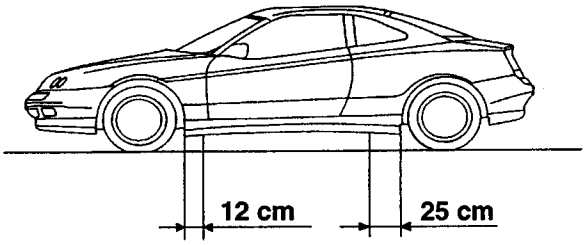
JACKING POINTS

With arm hoist or shop jack.

- Position the arms or the jack in the areas shown.



IMPORTANT:
Be very careful when positioning the arms or the jack in the front jacking points to avoid squeezing the brake and fuel lines.

TOWING POINTS

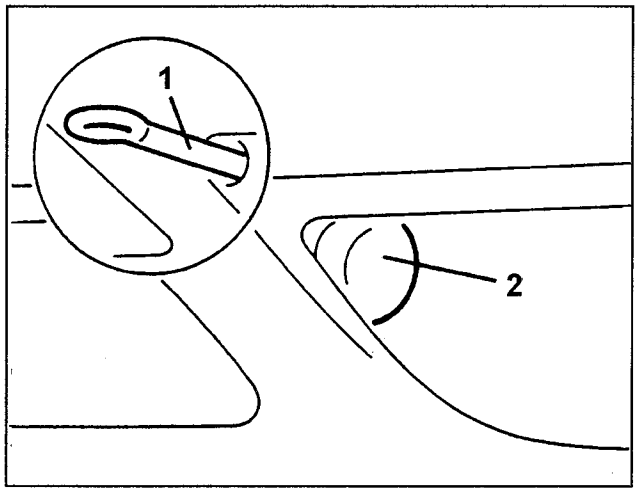
The vehicle is equipped with two threaded attachments - one at the front and the other at the back - where to screw the tow hitch which is provided in the tool bag (in the boot).

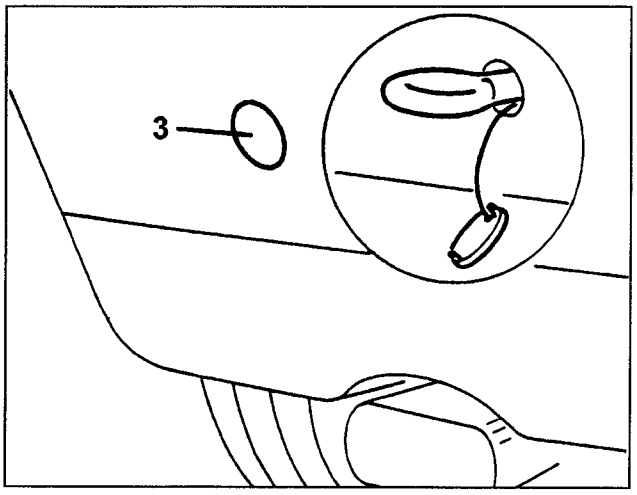
Attain scrupulously to the laws regulating towing.

IMPORTANT:
Before towing the vehicle, turn the key to MAR and back to STOP without removing it to prevent the steering wheel from locking.

Consider that while towing, the brake booster system is not running. Consequently, more effort on the brake pedal will be required.

Furthermore, when the engine is not running, the power steering system is neither working. Consequently, more effort on the steering wheel is required.





1. Front tow hitch
2. Front bumper slot
3. Rear bumper cover

TECHNICAL FEATURES

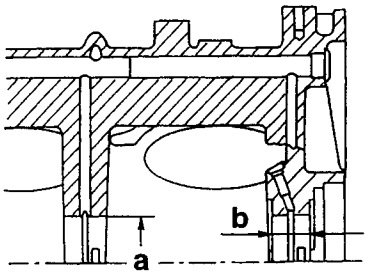
CHARACTERISTIC DATA

Engine		AR 16202
Stroke		Otto, four stroke
Injection/Ignition		Motronic ML4.1 / EZ212K
Firing order		1 - 4 - 2 - 5 - 3 - 6
Capacity	cm^3	1996
Number of cylinders		6 V positioned a 60°
Bore	mm	80
Stroke	mm	66.2
Maximum power	CV CEE (kW CEE) rpm	200 (147) 6000
Maximum torque	kgm CEE Nm CEE rpm	27.6 (28.5 *) 271 (280 *) 2400
Compression ratio		8 : 1
Engine oil pressure (oil at 100°C) - Idling - 4000 rpm	bar	 0.7 3.8
Idling ratio	rpm	800 ± 20

(*): With overboost running.

CRANKCASE

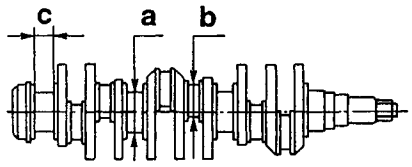
Crankcase



Unit: mm

Main journal diameter "a"	Class A - Red	63.657 ÷ 63.663
	Class B - Blue	63.663 ÷ 63.669
	Class C - Green	63.669 ÷ 63.675
Rear main journal shoulder length "b"		26.450 ÷ 26.500

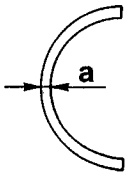
Crankshaft



Unit: mm

Main bearing diameter "a"	Class A - Red	59.973 ÷ 59.979
	Class B - Blue	59.967 ÷ 59.973
	Class C - Green	59.961 ÷ 59.967
Connecting rod pin diameter "b"	Class A - Red	51.990 ÷ 52.000
	Class B - Blue	51.980 ÷ 51.990
Rear main bearing length "c"		31.300 ÷ 31.335
Maximum main bearing-rod ovality		0.004
Maximum main bearing-rod taper ratio		0.010
Maximum main bearing-rod parallel error		0.015
Maximum main bearing eccentricity		0.040

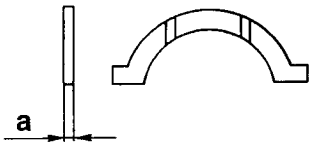
Main half-bearings



Unit: mm

Main half-bearing thickness "a"	Class A - Red	1.833 ÷ 1.839
	Class B - Blue	1.839 ÷ 1.845
	Class C - Green	1.845 ÷ 1.851
Main half-bearing and bearing operating play		0.000 ÷ 0.024

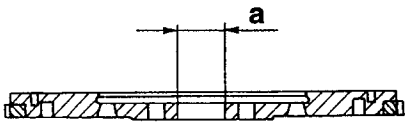
Thrust half-rings



Unit: mm

Thrust half-ring thickness "a"	2.310 ÷ 2.360
Crankshaft axial play	0.080 ÷ 0.265

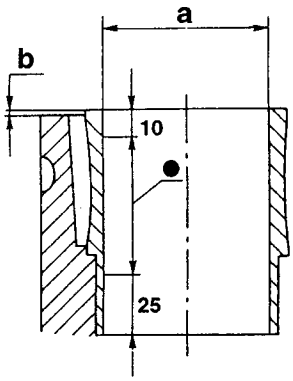
Flywheel



Unit: mm

Central bush internal diameter (bore) "a"	35.000 ÷ 35.025
Crown wheel heating temperature for fitting on flywheel	120° ÷ 140°C

Cylinder liner

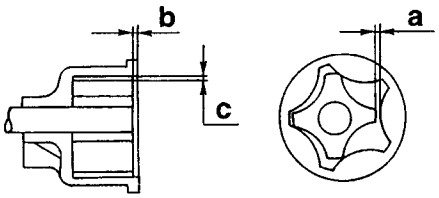


(•) Dimensional check area

Unit: mm

Cylinder liner diameter "a"	Class A - Blue	79.985 ÷ 79.994
	Class B - Pink	79.995 ÷ 80.004
	Class C - Green	80.005 ÷ 80.014
Cylinder liner projection from crankcase "b"		0.01 ÷ 0.06
Cylinder liner ovality/taper limit		0.01

Oil pump

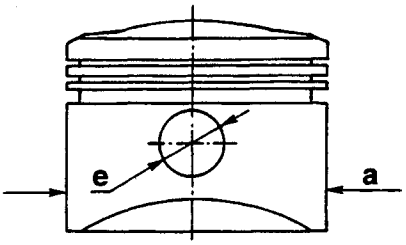


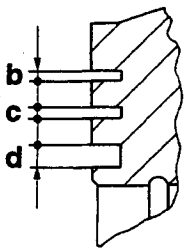
Unit: mm

Driven and internal gear play "a"	0.040 ÷ 0.290
Pump casing surface and upper gear axial play "b"	0.025 ÷ 0.075
Pump casing and driven gear axial play "c"	0.170 ÷ 0.275

CONNECTING ROD - PISTON ASSEMBLY

Piston



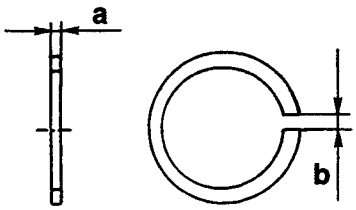


Unit: mm

Diameter of pistons "a" (1)	Class A - Blue	79.935 ÷ 79.945
	Class B - Pink	79.945 ÷ 79.955
	Class C - Green	79.955 ÷ 79.965
Height of seats of first seal ring "b"		1.525 ÷ 1.545
Height of seats of second seal ring "c"		1.525 ÷ 1.545
Height of seats of oil scraper ring "d"		3.515 ÷ 3.535
Diameter of gudgeon pin holes in pistons "e"	Class A - Black	22.001 ÷ 22.003
	Class B - White	22.003 ÷ 22.005
Clearance between liners and pistons		0.040 ÷ 0.059
Difference in weight between pistons		≤ 4 g

(1) To be measured perpendicularly to the gudgeon pin hole at a distance of 17 mm from lower edge of skirt.

Seal rings

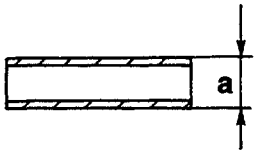


Unit: mm

Thickness of rings "a"	First ring	1.478 ÷ 1.490
	Second ring	1.478 ÷ 1.490
	Oil scraper ring	3.478 ÷ 3.490
Ring gap "b" (1)	First ring	0.30 ÷ 0.50
	Second ring	0.30 ÷ 0.50
	Oil scraper ring	0.25 ÷ 0.50
Axial play between rings and their seats	First ring	0.035 ÷ 0.067
	Second ring	0.035 ÷ 0.067
	Oil scraper ring	0.025 ÷ 0.057

(1) To be measured in the ckeck ring nut or in the cylinder liner

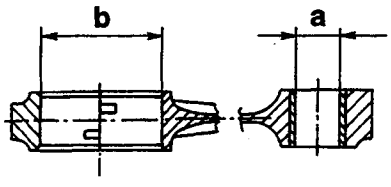
Gudgeon pins



Unit: mm

Outside diameter of gudgeon pins "a"	Class A - Black	21.994 ÷ 21.997
	Class B - White	21.997 ÷ 22.000
Clearance between pins and their housings on pistons	Class A - Black	0.004 ÷ 0.009
	Class B - White	0.003 ÷ 0.008

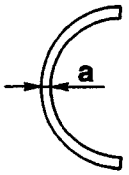
Connecting rods



Unit: mm

Diameter of connecting rod bush hole "a"		22.004 ÷ 22.014
Inside diameter of big ends "b"		55.511 ÷ 55.524
Difference in weight between connecting rods		≤ 2 g
Big end end float		0.2 ÷ 0.3
Clearance between gudgeon pins and small end bushes	Class A - Black	0.007 ÷ 0.020
	Class B - White	0.004 ÷ 0.017

Connecting rod half bearings

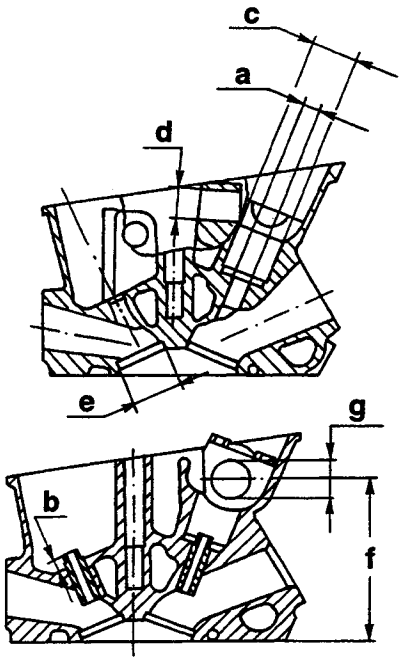


Unit: mm

Thickness of connecting rod half bearings "a"	Class A - Red	1.737 ÷ 1.745
	Class B - Blue	1.741 ÷ 1.749
Operating clearance between rod pins and their half bearings	Class A - Red	0.034 ÷ 0.060
	Class B - Blue	0.036 ÷ 0.062

CYLINDER HEADS

Heads

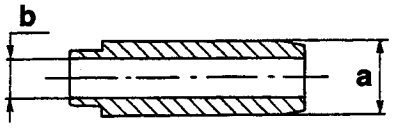


Unit: mm

Diameter of valve guide seats "a"		13.990 ÷ 14.018
Valve guide protrusion "b"		9.7 ÷ 10.1
Diameter of valve cup seats	Intake "c"	35.000 ÷ 35.025
	Exhaust "d"	22.000 ÷ 22.021
Diameter of valve seat housings "e"	Intake	37.500 ÷ 37.525
	Exhaust	32.500 ÷ 32.52
Minimum permissible height of heads after refacing "f"		124.85 ÷ 125.15
Maximum error of flatness of head lower surface		0.05
Diameter of camshaft supports "g"		27.000 ÷ 27.033
Length of camshaft support		26.851 ÷ 26.940
Diameter of camshaft pulley hub bush		32.000 ÷ 32.025
Diameter of oil pump drive shaft hub bush (1)		19.000 ÷ 19.021
Diameter of oil pump driving gear bush (1)		19.000 ÷ 19.021

(1) Specific for right-hand cylinder head

Valve guides

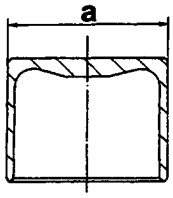


Unit: mm

Outside diameter of valve guides "a"	Intake	14.033 ÷ 14.044 14.047 ÷ 14.058 (1)
	Exhaust	14.048 ÷ 14.059 14.062 ÷ 14.073 (1)
Inside diameter of valve guides (bore) "b"		9.000 ÷ 9.015
Interference between valve guides and their seats	Intake	0.015 ÷ 0.054
	Exhaust	0.030 ÷ 0.069

(1) For Spares only

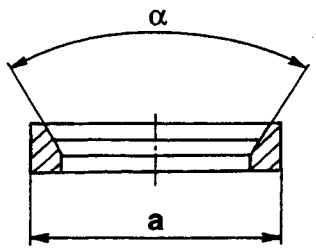
Valve cups



Unit: mm

Diameter of valve cups "a"	Intake	34.973 ÷ 34.989
	Exhaust	21.971 ÷ 22.989
Radial clearance between valve cups and seats	Intake	0.011 ÷ 0.052
	Exhaust	0.011 ÷ 0.050

Valve seats

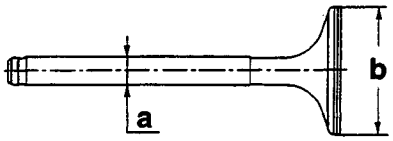


Unit: mm

Outside diameter of valve seats "a"	Intake	37.565 ÷ 37.600 37.865 ÷ 37.900 (1)
	Exhaust	32.610 ÷ 32.626 32.910 ÷ 32.926 (1)
Valve seat taper "α"		90° ± 20'
Interference between valve seats and their seats	Intake	0.040 ÷ 0.100
	Exhaust	0.085 ÷ 0.126
Heating temperature of cylinder heads for fitting valve seats		100 °C

(1) For Spares only

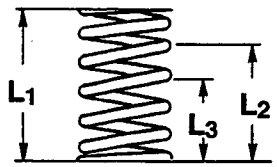
Valves



Unit: mm

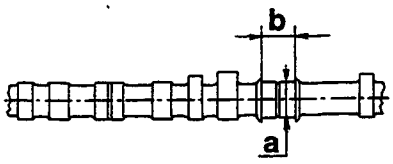
Diameter of valve stems "a"	Intake	8.972 ÷ 8.987
	Exhaust	8.940 ÷ 8.955
Diameter of valve mushrooms "b"	Intake	36.35 ÷ 36.50
	Exhaust	32.45 ÷ 32.60
Radial clearance between valve stems and valve guides	Intake	0.015 ÷ 0.043
	Exhaust	0.045 ÷ 0.075

Valve springs



	Inner spring	Outer spring
Free length "L_1"	44.6 mm	44.1 mm
Length with valves closed "L_2"	32.5 mm	30.5 mm
Corresponding load at "L_2"	243 ÷ 252 N (24.8 ÷ 25.7 kg)	126 ÷ 130 N (12.8 ÷ 13.3 kg)
Length with valves open "L_3"	23.5 mm	21.5 mm
Corresponding load at "L_3"	470 ÷ 488 N (47.9 ÷ 49.7 kg)	222 ÷ 231 N (22.7 ÷ 23.5 kg)

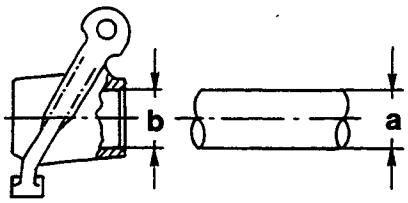
Camshafts



Unit: mm

Diameter of camshaft journals "a"		26.949 ÷ 26.970
Maximum eccentricity between journals		0.03
Width of camshaft shoulders "b"		27.000 ÷ 27.052
Nominal cam lift	Intake	7.65
	Exhaust	6.40
Clearance between camshaft journals and their seats		0.030 ÷ 0.084
Camshaft end float		0.060 ÷ 0.201

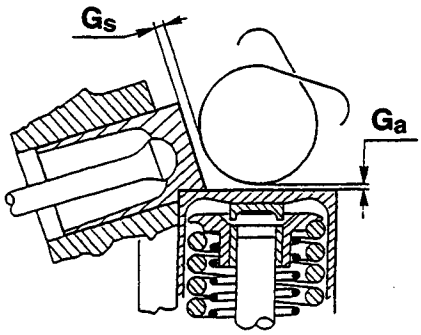
Rockers



Unit: mm

Diameter of rocker shaft "a"	15.988 ÷ 16.000
Inside diameter of rockers "b"	16.016 ÷ 16.034
Radial clearance between rockers and shafts	0.016 ÷ 0.046

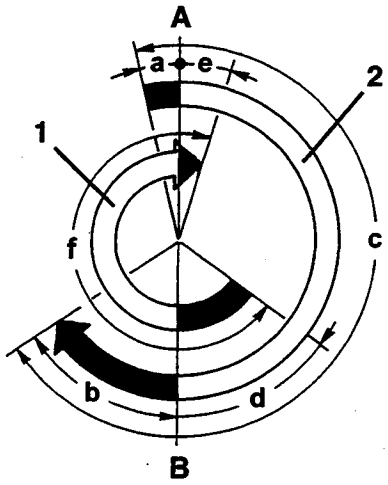
Valve clearance



Unit: mm

Valve clearance (with engine cold)	Intake "G_a"	0.475 ÷ 0.500
	Exhaust "G_s"	0.275 ÷ 0.300

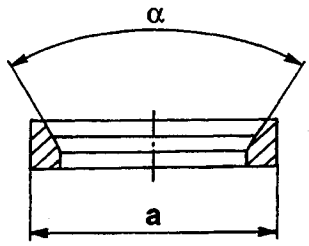
ANGLES OF ACTUAL TIMING DIAGRAM



Intake	Opens (before T.D.C.)	"a"	28°
	Closes (after B.B.C.)	"b"	59°
	Intake angle	"c"	268°
Exhaust	Opens (before B.D.C.)	"d"	65°
	Closes (after T.D.C.)	"e"	38°
	Exhaust angle	"f"	284°

(1) Exhaust
(2) Intake
(A) T.D.C.
(B) B.D.C.

Valve seats



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Interference between valve seats and their seats	Intake	0.040 ÷ 0.100
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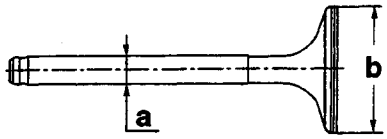
Heating temperature of cylinder heads for fitting valve seats		100 °C

(1) For Spares only

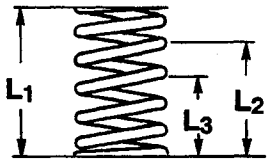
Valves



Unit: mm

Diameter of valve stems "a"	Intake	8.972 ÷ 8.987
	Exhaust	8.940 ÷ 8.955
Diameter of valve mushrooms "b"	Intake	36.35 ÷ 36.50
	Exhaust	32.45 ÷ 32.60
Radial clearance between valve stems and valve guides	Intake	0.015 ÷ 0.043
	Exhaust	0.045 ÷ 0.075

Valve springs



	Inner spring	Outer spring
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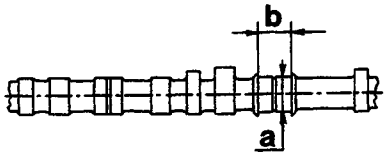
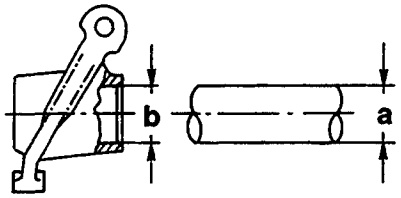
Camshafts



Unit: mm

Diameter of camshaft journals "a"		26.949 ÷ 26.970
Maximum eccentricity between journals		0.03
Width of camshaft shoulders "b"		27.000 ÷ 27.052
Nominal cam lift	Intake	7.65
	Exhaust	6.40
Clearance between camshaft journals and their seats		0.030 ÷ 0.084
Camshaft end float		0.060 ÷ 0.201

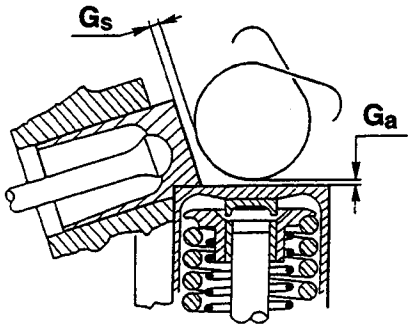
Rockers



Unit: mm

Diameter of rocker shaft "a"	15.988 ÷ 16.000
Inside diameter of rockers "b"	16.016 ÷ 16.034
Radial clearance between rockers and shafts	0.016 ÷ 0.046

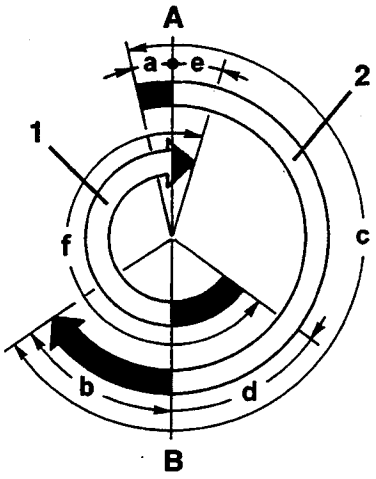
Valve clearance



Unit: mm

Valve clearance (with engine cold)	Intake "G_a"	0.475 ÷ 0.500
	Exhaust "G_s"	0.275 ÷ 0.300

ANGLES OF ACTUAL TIMING DIAGRAM



Intake	Opens (before T.D.C.)	"a"	28°
	Closes (after B.B.C.)	"b"	59°
	Intake angle	"c"	268°
Exhaust	Opens (before B.D.C.)	"d"	65°
	Closes (after T.D.C.)	"e"	38°
	Exhaust angle	"f"	284°

(1) Exhaust (2) Intake
(A) T.D.C. (B) B.D.C.

FUEL SYSTEM

FUEL	Unleaded petrol	minimum R.O.N. = 95
FUEL TANK	Total capacity	70 litres
	Reserve	~ 9 litres

SPARK PLUGS

GOLDEN LODGE 25HL

CHARGING

BATTERY	Nominal voltage	12 V
	Capacity	70 A/h

FUEL SYSTEM

FUEL

Unleaded petrol	minimum R.O.N. = 95

FUEL TANK

Total capacity	70 litres
Reserve	~ 9 litres

CHECKING FUEL SUPPLY PRESSURE

Fuel pressure at idle speed	3 bar
Maximum control pressure	~ 4 bar

AIR SUPPLY

FLUXING TEST

Air blow-by with accelerator throttle in closed position (Solex flow meter)	280 ± 10 Scale "N"

TURBINE IMPELLER CLEARANCE

End float	0.013 ÷ 0.081 mm
Radial clearance	0.076 ÷ 0.145 mm

WASTE-GATE OVERPRESSURE VALVE SETTING

Control pressure	Corresponding actuator stroke
0.55 ÷ 0.61 bar	1 mm
0.64 ÷ 0.75 bar	4 mm

CHECKING EMISSION AT THE EXHAUST

CO at exhaust	% vol.	≤ 0.5
HC at exhaust	p.p.m.	≤ 50

SENSORS

RPM AND TIMING SENSOR GAP

0.5 ÷ 1.5 mm

COOLING SYSTEM

THERMOSTAT

Temperature at start of opening	83 ± 2°C

COOLING FAN THERMAL CONTACT

Fan cut-in/cut-out temperature		
1st speed	Cut-in (contacts closed)	92 ± 2°C
	Cut-out (contacts open)	87 ± 2°C
2nd speed	Cut-in (contacts closed)	97 ± 2°C
	Cut-out (contacts open)	92 ± 2°C

MAXIMUM COOLANT TEMPERATURE SENDER

Conctact closing temperature	115 ± 3°C
Contact opening temperature	≥ 102°C

CLUTCH

Clutch disk thickness	New	7.1 ÷ 7.7 mm
	Worn to minimum	6.3 mm
Clutch disk diameter		235 mm

GEARBOX

RATIOS

Axle ratio	Gear engaged	Gear ratio	Total ratio
17/57 1 : 3.353	1^ 2^ 3^ 4^ 5^ RM	1 : 3.800 1 : 2.235 1 : 1.520 1 : 1.156 1 : 0.914 1 : 3.545	1 : 12.471 1 : 7.494 1 : 5.100 1 : 3.876 1 : 3.065 1 : 11.886

DIFFERENTIAL

Bearings pre-load (discharged) = 0.12 mm

NOTE: The bearings preload adjustment is obtained with spare rings having a thickness ranging from 1.70 mm to 2.60 mm in steps of 0.05 mm.

Crown wheel - side pinion clearance = 0.07 ÷ 0.20 mm

BRAKES

BRAKE DISK

		FRONT	REAR
Diameter	(mm)	284	240
Minimum thickness for use	(mm)	20.2	9.2
Minimum thickness after grinding	(mm)	21.9	10.1
Nominal thickness	(mm)	22.1	11

BRAKES PUMP

Type	ISOVAC
Diameter	15/16" (23.8 mm)
Stroke	9/16" (14 + 14 mm)

BRAKES SERVO

Type	ISOVAC
Working cylinder diameter	7" + 8" (17.8 + 20.3 cm)

FRONT BRAKE CALIPERS

Type	LUCAS
Piston diameter	54 mm
Brake shoes area	50 cm^2
Shoe nominal thickness	18.3 ± 0.2 mm

REAR BRAKE CALIPERS

Type	LUCAS
Piston diameter	34 mm
Brake shoes area	21 cm^2
Shoe nominal thickness	14 ÷ 14.4 mm

BRAKE SHOES

	FRONT	REAR
Minimum thickness for use of friction gasket	1.5 mm (Indicated by brake pad wear sensor)	1.5 mm

INDUCTIVE SENSORS AIR GAP - PHONIC WHEELS A.B.S.

Front wheels	0.3 ÷ 1.05 mm
Rear wheels	0.37 ÷ 0.9 mm

FRONT SUSPENSIONS

HELICAL SPRING

Wire diameter	12.9 mm
Free length	442 mm

SHOCK ABSORBERS

Rod diameter	22 mm
Stroke	158 mm

STABILISER BAR

Bar diameter	20 mm

REAR SUSPENSIONS

HELICOID SPRINGS

Wire diameter	13.9 mm
Free length	227 mm

SHOCK ABSORBERS

Stem diameter	39 mm
Stroke	94 mm

STABILISER

Bar diameter	18 mm

TRIM AND CHARACTERISTIC ANGLES (unladen with fluids)

Features		To '97 versions	'98 versions
Front trim (B - A)	(mm)	-37 ± 5	-48 ± 5
Rear trim (C - D)	(mm)	-77 ± 5	-77 ± 3
Front wheel toe-in (D_2 - D_1)	(mm)	-1.5 ± 0.5	-2.0 ± 1
Rear wheel toe-in (D_2 - D_1)	(mm)	+2.5 ± 0.5	+3.0 ± 1
Front wheel camber (α)		-0°40' ± 20'	-0°56' ± 20'
Caster (β)		3°10' ± 30'	2°54' ± 30'
Rear wheel camber (γ)		-1°8' ± 20'	-1°14' ± 20'

STEERING

Steering circle	10.8 m
Steering wheel turns (end to end)	2.23

THREE-LEVEL (TRINARY) PRESSURE SWITCH CALIBRATION

1. Level	contact open	2.45 ± 0.25 bar
	contact closed	2.85 ± 0.50 bar
2. Level	contact closed	15.2 ± 0.98 bar
	contact open	11.28 ± 1.99 bar
3. Level	contact open	25 ÷ 30 bar
	contact closed	17 ÷ 26 bar

COMPRESSOR

Make		SANDEN
Type		SD7 V16
Cylinder diameter		29.3 mm
Stroke	min.	2.2 mm
	max.	34.2 mm
Theoretic capacity	min.	10.4 cm^3 at tour
	max.	161.3 cm^3 at tour
Cylinders number		7
Rotation direction		clockwise
Max. continuous running		6000 rpm
Oil quantity ("PAG" SP10 or equivalent)		240 ± 15 cm^3
Electromagnetic coupling working voltage		12 V
Electromagnetic coupling min. insertion voltage		7.5 V
Power absorbed from electromagnetic coupling		48 W

IGNITION SYSTEM

SPARK PLUGS

Type	GOLDEN LODGE 25HL

STARTING

STARTER MOTOR

Nominal voltage		(V)	12
Nominal power rating		(kW)	Not available at time of going to press
Test under load	Voltage	(V)	
	Absorption	(A)	
	Revolutions	(rpm)	
	Torque	(Nm)	
Loadless test	Voltage	(V)	
	Absorption	(A)	
	Revolutions	(rpm)	
Short circuit test	Voltage	(V)	
	Absorption	(A)	
	Torque	(Nm)	

CHARGING

BATTERY

Nominal voltage	12V
Capacity	70 A/h

ALTERNATOR

Nominal voltage	12V
Nominal current	90A
Maximum continuous speed	Not available at time of going to press
Inductor winding resistance (measured between collector rings at 20°C)	

THREE-LEVEL PRESSURE SWITCH SETTING (TRINARY)

1. Level	contact opening	2.45 ± 0.25 bar
	contact closing	2.85 ± 0.50 bar
2. Level	contact closing	15.2 ± 0.98 bar
	contact opening	11.28 ± 1.99 bar
3. Level	contact opening	25 ÷ 30 bar
	contact closing	17 ÷ 26 bar

COMPRESSOR

Brand		SANDEN
Type		SD7 V16
Cylinder bore		29.3 mm
Stroke	min.	2.2 mm
	max.	34.2 mm
Theoretic capacity	min.	10.4 cm^3 per turn
	max.	161.3 cm^3 per turn
Number of cylinders		7
Direction of rotation		clockwise
Max. continuous speed		6000 rpm
Quantity of oil ("PAG" SP10 or equivalent)		240 ± 15 cm^3
Electromagnetic joint operating voltage		12 V
Minimum electromagnetic joint cut-in voltage		7.5 V
Power absorbed by electromagnetic joint		48 W

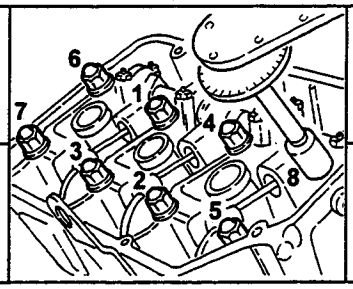
NOTE: For the tightening torques of the groups not mentioned here, refer to those for the engine 2959 V6

Group 00 - Engine maintenance

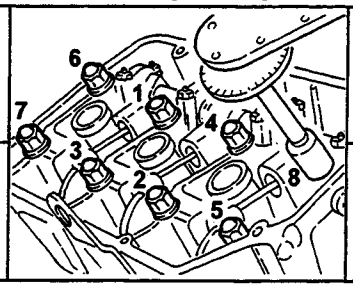
Part	Nm	kgm
Cylinder head cover fastening screws	9 ÷ 11	0.9 ÷ 1.1
Nut fastening camshaft pulley support hubs	97 ÷ 117	9.9 ÷ 11.9
Nuts fastening camshaft caps (1)	16 ÷ 18	1.6 ÷ 1.8
Nuts fastening timing belt tensioner	19 ÷ 23	1.9 ÷ 2.3
Fuel filter inlet union	30 ÷ 37	3.1 ÷ 3.8
Fuel filter outlet union	21 ÷ 26	2.1 ÷ 2.7
Spark plugs	25 ÷ 34	2.5 ÷ 3.5

(1): Lubricate with engine oil

Group 10 - Engine Removing/Refitting

Part		Nm	kgm
Power steering pump outlet pipe fitting		46 ÷ 50	4.7 ÷ 5.1
Screw fastening flange for turbocharger coolant inlet & outlet pipes		22 ÷ 24	2.2 ÷ 2.4
Axle shaft fastening bolts		40 ÷ 52	4.1 ÷ 5.3
Bolts fastening wishbones to wheel uprights		67 ÷ 74	6.8 ÷ 7.5
Screws fastening rear power unit support to gearbox		102 ÷ 126	10.4 ÷ 12.8
Rear screws fastening suspension crossmember to the body	Two side screws	93 ÷ 113	9.4 ÷ 11.5
	Four central	76 ÷ 94	7.7 ÷ 9.6
Side screws fastening suspension crossmember to the body		92 ÷ 113	9.4 ÷ 11.5
Screws fastening power steering box to suspension crossmember		43 ÷ 47	4.4 ÷ 4.8
Screws fastening gearbox side power unit support to gearbox		47 ÷ 57	4.8 ÷ 5.8
Screws fastening starter motor		18 ÷ 22	1.8 ÷ 2.2
Rpm and timing sensor fastening screw		8	0.8
Screw fastening gearbox side power unit support to flexible mount		75 ÷ 92	7.6 ÷ 9.4
Dash pot		10 ÷ 16	1 ÷ 1.6
Screws fastening throttle potentiometer		2 ÷ 4	0.2 ÷ 0.4
Lambda sensor		50 ÷ 60	5.1 ÷ 6.1
Engine coolant fluid temperature sensor (NTC)		30	2.9
Screws fastening pinging sensor		20	2
Cylinder head tightening			
Set all the screws to a torque of:		25	2.5
Turn all the screws an angle of:		240° ± 1°30'	

Group 10 - Engine overhauling

Part		Nm	kgm
Nuts fastening main bearing caps to supports on crankcase (1)		84 ÷ 93	8.6 ÷ 9.5
Main bearing cap locknuts		20 ÷ 25	2 ÷ 2.5
Screws fastening flywheel to crankshaft (with fixer)		113	11.5
Nut fastening crankshaft front pulley (1)		235	24
Screws fastening connecting rod caps (1)		53 ÷ 59	5.4 ÷ 6
Screws fastening water pump casing to crankcase		8 ÷ 9	0.8 ÷ 1
Nuts fastening camshaft caps (1)		16 ÷ 18	1.6 ÷ 1.8
Nut fastening timing gear pulley support hubs		97 ÷ 117	9.9 ÷ 11.9
Spark plugs		25 ÷ 34	2.5 ÷ 3.5
Screws fastening ignition distributor cap		4 ÷ 5	0.4 ÷ 0.5
Nuts fastening ignition distributor body		18 ÷ 22	1.8 ÷ 2.2
Screws fastening ignition distributor brush		2.5 ÷ 3	0.2 ÷ 0.3
Nuts fastening exhaust ducts		25	2.5
Cylinder head tightening			
Set all the screws to a torque of:		25	2.5
Turn all the screws an angle of:		240° ± 1°30'	

(1): Lubricate with engine oil

Group 55 - Electric system

Part	Nm	kgm
Screws fastening ignition distributor cap	4 ÷ 5	0.4 ÷ 0.5
Screws fastening ignition distributor brush	2.5 ÷ 3	0.2 ÷ 0.3
Nuts fastening ignition distributor body	18 ÷ 22	1.8 ÷ 2.2
Spark plugs	25 ÷ 34	2.5 ÷ 3.5
Screws fastening starter motor	18 ÷ 22	1.8 ÷ 2.2
Screw fastening gearbox side power unit support to flexible mount	75 ÷ 92	7.6 ÷ 9.4

Generalities

Special tools play an important part in vehicle maintenance, as they are essential in ensuring accurate, quick and reliable service.
It should be noted that the times of the various operations have been calculated assuming the use of these tools.

This manual lists and illustrates the special tools developed expressly by the Manufacturer for the vehicle overhauling, servicing and repair operations.
The service network can supply specific tools following the procedures already in course c/o the single Alfa Romeo Dealers.
Below, we are giving the list of the special tools used.

NOTE: For the tools of the groups not mentioned herein, refer to those for the engine 2959 V6

Group 00 - Engine maintenance

1.820.150.000 (R.9.0001)	Container for valve clearance adjustment caps
1.820.232.000	Puller tool for camshaft pulleys
1.822.016.000 (A.5.0220)	Wrench for adjusting exhaust side tappets
1.822.146.000	Support for pulley wrenches
1.822.151.000	Wrench for timing gear pulleys
1.824.018.000 (C.2.0131)	Tool for checking belt tensioning
1.824.034.000	Dial guage for checking valve caps
1.825.013.000 (C.6.0183)	Tool for checking T.D.C.
1.825.018.000 (C.6.0197)	Curved thickness guage for checking valve clearance

Group 10 - Engine overhauling

1.820.011.000 (A.2.0192)	Tool for supporting valves
1.820.012.000 (A.2.0195)	Base for cylinder head support tool
1.820.049.000 (A.2.0359)	Special nut for valve support tool
1.820.050.000 (A.2.0360)	Cylinder head support fork
1.820.115.000 (A.4.0195)	Guide for reaming oil pump drive pulley/shaft
1.820.145.000 (R.4.0178)	Engine support brackets for assembly on overhauling stand
1.820.150.000 (R.9.0001)	Container for valve adjustment caps

(CONTINUED)

(CONTINUED)

1.820.228.000	Flywheel stopper tool
1.820.232.000	Puller tool for camshaft pulleys
1.820.277.000	Graduated disk for angle torque tightening
1.820.279.000	Cylinder liner stopper
1.821.002.000 (A.3.0113)	Tool for installing seals on rear main bearing cap
1.821.005.000 (A.3.0134)	Puller tool for valve guides
1.821.006.001 (A.3.0139/0001)	Lever for removing rear main bearing cap
1.821.006.002 (A.3.0139/0002)	Fork for removing rear main bearing cap
1.821.010.000 (A.3.0178)	Tool for installing crankshaft rear oil seal
1.821.016.000 (A.3.0244)	Tool for installing valve guide oil seal
1.821.018.000 (A.3.0247)	Puller tool for valve guide oil seal
1.821.058.000 (A.3.0324)	Lever for removing/refitting valves
1.821.122.000 (A.3.0520)	Cage for removing/refitting valves
1.821.124.000 (A.3.0522)	Support for removing/refitting valves
1.821.125.000 (A.3.0524)	Tool for installing crankshaft front oil seal
1.821.126.000 (A.3.0525)	Tool for installing camshaft front oil seal
1.821.127.000 (A.3.0526)	Tool for installing intake valve guides
1.821.128.000 (A.3.0527)	Tool for installing exhaust valve guides
1.821.129.000 (A.3.0528)	Puller - installing tool bushes on oil pump pulley/drive shaft and front camshaft bush
1.822.016.000 (A.5.0220)	Wrench for adjusting exhaust side tappets
1.822.146.000	Support for pulley wrenches and wrench for oil pump drive pulley
1.822.151.000	Wrench for camshaft pulleys
1.824.034.000	Dial gauge for checking valve caps
1.825.003.000 (C.6.0148)	Tool for checking cylinder liner protrusion
1.825.013.000 (C.6.0183)	Tool for checking T.D.C.
1.825.018.000 (C.6.0197)	Curved thickness gauge for checking valve clearance

Group 10 - Engine removing/refitting

1.820.225.000	Support for removing/refitting power unit
1.820.234.000	Bracket for removing/refitting power unit
1.820.239.000	Supports for supporting engine support crossrail
1.820.277.000	Graduated disk for angle torque tightening
1.820.279.000	Cylinder liner stopper
1.820.581.000 (R.4.0194)	Engine support crossrail
1.825.013.000 (C.6.0183)	Tool for checking T.D.C.

Group 10 - Engine supply

1.820.098.000 (A.2.0471)	Tool for checking Waste-Gate overpressure valve setting
1.822.135.000	Wrench for removing locknut fastening fuel pump unit to fuel tank
1.822.159.000	Wrench for removing locknut fastening fuel level gauge to fuel tank
1.824.011.000 (C.2.0056)	Plug for flux test

MAINTENANCE OPERATIONS

The maintenance operations comprise checking and restoring the efficiency of certain parts of the vehicle on which wear and phase displacement are foreseeable after normal use.
The following table gives the list of maintenance operations to be carried out at the specified mileage intervals.

WARNINGS:
Precautions to be taken before maintenance operations. The engine compartment contains many moving parts, high temperature components and high voltage cables that can be dangerous.
Carefully follow the precautions given below:
- Turn the engine off and allow it to cool down.
Do not smoke or use naked flames. The presence of fuel can cause a fire hazard.
- Always work with a fire extinguisher handy.

Operations to have done at the mileage shown	km x 1.000									
	20	40	60	80	100	120	140	160	180	200
Change engine oil and filter (at all events once a years) and checking lubrication circuit for leaks	EVERY 10.000 km									
Checking valves clearance (except engines with hydraulic tappets)		●		●		●		●		●
Changing timing belts						●				
Checking conditions of trapezoidal belts		●		●		●		●		●
Checking conditions of Poly V belts				●				●		
Changing air cleaner cartridge		●		●		●		●		●
Changing fuel filter cartridge				●				●		
Checking operation of exhaust gas oxygen sensor (lambda probe)				●				●		
Changing spark plugs	●	●	●	●	●	●	●	●	●	●
Changing anti-freeze mixture				●				●		
Checking level of gearbox and differential oil				●				●		
Checking conditions of protective bellows for axle shafts, power steering and steering knuckle caps		●		●		●		●		●
Checking brake and fuel system piping for leaks		●		●		●		●		●
Checking handbrake travel		●		●		●		●		●
Checking power steering oil level		●		●		●		●		●

IMPORTANT:

Attain to the following instructions to ensure good car operation:

Every 500 km (or when refilling) check:
- engine oil level;
- coolant level;
- brake/clutch fluid level;
- windscreen washer fluid level.

Engine oil and filter

Change/replace as scheduled, however once a year.

Air cleaner

Replace the air cleaner more frequently than scheduled if the car is normally used on dusty roads.

Brake pads

Front brake pad wear is signalled by a warning light on the instrument panel. Check the rear brake pads when replacing the front brake pads. The rear brake pads may not require immediate replacement, according to the vehicle conditions of use. In this case, check them later.

Brake/clutch fluid

Brake fluid is hygroscopic, i.e. it absorbs moisture. To prevent faulty braking, change the brake fluid every two years, regardless of the mileage.

Battery

Check the electrolyte level frequently during the summer.

Dust and/or pollen filter (where fitted)

Check the dust and/or pollen filter once a year, preferably at the beginning of summer. If the car is mainly used in cities, on motorways or on dusty roads, check the filter more frequently. The climate control system efficacy may be considerably reduced if the filter is not replaced.

Anti-freeze

We recommend topping up with Climafluid Super Permanent -40°C Alfa Romeo to preserve the protective features of the mixture.

Notes

In particular conditions of use (e.g. on roads sprinkled with ice salt and/or corrosive substances, badly surfaced roads, etc.), check the drive shaft bellows and the steering unit frequently. Furthermore, clean and lubricate joints, hinges, door locks, bonnet lock, etc.
If in an emergency fuel, lubricant and/or fluids with features not corresponding to the manufacturer's specifications are used, change the fluid and replace the filters in the circuit as soon as possible.

'98 MODELS

Operations to be performed at the indicated km	Km x 1.000								
	20	40	60	80	100	120	140	160	180
Check tyre conditions and wear	●	●	●	●	●	●	●	●	●
Check front disc brake pad wear warning light operation	●	●	●	●	●	●	●	●	●
Check rear disc brake pad wear		●		●		●		●	
Check intactness of drive shaft bellows, power steering, joint caps and tightness of fuel and brake lines	●	●	●	●	●	●	●	●	●
Inspect conditions of: external bodywork and underbody protection (exhaust - fuel feed - brakes); rubber parts (boots - sleeves - bushings - etc.)	●	●	●	●	●	●	●	●	●
Inspect conditions of accessory drive Poly-V belt		●							●
Check tension of accessory drive belt and adjust, if required	●						●		
Check handbrake lever travel		●		●		●		●	
Check/adjust tappet clearance	●	●	●	●	●	●	●	●	●
Check exhaust emissions		●		●		●		●	
Check evaporation system operation				●				●	
Replace air cleaner cartridge		●		●		●		●	
Check fluids and top up if required (brakes, hydraulic clutch, power steering, windscreen washer, battery, engine coolant, etc.)	●	●	●	●	●	●	●	●	●
Replace timing belt and accessory drive Poly-V belt						●			
Replace spark plugs	●	●	●	●	●	●	●	●	●
Check engine control system operation (via diagnostic socket)		●		●		●		●	
Check gearbox and differential oil level				●				●	
Change engine oil and filter (*)	●	●	●	●	●	●	●	●	●
Change brake fluid (or every 24 months)			●			●			●
Check dust/pollen filter	●	●	●	●	●	●	●	●	●

(*): Or every 18 months for lower mileage.

IMPORTANT:
Perfect operation and long working life of a car is strictly related to its good use and, above all, to the care with which regular service is performed. Considering product evolution, new service schedules have been adopted. The scheduled service coupons are planned at 20,000 km. It is, however, important to note that the car requires ordinary precautions, such as systematic fluid checks and topping up, tyre pressure checks, etc. In any case, remember that the correct car maintenance is certainly the best way to ensure performance, safety, environmental friendliness and low running costs in time.

Additional operations
The following precautions are required in addition to the operations shown in the Service Schedule to ensure good operation of the car:
Every 1000 km or before long trips, check and top up if required:
- engine oil
- engine coolant
- brake/clutch fluid
- power steering fluid
- battery electrolyte
- tyre pressure
- windscreen washer fluid.

Engine oil
If the car is mainly used in one of the following especially demanding conditions:
- towing trailers
- dusty roads
- short, repeated trips (less than 7-8 km) with temperature below zero degrees centigrade
- engine frequently idling or long distances at slow speed (or after a long storage period)

we recommend changing the engine oil more frequently than shown in the Service Schedule.

Air cleaner
Replace the air cleaner more frequently than prescribed if the car is mainly used on dusty roads.

Brake pads
The brake pads are subject to different use and wear, according to conditions of use and to driving style. Have the pad thickness checked at an Alfa Romeo Dealership as soon as the front brake pad warning light comes on. As the car is equipped with front brake pad wear sensors only, check the rear pads when the front pads are replaced. According to the car use, the rear brake pads may not need to be replaced immediately. We recommend in this case to check them later.

Brake/clutch fluid
Brake fluid is hygroscopic, i.e. it absorbs moisture. To prevent faulty braking, change the brake fluid every two years, regardless of the mileage (see the Service Schedule).

Battery
Check the battery charge status, preferably at the beginning of winter, to prevent the electrolyte from freezing. Perform this check more frequently if the car is mainly used for short trips or if permanent intake devices also running when the key is removed are fitted, especially those fitted after market.

Climate control system
To keep the system in perfect shape, simply turn it on every fortnight - also in winter - and run the compressor for a few minutes. Furthermore, we recommend having the system checked before the summer, when the system will be used.

Dust/pollen filter (cars with climate control only)
Have the filter checked once a year, preferably at the beginning of summer, by an Alfa Romeo Dealership. If the car is frequently used in dusty or very polluted environments, we recommend you have the filtering element checked more frequently than shown in the Service Schedule. The filter should be replaced in particular if decreased air intake into the passenger compartment is noticed.

Anti-freeze
We recommend topping up with Climafluid Super Permanent -40°C Alfa Romeo to preserve the protective features of the mixture.

Rubber hoses
The rubber hoses in the brake, power steering, fuel feed lines, etc. should be carefully checked at the frequency shown in the Service Schedule.

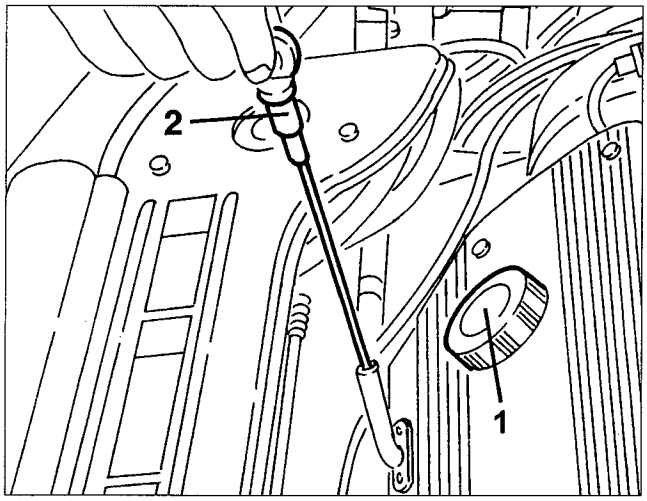
Wheels
Periodically and before long trips, check the pressure of each tyre, including the spare. Check pressure on cold tyres.
Periodically check that the depth of the tread complies with the minimum legal prescriptions. Periodically check that the tyres are not cut, swollen or present irregular wear. If this is so, go to an Alfa Romeo Dealership.
If a tyre is punctured, stop immediately and replace it to prevent damage to the tyre, the rim, the suspension and the steering.
The factory fitted wheels (rims and tyres) are suited to the features of the car and ensure maximum safety and comfort in all normal conditions of use. Before replacing the rims or tyre fitted on the car, check the allowed type table. However, attain to the rim-tyre coupling of the original fitting. Always fit new tyres. Avoid tyres from unknown sources.

ENGINE MAINTENANCE

ENGINE OIL AND FILTER REPLACEMENT

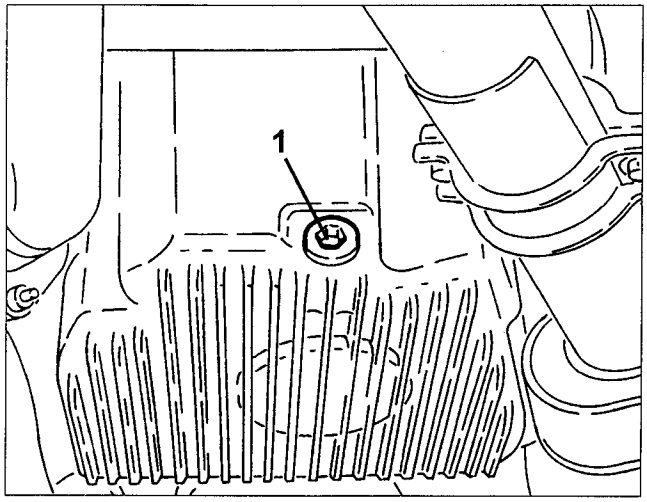
IMPORTANT:
Engine oil is harmful for skin: avoid contact. In the event of contact, wash the affected part with soap and water.

1. With the engine warm, remove the filler cap.
2. Remove the dipstick and check oil level.



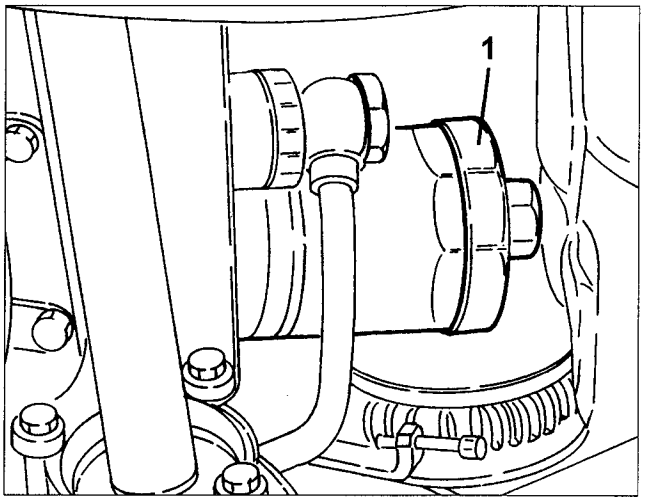
- Lift the vehicle.
1. Remove the drain cap and drain all the oil into a suitable container.

IMPORTANT:
Remove the drain cap with care: the oil could be very hot.



IMPORTANT:
Do not disperse oil in the environment: waste oil is a potential environmental hazard.

1. From under the vehicle, release and remove the oil filter with the specific wrench.



- Clean the drain cap and fasten it with its seal.
- Dampen the new filter with engine oil and fasten by hand.
- Lower the vehicle.
- Fill the engine with oil of the prescribed type and amount.
- Check the correct engine oil level with the dipstick.

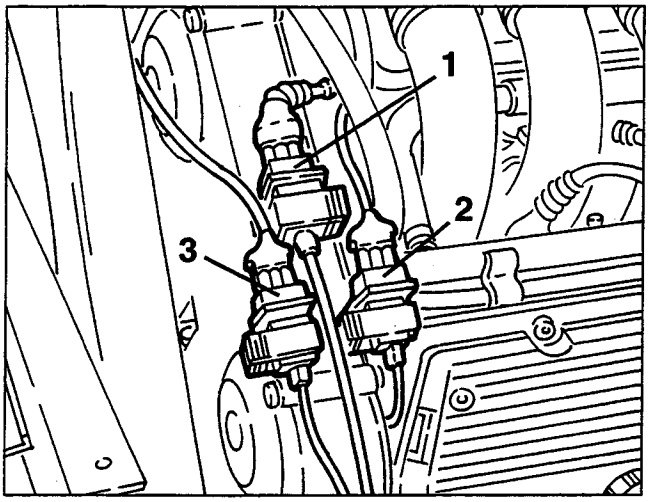
IMPORTANT:
Check the level with the vehicle on level ground. The oil may evaporate excessively and lead to drops in pressure if the level exceeds the MAX notch.

- Refit the filler cap and idle the engine for approximately 2 minutes. Stop the engine and wait for a few minutes.
- Check level. Check for any leaks.

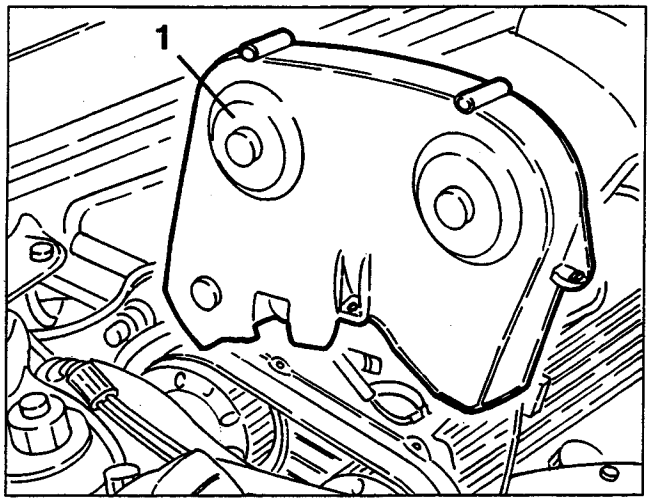
IMPORTANT:
When topping up, be very careful not to drip engine oil accidentally on the alternator ventilation fins. This could seriously damage the alternator and cause fires.

CHECKING AND ADJUSTING THE VALVE CLEARANCE

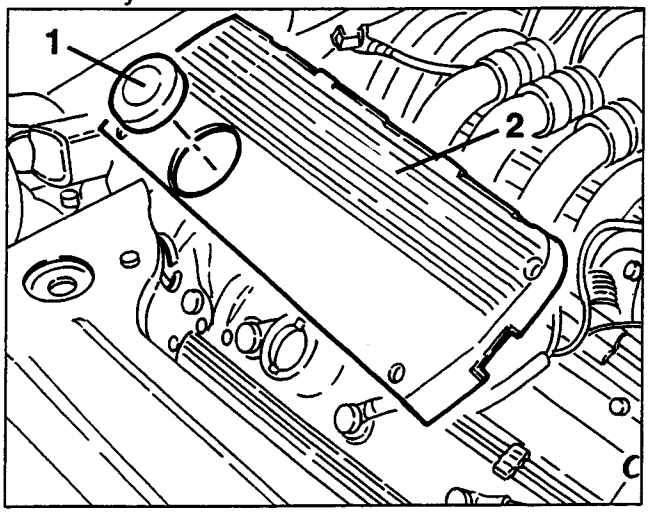
- Remove the intake box (see specific paragraph).
1. Disconnect the connection of the rpm and timing sensor.
2. Disconnect the connection of the pinging sensor.
3. Disconnect the connection of the lambda sensor.



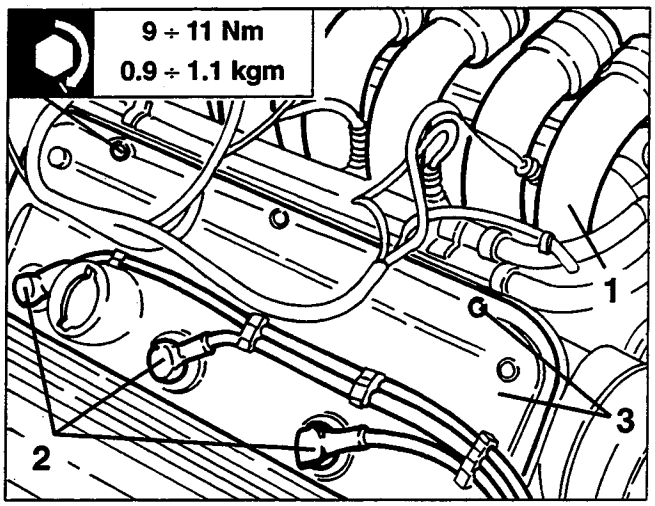
1. Slacken the fastening screws and remove the timing belt cover.



1. Remove the oil filler cap.
2. Slacken the fastening screws and remove the lefthand cylinder head cover.

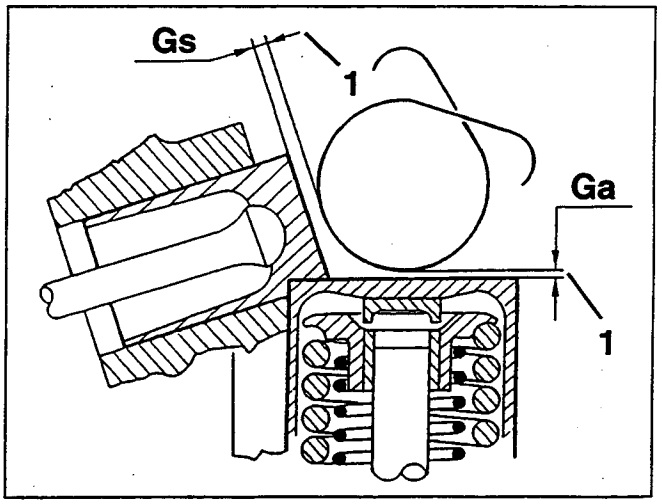


1. Slacken the fastening screws and remove the intake manifolds.
2. Disconnect the high voltage cables from the spark plugs.
3. Slacken the fastening screws and remove timing covers from the cylinder heads.

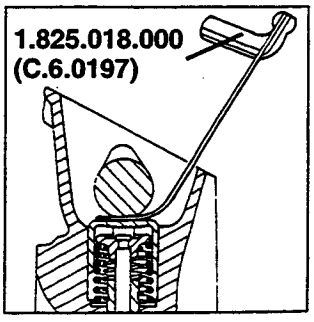


1. With the engine cold, check that the clearance between the lowered cam radius and the crown of the corresponding cups is within the specified limits.

Intake side valve clearance "Ga"	0.475 ÷ 0.500 mm
Exhaust side valve clearance "Gs"	0.275 ÷ 0.300 mm



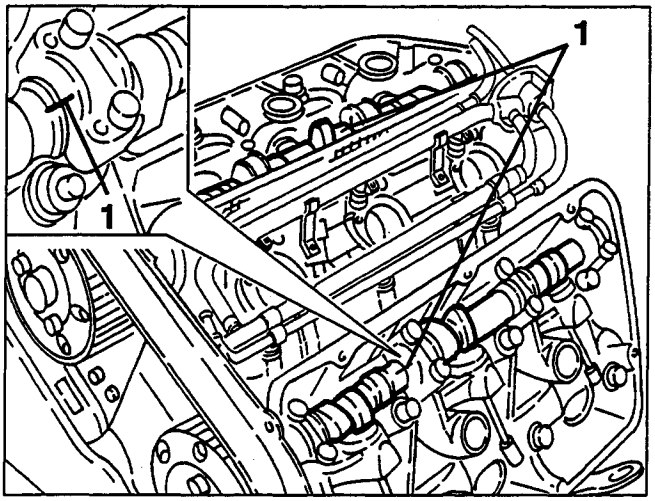
NOTE: To measure the clearance of the intake valves, use thickness gauge no. 1.825.018.000 (C.6.0197).



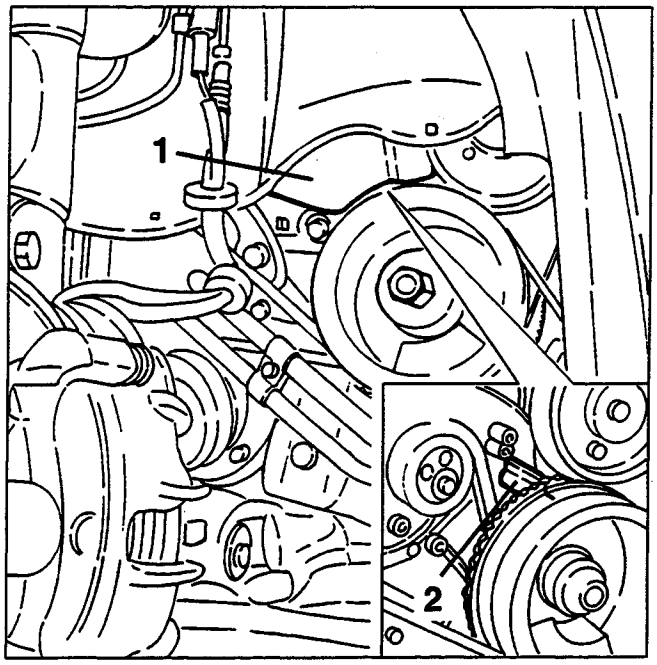
- If the valve clearance is not within the specified limits, adjust as described below.

Adjusting the intake valve clearance

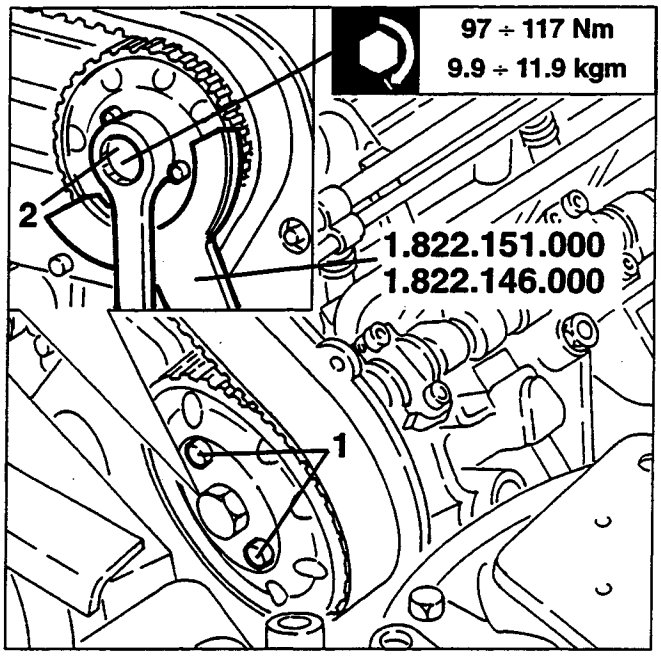
- Remove the complete ignition distributor (see specific paragraph).
1. Turn the crankshaft until the notches on the camshafts are aligned with those on the corresponding caps.



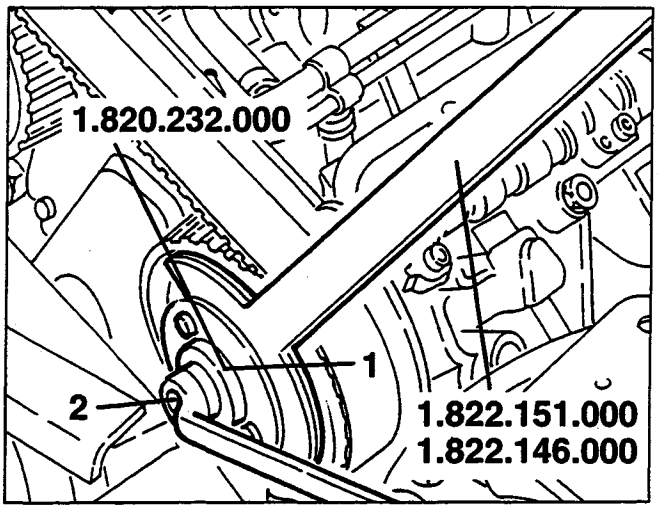
- Remove the right front wheel and mudflap.
1. Slacken the fastening screws and remove timing belt tensioner guard.
2. Check the alignment of the notch on the phonic wheel with the reference pin on the crankcase front cover.



1. Slacken the screws fastening the pulley to the support hub.
2. Levering with tool no. 1.822.151.000 complete with tool no. 1.822.146.000 release and remove the hub fastening nut.

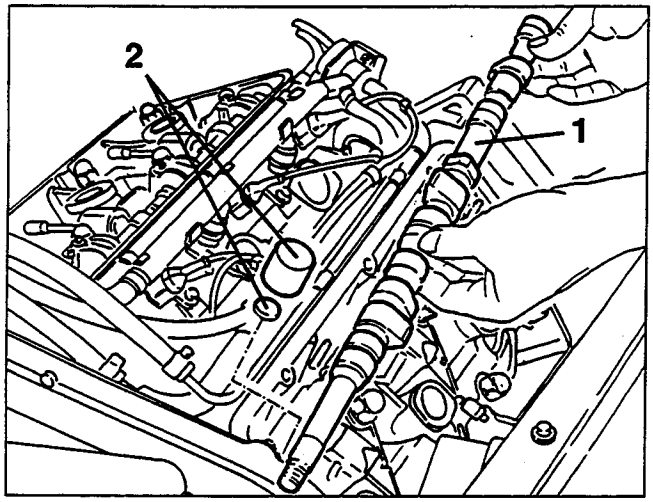


- Slacken and remove the screws fastening the timing gear pulley to the hub slackened previously.
1. Install tool no. 1.820.232.000 on the timing gear pulley tightening the three screws to the support hub.
2. Tighten the nut of tool no. 1.820.232.000 and locking the pulley with tool no. 1.822.151.000 and no. 1.822.146.000, move the pulley and hub forwards to release them from the camshaft.

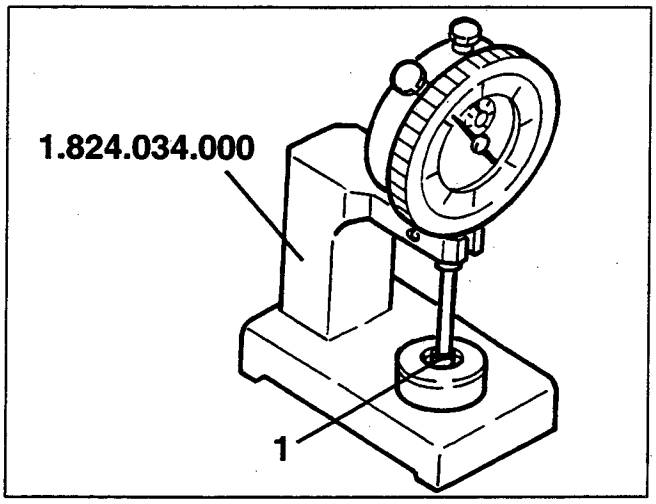


- Slacken the fastening nuts and remove the camshaft caps.

1. Remove the camshaft raising it from the rear.
2. Withdraw a cup and the corresponding valve clearance adjustment cap.

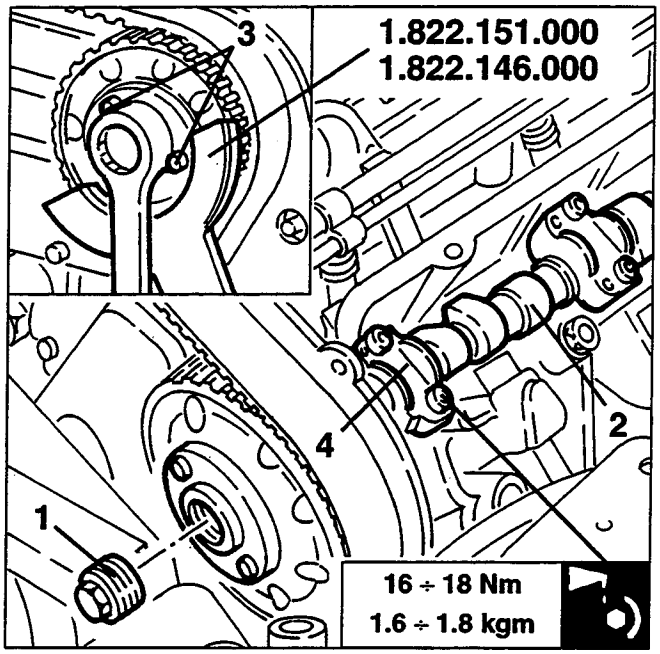


1. Measure the thickness of the caps using tool no. 1.824.034.000 then, calculating the difference against the values measured previously, choose from set no. 1.820.150.000 (R.9.0001) the suitable ones to restore the correct clearance of each valve.



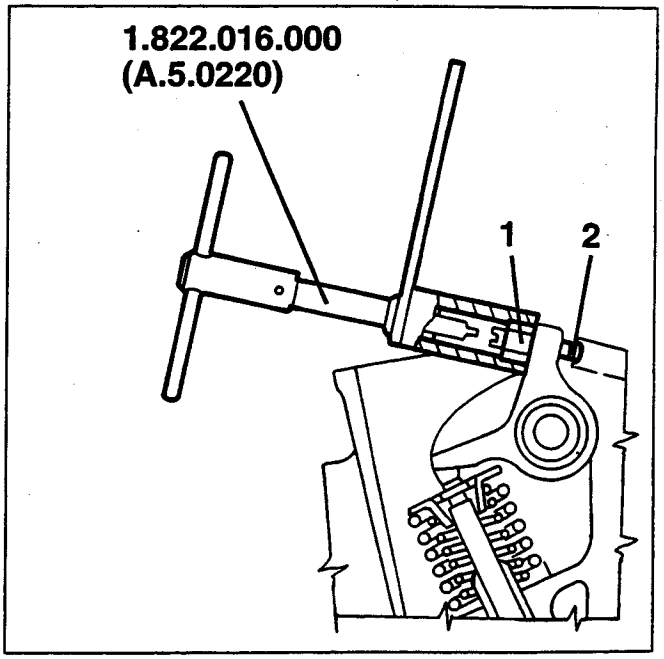
- Install the new cap and the valve cup after lubricating with engine oil.
- Do the same on the remaining pairs of cups - caps.
1. Remove the centre part of tool no. 1.820.232.000.
2. Assemble the camshaft checking from the hole of the tool that the key is positioned correctly.
- Push the camshaft drive pulley to the initial assembly position, then remove tool no. 1.820.232.000.

3. Tighten the three screws fastening the pulley and the hub fastening nut levering with tools no. 1.822.151.000 and no. 1.822.146.000.
4. Assemble the camshaft caps and tighten the fastening nuts to the specified torque.

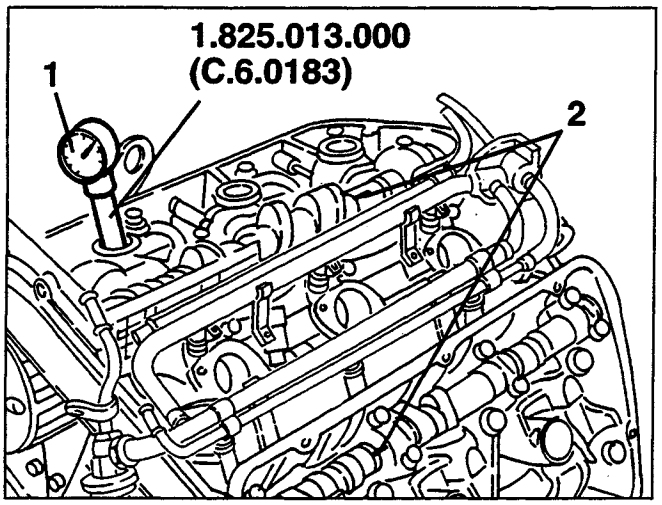


Adjusting the exhaust valve clearance

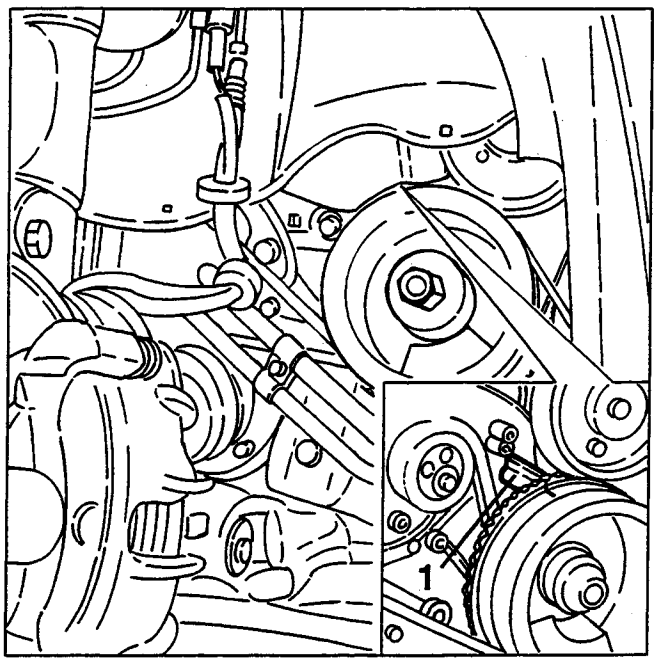
1. Using tool no. 1.822.016.000 (A.5.0220), slacken the locknut of the adjustment screw working on the intermediate lever of the tool.
2. Still using the same tool, work on the adjustment screw until reading the specified valve clearance.
- Lock the locknut and check the valve clearance again.



- Before re-assembly, position the camshafts correctly as follows:
1. Install tool no. 1.825.013.000 (C.6.0183), fitted with a dial gauge, in the seat of the spark plug of the first cylinder.
- Turn the crankshaft to take the piston of the 1st cylinder to the T.D.C. in the bursting stroke.
2. Check the alignment of the notches on the camshafts with those on the corresponding caps.



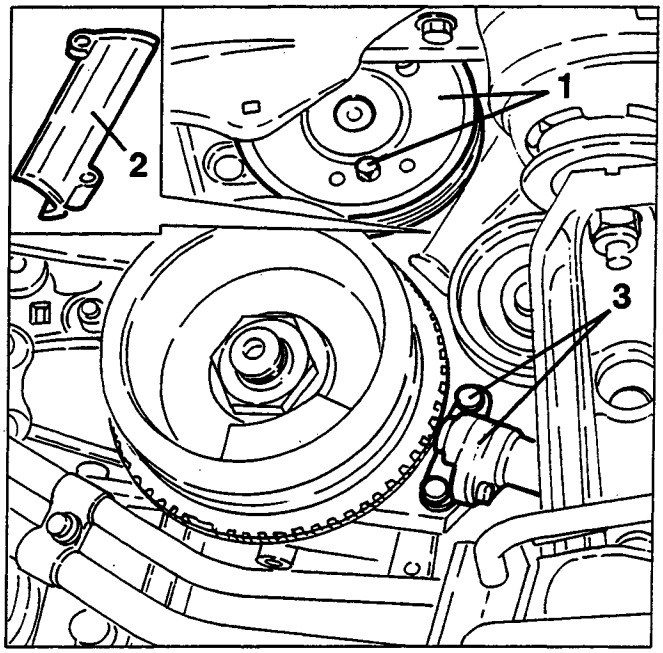
1. Check the alignment of the notch on the phonic wheel with the reference pin on the crankcase front cover.



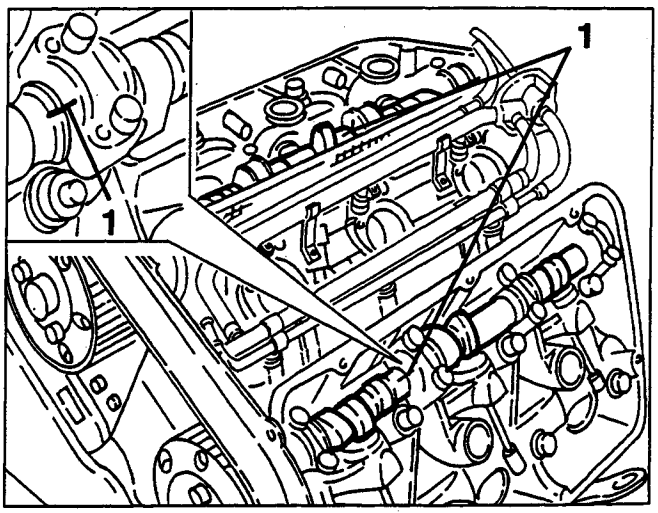
- Complete re-assembly reversing the sequence followed for removal.

CHANGING THE TIMING GEAR BELT

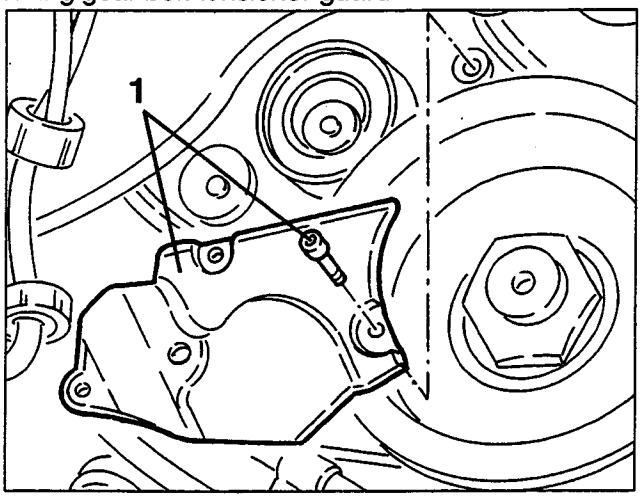
- Proceed as described in "CHECKING AND ADJUSTING THE VALVE CLEARANCE" up to removal of the timing gear covers from the cylinder heads.
- Remove the right front wheel and mudflap.
- Raise the car, slacken the fastening screws and remove the timing gear belt tensioner guard.
- Remove the conditioner compressor drive belt and the alternator-water pump drive belt (see specific paragraphs).
1. Slacken the fastening screws and remove the water pump pulley.
2. Slacken the two screws and remove the timing gear belt lower cover.
3. Slacken the fastening screws, then remove the rpm and timing sensor complete with support.



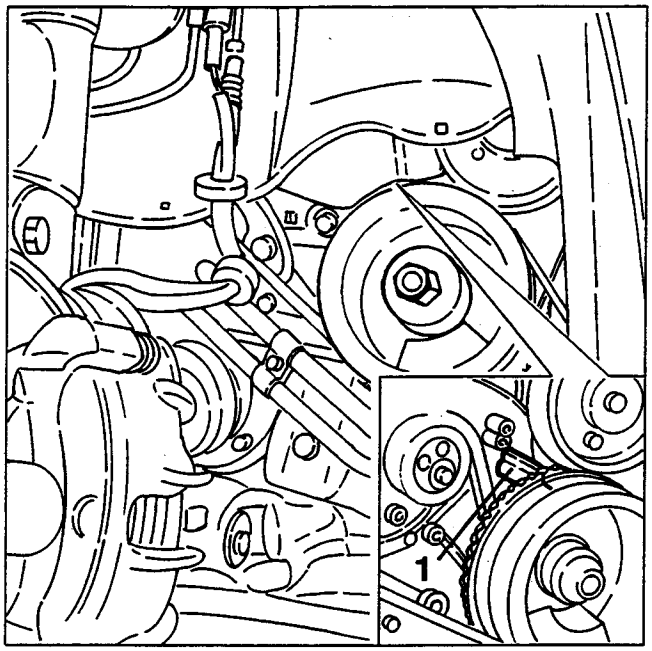
1. Lower the car and turn the crankshaft until the notches on the camshafts coincide with those on the corresponding caps.



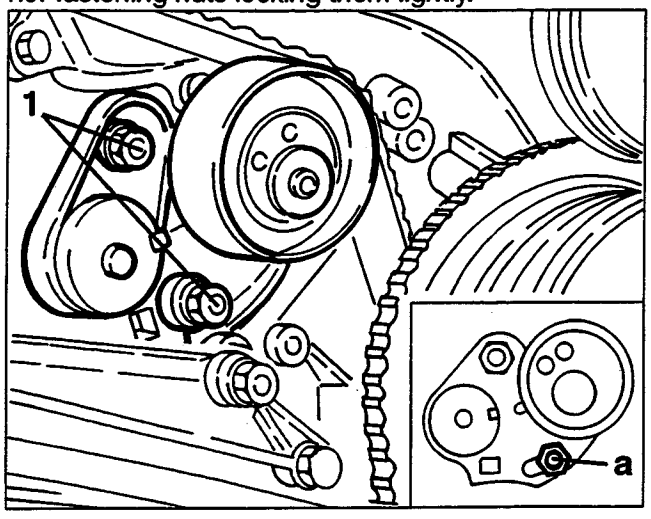
1. Slacken the fastening screws and remove the timing gear belt tensioner guard.



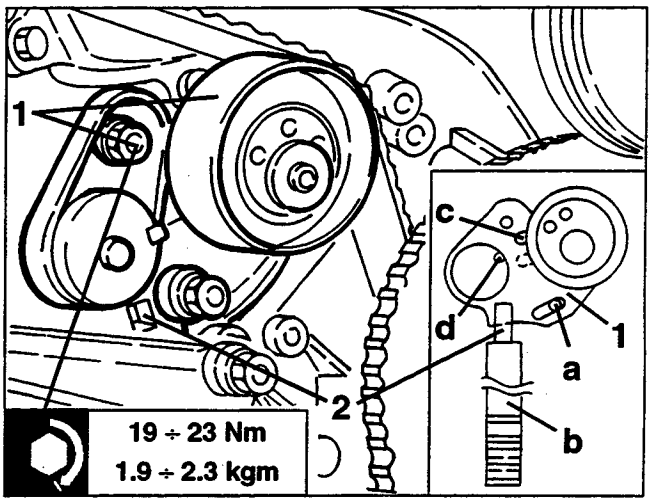
1. Raise the car and check the alignment of the notch on the phonic wheel with the reference pin on the crankcase front cover.



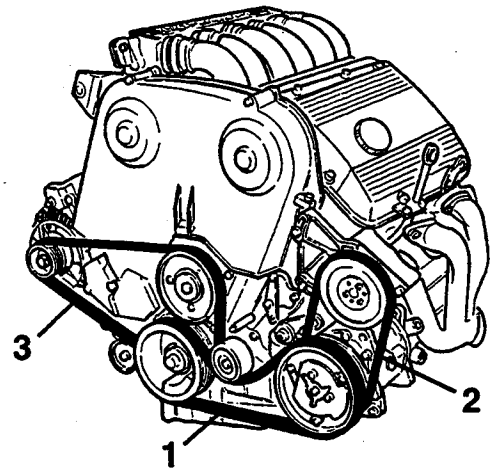
1. Slacken the two nuts fastening the timing gear belt tensioner, then position it in the slack belt position: stud "a" as illustrated, then tighten the two belt tensioner fastening nuts locking them lightly.



- Lower the car, then prise the timing gear belt from the pulleys.
- Raise the car and remove the timing gear belt.
- Fit a new timing gear belt on the pulleys starting from the drive pulley and continuing counter-clockwise.
1. Slacken the two belt tensioner fastening nuts.
2. Insert the 10mm square of the tensioning lever "**b**" (3/8" ratchet) in the hole of the belt tensioner, then turn it clockwise to move the pointer "**c**" by 2 ÷ 3 mm in relation to notch "**d**", then turn clockwise until they coincide, without locking the two belt tensioner fastening nuts.
- Turn the crankshaft twice in its normal direction of rotation to take the piston of cylinder 1 to the T.D.C. in the bursting stroke checking that the timing references coincide.
- Check that pointer "**c**" coincides with notch "**d**" and tighten the two belt tensioner fastening nuts to the specified torque.
- Remove the tensioning lever "**b**" from the belt tensioner.



AUXILIARY COMPONENTS BELT



1. Conditioner compressor drive belt
2. Power steering pump drive belt
3. Alternator - water pump drive belt

When checking the tension of the belt, visually check that the belt is intact and in particular that there are no:
- cuts and cracks
- surface wear of the material (smooth and shiny)
- Dry or stiff parts (loss of grip)

If the above defects are found, change the belt.

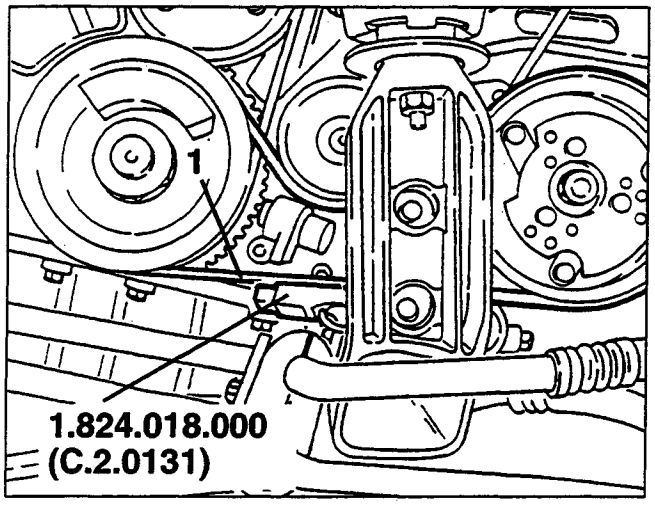
WARNING:
The contact of the belts with oil or solvents can reduce the flexibility of the rubber thereby their grip.

Conditioner compressor drive belt

Checking and tensioning

- Set the car on a lift and raise it.

1. Working as illustrated, measure the belt tension using tool no. 1.824.018.000 (C.2.0131).



- Check that the tension values measured, with the special tool, are within the specified limits.

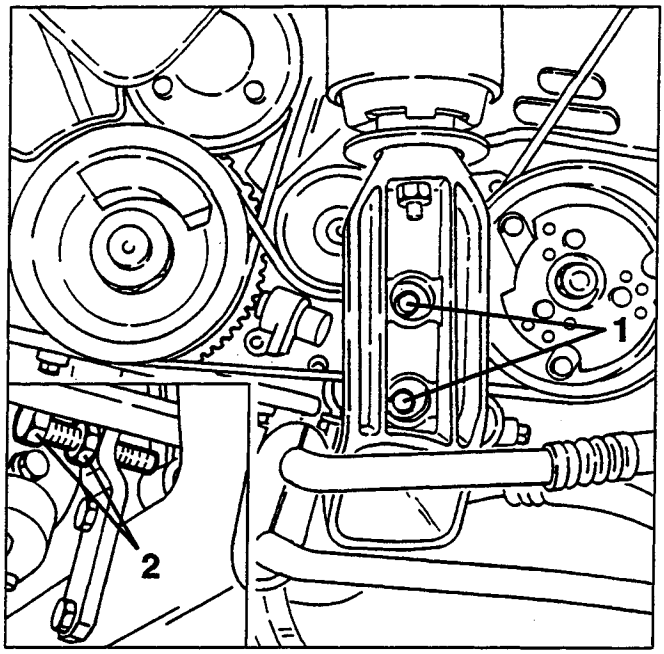
Tensionig the "Poly V" conditioner compressor drive belt	
At assembly	630 ÷ 800 N
Retensioning	360 ÷ 520 N

NOTE: The belt can be re-tensioned after a brief running-in period, proceeding as follows:
- take the engine to normal operating temperature;
- turn off the engine and wait for it to cool down;
- re-tension the belt to the specified value.

- If the belt tensioning is not correct proceed as follows:

1. Slacken the two screws fastening the belt tensioner guide.
2. Slacken the locknut, then work on the screw of the micrometric tensioner until obtaining the specified belt tension.

- Tighten the locknut of the micrometric tensioner and the two belt tensioner fastening screws.



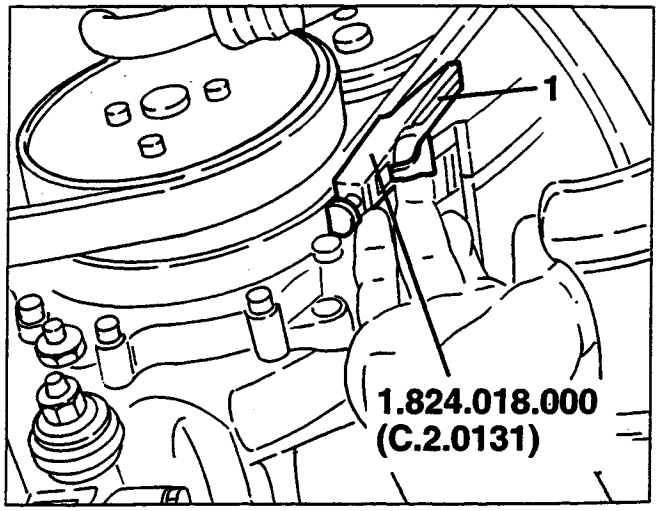
- To replace the conditioner compressor drive belt, suitably adapt the above procedure.

Power steering pump drive belt

Checking and tensioning

- Set the car on a lift and raise it.

1. Working as illustrated, measure the belt tension using tool no. 1.824.018.000 (C.2.0131).

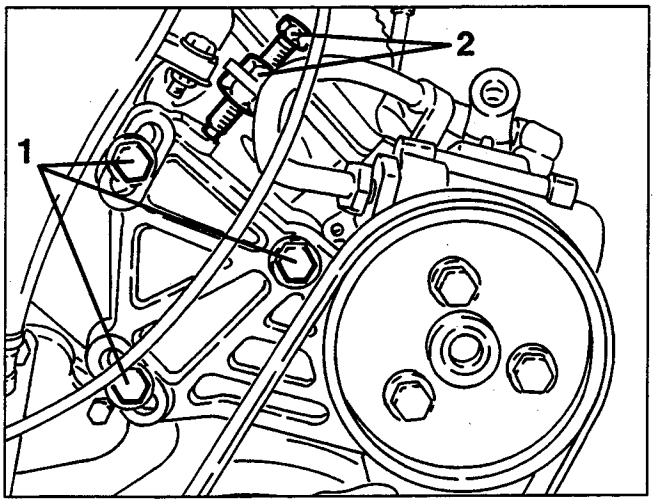


- Check that the tension values measured, with the special tool, are within the specified limits.

Tensioning the "Poly V" power steering pump drive belt	
At assembly	420 ÷ 550 N
Retensioning	240 ÷ 360 N

NOTE: The belt can be re-tensioned after a brief running-in period, proceeding as follows:
- take the engine to normal operating temperature;
- turn off the engine and wait for it to cool down;
- re-tension the belt to the specified value.

- If the belt tensioning is not correct proceed as follows:
1. Working from the engine compartment, slacken the three screws fastening the power steering pump support bracket.
2. Slacken the locknut, then work on the screw of the micrometric tensioner until obtaining the specified belt tension.
- Tighten the locknut of the micrometric tensioner and the three screws fastening the power steering pump support bracket.

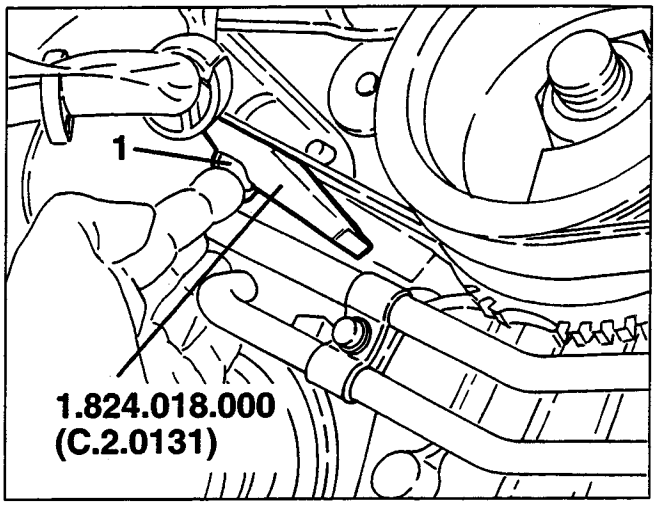


- To replace the power steering pump drive belt, suitably adapt the above procedure.

Alternator - water pump drive belt

Checking and tensioning

- Set the car on a lift and raise it.
1. Working as illustrated, measure the belt tension using tool no. 1.824.018.000 (C.2.0131).

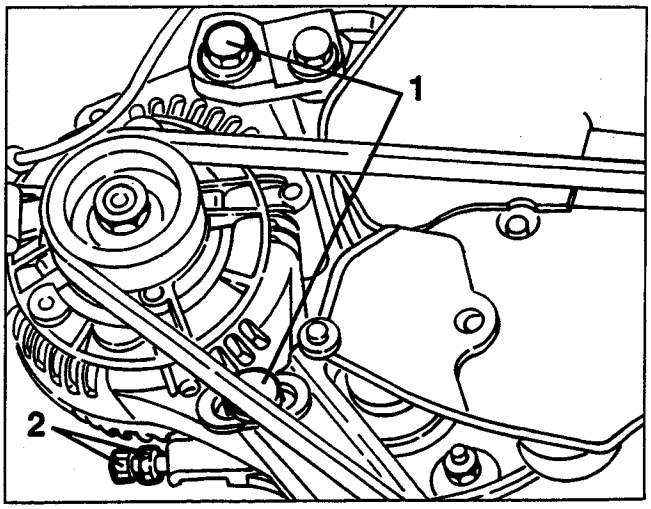


- Check that the tension values measured, with the special tool, are within the specified limits.

Tensioning the "Poly V" alternator - water pump drive belt	
At assembly	520 ÷ 670 N
Retensioning	300 ÷ 450 N

NOTE: The belt can be re-tensioned after a brief running-in period, proceeding as follows:
- take the engine to normal operating temperature;
- turn off the engine and wait for it to cool down;
- re-tension the belt to the specified value.

- If the belt tensioning is not correct proceed as follows:
1. Slacken the two bolts fastening the alternator to the support brackets.
2. Slacken the locknut, then work on the screw of the micrometric tensioner until obtaining the specified belt tension.
- Tighten the locknut of the micrometric tensioner and the two bolts fastening the alternator.

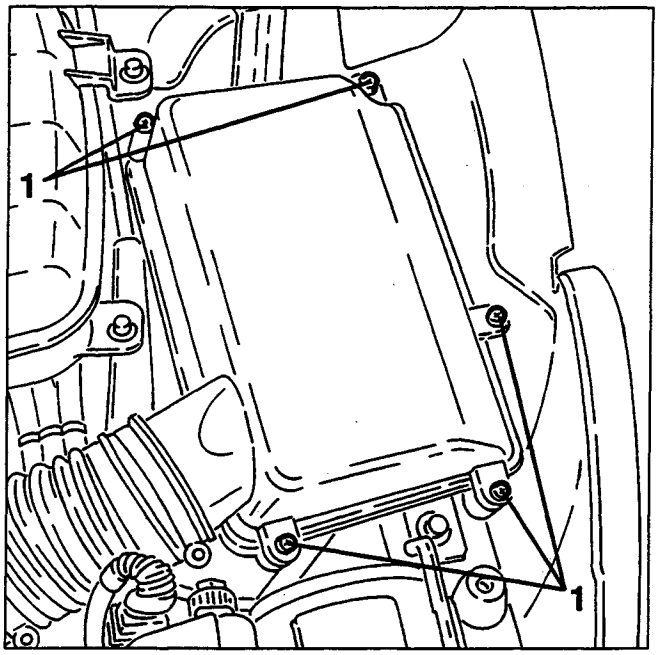


- To replace the alternator - water pump drive belt, suitably adapt the above procedure.

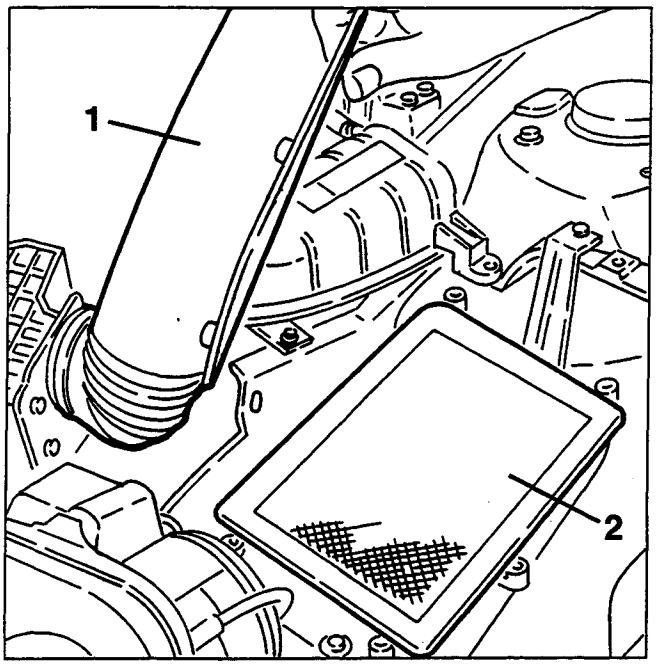
CHANGING THE AIR CLEANER CARTRIDGE

WARNING:
Any filter cleaning operation might damage it, thereby adversely affecting the correct operation of the engine.

1. Slacken the five screws fastening the air cleaner cover.

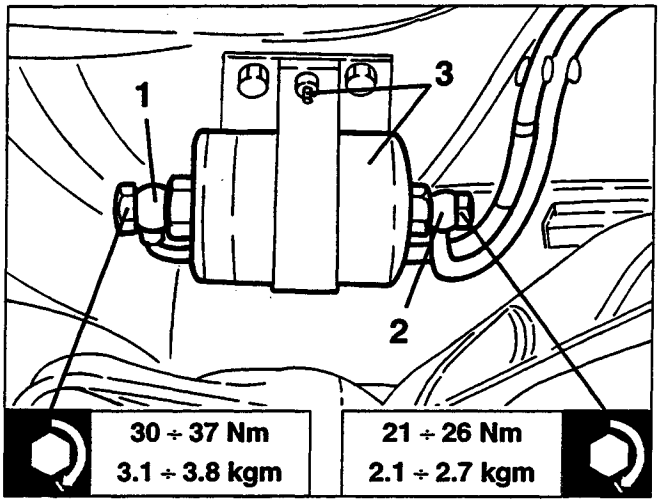


1. Raise the air cleaner cover without disconnecting the corrugated sleeve.
2. Remove the filtering element.



CHANGING THE FUEL FILTER

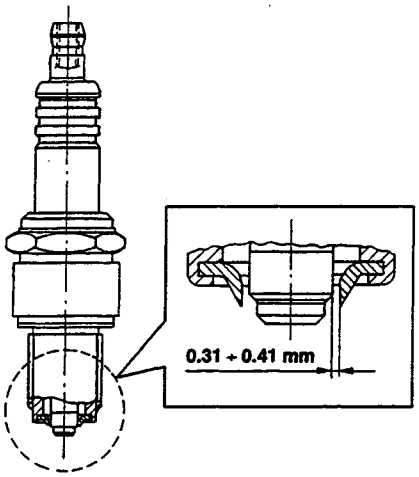
- Set the car on a lift and raise it.
1. Disconnect the fuel inlet hose connection from the filter.
2. Disconnect the fuel outlet hose connection from the filter.
3. Slacken the fastening clamp and remove the fuel filter.



- Install the new filter reversing the sequence followed for removal and taking care to:
• change the copper gaskets of the connections;
• assemble the filter with the arrow stamped on it pointing in the direction of the flow of fuel.

CHECKING AND CHANGING SPARK PLUGS

The standard spark plugs are of the surface discharge type with four peripheral points and a centre electrode.



Spark plugs	Golden Lodge 25HL

- With the engine cold, remove the spark plugs, firstly blowing inside the spark plug openings to remove any impurities and traces of dirt.
- Check the spark plugs for dirt and the ceramic insulation for breaks. In this case replace the spark plugs.

WARNING: The use of spark plugs with different characteristics or sizes than those specified can cause serious damage to the engine and change the level of harmful emission at the exhaust.

WARNING: A dirty or worn out spark plug is often the sign of a failure in the engine supply system. For example:
- **Traces of carbon dust: incorrect mixture, air cleaner very dirty.**
- **Spots of oil: oil leaking from the piston rings.**
- **Formation of ash: presence of aluminium materials, contained in the oil.**
- **Burnt electrodes: overheating due to unsuitable fuel, defects in the valves.**
- **High electrode wear: harmful additives in the fuel or in the oil, pinging in the cylinder head, overheating;**
- **Etc.**

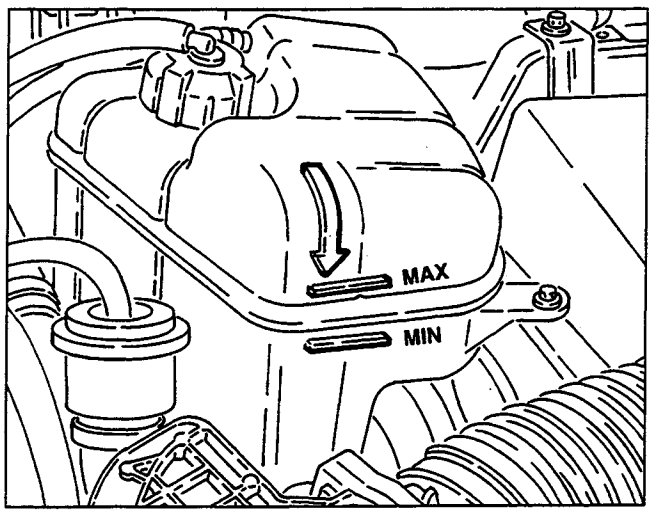
- When installing tighten the spark plugs to a torque of:

25 ÷ 34 Nm 2.5 ÷ 3.5 kgm

CHECKING THE LEVEL AND CHANGING THE ENGINE COOLANT FLUID

Checking

- With the engine cold, check that the level in the coolant in the header tank is between the MIN and MAX marks.



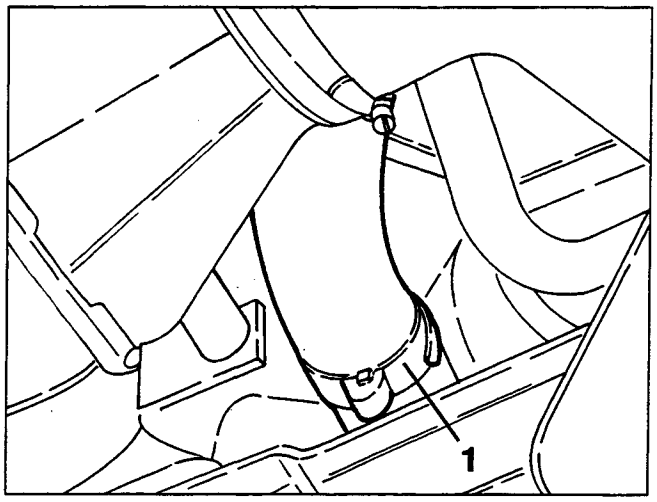
Replacement

- Set the car on a lift.
- Slacken and remove the header tank plug.

WARNING:
Absolutely never remove the header tank plug when the engine is hot!

1. Raise the car, disconnect the radiator outlet sleeve and drain the coolant into a suitable recipient.

WARNING:
The anti-freeze mixture used as coolant can harm the paintwork: therefore avoid any contact with painted components.



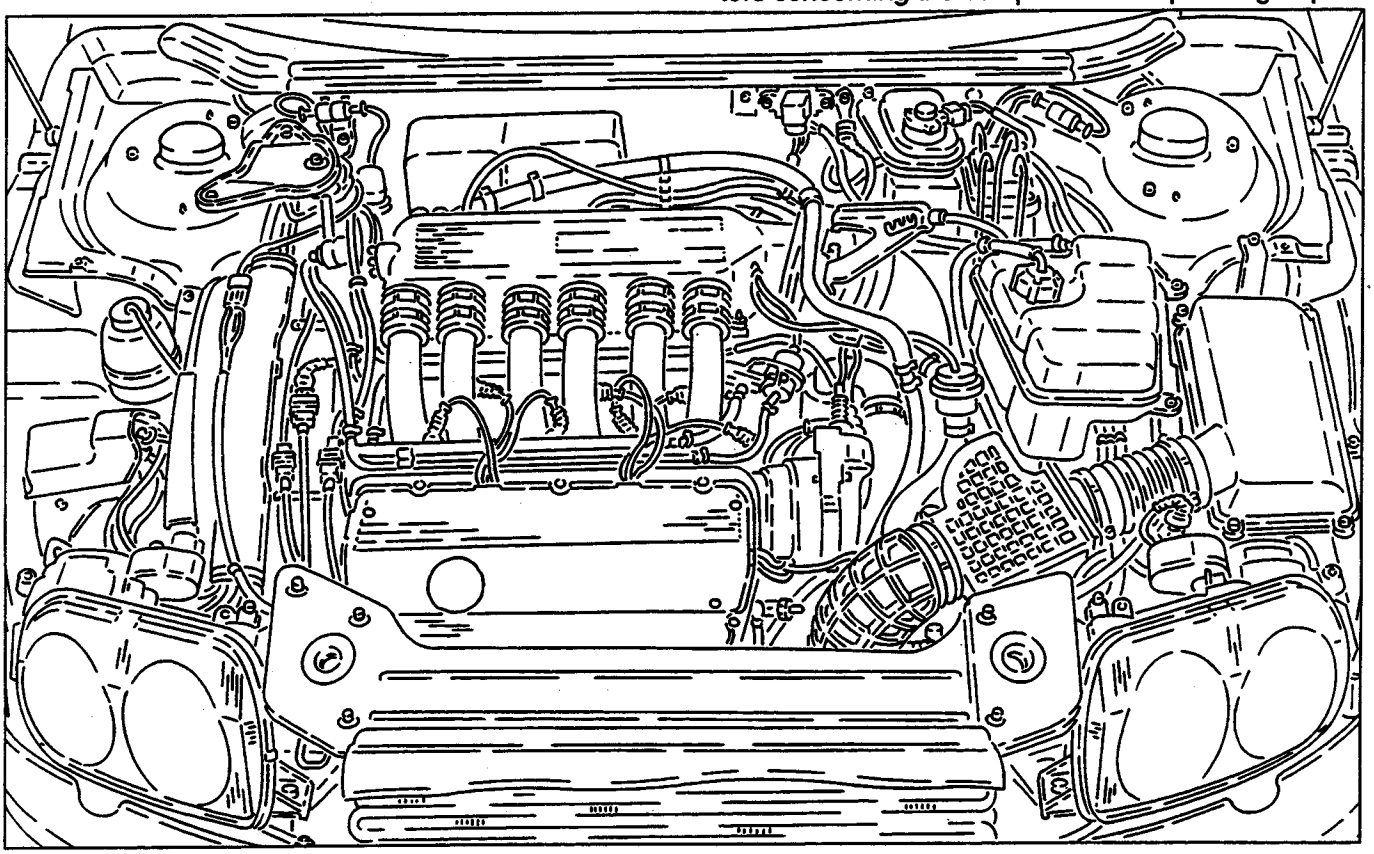
- Reconnect the sleeve to the radiator and any disconnected pipes, checking that all the clamps are firmly tightened.
- Fill the header tank to the MAX mark with fluid of the specified type and quantity.
- Start the engine and bring it to normal operating temperature so that the thermostat opens to release the amount of residual air in the circuit.
- With the engine cold, top up to the MAX mark on the header tank.
- Retighten the pressurised cap on the header tank.

WARNING:
It is unwise to mix anti-freeze fluids of different types or brands!
Never use antirust additives: they might not be compatible with the anti-freeze in use.

DESCRIPTION

The information and illustrations given below enable the rapid removal of the power unit from its housing and its subsequent refitting.

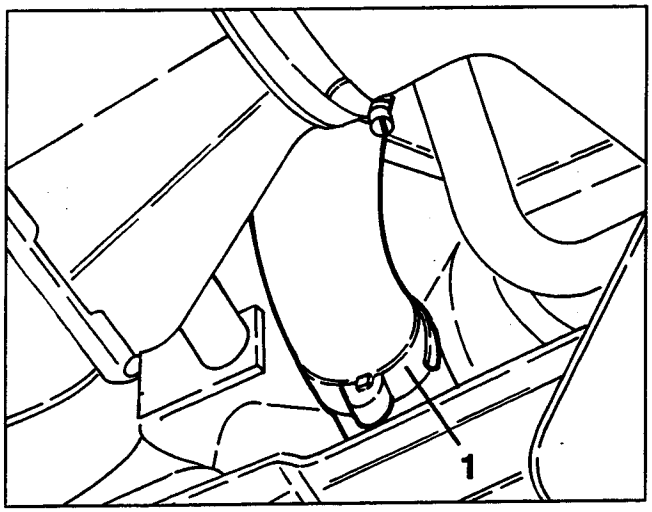
Dis-assembly of the single components on the bench is described in the volume "ENGINE OVERHAULING".
The following procedure may be used only in part according to requirements.
For further information and details, refer to the chapters concerning the components or specific groups.



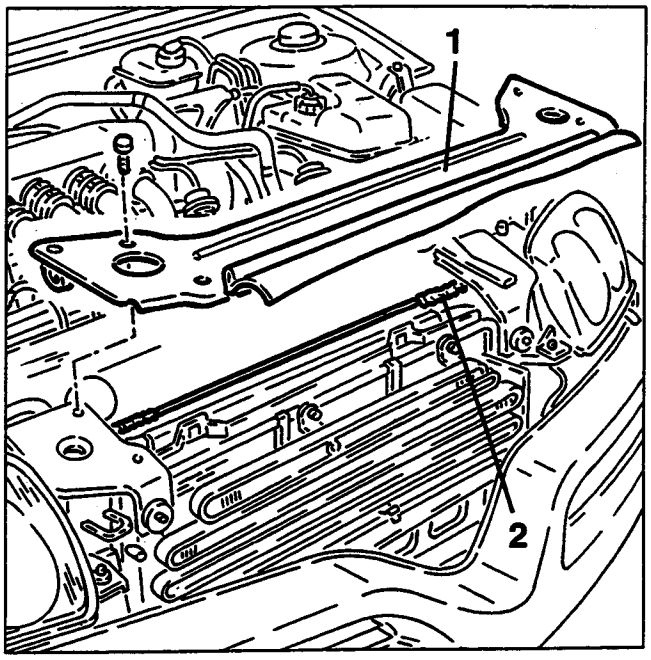
REMOVAL

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Remove the front wheels and mud flaps.
- Drain the coolant fluid (R13a) from the air conditioning system (see specific paragraph).

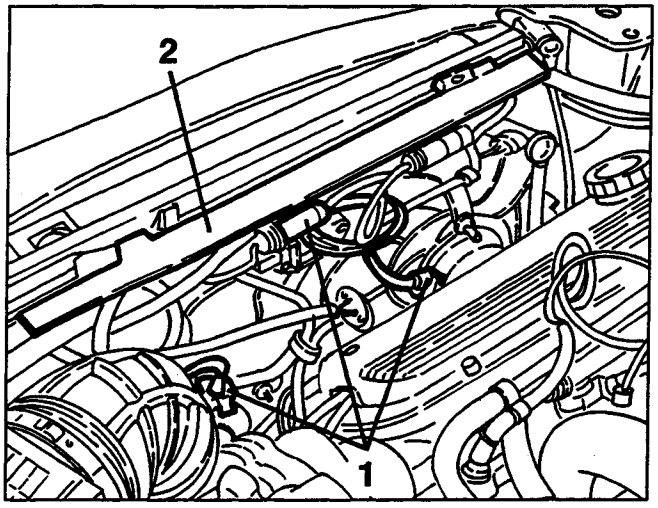
1. Raise the car and drain the coolant fluid into a suitable recipient disconnecting the radiator outlet sleeve.



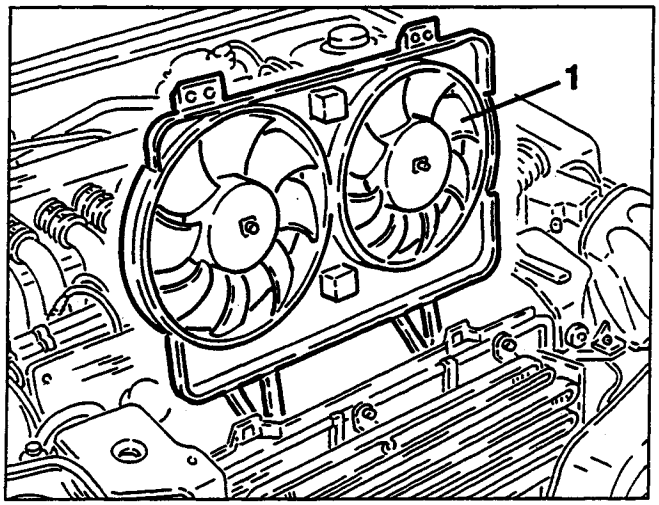
1. Lower the car, slacken the fastening screws and remove the upper radiator crossmember.
2. Disconnect and move to one side the bonnet lock opening cable.



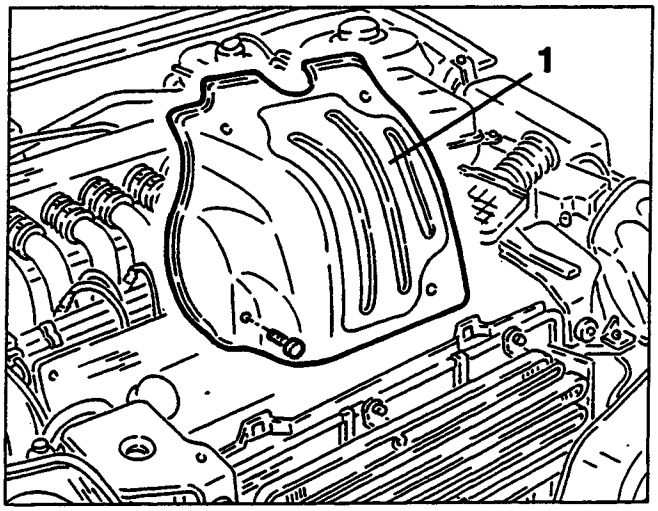
1. Disconnect the electrical connections from the cooling fans.
2. Slacken the fastening screws, then move aside the cable fairing complete with electric cables.



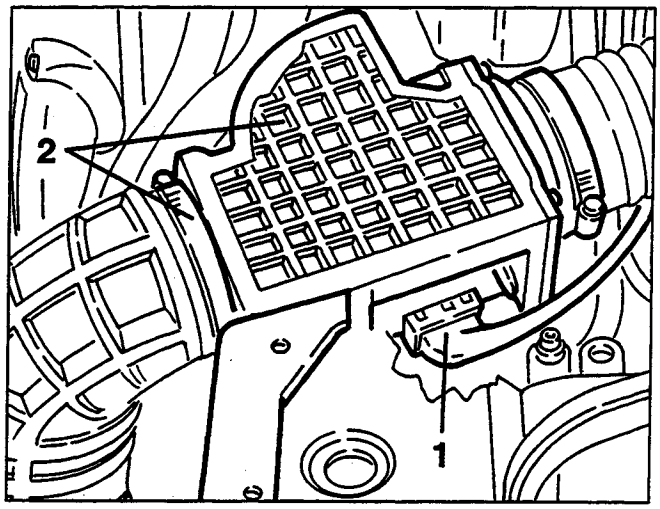
1. Withdraw and remove the cooling fans.



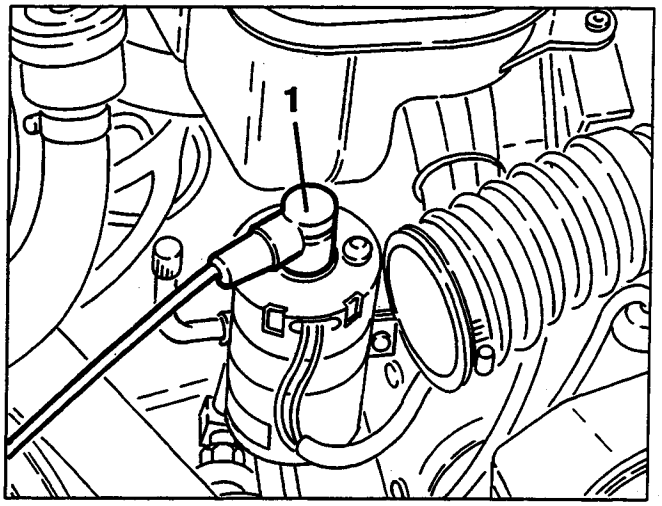
1. Slacken the fastening screws and remove the heat shield from the exhaust manifolds.



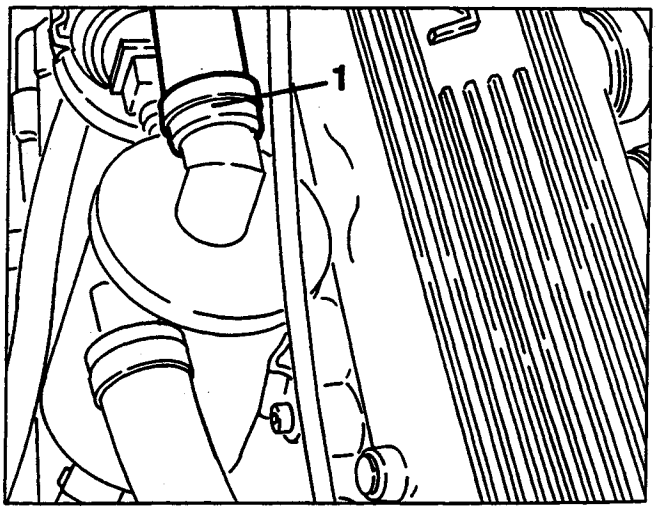
1. Disconnect the electrical connection from the air flow meter .
2. Slacken the two clamps fastening to the corrugated sleeve, then remove the air-flow meter complete with support bracket.



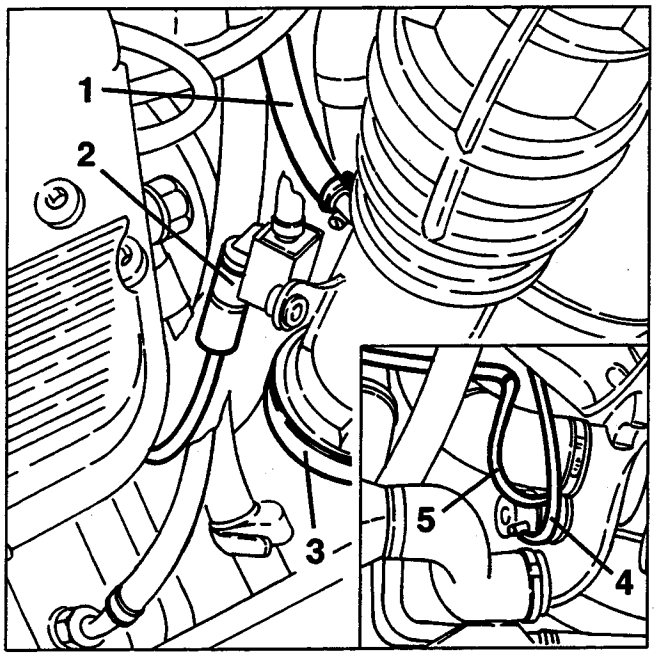
1. Disconnect the high voltage cable from the ignition coil.



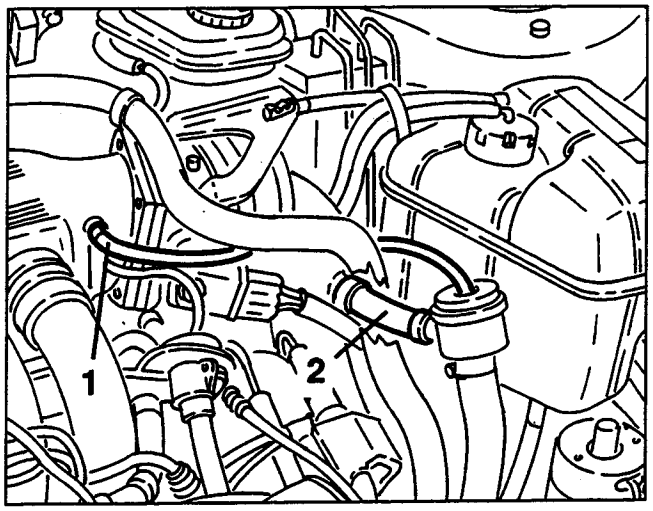
1. Disconnect the oil vapour recirculation pipe from the oil vapour separator.



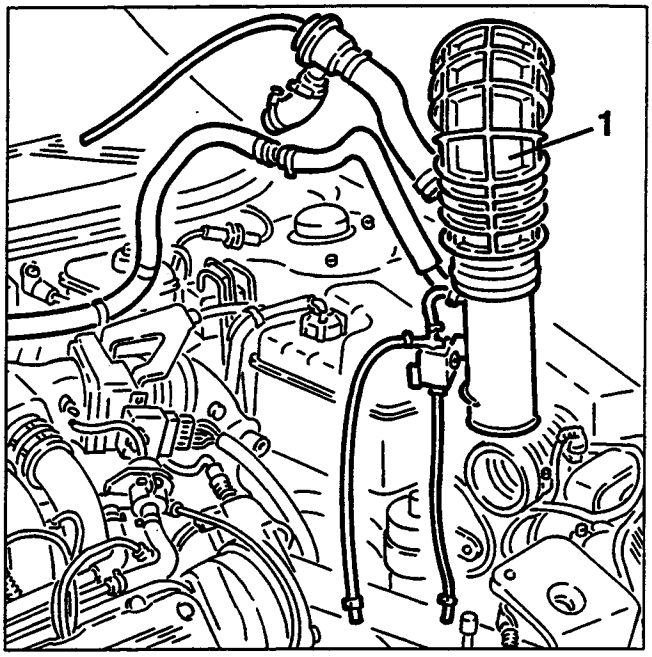
1. Disconnect the fuel vapour recirculation pipe from the corrugated sleeve.
2. Disconnect the electrical connection from the "Pierburg" solenoid valve of the supercharging control system.
3. Slacken the clamp fastening the corrugated sleeve to the turbocharger air intake elbow.
4. Disconnect the connection pipe to the "Pierburg" solenoid valve from the Waste-Gate valve control actuator.
5. Disconnect the "Pierburg" solenoid valve connection pipe from the turbocharger.



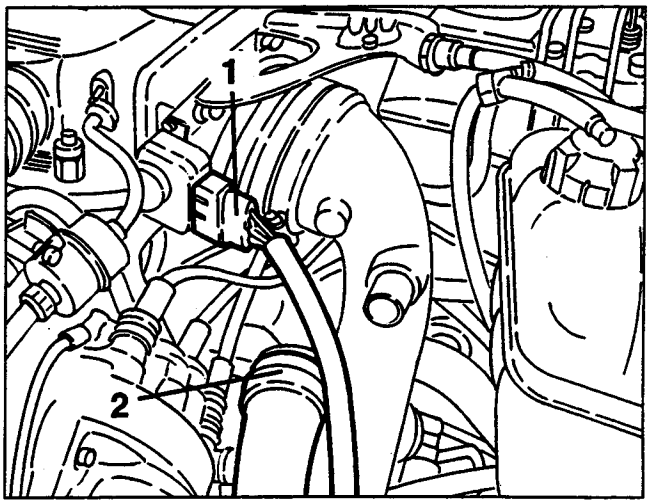
1. Disconnect the vacuum takeoff pipe for the antistalling valve from the intake box.
2. Disconnect the antistalling valve by-pass pipe from the throttle exhaust manifold.



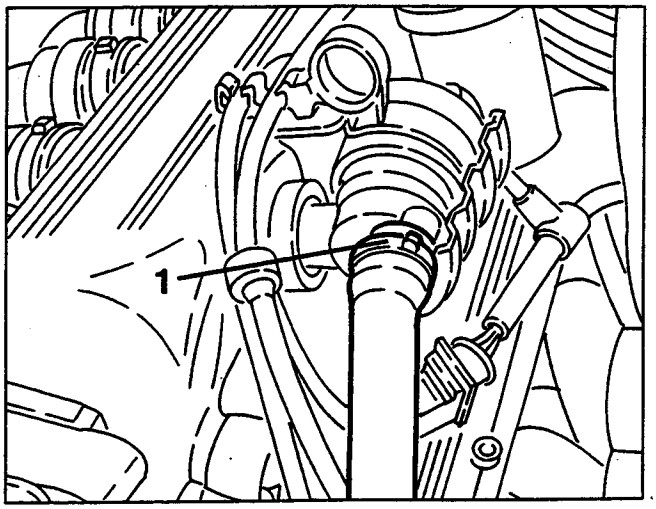
1. Remove the air intake corrugated sleeve, complete with antistalling valve, "Pierburg" solenoid valve and their connection pipes.



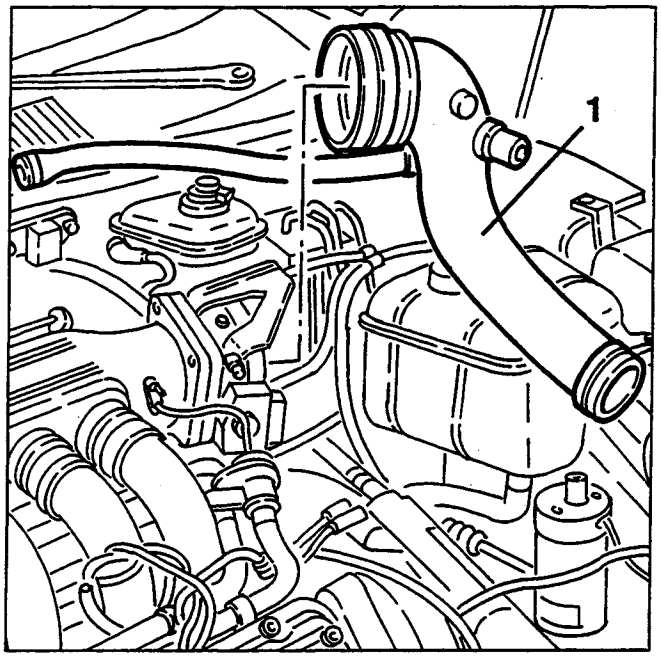
1. Disconnect the electrical connection from the throttle potentiometer.
2. Disconnect the coolant fluid delivery pipe to the radiator from the thermostatic cup.



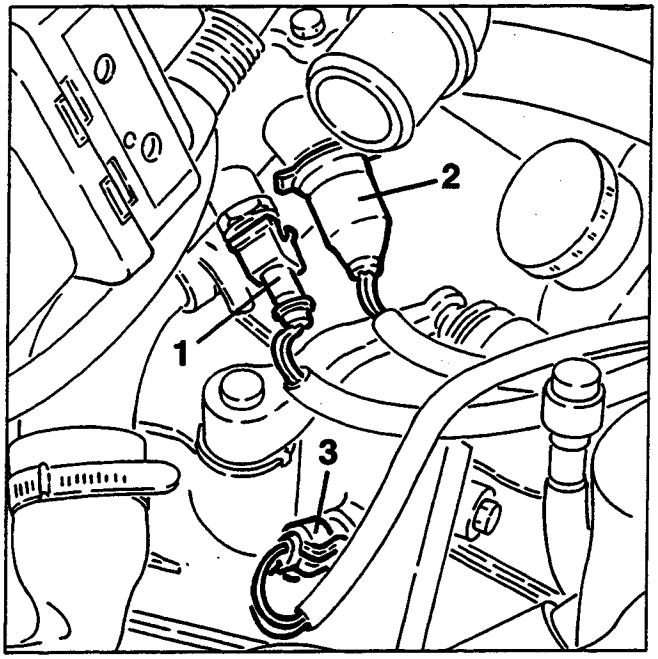
1. Disconnect the air takeoff pipe from the constant idle speed actuator.



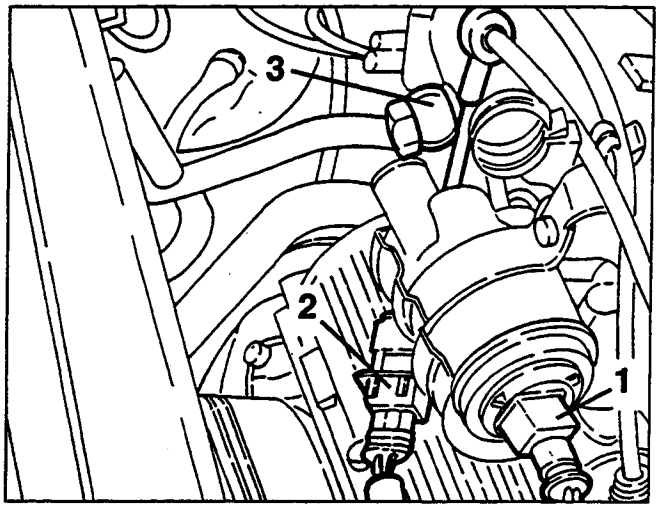
1. Slacken the two fastening clamps and remove the throttle intake manifold.



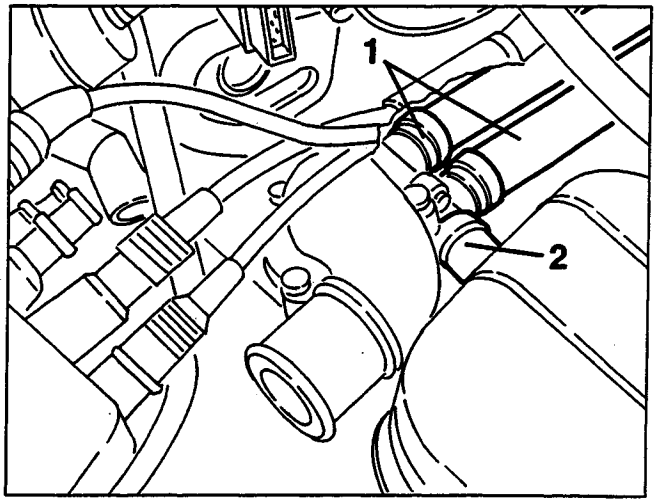
1. Disconnect the electrical connection from the engine coolant temperature sensor (NTC).
2. Disconnect the electrical connection from the engine coolant temperature gauge sender and maximum temperature warning light contact.
3. Disconnect the electrical connection from the reversing switch.



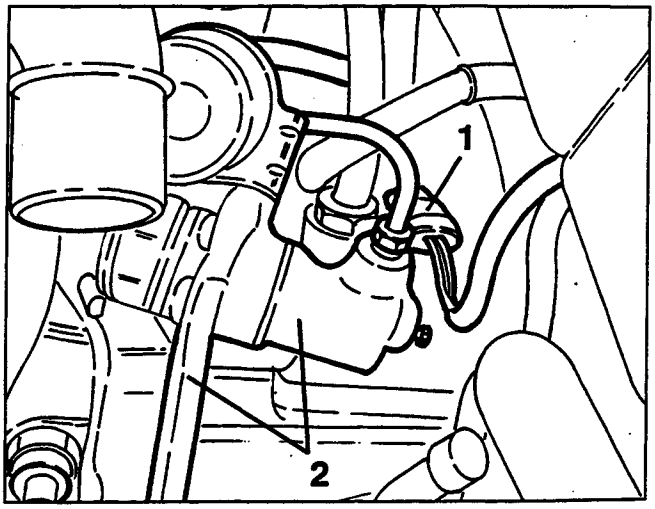
1. Disconnect the electrical connection from the constant idle speed actuator.
2. Disconnect the electrical connection of the 1st cylinder detection sensor.
3. Disconnect the servobrake vacuum takeoff pipe from the intake box.



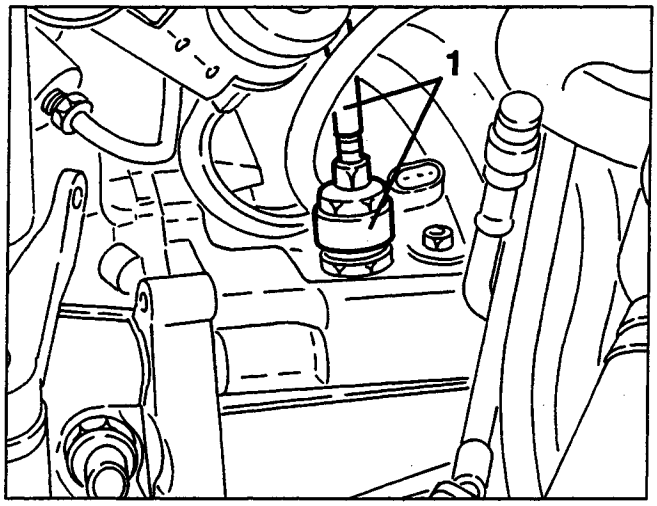
1. Disconnect the coolant delivery and return pipes to the climate control system heater from the thermostatic cup.
2. Disconnect the delivery sleeve leading from the header tank from the thermostatic cup.



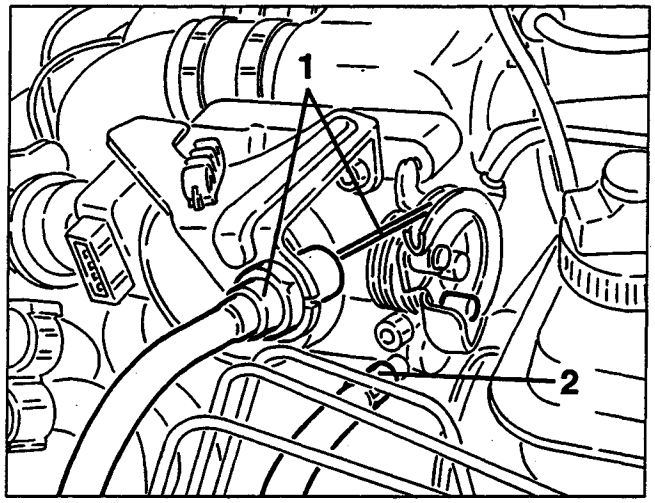
1. Disconnect the electrical connection of the tachometric sensor.
2. Slacken the three screws fastening the clutch control cylinder support bracket, then move all aside without disconnecting the pipes.



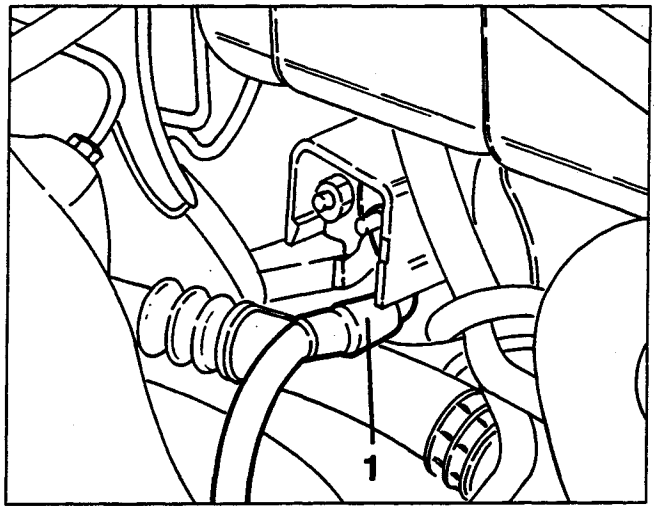
1. Disconnect the cable for synchronized reverse gear engagement.



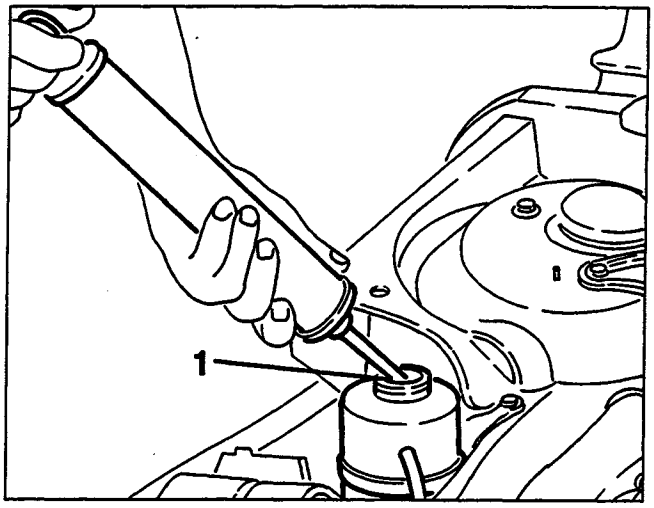
1. Disconnect the accelerator cable from the throttle.
2. Disconnect the header tank coolant delivery and system air relief pipe from the throttle body.



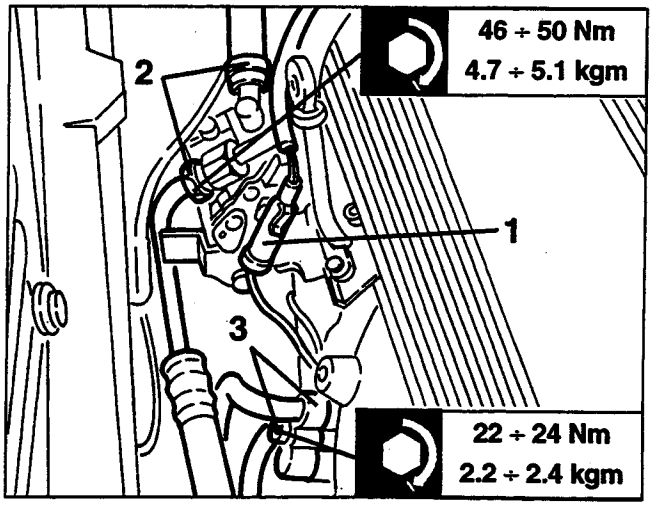
1. Disconnect the starter motor supply cable from the branch terminal box located under the header tank.



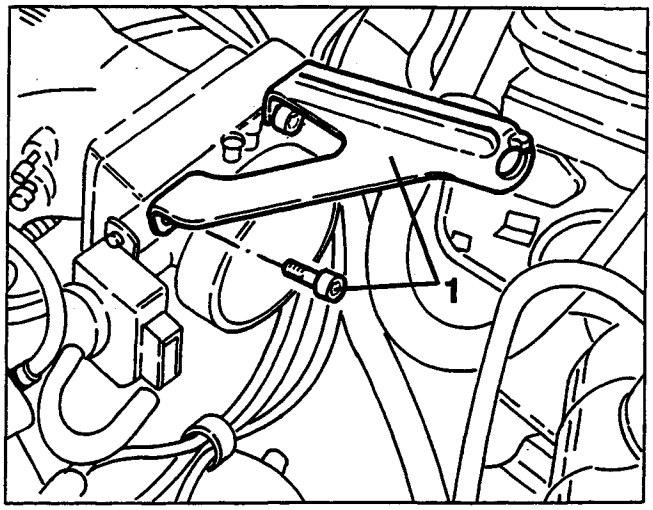
1. Using a suitable syringe empty the power steering tank.



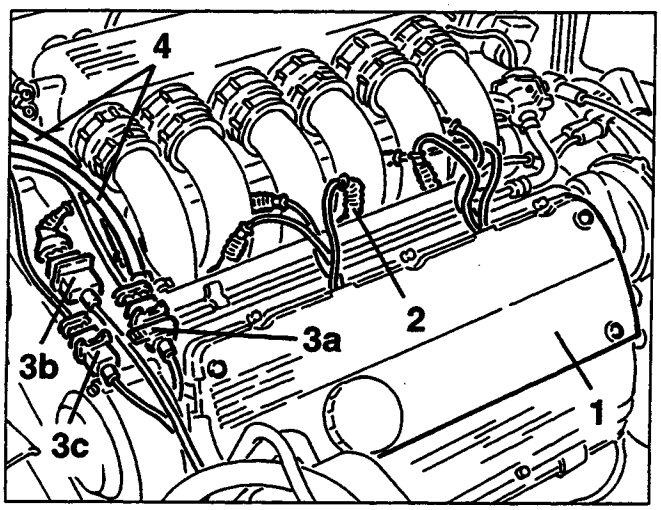
1. Disconnect the conditioner compressor electro-magnnetic joint supply connection.
2. Disconnect the two oil inlet and delivery pipes from the power steering pump.
3. Slacken the fastening screw and disconnect the coolant inlet and delivery pipes from the conditioner compressor.



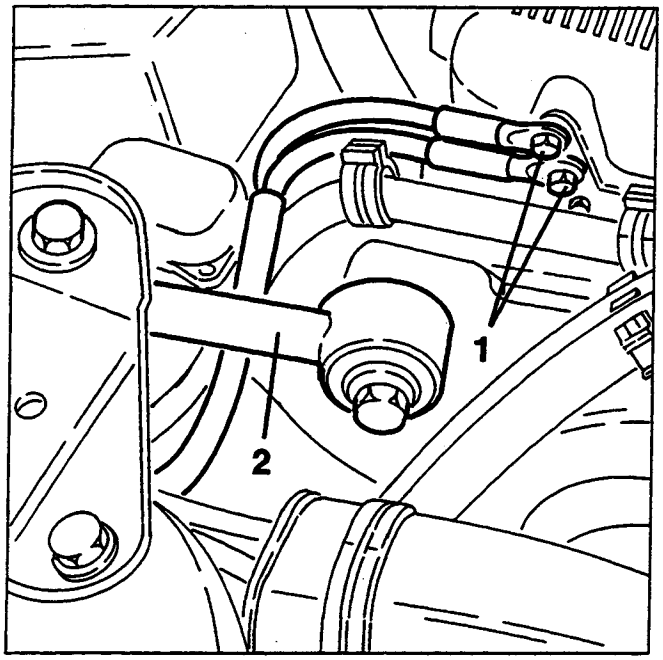
1. Slacken the fastening screws and remove the accelerator cable support bracket from the throttle body.



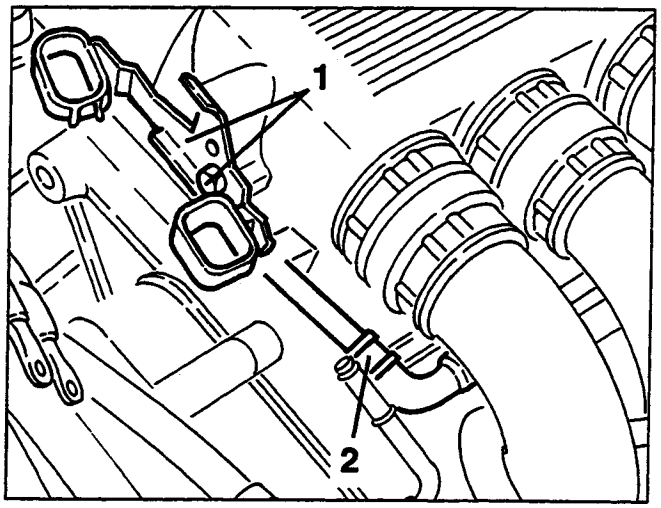
1. Slacken the four fastening screws and remove the lefthand cylinder head cover.
2. Disconnect the electrical connections from the injectors.
3. Disconnect the electrical connections (3a) of the rpm and timing sensor, (3b) pinging sensors and (3c) lambda sensor, then move the wiring to one side.
4. Disconnect the two fuel inlet and outlet pipes from the distributor manifold.



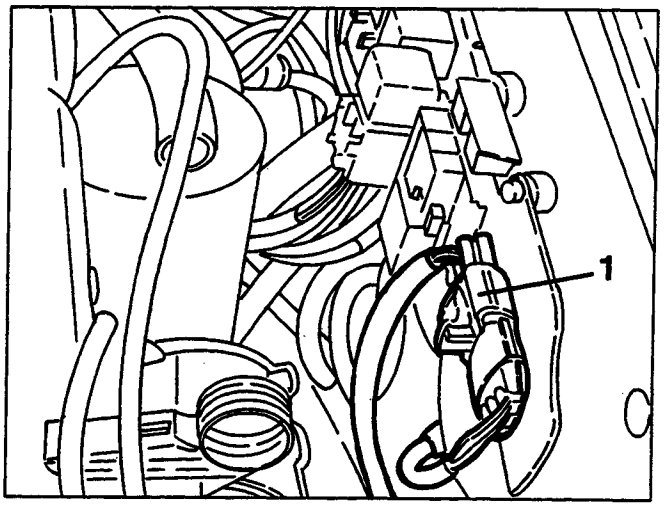
1. Disconnect the earth cables from the intake box.
2. Slacken the fastening screws and remove the engine stay connecting rod.



1. Slacken the fastening screw and remove the earth cables support bracket from the intake box.
2. Disconnect the fuel vapour recirculation pipe from the fuel distributor manifold.

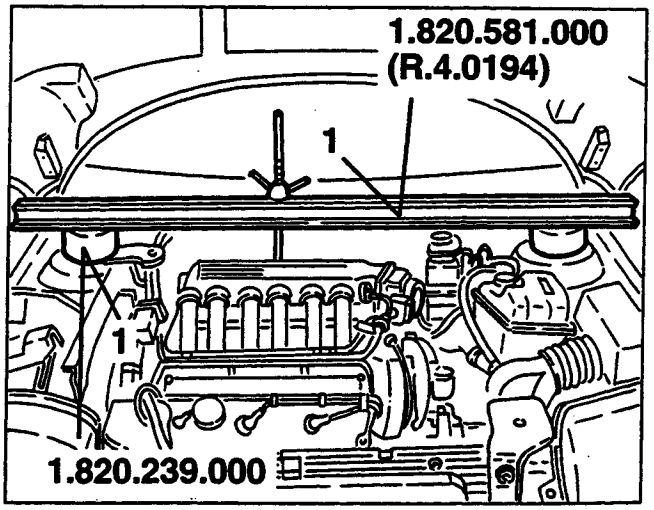


1. Remove the protective cover, then disconnect the electrical connection for energizing the starter motor, of the low battery charge warning light and of the minimum engine pressure warning light.

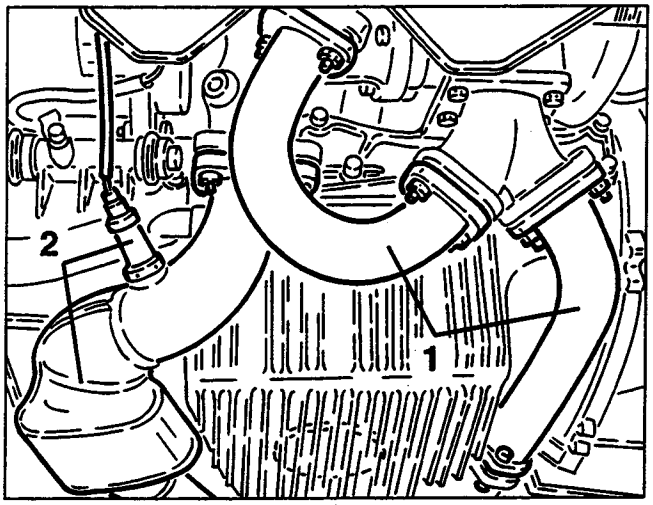


1. Install crossrail no.1.820.581.000 (R.4.0194) complete with supports no. 1.820.239.000 to support the power unit.

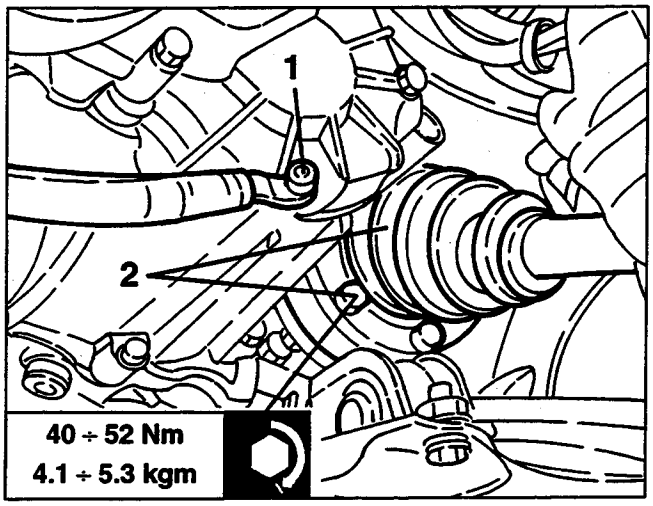
WARNING: Interpose suitable thicknesses between the crossrail and the side panel.



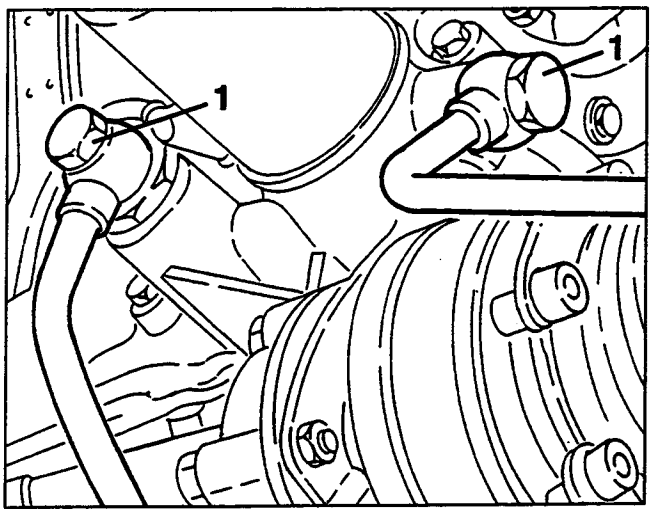
1. Raise the car, slacken the fastenings and remove the exhaust gas delivery pipes from the cylinder heads to the turbocharger.
2. Slacken the fastenings and remove the front section of the exhaust pipe complete with lambda sennsor.



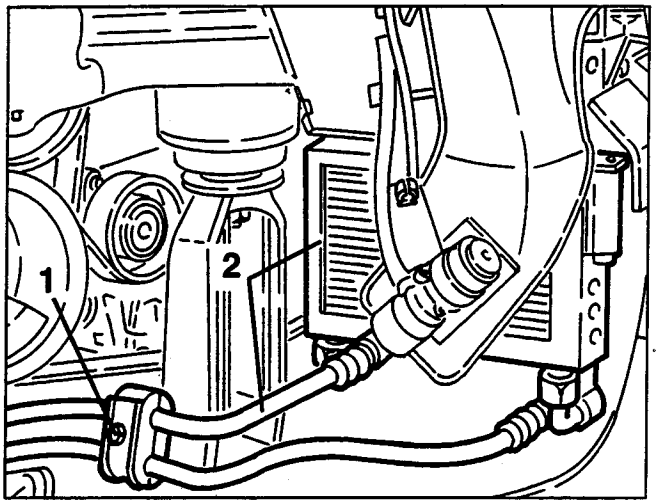
1. Disconnect the earth braid from the rear gearbox cover.
2. Slacken the fastening bolts and disconnect the axle shafts.



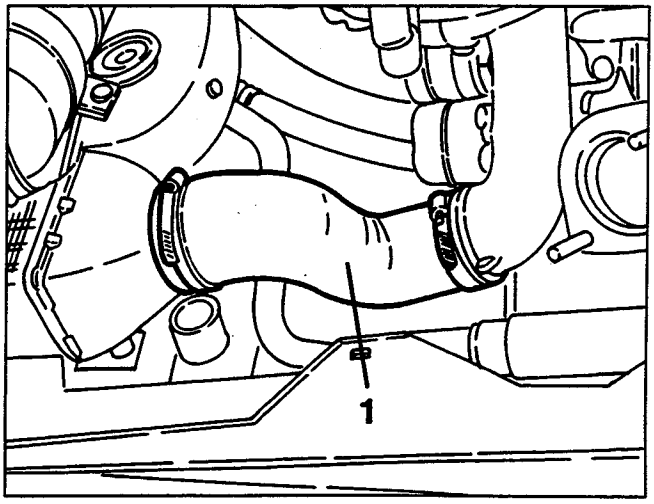
1. Disconnect the two oil delivery and return pipes to the cooling radiator from the oil filter support.



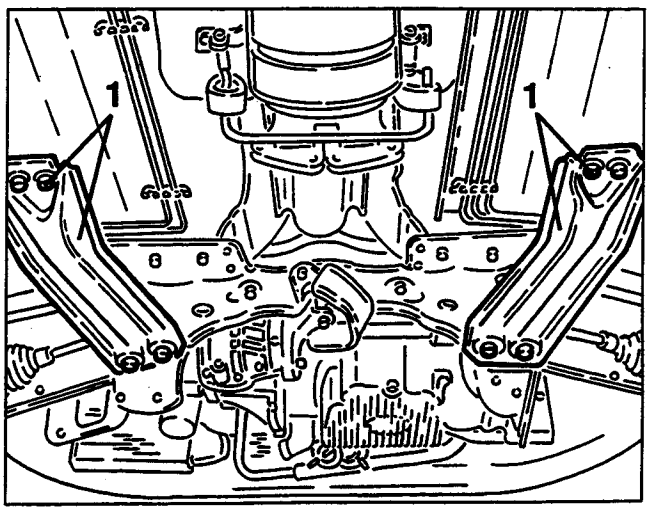
1. Slacken the intermediate clamps supporting the oil delivery and return pipes to the cooling radiator.
2. Slacken the fastening screws and remove the engine oil cooling radiator complete with the pipes.



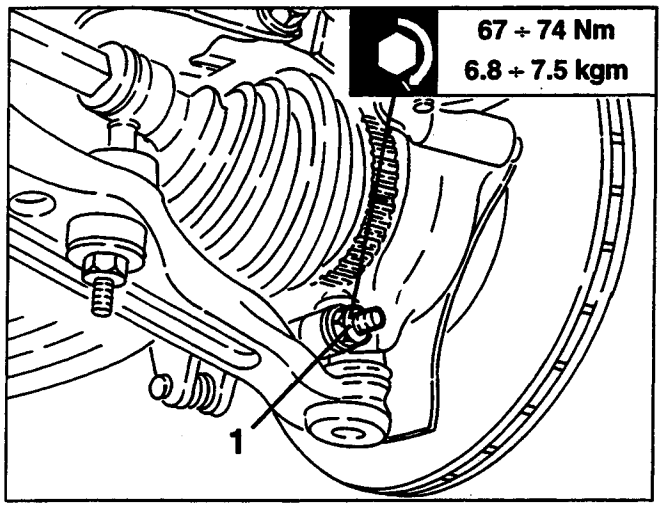
1. Slacken the fastening clamps and remove the air delivery pipe from the turbocharger to the intercooler.



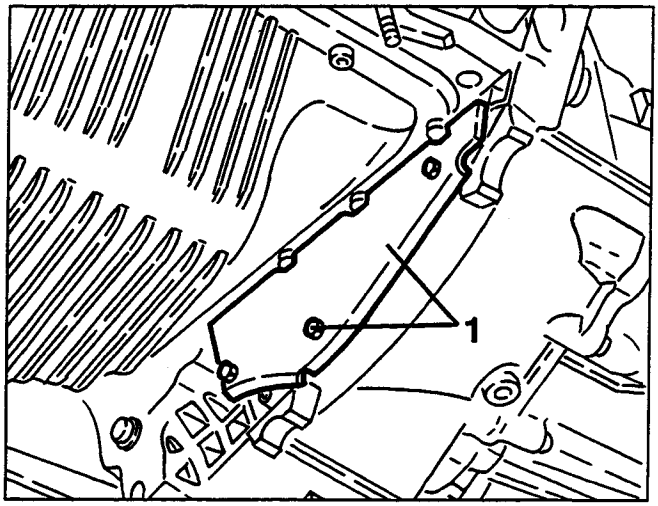
1. Slacken the fastening screws and remove the two reinforcements from the suspension crossmember.



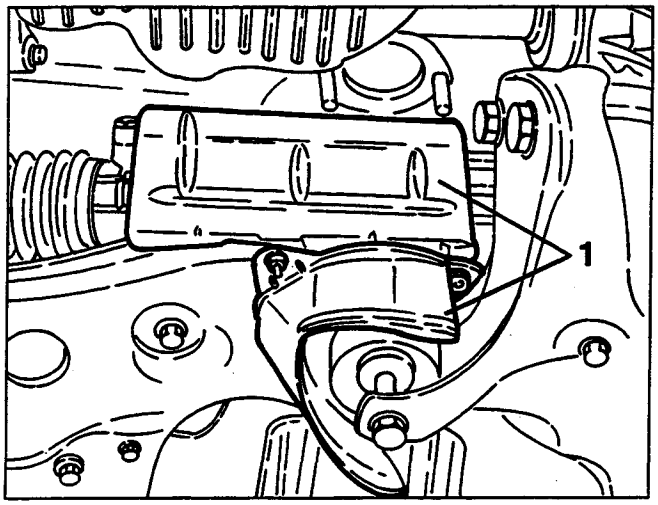
1. Slacken the bolts fastening the wishbones to the wheel uprights.



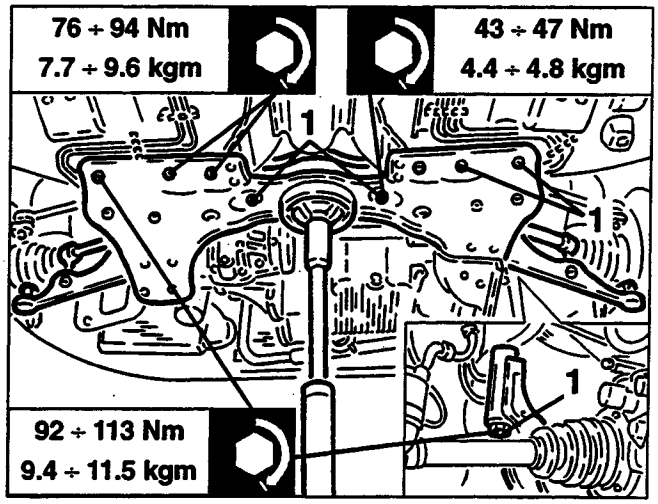
1. Slacken the fastening screws and remove the lower flywheel cover.



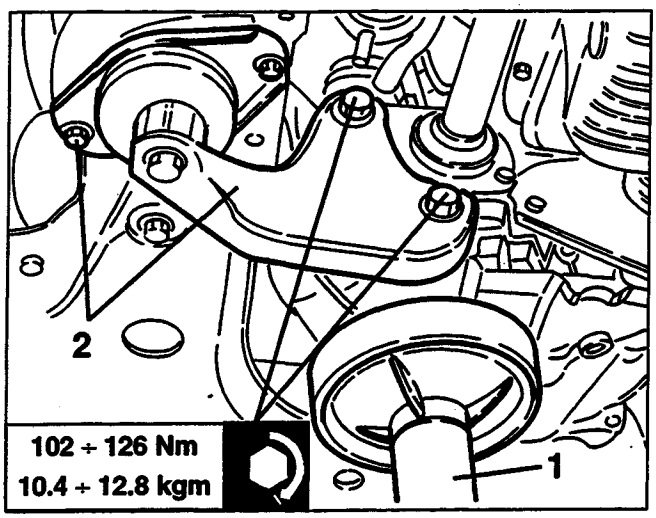
1. Slacken the fastenings and remove the two heat shields of the power steering box.



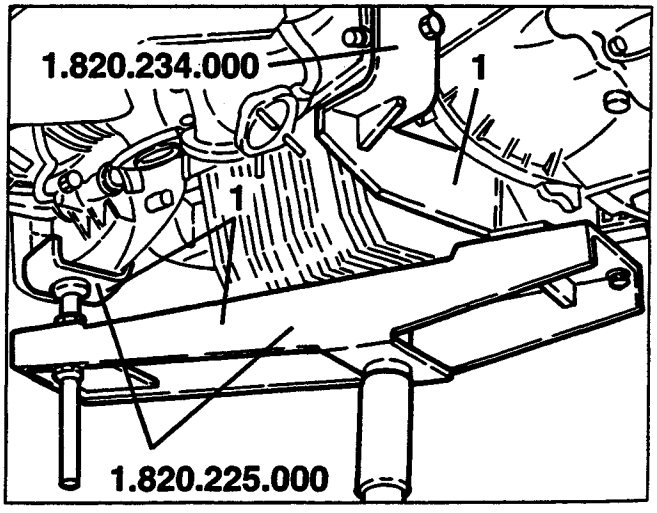
1. Slacken the fastening screws and nuts, then, using a hydraulic jack, remove it complete with wishbones and stabilizer bar.



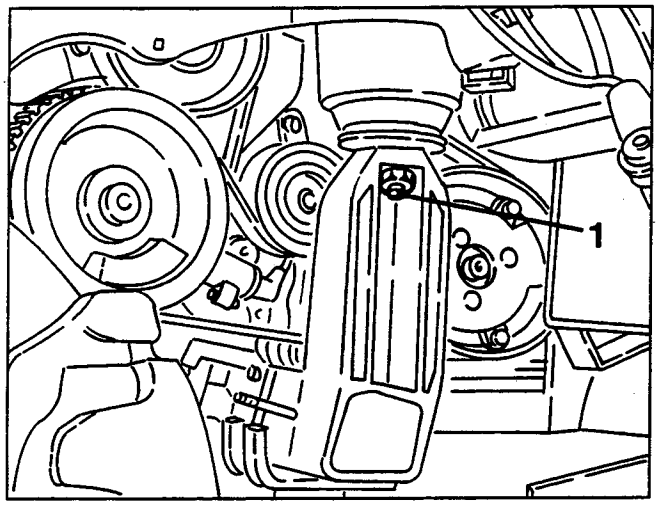
1. Position a hydraulic jack under the gearbox as illustrated.
2. Slacken the fastening screws and remove the power unit rear support.



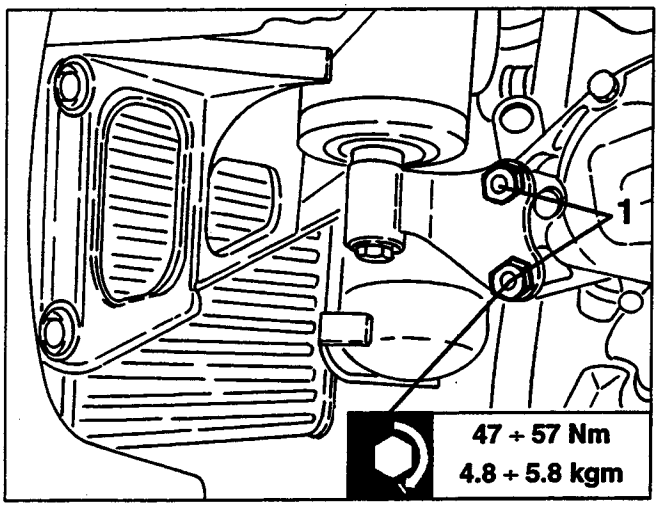
1. Position a hydraulic jack complete with tools No. 1.820.225.000 and No. 1.820.234.000 to support the power unit.



1. Slacken the bolt fastening the power unit support on the camshaft side.

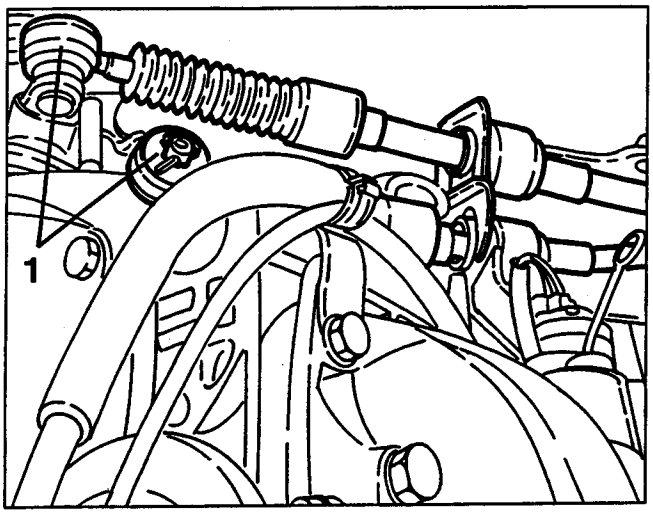


1. Slacken the fastening screws of the power unit support on the gearbox side.



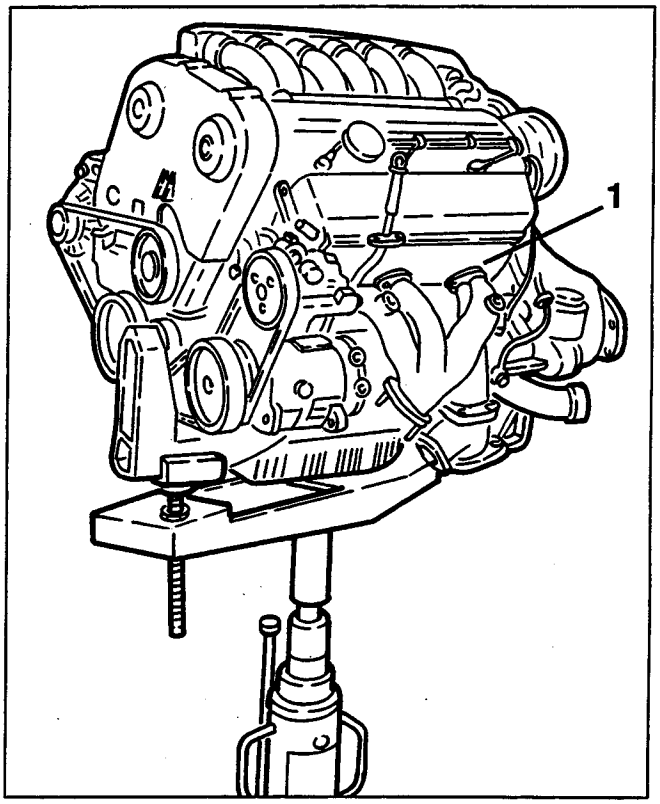
- Remove the power unit support crossrail No. 1.820.581.000 (R.4.0194) complete with supports No. 1.820.239.000, installed previously.

1. Lower the power unit just enough to disconnect the gear control cables.



WARNING:
The hydraulic jack must have a capacity of at least 1000 kg.
Free the electrical wires from any cable clamps and move them away from the engine to prevent them from getting caught in the engine when it is removed.

1. Lower the hydraulic jack completely and remove the power unit from the engine compartment.

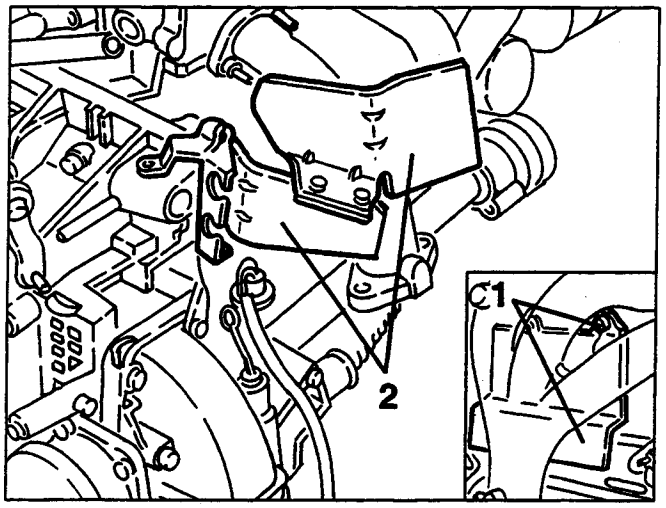


WARNING:
When lowering the car make sure that there are no cables or pipes still connected.
Take due care not to damage any components.

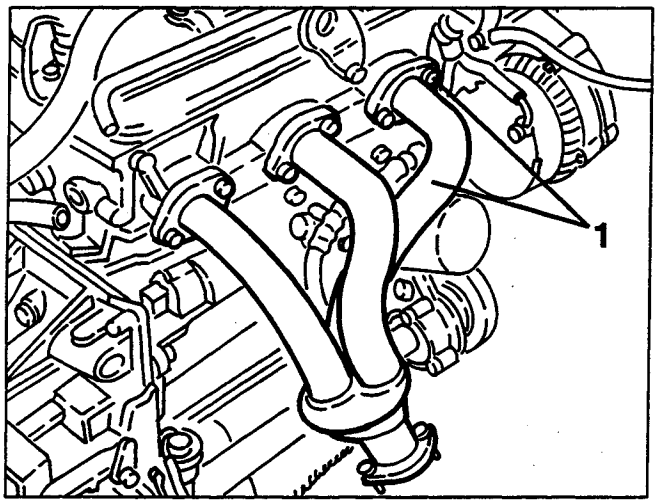
- Support the power unit with a hydraulic hoist as well as with the hydraulic jack used for removal.

WARNING:
For moving the power unit, use a hydraulic hoist after freeing it from the hydraulic jack.

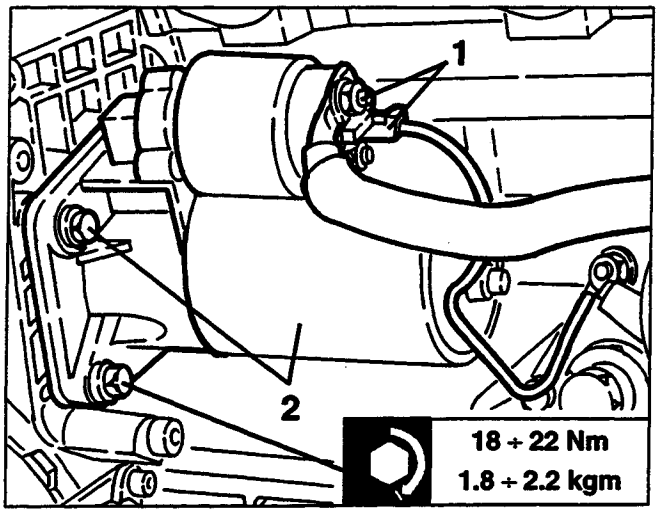
1. Slacken the two fastening nuts and remove the heat shield from the starter motor.
2. Slacken the fastening screws and remove the gearshift control cables support bracket and heat shields.



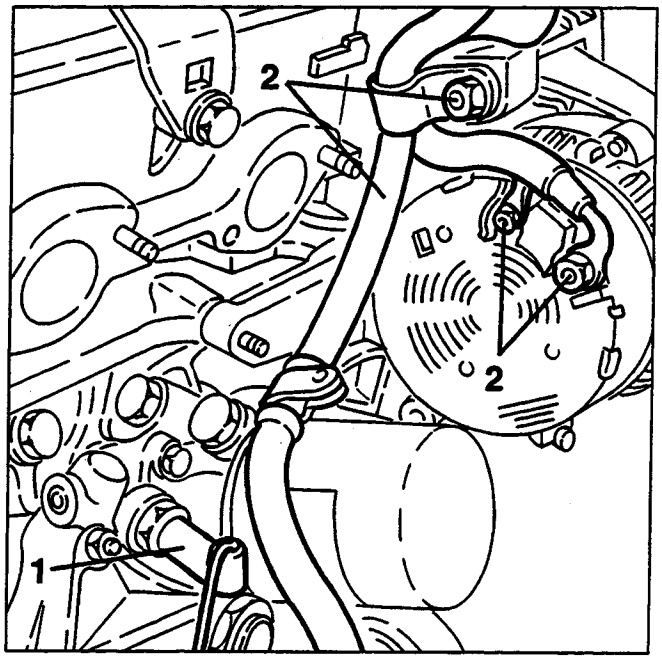
1. Slacken the fastening nuts and remove the right-hand exhaust manifold.
- Remove the corresponding seals.



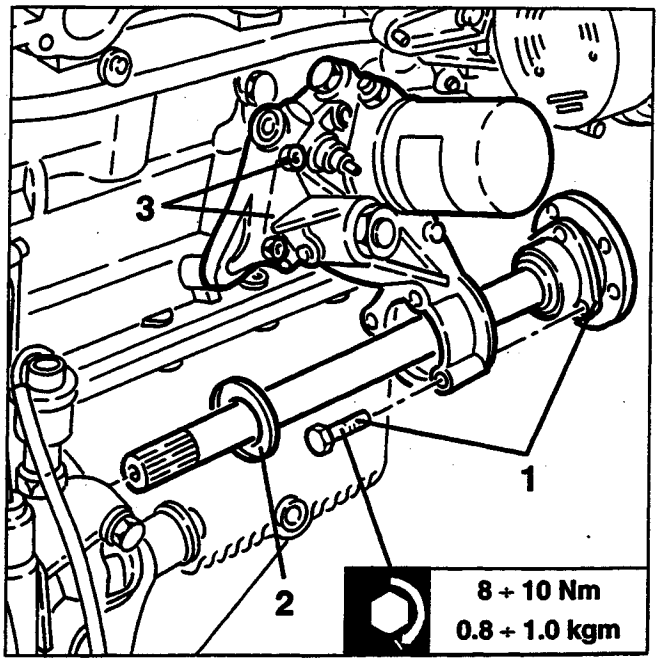
1. Disconnect the electrical connections from the starter motor.
2. Slacken the three fastening screws and remove the starter motor.



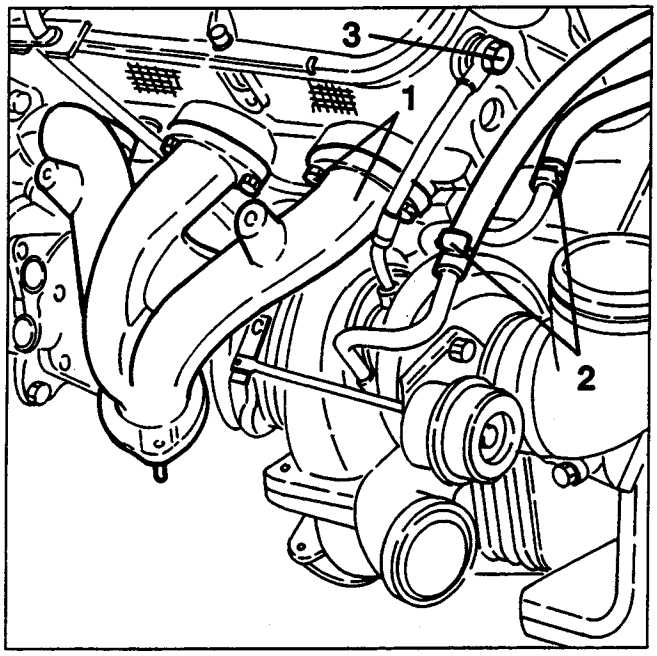
1. Disconnect the electrical connections from the engine oil minimum pressure sensor.
2. Disconnect the electrical connections from the alternator, then remove the electric wiring after freeing from the fasteners.



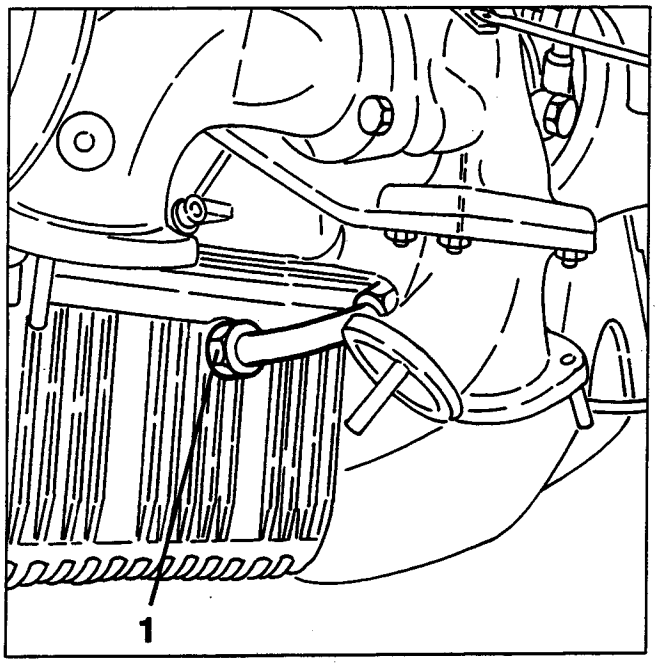
- Drain the gearbox-differential oil.
1. Slacken the three fastening screws and withdraw the intermediate shaft.
2. Remove the dust guard ring.
3. Slacken the screws and fastening nuts and remove the oil filter support complete.



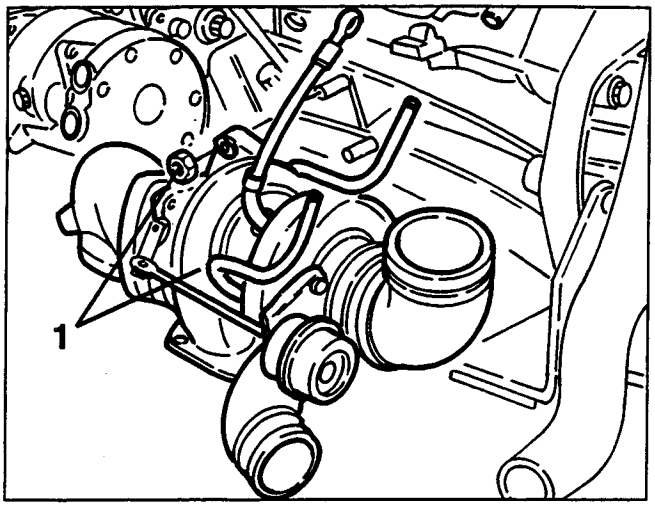
1. Slacken the fastening nuts and remove the left-hand exhaust manifold.
- Remove the corresponding seals.
2. Disconnnect the coolant fluid inlet and outlet pipes from the turbocharger.
3. Disconnect the engine oil delivery pipe to the turbocharger from the cylinder head.



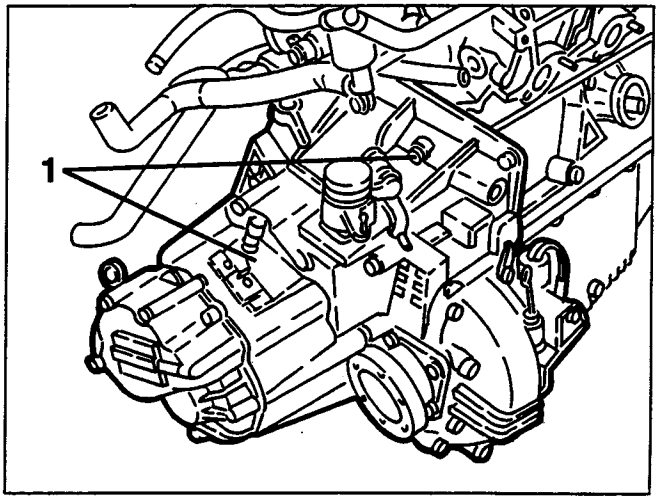
1. Disconnect the engine oil return pipe leading from the turbocharger from the sump.



1. Slacken the fastening nuts and remove the turbocharger.



1. Slacken the screws and fastening nuts and, using a hydraulic hoist, remove the gearbox-differential unit.



REFITTING

Reverse the sequence followed for removing operations adhering to the following instructions:
- Prepare the engine compartment to receive the power unit assembly, positioning all the electrical cables, pipes, etc. so that they do not interfere with assembly operations.
- Take due care when refitting the power unit to avoid damaging the single components.

WARNING:
Make sure that the support points of the power unit have been fastened correctly.

- Upon completion of assembly operations, check that the belts are tensioned correctly, refill the various systems as specified (see GROUP 00).
- Carry out all the necessary checks and adjustments (see GROUP 00).

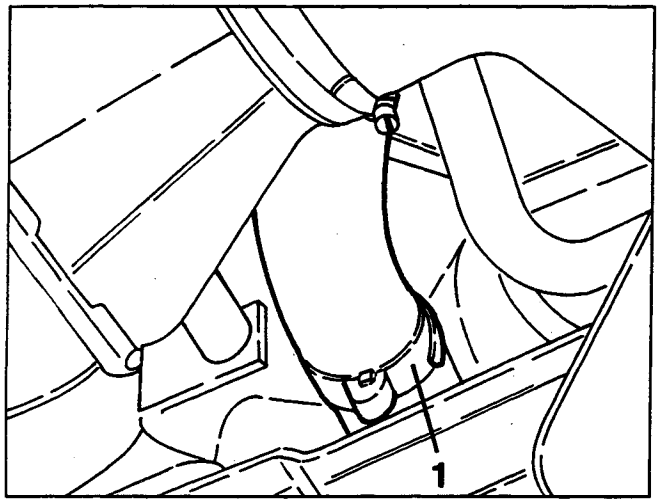
CYLINDER HEADS

NOTE: On the vehicle it only possible to remove the right- hand cylinder head as described below. Should it be necessary to remove the left-hand cylinder head, it is necessary to remove the power unit (see specific paragraph).

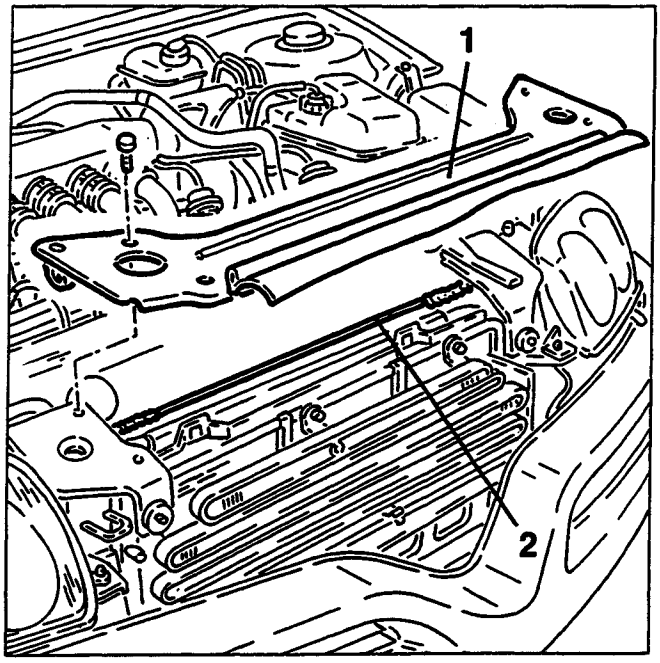
REMOVING/REFITTING THE RIGHT-HAND CYLINDER HEAD

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Remove the front wheels and mud flaps.

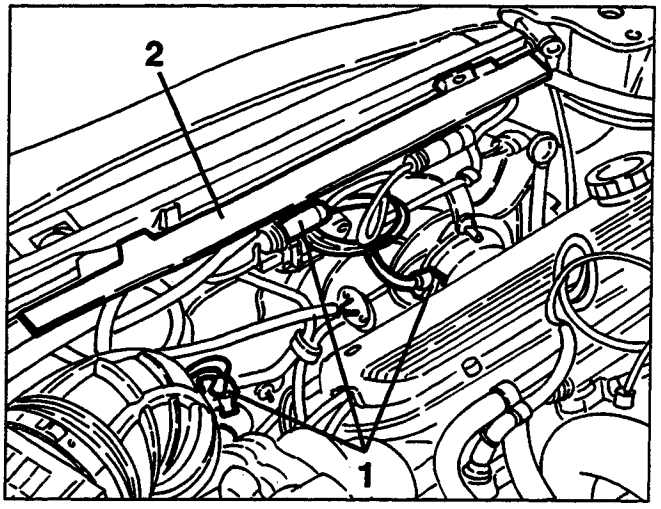
1. Raise the car and drain the coolant fluid into a suitable recipient disconnecting the radiator outlet sleeve.



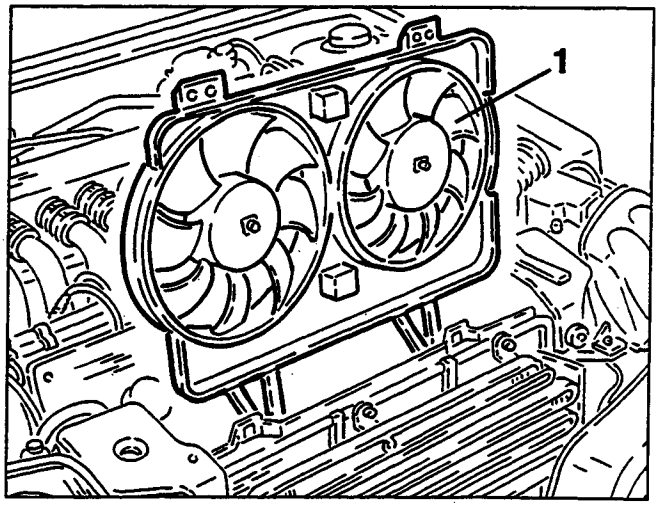
1. Lower the car, slacken the fastening screws and remove the upper radiator crossmember.
2. Disconnect and move to one side the bonnet lock opening cable.



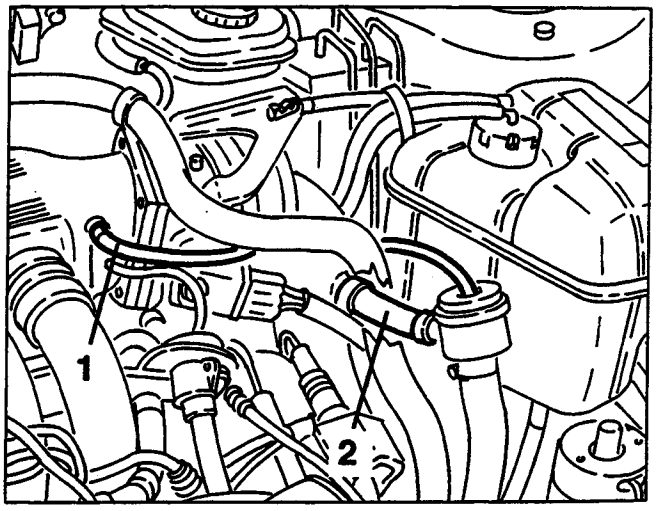
1. Disconnect the electrical connections from the cooling fans.
2. Slacken the fastening screws, then move aside the cable fairing complete with electric cables.



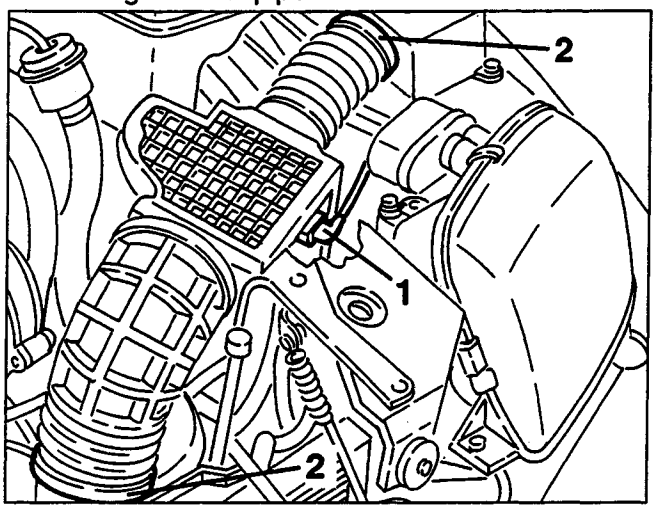
1. Withdraw and remove the cooling fans.



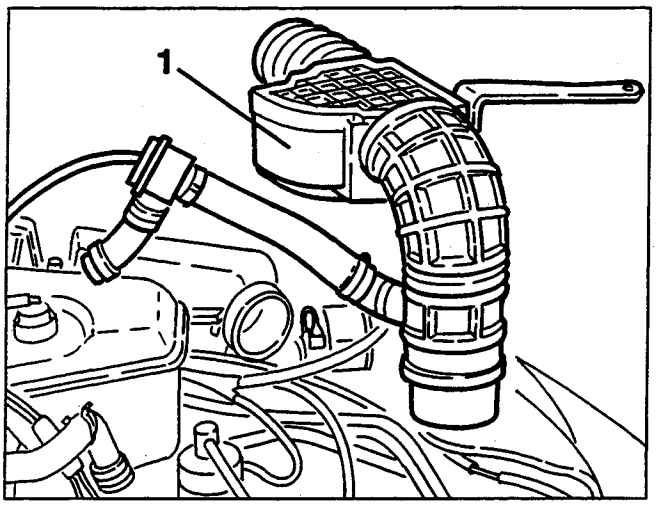
1. Disconnect the the vacuum takeoff pipe for the antistalling valve from the intake box.
2. Disconnect the the antistalling valve by-pass pipe from the throttle exhaust manifold.



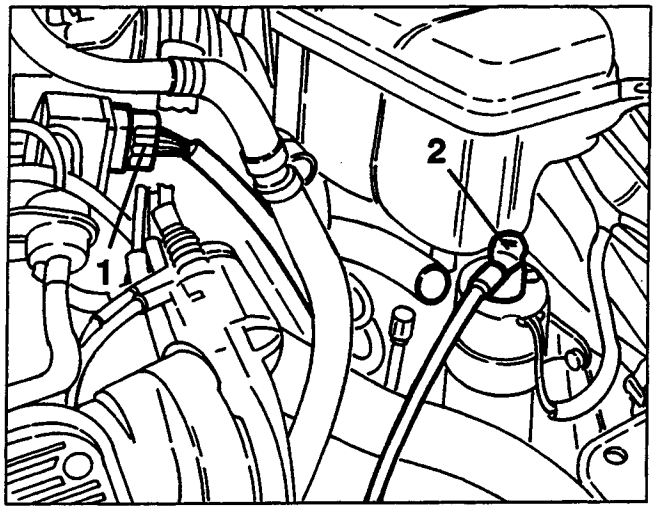
1. Disconnect the electrical connection from the air flow meter .
2. Slacken the clamps fastening the two sections of the corrugated sleeve to the air cleaner and to the turbocharger intake pipe.



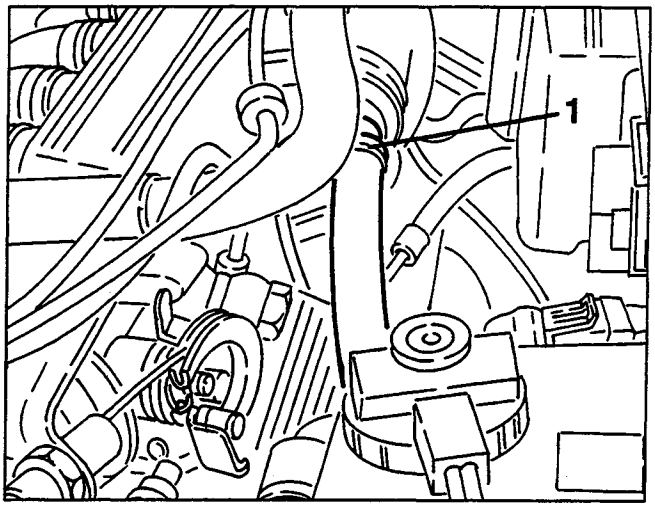
1. Remove the air-flow meter, corrugated sleeve and antistalling valve assembly complete with connection pipes.



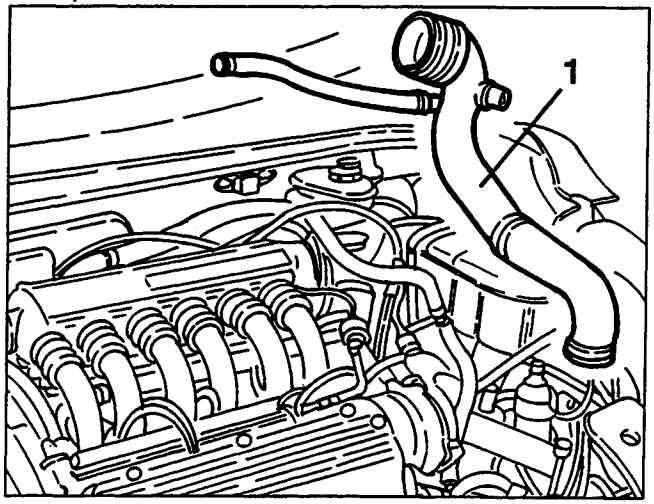
1. Disconnect the electrical connection from the throttle potentiometer.
2. Disconnect the high voltage cable from the ignition coil.



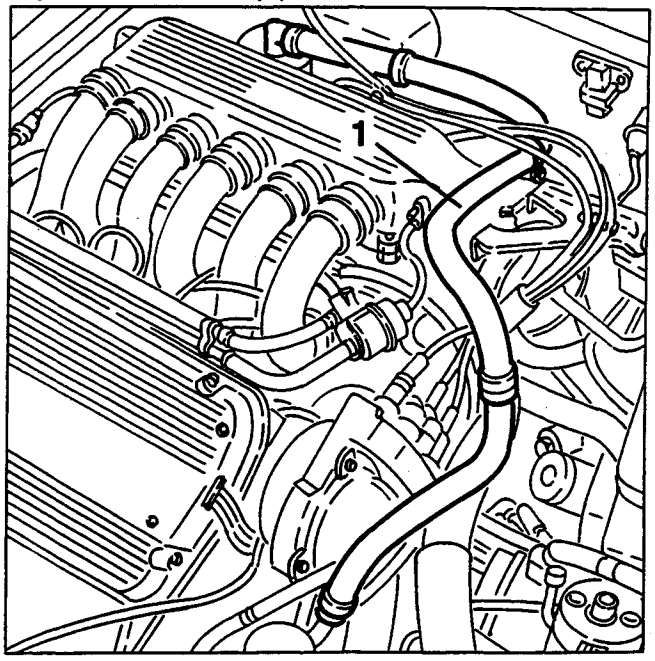
1. Disconnect the air intake pipe from the constant idle speed actuator.



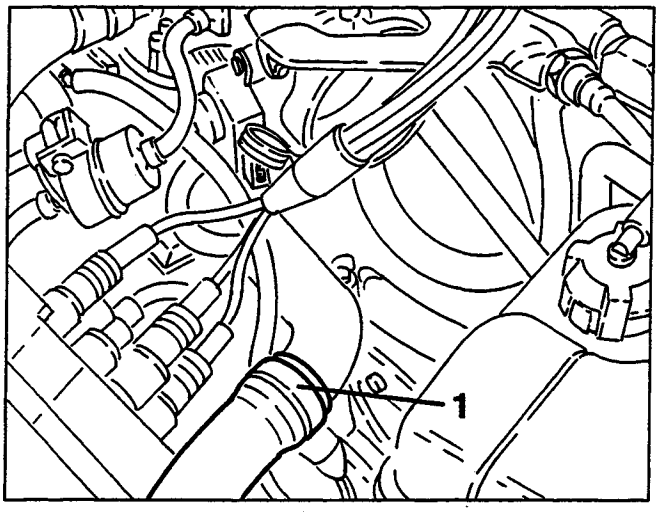
1. Slacken the fastening clamps and remove the air delivery manifold from tirbocharger to throttle body complete with the air takeoff pipe from the constant idle speed actuator.



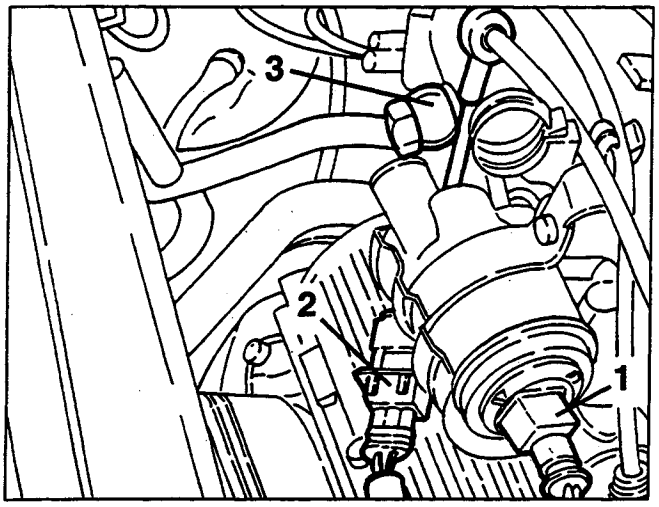
1. Slacken the fastening clamp and remove the oil vapour recirculation pipe.



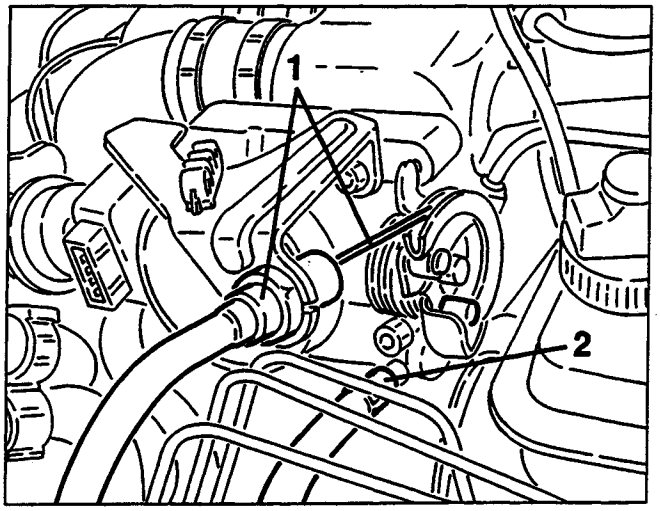
1. Disconnect the coolant oil delivery sleeve to the radiator from the thermostatic cup.



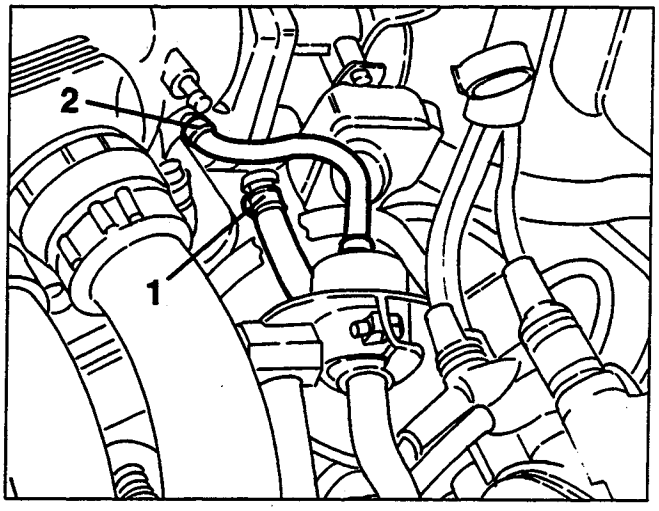
1. Disconnect the electrical connection from the constant idle speed actuator.
2. Disconnect the electrical connection of the 1st cylinder detection sensor.
3. Disconnect the servobrake vacuum takeoff pipe from the intake box.



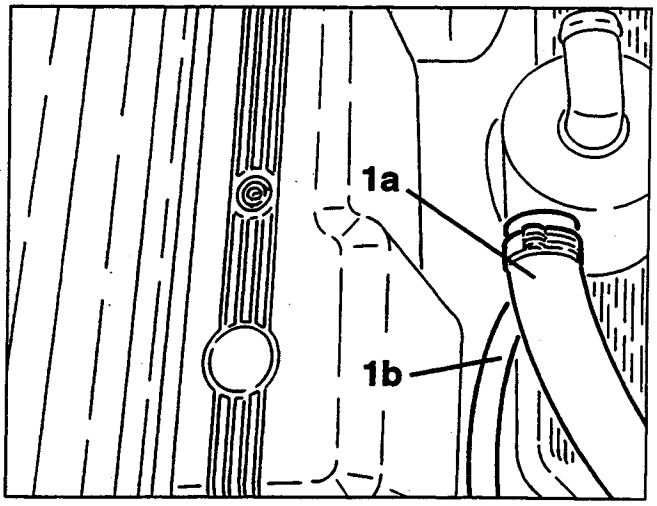
1. Disconnect the accelerator cable from the throttle.
2. Disconnect the header tank coolant delivery and system air relief pipe from the throttle body.



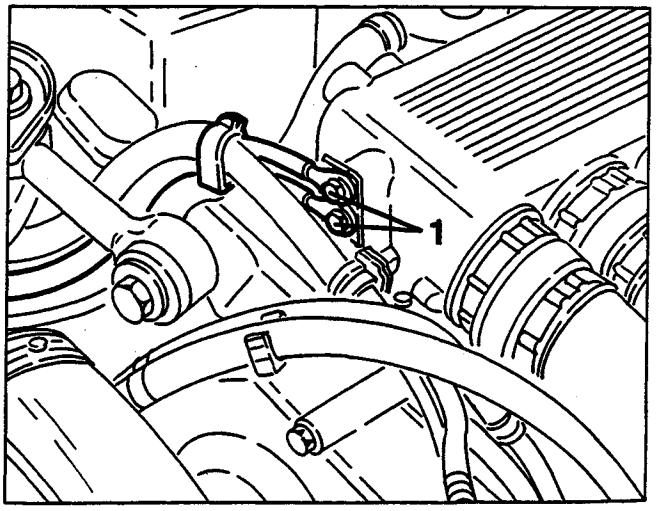
1. From the throttle body disconnect the coolant inlet pipe.
2. Disconnect the vacuum takeoff pipe for the fuel pressure regulator from the intake box.



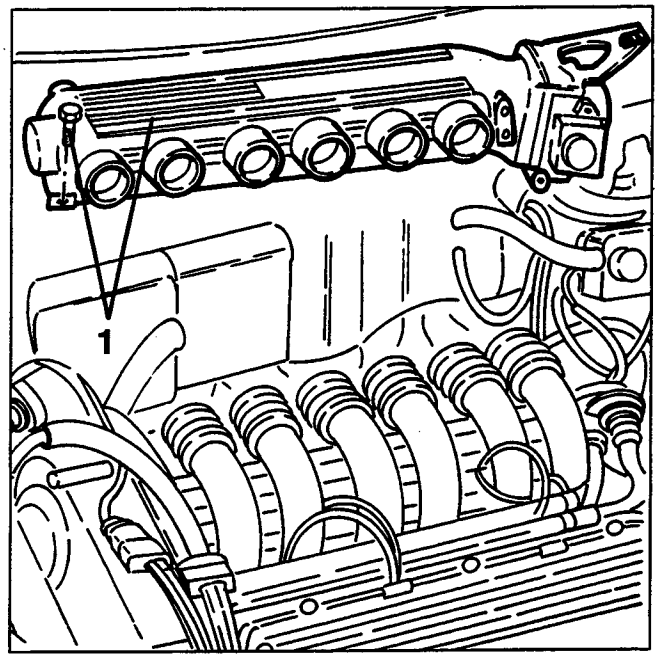
- Disconnect the high voltage cables from the spark plugs of the righthand cylinder head.
1. From the oil vapour separator disconnect the oil vapour recovery pipe (1a) and the condensed oil recovery pipe (1b).



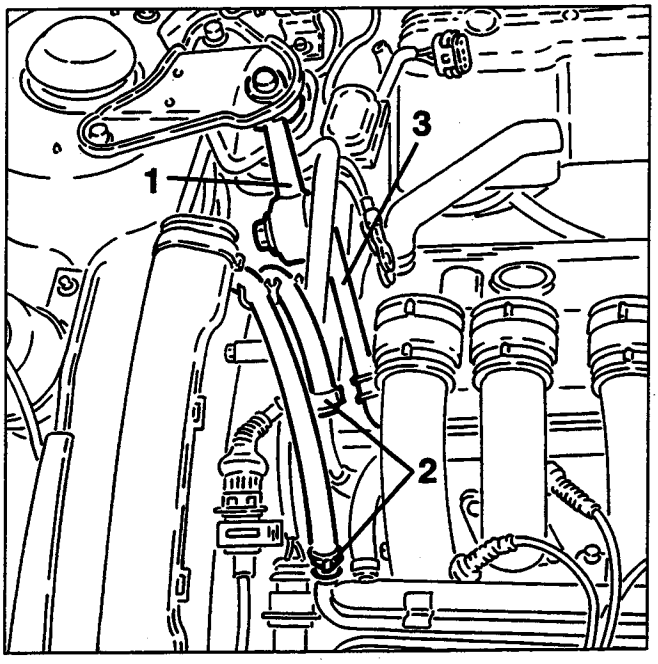
1. Disconnect the earth cables from the intake box.



1. Slacken the clamps fastening the intake manifold to the intake box then remove the latter after unscrewing the two fastening screws.

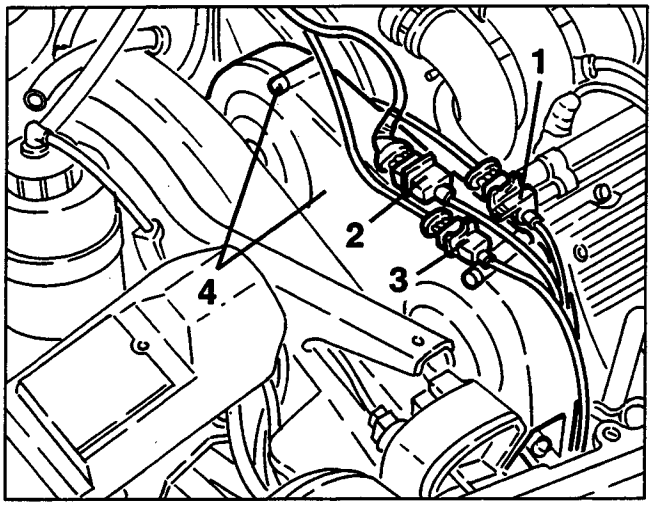


1. Slacken the fastenings and remove the engine stay connecting rod.
2. Disconnect the fuel inlet and outlet pipes from the distributor manifold.
3. Disconnect the fuel vapour recirculation pipe from the fuel distributor manifold.

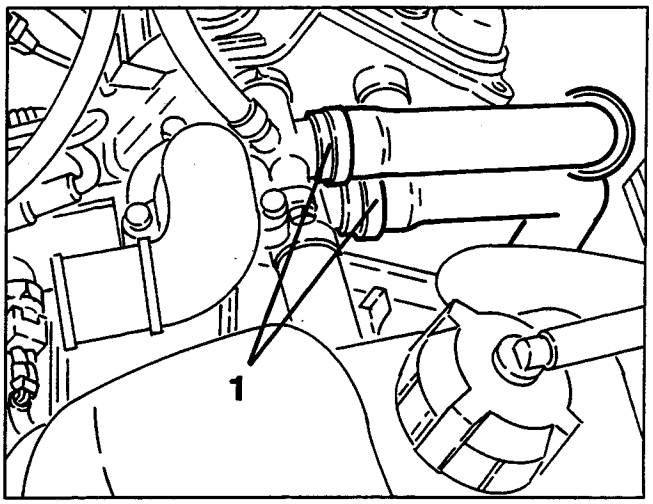


1. Disconnect the electrical connection from the rpm and timing sensor.
2. Disconnect the electrical connection of the pinging sensor.
3. Disconnect the electrical connection of the lambda probe.

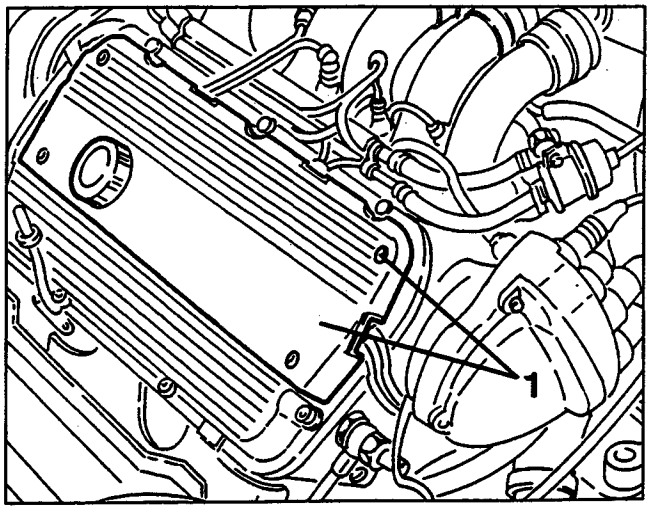
4. Slacken the fastening screws and remove the timing gear belt cover.



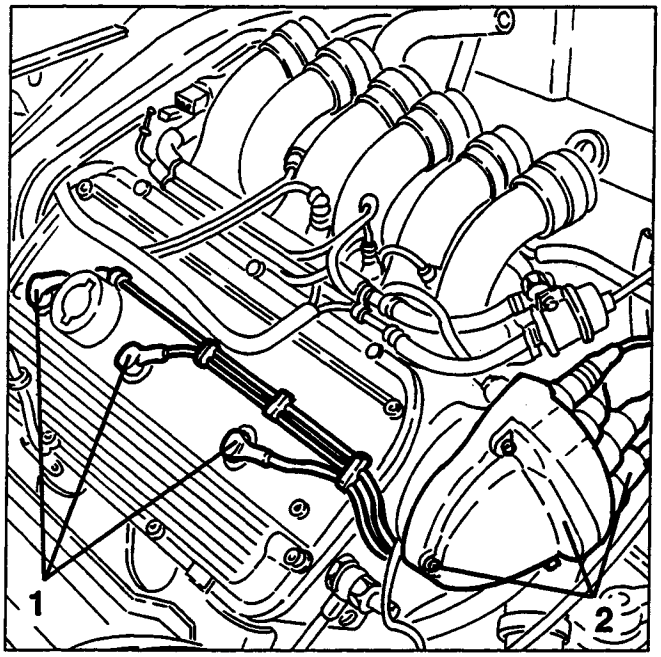
1. Disconnect the coolant delivery and return pipes to the climate control heater.



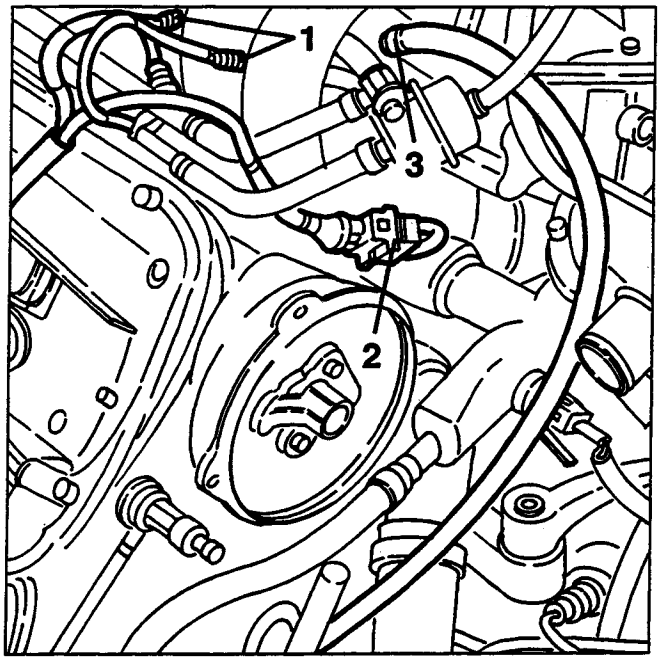
1. Slacken the four fastening screws and remove the left- hand cylinder head.



1. Disconnect the high voltage cables from the spark plugs of the left-hand cylinder head.
2. Slacken the three fastening screws and remove the ignition distributor cap complete with spark plug cables.

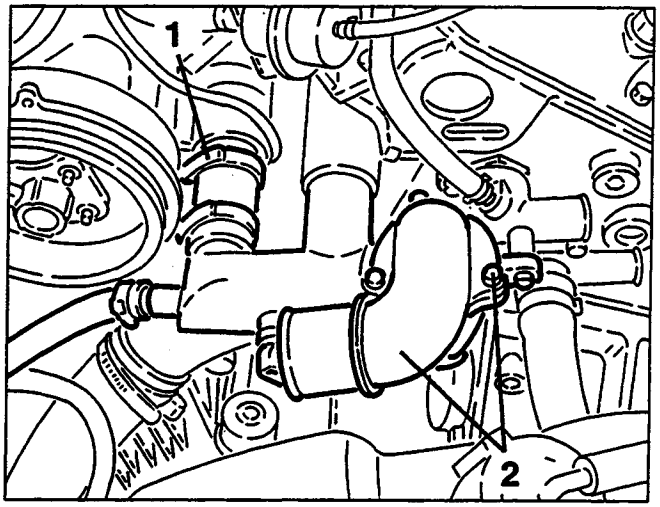


1. Disconnect the electrical connections from the injectors.
2. Disconnect the electrical connections from the rear pinging sensor, then move the wiring to one side.
3. Disconnect the fuel vapour recovery pipe from the fuel distributor manifold.

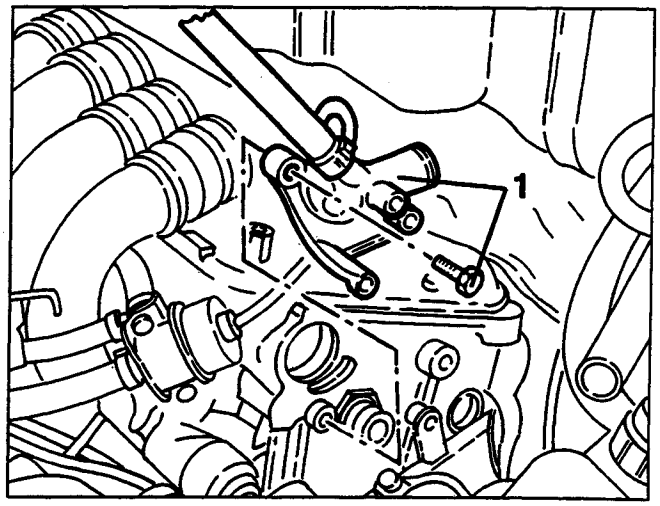


1. Slacken the clamp fastening the coolant fluid outlet sleeve from the left-hand cylinder head.

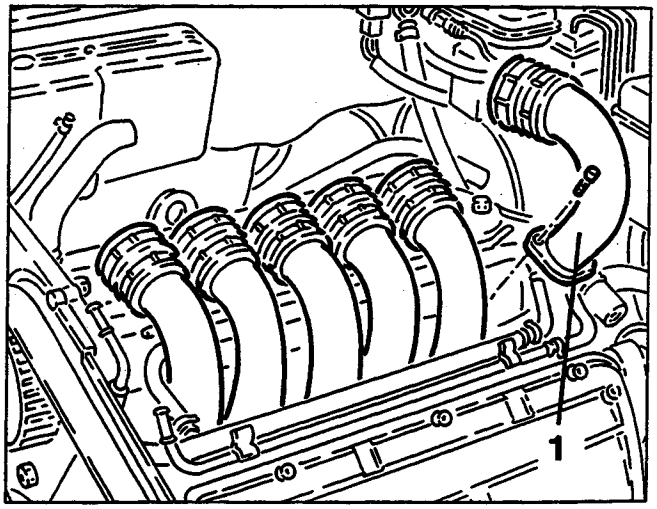
2. Slacken the two fastening screws and move aside the thermostatic cup with its pipes.



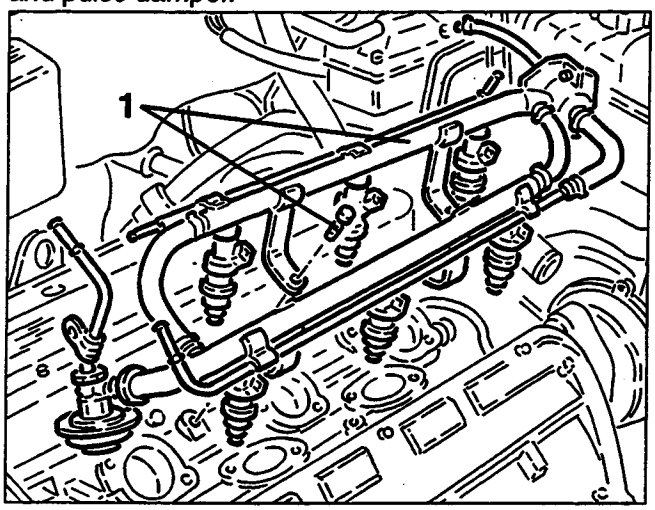
1. Slacken the two fastening screws and remove the coolant outlet union from the right-hand cylinder head.



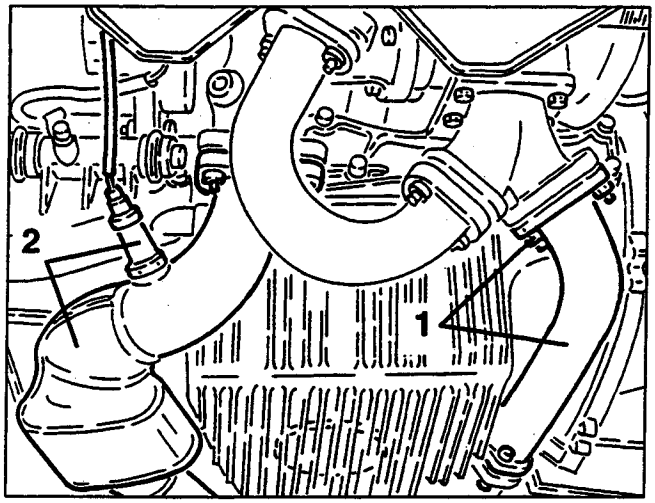
1. Slacken the fastening screws and remove the intake manifolds.



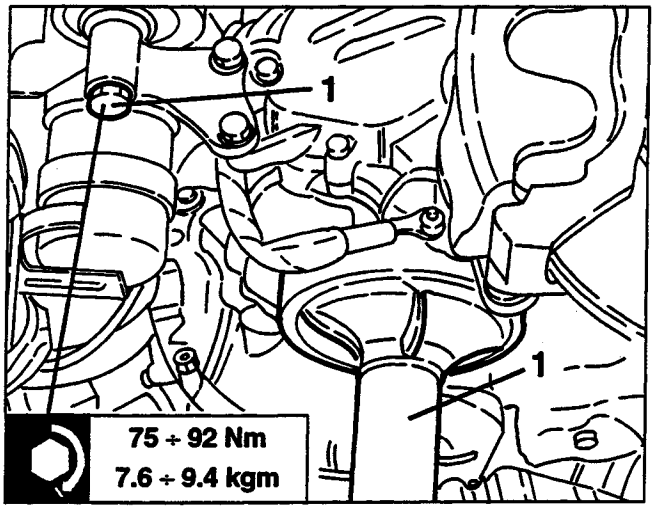
1. Slacken the fastening screws and remove the fuel distributor manifold complete with pressure regulator and pulse damper.



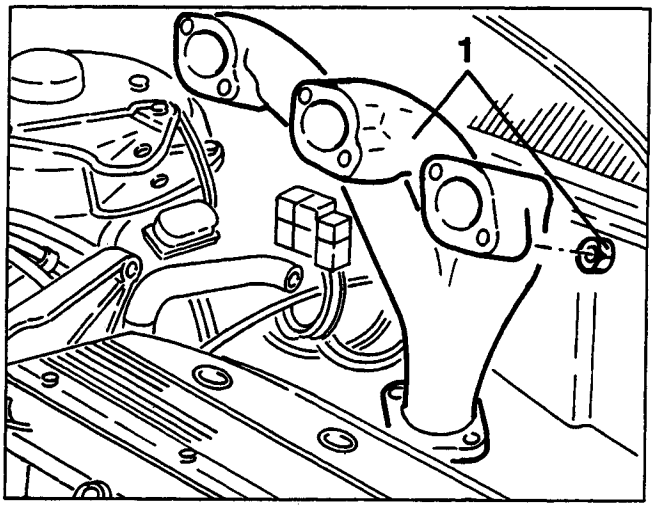
1. Raise the car, slacken the fastening screws and remove the exhaust gas delivery pipe from the manifold of the right-hand cylinder head to the turbocharger.
2. Slacken the fastenings and remove the front section of the exhaust pipe complete with lambda sensor.



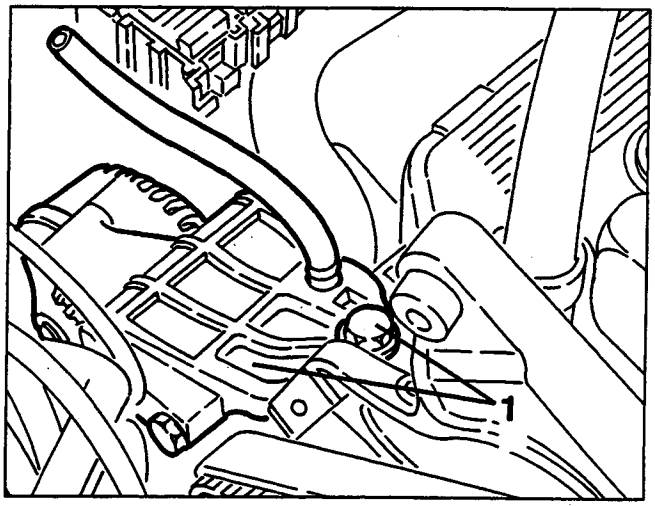
1. Set a hydraulic jack under the gearbox, then slacken the screw fastening the power unit support on the gearbox side



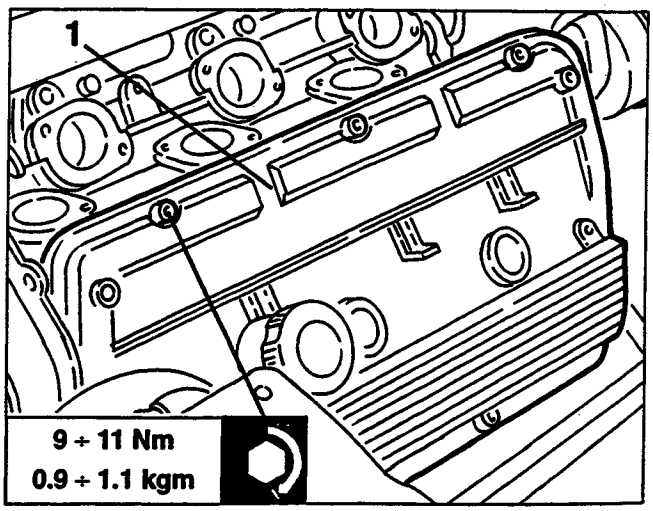
1. Lower the power unit just enough to unscrew the fastening nuts and remove the right-hand side exhaust manifold.



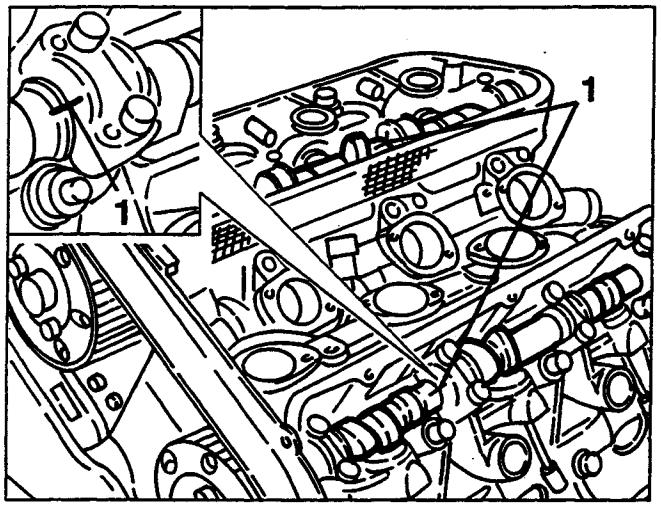
1. Slacken the screws fastening the alternator and upper bracket, remove the drive belt and move it to one side.



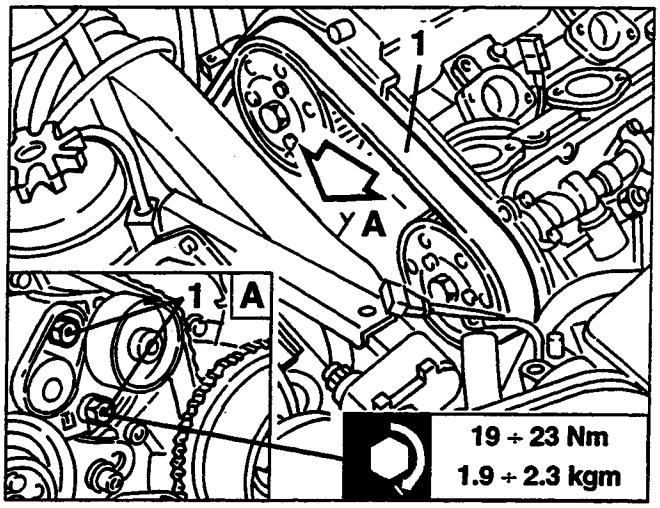
1. Slacken the fastening screws and remove the timing gear covers from the cylinder heads.



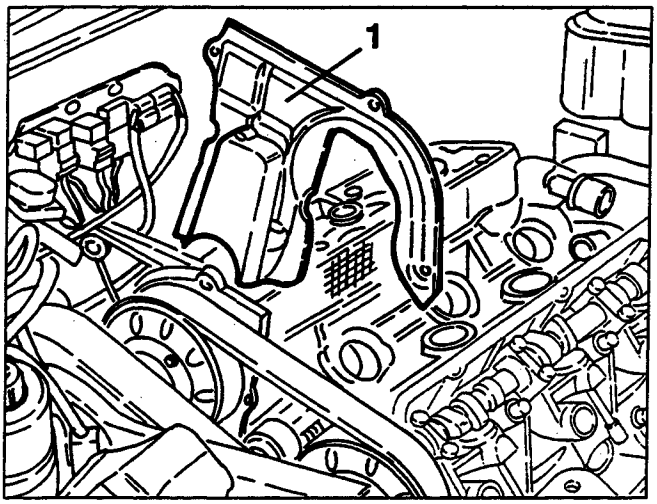
1. Turn the crankshaft until the noteches on the camshafts coincide with those on the corresponding caps.



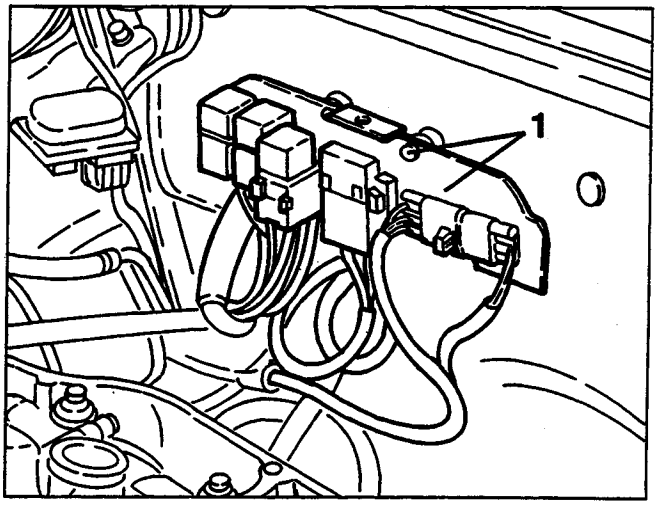
1. Slacken the two nuts fastening the timing gear belt tensioner, then prise off the belt.



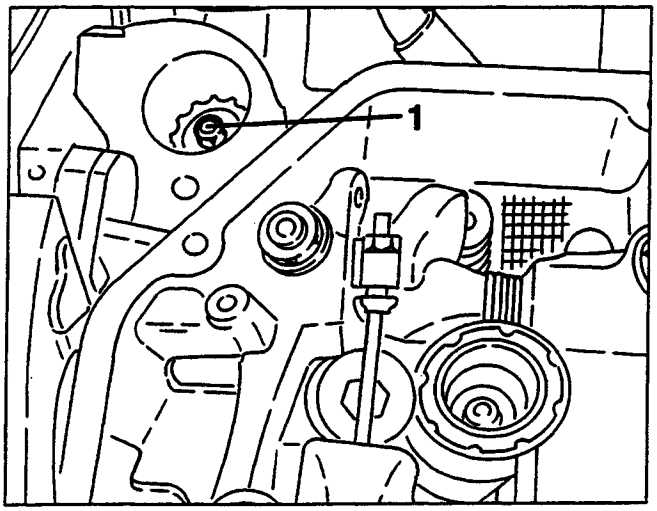
1. Slacken the fastening screws and remove the rear timing belt cover.



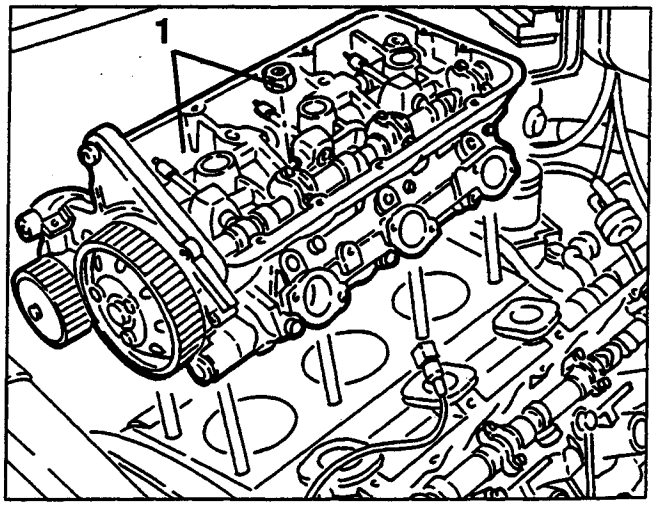
1. Slacken the fastening screws and move aside the relay support bracket and electrical connections.



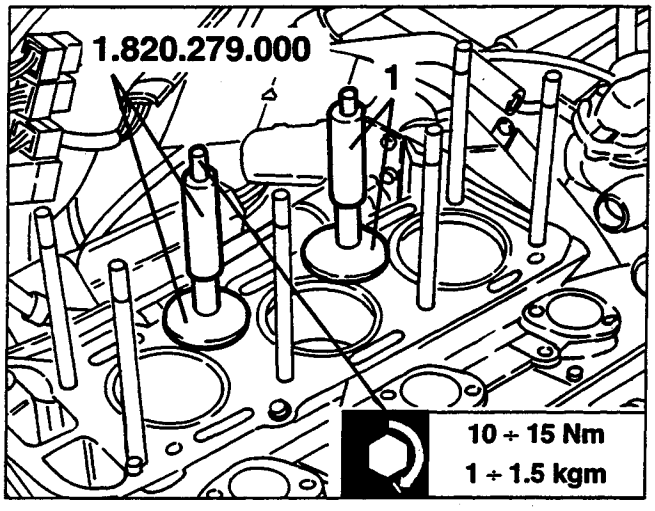
1. Slacken the nut fastening the intermediate oil pump drive gear.



1. Slacken the fastening nuts and remove the right-hand cylinder head.
- Remove the seal.

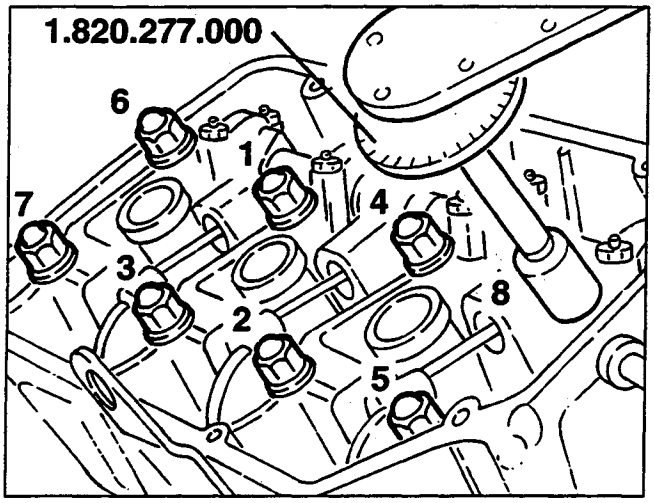


1. Install the cylinder liner tools no. 1.820.279.000 as illustrated.



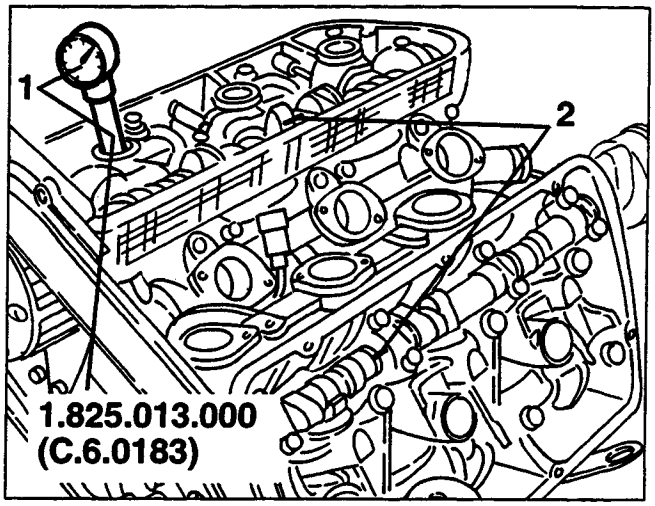
INSTRUCTIONS FOR REFITTING

Reverse the sequence followed for removal observing the following instructions.
- Assemble the right-hand cylinder head with the timing references aligned.
- Tighten the cylinder head fastening screws proceeding as described below and bearing in mind that, for each step, the tightening sequence is the one illustrated.

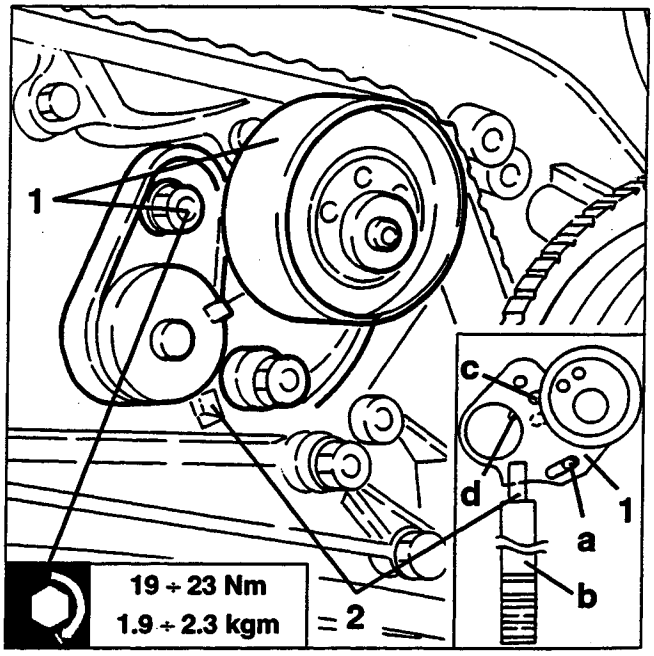


Tightening procedure	
Set all the screws to a torque of:	25 Nm 2.5 kgm
Complete tightening by a further angle of:	240° ± 1°30'

1. Using tool no. 1.825.013.000 (C.6.0183) fitted with a dial gauge, turn the crankshaft until the piston of the first cylinder is at the T.D.C. in the bursting stroke.
2. Check the alignment of the notches on the camshafts with those on the corresponding caps.



1. Position the timing gear belt tensioner so that stud "**a**" is as illustrated, then fully tighten the two fastening nuts, locking them lightly.
- Fit the timing gear belt on the pulleys starting from the drive pulley and continuing counter-clockwise.
- Slacken the two belt tensioner fastening nuts.
2. Insert the 10 mm square of the tensioning lever "**b**" (3/8" ratchet in the square hole of the belt tensioner, then turn it counter-clockwise to move pointer "**c**" by 2-3 mm in relation to notch "**d**", then turn clockwise until they coincide; tighten the two belt tensioner fastening nuts without locking them.
- Turn the crankshaft twice to take the piston of cylinder 1 to the T.D.C.
- Check that pointer "**c**" coincides with the centre notch "**d**" and tighten the two belt tensioner fastening nuts to the specified torque.
- Remove the tensioning lever "**b**" from the belt tensioner.



GENERAL DESCRIPTION

In this system the ignition and injection functions are operated by two control units, the Motronic ML4.1 and EZ212K both made by BOSCH.
The experience acquired and the continuous research developed in this sector have made it possible to bring forward an up-dated, fine-tuned system, simplifying and reducing as far as possible the data detection sensors and making the control actuators more precise and powerful.
In order to optimise the performance of the vehicle during acceleration and at top speeds, in the EZ212K control unit, a new OVERBOOST function control has been implemented which makes it possible to increase the supercharging pressure according to a certain logic, while the ML4.1 control unit determines the necessary fuel enrichment.

SYSTEM FUNCTIONS

The system functions are essentially the following:
- injection times adjustment;
- spark advance adjustment;
- cold starting control;
- control of enrichment during acceleration;
- fuel cut-off during deceleration;
- constant idle speed control;
- maximum rpm limiting;
- evaporative solenoid valve control;
- lambda probe control;
- connection with the ALFA ROMEO CODE system;
- self-diagnosis.

Injection times adjustment

Digital technology has made it possible to optimise consumption and performance levels through programmed maps memorised inside the electronic control unit, in relation to engine rpm and load.
With the help of sensors which detect the many variables involved, the ML4.1 control unit controls the electroinjectors extremely quickly and accurately. The injection time is mainly corrected on the basis of the battery voltage and engine temperature.

Spark advance adjustment

The gap on the phonic wheel due to the lack of two teeth gives the ML4.1 control unit a reference; each side of the subsequent tooth determines the angular position of the crankshaft. This reference is sent to the ML4.1 control unit, which, according to a map programmed inside the control unit itself and in relation to the engine rpm and load, establishes the correct advance rate. The advance determined in this way is transferred to the EZ212K control unit which, on the basis of the signals received from the pinging, temperature and throttle angle sensors, delays the advance if necessary, selectively on the cylinder that needs it.

Control of cold starting

During cold starting, the system controls the spark advance and the injection time.
The spark advance depends solely on engine rpm and temperature and the advance rate is at its highest at a temperature of -30°C.

The injection time is obtained from a value programmed in the ML4.1 control unit and corrected through the measurement of the intake air temperature, engine temperature, battery voltage and engine rpm.
During starting, the control unit provides injection at each ignition pulse, therefore in four phases per engine cycle.
Once a pre-established rpm (depending on the engine temperature) has been reached, the control unit operates injection at each turn of the crankshaft.

Control of enrichment during acceleration

Each time acceleration is required if the change in the signal of the air-flow meter exceeds a predetermined increase, the ML4.1 control unit not only adapts injection to the new requirement, but increases it further in order to quickly reach the rpm required.
When nearing the established rpm, the increase of injection is gradually eliminated.

Fuel cut-off during deceleration

Fuel cut-off during deceleration is of the adapted type. With the detection of the throttle closed condition and engine speeds above 1080, fuel injection is de- activated.
As the supply is lacking, the engine rpm will fall more or less rapidly according to the conditions of the vehicle.
Before reaching idle speed, the dynamics of the lowering of the rpm is monitored. If this is above a certain value, the fuel supply is partially re-activated according to a logic which involves smoothly accompanying the engine to idle speed.
Once this condition has been reached, the normal idle speed functions are reactivated and fuel cut-off will only be reactivated after exceeding the fuel cut-off threshold to prevent the engine from "gasping"
The thresholds for resuming the fuel supply and cut off vary depending on the temperature of the engine. Another fuel cut off logic is developed inside the ML4.1 control unit which comes into operation during partial deceleration, i.e. when a lower engine load is required. This function is active only if the new condition lasts for a pre-established length of time and after adapting the ignition angle to the new situation.

Constant idle control

The adjustment of idle speed is controlled under all operating conditions by the constant idle speed actuator with single coil.
When the engine is running at idle speed, the purpose of the actuator is to bring the real rpm to the nominal rpm rating acting on the throttle by-pass.
In addition to controlling the idle speed, it also acts as an additional air valve and regulator for the cutting in of the air conditioner compressor.
In addition to the constant idle speed actuator, idle rpm is also corrected by the adjustment of the spark angle (advance) as this has a more rapid effect.

Maximum rpm limiting

After exceeding a maximum rpm threshold (6,500 rpm) the injection of fuel is cut off to prevent the engine from over-loading.

Evaporative solenoid valve control

The fuel vapours gathered by the various points of the circuit in a special active carbon canister are sent to the engine where they are burnt: this takes place through a solenoid valve which is opened by the control unit only when the engine is in a condition to allow correct combustion without "disturbing" it: in fact, the control unit compensates this amount of incoming fuel by reducing delivery to the injectors.

Lambda probe control

The oxygen sensor (or "lambda" probe) informs the control unit of the amount of oxygen present at the exhaust, therefore of the correct fuel-air metering.
The optimum mixture is obtained when the lambda coefficient = 1 (optimum stoichiometric ratio).
The electric signal that the probe sends to the control unit changes abruptly when the mixture composition departs from lambda = 1. When the mixture is "lean" the control unit increases the amount of fuel and reduces it when the mixture is "fat": this way the engine always operates as far as possible around the ideal lambda rating.
The lambda probe signal is processed inside the control unit by a special integrator which prevents sharp "oscillations".
The probe is heated by an electrical resistance so that it quickly reaches the correct operating temperature (appr. 300°C).
Therefore through this probe it is possible to adjust engine carburetion accurately.
Among other things, this makes it possible to keep exhaust emission within the specified limits.

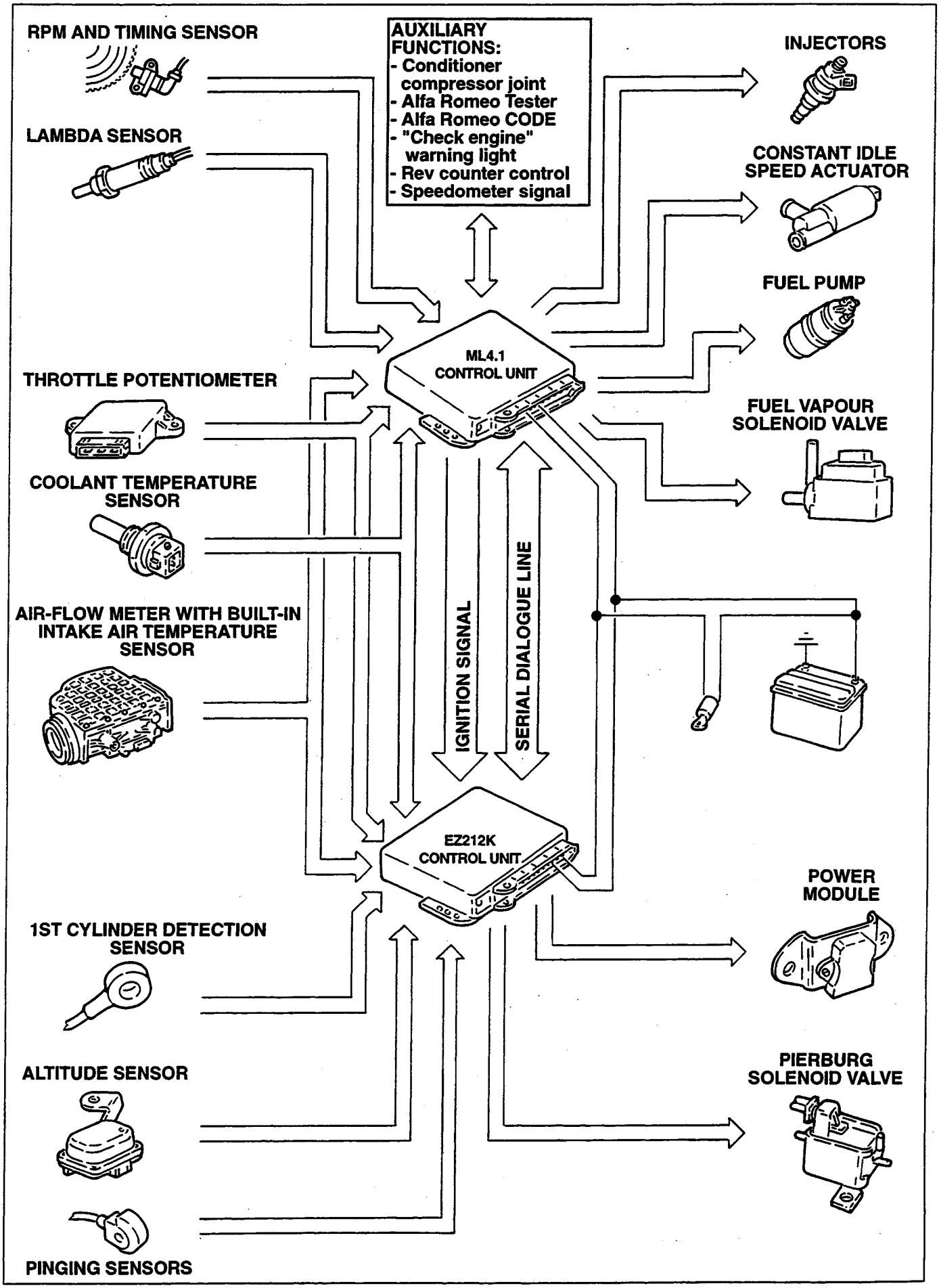
Connection with the ALFA ROME CODE system

On vehicles fitted with ALFA ROMEO CODE, as soon as the Motronic control unit receives the signal that the "key is at MARCIA", it "asks" the ALFA ROMEO CODE system for consent to start the engine: this consent is only given if the ALFA ROMEO CODE control unit recognises the code of the key engaged in the ignition as correct. This dialogue between the two control units takes place on diagnosis line K already used for the Alfa Romeo Tester.

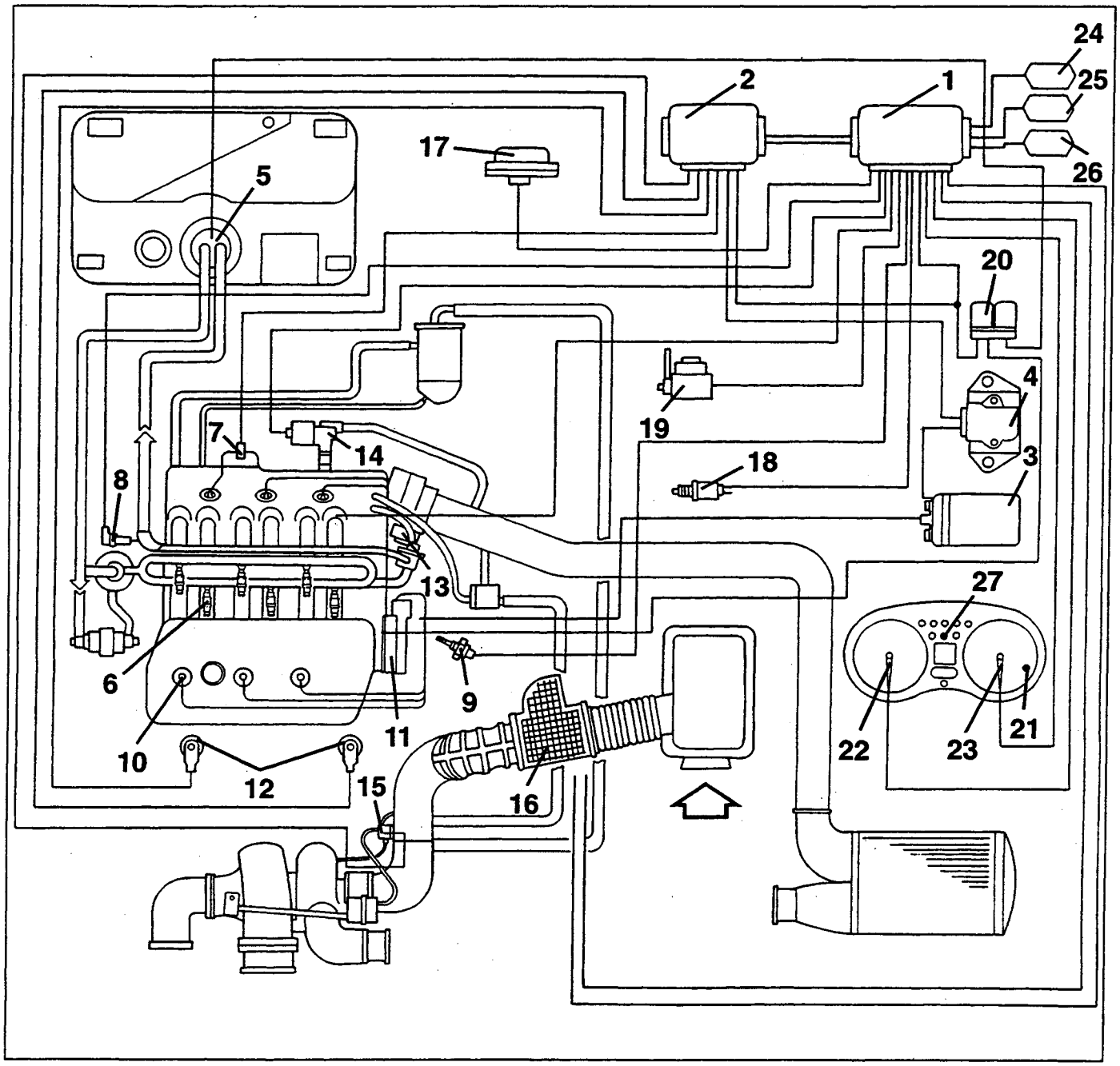
Self-diagnosis

The Motronic ML4.1 and EZ212K control units are fitted with a self-diagnosis system. In the event of a system malfunction, the control units detect the fault and, where possible, they replace the missing signals with fixed parameters. However, only the Motronic ML4.1 control unit is capable of memorising and maintaining the data also when the engine is turned off. Therefore, also the errors of the EZ212K control unit are stored in the ML4.1 control unit, via the serial line which connects them.
When required by the operator, the faults can be read on the Motronic ML4.1 control unit using the ALFA ROMEO TESTER.

FUNCTIONAL LAYOUT OF THE ML4.1/EZ212K INJECTION - IGNITION SYSTEM

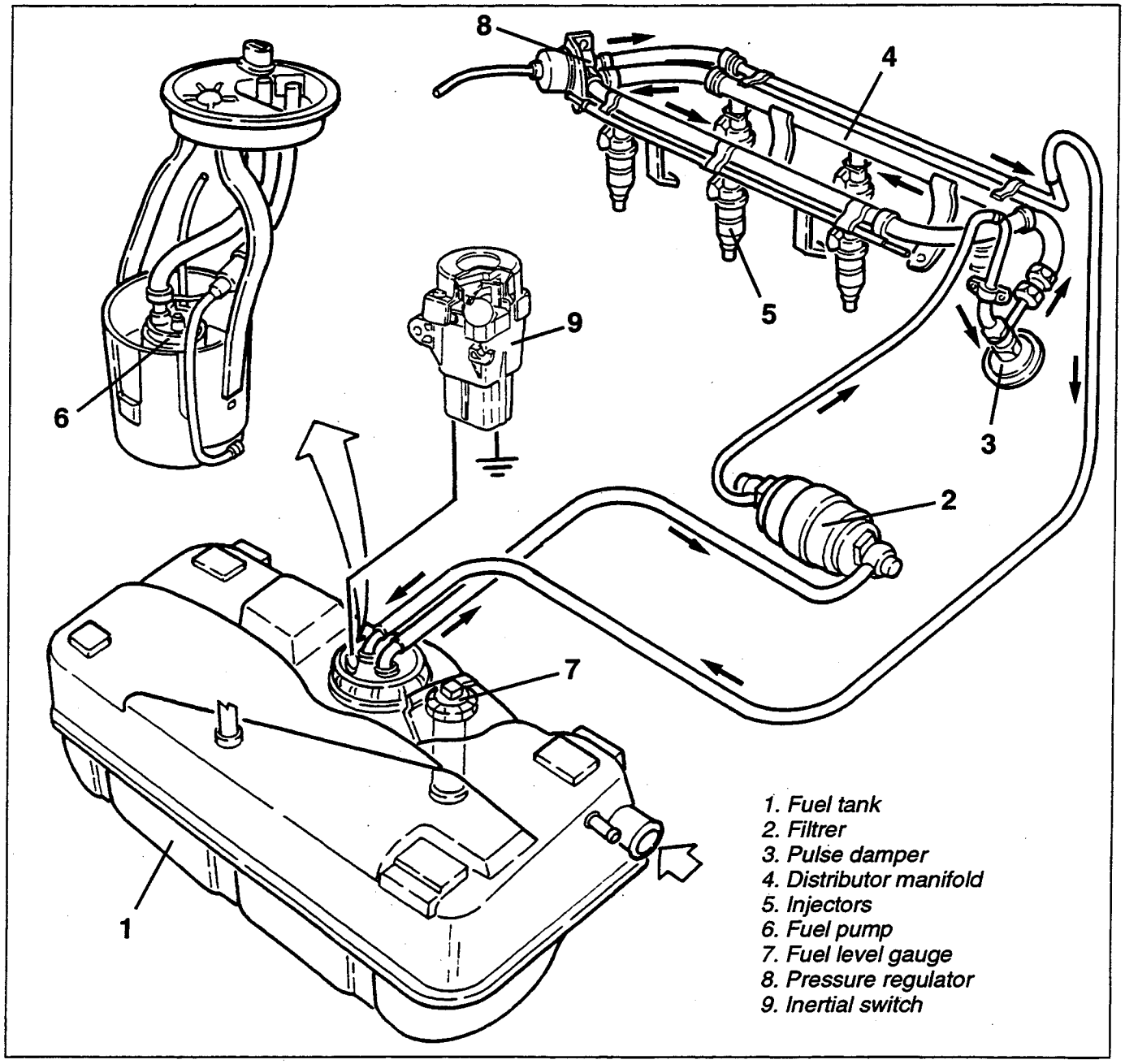


COMPONENTS OF THE ML4.1/EZ212K INJECTION - IGNITION SYSTEM



1. *Motronic ML4.1 control unit*
2. *EZ212K control unit*
3. *Ignition coil*
4. *Power module*
5. *Fuel pump*
6. *Injectors*
7. *1st cylinder detection sensor*
8. *Rpm and timing sensor*
9. *Engine coolant temperature sensor*
10. *Spark plugs*
11. *Ignition distributor*
12. *Pinging sensors*
13. *Throttle potentiometer*
14. *Constant idle speed actuator*
15. *Pierburg solenoid valve*
16. *Air-flow meter with built-in intake air temperature sensor*
17. *Altitude sensor*
18. *lambda sensor*
19. *Fuel vapour solenoid valve*
20. *Set of relays*
21. *"Check engine" warning light*
22. *Speedometer*
23. *Rev counter*
24. *Connector for connection with Alfa Romeo Code control unit*
25. *Diagnosis socket (Alfa Romeo Tester)*
26. *Climate control system connector*
27. *Alfa Romeo Code warning light*

DESCRIPTION OF THE SYSTEM



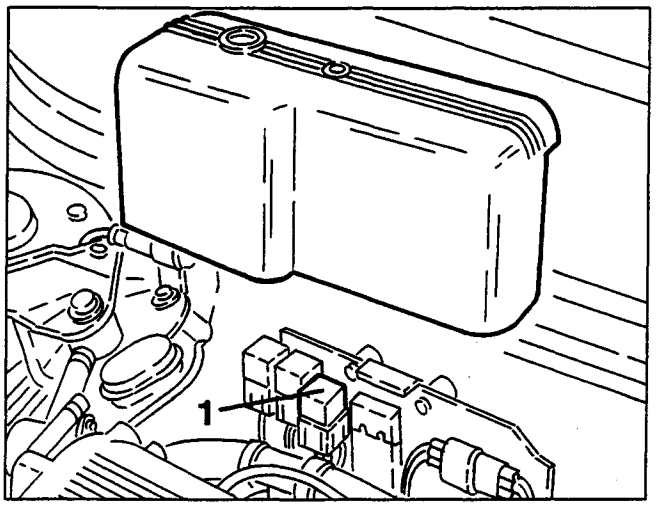
The fuel supply circuit comprises an electric fuel pump (6) located in the tank (1) which sends the pressurised fuel through a special pipe to the filter (2).
From here, the fuel is sent to the pulse damper (3) and then to the distributor manifold (4) which distributes it to the injectors (5).
The excess fuel returns to the tank through a special tube via the pressure regulator (8) operated by the vacuum withdrawn from the intake box.
The amount of fuel injected depends solely on the injection time which is controlled by the control unit.

The connection between the various sections of the fuel lines is made by special connectors (to disconnect them see specific paragraph).
The fuel supply system is fitted with an inertial switch (9) which is triggered in the event of a crash cutting off the fuel pump connection to earth, thereby also the flow of fuel to the injection system.

Note on serviceable fuels:
in order to work correctly, the engine must run on unleaded fuel (95 R.O.N.) as the presence of lead would quickly wear out the catalytic converter of the exhaust system.

WARNINGS

Before doing any work on the components of the fuel supply system, to prevent dangerous leaks of fuel, proceed as follows:
- Disconnect the fuel pump supply relay (1).



- Run the engine until it stops.

FUEL PIPE CONNECTORS

"JOHN GUEST" TYPE

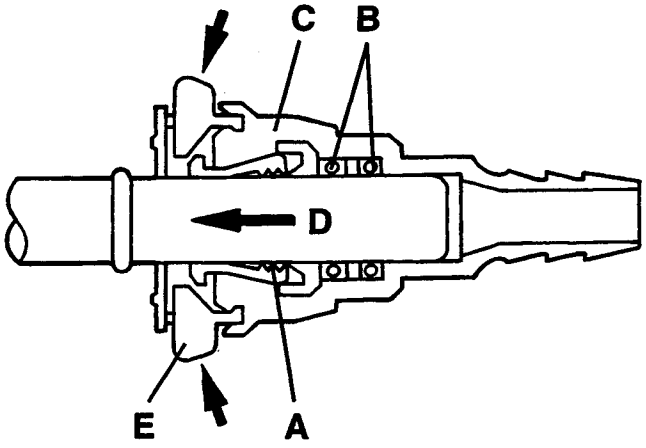
Cleaning for disconnection

Preferably use one of the following systems which are given in the order of their degree of efficiency.
a) Jet of lukewarm water (max 50 °C) on the connector and drying with jets of compressed air to prevent any residual water in the interstices from entering the pipe after disconnection.
b) Jet of cold water and drying with a jet of compressed air.
c) Jet of hot water with neutral soap.
d) Jet of cold water with neutral soap.

Never use solvents and/or materials that are not compatible with the pipes in general and for the connector in particular, not compatible with nylon and acetalic resin.

Operations for disconnection

After a certain length of time the connector tends to act as follows:
- The clamp "A" bites the tang with the steel teeth; if in plastic, the teeth can slightly dent the tang without adversely affecting sealing.
- Over the course of time, the seals (O-Ring) "B" nel tempo, tend to stick on the surface of the tang regardless of whether it is plastic or metal, this way the coupling appears to be stuck and impossible to release only pressing on the tab "E" and pulling.



In this case, to disconnect proceed as follows:
- Turn 1/4 - 1/2 a turn right and left several times (at least five) the body "C" of the connector with respect to the tang to eliminate friction of the seals on the tang itself and at the same time push the connector in the direction of the arrow "D" to loosen the grip of the clamps.
- Press the release buttons with the fingers.
- Pull the connector to disconnect it.
If this is still difficult, repeat the above operations checking that the connector is clean and that there is no mud or dirt in the interstices hindering the movement of the release mechanisms.

NOTE: Do not use pliers, screwdrivers, etc. to disconnect the connector. If the connector has not been tampered with and the operations have been carried out correctly, no tools are necessary.

"HURON" TYPE

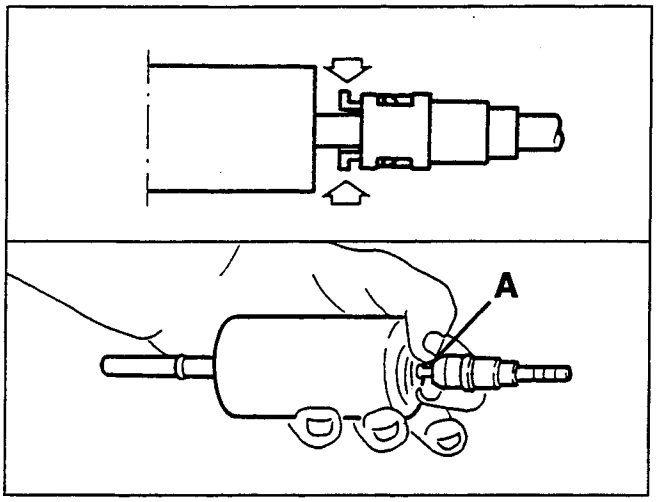
Operations to be carried out before disconnection

- Thouroughly clean the connector area with a jet of cold water (or hot, max 50°C) and dry with compressed air.
- A jet of water (hot or cold) may also be used with neutral soap.

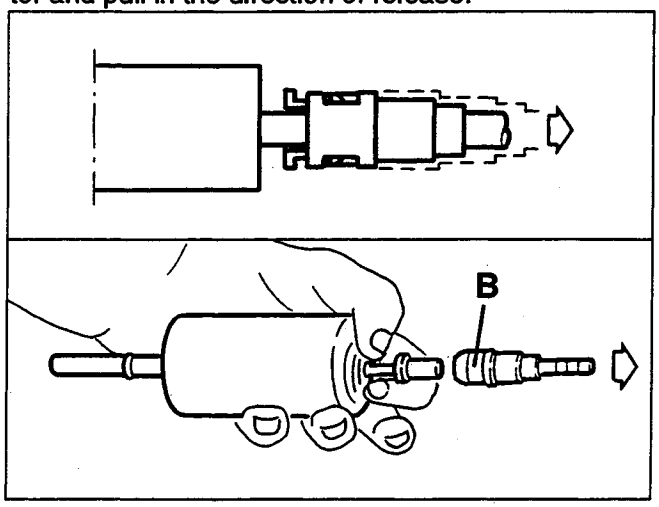
Never use solvents and/or materials that are not compatible with the pipes in general and for the connector in particular, not compatible with nylon and acetalic resin.

Operations for disconnection/connection

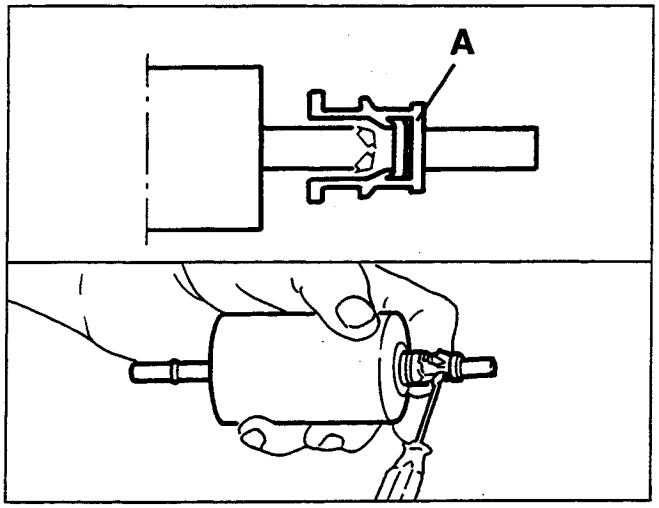
- Pinch the white transparent insert "A" between the thumb and forefinger and keep it pressed.



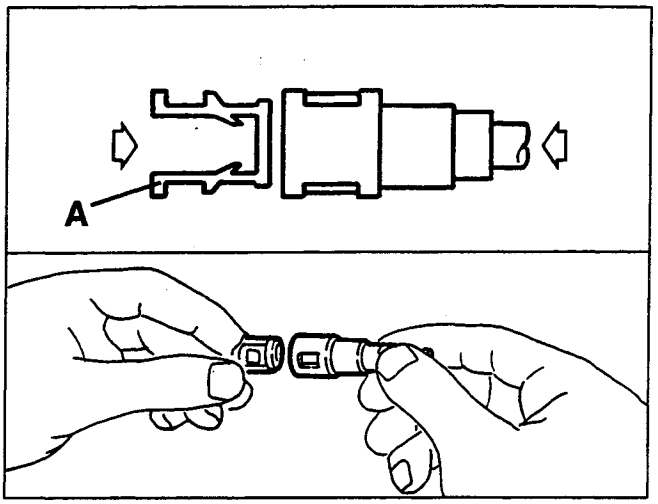
- With the other hand, grip the body "B" of the connector and pull in the direction of release.



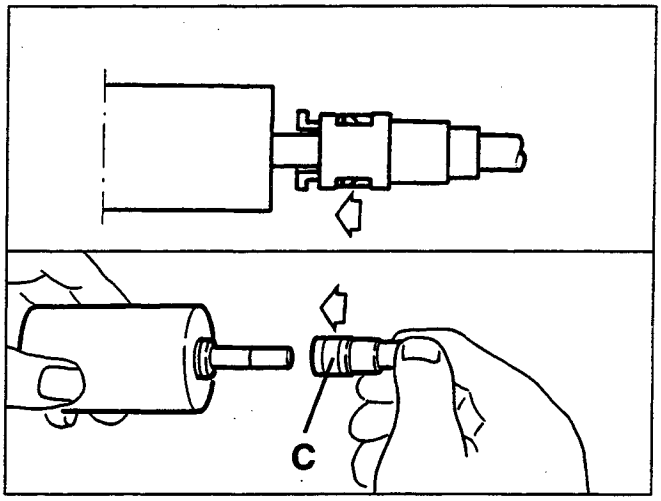
- Using a fine-tipped screwdriver in the points shown by the arrows, remove and retrieve the insert "A" taking care not to damage it.



- Refit insert "A" on the body of the quick coupling, fitted on the pipe, until it clicks meaning that it has been fitted correctly.

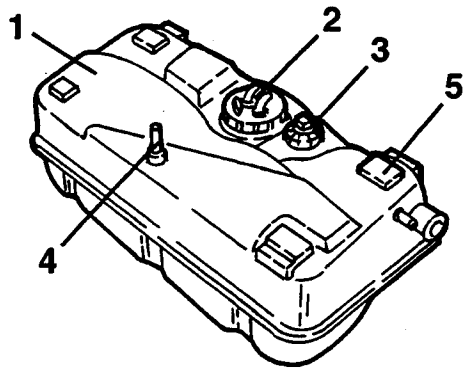


- Then connect the pipe with the quick coupling "C" pushing it until it clicks. Try to remove the coupling to make sure that it has been installed correctly.



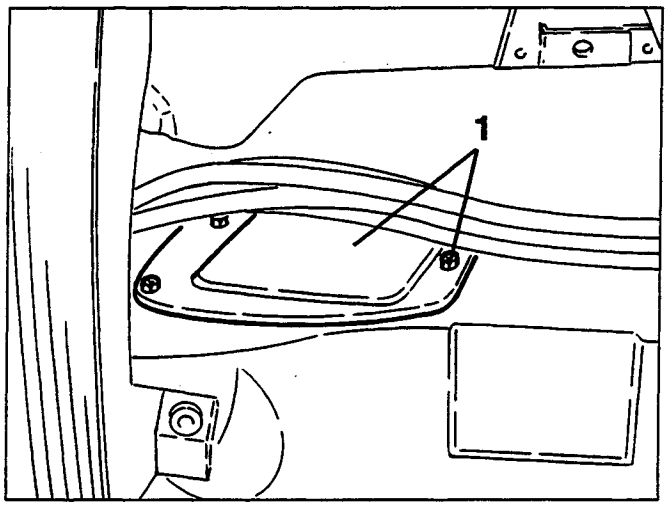
FUEL TANK

The fuel tank is made from sheet metal and has a capacity of 70 litres including a reserve of appr. 9 litres.
The fuel filler is on the main body and a special opening makes it possible to disconnect it from the tank for removal of the fuel tank itself.



1. Fuel tank
2. Fuel pump
3. Fuel level gauge
4. Vapour breather pipe
5. Antivibration pads

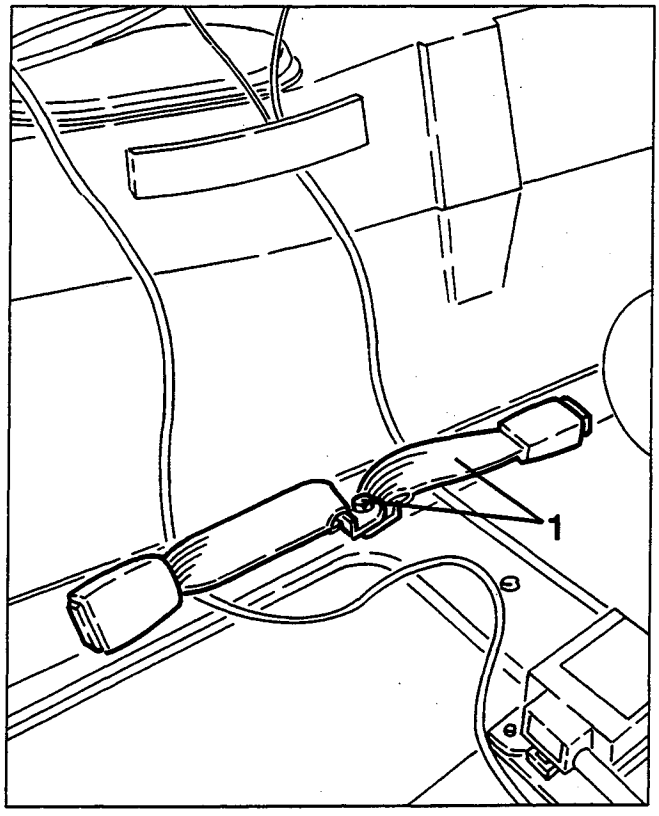
The fuel filler cap has a special device which enables it to be tightened only to the specified torque, this way excessive tightening beyond the specified value is prevented.
The tank is positioned in correspondence of the rear seat and fastened by two metal straps to the underbody and it is protected by a special sheet metal partition.
The pipe on the fuel filler acts as a breather.
There is an opening in the upper part of the tank for housing the fuel pump and fuel level gauge.
A special takeoff on the tank allows the fuel vapours to reach the vapour separator via a connection pipe.



REMOVING/REFITTING

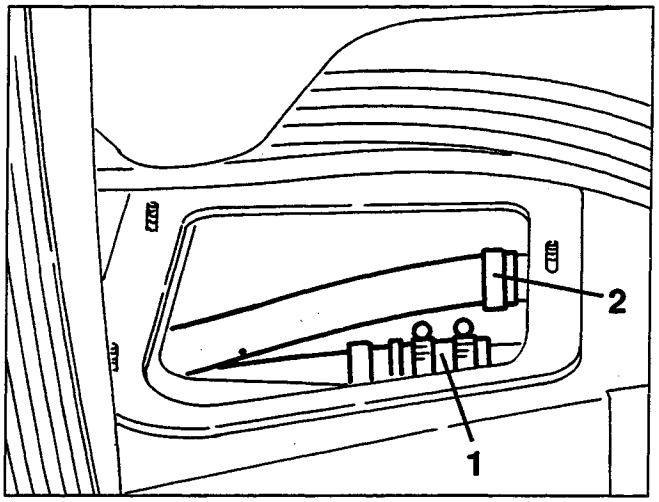
- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Empty the tank withdrawing the fuel through the filler using a special pump.
- Remove the rear seat cushion and back (see specific paragraph).

1. Slacken the fastening screw and remove the rear seat belt "whips".

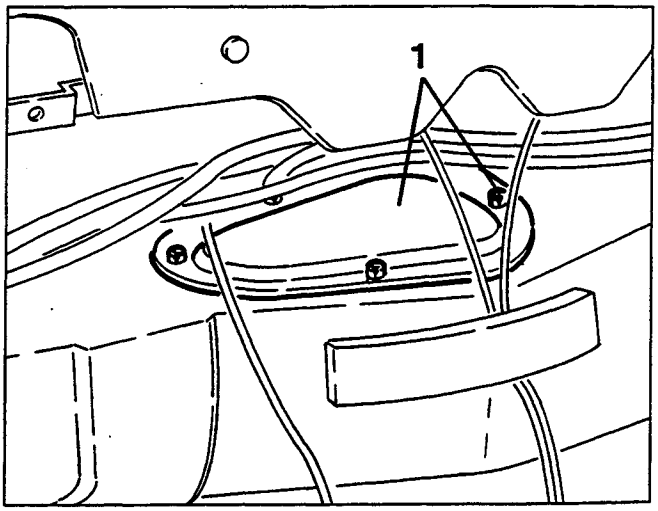


1. Slacken the fastening nuts and remove the access cover to the fuel filler.

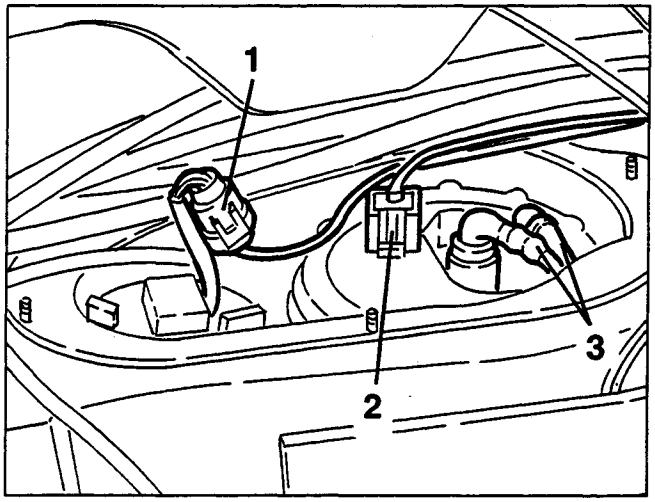
1. Slacken the fastening clamp and disconnect the fuel filler from the tank.
2. Slacken the fastening clamp and disconnect the breather pipe from the fuel tank.



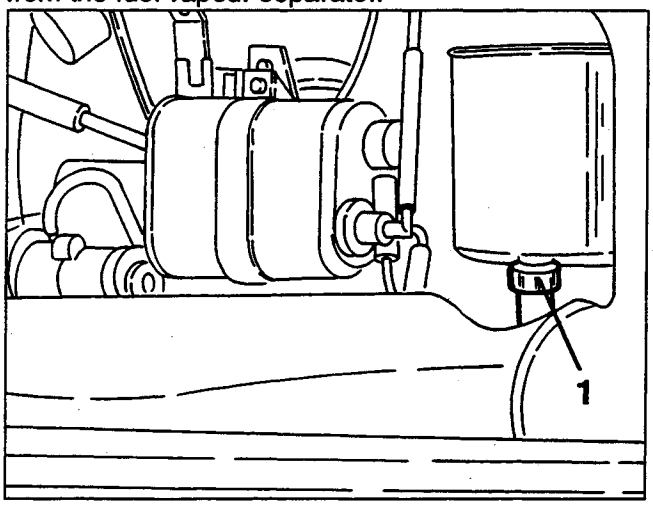
1. Slacken the fastening nuts and remove the access cover to the fuel pump and fuel level gauge.



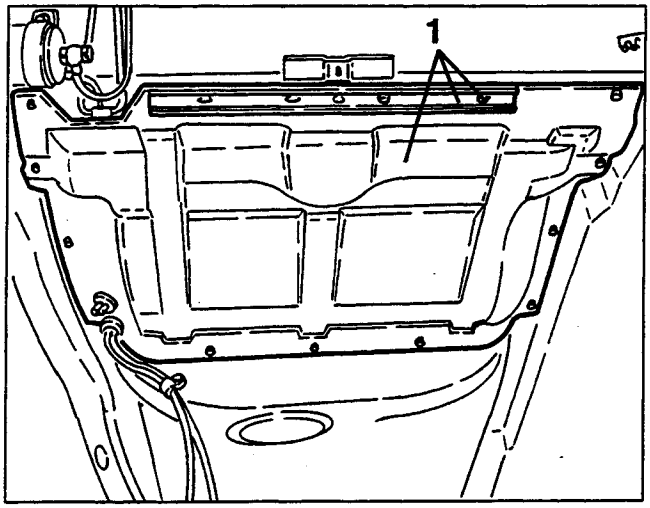
1. Disconnect the electrical connection from the fuel level gauge.
2. Disconnect the electrical connection of the fuel pump.
3. Disconnect the fuel delivery and return pipes from the pump.



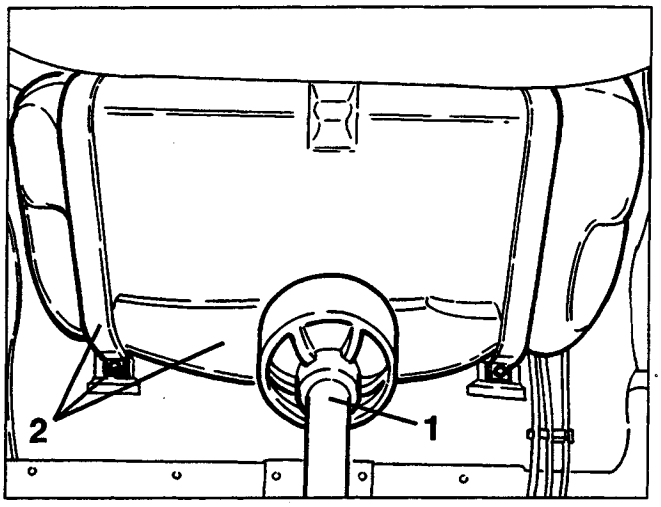
1. Working from the luggage compartment, pull back the trim and disconnect the the fuel vapour inlet pipe from the fuel vapour separator.



- Raise the car and remove the rear Multilink suspension (see specific paragraph).
1. Slacken the fastening screws and remove the sheet protecting the fuel tank complete with reinforcement bracket.



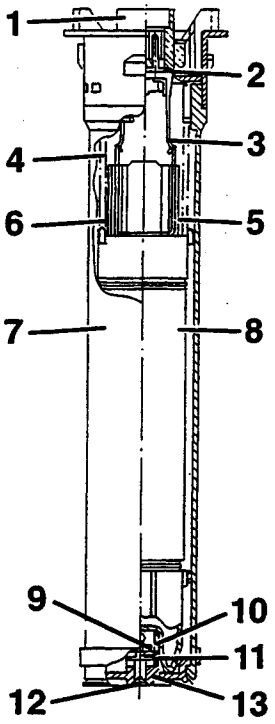
1. Position a hydraulic bracket under the tank.
2. Slacken the fastening screws of the fuel tank metal support straps, then remove the tank lowering the hydraulic jack.



FUEL LEVEL GAUGE

This is of the axial floating type and it is fastened to the tank by a bayonet coupling.
Its main feature is that it prevents the gauge pointer from swaying when cornering and on twisting roads. This is because the float that runs inside the tube of the level gauge is submerged in the fuel and is therefore only sensitive to the hydrostatic thrust and not to the differences in level due to swaying of the vehicle.

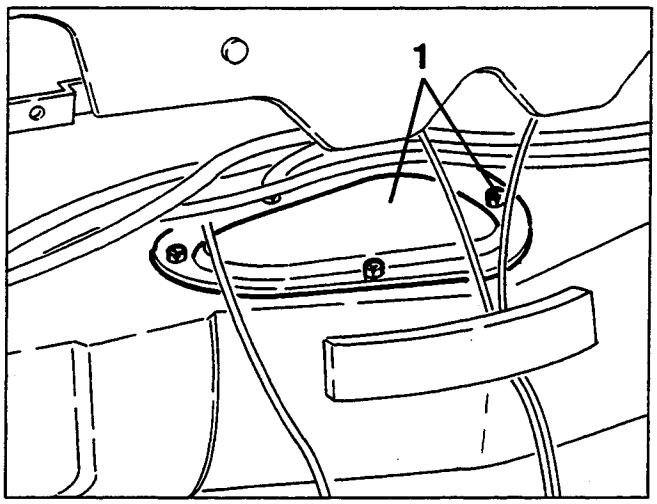
1. Connector
2. O-Ring
3. Sliding blade
4. Resistance
5. Common blade
6. Upper spring
7. Tube
8. Float
9. Adjustment pin
10. Lower spring
11. Cup
12. Cap
13. Base



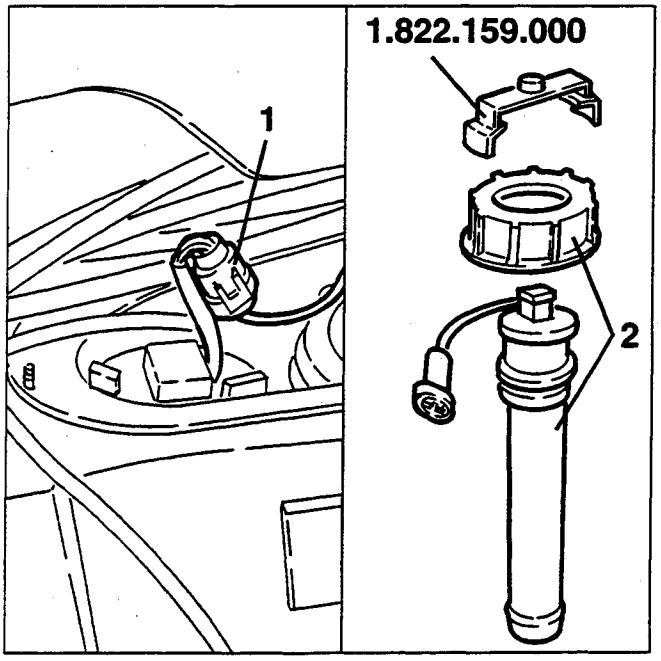
REMOVING/REFITTING

- Disconnect the battery (-) terminal.
- Remove the back of the rear seats (see specific paragraph).

1. Slacken the fastening nuts and remove the access cover to the fuel pump and to the fuel level gauge.



1. Disconnect the electrical connection of the fuel level gauge.
2. Using tool no. 1.822.159.000, slacken the locknut and remove the fuel level gauge complete with seal.

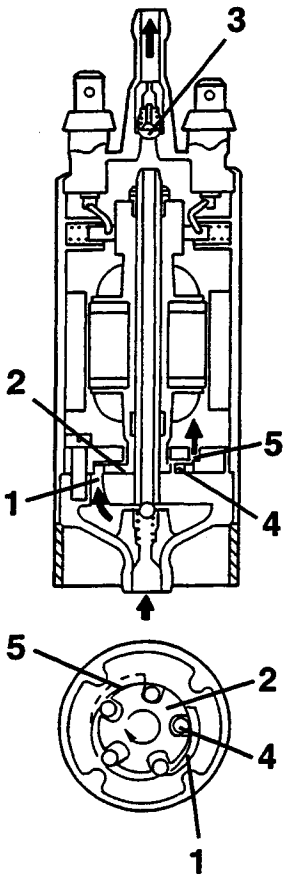


CHECKS AND INSPECTIONS

For a complete functional check, see GROUP 55 - ELECTRIC SYSTEM DIAGNOSIS.

FUEL PUMP

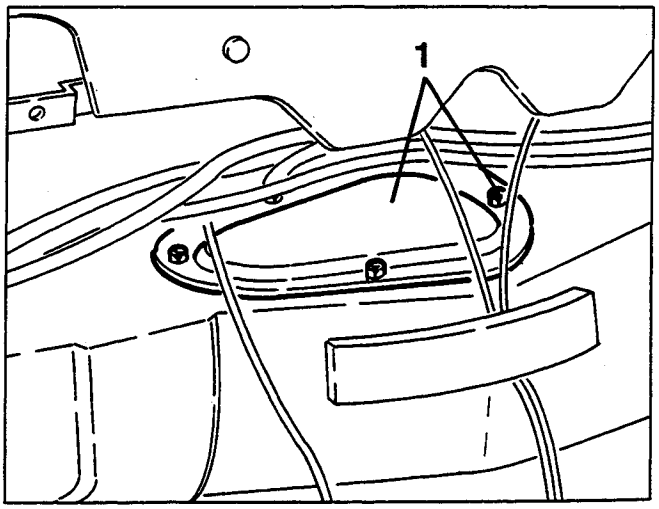
The electric pump, submerged in the tank is of the volumetric displacement type with rollers (4), with brush motor and excitation by permanent magnets.
The impeller (2) turns, pulled by the motor, creating volumes which move from the inlet port (1) to the delivery port (5).
These volumes are delineated by the rollers which during the rotation of the motor adhere to the outer ring.
The pump is fitted with two valves: one is a check valve (3) to prevent the fuel circuit from emptying, when the pump is not operating; the second is an overpressure valve which short circuits the delivery with the inlet when pressures build up above 5 bar, thereby avoiding overheating the electric motor.
The supply contacts are polarised to prevent the connections from being inverted.



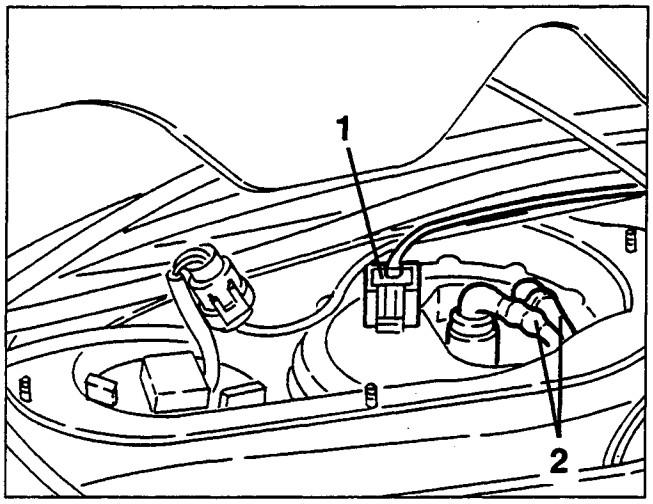
REMOVING/REFITTING

- Disconnect the battery (-) terminal.
- Remove the back of the rear seats (see specific paragraph).

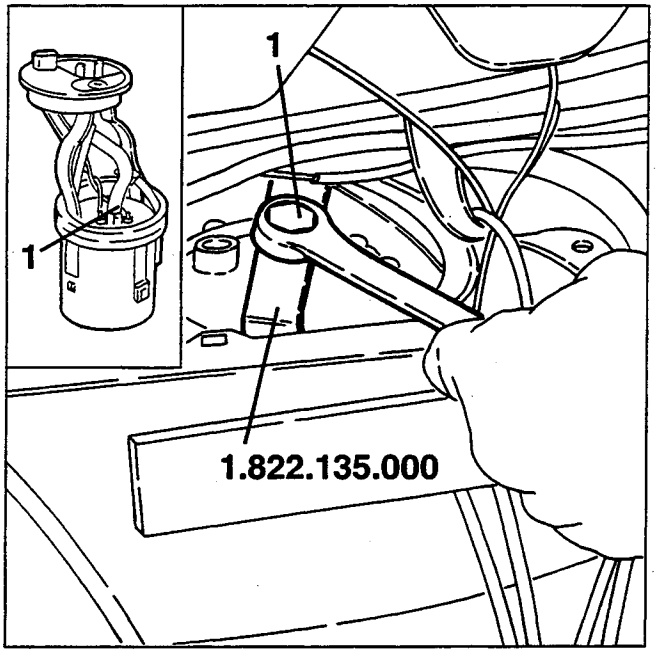
1. Slacken the fastening nuts and remove the access cover to the fuel pump and to the fuel level gauge.



1. Disconnect the electrical connection of the fuel pump.
2. Disconnect the fuel delivery and return pipes from the pump.

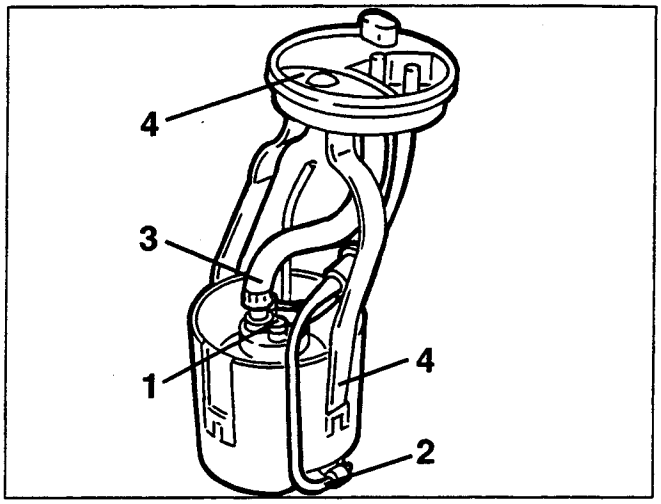


1. Using tool 1.822.135.000, slacken the locknut fastening the fuel pump, then withdraw it from its housing complete with seal.

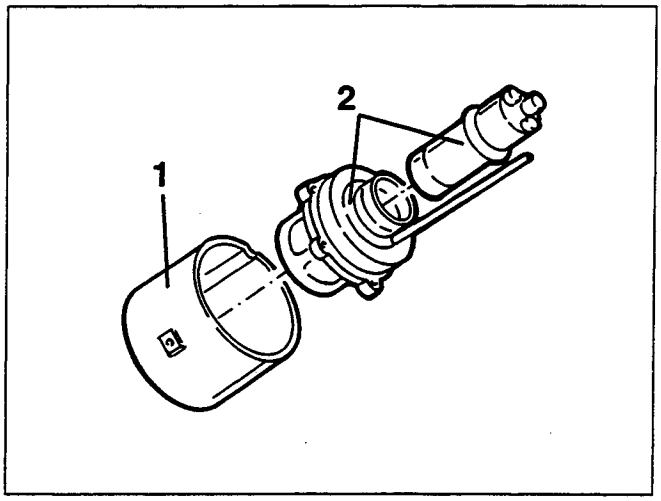


DIS-ASSEMBLY/RE-ASSEMBLY

1. Disconnect the two electrical connections from the fuel pump.
2. Disconnect the excess fuel return pipe from the pump tray.
3. Disconnect the delivery pipe from the fuel pump.
4. Prise the end of the spring, then separate the cover from the pump.



1. Withdraw the tray from the fuel pump assembly.
2. Slacken the fastening clamp and withdraw the fuel pump from the filtering support.



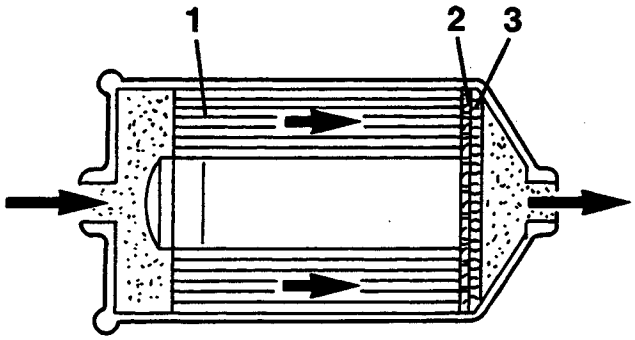
CHECKS AND INSPECTIONS

Accurately clean the mesh filter.
The presence of water in the fuel is particularly harmful to the pump as it causes inside rust. Carefully check the operation of the pump if the fuel is contaminated with water.
Also check the efficiency of the supply contacts since any rust would reduce the voltage at their terminals, thereby reducing delivery resulting in the formation of bubbles and reduction of the fuel injected.

NOTE: In the event of replacement, remember that the pump is supplied filled with protective oil and with the unions closed by special plugs. When installing on the vehicle, it is not necessary to empty the pump as the oil is burnt in the engine. If the protective oil is emptied from the pump, it is necessary to put it into operation within two weeks to prevent the formation of a film of dry oil on the motor collector which would ruin it due to the lack of electrical continuity.

FUEL FILTER

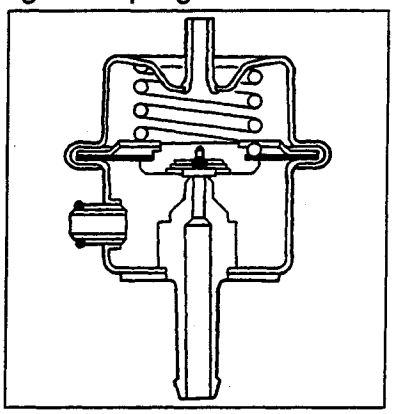
The filter is inserted in the fuel delivery pipe to the injectors, under the car floor, next to the fuel tank.
It is formed of an outer aluminium cover and an inner polyurethane support which contains a paper element with a high filtering power (~ 5 µm) and a surface of appr. 1400 cm^2.
Fuel filtering is indispensible to ensure correct operation of the electrojectors, given their sensitivity to foreign particles contained in the fuel circuit.
There is an arrow on the outer filter cover which indicates the direction in which the fuel flows and therefore the correct assembly position.



1. Paper filter *2. Fabric filter* *3. Mesh*

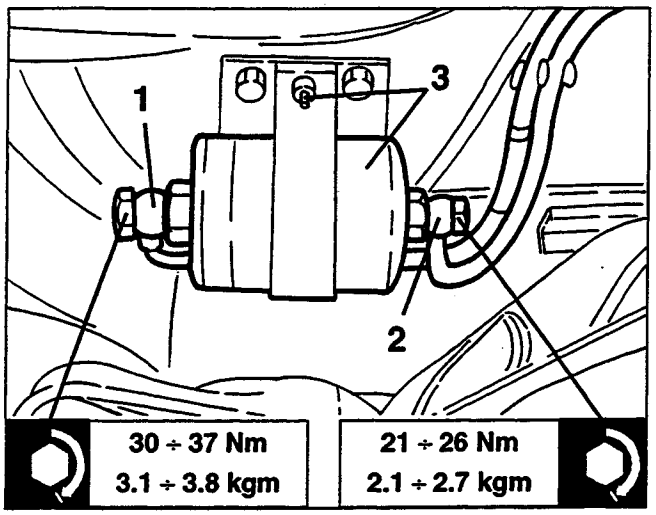
FUEL PRESSURE REGULATOR

The task of the fuel pressure regulator is to keep the difference between the pressure of the fuel and the pressure in the intake manifold constant.
This way it is possible to meter the amount of fuel solely on the basis of the injector opening time.
The pressure regulator is fitted downstream of the fuel distributor manifold.
It is a limiting regulator controlled by a diaphragm which regulates the fuel pressure to appr. 3 bar.
When the fuel pressure exceeds the maximum rating, the diaphragm acts on a valve which opens the return pipe, through which the excess fuel is returned to the fuel tank.
A tube connects the regulator spring chamber to the air intake box.
An interdependence is created by this connection between the pressure in the fuel circuit and the pressure in the intake box, so that the pressure between the inlet and outlet of the electroinjectors is always the same, when they are open.



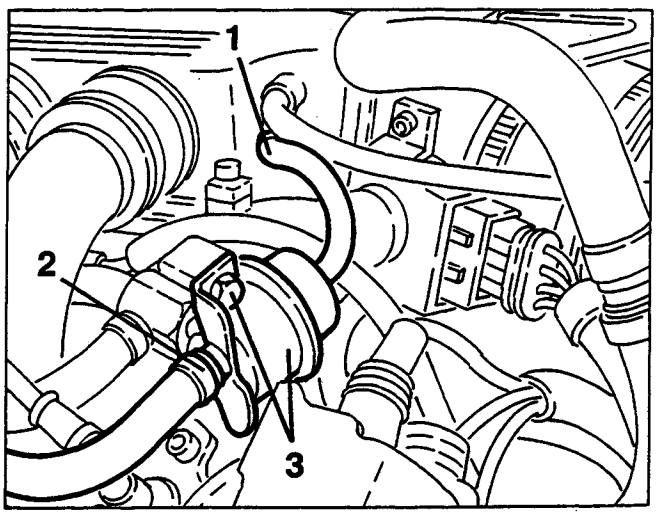
REPLACEMENT

- Set the car on a lift and raise it.
1. Disconnect the fuel inlet pipe fitting from the filter.
2. Disconnect the fuel outlet pipe fitting from the filter.
3. Slacken the fastening clamp and remove the fuel filter.



REMOVAL/REFITTING

1. Disconnect the vacuum takeoff pipe from the fuel pressure regulator.
2. Disconnect the excess fuel return pipe from the pressure regulator.
3. Slacken the two fastening screws and remove the fuel regulator from the fuel distributor manifold and retrieve the O-Ring.

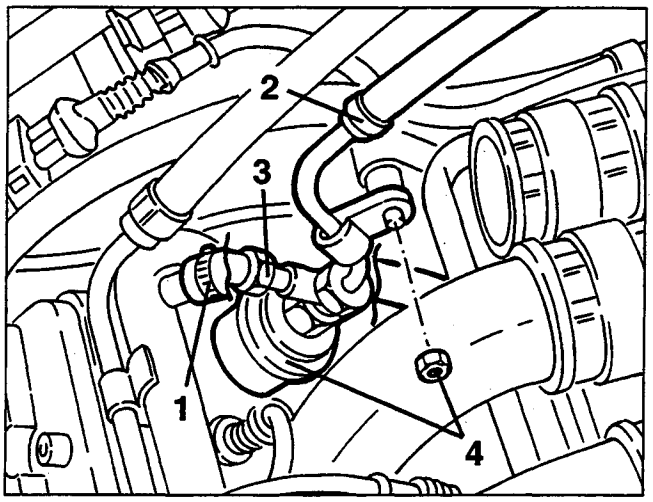


PULSE DAMPER

The pulse damper is connected to the inlet of the fuel distributor and it serves to suppress the pulsing noises that can occur especially at low engine rpm.
The pulsing is generated by pressure differences of the fuel deriving from the opening and closing of the electroinjectors or of the pressure regulator.

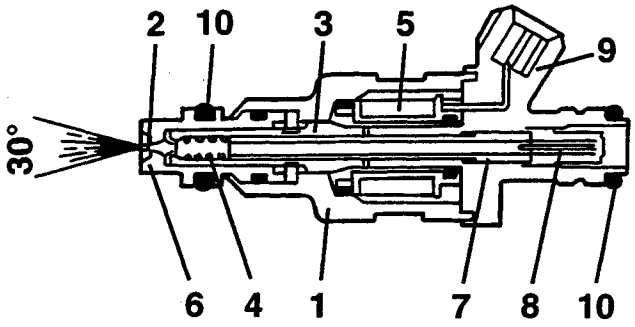
REMOVAL/REFITTING

- Remove the intake manifold of cylinder no. 4.
1. Disconnect the fuel distributor manifold connection pipe.
2. Disconnect the fuel inlet pipe from the pulse damper.
3. Disconnect the pulse damper from the fuel distributor manifold slackening its coupling.
4. Slacken the nut of the fastening clamp and remove the pulse damper complete with stiff pipes.



ELECTROINJECTORS

The injector nozzle is formed so that the jet of fuel atomizes into a 30° cone.
The injectors are locked by the fuel distributor which presses them into their housings machined on the intake ducts.
The injectors are also anchored to the fuel distributor by "safety catches" and sealed by two O-Rings.
The electroinjectors have the task of metering the amount of fuel needed by the engine.
They are "all or nothing" devices i.e. they only have two possible conditions, either open or closed.
They will let the fuel pass when they are "open" and prevent it from being delivered when they are "closed".
They basically comprise a nozzle controlled by an electromagnet and by a return spring.
In the rest position, the needle, which forms one piece with the core, is pushed by the spring onto the electroinjector nose to close the hole and ensure that unwanted fuel is unable to come out.
As soon as the winding is energized, the core is attracted, it compresses the spring opening the nozzle hole, thereby allowing the fuel to flow out.
Considering the physical characteristics of the fuel (viscosity, density) and the pressure difference (pressure regulator) constant, the amount of fuel injected depends on the injector opening time only.
The winding energizing time is normally called the "injection time".



1. Injector body
2. Needle
3. Magnetic core
4. Helical spring
5. Winding
6. Injector nose
7. Adjustable pressure plate
8. Filter
9. Electrical connection
10. Seal rings

CHECKING FOR CORRECT OPENING OF ELECTROINJECTORS

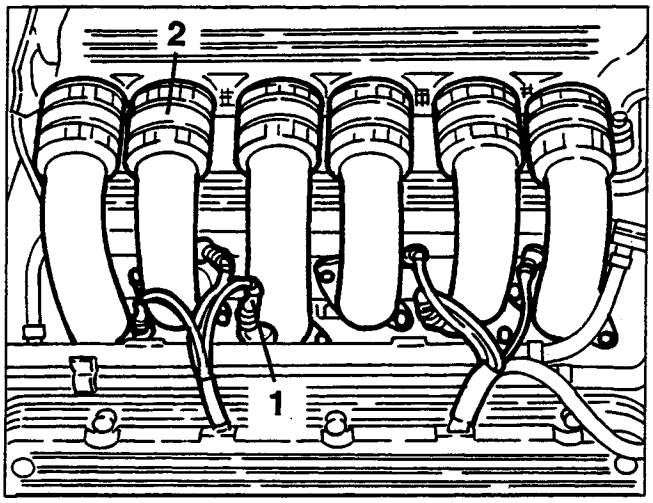
- Measure the percentage of CO at the exhaust.
- Disconnect the electroinjector connectors one by one; each time measure for a reduction of the CO percentage at the exhaust and check that this value remains constant at each check.
- If not, locate and replace the faulty electroinjector; in any case a visual index of the efficiency of the electroinjectors is given by the spark plug electrodes:
• a mixture which is too rich corresponds to a black colour.
• a mixture which is too lean corresponds to a light colour.

CHECKING THE SEALING OF ELECTROINJECTORS

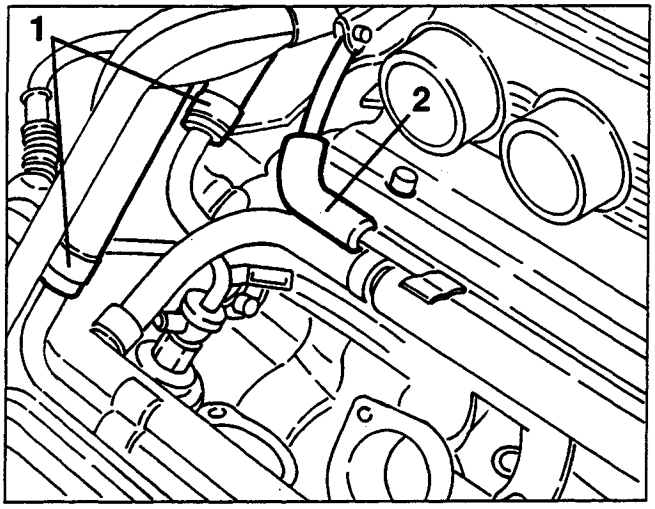
- Remove the electroinjectors complete with fuel distributor manifold, keeping the fuel supply circuit connected.
- Disconnect the electrical connections from the electroinjectors.
- Operate the starter motor and check that there are no leaks of fuel from the electroinjectors; if so replace the faulty injector.

REMOVAL/REFITTING

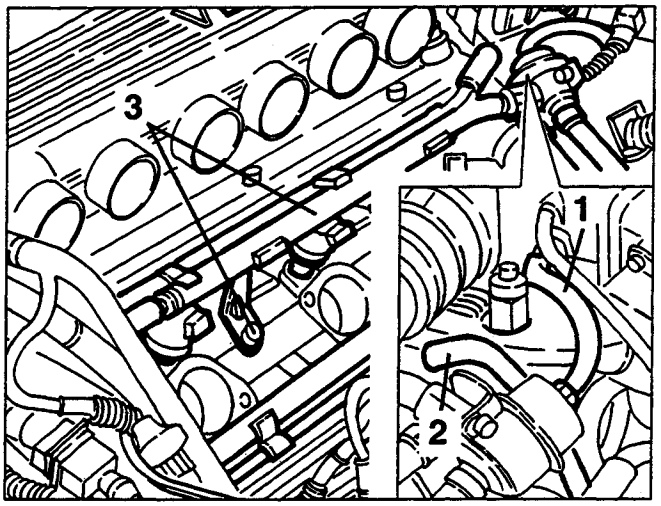
- Disconnect the battery (-) terminal.
1. Disconnect the electrical connections from the electroinjectors.
2. Remove the intake ducts.



1. Disconnect the fuel delivery and return pipes from the fuel distributor manifold.
2. Disconnect the fuel vapour recirculation pipe.

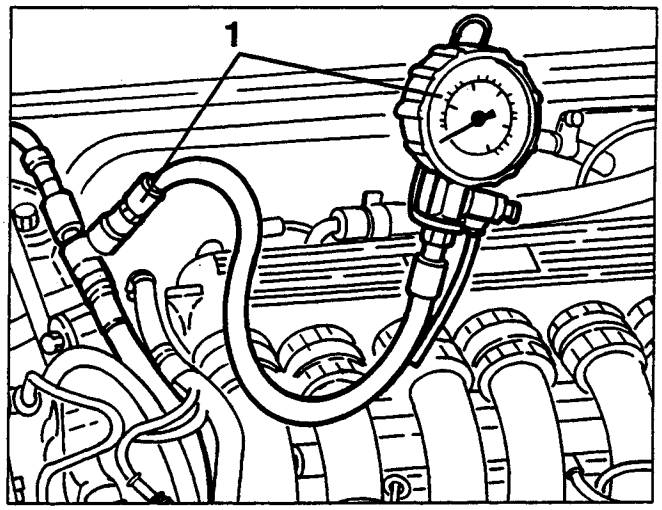


1. Disconnect the vacuum takeoff pipe for the fuel pressure regulator from the intake box.
2. Disconnect the fuel vapour delivery pipe to the intake from the distributor manifold.
3. Slacken the fastening screws and remove the fuel distributor manifold complete with injectors, fuel pressure regulator and pulse damper.
- Working on the bench remove the safety catches and remove the injectors from the fuel distributor manifold.



CHECKING THE PRESSURE AND TIGHTNESS OF THE FUEL CIRCUIT

1. Disconnect the fuel delivery pipe from the pulse damper, then connect a pressure gauge, using a "T" adapter, between the damper and the disconnected pipe.
- Disconnect the fuel pressure regulator vacuum takeoff pipe to avoid any irregularities in the rotation speed from causing abnormal readings.
- Start the engine and at idle speed check that the fuel pressure is within the specified limits.

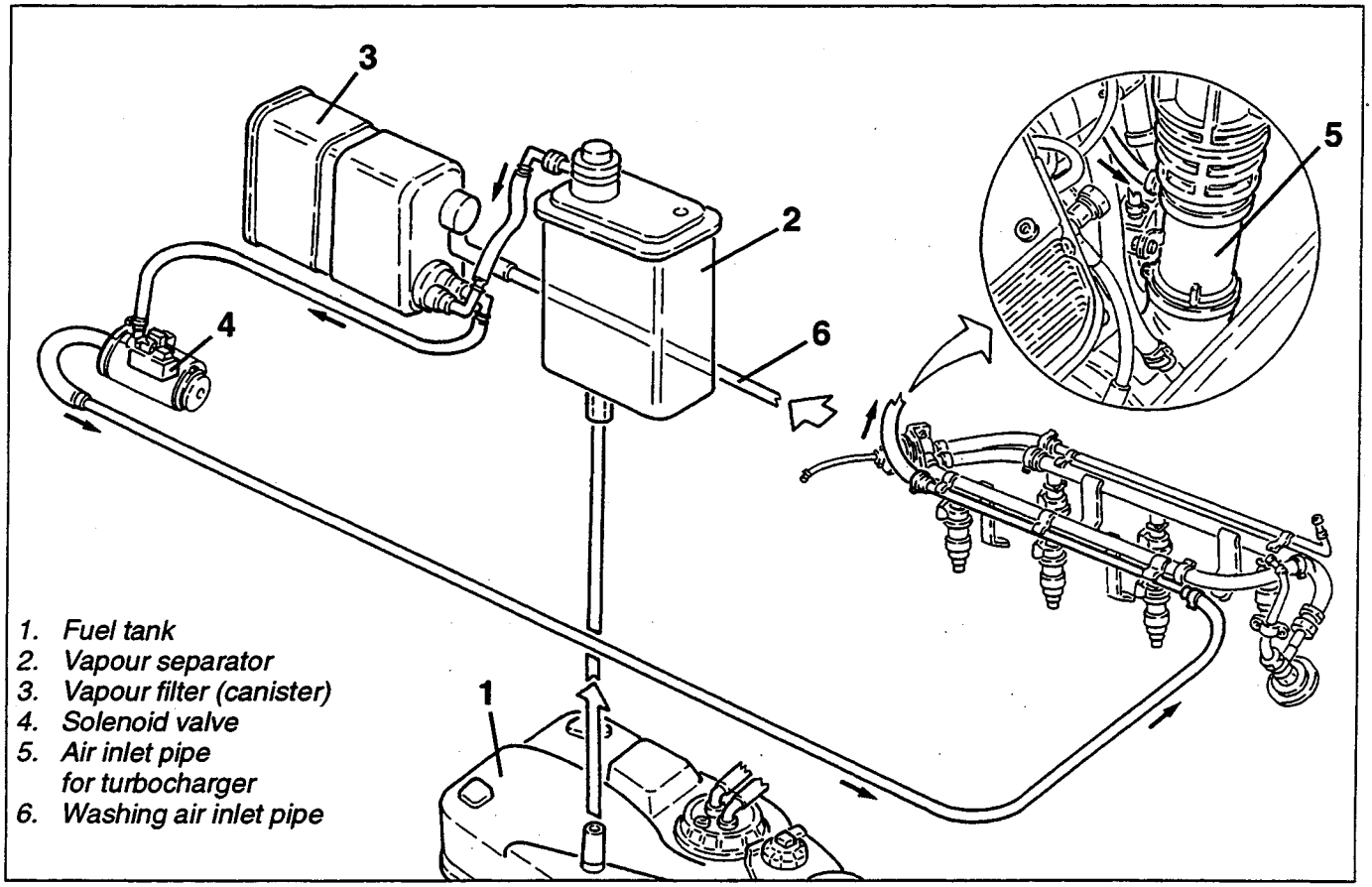


Fuel pressure at idle speed
3 bar

- Reconnect the vacuum takeoff pipe on the regulator and check that the fuel pressure falls by ~ **0.5 bar** and then rises again when the throttle valve opens.
If this fails to occur, look for any leaks in the vacuum takeoff pipe.

- Keeping the vacuum takeoff pipe connected to the regulator and with the engine running at idle speed, choke the regulator fuel outlet pipe noting the increase in pressure up to ~ **4 bar** (do not allow the pressure to exceed this rating).
- If the pressure does not reach this rating and no leaks are detected, check the fuel filter and/or that the pump is working properly.

DESCRIPTION OF THE FUEL VAPOUR RECOVERY SYSTEM



The fuel contained in the tank produces a considerable amount of vapours, which would pollute the environment if released.
The vapour control and recovery system gathers these vapours and burns them in the engine.
The vapours leading from the fuel tank through a special pipe reach the vapour separator which due to its special shape allows the condensed fuel to return in droplet form to the fuel tank. The remaining vapours are then sent to the fuel vapour filter canister where they are absorbed and stored by the active carbon contained in the filter.
There is a solenoid valve between the fuel vapour filter and the intake box: when the solenoid valve is not activated the connection with the intake is closed and the fuel vapours are collected in the canister in the active carbon.

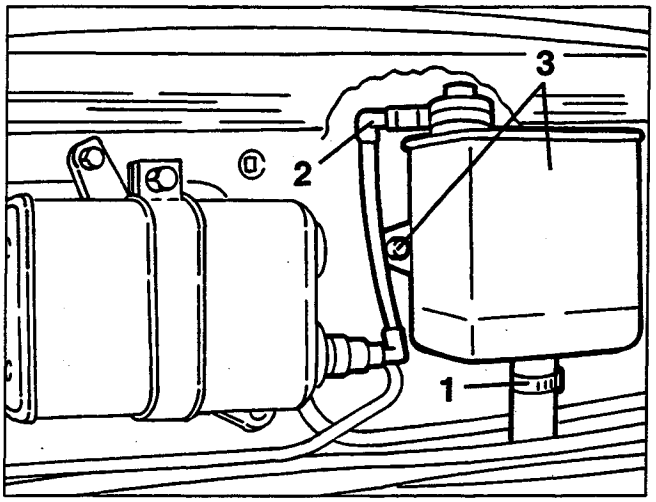
Under certain load conditions the control unit controls the opening of the solenoid valve allowing any fuel vapours in the canister to be withdrawn. This condition remains even if at the exhaust the lambda sensor detects a reduction of oxygen which, due to the presence of too much fuel in the combustion chamber, is signalled to the control unit which delivers less fuel to the injectors so that the engine is always supplied under optimal conditions.
If there is a lack of fuel vapours in the canister, resulting in withdrawing only air, the lambda sensor detects this and signals the control unit of an increase in the oxygen.
In this case the control unit closes the solenoid valve thus preventing the connection of the canister with the intake box, thereby eliminating the excess air.

FUEL VAPOUR SEPARATOR

This is located in the luggage compartment, and its task is to limit the amount of fuel vapours reaching the canister, condensing part of them due to its shape.
It is formed of a plastic container with two connections: a lower one for the inlet of fuel vapours and the return of condensed fuel to the tank and an upper one for sending vapours to the canister.

REMOVAL/REFITTING

- Remove the spare wheel and turn over the special luggage compartment trim. panel.
1. Disconnect the fuel vapour inlet pipe from the separator.
2. Disconnect the fuel vapour delivery pipe to the canister from the separator.
3. Slacken the two fastening screws and remove the fuel vapour separator.

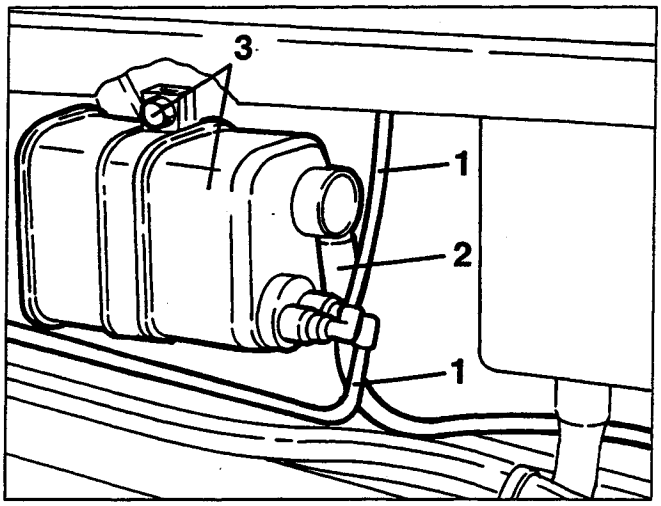


FUEL VAPOUR FILTER (CANISTER)

The filtering element is formed of active carbons enclosed in a plastic container. Their purpose is to absorb the fuel vapours leading from the separator.
A one-way valve, to which a special pipe is connected, admits outside air when the vapours are withdrawn to wash the active carbons.

REMOVAL/REFITTING

- Remove the spare wheel and turn over the special luggage compartment trim.
1. Disconnect the fuel vapour inlet and outlet pipes from the canister.
2. Disconnect the outside air inlet pipe from the one-way valve on the canister.
3. Slacken the fastening clamp screw and remove the canister.

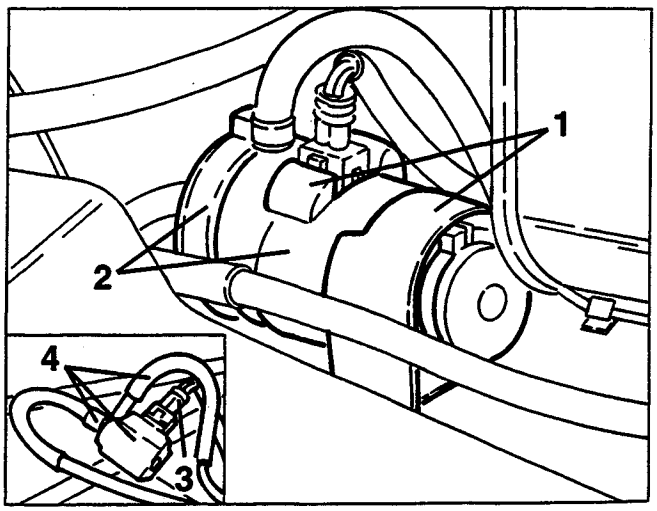


FUEL VAPOUR SOLENOID VALVE

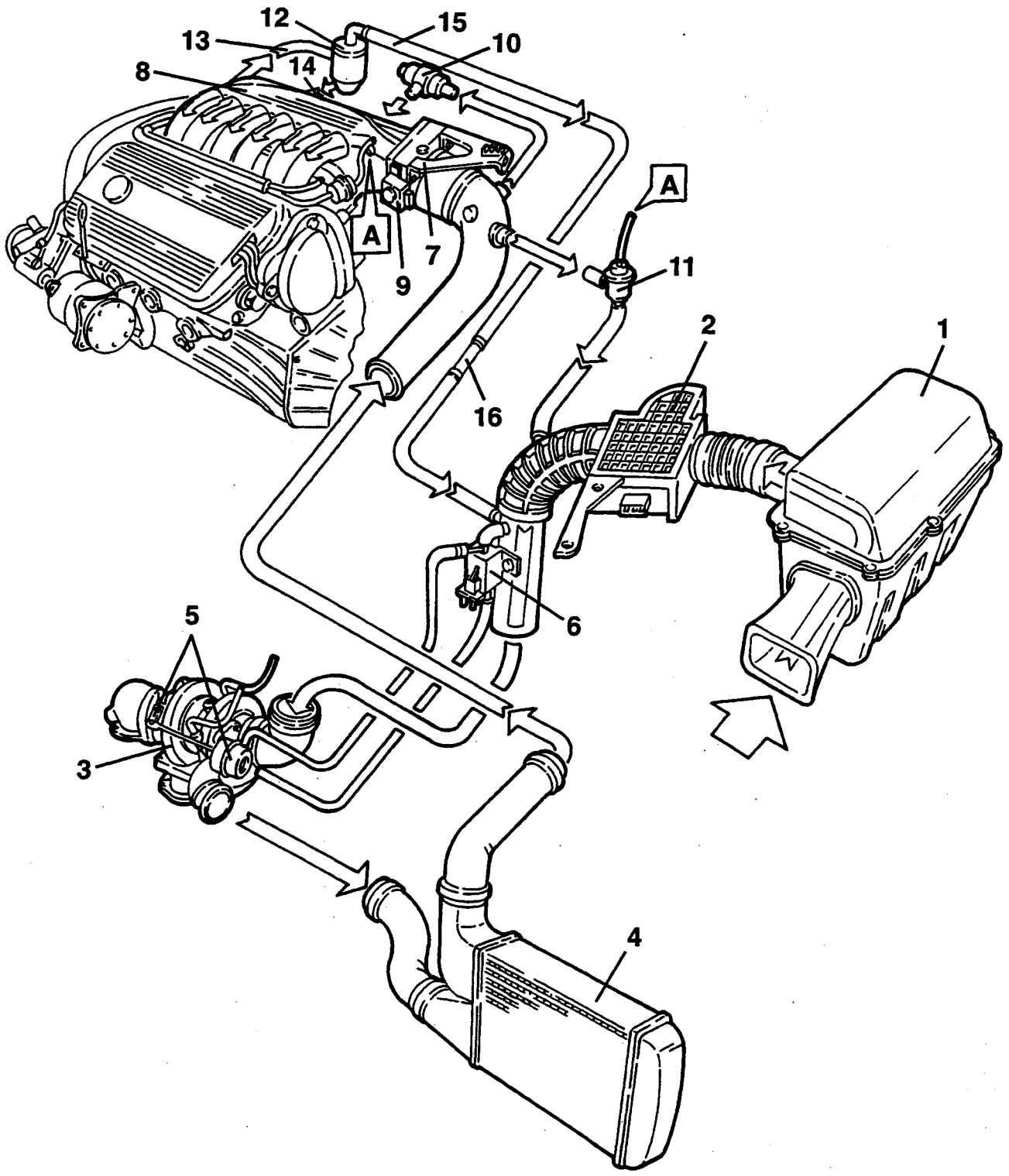
The reason for the use of this valve, controlled by the electronic control unit, is to send the vapours stored in the canister to the engine intake.

REMOVAL/REFITTING

- Remove the spare wheel and turn over the special luggage compartment trim.
- Disconnect the battery (-) terminal.
1. Remove the fuel vapour solenoid valve from its support.
2. Remove the clamps and release the solenoid valve from its protective case.
3. Disconnect the electrical connection from the fuel vapour solenoid valve.
4. Disconnect the fuel vapour inlet and outlet pipes, then remove the solenoid valve.



AIR SUPPLY AND OIL VAPOUR RECOVERY SYSTEM



1. Air cleaner
2. Air-flow meter with built-in intake air temperature sensor
3. Turbocharger
4. Intercooler
5. Waste Gate overpressure valve
6. Solenoid valve for controlling Over-Boost devices
7. Throttle body
8. Intake box
9. Throttle potentiometer
10. Constant idle speed actuator
11. Antistalling valve
12. Oil vapour separator
13. Oil vapour recovery pipe
14. Condensed oil recovery pipe
15. Oil vapour recirculation pipe
16. Sleeve with calibrated diameter

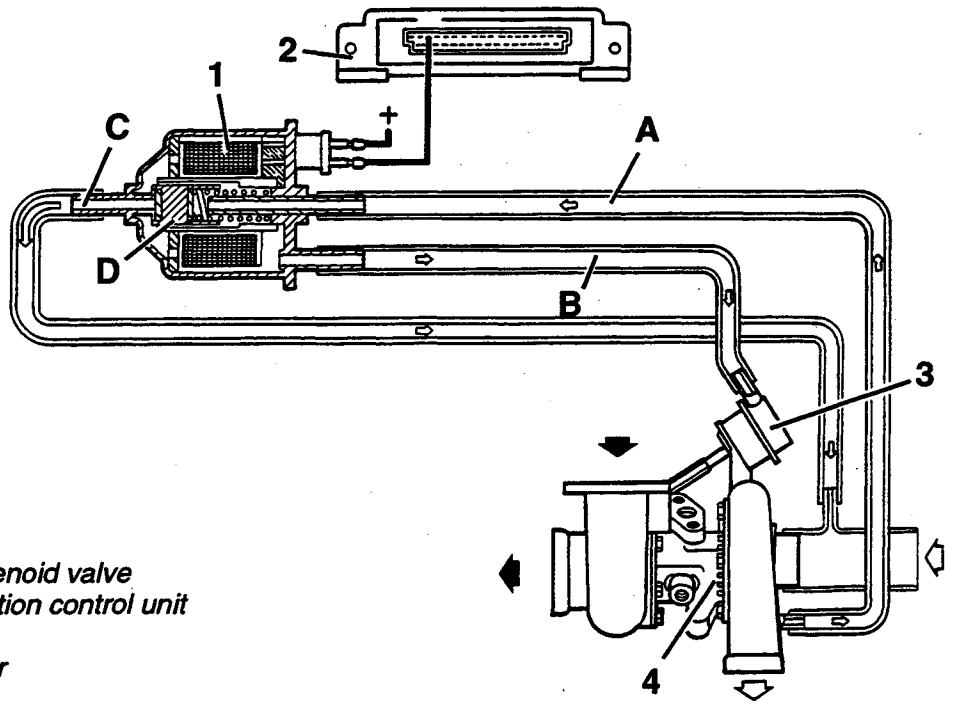
DESCRIPTION

The air taken in through a dynamic inlet and filtered by a cartridge element (1), passes through the corrugated sleeve via the air-flow meter (2) with built in intake air temperature sensor.
From the corrugated sleeve the air reaches the turbocharger (3) which sends it under pressure, via a special pipe, to the intercooler (4) which lowers its temperature enabling better filling of the cylinders due to the greater density.
Supercharging is managed by the ignition control unit which, after reading a whole series of parameters (rpm, throttle position, etc.), electronically controls the adjustment pressure in the Waste Gate overpressure valve (5) through a special Pierburg solenoid valve (6); for further details on supercharging management, see the following paragraph.
The air is sent from the intercooler through a special pipe to the throttle body (7) which is controlled by the accelerator cable and adjusts the amount of air to be sent to the intake box (8). On one side of the throttle body there is a potentiometer (9) fastened to the throttle pivot pin. The potentiometer informs the control unit of the position of the throttle.

On the intake box, there is an additional air solenoid valve (10) which, via a special pipe, by-passes the throttle body making it possible to keep engine rpm constant under particular operating conditions of the engine. The supercharging system is fitted with an antistalling valve (11) which has the purpose of reducing and eliminating "ramming" which occurs when the accelerator pedal is released abruptly when the engine is supercharging; it is controlled by a vacuum signal picked up from the intake box. When the throttle valve closes, the vacuum transmitted by the connection pipe to the intake box, the antistalling valve opens allowing the pressure upstream of the throttle (closed) from discharging into the intake pipe. The fuel vapours flow and oil vapours to the air supply system (see specific paragraph). These are produced while the engine is running and are gathered in the special separator (12) through a pipe (13) leading from the right-hand cylinder head; as the separator is lower in temperature, the oil vapours are partially condensed. The condensed oil returns to the engine through a special pipe (14), while the remaining vapours are sent through a pipe (15) to the intake and then burnt in the engine.

BOOST-DRIVE MANAGEMENT

The Pierburg solenoid valve is supplied directly from a key-operated positive signal controlled permanently by the electronic control unit.
With the solenoid valve electrically de-energized cylinder D closes duct C, leaving ducts A and B in communication; the pressure of the supply arriving in duct B acts on the Waste-Gate valve, thereby adjusting the boost pressure.

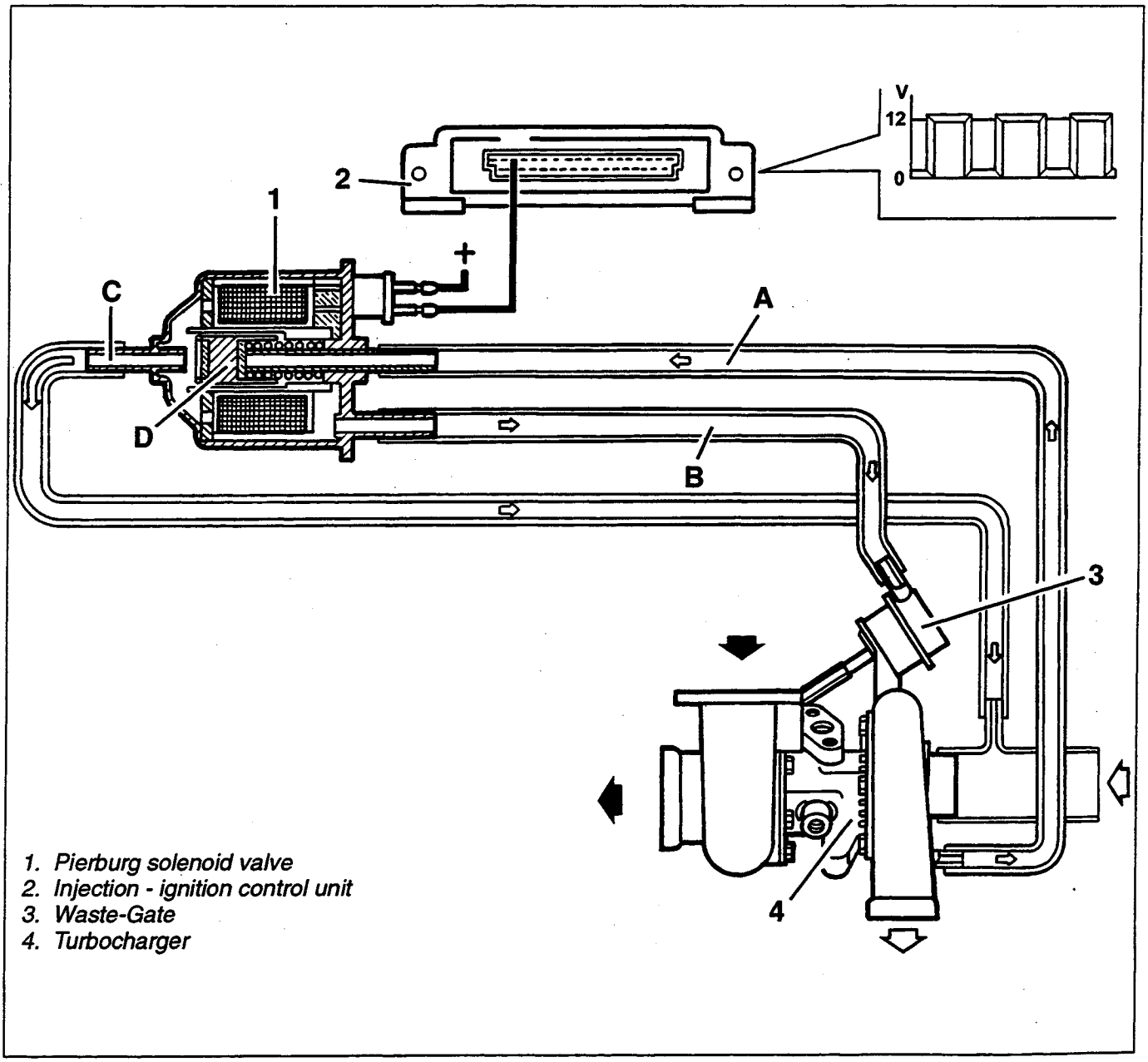


1. *Pierburg solenoid valve*
2. *Injection ignition control unit*
3. *Waste-Gate*
4. *Turbocharger*

When the control unit reads precise parameters such as the throttle valve opening and engine rpm, memorised inside it, it engergizes the Pierburg solenoid valve.
With the solenoid valve electrically energised, cylinder D opens duct C putting it into communication with duct A, at the same time closing duct B; the pressure supplied by the turbocharger, instead of acting totally on the Waste-Gate valve, it is partially relieved into the intake duct thereby enabling the supercharging of the engine to be increased.
When the solenoid valve is activated by the control unit cylinder D, controlled by a Duty-Cycle signal at a fixed frequency, opens duct C with variable times.
The Duty-Cycle varies on the basis of master curves memorised in the control unit which take account of the pressure in the intake manifold, engine rpm and the position of the throttle valve.

This new strategy enables continuous modulation of the supercharging pressure, thereby obtaining:
- high torque in a broader field of engine rpm;
- the power is delivered more gradually and smoothly;
- a guarantee of constant performance over time of the engines.

Owing to safety reasons, the control unit immediately suppresses the injection pulses if the supercharging pressure exceeds ~ **1.5 bar** and resumes them when the pressure has fallen below that rating.
When the pinging sensor signals the presence of pinging the control unit reduces the spark advance up to a maximum of **-6°** in **-3°** steps.

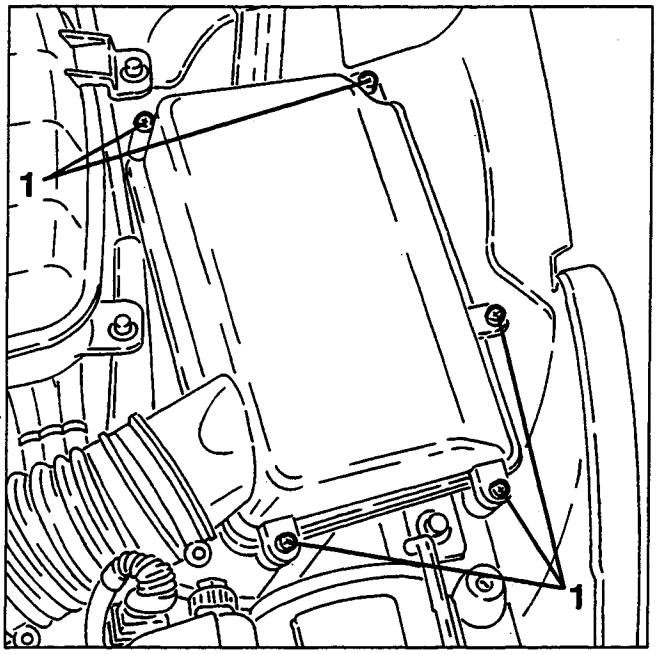


1. Pierburg solenoid valve
2. Injection - ignition control unit
3. Waste-Gate
4. Turbocharger

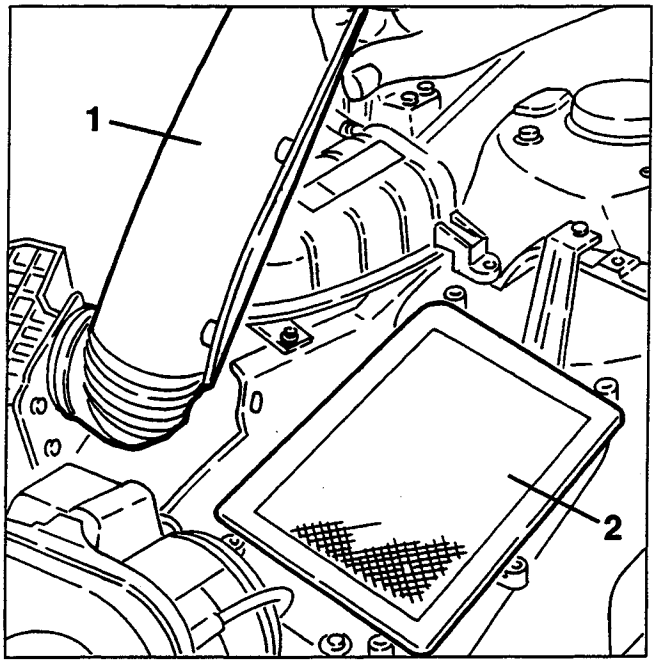
REPLACING THE AIR CLEANER CARTRIDGE

WARNING:
Any cleaning operation can damage the cleaner and may adversely affect operation of the engine.

1. Slacken the five screws fastening the air cleaner cover.



1. Raise the air cleaner cover without disconnecting it from the corrugated sleeve.
2. Remove the filtering element.

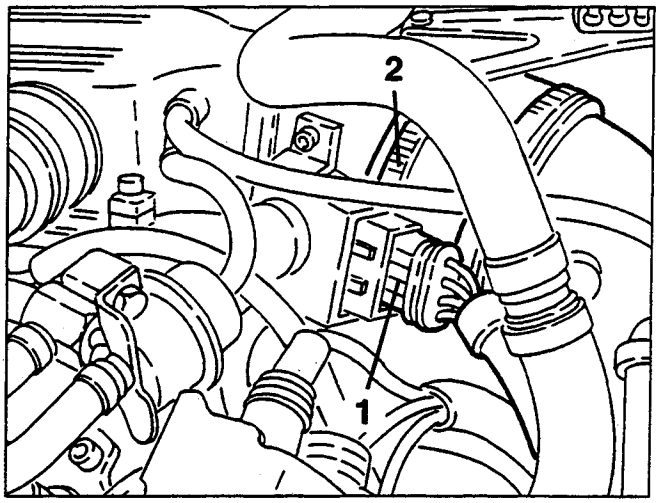


THROTTLE BODY

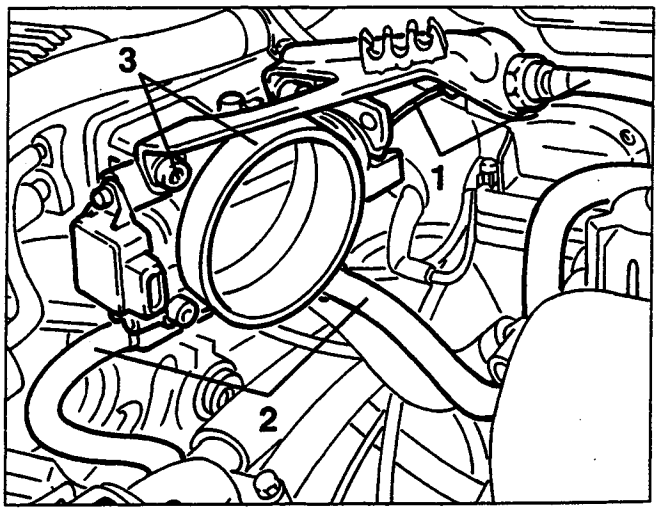
The throttle body adjusts the amount of air sent to the intake box in relation to the position of the accelerator pedal. In fact, the accelerator acts on a specific sector of pulley locked on the throttle valve pivot pin.
A coil spring allows the throttle to return to the closed position.
To prevent the formation of ice on the throttle valve which would prevent it from closing, the throttle body is heated by the engine coolant fluid.

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the throttle potentiometer.
2. Slacken the fastening clamp and disconnect the intake duct from the throttle body.



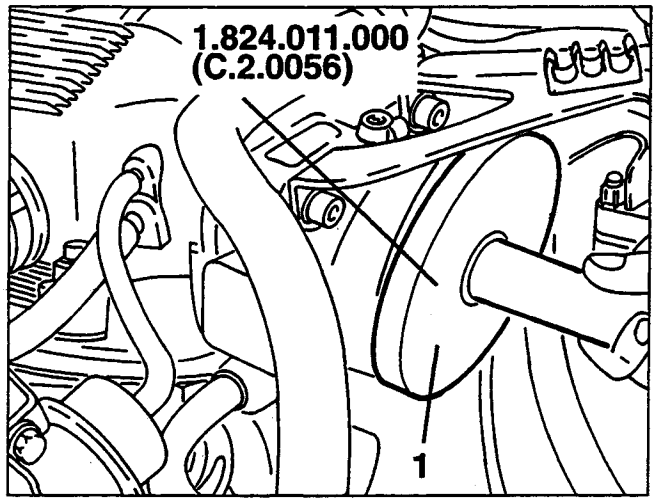
1. Disconnect the accelerator cable from the throttle.
2. Disconnect the two coolant fluid inlet and outlet pipes from the throttle body.
3. Slacken the fastening screws and remove the throttle body complete with potentiometer and accelerator cable support bracket and if necessary separate them on the bench.
- Remove the throttle body seal.



FLUXING TEST

- Proceed as described in the first two steps of the procedure for "Throttle body - Removal/Refitting".
1. Make sure that the throttle is in the closed position, then using tool no. 1.824.011.000 (C.2.0056) connected to the flow meter, check that the flow is within the specified limits.

Accelerator throttle air blowby in closed position (Solex flow meter)
280 ± 10 Scale N

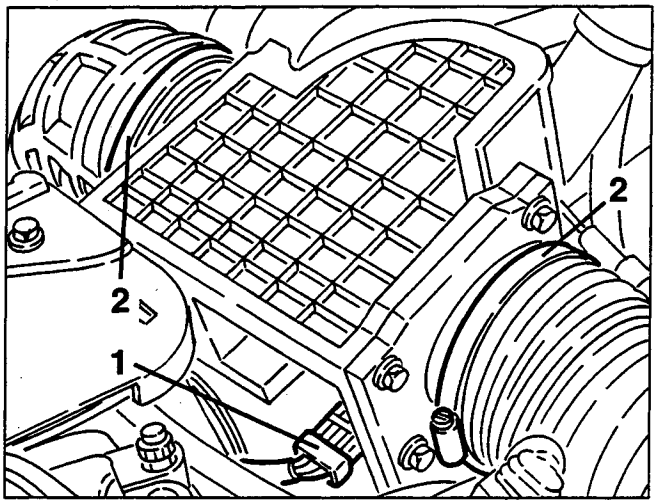


AIR-FLOW METER

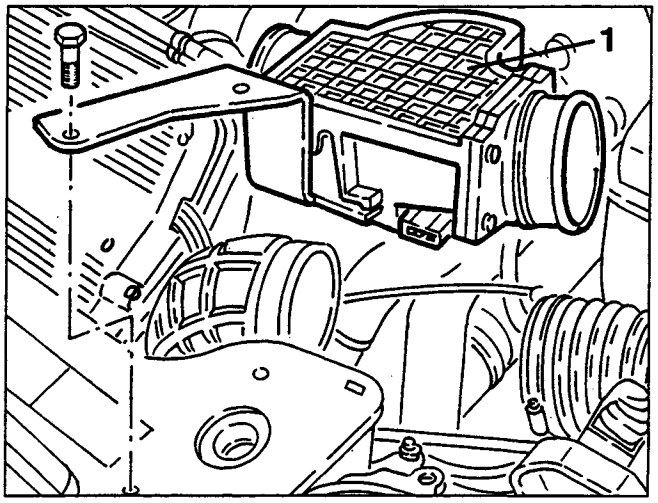
The air-flow meter quantifies the amount of air taken in by the engine through the throttle valve controlled by the accelerator pedal and sends the control unit a signal on the base of which the control unit determines the fuel injection time.
The air-flow meter works on the principle of fluctuating throttle: a coil spring acts as an opposing force on the actual throttle, therefore with a determinate amount of air there will be a precise angular position.
The compensation for oscillating pressure due to the stroke of the pistons is carried out through a compensating throttle strictly connected to the detecting throttle.
The electric signal is generated by the pulling of a potentiometer fastened to the pivot pin of the fluctuating throttle.
Inside the air-flow meter there is the intake air temperature sensor which is also connected to the control unit and made with negative coefficient resistance (NTC), i.e. capable of lowering its resistance as the temperature increases.
This sensor allows the control unit to take account of the changes in density of the air during injection.

REMOVING/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the air-flow meter.
2. Slacken the clampsaggio manicotto corrugato al misuratore portata aria. fastening the corrugated sleeve to the air- flow meter.



1. Slacken the two fastening screws and remove the air-flow meter complete with support bracket.

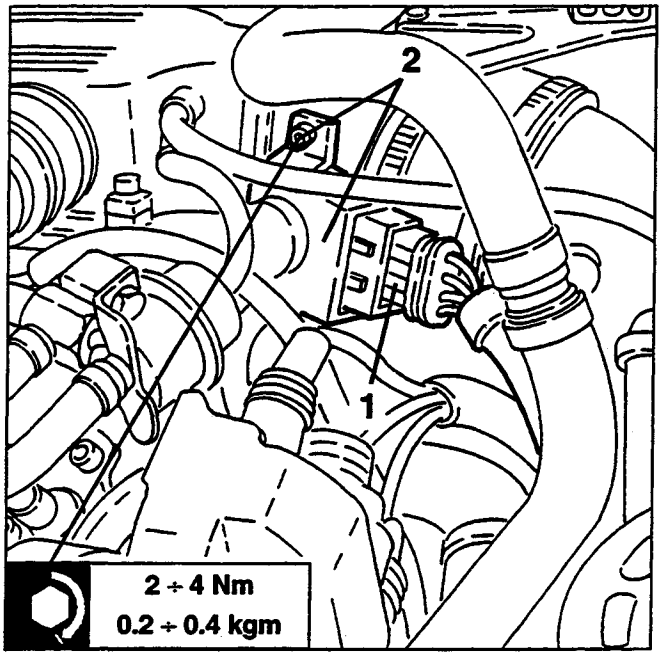


THROTTLE POSITION SENSOR

The throttle position sensor comprises a microswitch which supplies the injection control unit a single for a throttle angle of 0° (completely closed) and a potentiometer which measures the degree of opening of the throttle and sends a signal to the ignition control unit. The first signal allows fuel cut off during deceleration and engine management at idle speed, while the second signal enables supercharging and full power engine control.

REMOVING/REFITTING

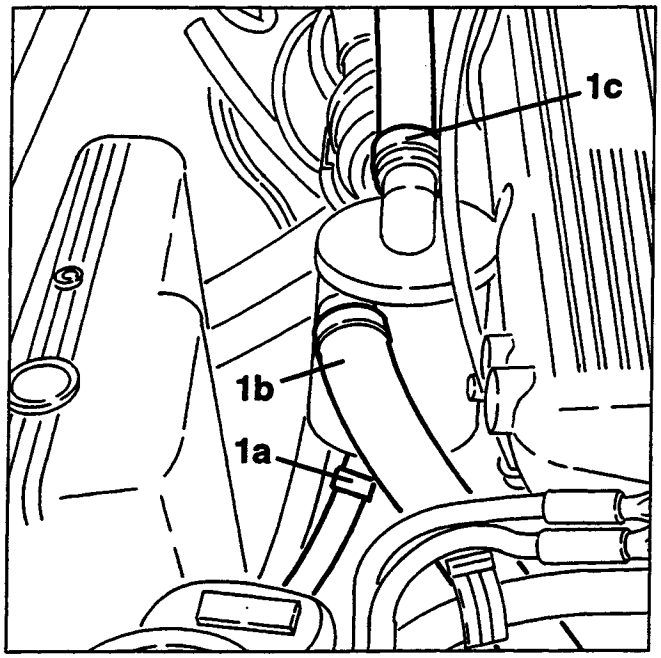
- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the throttle potentiometer.
2. Slacken the two fastening screws and remove the throttle potentiometer.



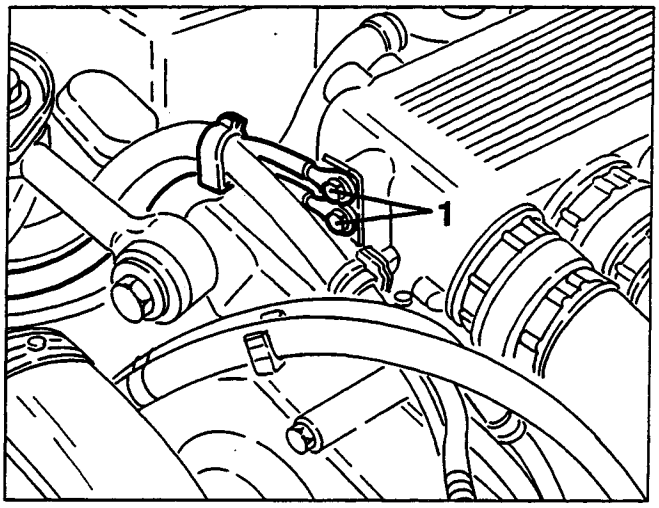
INTAKE BOX

REMOVING/REFITTING

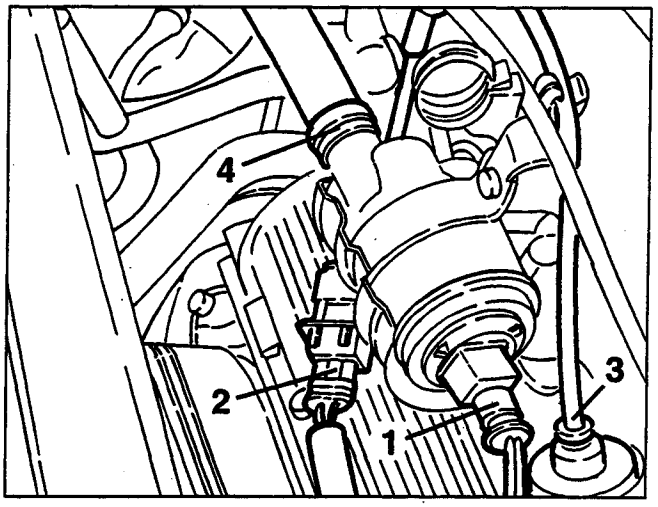
- Disconnect the battery (-) terminal.
1. Disconnect the condensed oil recovery pipe (1a), the oil vapour recovery pipe (1b) and the oil vapour recirculation pipe (1c), from the oil vapour separator, then release the latter from the fastening clamps and set it on one side.



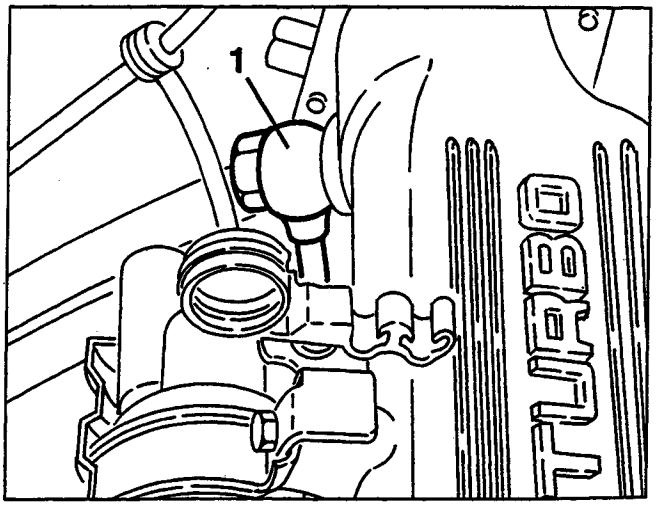
1. Disconnect the two earth cables from the intake box.



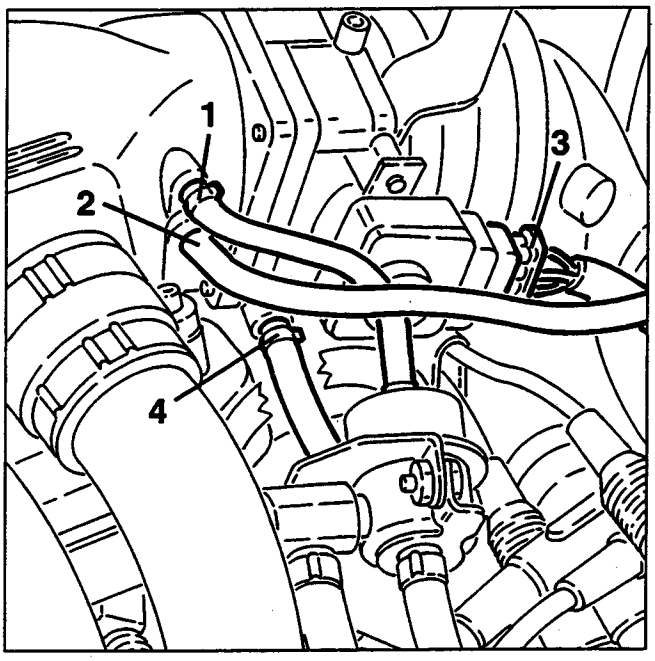
1. Disconnect the electrical connection from the constant idle actuator.
2. Disconnect the electrical connection 1st cylinder detection sensor.
3. Disconnect the high voltage cables from the spark plugs of the right-hand cylinder head.
4. From the constant idle speed actuator disconnect the air takeoff pipe.



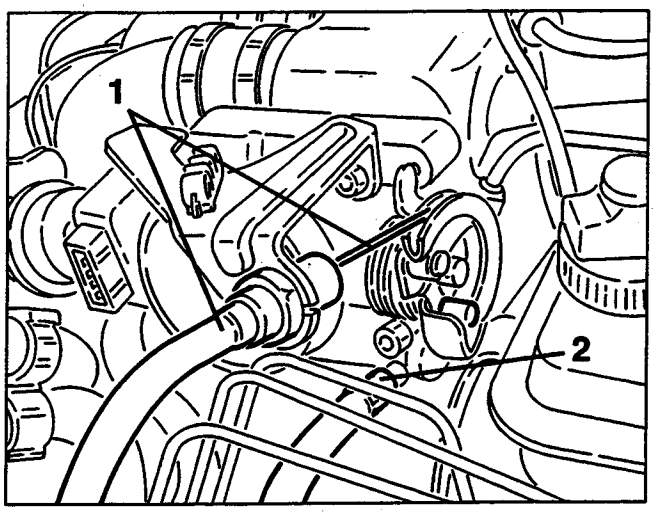
1. Disconnect the servobrake vacuum takeoff pipe from the intake box.



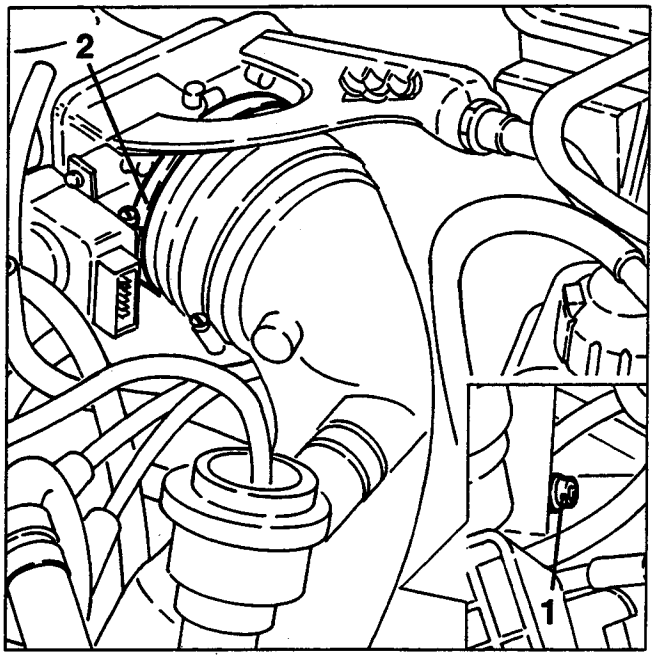
1. From the intake box disconnect the vacuum takeoff pipe for the fuel pressure regulator.
2. From the intake box disconnect the vacuum takeoff pipe for the antistalling valve.
3. Disconnect the electrical connection from the throttle potentiometer.
4. Disconnect the coolant inlet pipe from the throttle body.



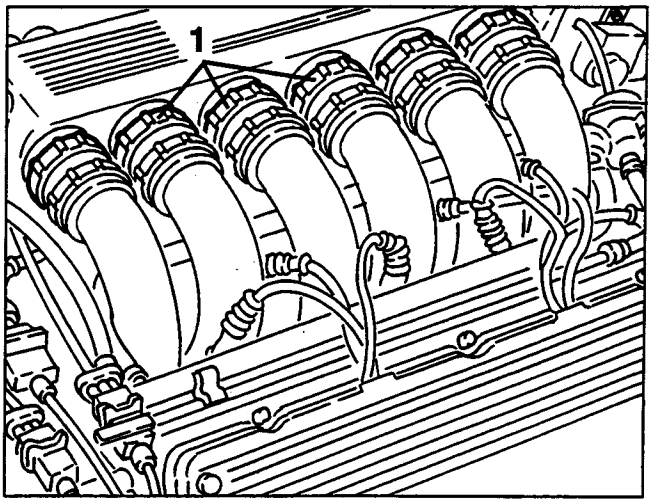
1. Disconnect the accelerator cable from the throttle body.
2. Disconnect the coolant outlet pipe from the throttle body.



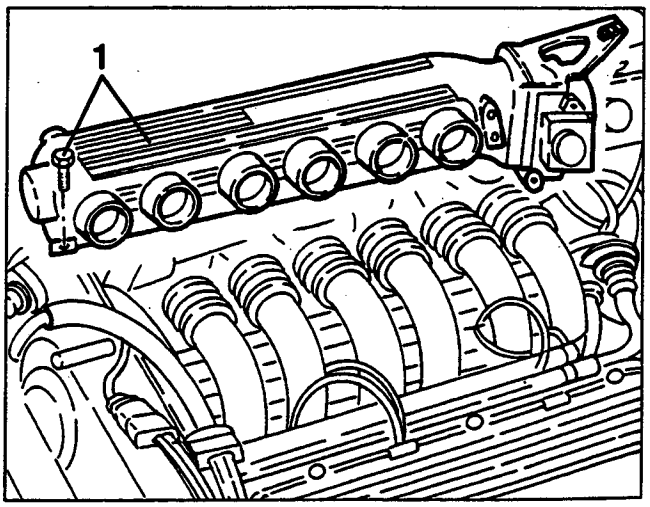
1. Slacken the fastening of the air intake manifold for the throttle body.
2. Loosen the clamp fastening the air intake manifold to the throttle body.



1. Loosen the clamps fastening the intake ducts to the intake box.

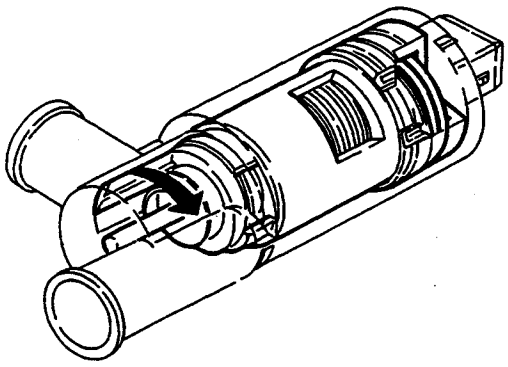


1. Slacken the fastening screws and remove the air intake box complete with throttle body, constant idle speed actuator, oil vapour separator and, if necessary, separate them on the bench.



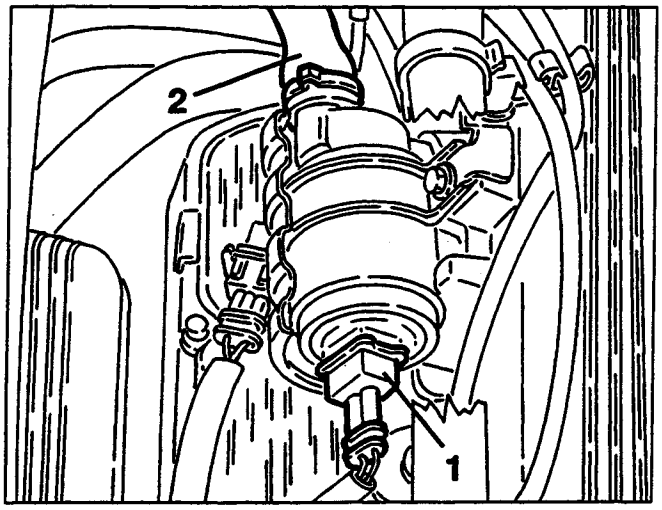
CONSTANT IDLE SPEED ACTUATOR

Idle rpm is controlled through an actuator which adjusts the amount of air taken in by the engine when the throttle valve is closed.
This makes it possible to compensate the power required by the different services (conditioner compressor, etc.) so that the engine speed remains unaffected.
The actuator used is a rotary regulator with single winding which, upon a command from the injection control unit, moves a rotary valve in the opening direction. Rotation in the closing direction is ensured by a counter spring which opposes the command from the control unit.
The control of the constant idle speed actuator is made with a variable number of pulses (alternating between current and pause) at a fixed frequency of 100 Hz. A determinate number of pulses, at constant battery voltage and winding temperature corresponds to a well-defined angular position of the rotary valve and, thus, a precise by-pass diameter.

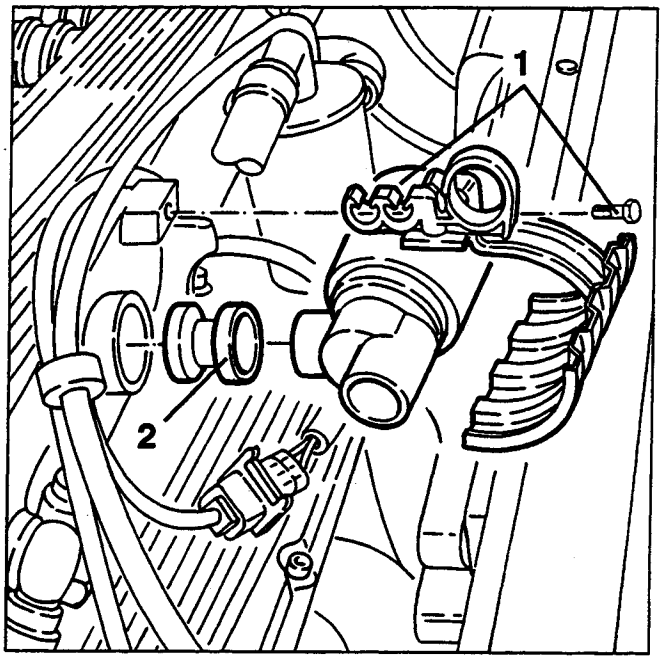


REMOVING/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the constant idle speed actuator.
2. Disconnect the air takeoff pipe from the constant idle speed actuator.



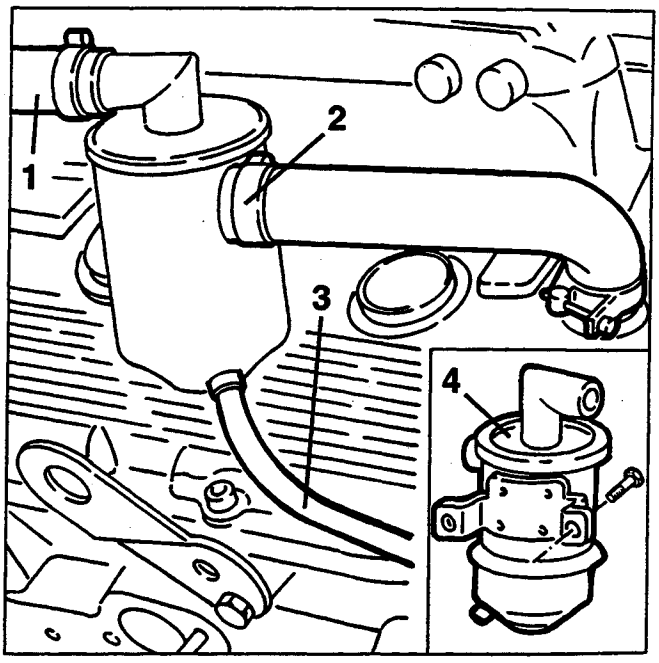
1. Slacken the two screws of the fastening clamp and remove the constant idle speed actuator withdrawing it from the intake box.
2. Retrieve the seal.



OIL VAPOUR SEPARATOR

REMOVING/REFITTING

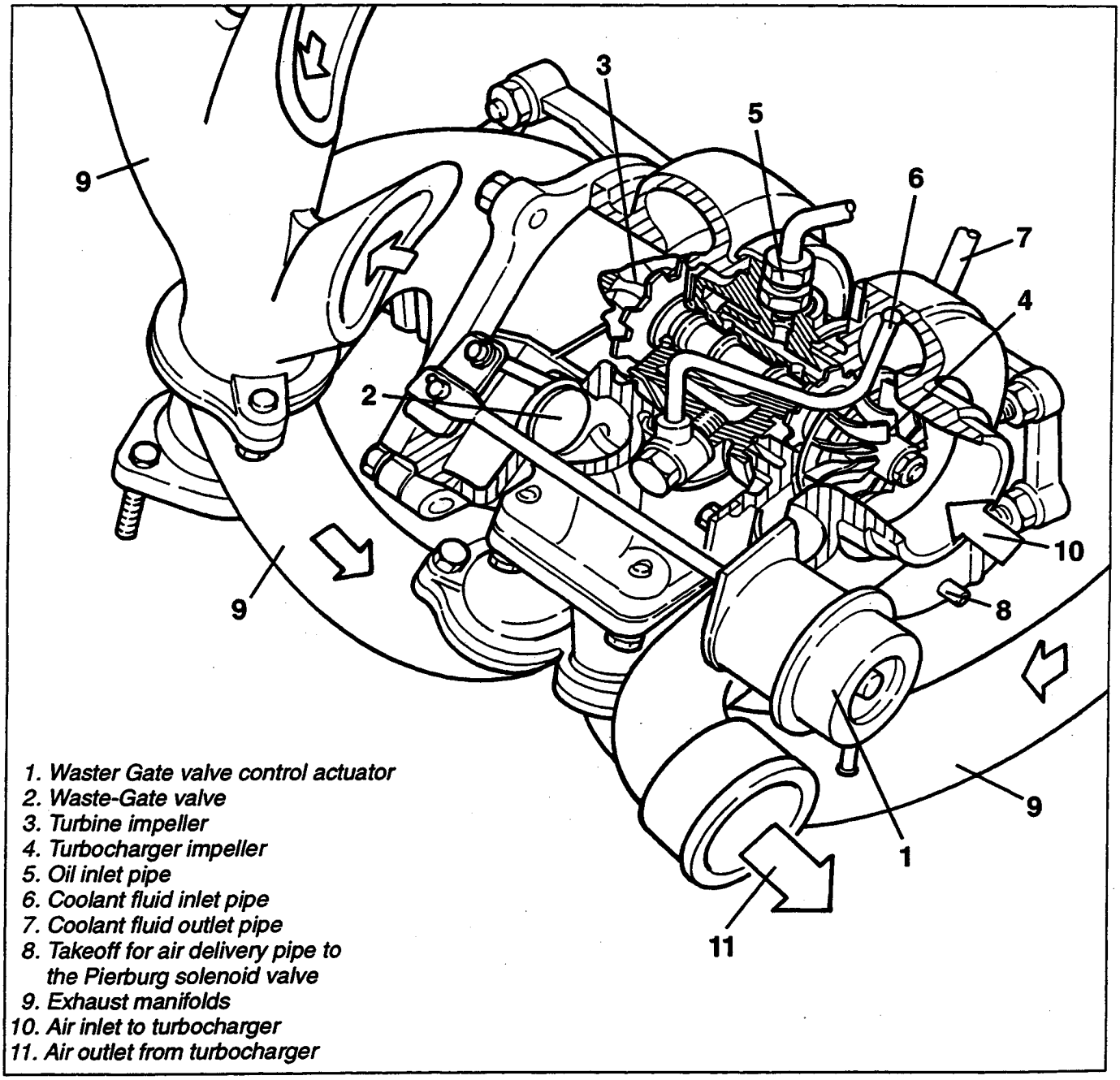
1. Disconnect the oil vapour recovery pipe from the separator.
2. Disconnect the oil vapour recovery pipe from the separator.
3. Disconnect the condensed oil recovery pipe from the separator.
4. Slacken the two fastening screws and remove the oil vapour separator.



TURBOCHARGER

This substantially comprises two impellers splined onto the same shaft, which turns on two special lubricated supports through two branches (input and output) of the lubrication circuit of the engine.
Two special pipes (6 - 7) branched from the engine cooling circuit are connected to the turbocharger and their purpose is to disperse most of the heat released by the turbine exhaust gas.
An impeller (3) "turbine", connected to the exhaust manifolds (9), is turned by the energy still possessed by the exhaust gas ducted to it. The turbine sets into motion, at the same speed, the other impeller (4) "compressor" which is connected to the intake manifold.

Due to its speed of rotation and the particular shape of the blades, the charger withdraws outside air and compresses it in the intake manifold, consequently in the cylinders of the engine.
If the engine increases the number of revolutions, also the turbine and the charger increase their speed of rotation thereby increasing the quantity of air delivered to the engine.
On the turbocharger there is a Waste-Gate valve (2) which, through a command from the Pierburg solenoid valve, allows part of the axhaust gas to by-pass (or not to by-pass) the turbine depending on the engine's need for power/torque.



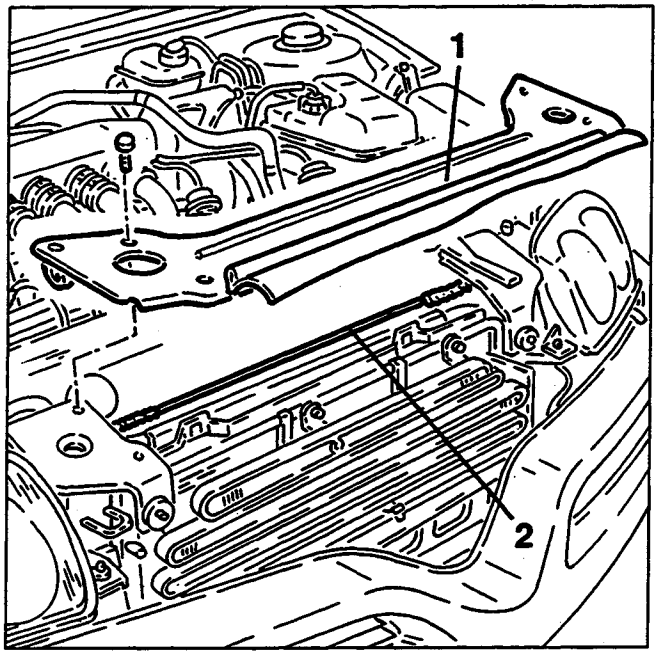
1. Waster Gate valve control actuator
2. Waste-Gate valve
3. Turbine impeller
4. Turbocharger impeller
5. Oil inlet pipe
6. Coolant fluid inlet pipe
7. Coolant fluid outlet pipe
8. Takeoff for air delivery pipe to the Pierburg solenoid valve
9. Exhaust manifolds
10. Air inlet to turbocharger
11. Air outlet from turbocharger

REMOVING/REFITTING

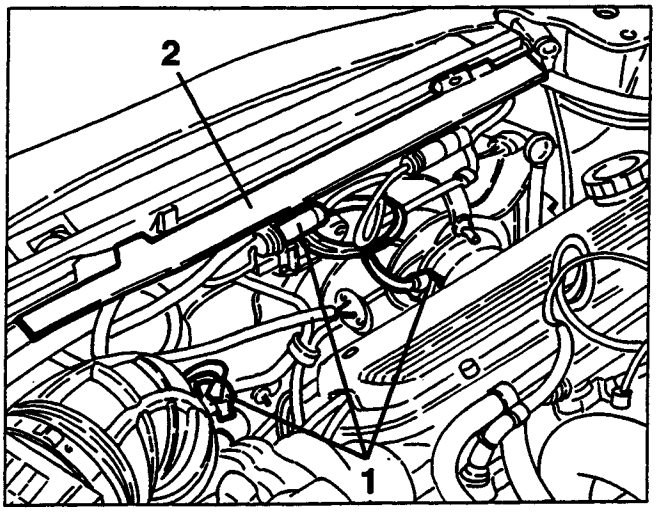
ATTENZIONE:
When carrying out work on the turbocharger strictly adhere to the following instructions for cleaning:
- before dis-assembly clean the connection points and carefully close or cover open or exposed parts;
- remove foreign matter or dirt from all the pipes and fittings connected to the turbocharger;
- refit the parts after cleaning them thoroughly.

- Set the car on a lift.
- Disconnect the battery (-) terminal.

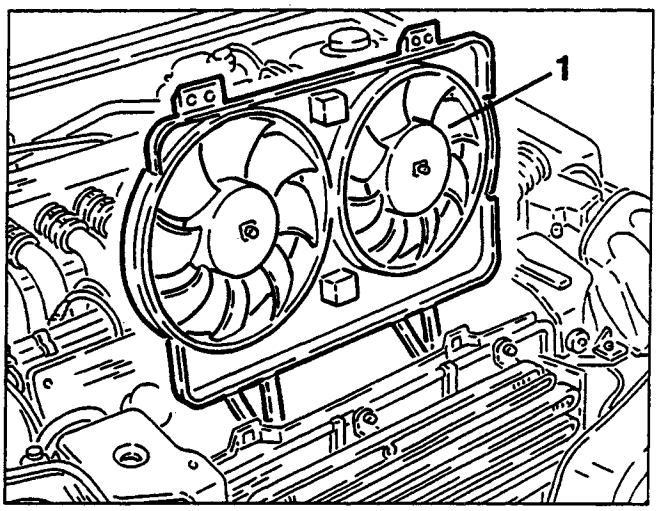
1. Slacken the fastening screws and remove the upper radiator crossmember.
2. Disconnect and move aside the bonnet opening cable.



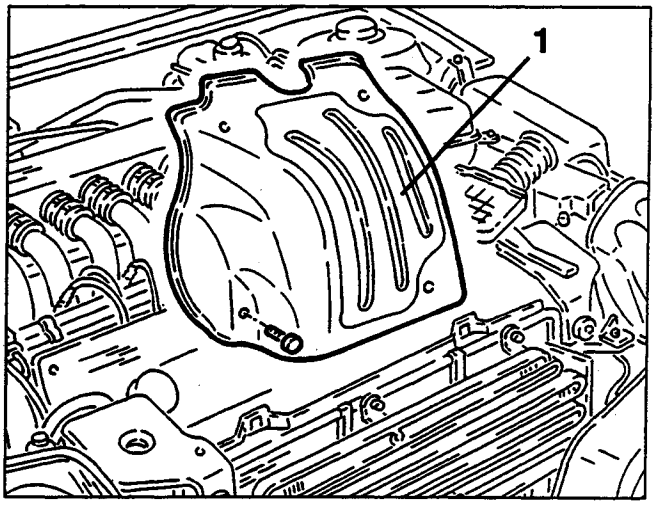
1. Disconnect the electrical connections from the cooling fans.
2. Slacken the fastening screws, then move to one side the cable fairing complete with electric cables.



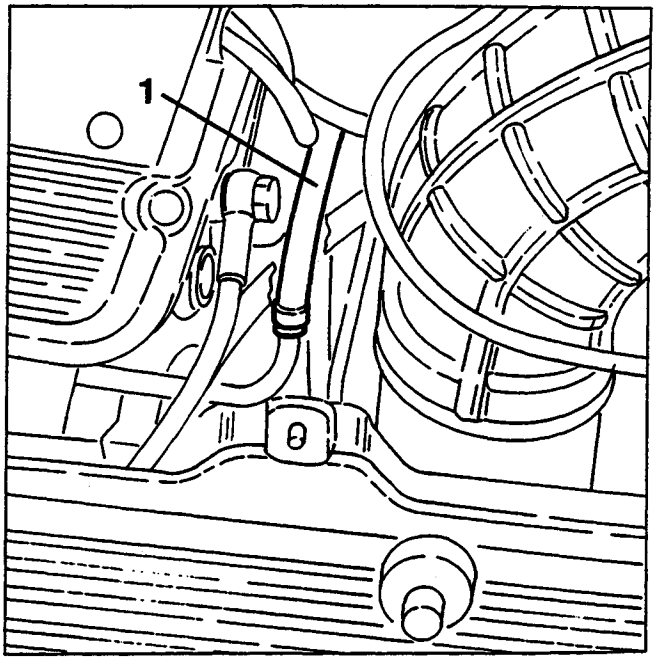
1. Withdraw and remove the cooling fans.



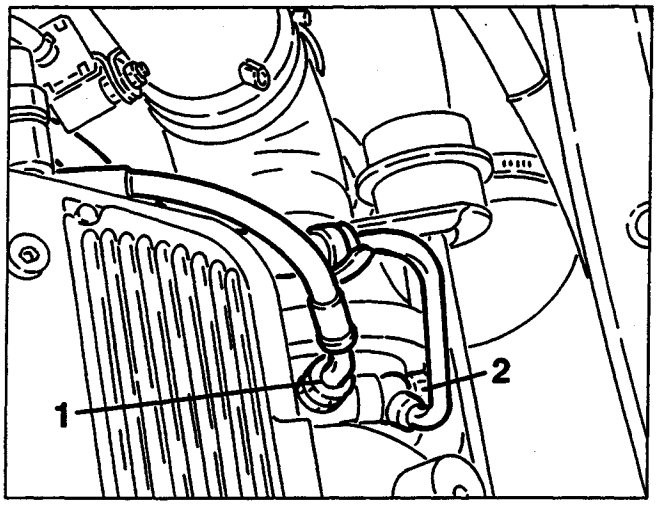
1. Slacken the fastening screws and remove the heat shield from the exhaust manifolds.



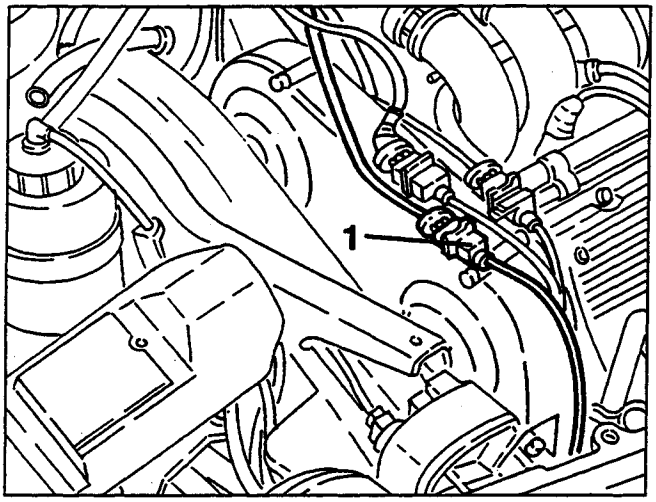
1. Disconnect the coolant fluid outlet pipe from the turbocharger.



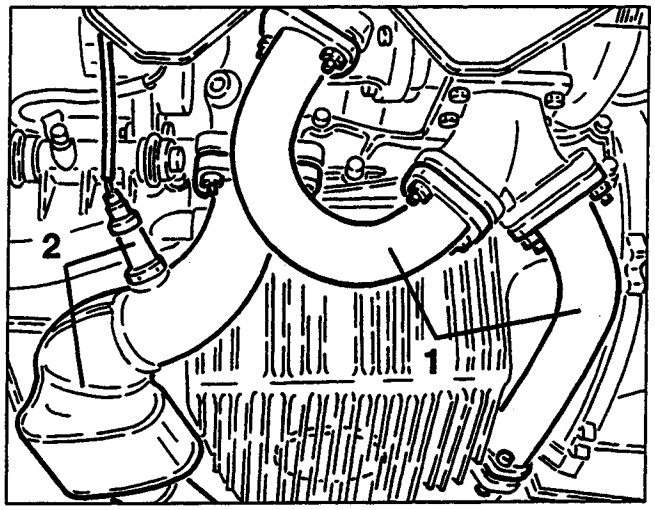
1. Disconnect the lubricating oil pipe fitting from the turbocharger.
2. Disconnect the ball joint of the coolant fluid inlet pipe from the turbocharger.



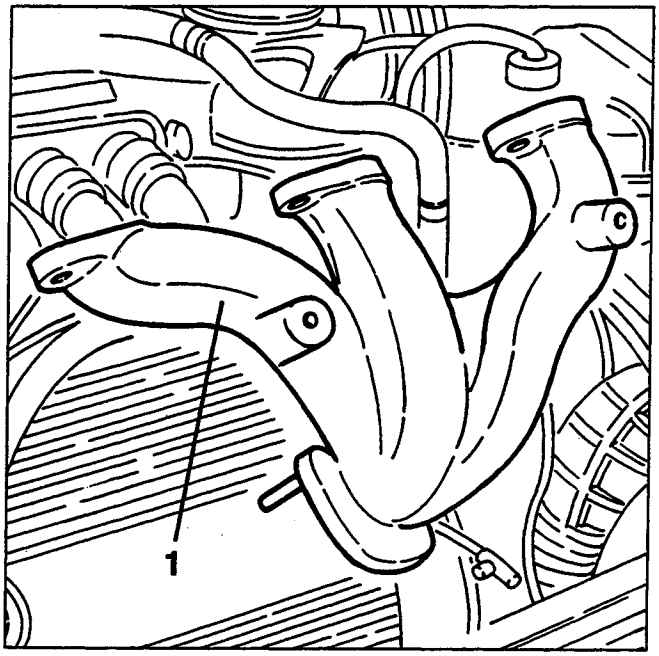
1. Disconnect the electrical connection of the lambda sensor.



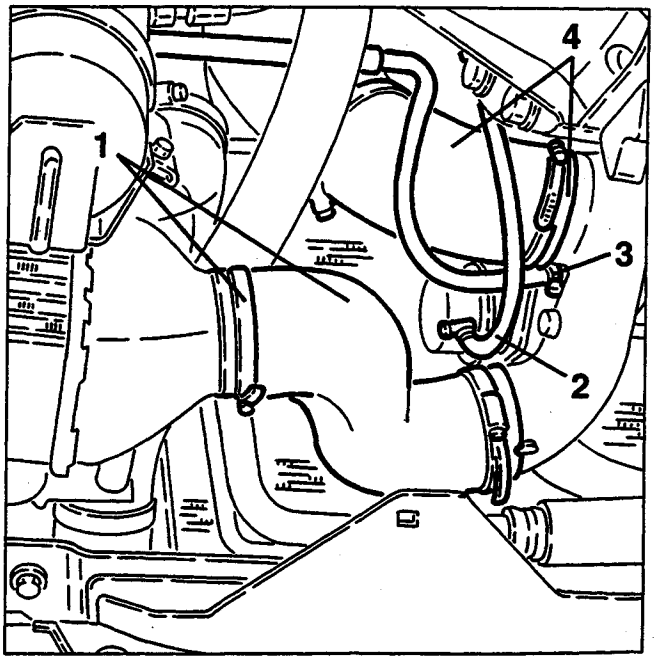
1. Raise the car, slacken the fastenings and remove the exhaust gas delivery pipes from the cylinder head manifolds to the turbocharger.
2. Slacken the fastenings and remove the front section of the exhaust pipe complete with lambda sensor.



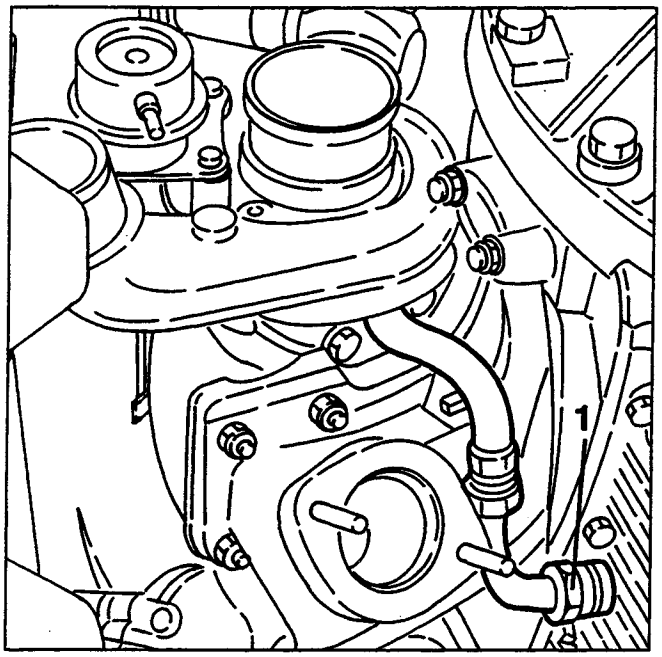
1. Slacken the cylinder head fastening nuts, then remove the left-hand exhaust manifold.



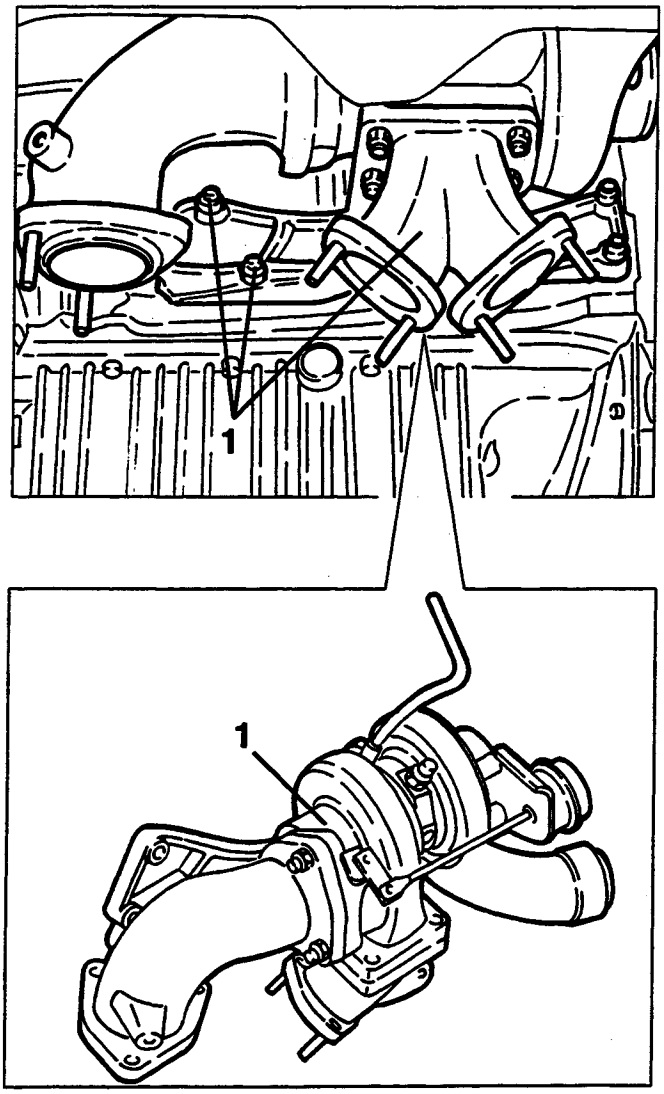
1. Slacken the fastening clamps and remove the air delivery sleeve from the turbocharger to the intercooler.
2. Disconnect the connection pipe to the Pierburg solenoid valve from the Waste-Gate overpressure control valve actuator.
3. Disconnect the Pierburg valve connection pipe from the turbocharger.
4. Slacken the fastening clamps and remove the turbocharger air inlet elbow.



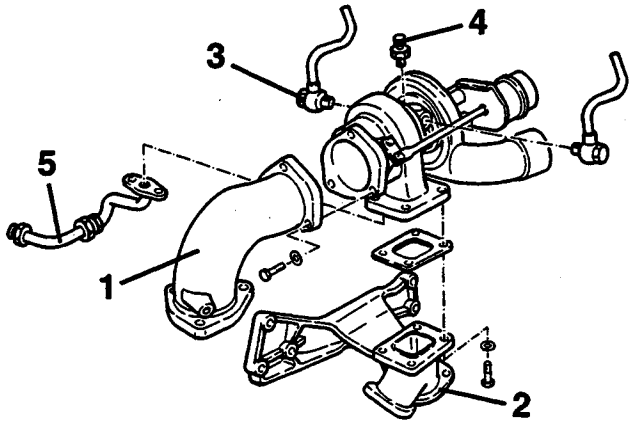
1. Disconnect the turbocharger oil outlet pipe fitting from the oil sump.



1. Slacken the nuts fastening the turbocharger assembly to the crankcase, then remove it complete.



1. On the bench slacken the fastening nut and remove the exhaust gas outlet elboz from the turbocharger.
2. Slacken the fastening nuts and remove the exhaust gas inlet manifold in the turbocharger with the corresponding seal.
3. Slacken the ball joint and remove the turbocharger coolant outlet pipe.
4. Slacken and remove the turbocharger oil inlet pipe fitting.
5. Slacken the fastening screws and remove the turbocharger oil outlet pipe.

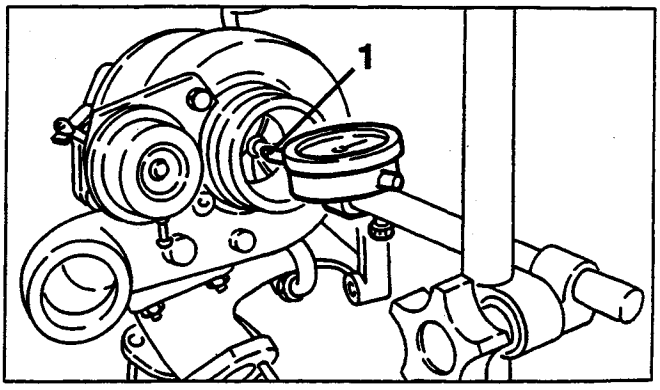


CHECKS AND INSPECTIONS

Checking the end float

1. Position the feeler of a dial gauge set on a special support, in contact with the centre line of the turbine as illustrated.
- Working acially on the other side of the turbine centre line check that the end float is within the specified limits.

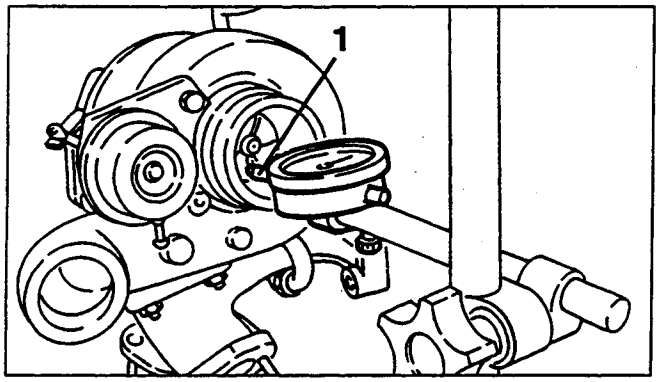
End float of turbine impeller
0.013 ÷ 0.081 mm



Checking the radial clearance

1. Position the feeler of a dial gauge set on a special support, in contact with the blades of the turbine as illustrated.
- Working transversally with respect to the turbine centre line, check that the turbine radial clearance is within the specified limits.

Turbine impeller radial clearance
0.076 ÷ 0.145 mm

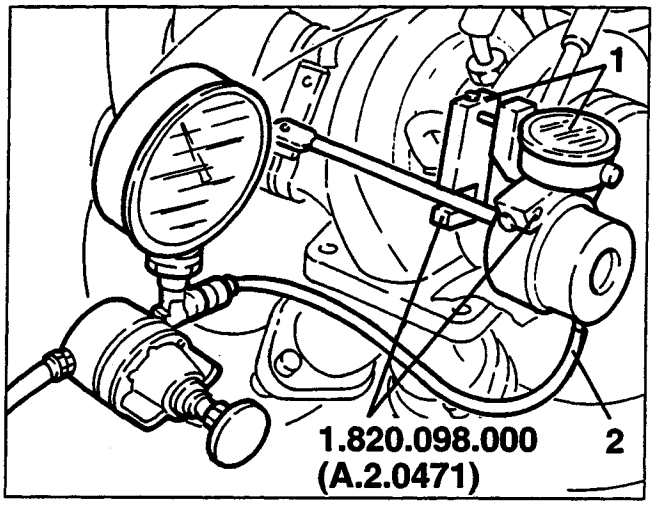


WARNING:
Overhauling operations of the turbocharger unit are not allowed, once an operating fault has been found, the unit must be replaced completely.

CHECKING THE SETTING OF THE WASTE-GATE OVERPRESSURE VALVE

- Disconnect the connection pipe to the Pierburg solenoid valve from the Waste-Gate overpressure valve actuator.
1. Install tool no. 1.820.098.000 (A.2.0471) fitted with a dial gauge on the Waste-Gate overpressure valve actuator.
2. Connect to the actuator a compressed air pipe with pressure gauge.
- Inject air at the pressure given and check on the dial gauge that the corresponding compressor stroke is as specified.

Waste - Gate valve setting	
Control pressre	Corresponding stroke of the actuator
0.55 ÷ 0.61 bar	1 mm
0.64 ÷ 0.75 bar	4 mm

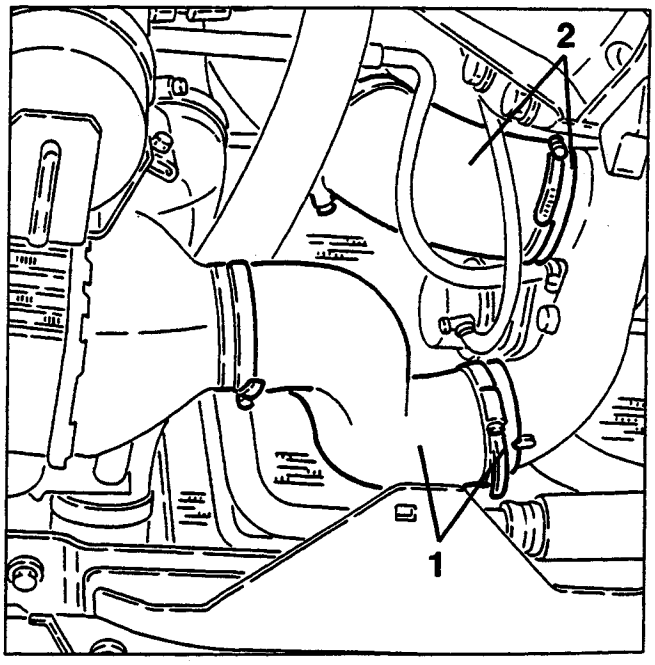


INTERCOOLER

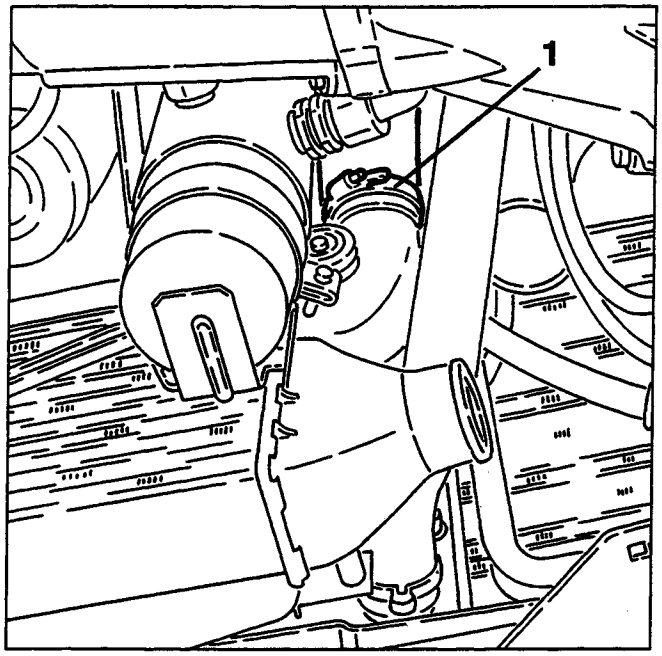
This is an air-air heat exchanger which makes it possible to improve engine performance levels, as the lowering of the temperature of the air in the cylinders improves their filling due to the greater density.
The intercooler is located in front of the left front wheelhouse and a special duct improves the flow of outside air to it.

REMOVING/REFITTING

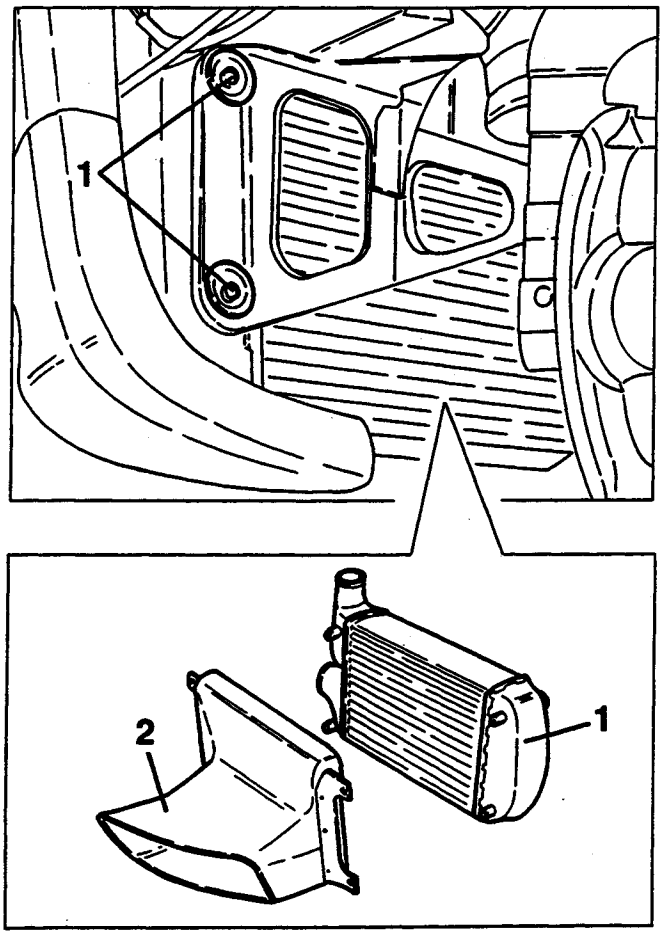
- Set the car on a lift and raise it.
- Remove the left front wheel and wheelhouse.
1. Slacken the fastening clamps and remove the air delivery sleeve from the turbocharger to the intercooler.
2. Slacken the fastening clamps and remove the turbocharger air inlet elbow.



1. Slacken the fastening clamp and disconnect the engine intake air delivery pipe from the intercooler.

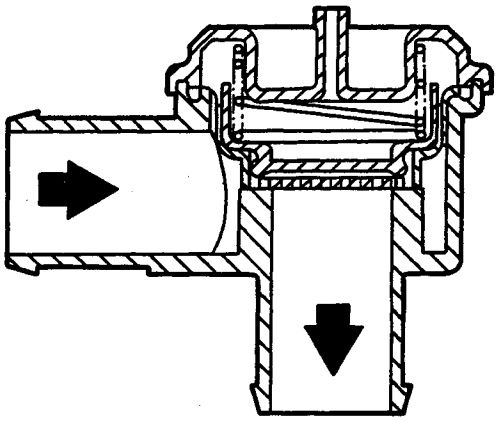


- Slacken the two screws fastening the front bumper, then remove only the one on the left-hand side and move the bumper forwards just enough to gain access to the intercooler fastening screws.
1. Slacken the three fastening bolts and the screw and remove the intercooler.
2. Retrieve the air duct.



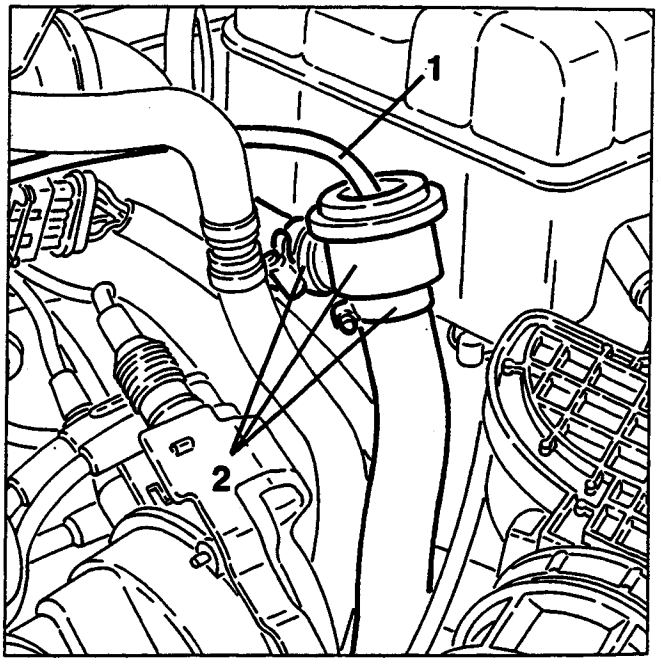
ANTISTALLING VALVE

This is a by-pass valve with the purpose of eliminating the "ramming effect" which occurs each time the accelerator pedal is released abruptly when the engine is supercharged; it is controlled by a vacuum signal picked up from the intake box.
When the throttle valve closes, the vacuum transmitted from the connection pipe to the intake box, opens the antistalling valve; this enables the pressure upstream of the throttle (closed) to be relieved in the intake duct.

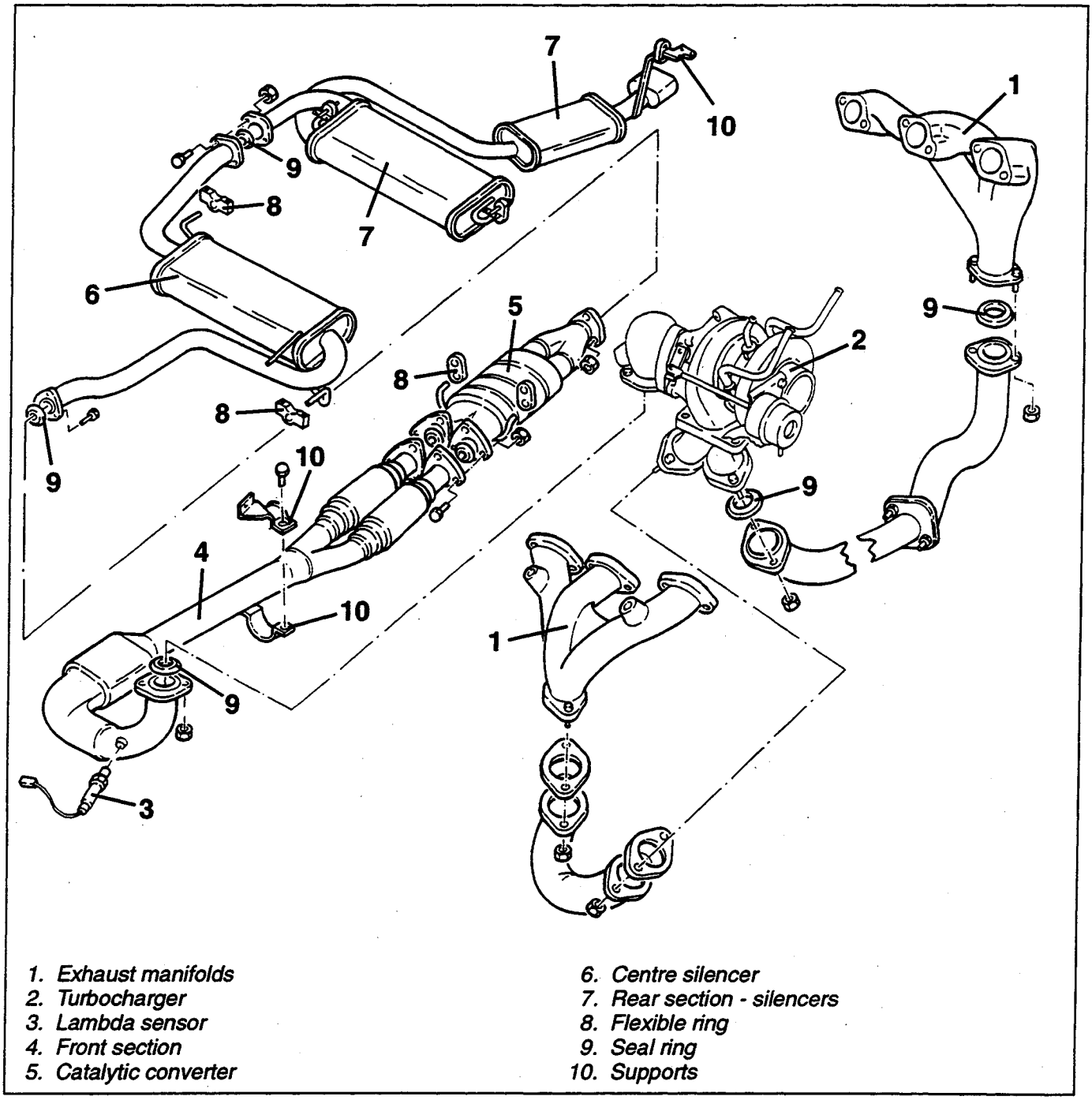


REMOVING/REFITTING

1. Disconnect the vacuum takeoff pipe from the antistalling valve.
2. Slacken the fastening clamps, disconnect the two pipes, then remove the antistalling valve.



DESCRIPTION OF THE EXHAUST SYSTEM

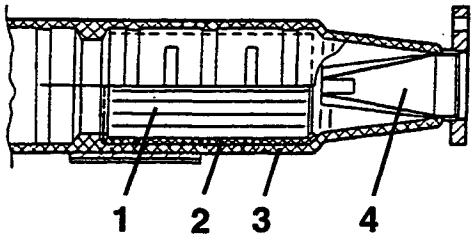


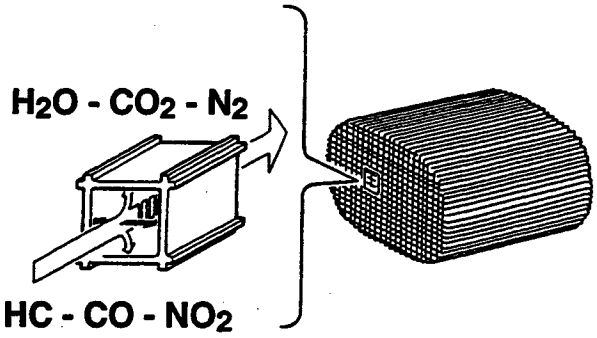
1. *Exhaust manifolds*
2. *Turbocharger*
3. *Lambda sensor*
4. *Front section*
5. *Catalytic converter*
6. *Centre silencer*
7. *Rear section - silencers*
8. *Flexible ring*
9. *Seal ring*
10. *Supports*

The exhaust gas leading from the cylinder heads is ducted into the manifolds (1) which in turn, via special pipes, send it to the turbine for boosting the engine.
From the turbine the exhaust gas passes through an elbow to the front section of the exhaust pipe (4), in the first section of which there is a precatalyst followed by the lambda sensor (3) which informs the control unit of the amount of oxygen contained in the exhaust gas making it possible to adapt the injection time to keep the stoichiometric ration (air - fuel) at an optimum level. The last part of the front section branches into two trunks in which two "flexible sections" are inserted to compensate heat expansion and vibrations transmitted from the engine.

From the front section the exhaust gas is sento to the three-way catalytic converter (5) in which most of the polluting substances are transformed.
From the catalytic converter the exhaust gas flows towards a centre silencer (6) and from this to another two rear silencer (7) which are inseparable.
The various lengths of the exhaust pipe are connected by flanges with interposed seals and connection to the body is by brackets with flexible rings.
The very high amount of heat radiation to the body due to the presence of the catalytic converter is limited by a set of heat guards.

WARNING:
When the engine is running all the exhaust pipes and the catalytic converter in particular get considerably hot.
Therefore, before doing any work it is necessary to leave the engine off for an adequate length of time.
Never touch the catalytic converter without suitable protection, such as gloves, etc. Never place inflammable materials near the catalytic converter.





1. Ceramic monolith
2. Metal support
3. Outer casing
4. Perforated sheet metal cone

CATALYTIC CONVERTER

Closed loop mixture titration is activated by the lambda sensor which detects the amount of oxygen contained in the exhaust gas upstream of the catalytic converter.
The measurements of the lambda sensor allow the electronic control unit to continuously correct the mixture titration keeping the air-fuel ratio constant. This way harmful emissions at the exhaust are controlled and this is completed by the three-way catalytic converter. The effectiveness of the catalytic converter, thus the amount of harmful gas at the exhaust depends on the air-fuel ratio with which the engine is supplied.
The trivalent catalytic converter removes the three polluting substances contained in the exhaust gas:
- unburnt hydrocarbons (HC);
- carbon monoxide (CO);
- nitric oxide (NOx).

Two types of chemical reactions take place inside the converter:
- oxidation of CO and HC, turned into carbon dioxide (CO_2) and water (H_2O);
- reduction of NOx turned into Nitrogen (N_2).

The converter comprises a monolith, a metal mesh support to dampen shocks and vibrations and an outer stainless steel casing resistant to high temperatures and the weather.
The monolith is made with a honeycomb structure composed of ceramic material coated with a fine layer of catalytically acyive substances (platinum or rhodium) which quicken the chemical decomposition of the harmful substances contained in the exhaust gas which cross the cells of the heart at temperatures above 300 ÷ 350°C, activating the catalysts and starting the chemical reduction and oxidation processes.
In order to optimise the efficiency and life of the catalyst, a perforated sheet metal cone improves the diffusion of the exhaust gas in the cells of the ceramic heart.

The causes which quickly and irreparably put the catalytic converter out of order are the following:
- the presence of lead in the fuel, which lowers the degree of conversion to levels that make the presence of the system useless;
- presence of unburnt fuel in the converter: indeed a flow of petrol for 10 seconds in an environment at a temperature of 800°C (inside temperature of the catalyst) is sufficient to melt and break the catalyst.

The ignition system must absolutely be in perfect operating conditions and for no reason whatsoever may the spark plugs be disconnected with the engine running, therefore in the event of tests, the catalytic converter must be replaced by an equivalent length of piping.
If used correctly the catalytic converter works effectively for at least 80,000 km or five years.

WARNING:
The precious metals contained in the catalytic converter are chemically attacked by the presence of lead because of the high temperature.
Because of this leaded fuels must be avoided as they quickly and irreversibly ruin the converter.
Never use petrol containing lead, not even for a very short time in an emergency.

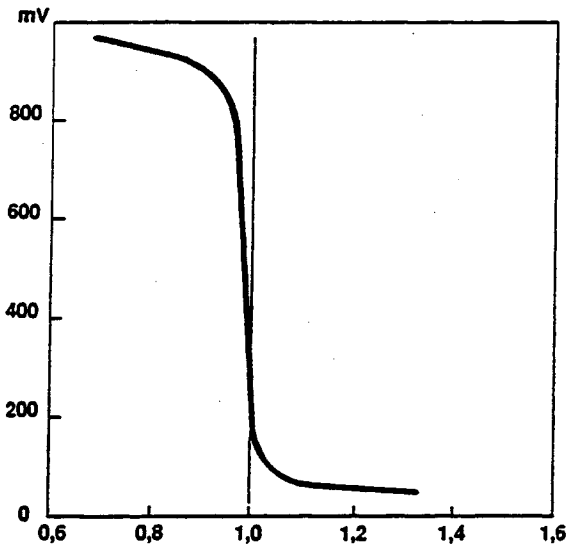
LAMBDA PROBE

The lambda sensor informs the injection-ignition control unit about the progress of the combustion of the air-fuel mixture and enables the system to keep the stoichometric ratio of the mixture as close as possible to the theoretical value.
In order to obtain an optimal mixture the amount of air taken in by the engine should be the equivalent of the theoretical amount that would be needed to burn all the fuel injected.
In this case, it is said that the lambda factor (λ) is 1, in fact:

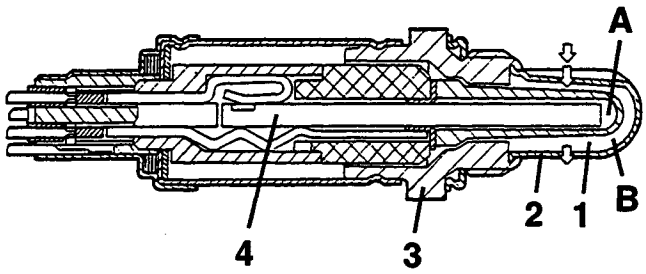
$$\lambda = \frac{\text{QUANTITY OF INTAKE AIR}}{\text{THEORETICAL AMOUNT OF AIR NEEDED TO BURN ALL THE INJECTED FUEL}}$$

Therefore:
1 = 1 IDEAL MIXTURE
λ > 1 LEAN MIXTURE
λ < 1 RICH MIXTURE

The lambda sensor set in contact with the exhaust gas, generates an electric signal, the voltage rating of which depends on the concentration of oxygen contained in the gas. This voltage is characterised by a sharp variation when the composition of the mixture departs from λ = 1.



The lambda sensor comprises a ceramic body, based on zirconium bioxide, coated with a fine layer of platinum closed at one end, inserted in a protective tube and housed in a metal container which offers further protection and makes assembly on the exhaust manifolds possible.
The outer part of the ceramic is exposed to the flow of the exhaust gas, while the inner part communicates with the environment.

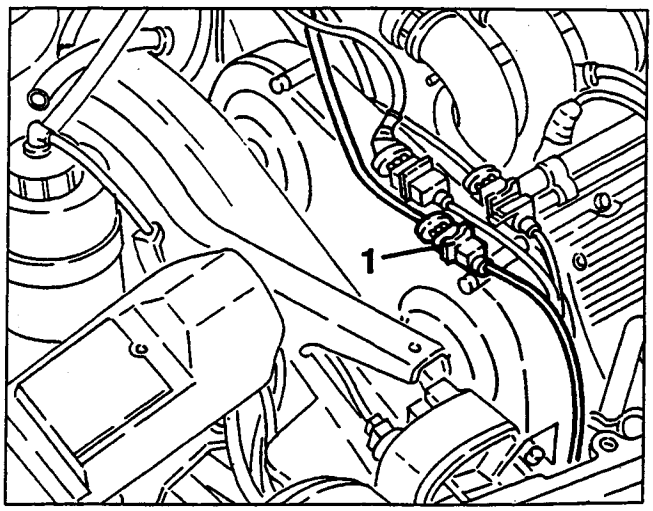


1. Ceramic body
2. Protective tube
3. Metal body
4. Electric resistance
A. Inner ceramic part
B. Outer ceramic part

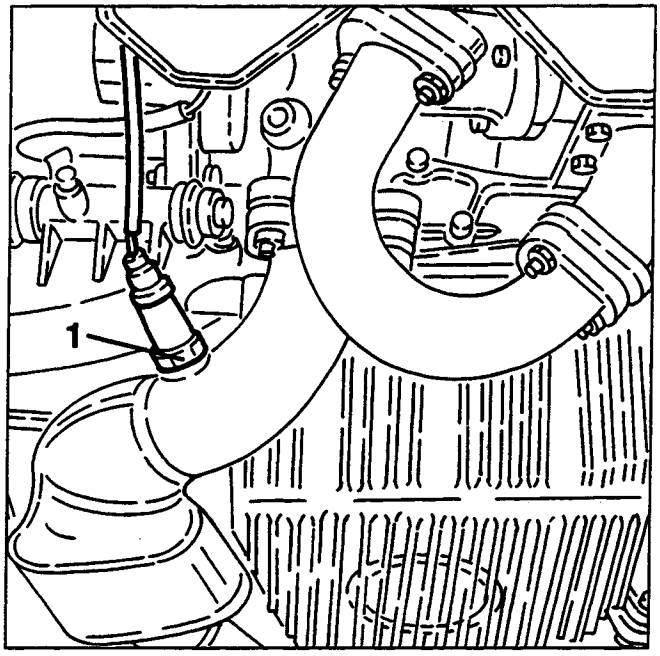
The sensor works on the basis of the fact that, with temperatures of above 300 °C, the ceramic material used becomes a conductor of oxygen ions.
Under these conditions, if the quantity of oxygen at the two sides (A and B) of the sensor is in different percentages, a voltage difference between the two ends is originated, which is the index of measurement for the difference of the amount of oxygen in the two environments (outside air side and exhaust gas side) and it informs the control unit that the oxygen remaining in the exhaust gas is not in sufficient percentage to warrant combustion with a low quantity of harmful by-products.
For temperatures below 300 °C the ceramic material is not active, therefore the sensor does not send utilisable signals and a special circuit in the control unit prevents loop mixture adjustment while the sensor is warming.
To ensure that the sensor quickly reaches its operating temperature, it is fitted with an electrical resistance appropriately supplied by the battery; this also makes it possible to install the sensor in cooler areas of the exhaust manifold.

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the lambda sensor electrical connection.



1. Raise the car, then slacken and remove the lambda sensor complete with wiring.



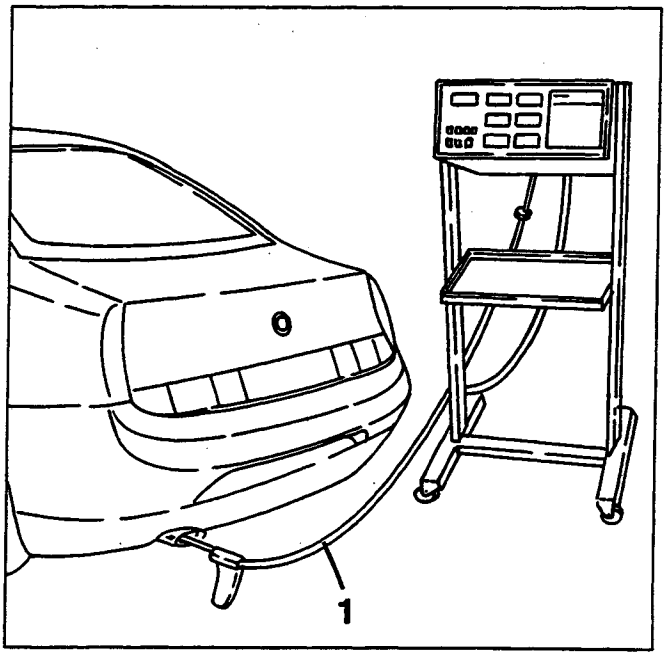
CHECKING EMISSIONS AT THE EXHAUST

WARNING:
Exhaust emissions must be checked outdoors, or at least in a suitable place equipped according to the regulations in force.

The control should be carried out with the engine at normal operating temperature (i.e. when the fan has turned on and then off) and running at idle speed.
If the idle speed is not within the specified limits, check the constant idle speed actuator.

- Check that the engine oil level is correct and that the air cleaner cartridge is clean.
- Start the engine and keep it at idle speed.
1. Insert the feller of the analyzer in the end piece of the exhaust pipe anch check that the amount of CO and HC are within the specified limits.

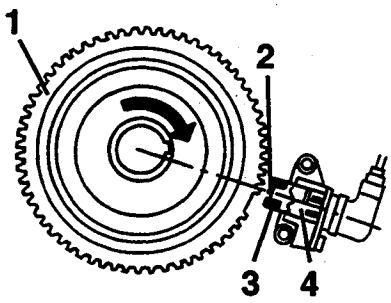
CO at the exhaust	**% vol.**	≤ 0.5
HC at the exhaust	**p.p.m.**	≤ 50



RPM SENSOR AND TIMING SENSOR

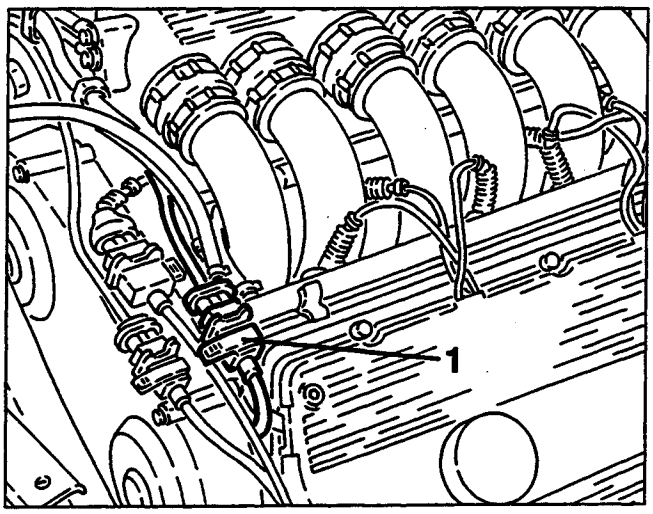
The sensor for detecting the rpm and engine timing is of the inductive type which operates through the change of a magnetic field generated by the passage of the teeth of a toothed pulley (phonic wheel) splined on the crankshaft.
The teeth which pass in front of the magnetic field generator change the gap between the pulley and the sensor; therefore, the dispersed flux, which consequently varies, induces an alternate sinusoidal voltage in the coils of the sensor, the amplitude of which depends on the peripheral speed of the phonic wheel, the gap between the tooth and the sensor, the shape of the teeth, the magnetic characteristics of the sensor and on the support system.
The output signal which varies in relation to the rpm is processed by the control unit to obtain a signal at each passage through zero and a constant rectangular oscillation of amplitude to enable the control of the digital circuits inside the control unit.
The interval between the start of one tooth and another is 6° with the exception of the reference mark which is made by eliminating two of the 60 teeth of the pulley. The hollow due to the lack of two teeth gives the control unit a reference point of the crankshaft and each subsequent tooth of the phonic wheel informs the control unit of an increase in its angular position.

1. Phonic wheel
2. Core
3. Winding
4. Permanent magnet

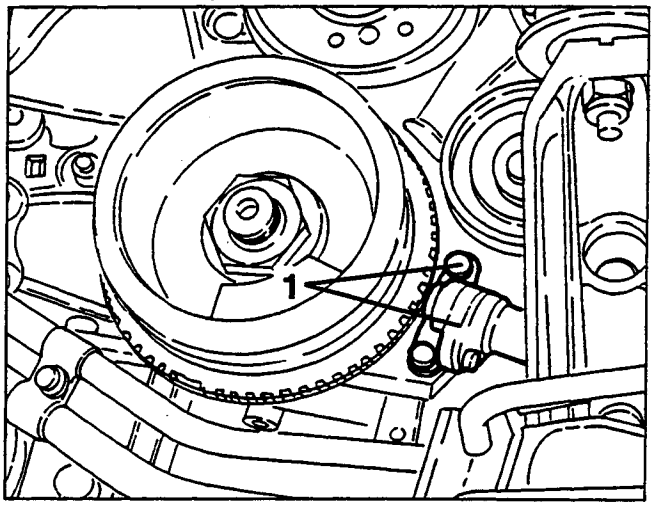


REMOVAL/REFITTING

1. Disconnect the electrical connection of the rpm and timing sensor.



- Remove the right front wheel and mud flap.
1. Slacken the two fastening screws and remove the rpm and timing sensor complete with support.



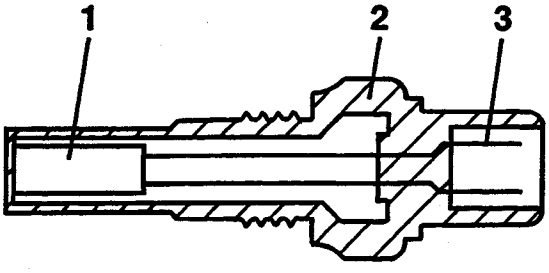
CHECKING THE GAP

- Remove the right front wheel and mud flap.
- Using a thickness gauge, check that the gap between the sensor and phonic wheel is within the specified limits.

Rpm and timing sensor gap
0.5 ÷ 1.5 mm

ENGINE COOLANT TEMPERATURE SENSOR (NTC)

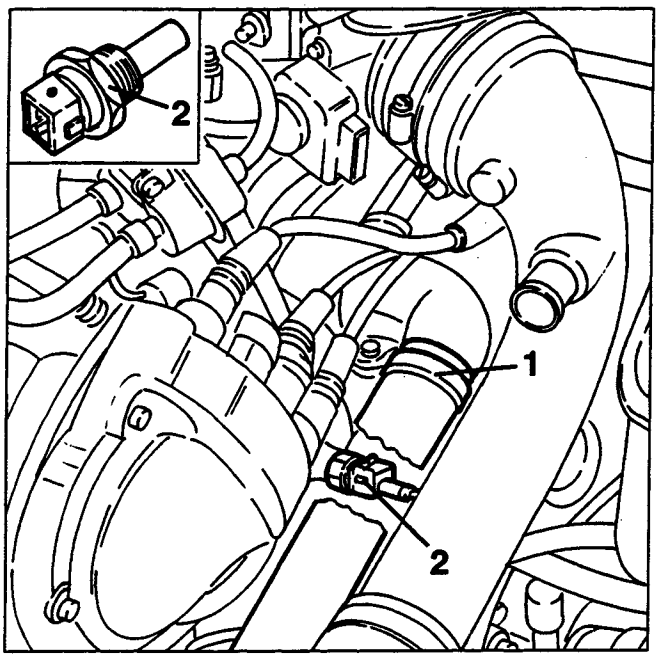
This sensor detects the engine coolant temperature on the thermostatic cup through a thermistor (NTC) with a negative resistance coefficent, i.e. capable of lowering its resistance as the temperature increases. The electric signal obtained reaches the electronic control unit where it is used to correct the air-fuel mixture.

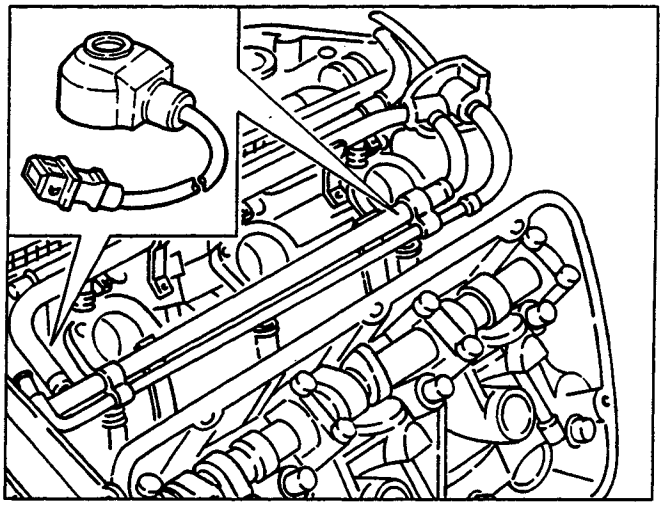


1. NTC resistance
2. Body
3. Connector

REMOVAL/REFITTING

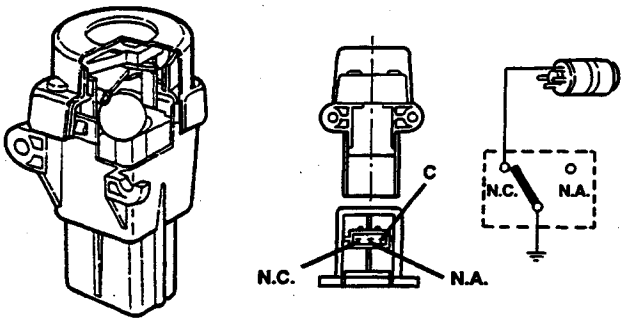
- Disconnect the battery (-) terminal.
1. Disconnect the coolant delivery sleeve to the radiator from the thermostatic cup and recover the fluid that comes out.
2. Disconnect the electrical connection, then remove the coolant fluid temperature sensor from the thermostatic cup.





INERTIAL SWITCH

In the front side of the driver's seat there is a safety switch which is triggered in the case of an impact, cutting off the fuel pump connection to earth, thereby also the supply to the injection system.



PINGING SENSORS

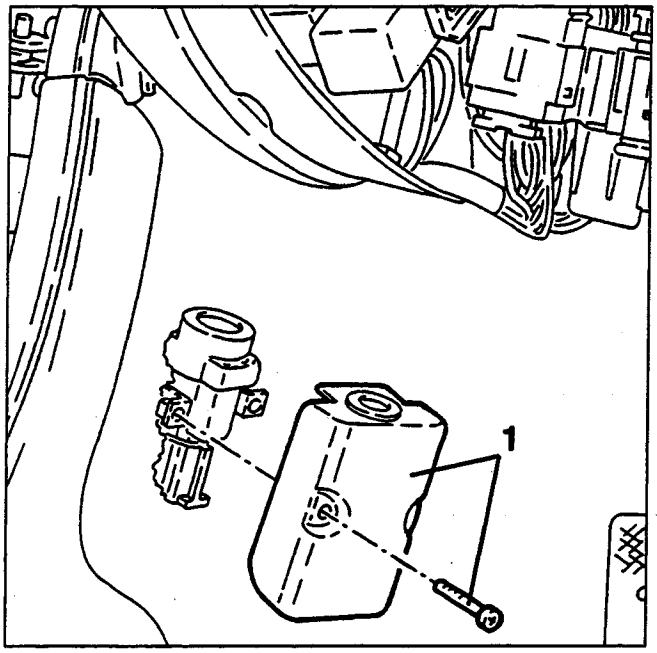
The pinging sensors are to be found on the crankcase, at the centre of the two cylinder heads.
They comprise a piezoelectric plate and a seismic mass buried in a plastic mould.
Their purpose is to detect the vibrations produced when the engine is running, exploiting a particular characteristic of piezoelectric materials which generate an output voltage when they are subjected to mechanical stresses.
This voltage is filtered and analyzed by the ignition control unit, which then adjusts spark angle in the "delay" direction, to command the injection control unit to enrich the fuel and reduce the boosting pressure.
As the boosting pressure falls the ignition control unit adjusts the spark angle again until the optimum rating is reached.
The detection and limiting of pinging take place for each cylinder.
As the pinging signals are allocated to the corresponding cylinder (by the 1st cylinder detection sensor), it is possible to adjust for each cylinder.

A steel ball fitted in a taper housing is normally held in place by the force of attraction of an adjacent magnet.
Under specific acceleration loads the ball releases itself from the magnetic force and gradually moves out of the taper support rising upwards following the angle of the taper.
A quick snap connection is fitted above the ball which forms the normally closed (N.C.) electric circuit.
When the mechanism is hit by the ball it changes position, from N.C. circuit to normally open circuit (N.A.), cutting off the fuel pump earth circuit.
In the event of impact in any one of the three orthogonal directions, the switch will be triggered above 12 g peak equivalent to a speed of 25 kph.
The switch can be reset pressing the pushbutton protected by a flexible cover (this also protects against foreign particles which might prevent the switch from operating or reprogramme it).

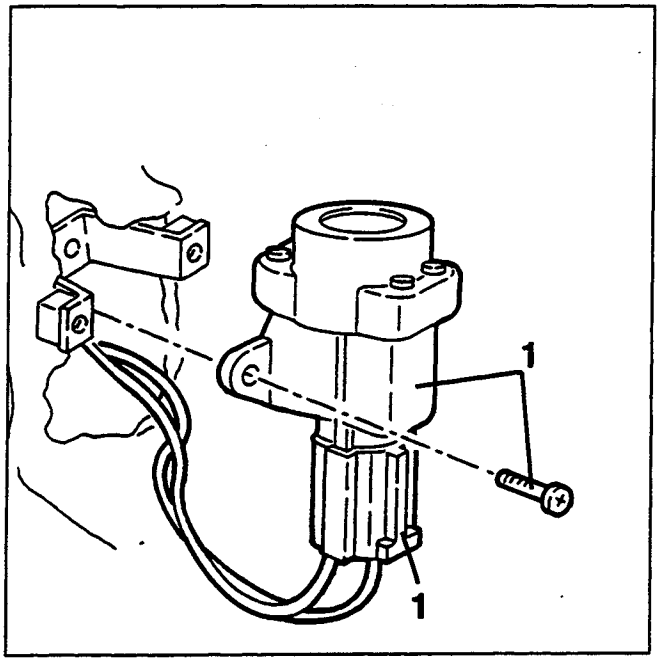
NOTE:
If after even a light crash, there is the smell of petrol or leaks are noted from the fuel supply system, do not reset the switch, but firstly seek the failure and repair it to prevent the hazard of fire.
Conversely, if there are no leaks and the car can be restarted, press the pushbutton to reactivate the fuel pump.

REMOVING/REFITTING

- Disconnect the battery (-) terminal.
1. Slacken the two fastening screws and remove the plastic cap protecting the inertial switch.



1. Slacken the two fastening screws, disconnect the electrical connection and remove the inertial switch.

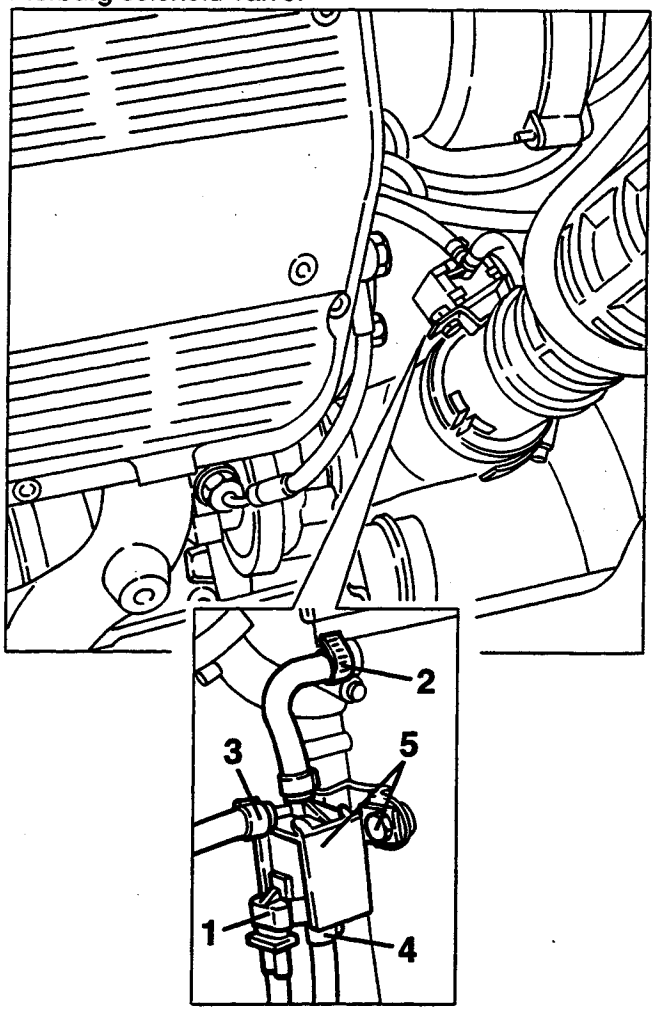


BOOST DRIVE DEVICE CONTROL SOLENOID VALVE (PIERBURG)

This is controlled directly by the control unit and operates the Waste-Gate overpressure valve via the actuator to which it is connected, allowing part of the exhaust gas to by-pass (or not to by-pass) the turbine depending on the need for torque/power of the engine.
For further information see the paragraph "DEL BOOST-DRIVE MANAGEMENT".

REMOVING/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the Pierburg solenoid valve.
2. Slacken the fastening clamp and from the Pierburg solenoid valve disconnect the connection pipe with the turbococharger inlet.
3. Slacken the fastening clamp and disconnect from the Pierburg solenoid valve the pipe connecting with the turbocompressor.
4. Slacken the fastening clampand disconnect from the Pierburg solenoid valve the pipe connecting the Waste-Gate overpressure valve actuator.
5. Slacken the two fastening bolts and remove the Pierburg solenoid valve.

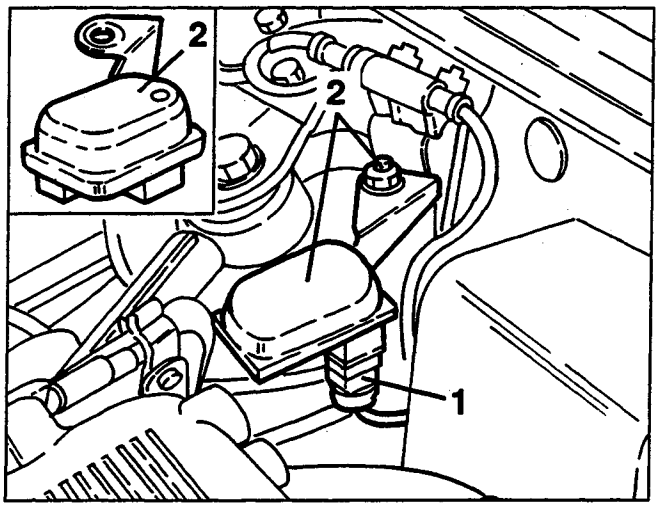


ALTITUDE SENSOR

Since at high altitudes the air is more rarefied, a lower mass of air passes through the air-flow meter at an equivalent volumetric capacity. For this reason it is necessary for a sensor which detects the pressure of the air in which the car is travelling and sends the ignition control unit a signal proportionate with the atmospheric pressure to control the boosting pressure to avoid excessive pressure. This is the reason for the altitude sensor.
It comprises a barometric capsule sensitive to the atmospheric pressure.
As the pressure changes, the capsule changes its size, thereby moving a slider with which it is integral. The movement of the slider, which forms one of the contacts of the resistance inside the sensor, causes a change in the length of the section of resistance involved by the circuit, thereby changing the output voltage rate.

REMOVING/REFITTING

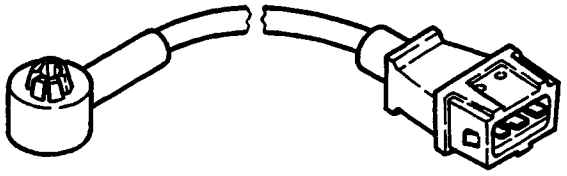
- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the altitude sensor.
2. Slacken the fastening nut and remove the altitude sensor.



1ST CYLINDER DETECTION SENSOR

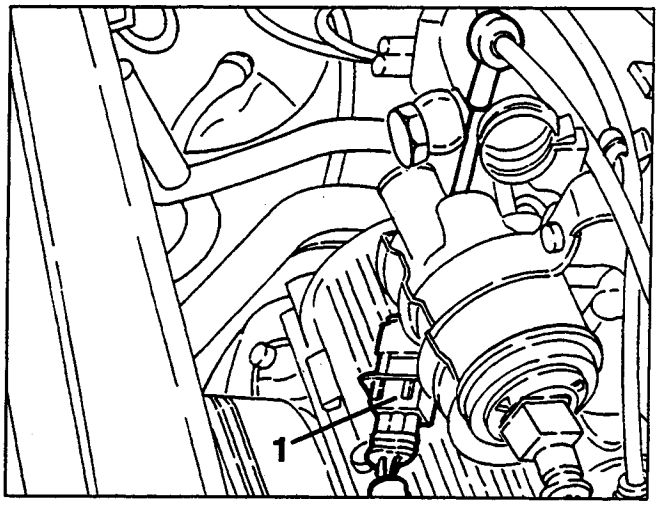
The 1st cylinder detection sensor is located on the high voltage cable of the 1st cylinder.
Its purpose is to identify any cylinder that is pinging in order to delay the spark on that cylinder only.

The sensor is formed of a coil buried in a plastic toroidal support, which generates a voltage proportionate with the change in the current that crosses the high voltage cable of the 1st cylinder.



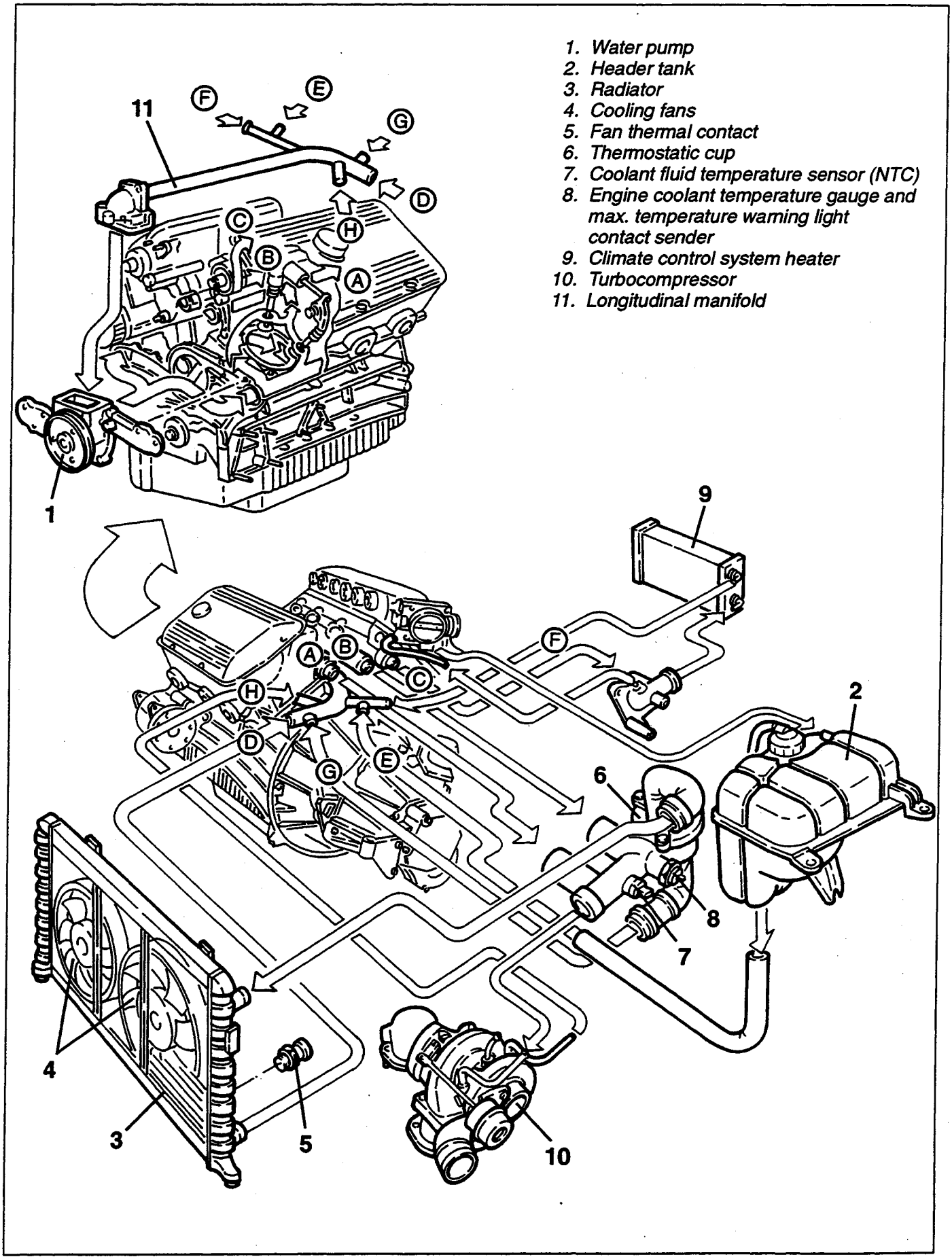
REMOVING/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection of the 1st cylinder detection sensor.



- Disconnect the high voltage cable of the 1st cylinder spark plug.
- Slacken and remove the "pipette" connecting to the spark plug from the high voltage cable.
- Run the 1st cylinder detection sensor on the high voltage cable, towards the spark plug to remove it.

ENGINE COOLING SYSTEM



DESCRIPTION

The cooling system is of the sealed type with forced circulation by a centrifugal pump (1) operated by the crankshaft through a Poly-V belt.
A thermostatic cup (6), on the rear of the engine, keeps the engine at an optimum temperature level; it opens when the temperature of the coolant reaches 83 ± 2°C.
As well as with dynamic air the radiator (3) also cools the engine fluid by two fans with two speeds which are turned on by a thermal contact (5) on the radiator.
The purpose of the header tank (2) is to supply the circuit if the level falls and it acts as a lung absorbing the changed in volume of the fluid as the temperature changes; it also vents air from the circuit.
The circuit is fitted with a coolant temperature sender (8) for the temperature gauge and for contact of the max. temperature warning light contact which turns on when the coolant temperature exceeds 115 ± 3°C.

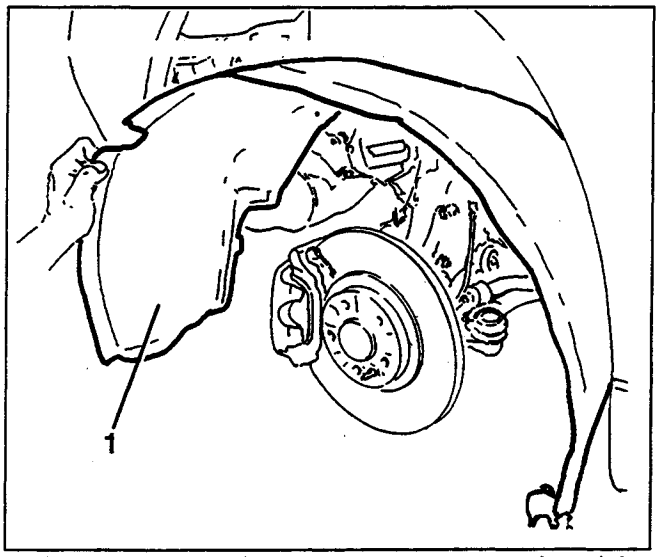
OPERATION OF THE CIRCUIT

After cooling the engine, the fluid flows through the cylinder heads to the thermostat unit (6).
From here, if the temperature is below 83 ± 2°C, it is withdrawn by the pump (1) through a longitudinal coolant return manifold (11) located between the cylinder heads.
Conversely, if the temperature exceeds this value, it is ducted by the opening of the thermostat towards the radiator (3).
After being cooled in the radiator, the fluid returns, still through the longitudinal manifold, to the pump which directs it to the engine again.
Regardless of the position of the thermostat, from the thermostat unit, a pipe sends the fluid to cool the turbocompressor (10) which it leaves through a special pipe to return to the longitudinal manifold leading to the pump inlet.
A special union on the right-hand cylinder head receives the coolant fluid from an additional duct of the cylinder head and sends it through two special pipes to the heater (9) of the climate control system and to the throttle body to heat it.
The latter is connected to the header tank (2) through a special pipe which, besides allowing the fluid to return also vents the air from the system.
The pump intake manifold is also connected to the system supply pipe leading from the header tank and the return pipe from the climate control heater.

GEARBOX UNIT 1996 TB

REMOVAL/REFITTING

– Set the car on a lift.
– Disconnect the battery.
– Remove the front wheels.
1. Remove the left front gravel guard.

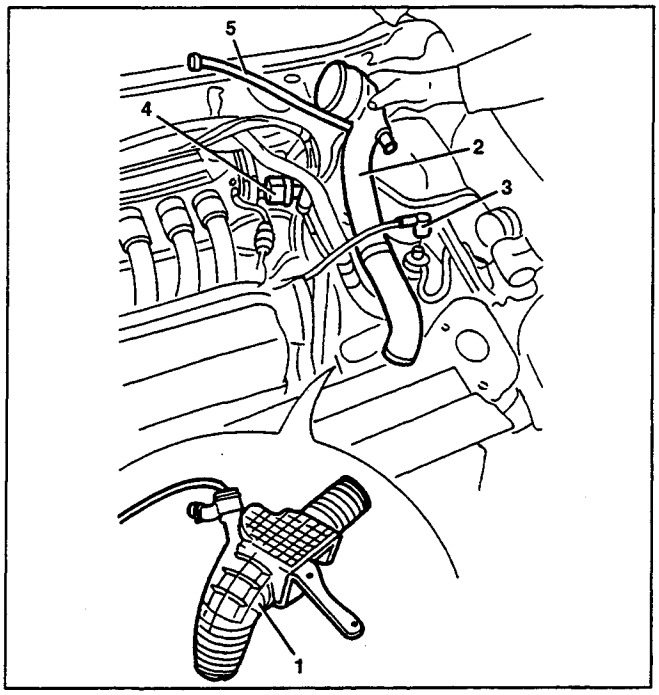


– Remove the engine compartment protection, right-hand (see GROUP 70).

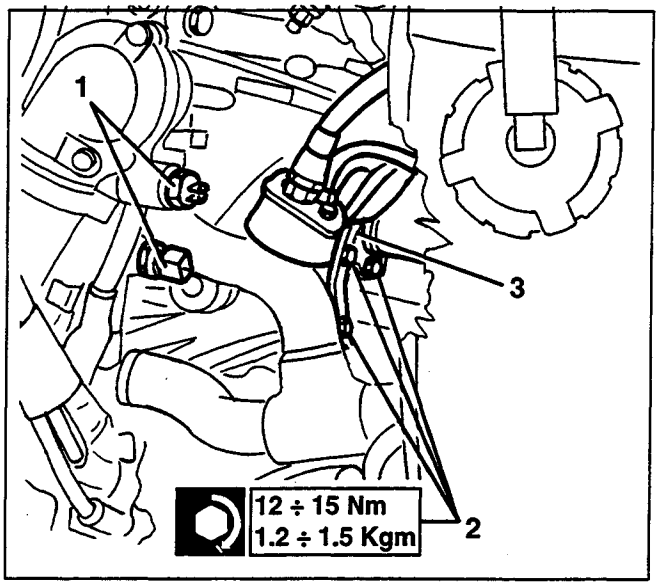
1. After disconnecting the connection, remove the air-flow meter with the two corrugated pipes, the fastening bracket and the by- pass valve with corresponding pipes.

2. Remove the pipe between the throttle and the intercooler.

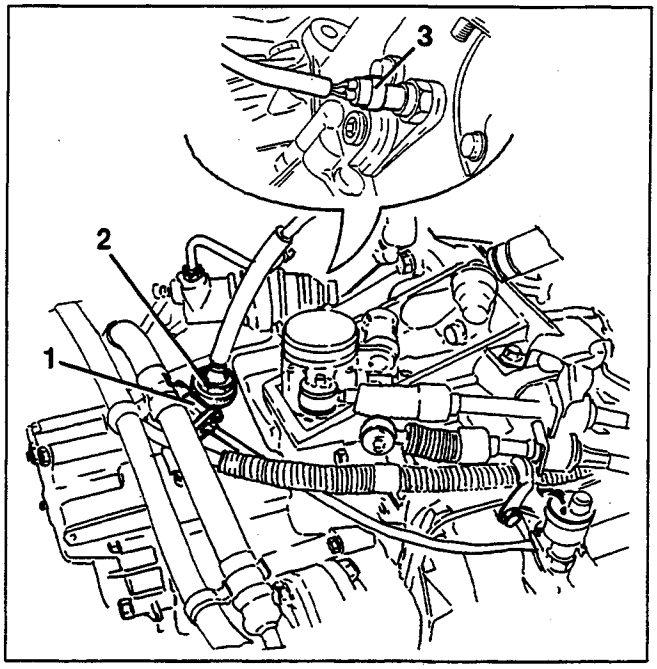
– Suitably plug the hole in the pipe towards the turbocharger and intercooler.
3. Disconnect the ignition coil cap.
4. Disconnect the throttle sensor connection.
5. Disconnect the by-pass pipe clamp



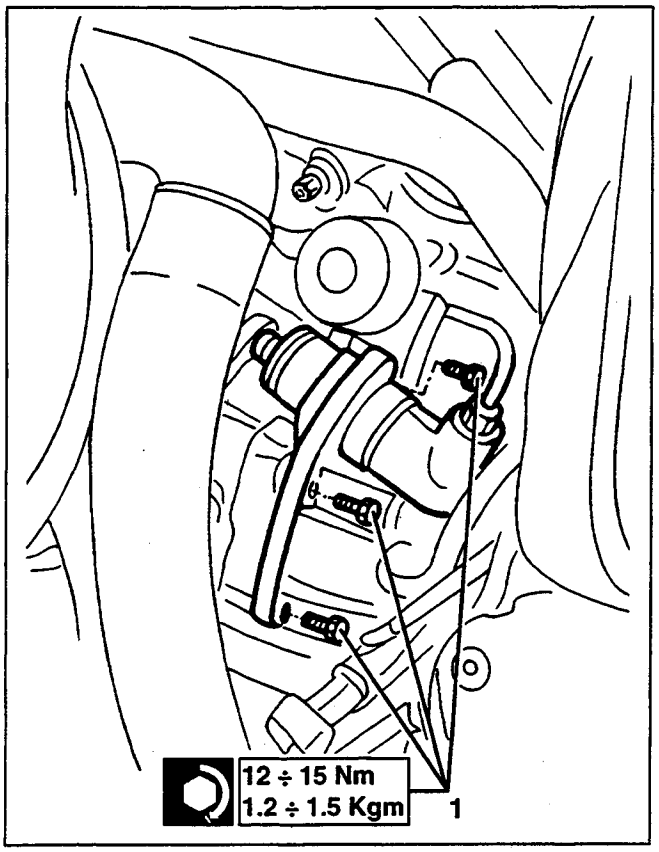
1. Disconnect the electrical connections of the engine temperature sensors



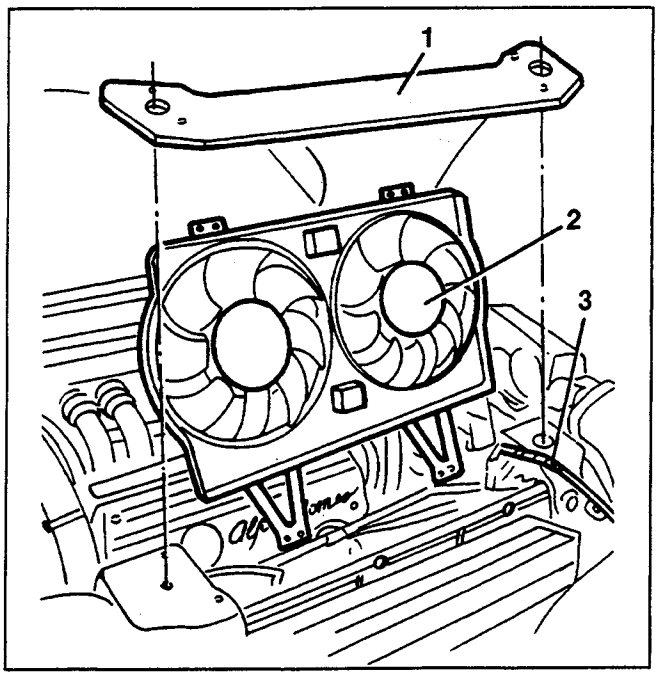
1. Disconnect the electrical connection of the mileage recorder sensor.
2. Disconnect the reversing gear release cable from the gearbox.
3. Disconnect the electrical connection of the reversing switch.



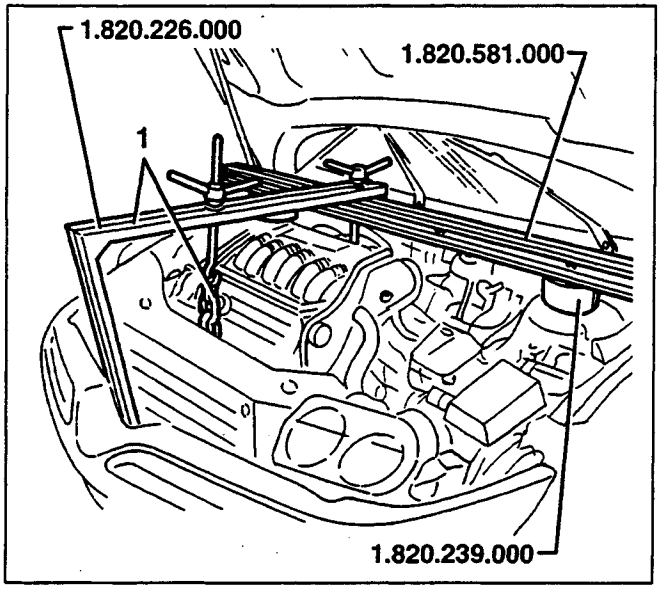
– Raise the car
1. Working from below, disconnect the fastening bracket of the clutch cylinder
– Lower the car and move the cylinder, without disconnecting the piping



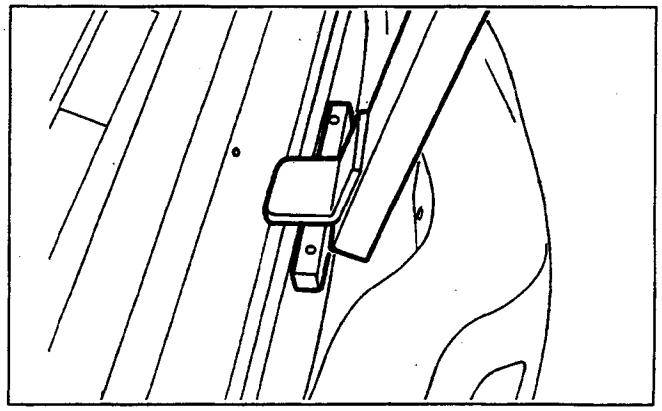
1. Remove the front crossmember above the radiator.
2. Remove the fan ducts, after disconnecting all the electrical connections.
3. Remove the bonnet opening cable



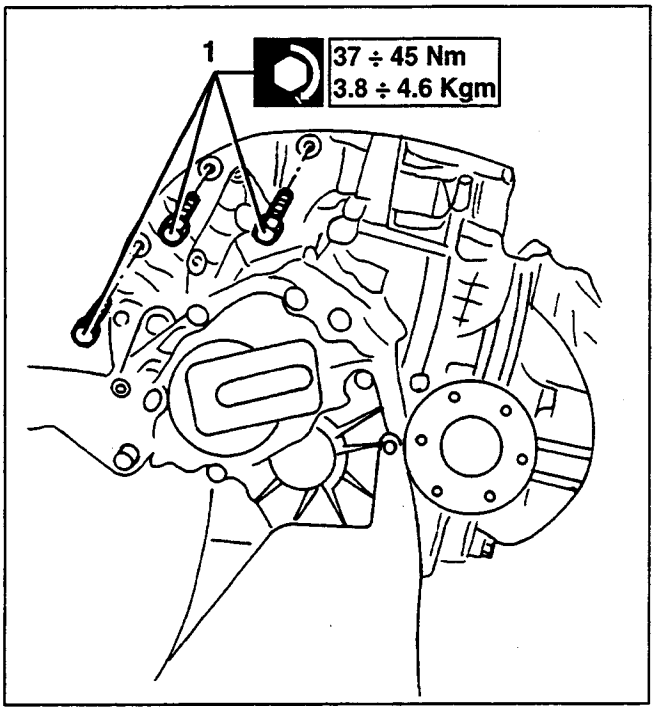
1. Using tools 1.820.239.000, 1.820.581.000 and 1.820.226.000 suitably support the engine with a chain.



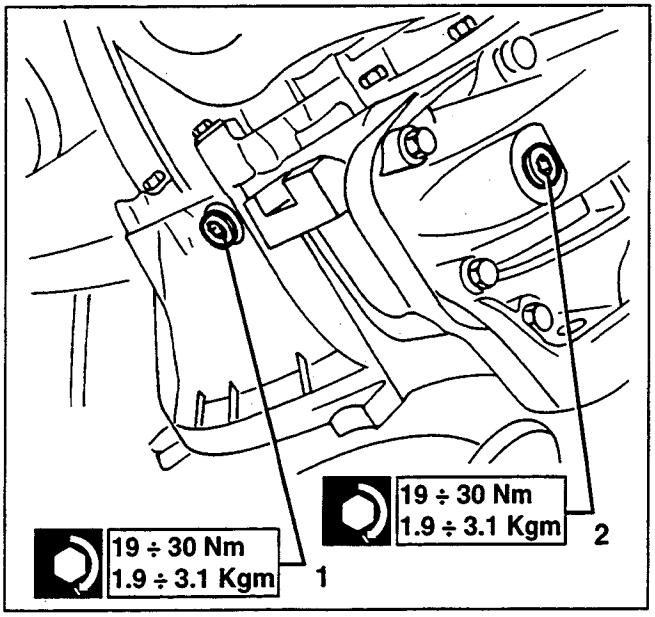
WARNING:
To avoid damaging the power steering pipes, housed at the front of the radiator, interpose a suitable thickness between the front connection of the tool and its resting surface.



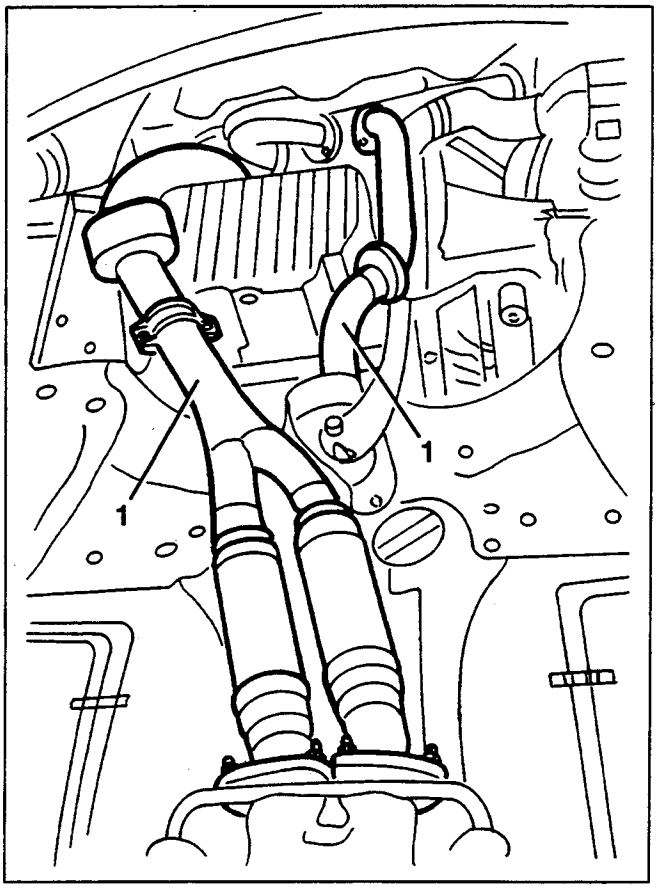
1. Slacken the three upper screws fastening the gearbox cover to the crankcase.



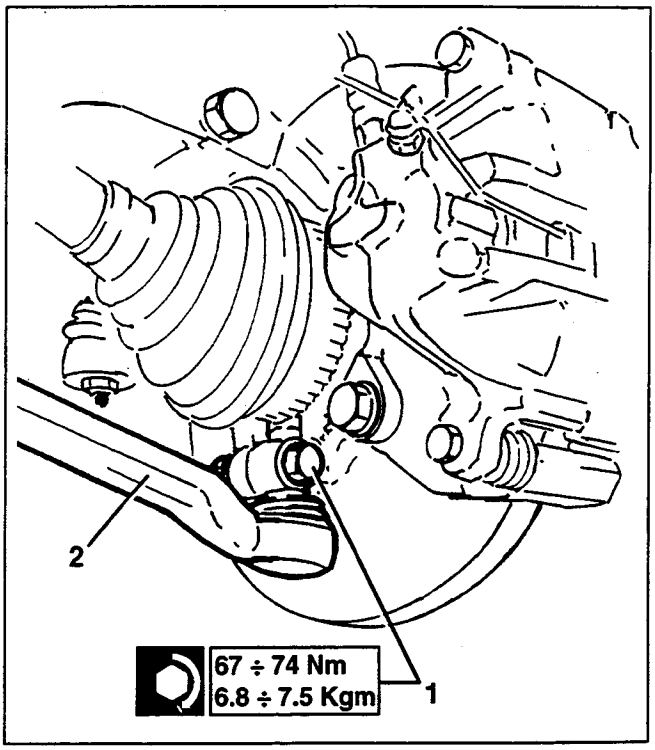
– Raise the lambda probe connection.
– Raise the car.
– Position a suitable recipient under the engine compartment
1. Slacken the plug and drain the oil from the gearbox.
2. Slacken the plug and drain the oil from the differential.



– Retrieve the lambda probe cable
1. Remove the front exhaust manifolds, up to the catalytic converter.

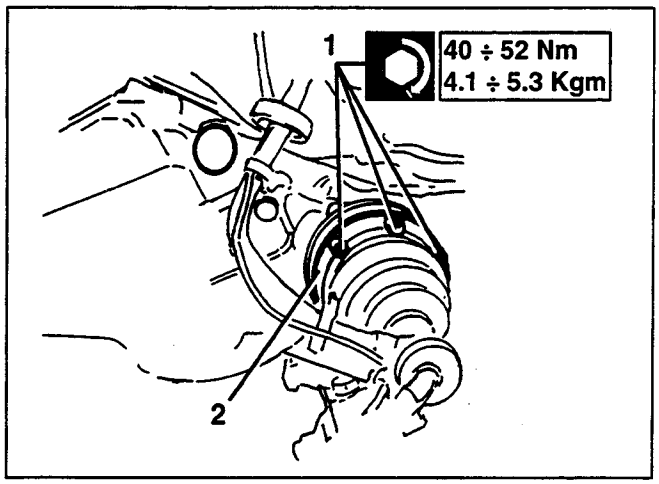


1. Working from both sides of the car, slacken the bolt fastening the suspension wishbone to the wheel hub.
2. Withdraw the suspension wishbone ball pin.

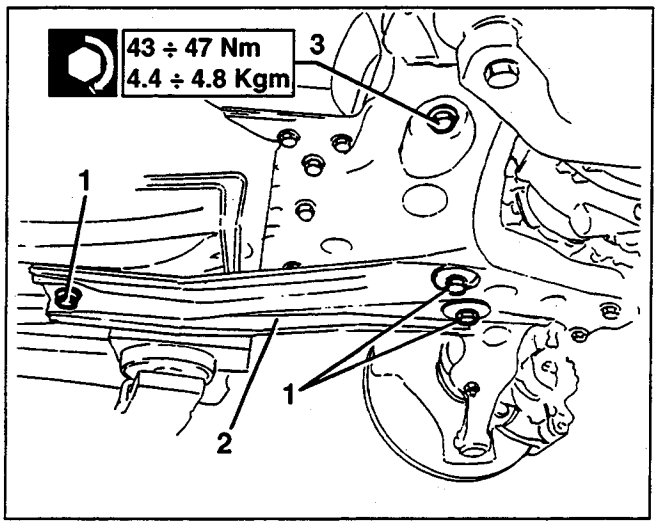


– Working on the left-hand side of the car, disconnect the earth braid from the gearbox.

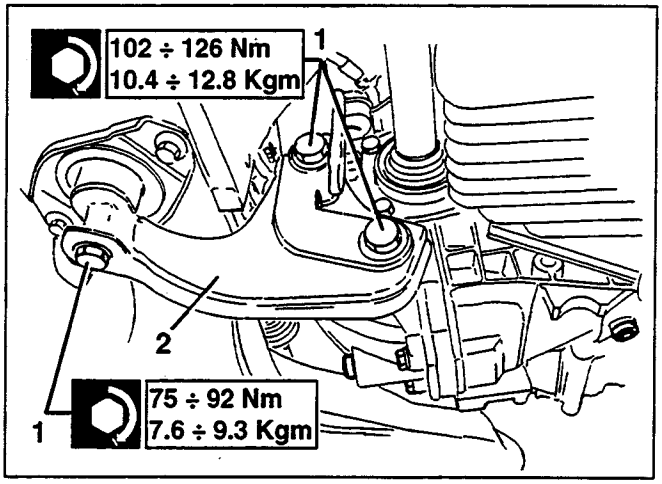
1. Slacken the six bolts and disconnect the axle shaft from the differential.
2. Retrieve the safety plates.



1. Working from under the car, slacken the four screws fastening each of the two front crossmember reinforcement struts.
2. Retrieve the reinforcement struts.
3. Slacken the screws fastening the steering box to the crossmember.



1. Slacken the three fastening screws.
2. Remove the rear engine support.



1. Remove the two heat shields