8	35.8	29.4	13.6	7.9	9.6	E
CX TGI SAFARI/FAMILIALE Estate		A	21.7	29.4	24.4	13.0	9.6	11.6	E
CX TGD TURBO SAFARI Estate		M5	33.2	52.3	38.2	8.5	5.4	7.4	D
XM (2.0 carb)		M5	26.4	44.8	35.8	10.7	6.3	7.9	E
XM	(CAT)	M5	22.6	44.1	33.6	12.5	6.4	8.4	U
XM 2.0 i, si & sei		M5	24.6	44.8	34.9	11.5	6.3	8.1	E
XM 2.0 i, si & sei		A	21.9	41.5	33.2	12.9	6.8	8.5	E
XM 2.0 i, si & sei	(CAT)	M5	22.1	41.5	32.1	12.8	6.8	8.8	U
XM 2.0 i, si & sei	(CAT)	A	20.5	39.8	30.7	13.8	7.1	9.2	U
XM V6 si & sei	(CAT)	M5	18.8	36.2	29.4	15.0	7.8	9.6	U
XM V6 si & sei	(CAT)	A	16.7	35.3	28.0	16.9	8.0	10.1	U
XM V6-24V	(CAT)	M5	17.8	34.4	27.7	15.9	8.2	10.2	U
XM TURBO D, SD & SED		M5	33.2	57.6	43.5	8.5	4.9	6.5	D
XM TURBO D, SD & SED	(EGR)	M5	31.7	55.4	41.5	8.9	5.1	6.8	D

*R.U.L.E. Indicates suitability for use with unleaded petrol:
R — Refer to Dealer – can use 95 RON unleaded after modification or 98 RON unleaded without modification
U — Use Unleaded Petrol Only
L — Use 97 RON minimum (97 RON leaded or 98 RON unleaded)
E — Use Either
D — Diesel

IMPORTANT NOTE

The results given above do not express or imply any guarantee of the fuel consumption of the particular car to which this handbook refers. The car itself has not been tested and there are inevitably differences between individual cars of the same model. In addition, this car may incorporate particular modifications. Furthermore, the driver's style and road and traffic conditions, as well as the extent to which the car has been driven and the standard of maintenance will affect its fuel consumption.

NOTE: The mention of a model above does not imply availability at any given time.

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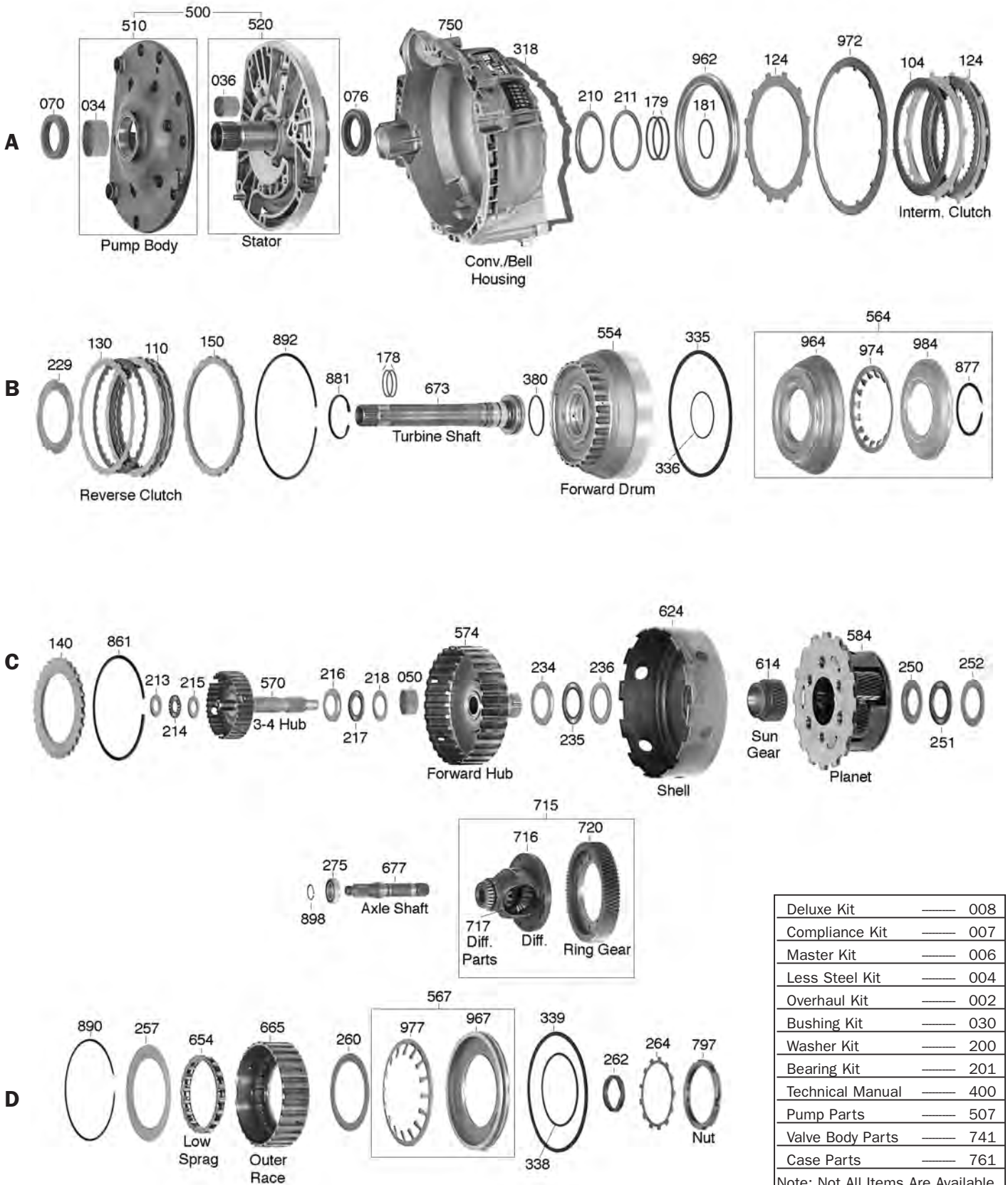
ZF4HP18 Q Saab



Deluxe Kit	——	008
Compliance Kit	——	007
Master Kit	——	006
Less Steel Kit	——	004
Overhaul Kit	——	002
Bushing Kit	——	030
Washer Kit	——	200
Bearing Kit	——	201
Technical Manual	——	400
Pump Parts	——	507
Valve Body Parts	——	741
Case Parts	——	761

Note: Not All Items Are Available For All Transmissions.

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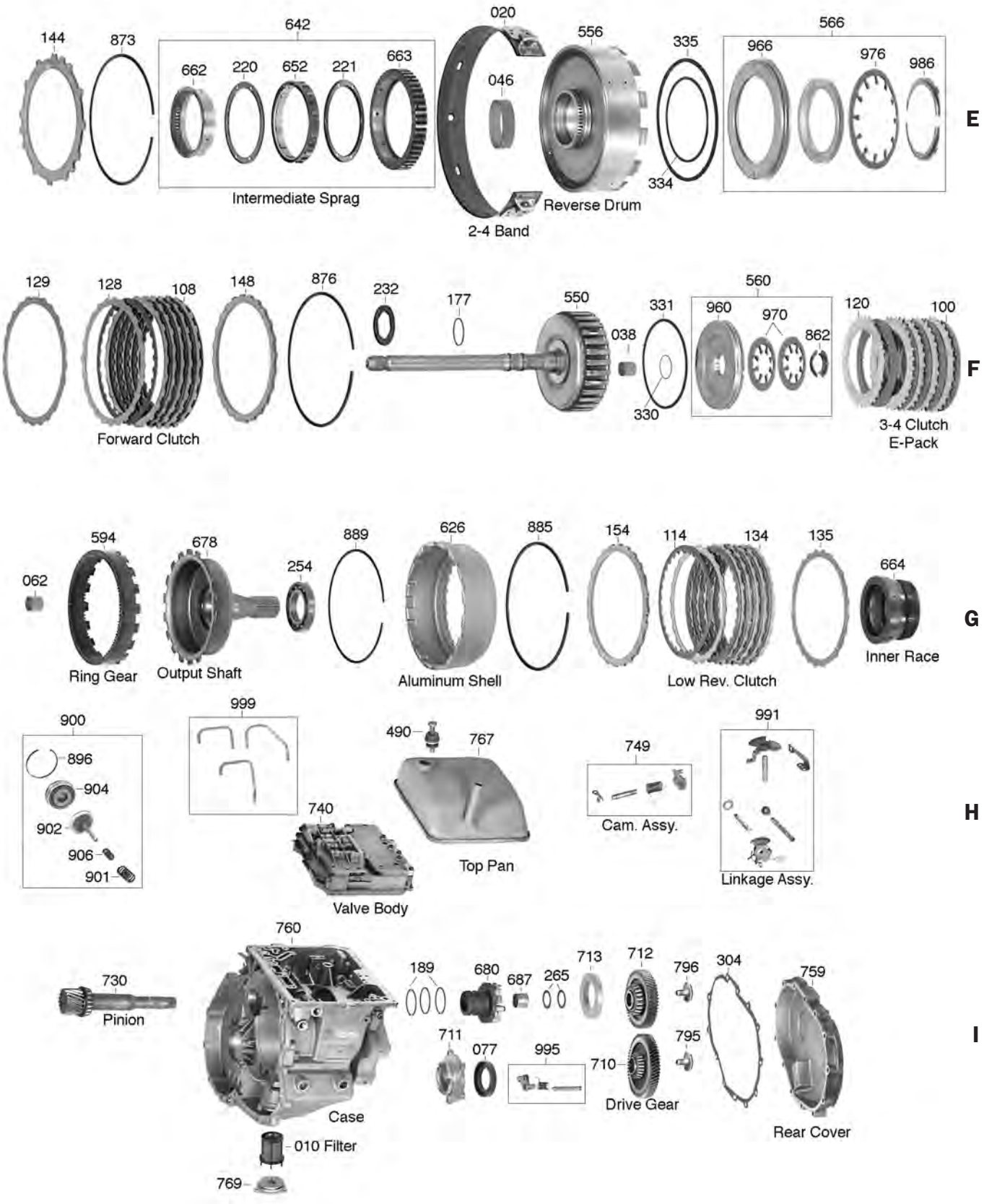

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ZF4HP18 Q Saab

Fwd 4 Speed

ILL #	Description	Qty	Year	Part #	Reference
	With Steel Kit (Master)				
006D	ZF4HP18Q Saab	1	86-98	79006S	2418112
	Less Steel Kit				
004D	ZF4HP18Q Saab	1	86-98	79004S	3418112
	Overhaul Kit w/ Rings & Seals				
002D	ZF4HP18Q Saab	1	86-98	79002S	1050 298 040
	Gasket & Seal Kit w/o Rings & Seals				
000D	ZF4HP18Q Saab	1	86-98	79000S	1050 298 001
	Filters				
010I	Filter, (Round Filter)	1	86-98	79010S	0501 311 497
	Filter Kits				
011	Filter Kit, (Round Filter, w/ Rubber Gasket)	1	86-98	79011S	4HP18FKS
	Bands				
	Prefix Key: B = Borg Warner, A = OEM (Exc BW), N = All Other New, R = Relined				
020E	Band	1	86-98	79020S	0501 208 881
	Bushings				
030D	Bushing Kit	1	86-98	79030S	
034A	Pump Body	1	86-98	79034S	
036A	Stator (Front)	1	86-98	79036E	
048A	Stator (Rear)	1	86-98	69048	
046E	Reverse Drum (Front)	1	86-98	79046E	
049	Turbine Shaft	1	86-98	79049E	
	Metal Clad Seals				
070A	Front	1	86-98	79070E	0750 111 079
076A	Right Axle (Rear)	1	86-98	79076S	0750 111 292
077I	Left Axle (Front)	1	86-98	79077S	0750 111 189
	Friction Plates				
100F	3-4 Clutch .063" (36 T) E Pack	4-5	86-98	79100E	1050 230 033
104A	Intermediate .071" (30 T) C Pack	3	86-98	79110B	1056 210 031
108F	Forward .063" (30 T) A Pack	4-5	86-98	79108E	1050 202 002
110B	Reverse .079" (30 T) B Pack	3-4	86-98	79110E	1056 272 024
114G	Low & Reverse .063" (30 T) D Pack	6	86-98	79114E	1050 217 002
	Steel Plates				
120F	3-4 Clutch .071" (30 T) E Pack	4-5	86-98	79120E	1050 330 017
124A	Intermediate .071" (24 T) C Pack	3-4	86-98	69126B	0302 302 037
128F	Forward .071" (24 T) A Pack	4-5	86-98	69128E	1050 302 011
128F	Forward .040" (24 T) A Pack (Waved)	2	86-98	69129E	1050 302 012
130B	Reverse .071" (24 T) A Pack	3	86-98	69128E	1050 302 011
134G	Low & Reverse .071" (24 T) D Pack	6	86-98	69128E	1050 302 011
	Pressure Plates				
	Prefix Key: D = Dealer, No Prefix = New Aftermarket, Q = Quality Inspected				
140C	3-4 Clutch 3.075" ID (30 T) (E Pack)	1	86-98	79140E	1056 271 014
144E	Intermediate Clutch 4.688" ID (12 T) (C Pack)	1	86-98	79144E	1043 302 092
148F	Forward Clutch 5.200" ID (24 T) (A Pack)	1	86-98	79148E	
150B	Reverse Clutch 5.200" ID (24 T) (B Pack)	1	86-98	79150E	1050 302 013
154G	Low/ Reverse Clutch 5.200" ID (24 T) (D Pack)	1	86-98	79154E	

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ILL #	Description	Qty	Year	Part #	Reference
Sealing Rings					
175D	Ring Kit	1	86-98	79175S	4HP14MPSR
177F	Input Shaft to Turbine Shaft (Rear) 1.023" OD (Metal)	1	86-98	79177E	0750 113 012
177F	Input Shaft to Turbine Shaft (Front) .868" OD (Teflon)	2	86-98	79177EBT	0501 309 030
178B	Turbine Shaft to Stator (Rear) 1.260" OD (Metal)	1	86-98	79178E	0750 113 014
178B	Turbine Shaft to Stator (Front) 1.220" OD (Metal)	1	86-98	79178EB	0750 113 013
179A	Stator to Reverse Drum 2.285" OD (Metal)	2	86-98	79179E	0750 113 015
181A	Stator to Forward Drum 2.049" OD (Metal)	1	86-98	79181E	0750 113 024
189I	Governor 2.205" OD (Metal)	2	86-98	79189E	0750 113 027
189I	Governor 2.205" OD (Rubber)	2	86-98	79189EB	0501 306 310
Thrust Washers					
211A	Stator to Band Drum .082"	1	86-98	79211SD	0730 150 612
211A	Stator to Band Drum .088"	1	86-98	79211SE	0730 150 613
211A	Stator to Band Drum .097"	1	86-98	79211SF	0730 150 614
Bearings					
N.I.	Bearing & Shim Kit	1	86-98	79201E	
214C	Bearing, 3-4 Drum to 3-4 Hub	1	86-98	79214S	
217C	Bearing, 3-4 Hub to Forward Hub	1	86-98	79217S	
235C	Bearing, Forward Clutch Hub to Bowl	1	86-98	79235S	
251C	Bearing, Output Shaft Hub (Front)	1	86-98	79251S	
Races					
N.I.	Bearing & Shim Kit	1	86-98	79201E	
210A	Race, Stator to Band Drum	1	86-98	79210S	
213C	Race, 3-4 Drum to 3-4 Hub (Front)	1	86-98	79213S	
216C	Race, 3-4 Hub to Forward Hub (Front)	1	86-98	79216S	
218C	Race, 3-4 Hub to Forward Hub (Rear)	1	86-98	79218S	
229B	Race, Reverse Drum to Forward Drum	1	86-98	79229S	
234C	Race, Forward Clutch Hub to Bowl (Front)	1	86-98	79234S	0635 290 066
236C	Race, Forward Clutch Hub to Bowl (Rear)	1	86-98	79236S	
250C	Race, Output Shaft Hub (Front)	1	86-98	79250S	
252C	Race, Output Shaft Hub (Front)	1	86-98	79252S	
260D	Race, Rear Hub to Case	1	86-98	79260S	
264D	Retaining Ring, Rear Sprag In Race to Lock Nut	1	86-98	79264S	1036 317 037
276	Race, For Pinion Bearing	1	86-98	79276S	
291	Race, Differential to Case	1	86-98	79291S	
Gasket & O-Rings					
300	Gasket, Bottom Pan (Rubber)	1	86-98	79300E	1050 301 036
304I	Gasket, End Cover	1	86-98	79304S	0750 112 156
318A	Gasket, Converter Housing to Main Case	1	86-98	79318S	0750 112 167
322	Gasket, Valve Body End Plate (13 Bolt Holes)	1	86-98	79322S	0750 112 166
326	Gasket, Valve Body to Filter	1	86-98	79326S	1050 326 112
334E	O-Ring, Forward Drum (Inner)	1	86-98	79334E	0734 313 020
335B	O-Ring, Forward Drum (Outer)	1	86-98	79335E	0750 112 045
373	O-Ring, Accelerator Cable	1	86-98	79373E	0734 303 040
399	O-Ring, Bearing Cover	1	86-98	79399S	0734 313 057
Technical Manuals					
400D	Tech Manual, Saab	1	86-98	79400S	
400D	Tech Manual, Saab (Supplement)	1	86-98	79400SC	
Detent Cables					
450	Detent Cable, Saab 9000	1	86-98	79450S	1050 206 044
450	Detent Cable, Saab (Tag #'s 031, 032, 084, 085)	1	86-98	79450SA	1050 206 041
450	Detent Cable Repair Kit	1	86-98	T57451	67999

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ZF4HP18 Q Saab

Fwd 4 Speed

ILL #	Description	Qty	Year	Part #	Reference
	Pumps				
	.Prefix Key: AR = Reman, D = Dealer, A = New Aftermarket, Q = Quality Inspected, U = Used				
507A	.Valve, Cooler Relief (In Pump)	1	86-98	79507S-1	1036 322 033
510A	.Pump Body & Gears,	1	86-98	79510S	1050 219 022
520A	.Stator, (Pump Cover) (Cast # 1050 422 092)	1	86-98	79520S	1050 222 070
520A	.Stator, (Pump Cover) (Cast # 1050,422 015)	1	86-98	79520SA	
	Drums				
	.Prefix Key: AR = Reman, D = Dealer, A = New Aftermarket, Q = Quality Inspected, U = Used				
550F	.Drum, 3-4 Clutch w/ Input Shaft	1	86-98	79550S	
554B	.Drum, Forward Clutch w/ Piston	1	86-98	79554S	
556E	.Drum, Reverse Clutch (Front, Band Drum)	1	86-98	79556S	
560F	.Piston Kit, 3-4 Clutch	1	86-98	79560S	
564B	.Piston Kit, Forward Clutch	1	86-98	79564S	
566E	.Piston Kit, Reverse Clutch	1	86-98	79566S	
567D	.Piston Kit, Low/ Reverse Clutch	1	86-98	79567S	
570C	.Clutch Hub, w/ Shaft 3-4 Clutch	1	86-98	79570S	
574C	.Clutch Hub, w/ Shaft Forward Clutch	1	86-98	79574S	
	Planets				
	.Prefix Key: AR = Reman, D = Dealer, A = New Aftermarket, Q = Quality Inspected, U = Used				
584C	.Planet	1	86-98	79584S	
594G	.Ring Gear	1	86-98	79594S	
	Sun Gears & Shells				
	.Prefix Key: AR = Reman, D = Dealer, A = New Aftermarket, Q = Quality Inspected, U = Used				
614C	.Sun Gear	1	86-98	79614S	
624C	.Shell, Sun Gear	1	86-98	79624S	1050 231 022
626G	.Shell, Rear (Aluminum)	1	86-98	79626S	
	Sprags				
	.Prefix Key: AR = Reman, D = Dealer, A = New Aftermarket, Q = Quality Inspected, U = Used				
642E	.Sprag Assembly, Intermediate w/ Races	1	86-98	79642S	1050 231 026
654D	.Sprag, Rear	1	86-98	79654S	
664G	.Inner Race, Rear Sprag	1	86-98	79664S	1050 317 036
665D	.Outer Race, Rear Sprag	1	86-98	79665S	
	Shafts				
	.Prefix Key: AR = Reman, D = Dealer, A = New Aftermarket, Q = Quality Inspected, U = Used				
673B	.Turbine Shaft	1	86-98	79673S	1050 202 026
677D	.Shaft w/ Bearing, Differential Drive	1	86-98	79677S	
678G	.Output Shaft, w/ Hub	1	86-98	79678S	1050 214 006
	Governors & Gears				
	.Prefix Key: AR = Reman, D = Dealer, A = New Aftermarket, Q = Quality Inspected, U = Used				
680I	.Governor, w/ Support	1	86-98	79680S	1050 333 180
710I	.Gear, Drive Transfer (59 T)	1	86-98	79710S	
711I	.Bearing Cover	1	86-98	79711S	0501 308 534
712I	.Gear, Driven Transfer (53 T)	1	86-98	79712S	
716D	.Differential Housing, (Less Ring Gear)	1	86-98	79716S	
720D	.Ring Gear, (Differential) (77 T)	1	86-98	79720S	
730I	.Pinion, (18 T)	1	86-98	79730S	
	Valve Bodies				
	.Prefix Key: AR = Reman, D = Dealer, A = New Aftermarket, Q = Quality Inspected, U = Used				
740H	.Valve Body	1	86-98	79740S	
741H	.Spring, 2-3 Accumulator	1	86-98	79741S-3A	0732 042 219
741H	.Spring, Accumulator	1	86-98	79741S-3C	0732 042 051
741H	.Spring, Cooler Relief	1	86-98	79741S-3D	0732 041 815
741H	.Spring, 1-2 Accumulator	1	86-98	79741S-3E	0732 042 380

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ILL #	Description	Qty	Year	Part #	Reference
	Valve Bodies				
741H	Spring, 1-2 Accumulator	1	86-98	79741S-3F	0732 042 019
741H	Pressure Regulator Valve, Oversized (Sonnax) (Req T-85991-TL)	1	86-98	S79741PK	85991-01
N.I.	Tool For S79741PK (Sonnax)	1	86-98	T-85991-TL	85991-TL
	Cases & Housings				
	Prefix Key: AR = Reman, D = Dealer, A = New Aftermarket, Q = Quality Inspected, U = Used				
750A	Bell Housing	1	86-98	79750S	
759I	Rear Cover	1	86-98	79759S	
760I	Case, (Cast #)	1	86-98	79760S	
767H	Pan, Top	1	86-98	79767S	
	Miscellaneous Components				
	Prefix Key: AR = Reman, D = Dealer, A = New Aftermarket, Q = Quality Inspected, U = Used				
796I	Bolt, Drive Gear	1	86-98	79796S	1036 309 269
797D	Slotted Nut, Rear Sprag Race	1	86-98	79797S	1036 317 038
901H	Washers, Servo Cushion Belleville Type (2 Per Bag) (Sonnax)	1	86-98	S79901A	85701-01
962A	Piston, Intermediate Clutch	1	86-98	79962S	
964B	Piston, Forward Clutch	1	86-98	79964E	1050 302 033
967D	Piston, Low/ Reverse Clutch	1	86-98	79967S	
972A	Spring, Intermediate Clutch Diaphragm	1	86-98	79972S	
977D	Spring, Low/ Reverse Clutch Diaphragm	1	86-98	79977S	

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