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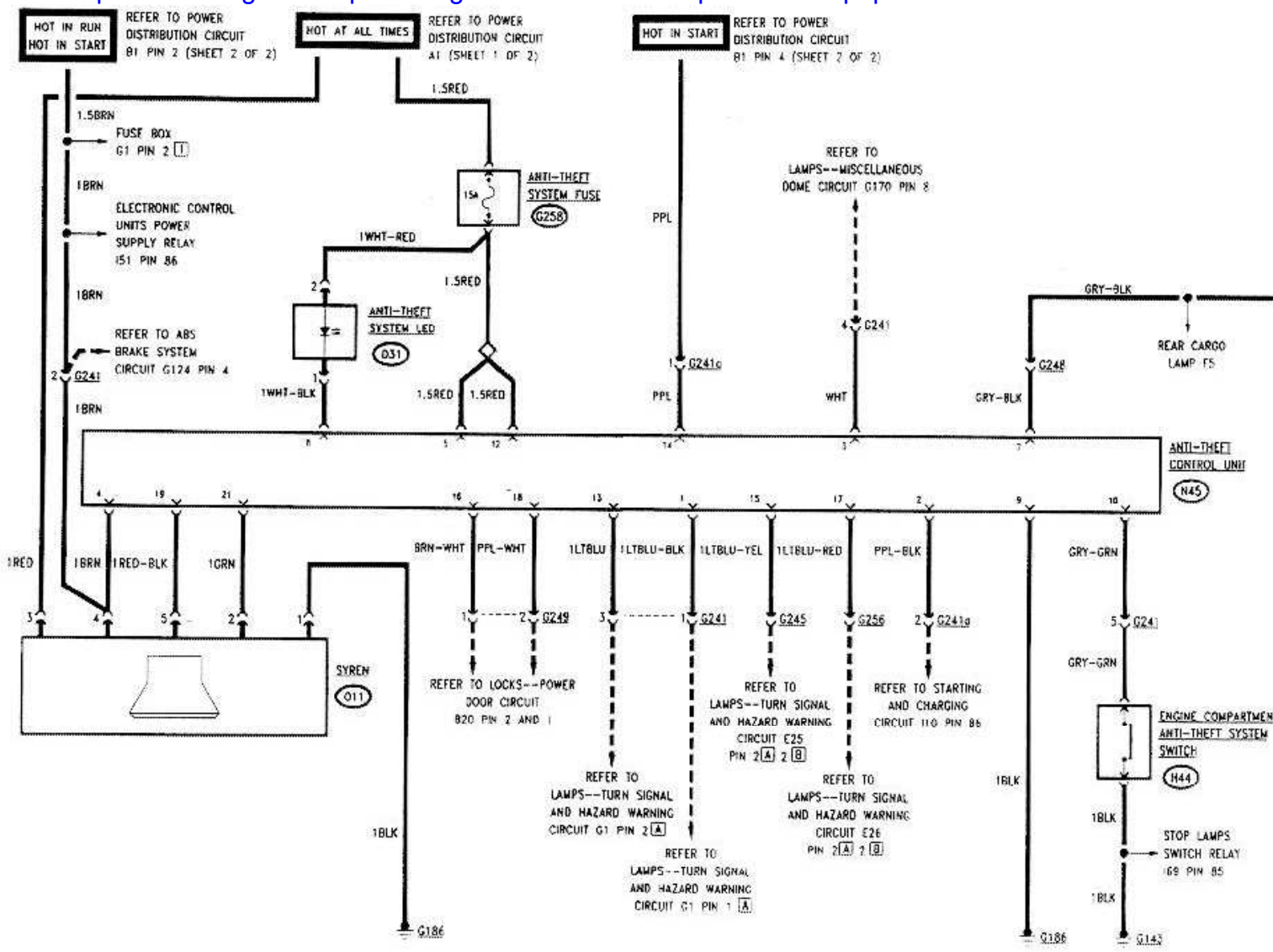
ALARM - - ELECTRONIC ANTI-THEFT SYSTEM

ALARM - - ELECTRONIC ANTI-THEFT SYSTEM



GENERAL

The vehicle is equipped with a remote control electronic anti-theft system. The remote control also actuates the centralized door lock/unlock system.
The anti-theft system consists of an electronic unit, a syren located in the right side of trunk, and a remote control used to activate/deactivate the system.
The syren is powered by a dedicated battery and is provided with an ON/OFF key.
Activation of the anti-theft system is indicated by flashing of a led on the central console, actuation of the centralized door lock and illumination for a few seconds of the turn signal lamps. Activation of the anti-theft system also locks the engine ignition circuit.
Deactivation of the anti-theft system is indicated by illumination of the turn signal lamps, centralized unlocking of door and switching off of led on the central console.
The system is protected by free fuse **G258** (15A) ANTI-THEFT SYSTEM.

OPERATIONAL DESCRIPTION

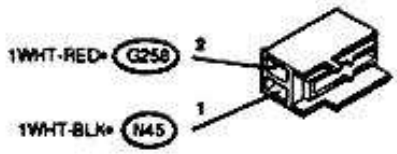
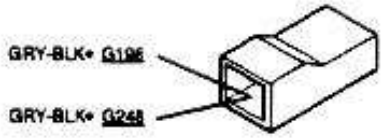
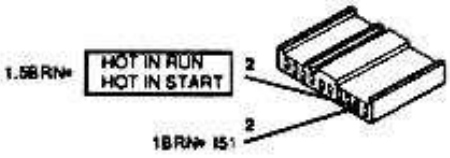
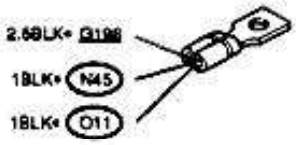
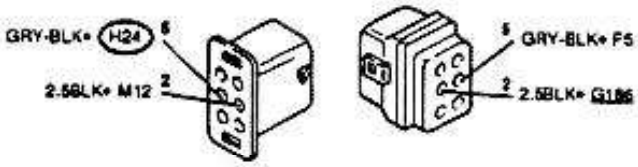
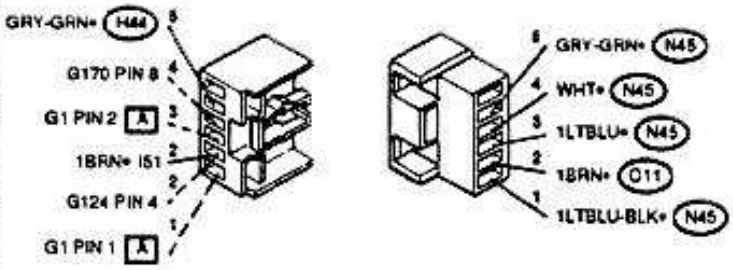
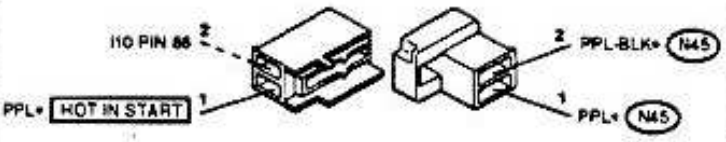
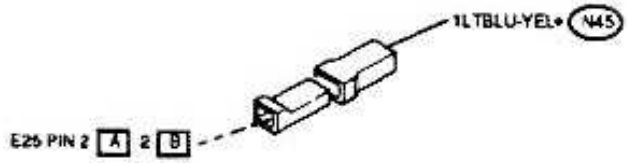
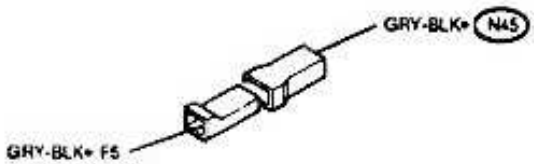
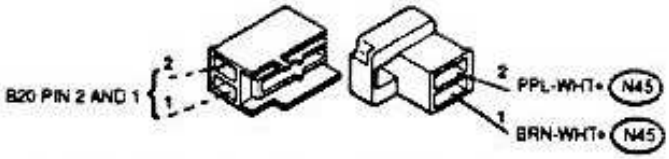
The 12V power supply line is connected directly to the anti-theft system syren **O11**, to pins 5 and 12 of the anti-theft control unit **N45** through the free fuse **G258**, and to led **D31** on the central console.
Activation of the anti-theft system is obtained by directing the remote control towards the vehicle and pressing the control push button; the remote control is provided with and indicator light which illuminates any time the control pushbutton is pressed.
The control unit **N45** provides the following functions when the anti-theft system is activated:

- Flashing of led **D31** (pin 8 of control unit).
- Actuation of centralized door lock (pins 16 and 18).
- Flashing of the four turn signal lamps (pins 1, 3, 15 and 17).
- Engagement of engine ignition circuit lock (pin 2).

When the anti-theft system is activated, opening of doors, engine hood or trunk lid is sensed by the control unit **N45**, with consequent activation of siren **O11**. Information about opening of doors, engine hood and trunk lid is trasmitted to the control unit by dedicated switches.
When a door is opened, the corresponding switch opens and supplies a "door open" input to pin 3 of control unit **N45**. When the engine hood or the trunk lid are opened, the corresponding switches **H44** and **H24** close, and connect to ground pins 10 or 7 of the control unit **N45**.
With the ignition key inserted, the battery power is supplied to pin 14 of control unit **N45**, thus allowing inhibition of the receiver to prevent accidental activations.

TROUBLESHOOTING TABLE

FAULT TYPE	FAILED COMPONENT						
	G258 FUSE	H24 SWITCH	H44 SWITCH	D31 LED	O11 SYREN	N45 CONTROL UNIT	REMOTE CONTROL
ANTI-THEFT ACTIVATION/DE-ACTIVATION MODES INOPERATIVE	●					●	●
ANTI-THEFT ACTIVATION MODE INOPERATIVE						●	
SYREN INOPERATIVE		●	●	●	●	●	

Anti-theft system led	D31	Rear cargo lamp	F5
			
Fuse box	**G1** I	**Central bulkhead ground**	**G143**
			
Trunk right side ground	**G186**	**Connector, right rear wiring to trunk lock wiring**	**G198**
			
Board wiring to anti-theft system wiring connector	**G241**	**Board wiring to anti-theft system wiring connector**	**G241a**
			
		Right rear wiring connector, anti-theft system	**G245**
			
Anti-theft system wiring connector right rear wiring	**G248**	**Anti-theft system wiring connector - console wiring**	**G249**
			

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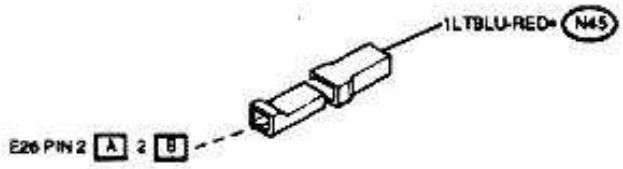
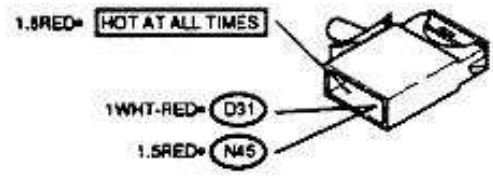
Left rear wiring connector, anti-theft system	G256

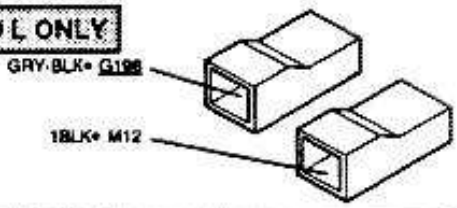


Anti-theft system fuse	G258



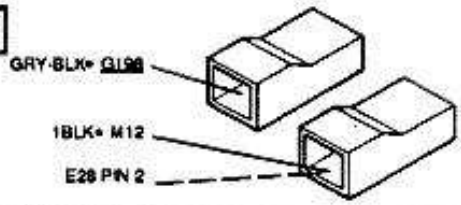
Trunk illumination switch	H24

BASE AND L ONLY

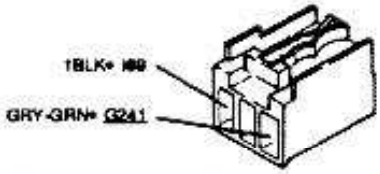


Trunk illumination switch	H24

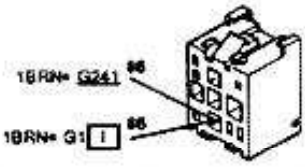
S ONLY



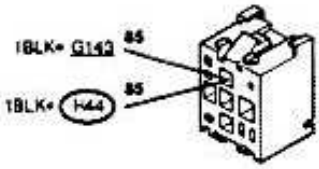
Engine compartment anti-theft system switch	H44



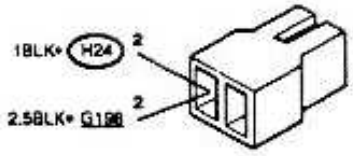
Electronic control units power supply relay	I51



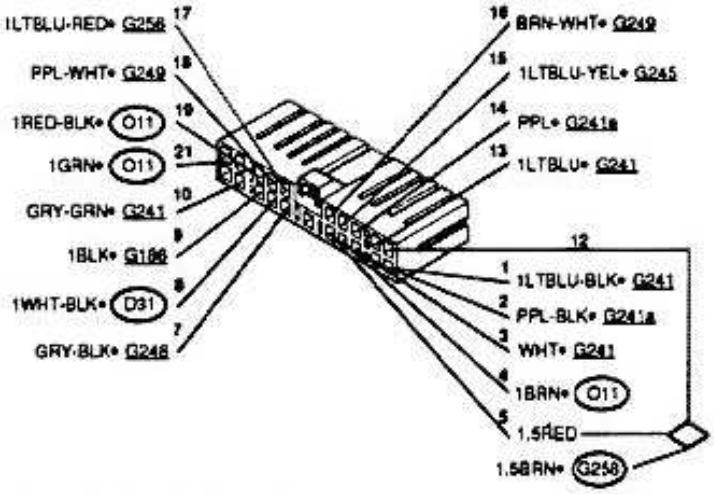
Stop lamps switch relay	I69



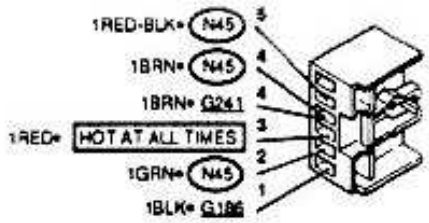
Trunk opening solenoid	M12

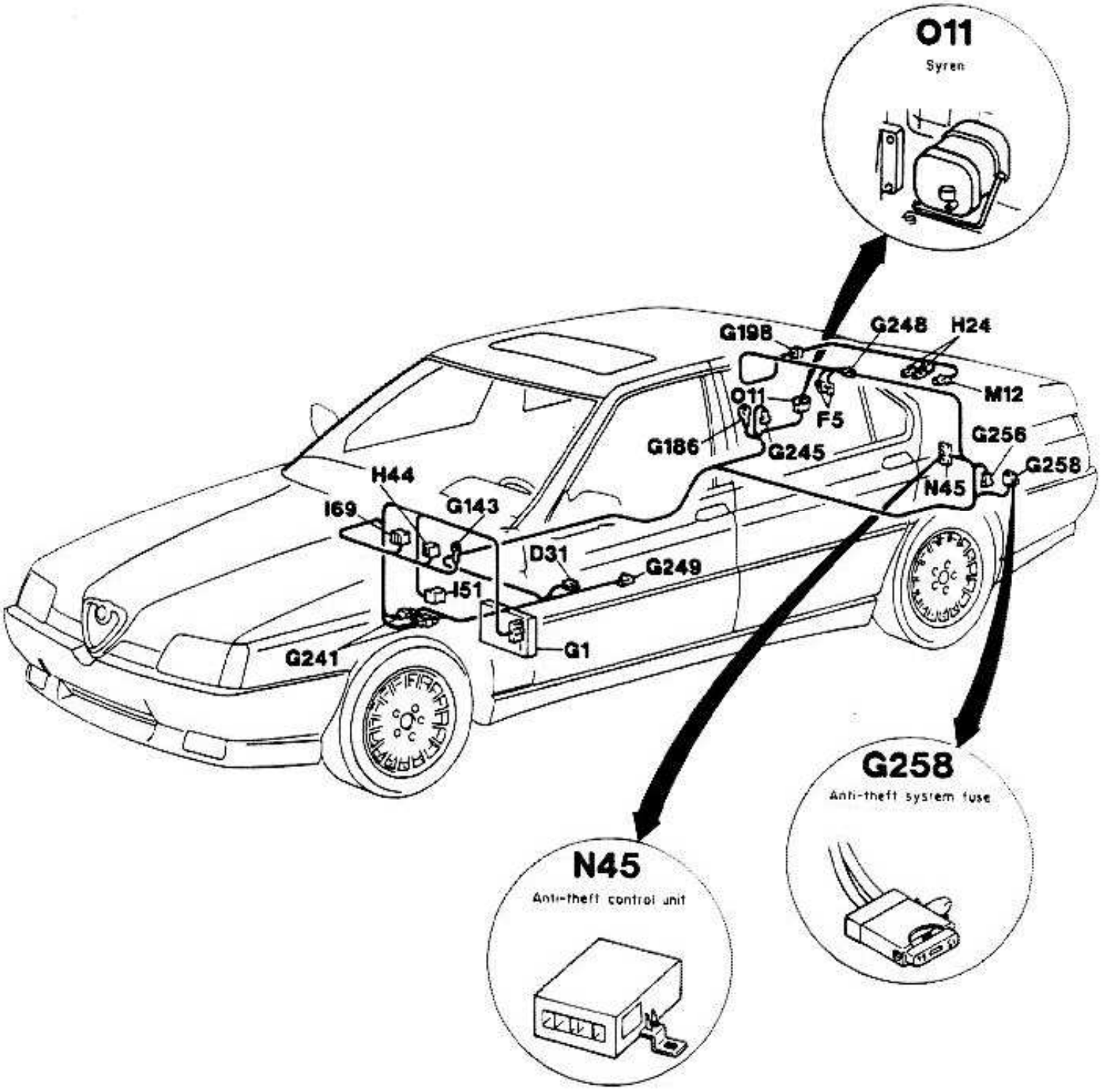


Anti-theft control unit	N45



Syren	O11





ANTI-THEFT ACTIVATION/DE-ACTIVATION MODES INOPERATIVE	TEST A

TEST STEPS	RESULTS	REMEDY
NOTE: In case the operation of remote control requires to approach the vehicle excessively, replace the remote control batteries. In any case, replacement of batteries every 12 months is recommended.		
A1 FUSE CHECK - Check free fuse **G258** for integrity	OK ▶ ~~OK~~ ▶	Carry-out step A2 Replace free fuse G258
A2 REMOTE CONTROL BATTERIES CHECK - Actuate the remote control pushbutton and check that led on remote control illuminates	OK ▶ ~~OK~~ ▶	Carry-out step A3 Replace remote control batteries
A3 CONTROL UNIT CHECK - Check for presence of 12V between pins 5 and 12 of control unit **N45** and ground	OK ▶ ~~OK~~ ▶	Replace control unit N45 Carry-out step A4
A4 VOLTAGE CHECK - Check for presence of 12V between pin of free fuse **G258** (RED wire) and ground	OK ▶ ~~OK~~ ▶	Carry-out step A5 Failure of the power distribution circuit, refer to the relevant circuit of sheet 1 of 2

(Cont.d)

ANTI-THEFT ACTIVATION/DE-ACTIVATION MODES INOPERATIVE	TEST A

TEST STEPS		RESULTS	REMEDY
A5	GROUNDING CHECK		
- Check for presence of 0V (zero) at pin 9 of control unit N45		OK ▶	Repair wiring between pins 5, 12 of control unit N45 and pin of free fuse G258
		~~OK~~ ▶	Repair wiring between pin 9 of control unit N45 and ground point G186

End of test A

ANTI-THEFT ACTIVATION MODE INOPERATIVE	TEST B

TEST STEPS	RESULTS	REMEDY
B1 SIMULTANEOUS ILLUMINATION OF TURN SIGNAL LAMPS CHECK - Check that the four turn signal lamps illuminate simultaneously	OK ▶ ~~OK~~ ▶	Carry-out step B11 Carry-out step B2
B2 TURN SIGNAL LAMPS CHECK - Check that all the four turn signal lamps remain off	OK ▶ ~~OK~~ ▶	Replace control unit N45 Carry-out step B3, B5 or B7 or B9
B3 LEFT FRONT TURN SIGNAL LAMP CHECK - Actuate the multiple switch as required to turn on the left front turn signal lamp, and check the lamp turns on	OK ▶ ~~OK~~ ▶	Carry-out step B4 Replace bulb
B4 CONTINUITY CHECK - Check for continuity between pin 1 of control unit N45, pin 1 of connector G241 and pin 1A of fuse box G1	OK ▶ ~~OK~~ ▶	Replace control unit N45 Replace or repair wires, as necessary

ANTI-THEFT ACTIVATION MODE INOPERATIVE	TEST B

TEST STEPS	RESULTS	REMEDY
B5 RIGHT FRONT TURN SIGNAL LAMP CHECK - Actuate the multiple switch as required to turn on the right front turn signal lamp, and check the lamp turns on	OK ▶ ~~OK~~ ▶	Carry-out step B6 Replace bulb
B6 CONTINUITY CHECK - Check for continuity between pin 13 of control unit N45, pin 3 of connector G241 and pin 2A of fuse box G1	OK ▶ ~~OK~~ ▶	Replace control unit N45 Replace or repair wires, as necessary
B7 LEFT REAR TURN SIGNAL LAMP CHECK - Actuate the multiple switch as required to turn on the left rear turn signal lamp, and check the lamp turns on	OK ▶ ~~OK~~ ▶	Carry-out step B8 Replace bulb
B8 CONTINUITY CHECK - Check for continuity between pin 17 of control unit N45, connector G256 and pins 2A and 2B of tail lamp E26	OK ▶ ~~OK~~ ▶	Replace control unit N45 Replace or repair wires, as necessary

ANTI-THEFT ACTIVATION MODE INOPERATIVE	TEST B

TEST STEPS	RESULTS	REMEDY
B9 RIGHT REAR TURN SIGNAL LAMP CHECK - Actuate the multiple switch as required to turn on the right rear turn signal lamp, and check the lamp turns on	OK ▶ ~~OK~~ ▶	Carry-out **step B10** Replace **bulb**
B10 CONTINUITY CHECK - Check for continuity between pin 15 of control unit **N45**, connector **G245** and pins 2A and 2B of tail lamp **E25**	OK ▶ ~~OK~~ ▶	Replace **control unit N45** Replace or repair **wires, as necessary**
B11 DOOR LOCK CHECK - Check locking of all the four doors	OK ▶ ~~OK~~ ▶	Carry-out **step B13** Carry-out **step B12**
B12 VOLTAGE CHECK - Check for presence of 12V between pins 16 and 18 of control unit **N45**	OK ▶ ~~OK~~ ▶	Repair wiring between **pins 16 and 18 of control unit N45, pins 1 and 2 of connector G249 and pins 2 and 1 of switch B20** Replace **control unit N45**

ANTI-THEFT ACTIVATION MODE INOPERATIVE	TEST B

TEST STEPS	RESULTS	REMEDY
B13 LED CHECK		
- Check flashing of led on the central console	OK ▶	Carry-out step B16
	~~OK~~ ▶	Carry-out step B14
B14 ELECTRONIC UNIT CHECK		
- Check for presence at pin 8 of control unit **N45** of a signal switching from 0V (zero) to open circuit conditions, and vice versa	OK ▶	Carry-out step B15
	~~OK~~ ▶	Replace control unit **N45**
B15 TTL SIGNAL CHECK		
- Check for presence of TTL signal to terminals of led **D31**	OK ▶	Replace led D31
	~~OK~~ ▶	Repair wiring between **pin 2 of led D31 (anode) and fuse G258, and between pin1 of led D31 (cathode) and pin 8 control unit N45**
B16 ENGINE IGNITION INHIBITION CHECK		
- With anti-theft system activated, check that engine can not be started	OK ▶	Carry-out step B19
	~~OK~~ ▶	Carry-out step B17

ANTI-THEFT ACTIVATION MODE INOPERATIVE	TEST B

TEST STEPS	RESULTS	REMEDY
B17 CONTROL UNIT CHECK		
- With anti-theft system activated, check for presence of 0V (zero) at pin 2 of control unit N45	OK ▶	Repair wiring between pin 2 of control unit N45, pin 2 of connector G241a and pin 86 of relay I10
	~~OK~~ ▶	Carry-out step B18
B18 VOLTAGE CHECK		
- With the ignition key set to "start" position, check for presence of 12V between pin 14 of control unit N45 and ground	OK ▶	Replace control unit N45
	~~OK~~ ▶	Carry-out step B19
B19 VOLTAGE CHECK		
- With the ignition key set to "start" position, check for presence of 12V between pin 1 of connector G241a and ground	OK ▶	Repair wiring beween pin 1 of G241a and pin 14 of control unit N45
	~~OK~~ ▶	Failure of the power distribution circuit, refer to the relevant circuit of sheet 2 of 2

End of test B

SYREN INOPERATIVE	TEST C

TEST STEPS	RESULTS	REMEDY
C1 SYREN CHECK - Check syren activation by disconnecting one of the battery terminals	OK ▶ ~~OK~~ ▶	Carry-out step C4 Carry-out step C2
C2 VOLTAGE CHECK - Re-connect battery terminal and, with the ignition key set to "run" or to "start" position, check for presence of 12V between pin 4 of syren O11 and ground	OK ▶ ~~OK~~ ▶	Replace syren battery and/or siren O11 Carry-out step C3
C3 VOLTAGE CHECK - With the ignition key set to "run" or to "start" position, check for preence of 12V between pin 2 of G241 and ground	OK ▶ ~~OK~~ ▶	Repair wiring between pin 2 of connector G241 and pin 4 of syren O11 Failure of the power distribution circuit, refer to the relevant circuit of sheet 2 of 2
C4 SYREN CHECK - Check that syren does not activate when the trunk lid, engine hood and doors are opened	OK ▶ ~~OK~~ ▶	Carry-out step C5 Carry-out step C7

SYREN INOPERATIVE	TEST C

TEST STEPS	RESULTS	REMEDY
C5 VOLTAGE CHECK - Check for presence of 12V between pins 1 and 2 of syren **O11**	OK ▶ ~~OK~~ ▶	Replace **syren O11** Carry-out **step C6**
C6 VOLTAGE CHECK - Check for presence of 12V between pin 21 control unit **N45** and ground	OK ▶ ~~OK~~ ▶	Repair wiring between **pin 21 of control unit N45 and pin 2 of syren O11, and between pin 1 of syren O11 and ground point G186** Replace **control unit N45**
C7 DOOR SYREN ACTIVATION CHECK - Check syren activation by opening of either door	OK ▶ ~~OK~~ ▶	Carry-out **step C9** Carry-out **step C8**
C8 GROUNDING CHECK - Check for presence of 0V (zero) at pin 3 of control unit **N45**	OK ▶ ~~OK~~ ▶	Replace **control unit N45** Repair wiring between **pin 3 of control unit N45, pin 4 of connector G241 and pin 8 of connector G170**

(Cont.d)

SYREN INOPERATIVE	TEST C

TEST STEPS	RESULTS	REMEDY
C9 HOOD SYREN ACTIVATION CHECK		
- Check syren activation by opening the engine hood	OK ▶	Carry-out step C12
	~~OK~~ ▶	Carry-out step C10
C10 GROUNDING CHECK		
- Check for presence of 0V (zero) at pin 10 of control unit N45	OK ▶	Replace control unit N45
	~~OK~~ ▶	Carry-out step C11
C11 GROUNDING CHECK		
- Check for presence of 0V (zero) at pin 5 of connector G241	OK ▶	Repair wiring between pin 5 of connector G241 and pin 10 of control unit N45
	~~OK~~ ▶	Carry-out step C12

SYREN INOPERATIVE	TEST C

TEST STEPS	RESULTS	REMEDY
C12 SWITCH CHECK - Check anti-theft system switch **H44** in the engine compartment for proper operation	OK ▶ ~~OK~~ ▶	Repair wiring between **switch H44 (GRY-GRN wire)** and **pin 5 of connector G241** and between **switch H44 (BLK wire)** and **ground point G143** Replace **switch H44**
C13 TRUNK LID SYREN ACTIVATION CHECK - Check syren activation by opening the trunk lid	OK ▶ ~~OK~~ ▶	Carry-out **step C3** Carry-out **step C14**
C14 GROUNDING CHECK - Check for presence of 0V (zero) at pin 7 of control unit **N45**	OK ▶ ~~OK~~ ▶	Replace **control unit N45** Carry-out **step C15**

SYREN INOPERATIVE	TEST C

TEST STEPS	RESULTS	REMEDY
C15 GROUNDING CHECK		
- Check for presence of 0V (zero) at connector **G248**	OK ▶	Repair wiring between **connector G248 and pin 7 of control unit N45**
	~~OK~~ ▶	Carry-out **step C16**
C16 GROUNDING CHECK		
- Check for presence of 0V (zero) at pin 5 of connector **G198**	OK ▶	Repair wiring between **connector G198 and G248**
	~~OK~~ ▶	Carry-out **step C17**
C17 SWITCH CHECK		
- Check that trunk illumination switch **H24** is operational	OK ▶	Repair wiring between **switch H24 and pin 5 of connector G198, and between switch H24, pin 2 of connector G198 and ground point G186**
	~~OK~~ ▶	Replace **switch H24**

End of test C

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BODY

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BODY

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BODY

DESCRIPTION

The body has been designed using, in great amount, the method of finished items. The high torsional stiffness obtained in this way renders the geometry indeformable, and assures precision of assembly tolerances, thus preventing noises and squeaking. The stresses are furthermore reduced within
absolute safety limits. The use of high-strength metal sheets allows a great indeformability to small impacts with a limited weight. To give the maximum resistance to corrosion, the entire body is fully treated with galvanization Zinc plating.
The following features further increase the resistance against rust and corrosion:

- Number of parts composing the body has been reduced to a minimum, with consequent reduction of joints number;
- The welding points have been reduced, while the number of spot weldings with automatized procedures has been increased;
- The seam welding total length has been reduced to 1 meter (3.2 ft) only (the seam welding is most subjected to defects);
- Vehicle body is integrally sealed;
- Box-type components have been fitted with vent holes to prevent moisture from condensating;
- The body underside has been coated with PVC as protective and soundproofing;
- As final cycle, a special wax-oil is injected into all box-type elements.

The painting process is accomplished following the cycle listed here below:

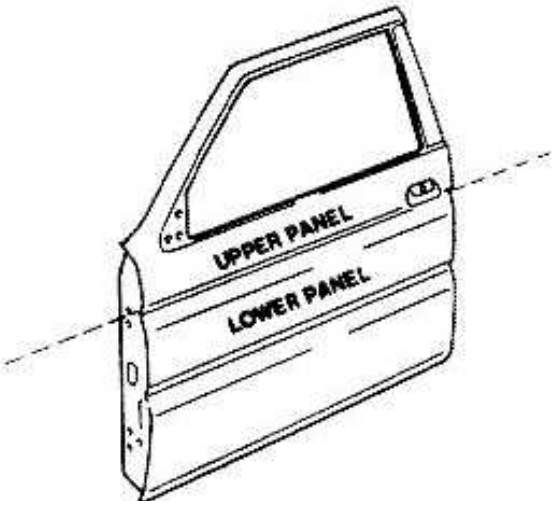
- De-oxidation;
- Degreasing (pickling);
- Phosphatizing and passivation (bonderizing) obtained with body full-immersion;
- Cataphoresis;
- Oven curing;
- Application of sealants and PVC coating on body underside and wheelhouse;
- Application of primer coating on external surfaces;
- Oven curing;
- Application of primer paint and transparent enamel (which gives a further protection and a particular luster). These coats are applied on automatic spray booth with the system of rotating cups, which assures a constant-coating thickness.

BODY REPAIRS AND PAINTING

The word "painting" usually means the restoring operation of a painted surface. When a surface is affected only partially, the operation is named "repainting".
The following repainting cycles have been defined depending on repair type:

- **PAINTING OF REPLACED FIXED METAL SHEET**
- **PAINTING OF REPLACED MOBILE METAL SHEET**
- **REPAINTING OF METAL SHEET WITH A DEFECT AFFECTING METAL**
- **REPAINTING OF METAL SHEET WITH SURFACE DEFECTS**
- **RESTORING OF METAL SHEET WITHOUT PAINTING (DENTS REMOVAL)**

For repainting purpose, it is important to define "what is a panel". The door depicted in figure has been taken as example to clarify the concept. The entire door is a panel, but it may be divided, in such a case, in two separate panels: the upper panel and the lower panel. A panel means a surface included between two delimitations.

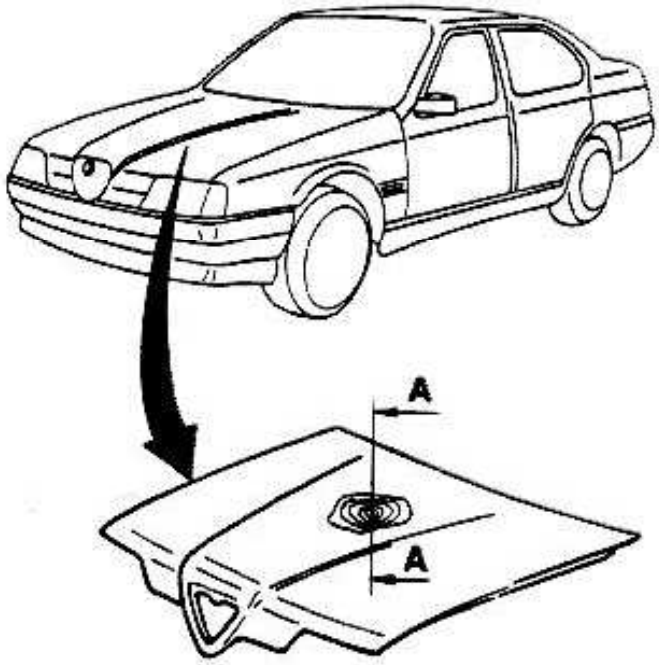


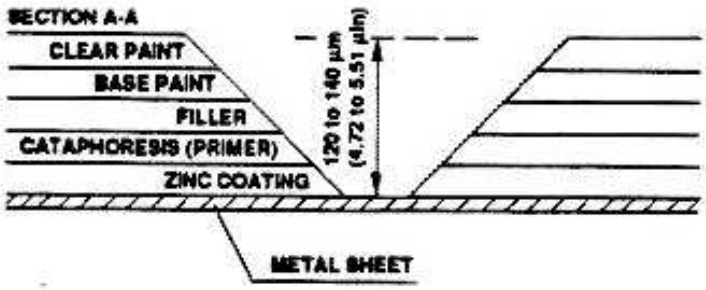
The procedures for repair and painting of a metal sheet delivered as spare part are listed below.

NOTE: Metal sheet delivered as spare parts are surface-treated with cataphoresis by manufacturer.

PREPARATION (sanding and cleaning)

Operate in the affected area by blending existing paint coats with abrasive paper of prescribed type as follows:





Thoroughly clean affected area with silicone-proof prod-

SURFACING

Sheet metal repairs usually require surfacing. Prepare stopper by adding catalyst to base resin as per ratio indicated by manufacturer.
Mix thoroughly and apply a coat sufficient to fill dents. Allow stopper to completely cure before proceeding with subsequent operations.

SANDING

The dry or wet-sanding may be carried-out manually or using electrically or pneumatically operated sand papering machines, with prescribed abrasive paper.

MASKING

The areas adjacent to zone to be repaired should be masked with paper sheet and pressure sensitive tape.
The masking is very important, and should be carried-out with the maximum care to avoid any possible damage.
The masking should be applied after stopper has been sanded, should be removed after filler sanding (due to contamination by powder and abrasive particles) and finally re-applied before final painting (enamel application).

PRIMER APPLICATION

The primer should be applied on bare metal surface for protection against corrosion.
When primer is dried, apply filler.

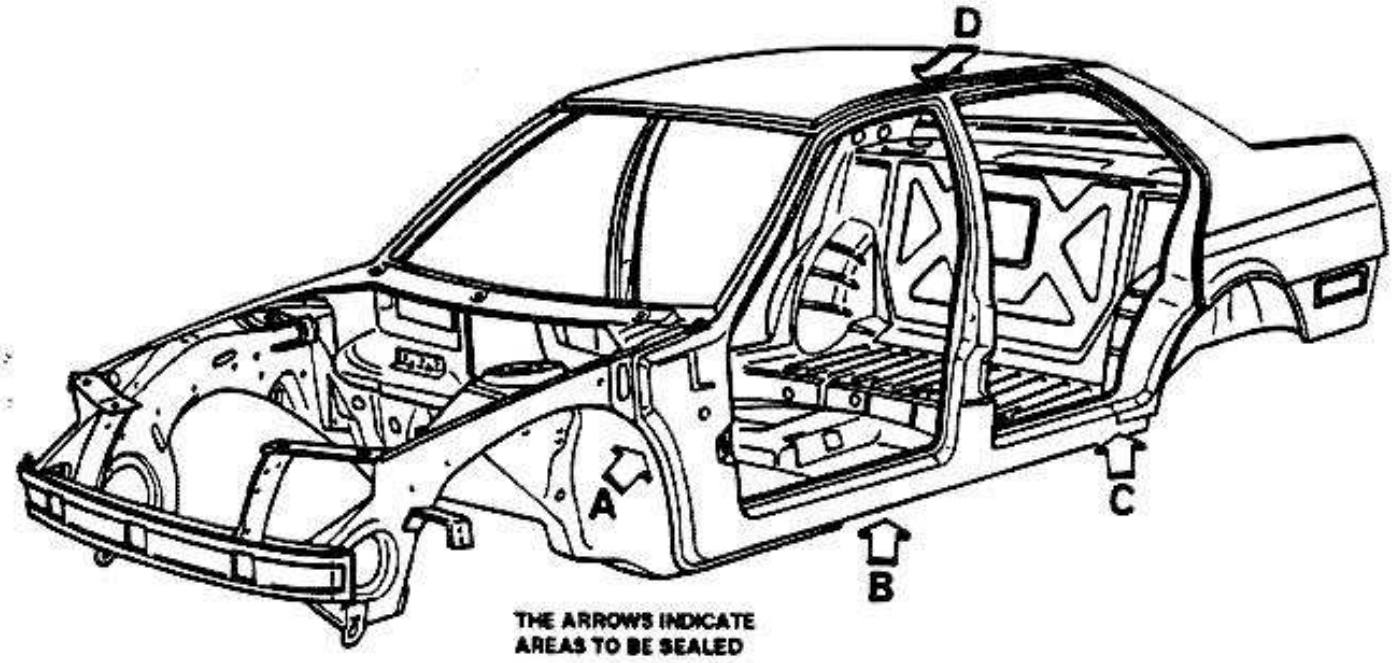
SEALING

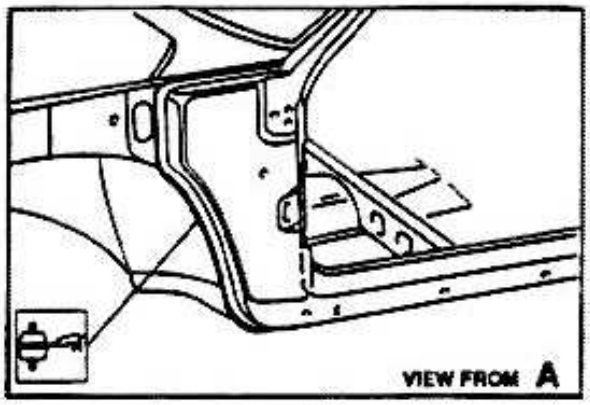
The sealing is the application of specific products in various areas of body to avoid water and moisture seepage.
The sealant should be applied on metal sheet joints using

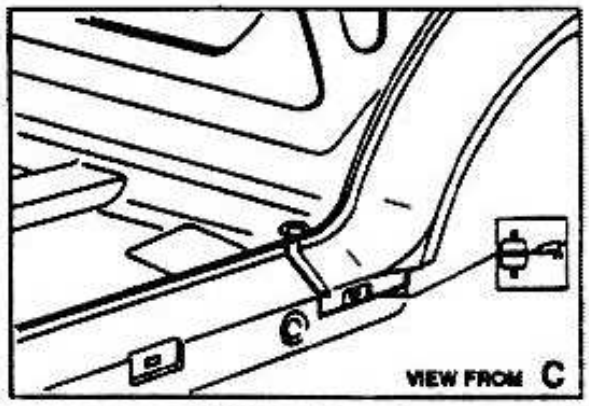
bolts.

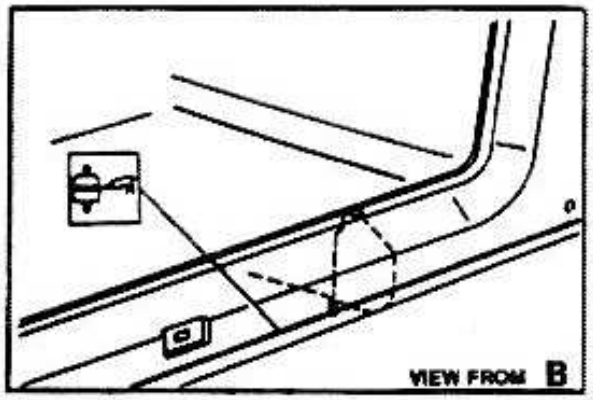
brush or suitable gun.

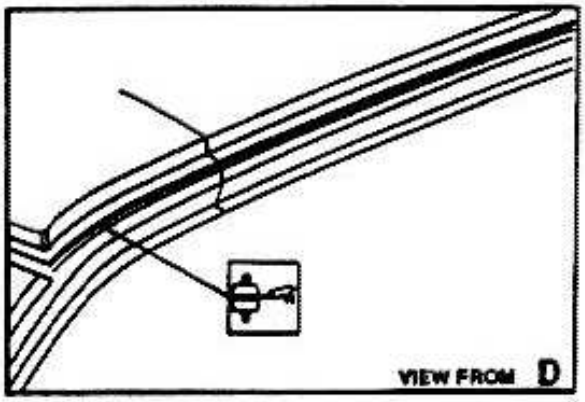
Apply sealant where indicated by heavy line in the following figures.

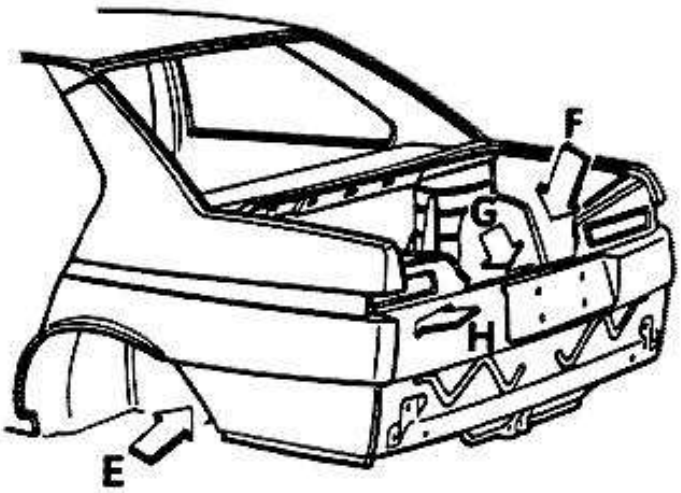




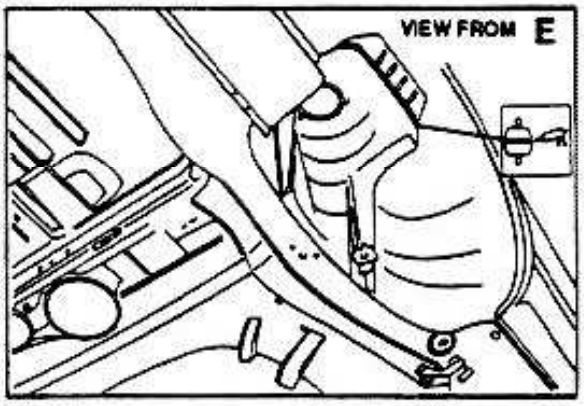


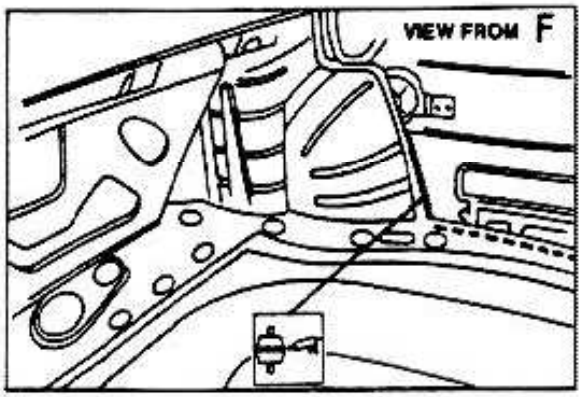


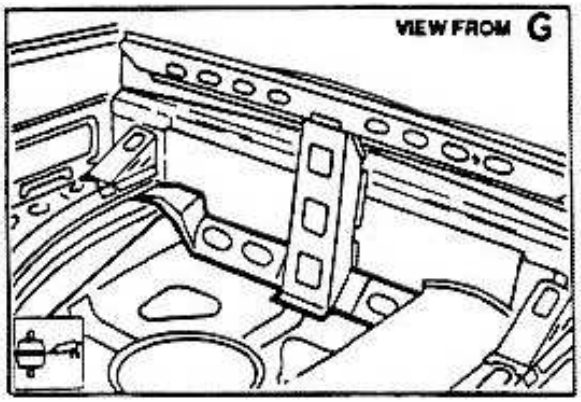


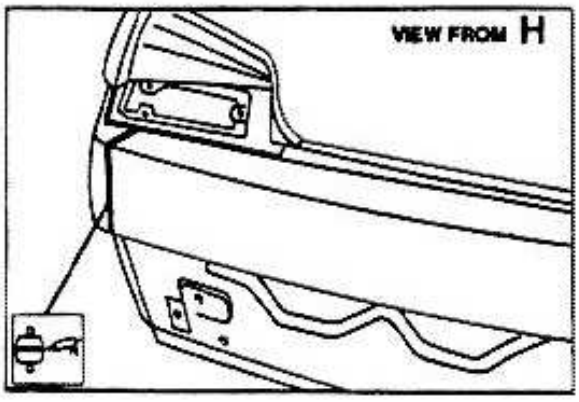


THE ARROWS INDICATE AREAS TO BE SEALED









CAUTION: Avoid any excess of sealant; apply sealant only where indicated.

NOTE: Sealant beads should be smooth, uninterrupted and free of ribbiness.

FILLER APPLICATION

The filler coating, due to its thickness, assures proper insulation from coats below and eliminates any defect of primer coating.
For the best results, it is advisable to apply filler in suitable booth; don't forget to wipe affected areas with dustproof cloth (Tack-Rag).
The filler should be prepared and applied as specified in paintwork schedule.
After filler has cured, apply a very thin coat of enamel (spy-coat) which will allows to detect any defect.
Allow enamel to cure as per manufacturer's instructions, then dry or wet-sand the area, manually or using electrically or pneumatically operated sand-papering machine with prescribed abrasive paper.
Sanding of "spy-coat" allows the detect defects, if any, and prepares filler coat for enamel application.
Clean area thoroughly with compressed air to eliminate any trace of dust and moisture. It is also advisable to clean area with silicone-proof solvent and to dry with compressed air.
Finally, rub area with dustproof cloth (Tack-Rag).

ENAMEL APPLICATION

The required color may be obtained by mixing basic colors by ratio indicated in the applicable color formula. The enamels obtained in this way don't have the proper viscosity value for application, and should therefore be mixed with catalyst (if required) and then thinned to ratio prescribed by paint-manufacturer. It is very important to apply a properly thinned enamel, in order to avoid defects (i.e. straining, pin punctures etc.).
Before enamel application, check that color of prepared enamel corresponds exactly with vehicle original color.
For this purpose, the operator should apply prepared enamel on a sample metal sheet, using the same procedure which will be used for vehicle painting.
The painted metal sheet should then be compared with one or more vehicle areas: add basic color(s) as required to obtain the desired color. When the proper color has been obtained and before painting the vehicle, the operator should be check that affected area is dry and free of dust and should never touch prepared surface with hands. In addition to the above listed precautions, some environmental conditions, such as temperature and humidity, may affect the final result.
A too high temperature will cause thinner to evaporate too quickly (when paint comes out from spray gun nozzle), thus preventing paint to form a uniform coat and reducing brilliance.
An high environmental humidity, on the contrary, prevents thinner evaporation and increases the risk of straining.
Each paint pass should overlap the previous pass for half width.
Apply the required number of coats, allowing proper dry-time between coats.
Metallic colors can appear to vary in richness, depending on dispersion of aluminum flakes. "Dry" coats of metallic paint appear light due to fine and uniform aluminum flakes dispersion.
Allow paint to cure according to manufacturer instructions.

PAINTS PREPARATION

Mix base paint with catalyst and thinner by observing thoroughly manufacturer recommendations.

PAINTING OF REPLACED FIXED METAL SHEET (complete cycle)

The following table contains the complete cycle for painting of a replaced fixed metal sheet:

1. PREPARATION (sanding and cleaning)
2. SURFACING
3. SANDING
4. MASKING
5. PRIMER APPLICATION (if required)
6. SEALING
7. FILLER APPLICATION
8. SANDING
9. MASKING
10. ENAMEL APPLICATION

Dry or wet-sand cataphoresis, blow-off with compressed air, clean with silicone-proof solvent and dry thoroughly.
Surface any defect and allow stopper to cure. Sand and clean thoroughly affected area. Mask, apply primer and allow air-drying.
Apply sealant, by brush or gun, on metal sheet mating areas.
Apply filler coating and "spy-coat" of enamel. Dry or wet sand, remove masking and clean with compressed air and silicone-proof solvent.
Mask area surrounding sanded surface and protect adequately all reaming parts of vehicle. Blow-off dust then clean with Tack-Rag.
Prepare and apply enamel (one or two coats). Allow prescribed dry-time then cure enamel as prescribed. Apply wax-oil on box-type elements.

PAINTING OF REPLACED MOBILE METAL SHEET (complete cycle)

The following table contains the complete cycle for painting of a replaced mobile metal sheet:

1. PREPARATION (sanding and cleaning)
2. PRIMER APPLICATION
3. SEALING
4. FILLER APPLICATION
5. MASKING
6. ENAMEL APPLICATION

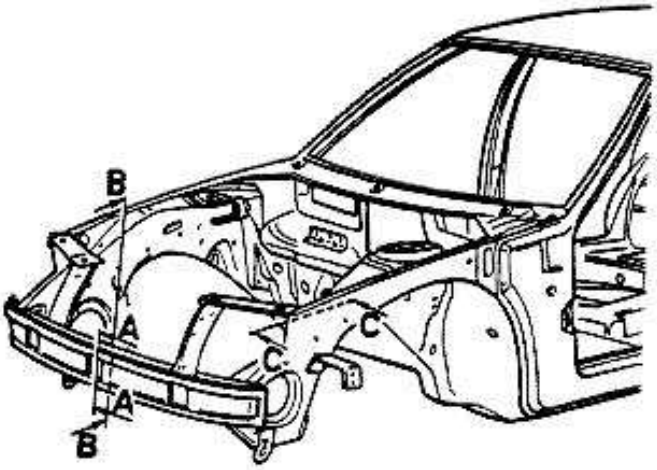
Remove affected component and dry or wet-sand cataphoresis coating; blow-off dust with compressed air, clean with silicone-proof solvent and dry thoroughly. Apply primer on affected area and allow air-drying.
Apply filler coating on inner and outer surface and allow to cure; apply enamel "spy-coat" then dry or wet-sand. Blow-off dust with compressed air, clean with silicone-proof solvent and dry thoroughly with compressed air. Clean with Tack-Rag then prepare and apply enamel. Allow prescribed drying-time then cure enamel. Install component when cool and apply wax-oil on box-type elements.

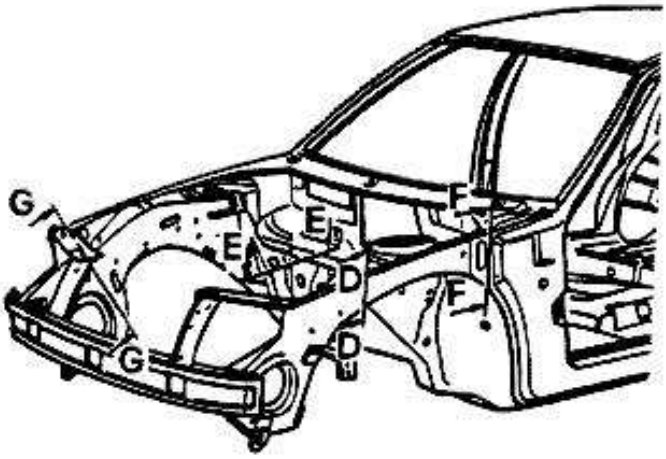
REPAINTING OF METAL SHEET WITH A DEFECT AFFECTING METAL (repair cycle)

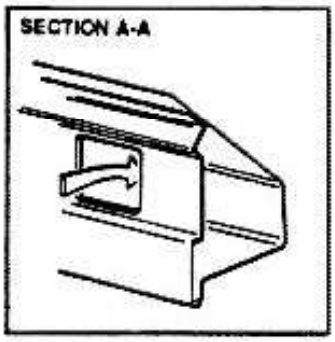
The following procedure applies both to fixed and moblie metal sheet. Repair defect on metal then proceed as described the paragraph "Painting of replaced fixed metal sheet".

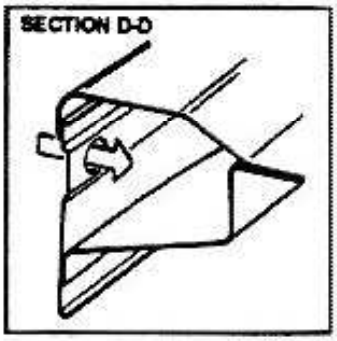
WAXING

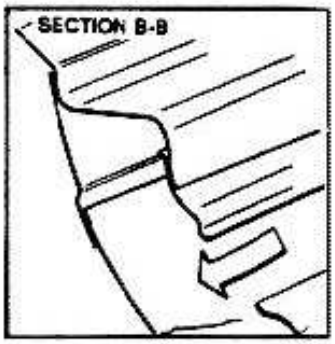
Apply prescribed wax on box-type elements areas indicated by arrows, trough vent holes.

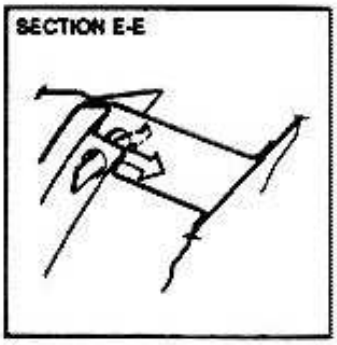


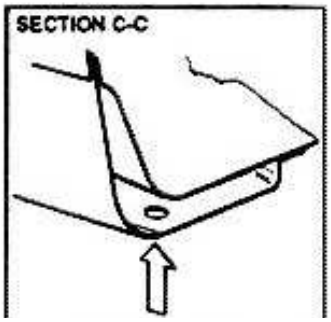


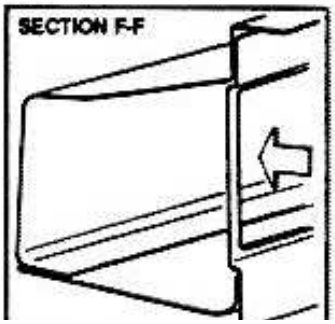


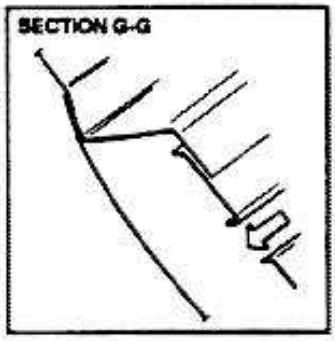


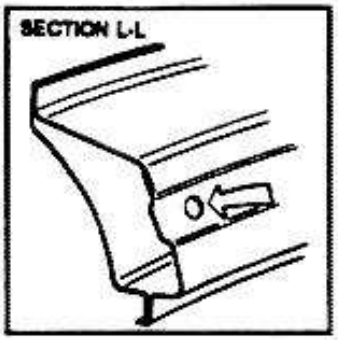


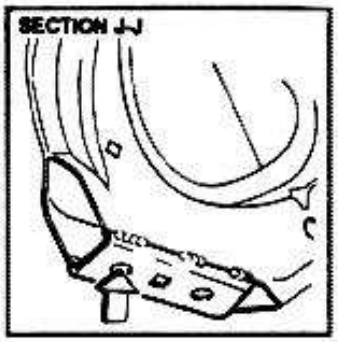


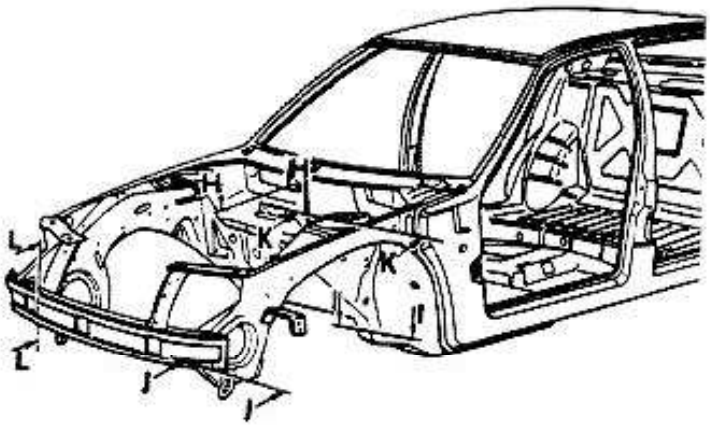


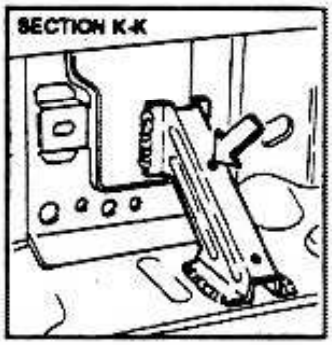


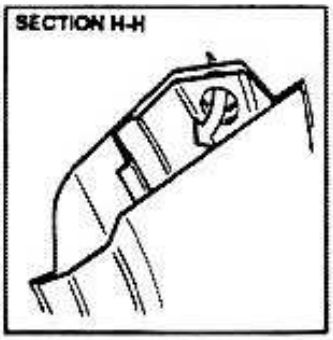


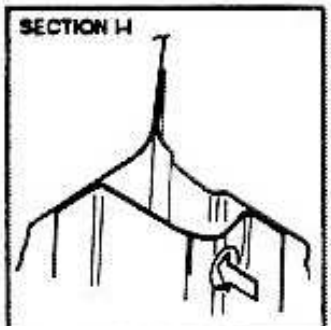


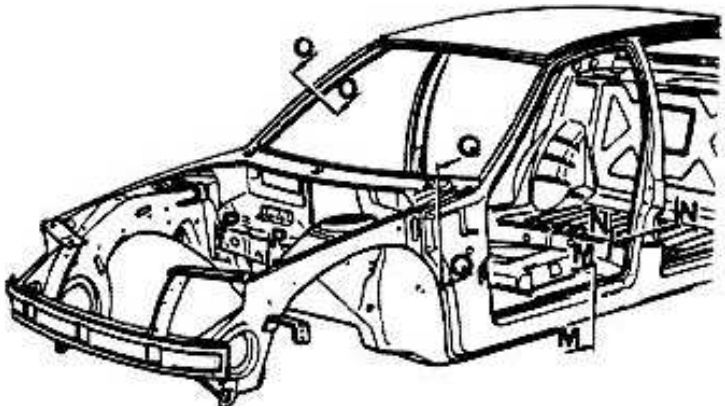


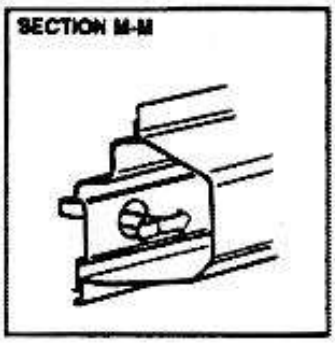


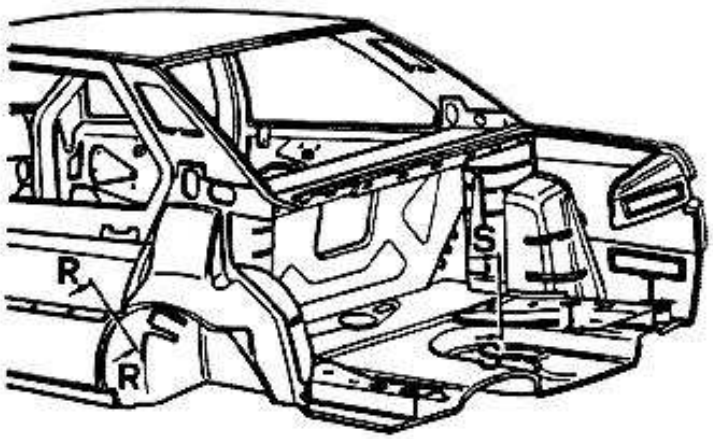


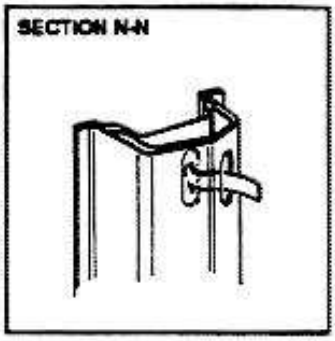


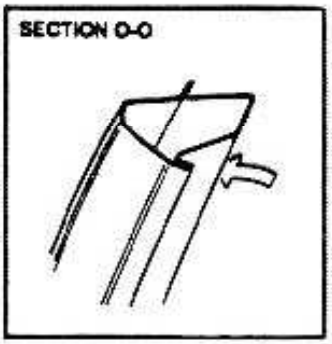


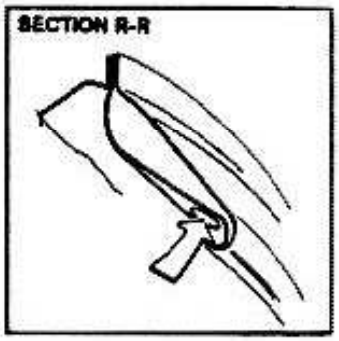


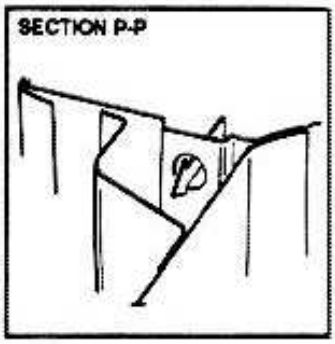


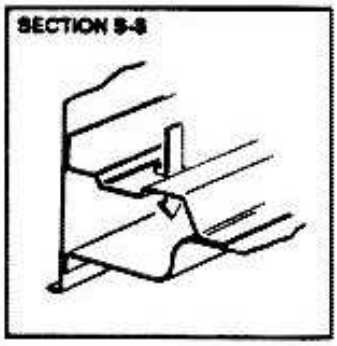


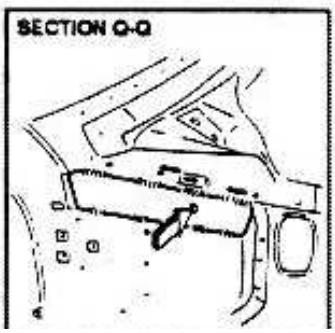


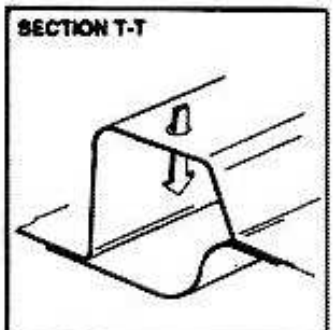


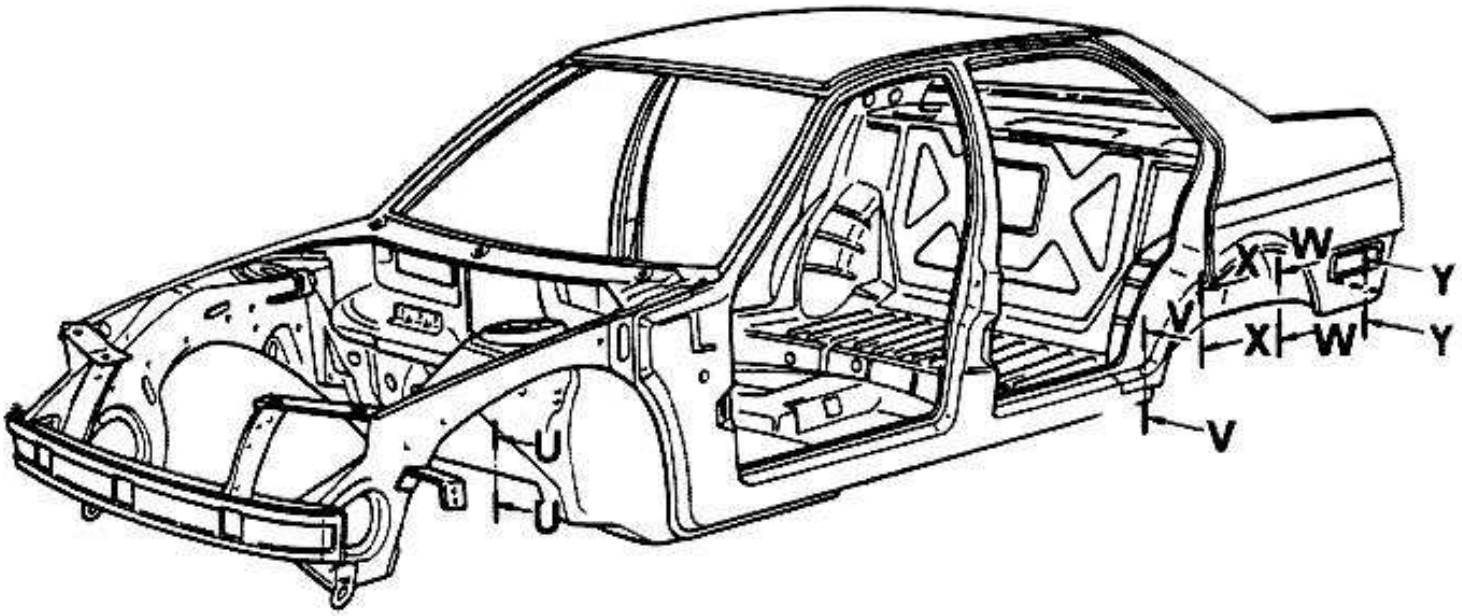




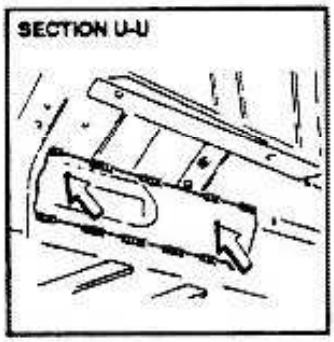








SECTION U-U



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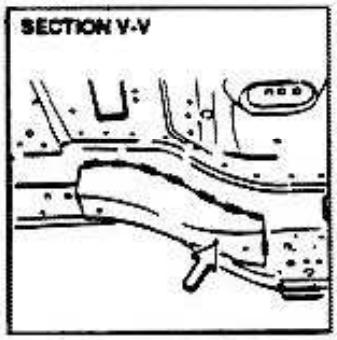

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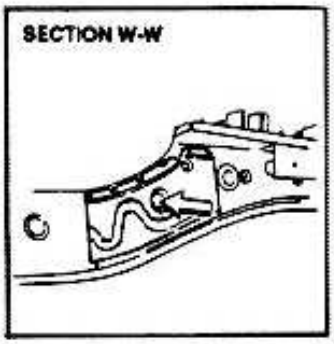

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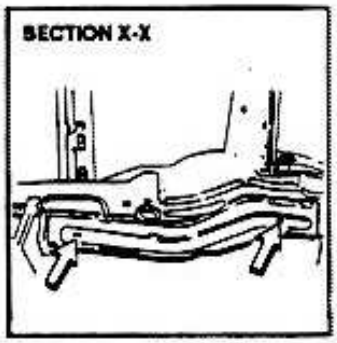

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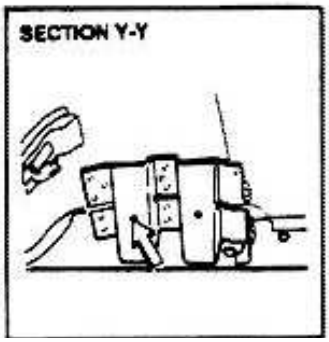
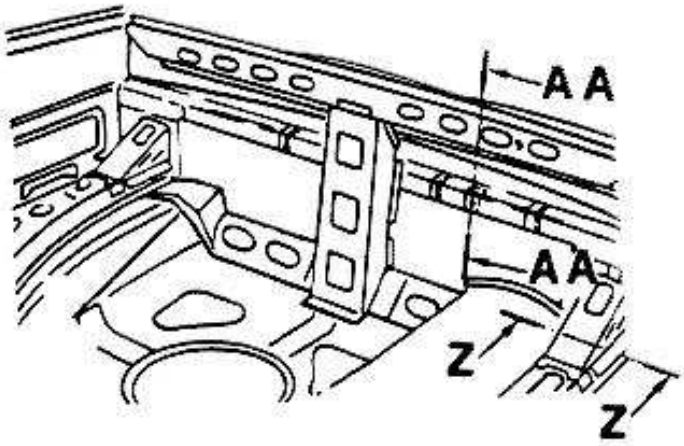
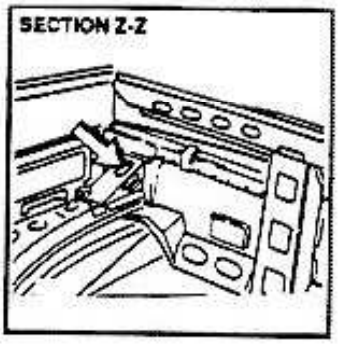
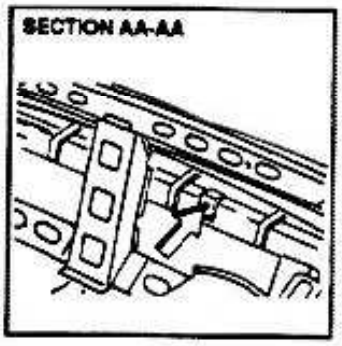








REPAINTING OF METAL SHEET WITH SURFACE DEFECTS (touch-up cycle)

When the damage is located in a not very exposed area, it is possible to carry-out a paint touch-up. Such procedure, however, requires tricks resulting from operator's experience.

If only paint is damaged, repair may be limited to enamel application, while if also metal sheet is damaged, complete repair is required.

Manually sand affected area until damage is removed. Make dull remaining of panel and mask all-around dull area. Clean with silicone-proof solvent and wipe with Tack-Rag. Prepare and apply enamel; allow prescribed drying-time then cure enamel. Remove masking and allow part to cool.

RESTORING OF METAL SHEET WITHOUT PAINTING (dents removal)

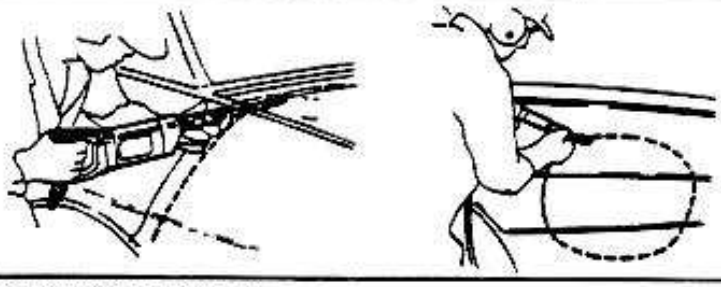
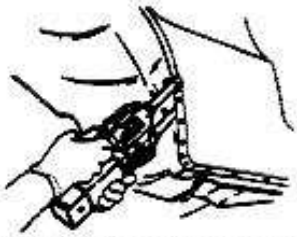
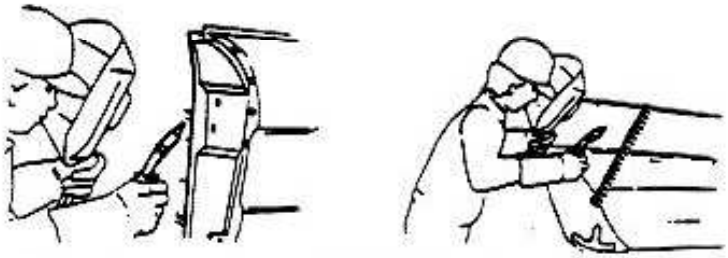
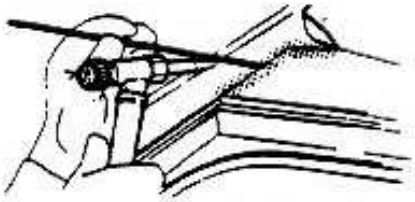
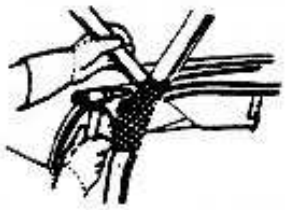
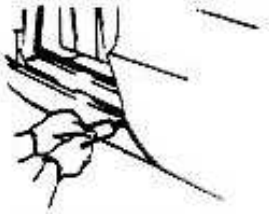
With this procedure, small dents are removed by using suitable tools and no repainting is necessary.

The metal sheet original characteristics remain unchanged.

REPLACEMENTS

SYMBOLS - Cutting and welding/brazing operations

The symbols used in this Manual for cutting and welding/brazing operations are indicated in the following figures:

CUTTING WITH SAW OR PNEUMATICALLY-OPERATED CHISEL		
SPOT WELDING	SPOT WELDING OF TWO OVERLAPPED PANELS	TWO OVERLAPPED PANELS   THREE OVERLAPPED PANELS NOTE: NUMBER BETWEEN BRACKETS ( ) INDICATES SPOT - WELD NUMBER
	SPOT WELDING OF TREE OR MORE OVERLAPPED PANELS	
CO_2 ARC WELDING	FILLING "MIG" WELDING	
	SEAM/SPOT "MIG" WELDING	
BRAZING		
TINNING		
SEALING		

GENERAL INFORMATION ON COMPONENTS REMOVAL AND INSTALLATION PROCEDURES

COMPONENTS REMOVAL

1. Make sure that all damaged parts have been identified by checking chassis installation dimensions. Refer to figure entitled "Body squaring".

Tools required:
- Centering tool
- Squaring tool
- Convex rule
- Ratchet jack or lifting jack

2. Pull chassis using tool suitable to damage extension. Removed parts can be reused, providing that they meet requirements of figure "Body squaring".

CAUTION:
- **Thoroughly secure tension chains to chassis, in order to avoid any accidental release.**
- **Apply tension load in a reverse direction of impact.**

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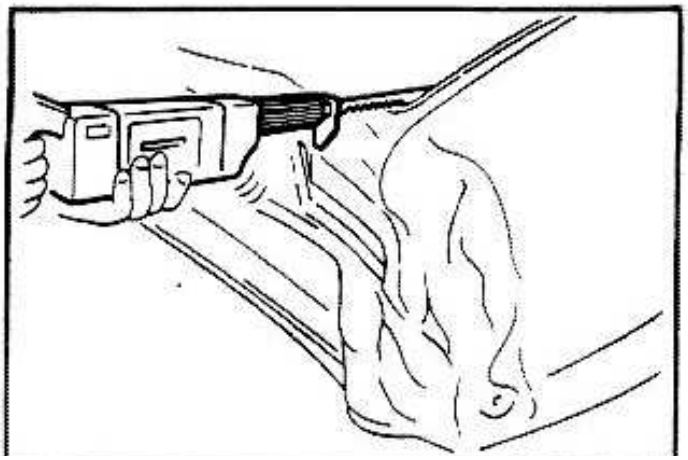
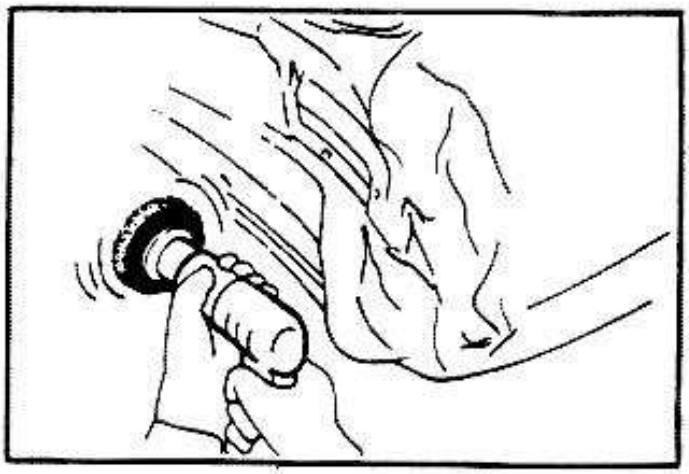
3. Cut away damaged parts.

Tools required:
- Pneumatic saw
- Pneumatic chisel



4. If spot weldings are not visible, remove paint using a metal brush.

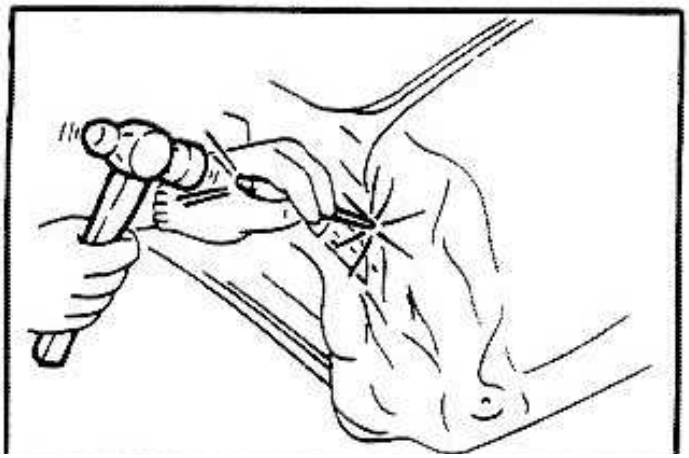
Tools required:
- Metal brush



5. Center punch each welding to exactly locate hole.

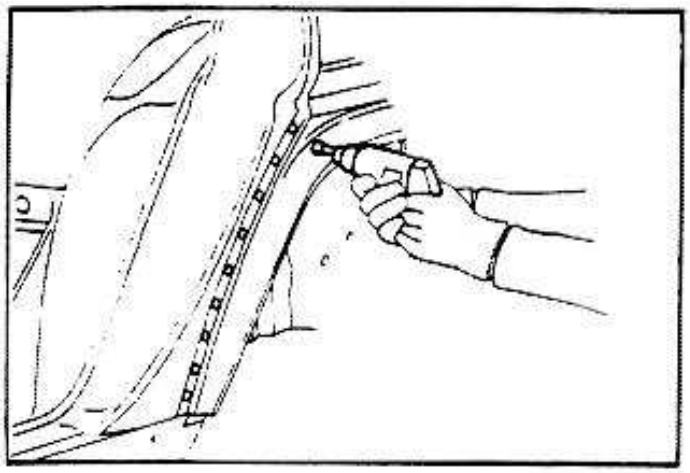
Tools required:
- Hammer
- Center punch

CAUTION:
- **Center punch should be deep and exactly centered. An out-of-center punch will not allow complete removal of welding, while an insufficient punch will not drive drill securely.**
- **As a general rule, center punching should be carried-out on edges of components which should be replaced.**



6. Remove spot-weldings using a spot cutter or pneumatically-operated drill.

Tools required:
- Spot-cutter
- Pneumatic drill



CAUTION:
- **Set drill to 1000 R.P.M.**
- **Care should be taken not to drill mating components. Plug holes, if any, with autogenons welding or projection welding. The holes can reduce component stiffness and allow water seepage.**
- **When using existing holes in welded components for securing new parts, use a small diameter drill (less then 8 mm / 0,31 in) and carry-out welding as soon as possible.**

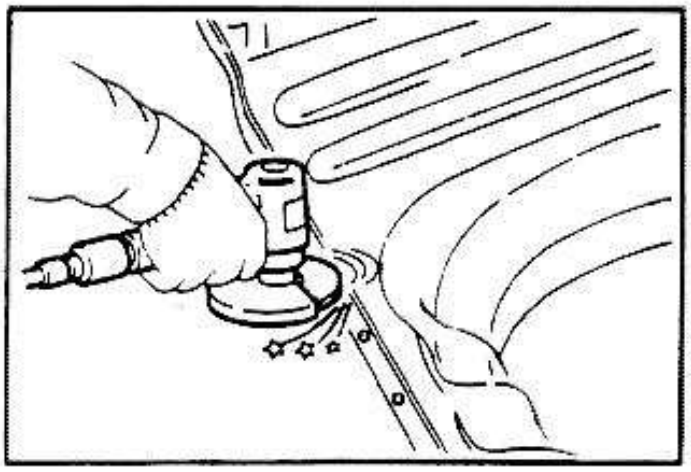
7. Remove any trace of welding using a chisel.

Tools required:
- Hammer
- Chisel

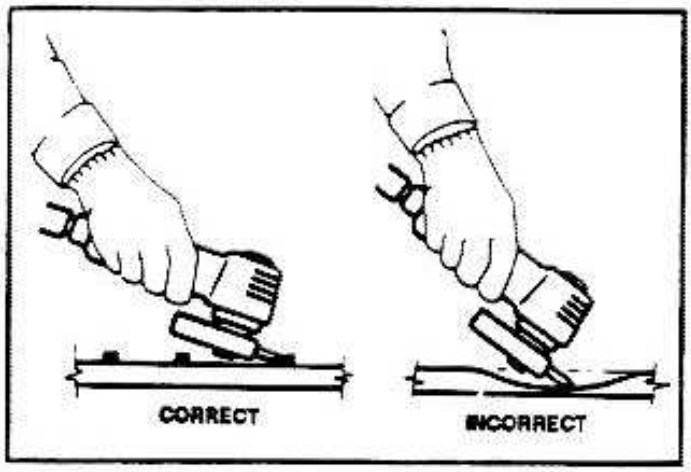
PREPARATION OF MATING SURFACES

1. Grind metal sheet in area of welding using a sanding machine

Tools required:
- Pneumatic sanding machine
- Disk-sanding machine



CAUTION:
- **Care should be taken not to reduce excessively the metal sheet thickness: welding strength may be adversely affected.**
- **Thoroughly remove metal chips from grinded areas: metal particles can reduce welding strength an cause corrosion.**



2. Straighten buckled areas with hammer and dolly block.

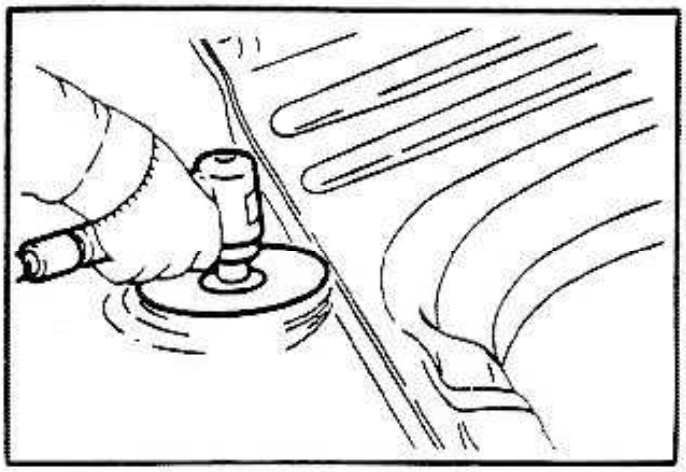
Tools required:
- Hammer
- Dolly block

- Pneumatic sanding machine - Dolly block

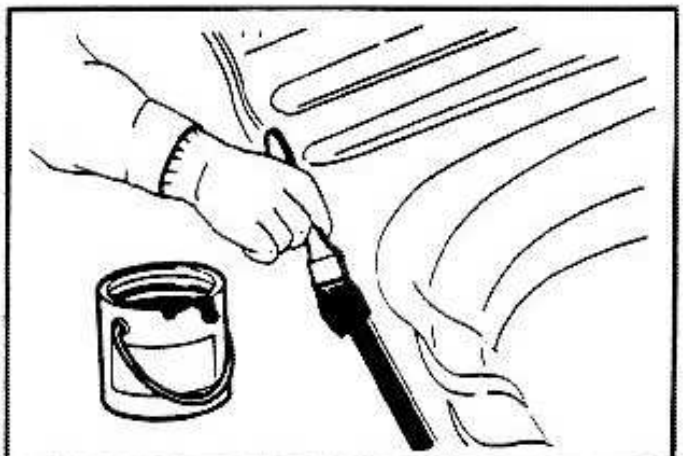
CAUTION:
- **Make sure that all bucklings are removed, in particular those on inner panels or in hidden positions. On the contrary, difficult installation or loss of strength may occur.**
- **Carefully check joint areas of each pillar.**

3. Remove all paint from welding areas

Tools required:
- Pneumatic sanding machine
- Disk-sanding machine



4. Apply primer on edges of replacement parts and chassis panels which are to be welded.



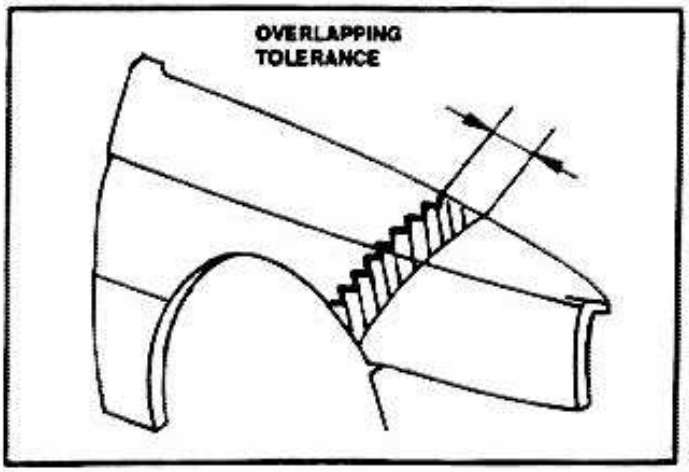
Before welding apply anti-rust conductive paint on edges of all metal sheets which are to be installed.
Metal sheets should be welded within 15 minutes after conductive paint application (paint drying-time).
The coat thickness should be 0.005 to 0.025 mm (0.0002 to 0.0010 in) after curing.

PREPARATION FOR INSTALLATION OF NEW COMPONENTS

1. If a component is partially replaced, maintain an overlapping tolerance of 50 mm (2 in) during cutting of damaged parts, to maintain a sufficient surface for metal sheets welding.

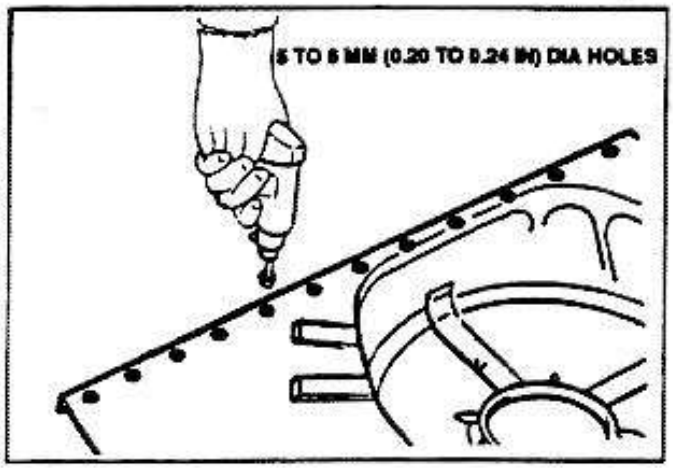
Tools required:
- Pneumatic saw
- Hand saw
- Scribe
- Convex rule (or equivalent)

It is recommended to use always Alfa Romeo genuine spare parts to assume the best results and to maintain vehicle serviceability.



2. Filling MIG welding.
This technique should be applied in areas where spot welding is not feasible. For such welding, drill 5 to 6 mm (0,20 to 0,24 in) dia holes in welding points.

Tools required:
- Punch
- Pneumatic drill

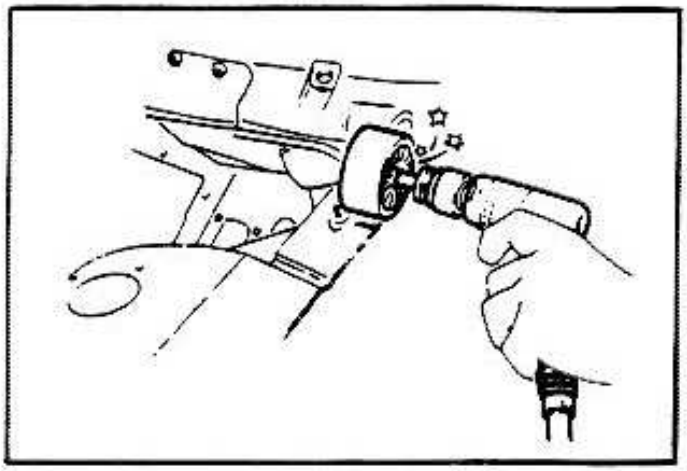


3. Remove paint from welding area.

Tools required:

- Belt-sanding machine
- Disk sanding machine

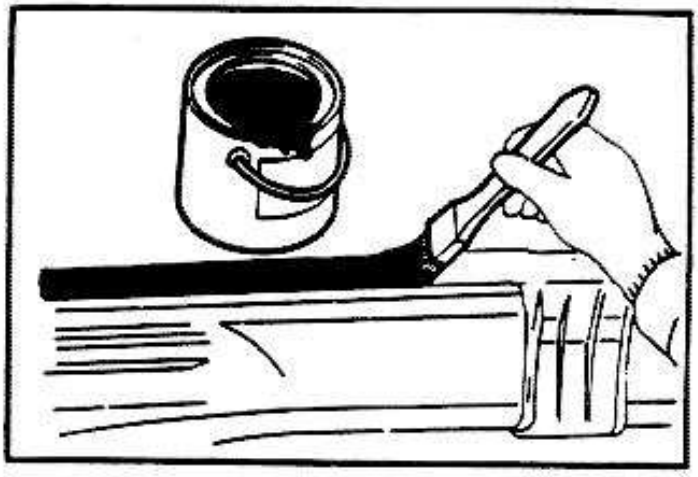
CAUTION:
Remove paint from both sides of components to be welded, such as spot-welding surfaces, spot-welding outlines and butt-welding laps. The paint prevents current flow, with consequent low strength of spot-welding and causes depressions in MIG weldings.



4. Apply primer on areas to be spot-welded.

Tools required:

- Brush
- Anti-rust conductive paint



COMPONENTS INSTALLATION

1. Temporary installation of new components.

Tools required:

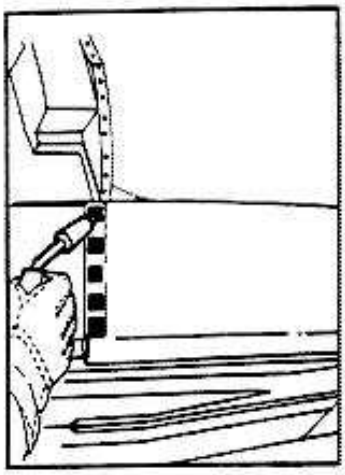
- Adjustable clamp
- Convex rule
- Squaring tool
- Centering tool
- Welding machine power supply
- Jack
- Spot-welding machine
- MIG-welding machine

CAUTION:
- **Position components as indicated in figures of "Body Squaring" paragraph. Position mobile parts (doors, trunk, lid) and check for proper installation by verifying gaps, parallelism and squaring. Adjust as necessary.**
- **Secure parts in proper position with clamps or some spot-weldings.**

2. Perform all necessary weldings, observing all rules contained in **"CAUTIONS FOR WELDINGS"**.

Tools required:

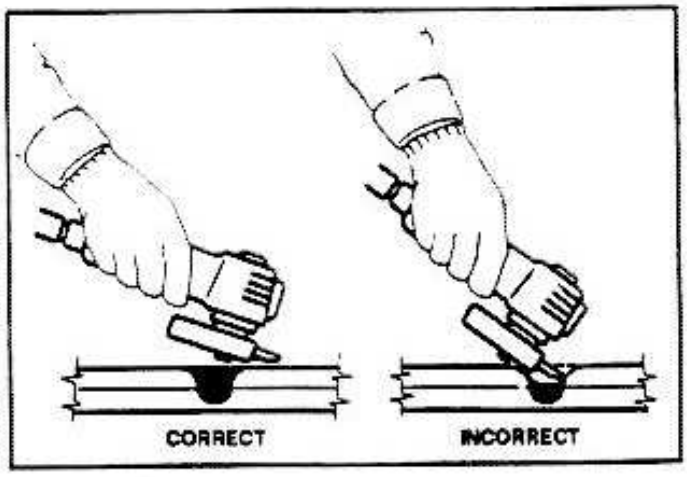
- Spot-welding machine
- MIG-welding machine
- Autogenous welding machine



3. Grind all MIG weldings using sanding machine.

Tools required:

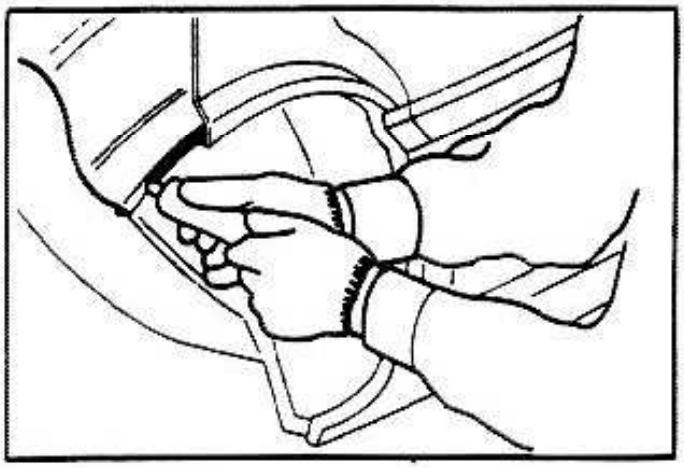
- Pneumatic sanding machine
- Disk-sanding machine



CAUTION:

- **Do not grind weldings excessively: metal sheet thickness may be reduced with consequent loss of strength**
- **Remove metal particles from grinded and surrounding areas. Metal particles can prevent a good welding and cause corrosion.**

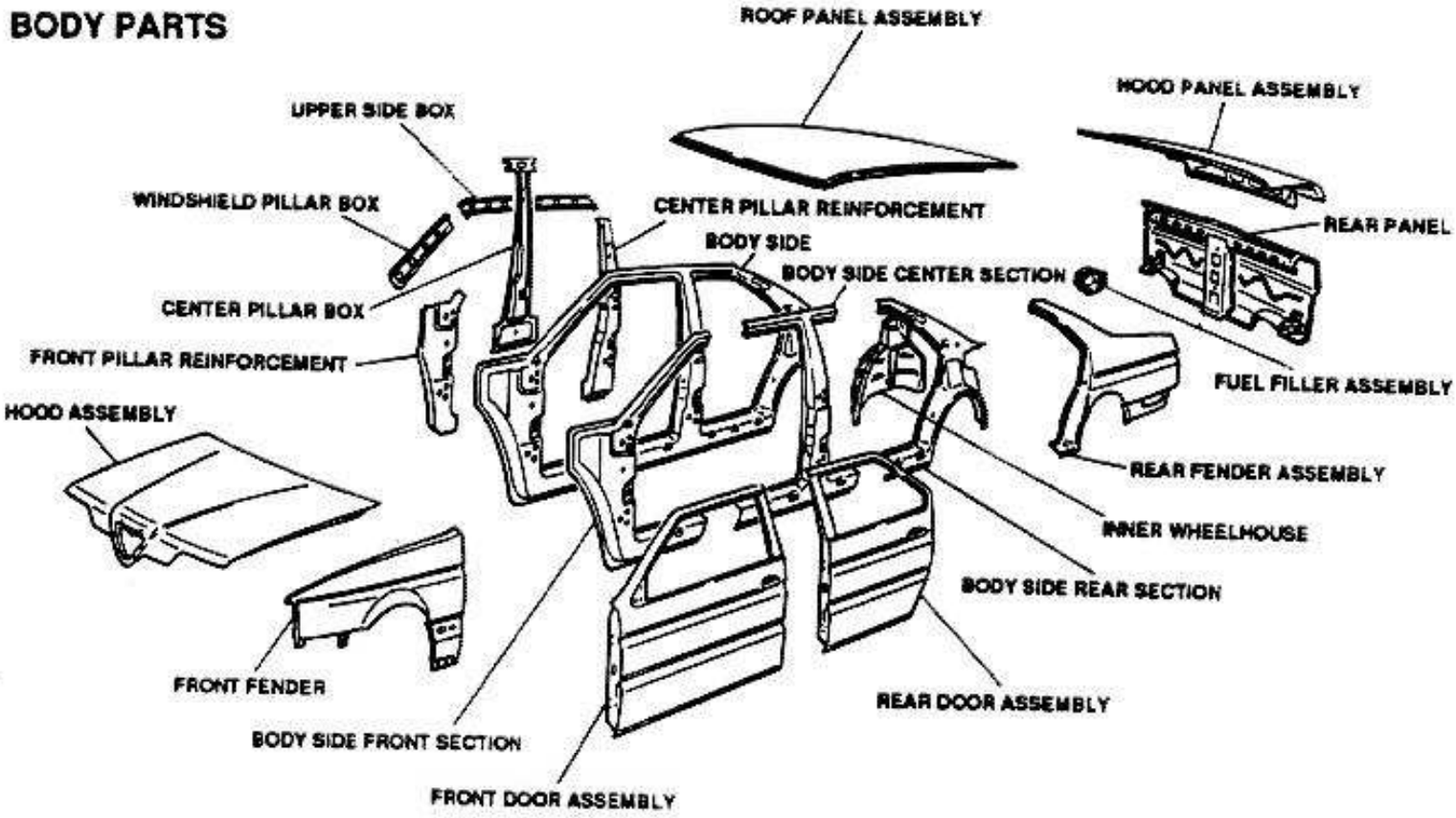
4. After welding have been completed, remove clamping devices and remove bucklings, if any.
5. Apply corrosion preventive compound on welded areas.
6. Apply sealant on metal sheet junctions; apply sealant with care to avoid corrosion. Refer to figures contained in **"SEALING"** paragraph.



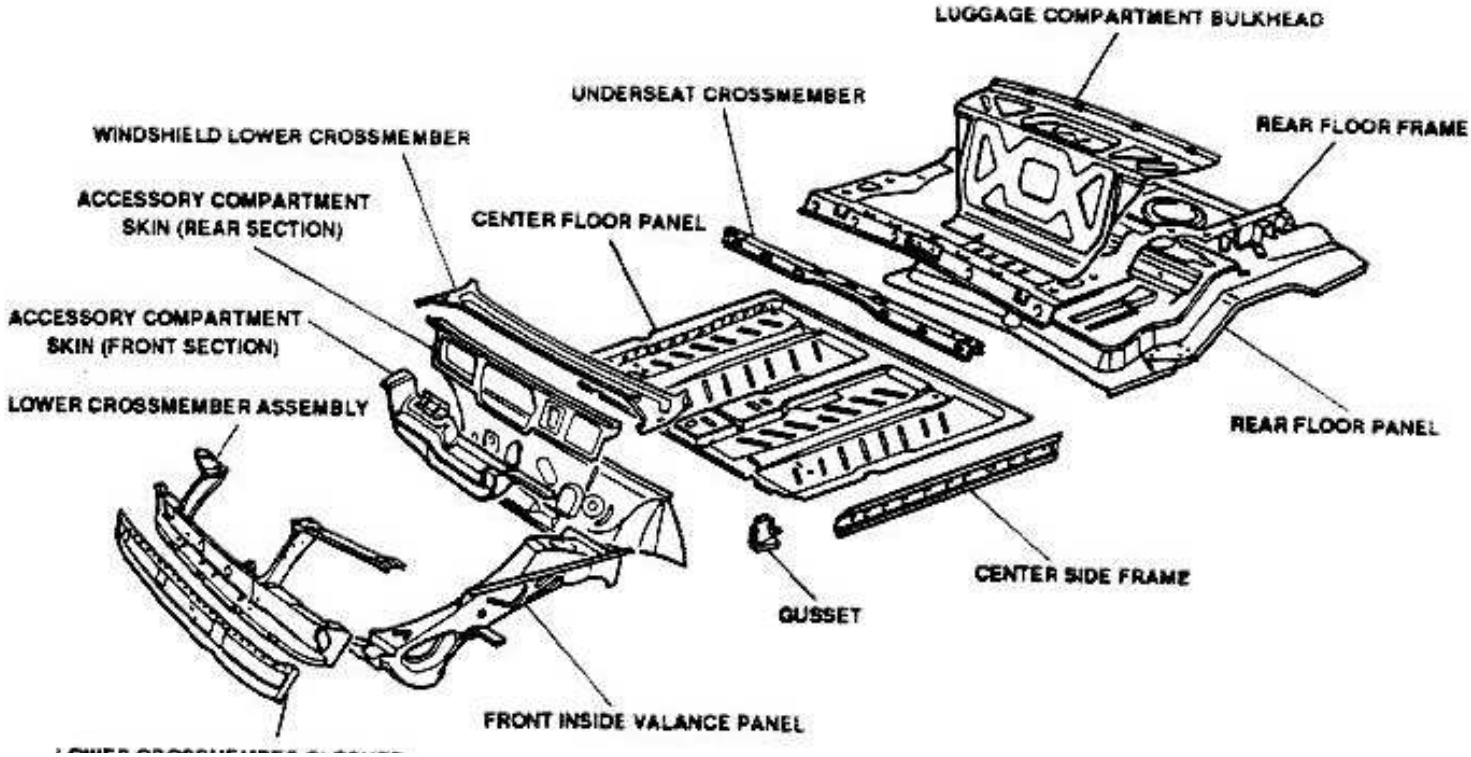
7. Apply a 4 mm (0.16 in) thick protective coat on chassis underside.

BODY COMPONENT PARTS

BODY PARTS



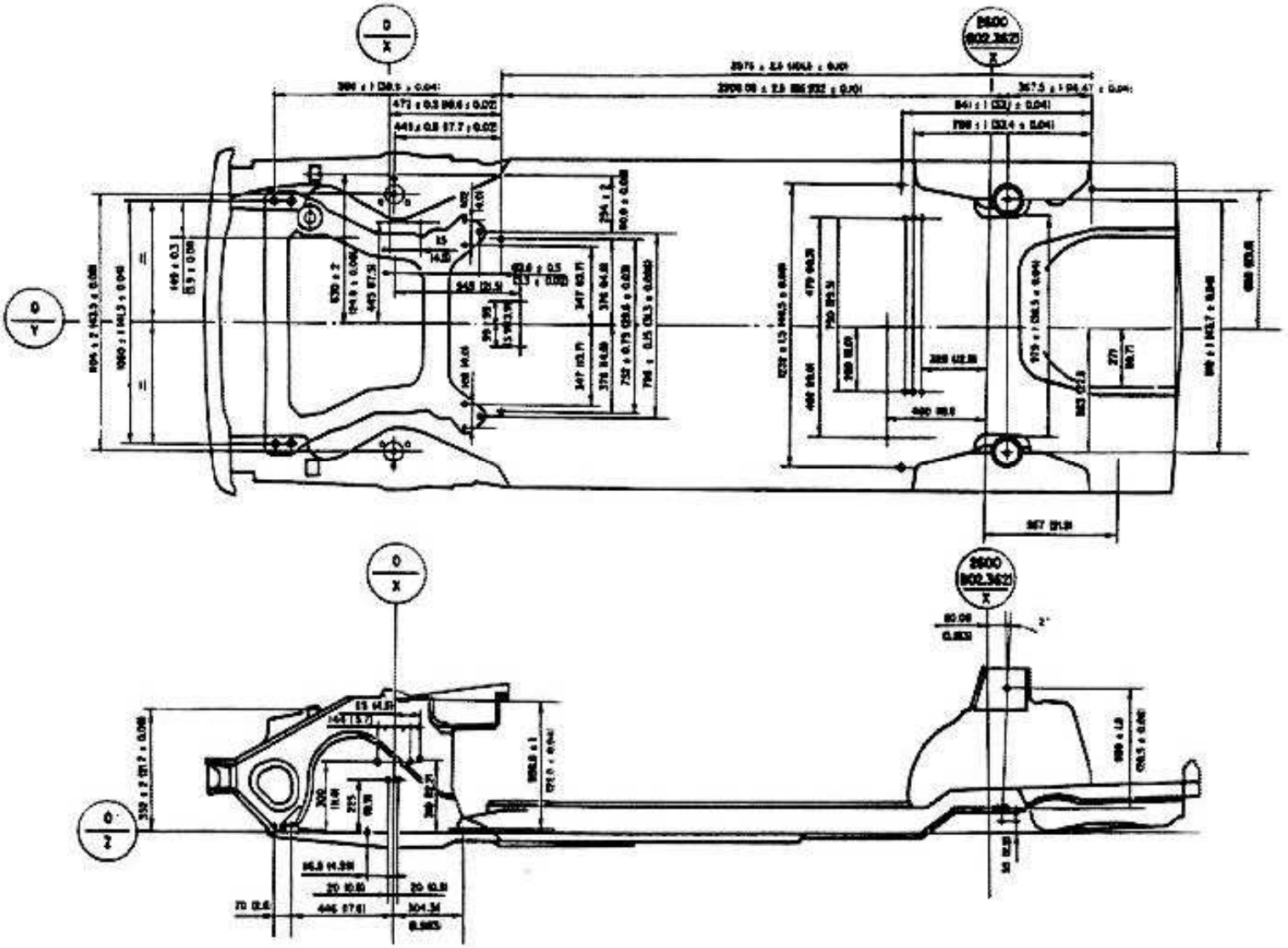
UNDERBODY PARTS



LOWER CROSSMEMBER CLOSURE

BODY SQUARING

REFERENCE DIMENSIONS

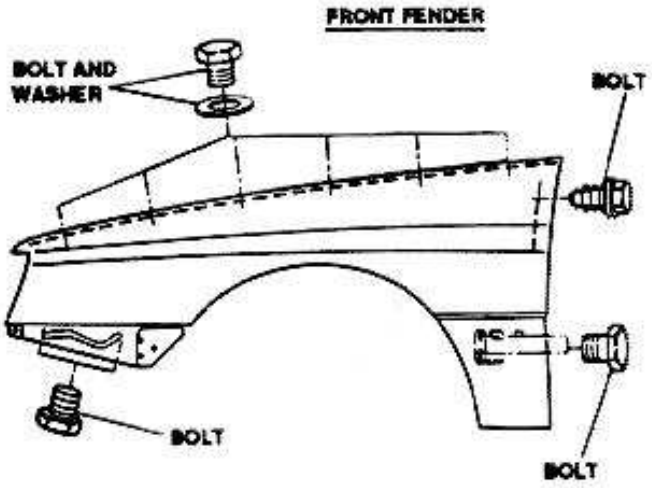


ALL DIMENSIONS
ARE IN mm (in)

FRONT FENDER

REMOVAL/INSTALLATION

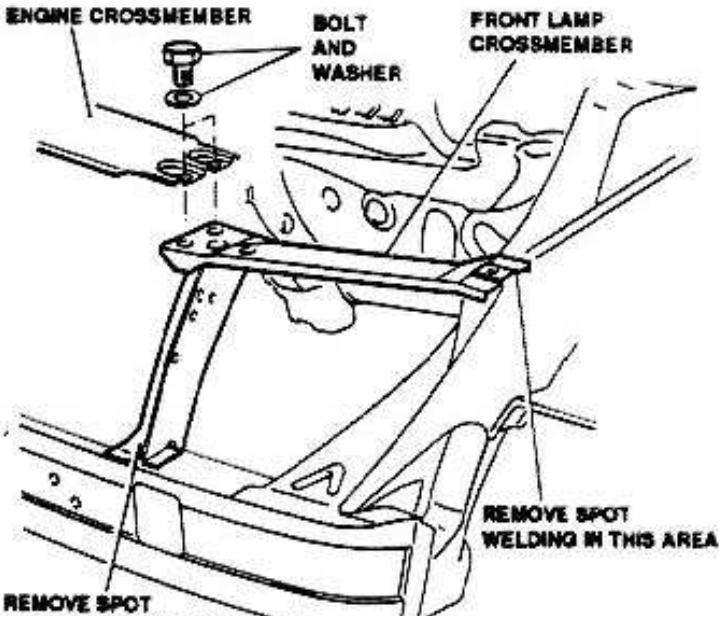
Remove bolts as depicted.



FRONT LAMP CROSSMEMBER ASSEMBLY

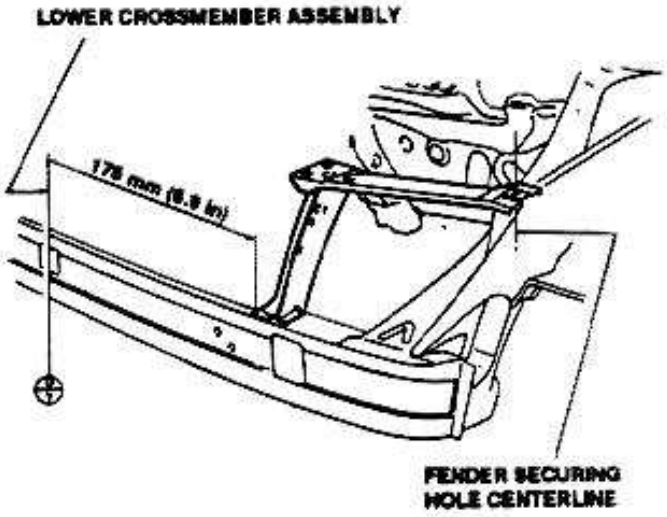
REMOVAL

1. Remove four bolts and washers and remove engine crossmember.
2. Remove spot weldings with proper tool and remove front lamp crossmember.

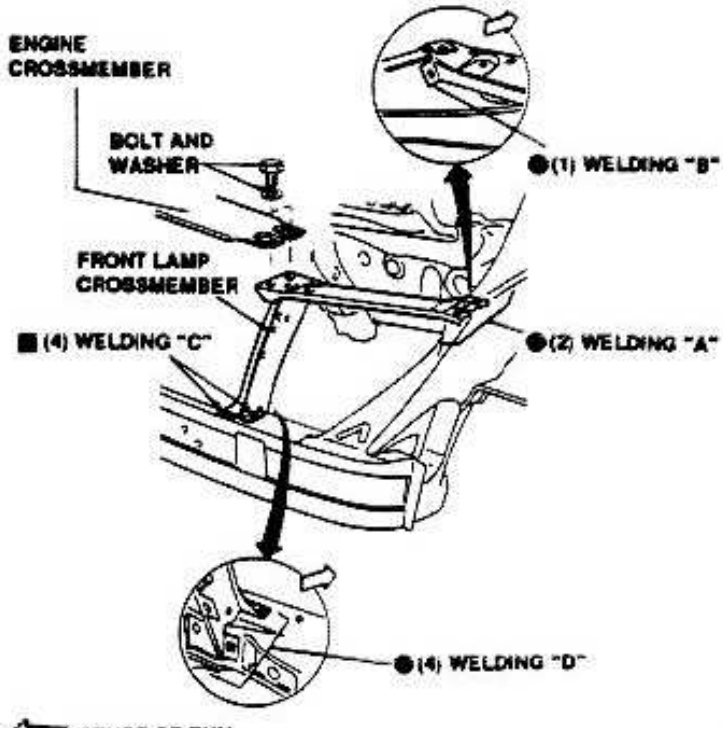


INSTALLATION

1. Position front lamp crossmember, observing specified dimension and referring to fender securing hole.



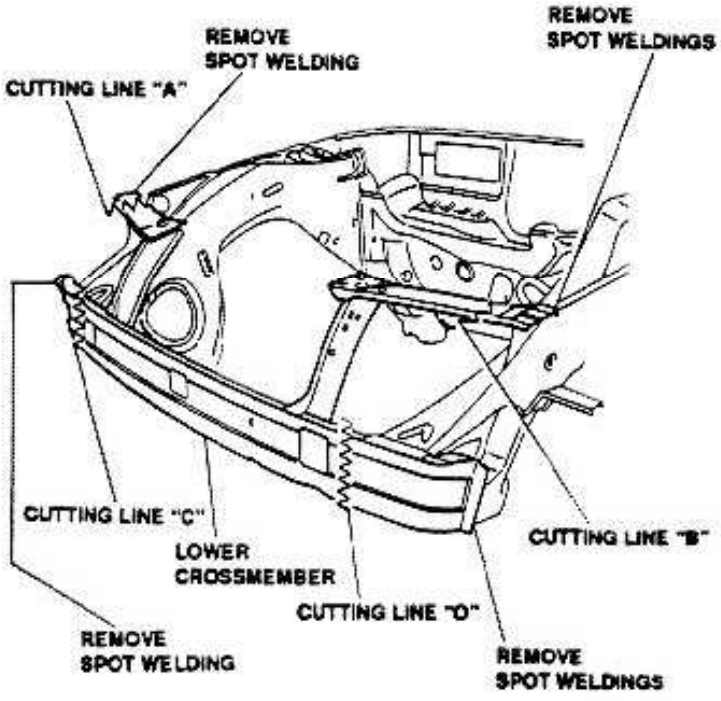
2. Carry-out weldings on points A (2 places) and B (1 place).
3. Carry-out filling weldings C (4 places) and D (4 places).
4. Install engine crossmember with four bolts and washers.
5. Check hood and front lamp parallelism.



LOWER CROSSMEMBER ASSEMBLY

REMOVAL

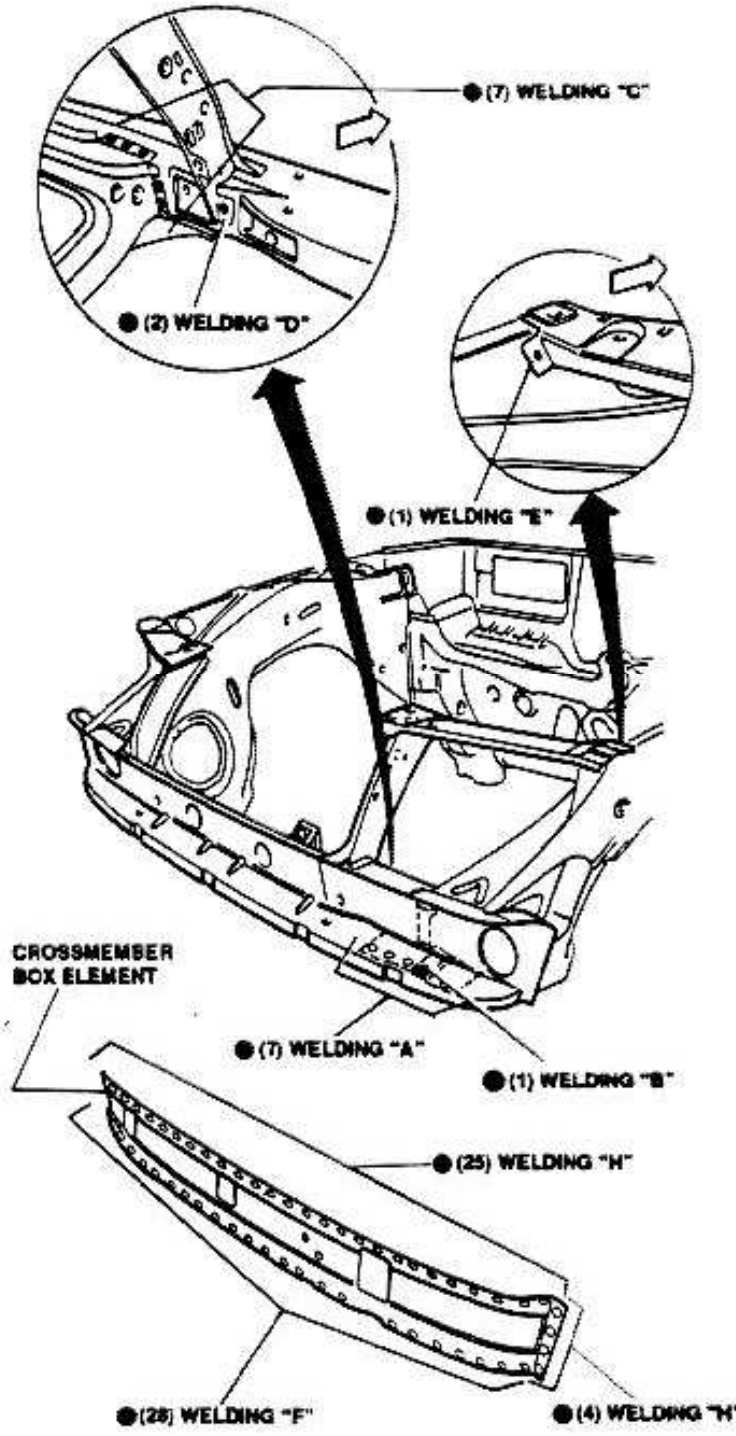
1. Saw-cut along cutting lines A,B,C and D and remove lower crossmember center section with front lamp crossmember inner sections.
2. Remove spot weldings and remove lower crossmember side sections and remaining of each lamp crossmember.



INSTALLATION

1. Position lower crossmember and carry-out, on both sides, spot weldings A (7 places), B (1 place), C (7 places), D (2 places) and E (1 place).
2. Position crossmember box element and carry-out spot weldings F (28 places), G (21 places), H (4 places).
   The last welding on both sides.
3. Apply wax (see **"WAXING", section A-A**).
4. Check lid and front lamp parallelism.

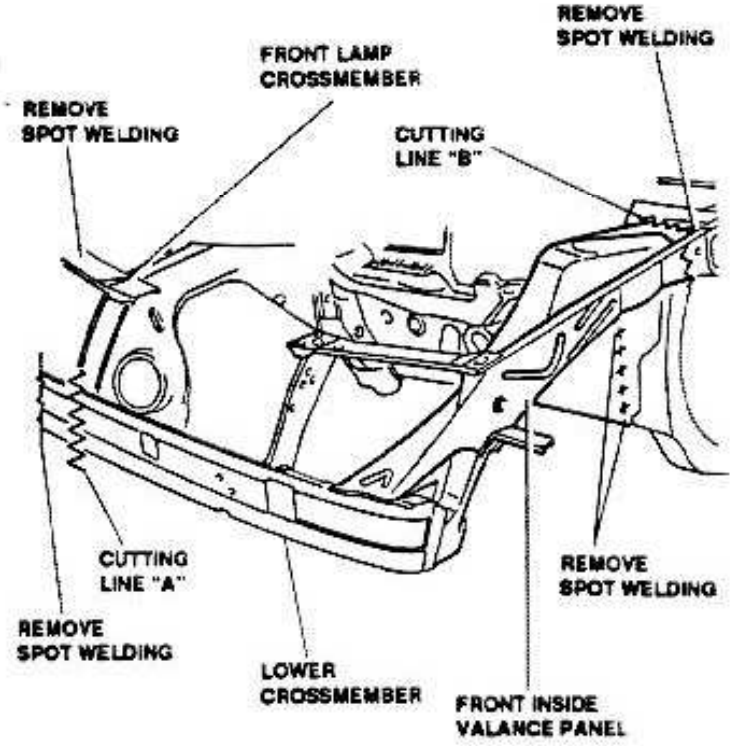
LOWER CROSSMEMBER WITH FRONT LAMP CROSSMEMBER

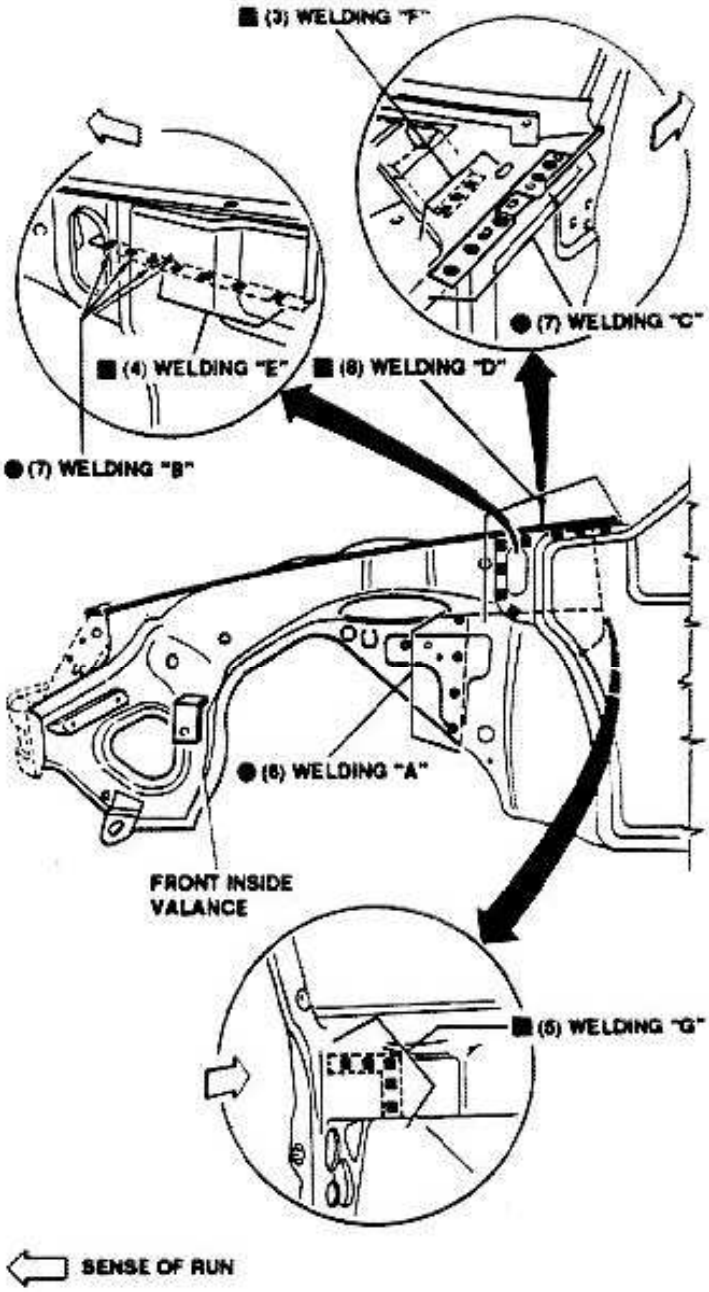


FRONT INSIDE VALANCE PANEL (replacement should be carried-out with vehicle on template stand)

REMOVAL

1. Cut lower crossmember following cutting line "A" and using pneumatic saw.
2. Cut front inside valance panel following cutting line "B" and using pneumatic chisel.
3. Remove spot weldings and remove remaining components.

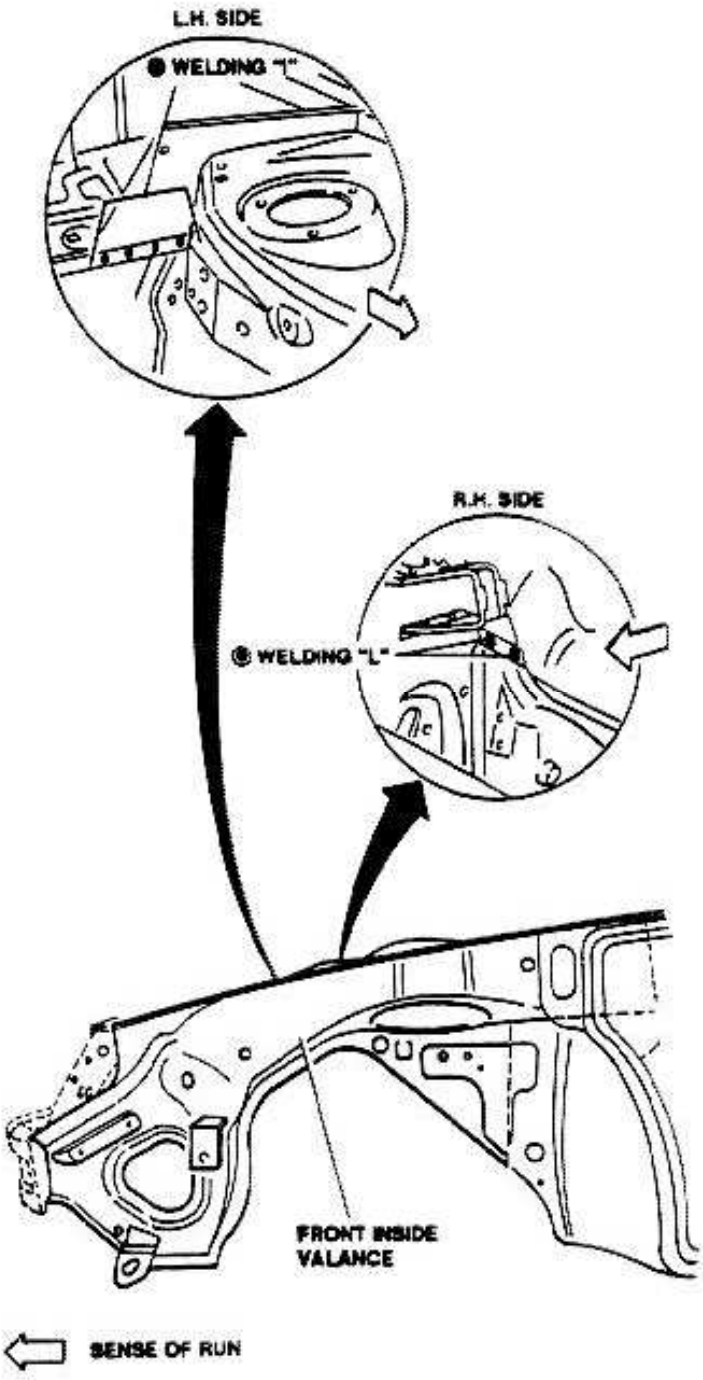




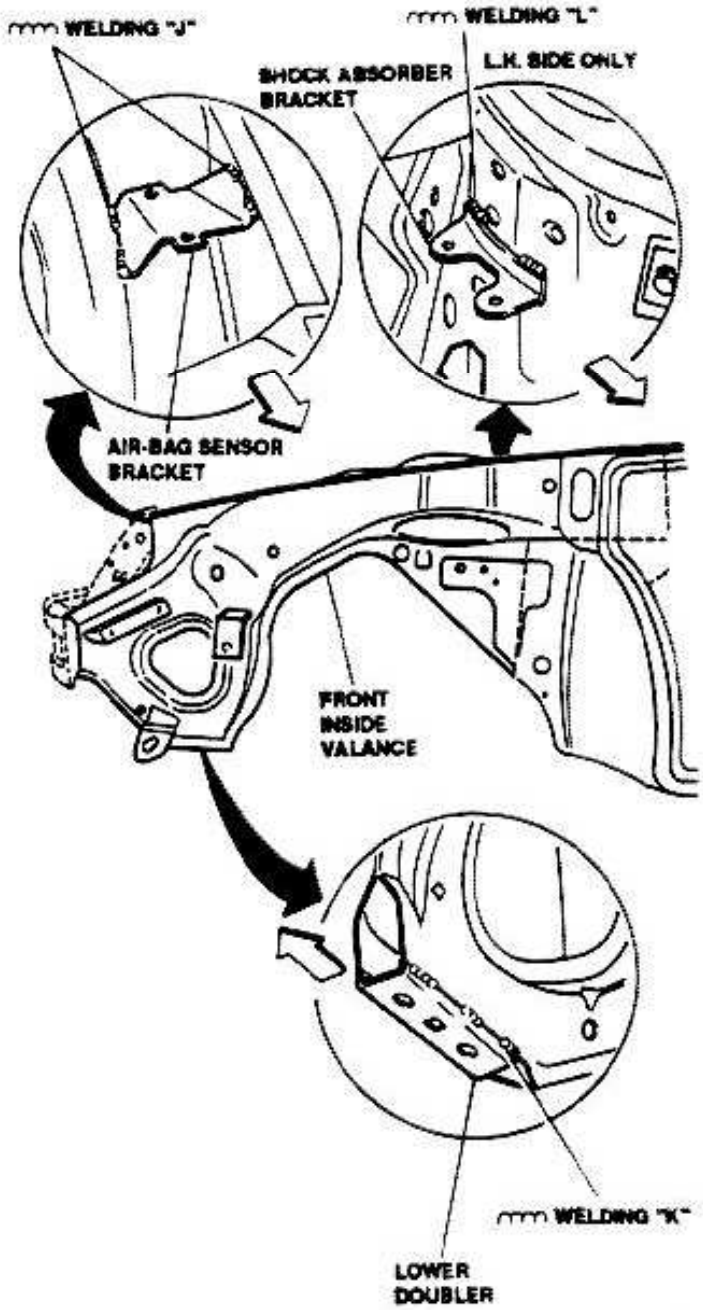
INSTALLATION

1. Carry-out spot weldings A (6 places), B (7 places) and C (7 places).
2. Carry-out filling weldings D (8 places), E (4 places), F (3 places) and G (5 places).

3. Carry-out spot welding I (4 places) on L.H. side, or spot welding L (2 places) on R.H. side.



4. Install lower crossmember as per applicable instructions.
5. Install air-bag sensor bracket, positioning it 552 ± 2 mm (21.7 ± 0.08 in) above lower edge and with aft hole 630 ± 2 mm (24.8 ± 0.08 in) from vehicle centerline (see "BODY SQUARING" figure). Carry-out arc-welding. The air-bag sensor bracket should be positioned so as line joining holes centers is parallel to vehicle centerline with an allowed tolerance of ± 2.5 mm (0.10 in), measured at forward hole.
6. Install lower doubler and carry-out arc-welding "K".
7. On L.H. side only, install shock absorber bracket and perform arc welding "L".
8. Apply wax (see "WAXING", sections B-B, D-D, F-F, G-G, J-J and L-L).

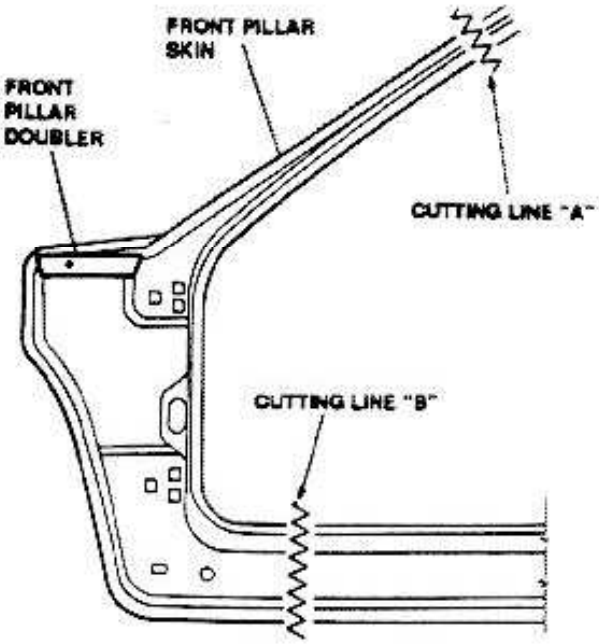


centering (see **BODY SQUARING** figure).

FRONT PILLAR SKIN

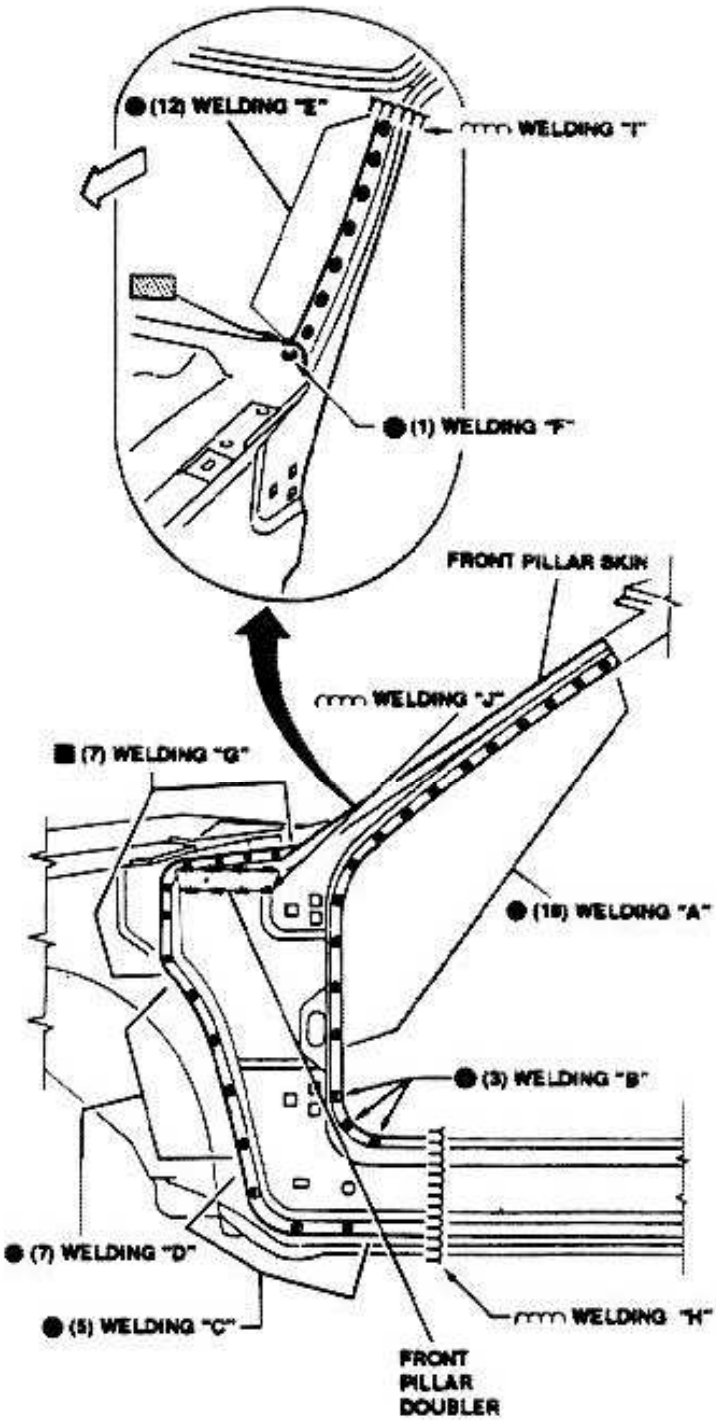
REMOVAL

1. Using pneumatic chisel, cut front pillar skin following cutting lines A and B.
2. Using a disk-sanding machine, grind spot weldings on front pillar doubler.
3. Remove spot weldings and remove remaining of front pillar skin.



INSTALLATION

1. Position and clamp pillar skin.
2. Carry-out spot weldings A (18 places), B (3 places), C (5 places), D (7 places), E (12 places) and F (1 place).
3. Carry-out filling welding G (7 places).
4. Carry-out arc weldings H and I.
5. Install front pillar doubler and carry-out arc welding I.

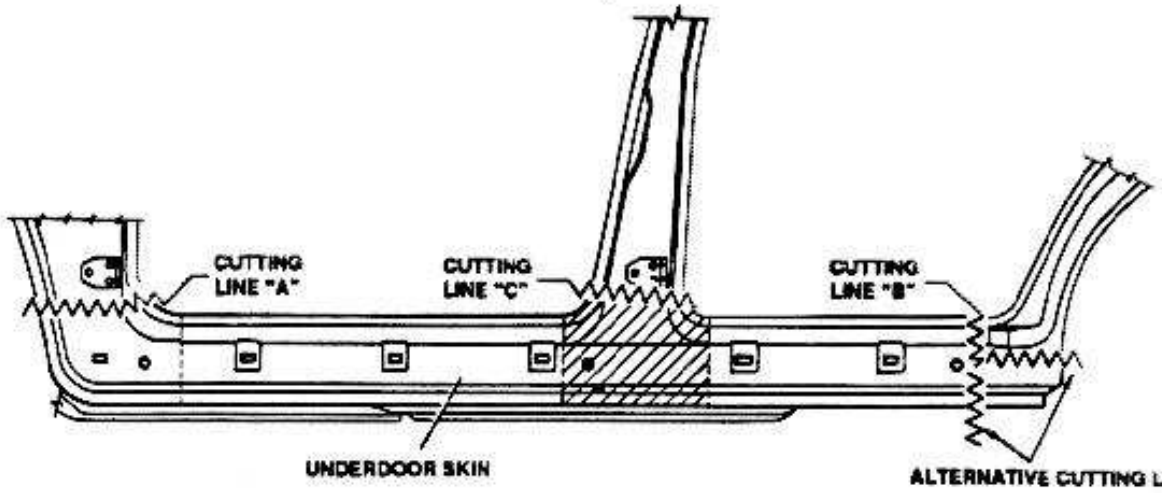


6. Remove clamping devices and check for proper installation.
7. Apply wax (see **"WAXING", sections C-C, H-H and O-O**).

UNDERDOOR SKIN

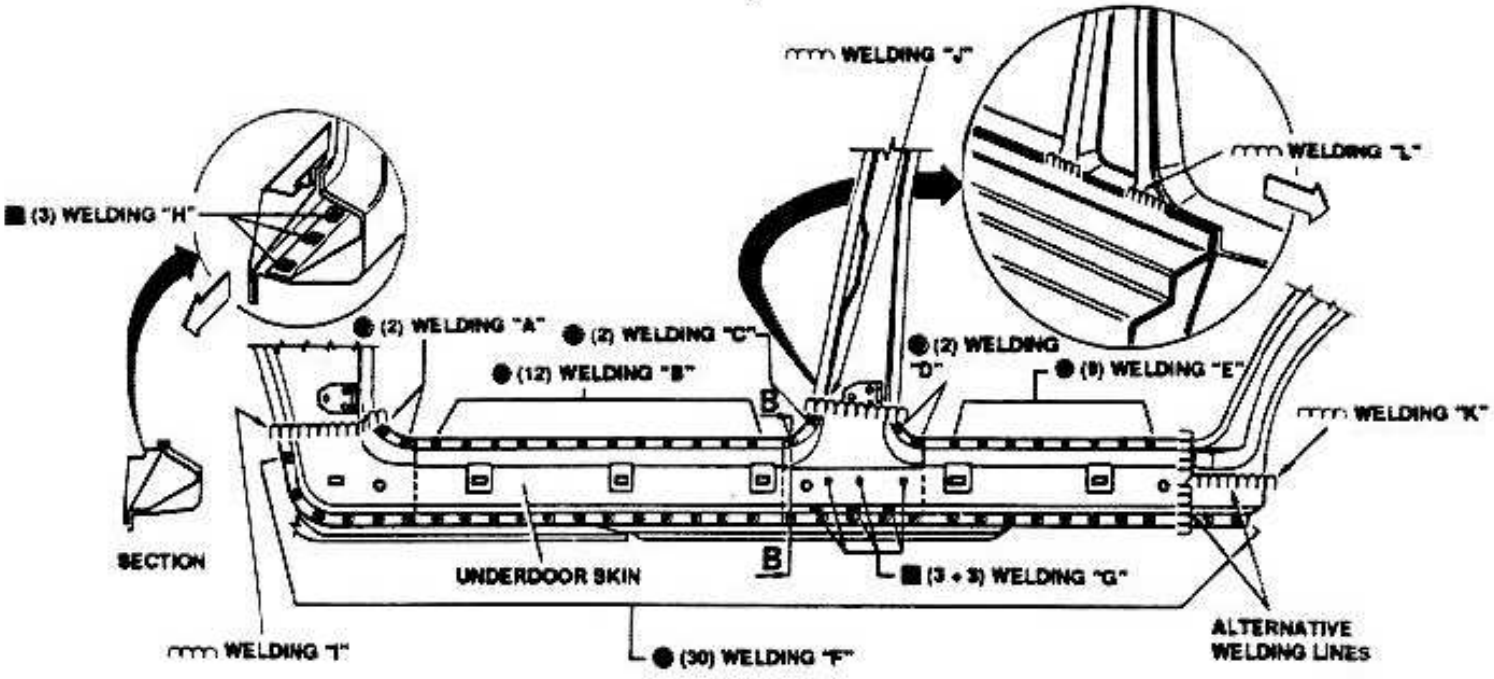
REMOVAL

1. Using alternative saw, cut underdoor skin following cutting lines "A" and "B", (to cutting lines B, one alternative to the other, are available).
2. Using pneumatic chisel, cut skin following cutting line "A". Care should be taken not to damage lower doubler.
3. Remove spot weldings and remove remaining of underdoor skin.



INSTALLATION

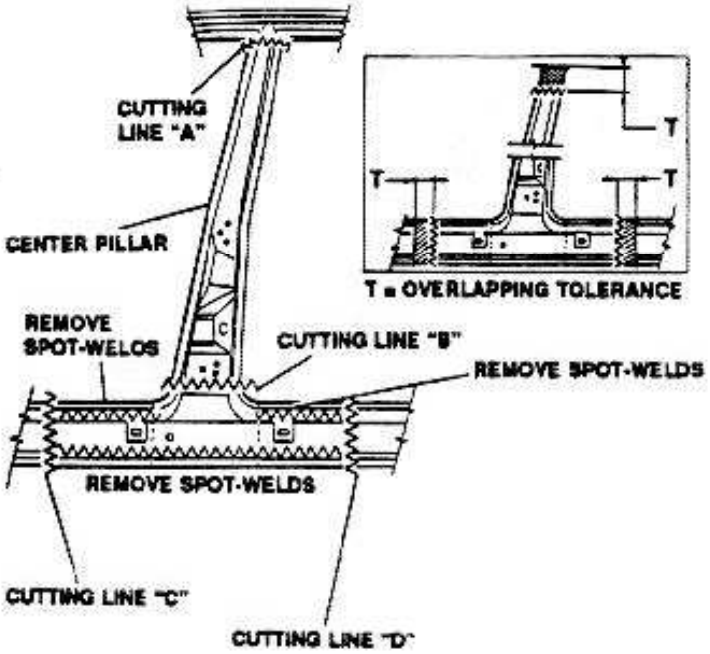
1. Position and clamp underdoor skin.
2. Carry-out spot-weldings A (2 places), B (12 places), C (2 places), D (2 places), E (9 places) and F (30 places).
3. Carry-out filling weldings G (3+3 places) and H (3 places).
4. Carry-out arc weldings I, J and K (following alternative lines).
5. Remove clamping devices and check for proper installation.
6. Apply wax (see **"WAXING", section M-M**).



CENTER PILLAR

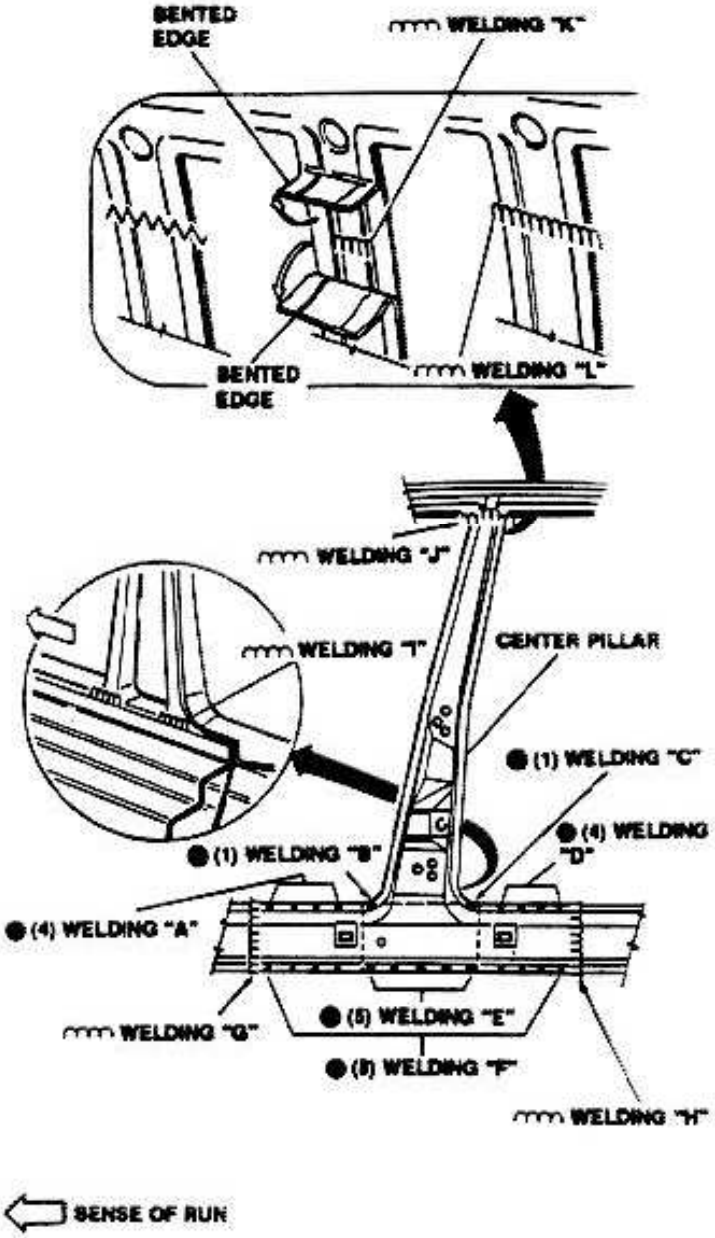
REMOVAL

1. Using alternative saw, cut pillar following cutting lines A and B.
2. Using pneumatic chisel, cut pillar following cutting lines C and D. Care should be taken not to damage remaining parts.
3. Remove spot-weldings and remove remaining components.



INSTALLATION

1. Position and clamp center pillar.
2. Carry-out spot-weldings A (4 places), B (1 place), C (1 place), D (4 places), E (5 places) and F (8 places).
3. Carry-out arc-weldings G, H, I and J.
4. Bend edges of pillar skin and carry-out arc-welding K
5. Straighten edges of pillar skin and carry-out arc-
6. Remove clamping devices and check for proper installation.
7. Apply wax (see "WAXING", section M-M).

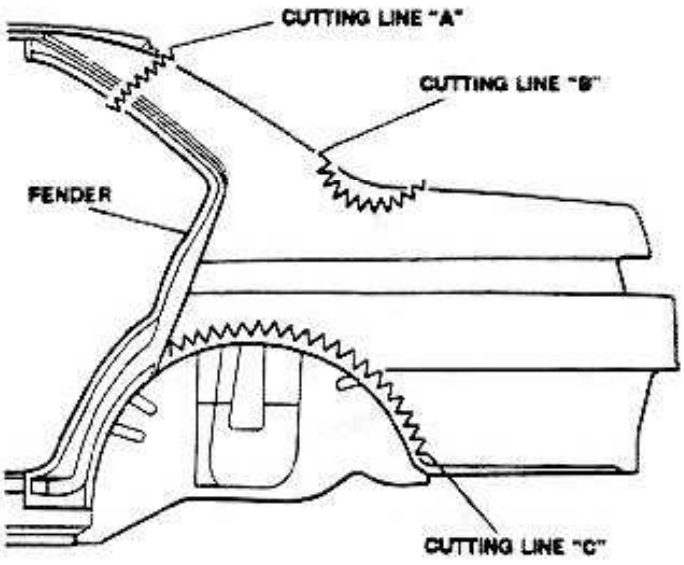


welding L.

REAR FENDER

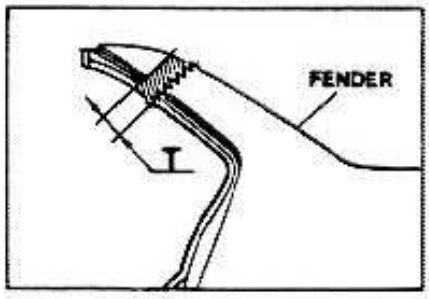
REMOVAL

1. Using pneumatic chisel, cut fender following cutting line A.
2. Using pneumatic chisel, cut fender following cutting line B. Care should be taken not to damage rear window lower crossmember.
3. Using pneumatic chisel, cut fender following cutting line C. Care should be taken not to damage inner wheelhouse.
4. Remove spot weldings and remove remaining part.



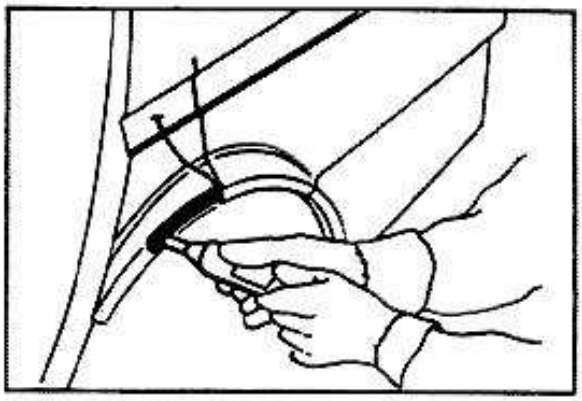
INSTALLATION

1. Cut spare fender in-line with attaching panel.

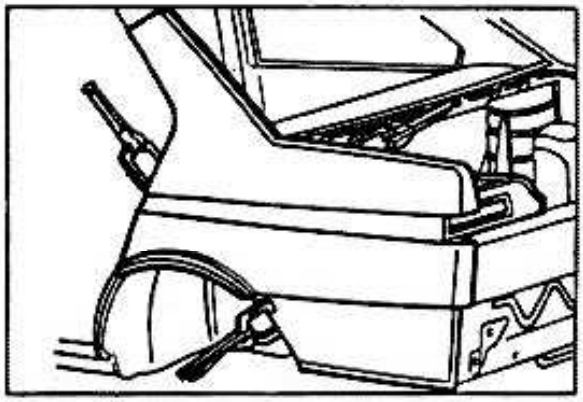


T = OVERLAPPING TOLERANCE

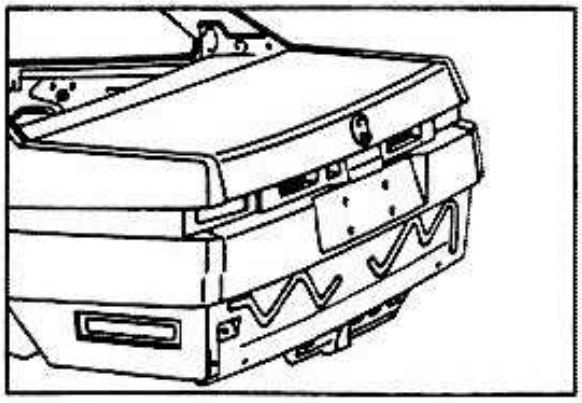
2. Seal joint area between fender, wheelhouse and floor.



3. Temporarily install spare fender.



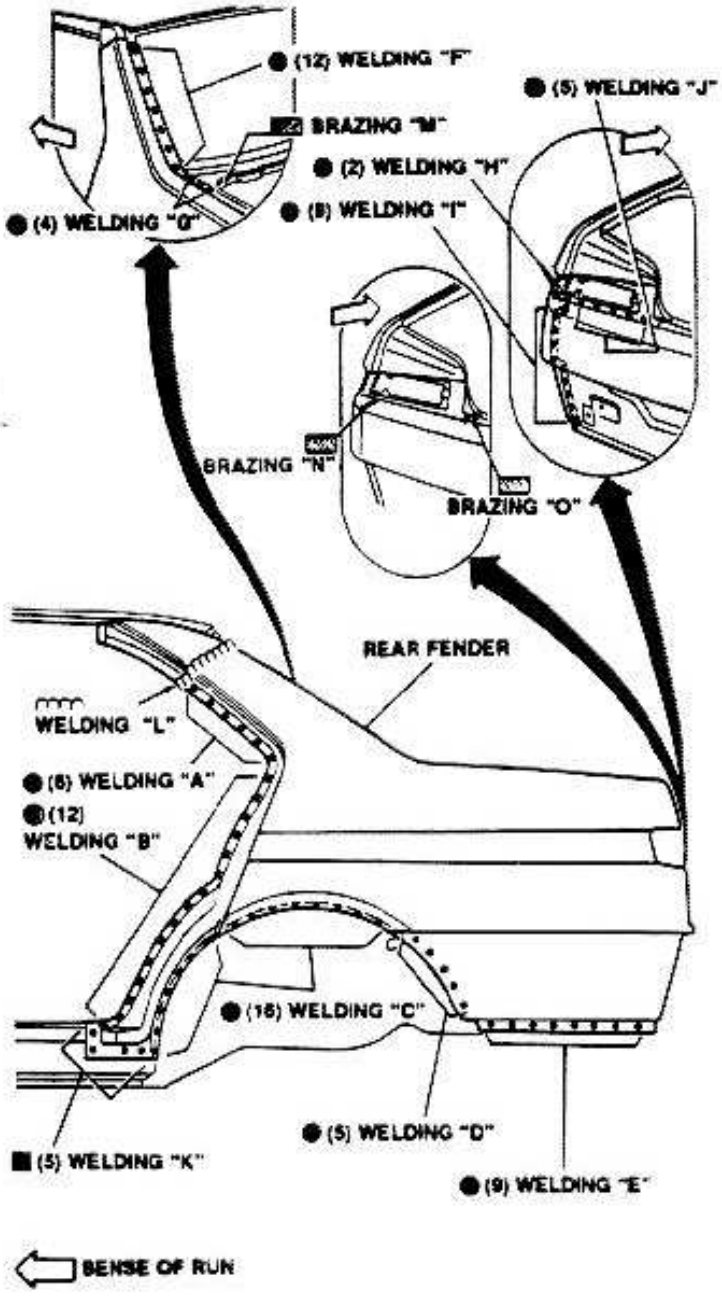
4. Install trunk and lid check alignment and parallelism.



5. Carry-out spot-weldings A (6 places), B (12 places), C (16 places), D (5 places), E (9 places), F (12 places), G (4 places), H (2 places), I (9 places) and J (5 places).
6. Carry-out filling-welding K (5 places).
7. Carry-out arc-welding L.

8. Carry-out brazings M, N and O.

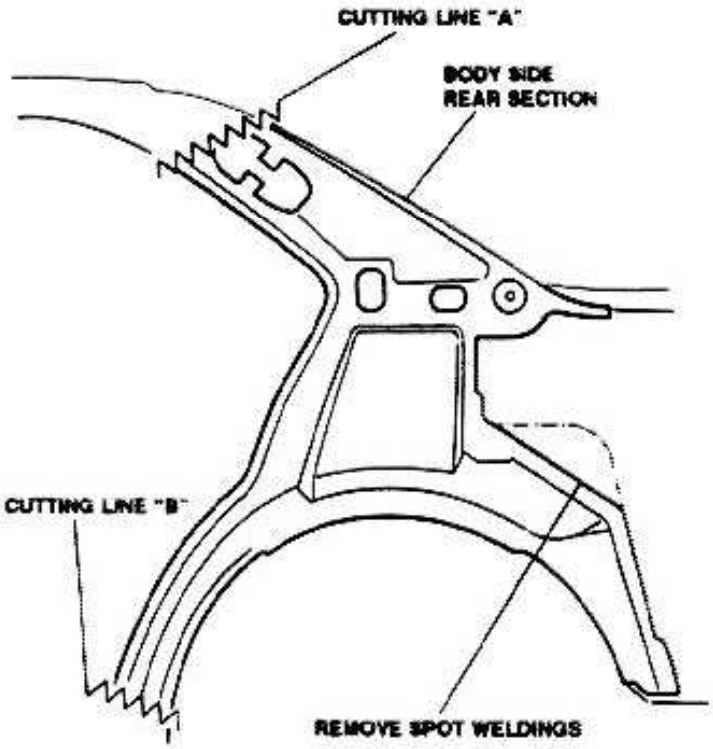
9. Remove clamping devices and check for proper installation.
10. Apply wax (see "WAXING", section O-O).



BODY SIDE REAR SECTION (procedure "A" with fender removed)

REMOVAL

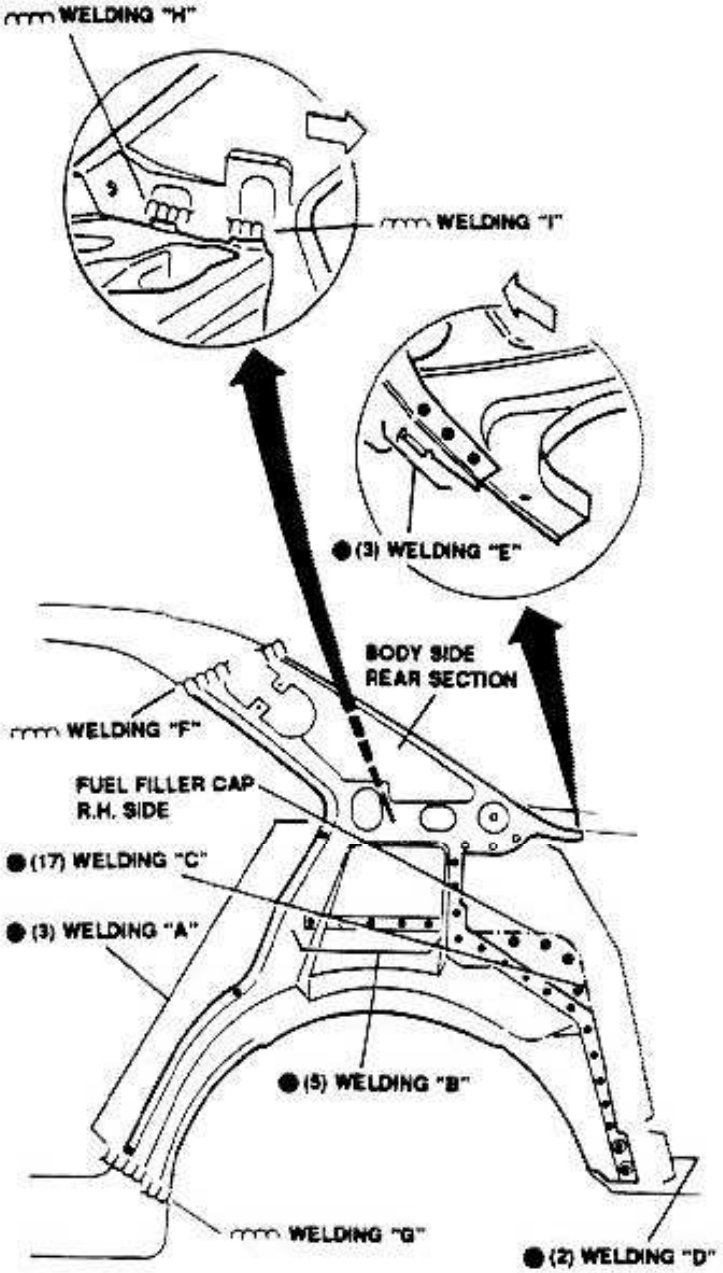
1. Using pneumatic chisel, cut following cutting lines A and B; care should be taken not to damage lower components.
2. Remove spot weldings and remove remaining section.



INSTALLATION

1. Carry-out spot-weldings A (3 places), B (5 places), C (17 places), D (2 places) and E (3 places).

2. Carry-out arc weldings F, G, H and I.

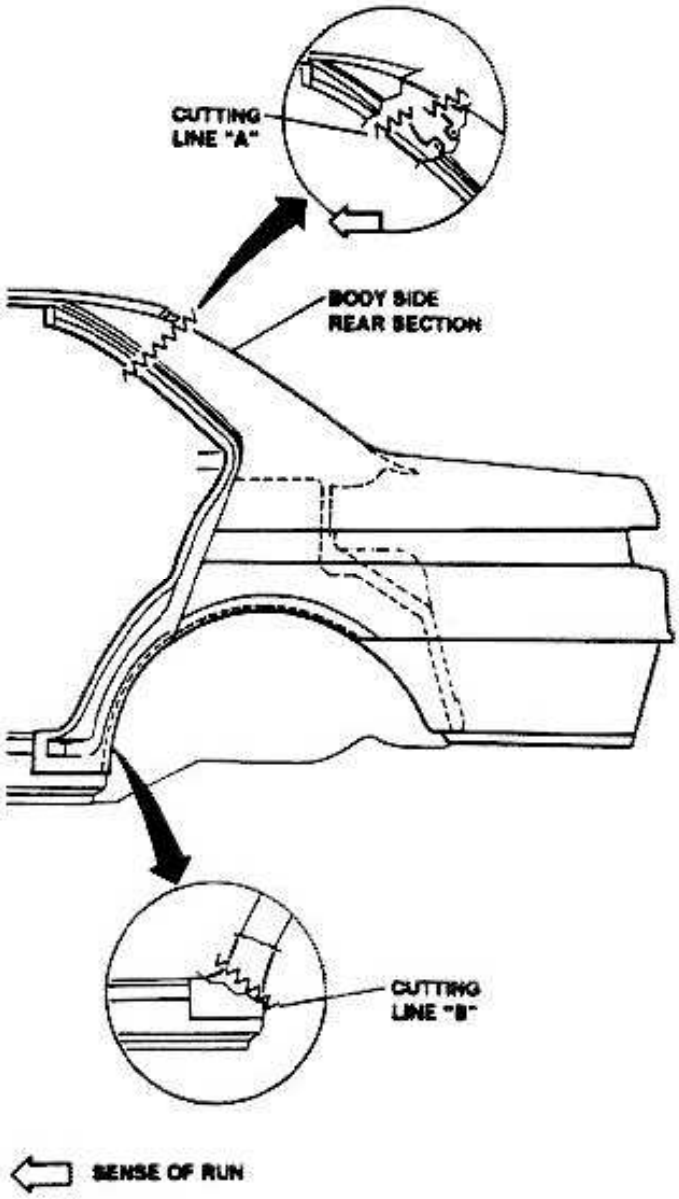


BODY SIDE REAR SECTION (procedure "B" with fender installed)

REMOVAL

NOTE: For fender removal, refer to applicable

1. Using pneumatic chisel, cut following cutting lines A and B; care should be taken not to damage lower components.
2. Remove spot weldings and remove remaining section.



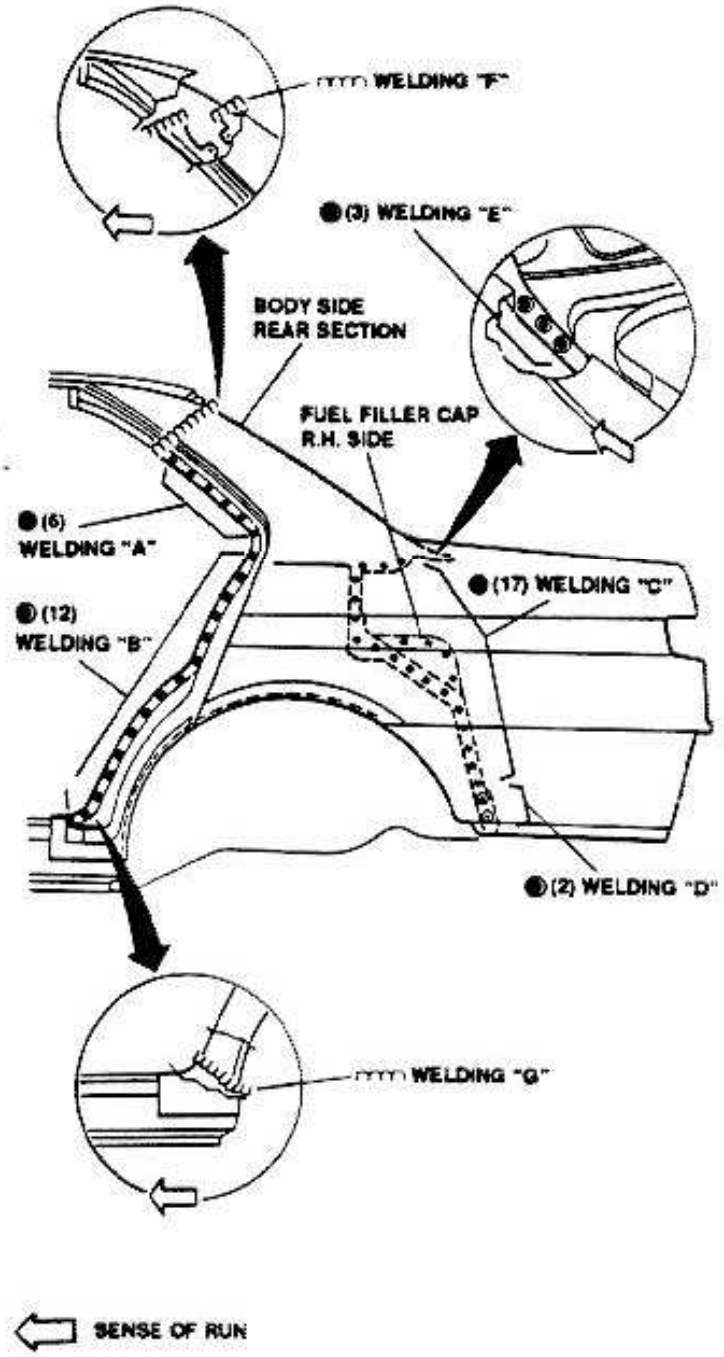
INSTALLATION

1. Carry-out spot-weldings A (6 places), B (12 places), C (17 places), D (2 places) and E (3 places).

procedure.

2. Carry-out arc weldings F and G.

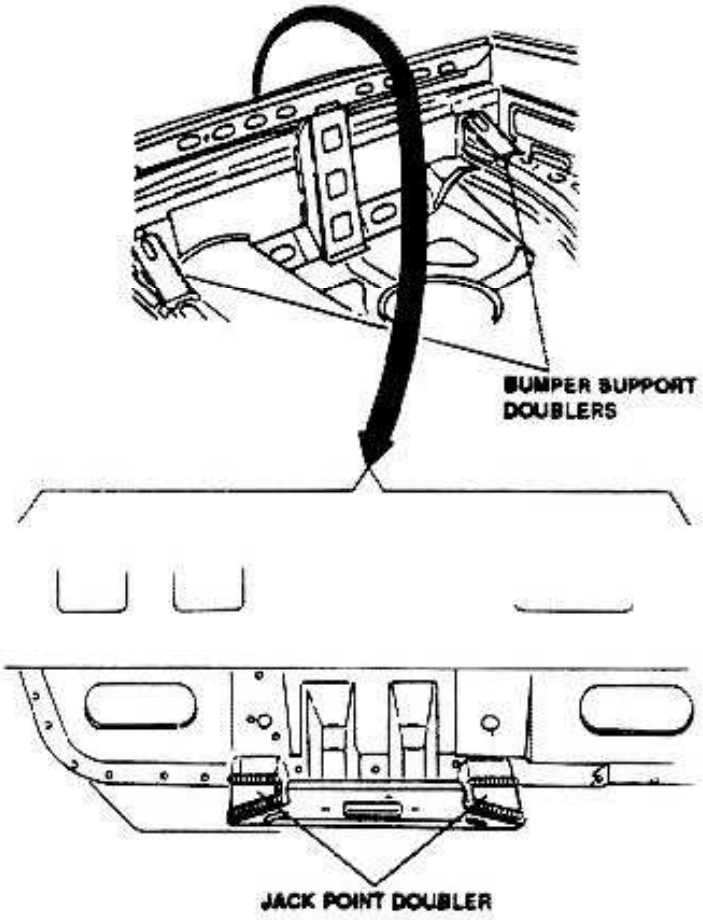
NOTE: **For remaining weldings of fender, refer to applicable procedure.**



REAR PANEL

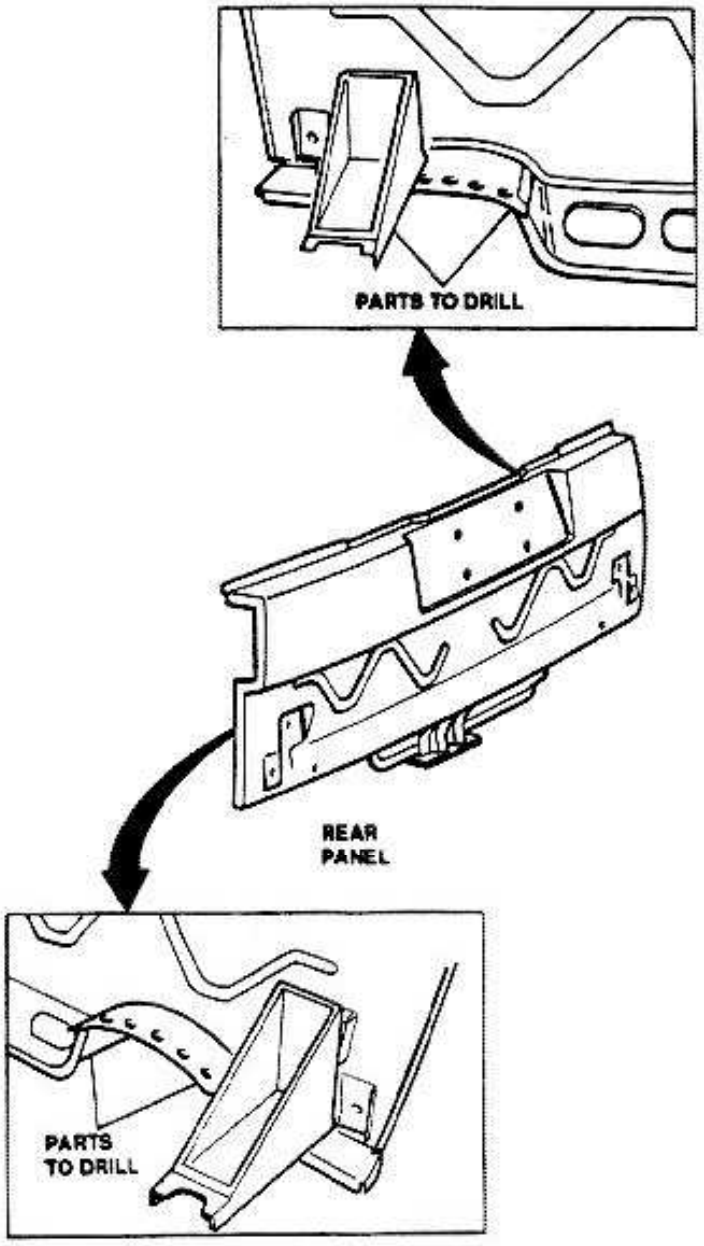
REMOVAL

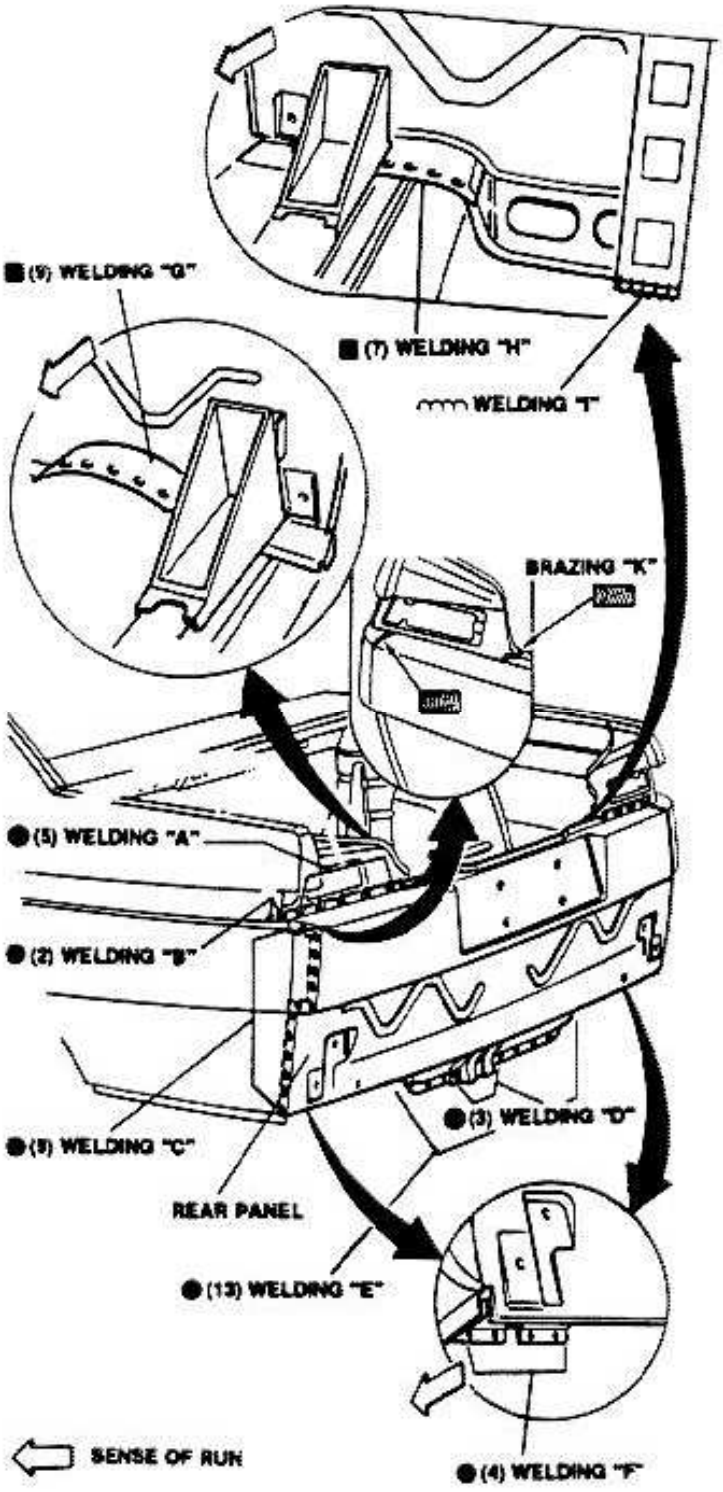
1. Remove jack point doubler by grinding weldings with disk sanding machine.
2. Remove two bumper support doublers by grinding weldings with disk sanding machine.
3. Remove spot weldings and remove panel.



INSTALLATION

1. Drill welding edges of new panel where filling weld-

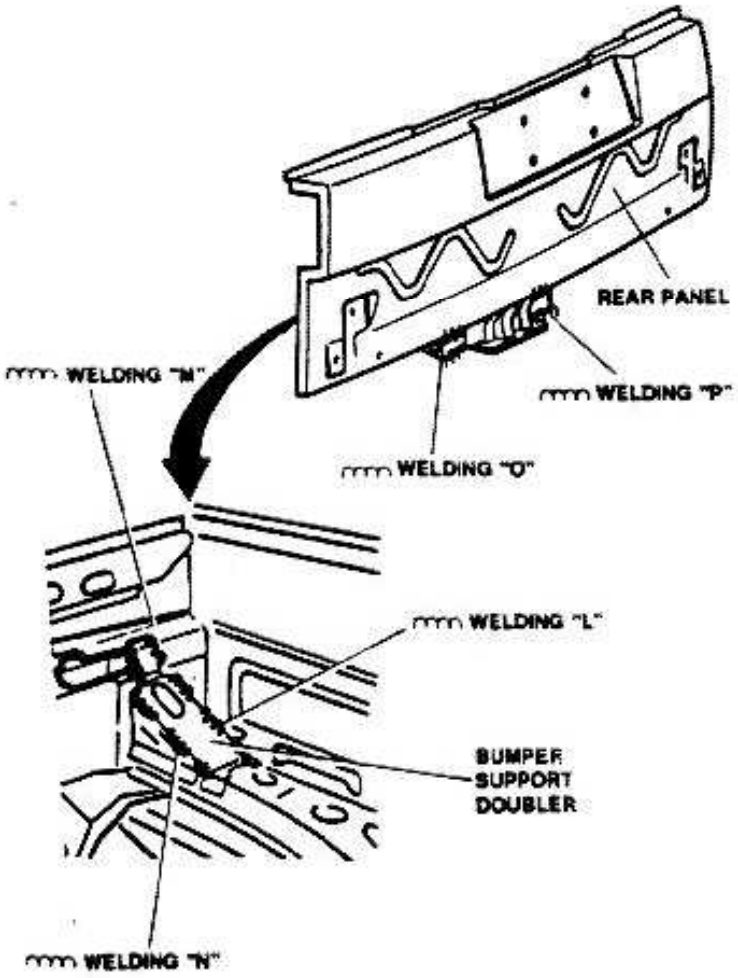




2. Carry-out spot-weldings A (5 places), B (2 places), C (9 places), D (3 places), E (13 places) and F (4 places).
3. Carry-out filling-weldings G (9 places) and H (7 places).
4. Carry-out arc-welding I.
5. Carry-out brazings J and K.

5. Carry-out brazings J and K.

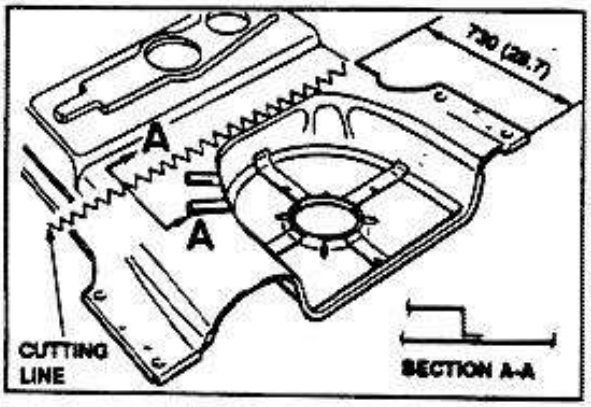
6. Install two bumper support doublers and carry-out arc-weldings L, M and N.
7. Install jack point doubler with related bracket and carry-out arc-weldings O and P.
8. Apply wax (see "WAXING", section Z-Z and AA-AA).



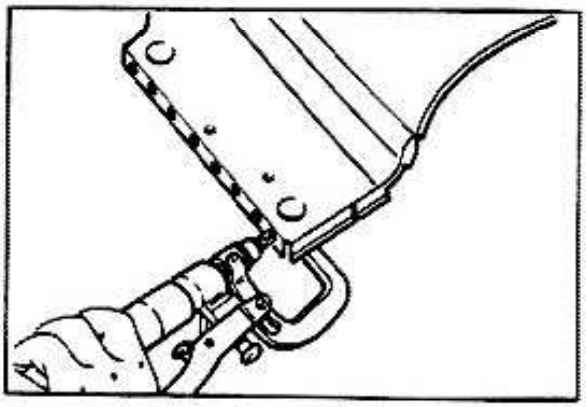
REAR FLOOR

REMOVAL

1. Using pneumatic chisel, cut floor, 730 mm (28.7 in) from rear edge (see section A-A).

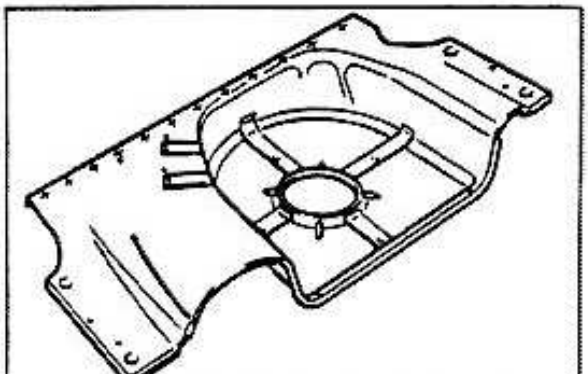


2. Remove spot weldings and remove floor.

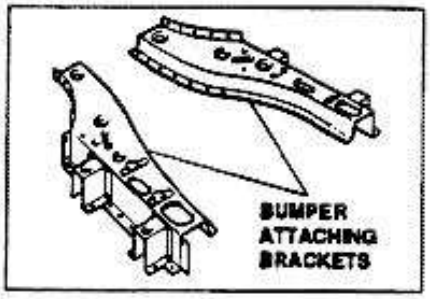


INSTALLATION

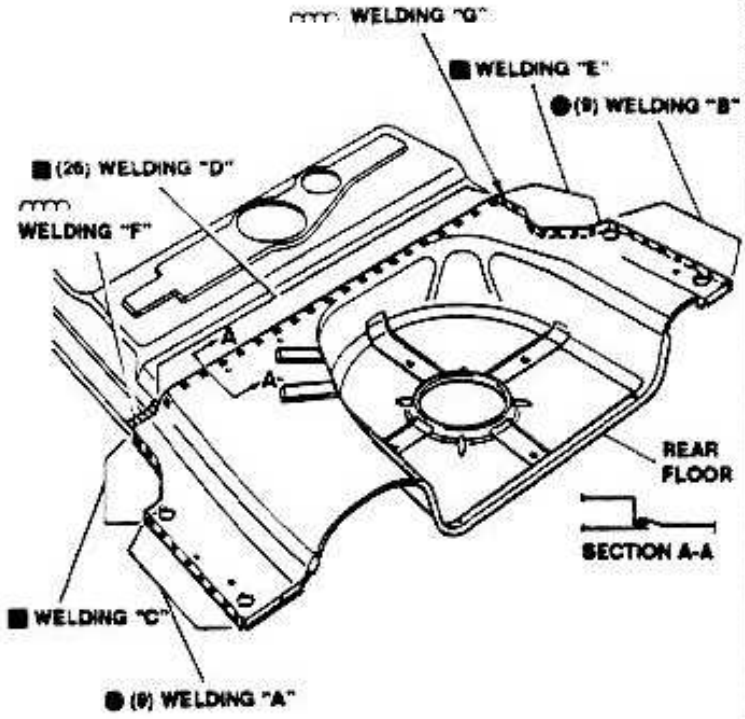
1. Using special tool, drill front edge of floor.



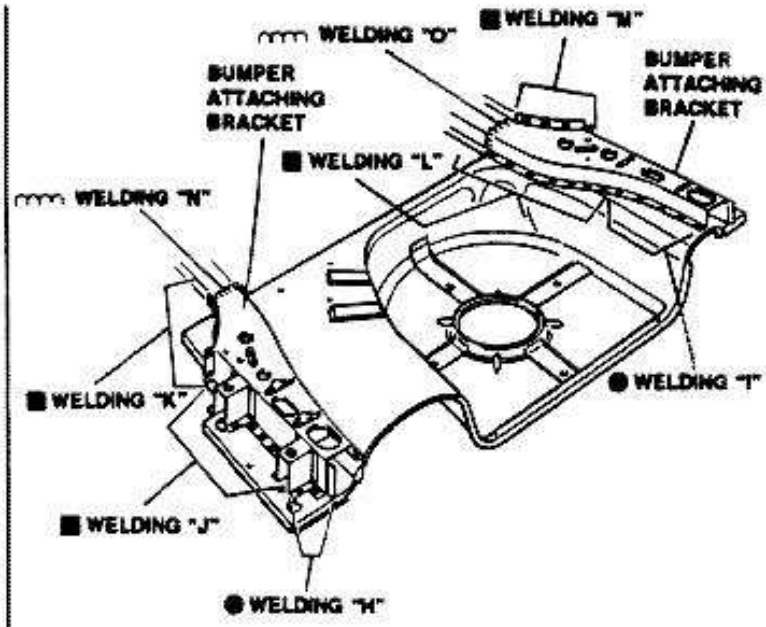
2. Using special tool, drill bumper attaching brackets where filling-weldings are to be carried-out.



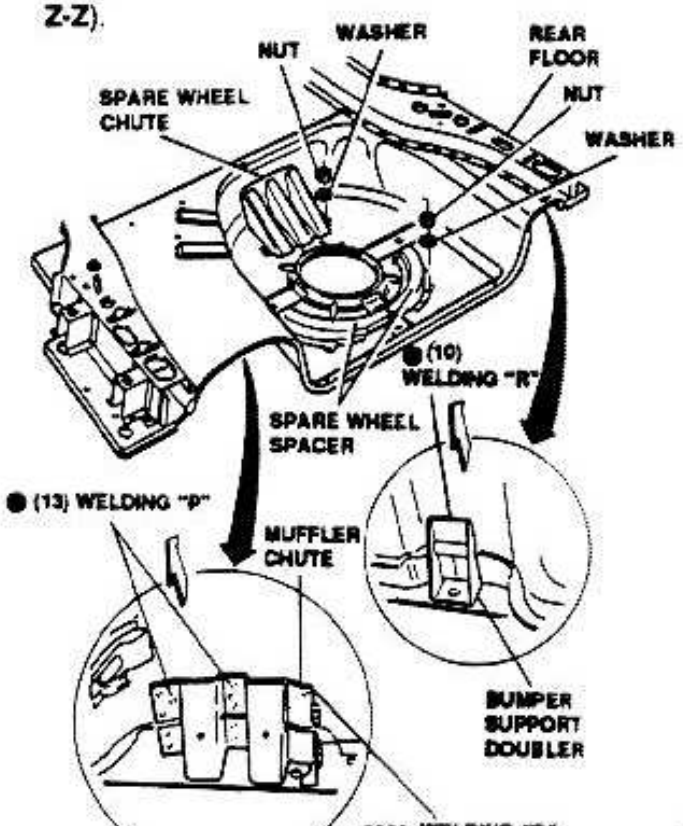
3. Carry-out spot-weldings A (9 places) and B (9 places).
4. Carry-out filling-weldings C, D and E.
5. Carry-out arc-weldings F and G.



6. Position bumper attaching brackets.
7. Carry-out spot-weldings H and I.
8. Carry-out filling-weldings J, K, L and M.
9. Carry-out arc-weldings N and O.



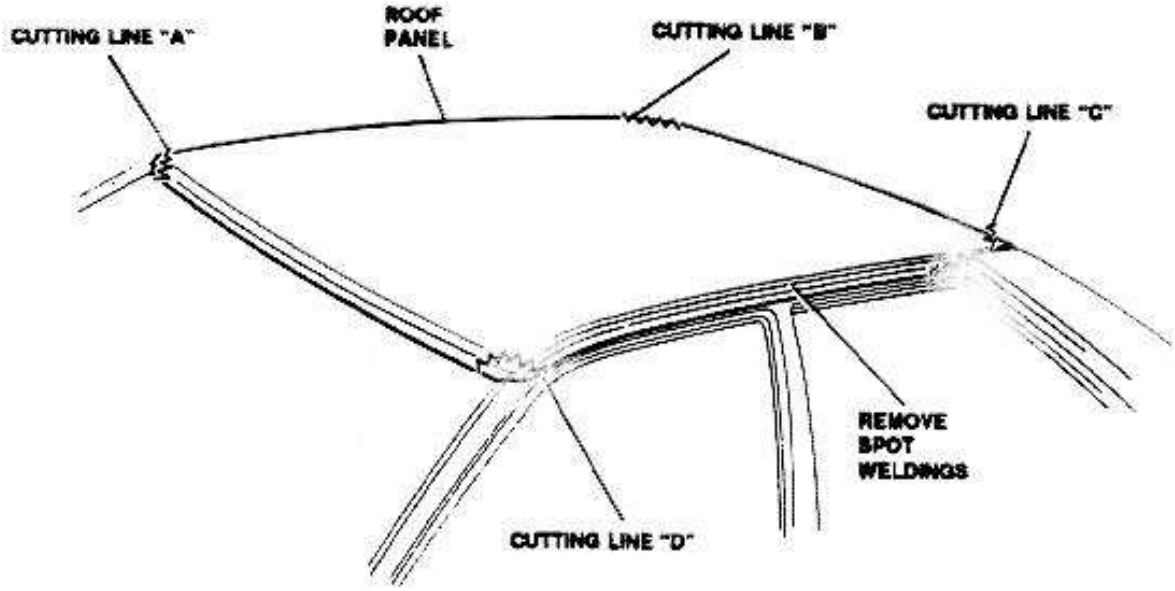
10. Install "compact spare wheel" chute with two nuts and related washers and spacers and five nuts and washers.
11. Install muffler chute with spot weldings P (13 places) and arc welding Q.
12. Install bumper support doubler with spot-welding R (10 places).
13. Apply wax (see **"WAXING", sections R-R, S-S and Z-Z**).



ROOF PANEL

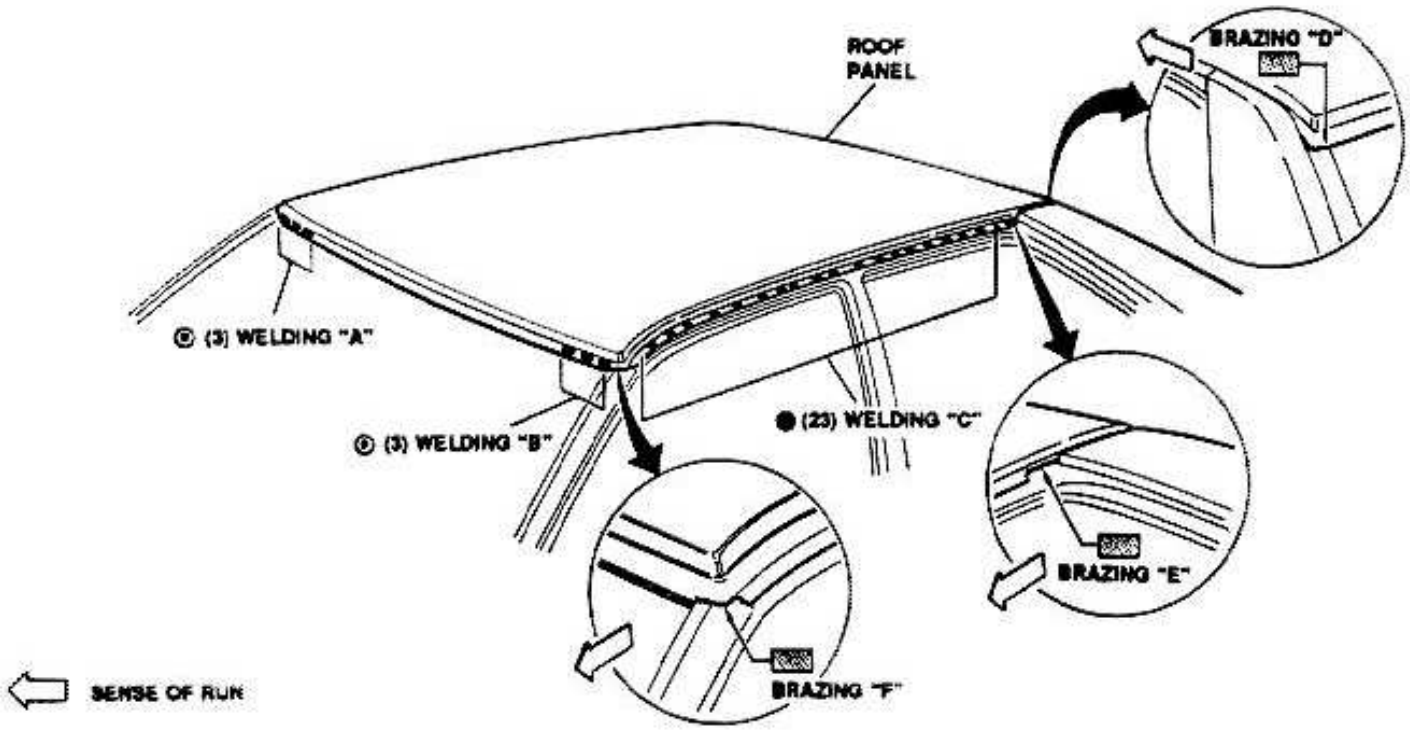
REMOVAL

1. Using pneumatic chisel, cut panel following cutting lines A, B, C and D.
2. Remove spot-weldings on both sides and remove panel.



INSTALLATION

1. Position roof panel and clamp it in position.
2. Carry-out spot-weldings A (3 places) and B (3 places).
3. Carry-out spot-welding C (23 places) on both sides.
4. Carry-out brazings D, E and F on both sides.

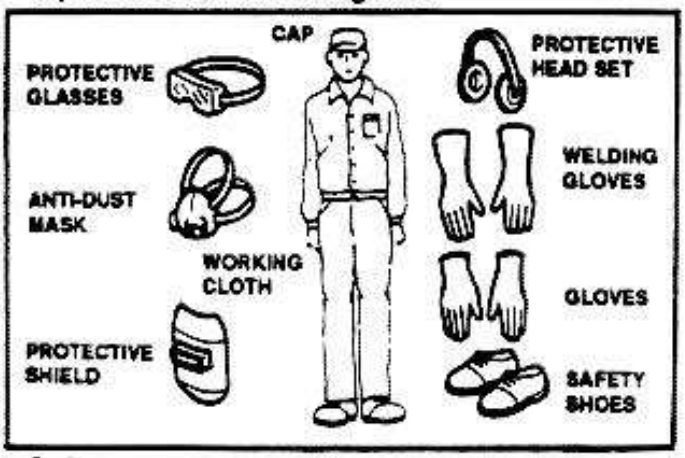


OPERATORS INFORMATION

WORK ACCIDENTS PREVENTION

1. **Protective cloths.**

- Make sure that adequate protective devices (glasses, mask, headset) are used, depending on work duties.
  As a general rule, working cloths, safety shoes and cap should be worn during work.

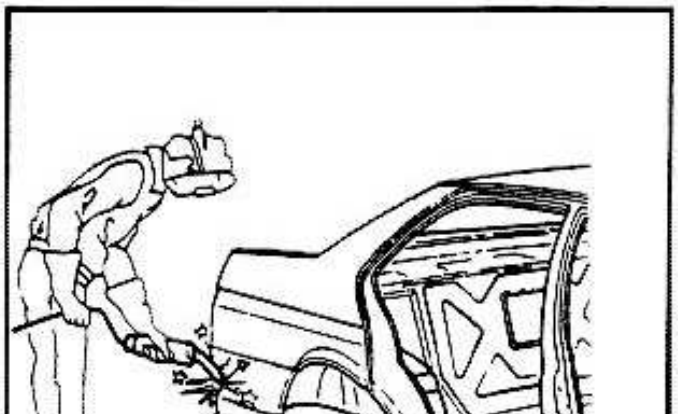


2. **Safety support.**

- When vehicle is lifted, apply suitable safety supports. Refer to **"LIFTING POINTS"** for location of bearing points.

3. **Flammables.**

- Make sure that negative (-) lead is disconnected from battery before attempting any repair.
- If weldings are to be carried-out near fuel tank, remove it and plug filler neck.
- When fuel and brake fluid lines are disconnected, plug open ends.
- Remove fuel injection electronic control unit before any welding.

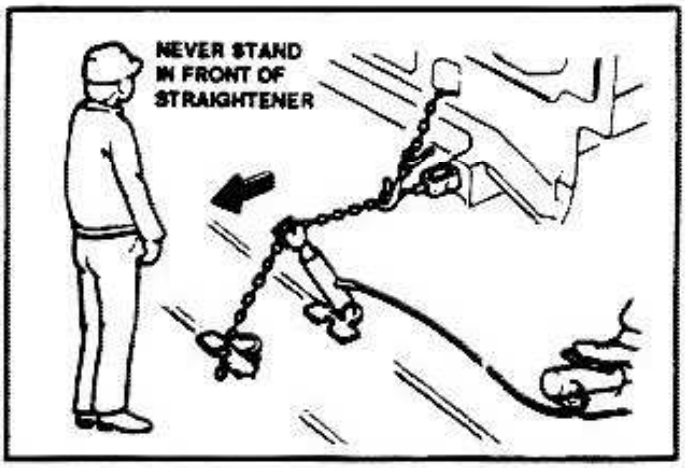


4. **Work environment.**

- Work environment should be well ventilated and lighted to assure operator's safety.
- Paints and sealants can produce toxic vapors under heat action.
  It is there fore advisable to use pneumatic chisel or saw, instead of oxhydrogen flame, for cutting and removing damaged metal sheets.
- Use belt-sanding machine or rotating brush to remove paint.

5. **Bodywork straightening.**

- Make sure that straightener is always used as per procedures set forth in Manufacturer's Instructions Manual.
- During straightening operations, never stand in front of straightener in the direction of pulling.



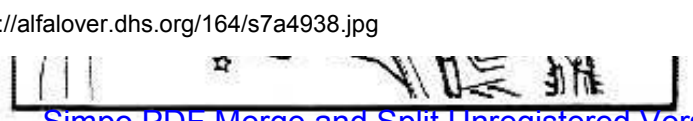
BODY AND EXTERNAL COMPONENTS PROTECTION

1. **Body protection.**

- Remove or protect internal furnishing (instruments, upholstery, carpets).
- Protect glasses, instrument, upholstery and carpets with heat-resistant materials before attempting any welding operation, in particular if arc welding in CO_2 atmosphere is to be carried-out.

2. External components protection.

- When removing external components (hood, trunk lid, finishing), adequately protect them against damage with tape, cloth or other suitable materials.
- Repair all painted surfaces which show damage:



also repair scratches, since they cause corrosion.

REPLACEMENTS INFORMATIONS

It is recommended to use always Alfa Romeo genuine spare parts, in order to assure the best results and maintain vehicle original service ability.

WELDINGS INFORMATIONS

Remove al the vehicle mounted electronic control units prior to perform any electric welding operations.

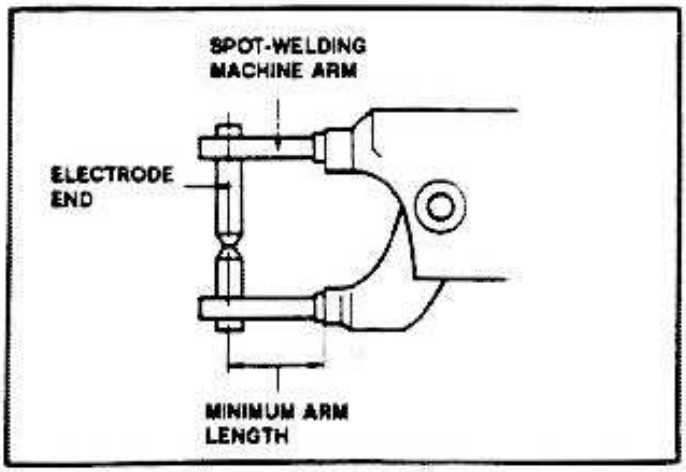
SPOT-WELDING

Spot welding machine

The maximum strength of spot weldings can be obtained only if the following checks are performed before starting welding operations.

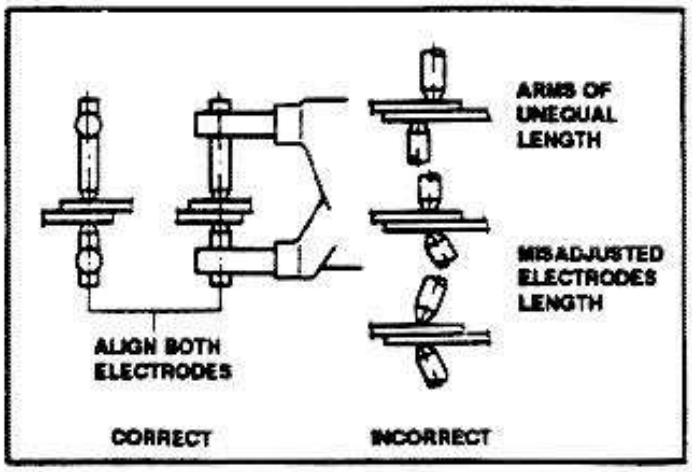
Adjustment of welding machine arm

1. Maintain as short as possible, to obtain the maximum load.
2. Carefully tighten arm and electrodes to prevent any movement during welding.



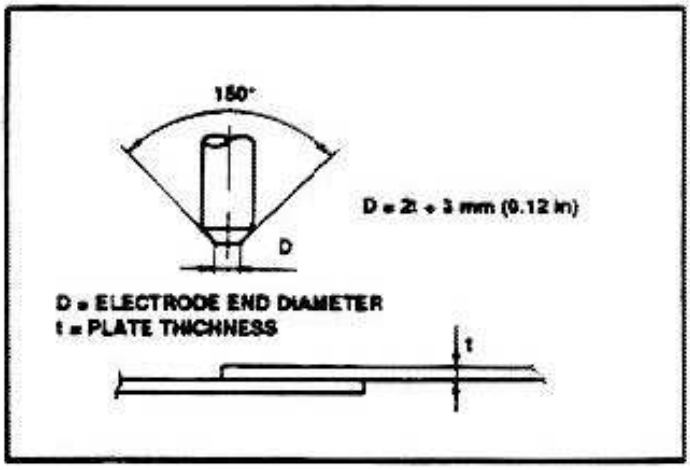
Electrodes alignment

Align ends of upper and lower electrodes. A misalignment causes a low pressure on welding points, with conse-



Electrode and diameter

It is very important to check electrode end diameter to obtain the best result.
The end diameter (D) should be adequate to the thickness of the metal sheets.
Remove any trace of burns and foreign materials from electrodes.



Preparation and conditions of panels

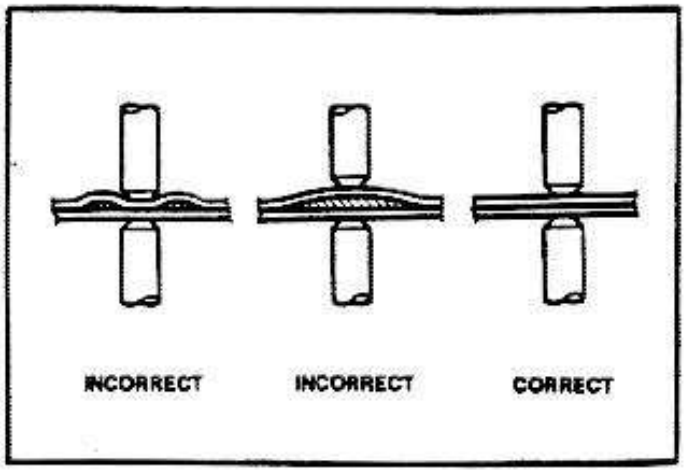
The presence of discontinuity, paint, rust or dirt on panel edges prevent current flow, thus reducing welding strength.
Check conditions of mating surfaces and correct as

quent low strength.

necessary before starting any welding operation.

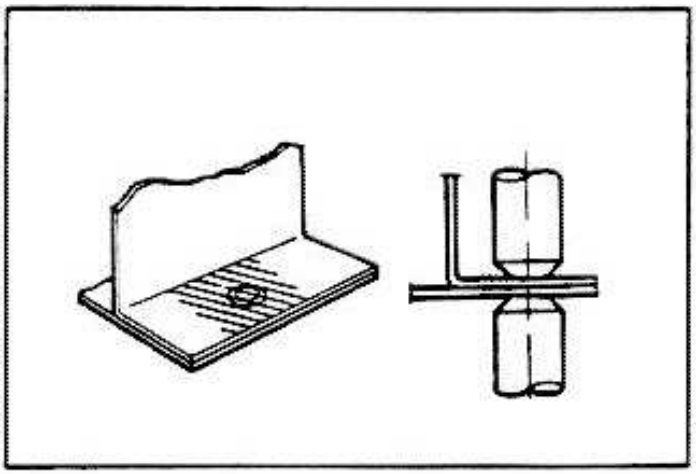
Gap between surfaces

If gap exists between surfaces to be welded, the current intensity may be reduced. The welding will results too poor and with low strength.
Make sure ,that surfaces mate properly; use clamps if necessary.



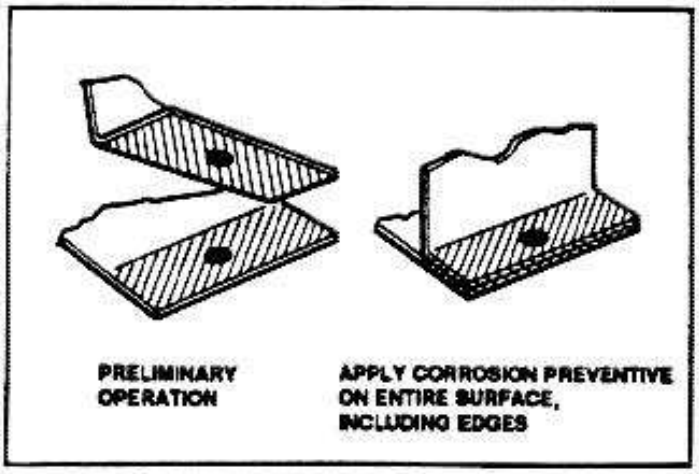
Welding of metal surfaces

Remove all foreign materials (paint, dust, rust) and dirt to prepare surface, in order to obtain the best result.



Corrosion prevention of metal surfaces

Coat areas to be welded with a corrosion preventive - high conductive compound. Apply coat also on edges.



Cautions to be observed for spot-welding

Spot welding

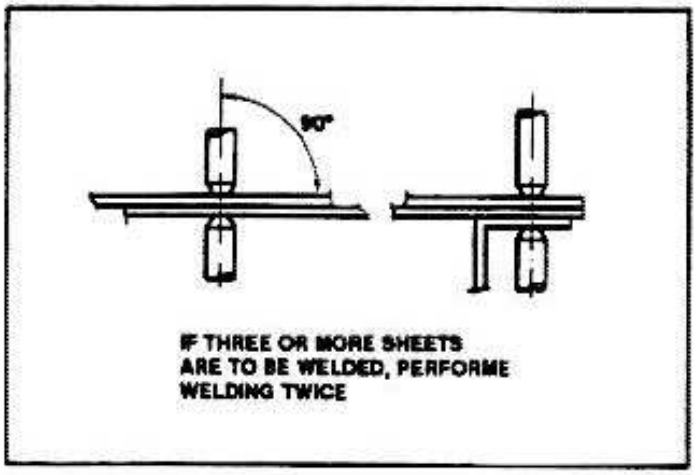
Use continuous method (if this method cannot be applied, use MIG welding).

Electrodes installation

Electrodes should be perpendicular to metal sheets: otherwise, the welding strength will be reduced.

Welding of three or more overlapped sheets

Where three or more sheets are to be welded, perform welding twice.



Number of spot-weldings

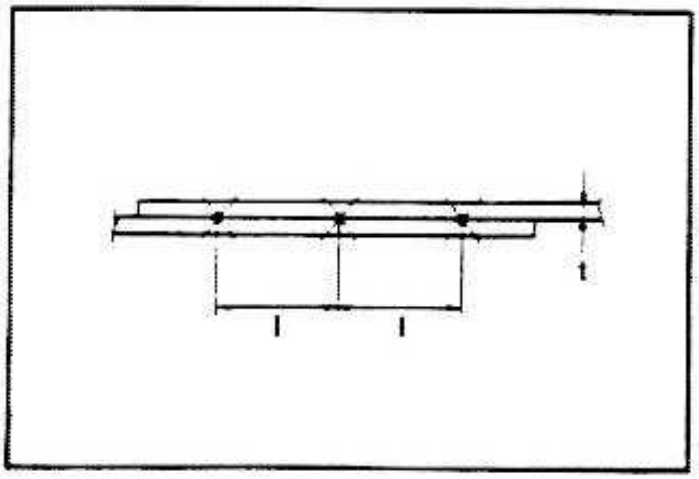
Generally, the welding machines used in repair workshops are less efficient than tose used by vehicle manu-

facturer. Therefore, the number of spot-weldings carried-out in repair workshop should be increased by 20 to 30% with respect to original welding.

Distance between spot weldings

The minimum distance between spot weldings depends on sheets total thickness. The value in the following table are applicable in most instances.

Thickness (t)	Minimum distance (l) mm (in)
0.6 (0.024)	10 (0.39)
0.8 (0.031)	12 (0.47)
1.0 (0.039)	18 (0.71)
1.2 (0.047)	20 (0.79)
1.6 (0.062)	27 (1.06)
1.8 (0.071)	31 (1.22)

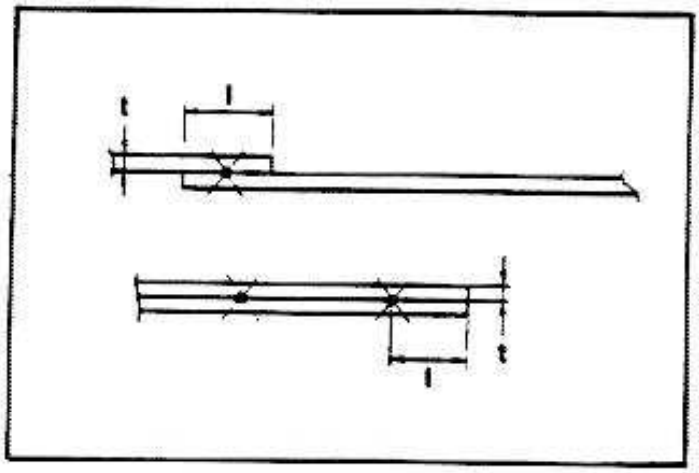


The above listed distances should not be reduced excessively, to avoid current leakage and consequent loss of welding strength.

Distance from edge of panel

If welding is close to panel edge, observe dimensions listed in the following table

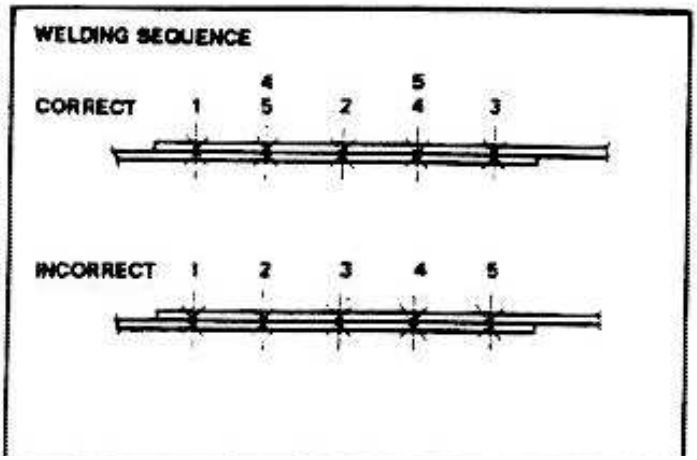
Thickness (t)	Minimum distance (l) mm (in)
0.6 (0.024)	11 (0.43)
0.8 (0.031)	11 (0.43)
1.0 (0.039)	12 (0.47)
1.2 (0.047)	14 (0.55)
1.6 (0.062)	16 (0.62)
1.8 (0.071)	17 (0.66)



A welding too close to edge has an insufficient strength, and sheets can be subject to warping.

Welding sequence

Do not carry-out welding by proceeding in one direction only: the welding can result weak due to current leakage. Interrupt operation if electrode ends overheat (color change).

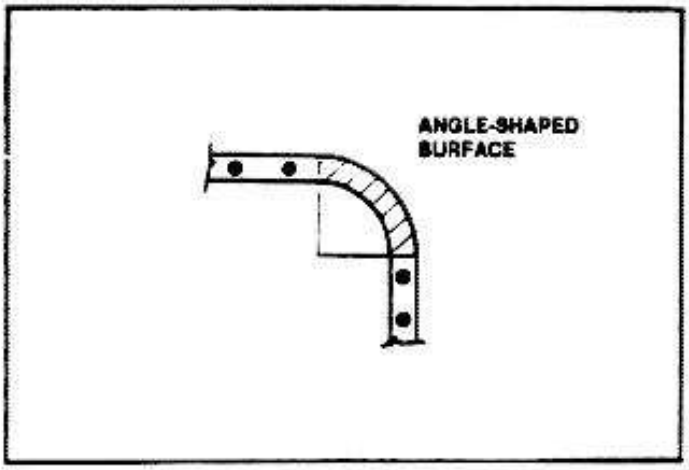


listed in the following table.

Weldings on angle-shaped surfaces

Do not carry-out weldings on angle-shaped surfaces, due to tension concentration which can cause cracks.
Examples:

- Front pillar upper corner.
- Rear fender forward section.
- Front and rear window corners.

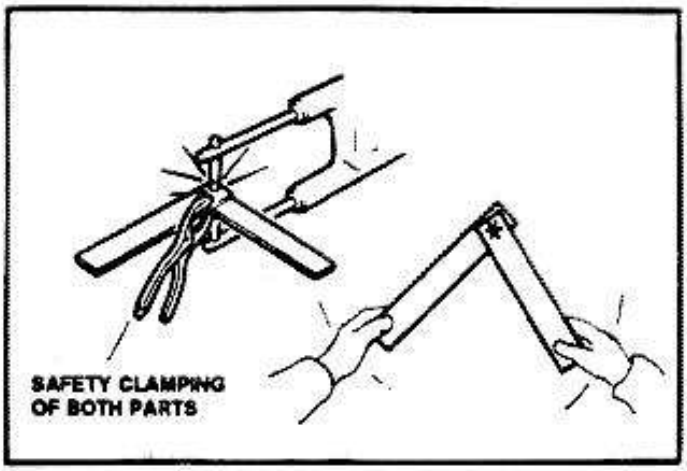


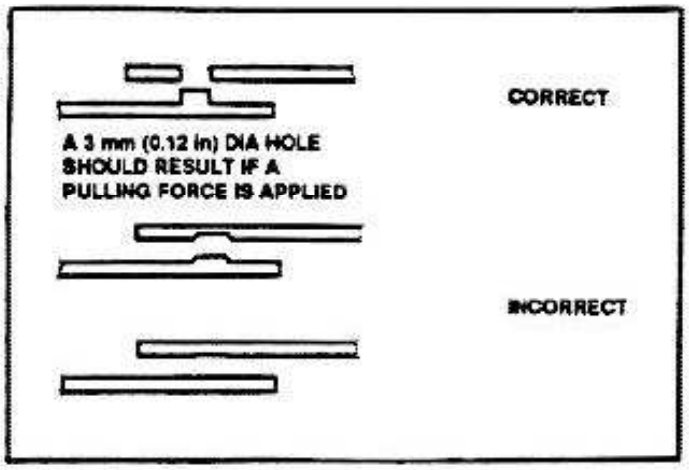
Weldings test

A spot-welded area can be inspected either visually or with destructive method. The last method should be applied on a specimen, and can be performed before and after repair.
Spot-weldings should be equally spaced and positioned at center of flange.

Specimen test, before welding

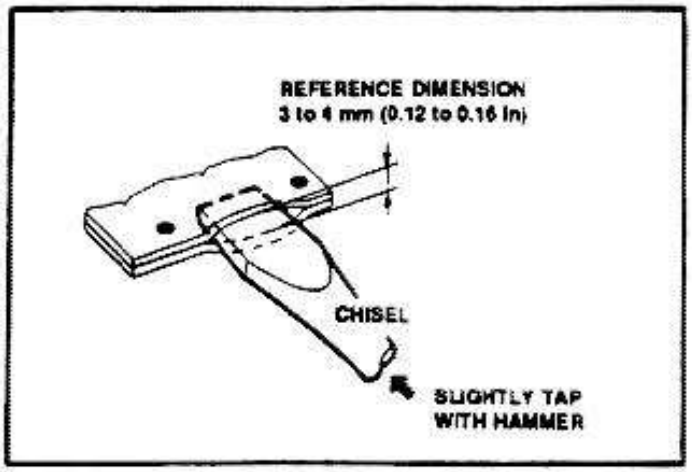
- Prepare specimen using metal sheets of the same thickness of parts to be welded. Clamp specimens together.
  Carry-out welding.
- Rotate specimens around spot-welding until they detach.
  All spot-welding should remain on one specimen, while a recircular opening should result in the other.
  If the above condition is not met, welding conditions are improper. Adjust pressure, current, time and all other conditions then repeat test until the best results are obtained.

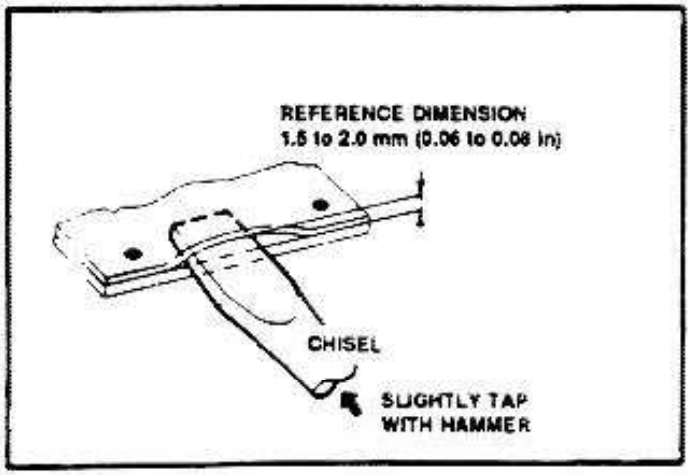




Test after welding, with chisel and hammer

- Insert chisel point between welded sheet and tap on chisel until 3 to 4 mm (0.12 to 0.16 in) gap is obtained. If no warpage is found, the welding is acceptable.
- If sheets thickness is not equal, gap should be limited to 1.5 to 2.0 mm (0.06 to 0.08 in).
- The above indicated gap is only a reference dimension.
- The gap can vary, depending on spot welding position, edge length, sheet thickness and other elements.
  Do not exceed this limit, to avoid any breakage.
- Make sure that tested area is repaired after test.





MIG WELDING

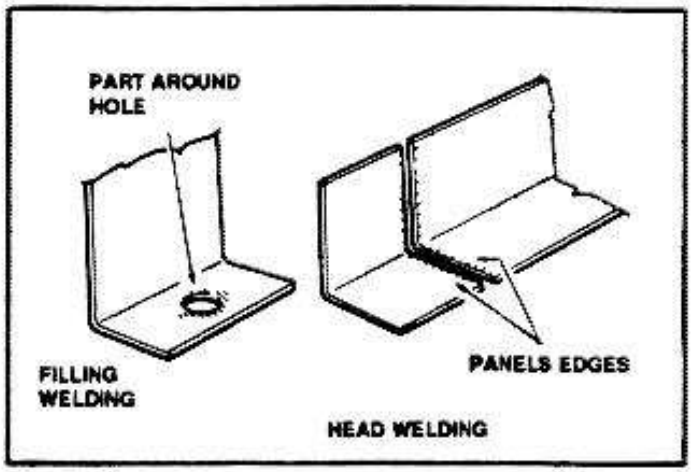
Conditions of panel

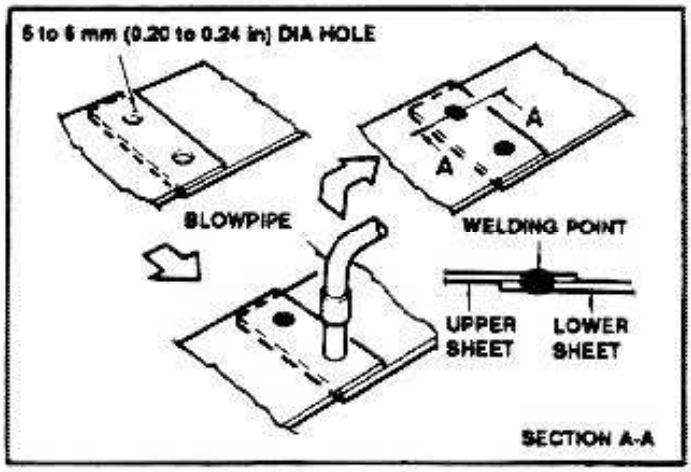
Remove any trace of foreign materials by grinding or brushing.
Paint, rust or oil on sheet surface could reduce the strength of welding, causing blistering.

Informations for welding

Filling-welding (of prepared holes)

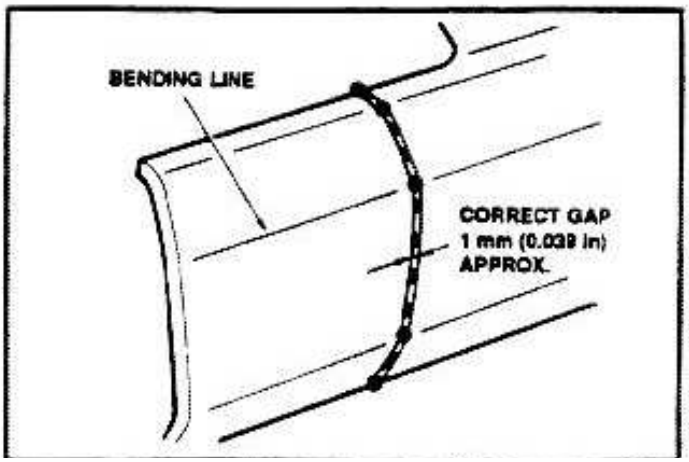
1. Drill a 5 to 6 mm (0.20 to 0.24 in) dia hole on one of sheets to be welded. Secure sheets together.
2. Position blowpipe perpendicular to sheet and perform welding by filling hole.
   Whenever welding is interrupted, an oxide coat generates on surface, causing blisterin. In such instance, brush off oxide.
3. Check for proper workmanship.





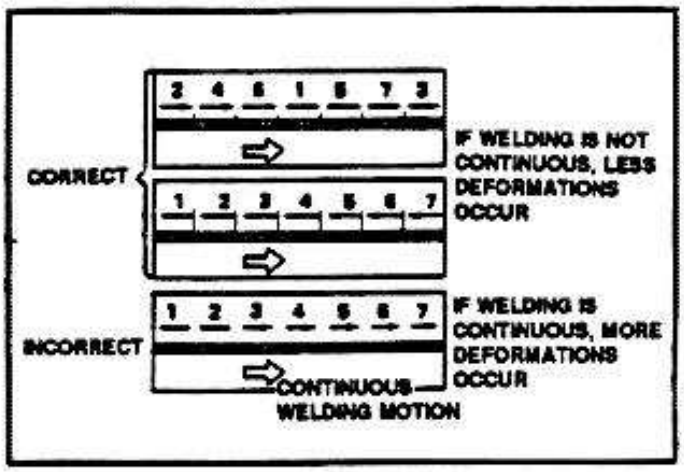
Head-welding

1. Tack parts to be welded (to prevent buckling and to align surfaces) then fill voids with welding seams.

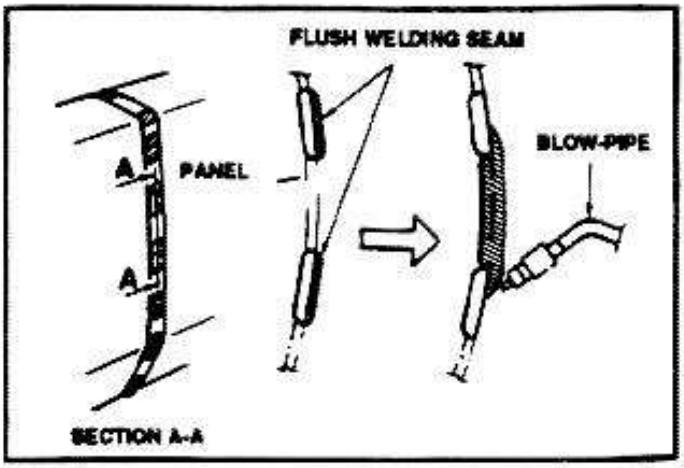


brush off oxide.

2. Do not carry-out step welding with a continuous seam: buckling may occur. Proceed as indicated in figure to reduce buckling.



3. Flush welding seams with a sanding machine before filling voids. If seams are not flush, buckling may occur.



Welding test

The last procedure is similar to that previously described for spot-welding.

TROUBLESHOOTING PROCEDURE: PAINTWORK DEFECTS

TROUBLES AND SYMPTOMS	TEST REFERENCE
DEFECTS OF APPLIED PRODUCT VISIBLE AFTER APPLICATION OR DRYING PROCESS	A
DEFECTS OF APPLIED PRODUCT DUE TO BY AGING (EXPOSITION TO LIGHT, TO ATMOSPHERE AND CHEMICAL AGENTS)	B

DEFECTS OF APPLIED PRODUCTS VISIBLE AFTER APPLICATION OR DRYING PROCESS	TEST A

Defect	Cause	Remedy
DIRT (dirt spots-inclusions) It shows as marking of pricks caused by impurity included during baking or spraying.	Dust sediments on painted surface when paint is not yet dry or dirt particles of different nature contained in the paint. Operator clothing not appropriate. Atmospheric dust. Lacquer not perfectly filtered. Oven filters no longer serviceable.	In case of superficial dust, polish with abrasive paste and Polish. When dirt is included in the layer it is necessary to repaint upon sanding of the affected area.
CISSING (Cissing hole) It appears, on wet paint, as a localized contraction in the form of small round depressions that may uncover the layer below (cissing hole) or affect subject layer only (cupel).	Variation of superficial tension due to: grease particles or presence of foreign matters on primer; ambient contaminated by silicone; steam saturation in the spraying cabin causing condensate on the wet paint; deficiency of spraying system.	Defect can be corrected by washing with antisilicone products and sanding the effected area, ensuring to reach a whole layer in the areas where defect was evidenced. Resume painting cycle after accurate cleaning by repeating treatment that previously showed the defect.
LOOK-THROUGH (Missed coating) It consists of a paint coat thickness that allows to see the color below.	Insufficient lacquer thickness, low covering capacity.	To correct these defects it is necessary to sand the surface and repeat painting.

(Cont.d)

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DEFECTS OF APPLIED PRODUCTS VISIBLE AFTER APPLICATION OR DRYING PROCESS	TEST A

Defect	Cause	Remedy
SPOTS (Spotting) It consists of the build-up of different color or brilliance areas on painted surface.	The brilliance variation is due to irregular absorption of support area.	Sand and repaint.
REMOVAL This defect arises when a product applied on a painted surface removes the layer below; it normally shows as wrinkling. This fault can arise both when applying and when drying off.	Primer not perfectly dry or incompatibility between the product being used and the previous ones.	Whether fault is found during application or drying, it is necessary to sand till a normal layer is reached, then repaint.
SHADING It shows on metallic paint, as areas or shades having tone different from the normal color.	Some metallic particles have not been distributed evenly during applications.	Sand and repaint.
ORANGE PEEL It shows as an irregular surface, more or less wrinkled, due to bad distribution of the product.	Spray viscosity too high; solvent too volatile; wrong application (improper jet or improper pressure: too low or too high); drying period too short or excessive application of product.	Light orange peel: sand and polish with abrasive past and Polish. Deep orange peel: sand and repaint.

DEFECTS OF APPLIED PRODUCTS VISIBLE AFTER APPLICATION OR DRYING PROCESS	TEST A

Defect	Cause	Remedy
STRAINING (Sliding-Sagging-Curtaining). It is a sliding of the applied paint layer, with consequent generation of irregular heaps such as drops, pockets, rims.	Gravity force prevails over the paint adhesion and cohesion capacities. This fault shows on vertical and inclined surfaces. If it shows during application of paint, it may be caused by a very low product viscosity, by spraying distance being too short, by not suitable spray gun jet, by low pressure, by high thickness of the applied film or by layers below not completely dry.	Operate as demanded by fault entity: for small straining allow the strained portion to dry and cool off; sand and polish with abrasive paste and Polish. For large straining sand till the fault is completely removed and repaint the affected area.
PIN PUNCTURES (Pin holes-Burns-Boiling) It shows as small holes in the paint film.	Presence of air bubbles or irregular evaporation of solvent; this generates, in the wet film, small craters unable to level out before the film is completely dry. In some cases it may be caused by porosity of the support or of the layers below, or by over pressure or very short drying time.	Polish with abrasive paste and Polish; if this operation is not sufficient, sand the affected area till a good layer is reached (Primer) and repaint.
SANDING RIBBINESS It shows as thin furrows of painted surface, of variable length, perfectly visible with the nacked eye.	They may be caused by strong furrows on the surface to be painted or by sanding of primer carried out with large grain abrasive paper.	If fault is not remarkable, sand and polish with abrasive paste and Polish. If fault is remarkable, sand and repaint.

End of test A

DEFECTS OF APPLIED PRODUCT CAUSED BY AGING (EXPOSITION TO LIGHT, TO ATMOSPHERE AND CHEMICAL AGENTS)	TEST B

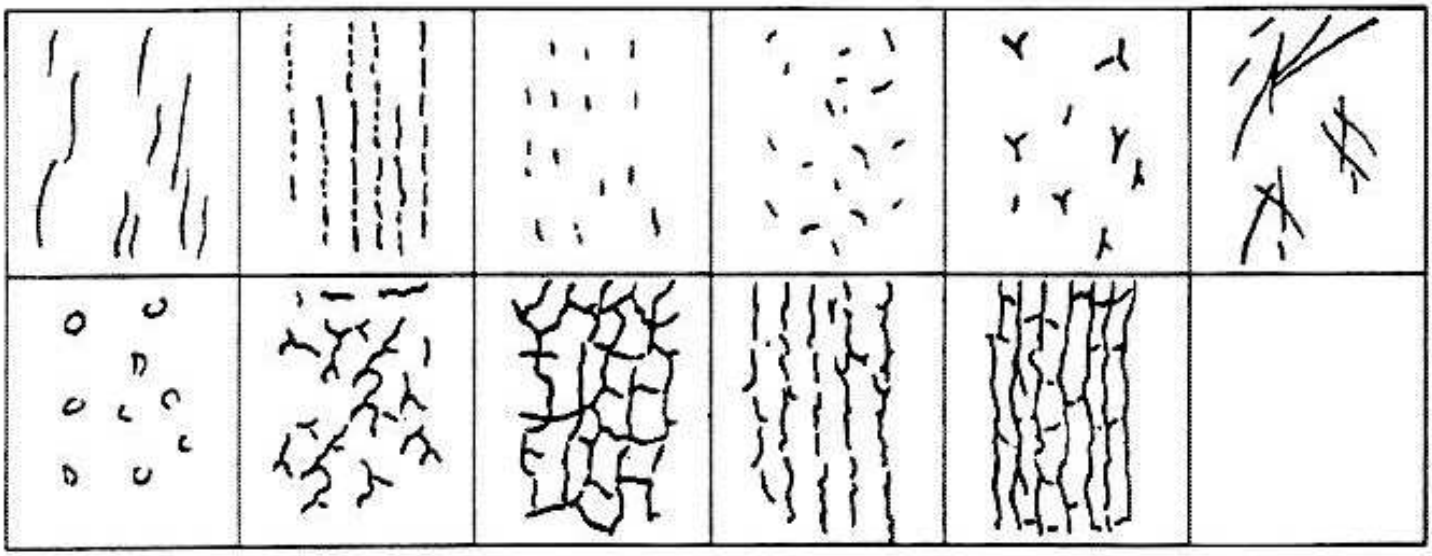
Defect	Cause	Remedy
BUBBLINGS (Blistering) It shows as swelling or bubbles localized on some points of the surface and, in special cases, on the complete surface. LACQUER OR PRIMER BLISTERING: presence below the paint film of mineral salts absorbing moisture through the paint film originates osmosis phenomena (due to difference of salt concentration between quantity of absorbed water and the external one) and consequent swelling.	Mineral salts contained in: water used to sand the primer; rinsing water; water absorbed by primer and not eliminated. It can also be caused by a hand print inadvertently left on the surface ready to be painted.	Repaint the affected layer.
FLATTING It shows as loss at brilliance and shine arising during application at one layer. If can affect a limited area, a specific component or the entire surface.	Primer not cured in deep; paint not correctly prepared, inadequate or incongruous catalyst.	Polish with abrasive paste and Polish; if the results are inadequate, sand and repaint.

(Cont.d)

DEFECTS OF APPLIED PRODUCT CAUSED BY AGING (EXPOSITION TO LIGHT, TO ATMOSPHERE AND CHEMICAL AGENTS)	TEST B

Defect	Cause	Remedy
HAIR CRACKINGS (Fissures-Reticulation) If shows as cracks, of dry film, that interlace in a more or less complex way. When they affect the final paint film, and are hardly visible,they are called **crazings**; when they affect the whole final layer ore more than one layers,they are called **checking crackings.** The **crazings** are present when the defect is limited to lacquer only. The **checking-cracking** affects all the protective coating; in severe cases they may reach body sheet metal.	Faulty curing of primer, showing a more remarkable withdrawal of the layer generating the superficial crackings.	Sand till a good layer is reached and repaint.

Following are presented schematic examples of checking-crackings.



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DEFECTS OF APPLIED PRODUCT CAUSED BY AGING (EXPOSITION TO LIGHT, TO ATMOSPHERE AND CHEMICAL AGENTS)	TEST B

Defect	Cause	Remedy
EXFOLIATION (Exfoliation-Flaking) It shows as separation of the film paint that did not stick to the support surface.	**Flaking**: it is caused by insufficient sanding or excessive curing of primer coat that generates vetrification of the paint film. **Exfoliation**: separation of the transparent paint from the metallic base might be caused by excessive time between application of base film and transparent film, or by excessive thickness of the transparent film.	Remove faulty film and repeat painting cycle.
CHALKING It shows as whitish pulverulent film on the surface.	Gradual degradation of the solvent with consequent release of pigment due to exposition to atmospheric agents and particularly to the action of the U.V. component of sun light.	Sand till a good layer and repaint.
COLOR CHANGE It shows as a light color change that may affect the tonality of one or more components, or the complete surface.	Products incorrectly prepared; touch-ups incorrectly done; aggressive action of atmospheric and/or chemical agents.	Sand and repaint.

(Cont.d)

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DEFECTS OF APPLIED PRODUCT CAUSED BY AGING (EXPOSITION TO LIGHT, TO ATMOSPHERE AND CHEMICAL AGENTS)	TEST B

Defect	Cause	Remedy
SPOTS DUE TO EXCESSIVE PEROXIDE CATALYST It shows as spots of different color in correspondence of plastered areas.	Use of excessive quantity of catalyst in the peroxide plastering.	Sand till the fault is eliminated and repaint.
BRONZING It shows as a bronze reflection on the film of some paints containing blue or red pigments.	Pigment oxidation.	Polish with abrasive paste and Polish.
SPOTS (Acid attack) It shows as spots of different color, more or less regular and of variable size and depth.	Atmospheric precipitations full of sulphuric acid depositing on vehicle flat surfaces. After water evaporation they may reduce to a solution with high concentration of sulphuric acid. The acid then attacks the paint; in the contact point with metallic paint, it may completely destroy the aluminum particles that give the metallizing effect to a paint.	Sand and repaint.
SPOTS (Attack by vegetable resins) This phenomenon affects horizontal surfaces of those vehicles parked often or for a long period under the trees.	Small resin drops cover the paint film; if hardened, they stick to the paint and they can be hardly removed with washing.	Wash with warm water, if spots persist repeat washing using technical octane diluted in water. If the paint surface is indented, polish with abrasive paste and Polish; if the operation shows no results, sand and repaint.

DEFECTS OF APPLIED PRODUCT CAUSED BY AGING (EXPOSITION TO LIGHT, TO ATMOSPHERE AND CHEMICAL AGENTS)	TEST B

Defect	Cause	Remedy
TAR SPOTS This phenomenon mainly affects the lower surface of vehicle, since it is the most exposed to tar sprays.	Driving on roads covered by fresh tar.	Clean the affected surface with a cloth imbedded with specific product.
CONCRETE SPOTS They show as small particles or rough concrete colored spots that stick more or less on the paint depending on the time they are left there.	Stopping near a concrete factory, where working dusts may deposit on the vehicle horizontal areas, which may harden in presence of moisture; exposition to water that licked cement wares (bridges, viaducts, etc.).	Wash vehicle using one of the following water solutions: - 50% of vinegar - 4% of acetic acid - 10% of oxalic acid Sand and repaint if washing is not sufficient.
SPOTS OF BIRDS EXCREMENTS They are known by anybody and undoubtly identified.	The excrements are of acid nature: they attack the car body when left in contact for long time.	Generally a strong polishing should be enough; if insufficient, sand and repaint.

End of test B

Brakes

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GROUP 22

BRAKES

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GROUP 22

BRAKES

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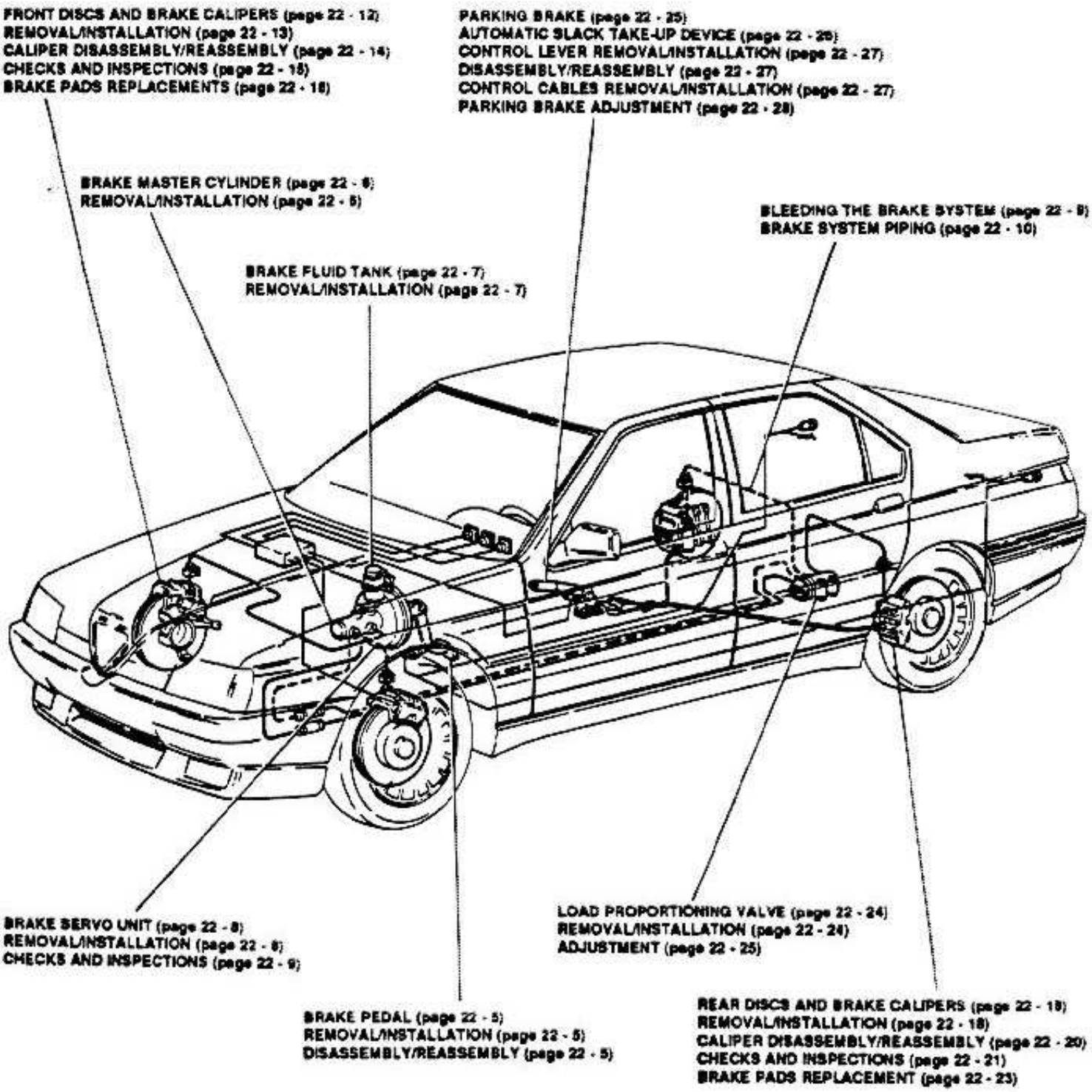
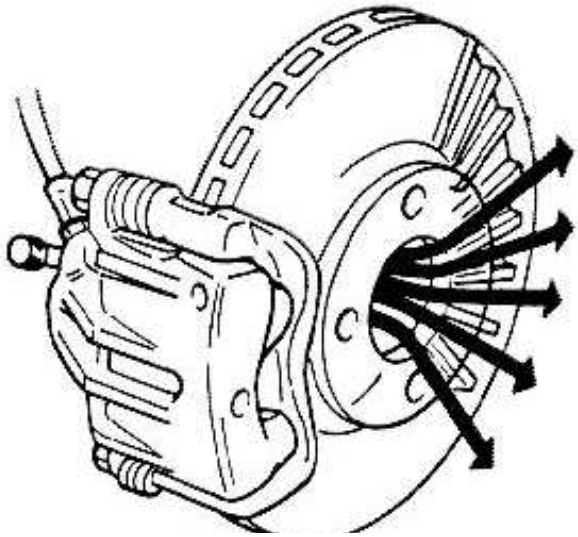


BRAKES

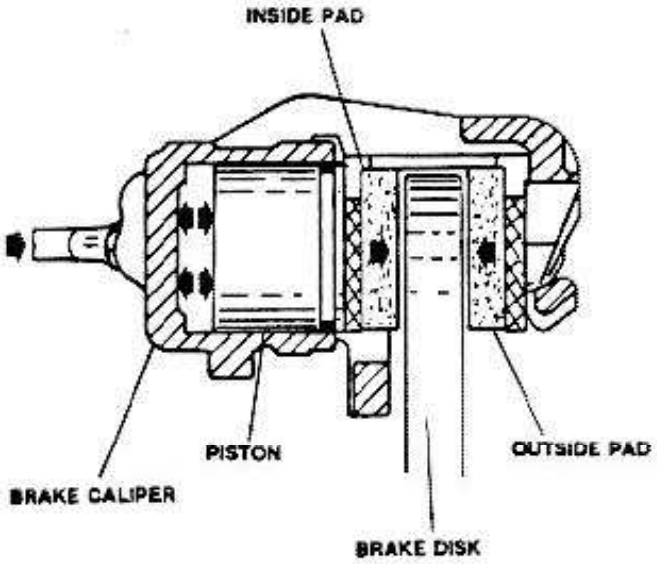
DESCRIPTION

The braking system of the Alfa Romeo 164 model, due to its technical configuration and sizing of its components, is fully adequate to the high performances of the vehicle.
The system is of the dual hydraulic circuit type, diagonally connected, and includes four disc brakes.
The system is provided with a vacuum servo unit that allows the driver to brake without applying high pressure on the brake pedal.
A load proportioning valve acts on the rear brakes as a function of braking load.
The parking brake, actuated by a manual control lever and mechanical linkage, acts on the rear brakes.
The use of a dual-stage brake master cylinder and of the two crossed circuits will assure the 50% of braking power is still available in case of seizing of one piston of the brake master cylinder, or in case of failure of one system.
The brake calipers are of the floating type (with guides protected against possible soiling), in other words the piston acts on one side only of the brake disc; this solution, as well as the use of suitably sized discs and self-ventilating discs on the front brakes, allows a better dissipation of heat produced during braking and a lower temperature of the brake fluid with respect to other conventional solutions.

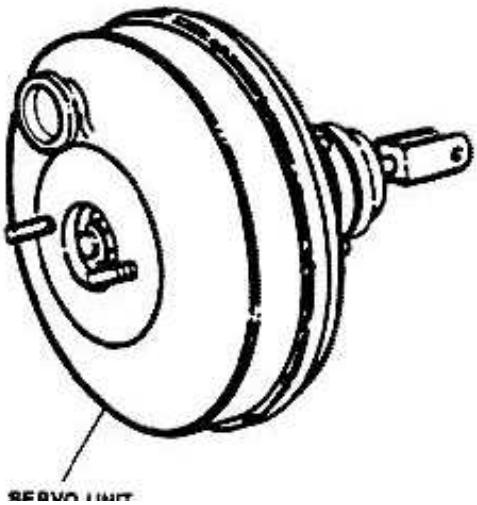


OPERATIONAL DESCRIPTION

Pressure on the brake pedal pressurizes the hydraulic circuit that acts directly on the piston located inside the brake caliper.
The piston pushes the inner brake pad against the disc, while the disc slides on drive pins and moves against the outer brake pad.



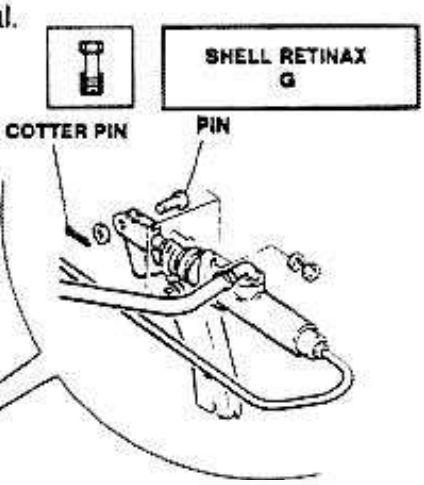
The efficiency of the braking action is implemented by a servo unit that contributes to optimize and amplify the pressure applied by the driver on the brake pedal.
Pressure for the servo unit is obtained by the differential pressure between vacuum in the engine intake manifold and the atmospheric pressure.

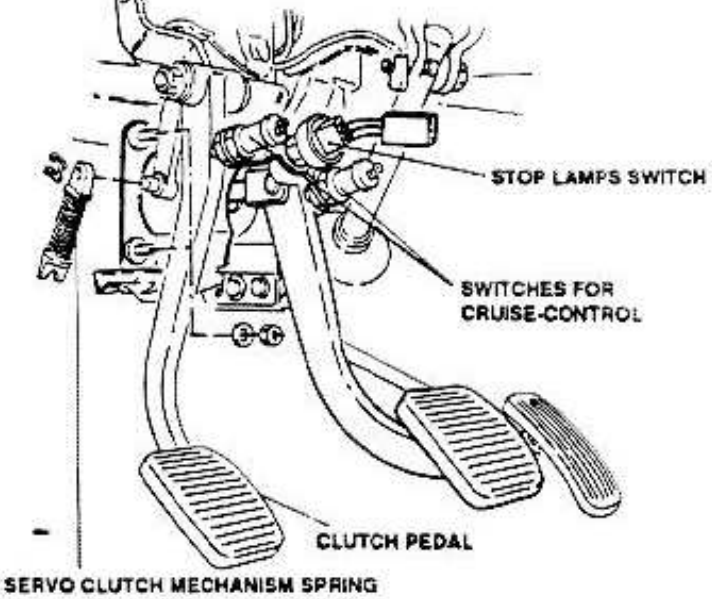


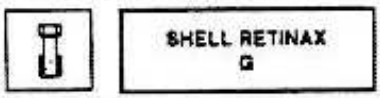
BRAKE PEDAL

REMOVAL/INSTALLATION

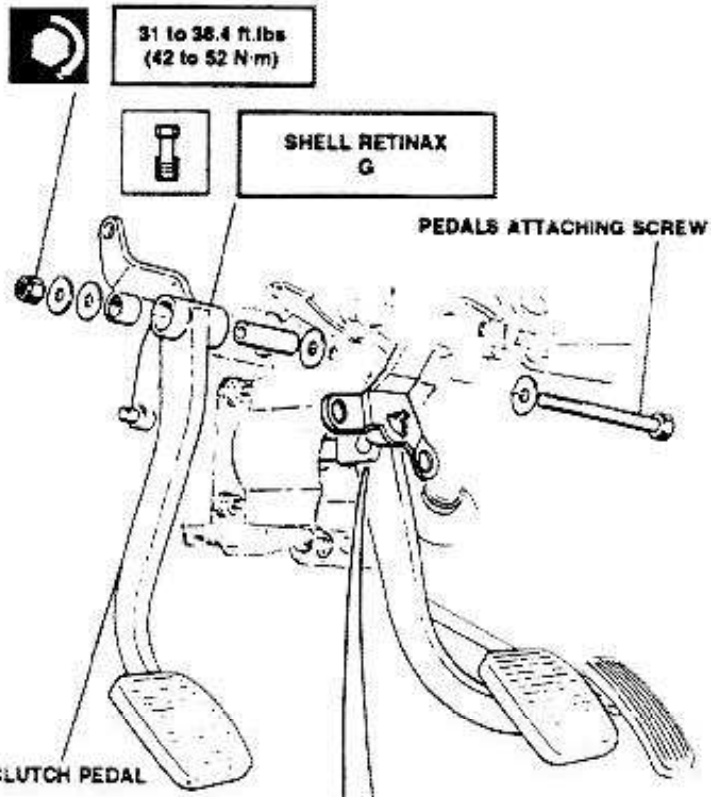
1. Remove the steering column lower shroud.
2. Remove the stop lamps switch and the 2 switches for cruise-control.
3. Remove the servo clutch mechanism spring.
4. Remove the cotter pin and remove pin attaching the pump-clutch pedal.

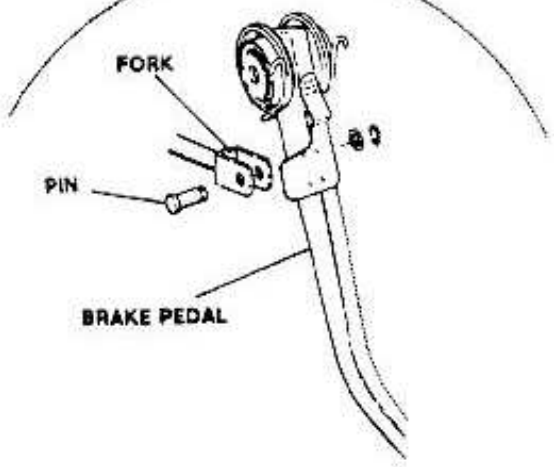






5. Remove nut and screw attaching the pedal group to its support.
6. Remove clutch pedal.
7. Withdraw pin connecting brake master cylinder control fork.
8. Unfasten spring from support and remove brake pedal.

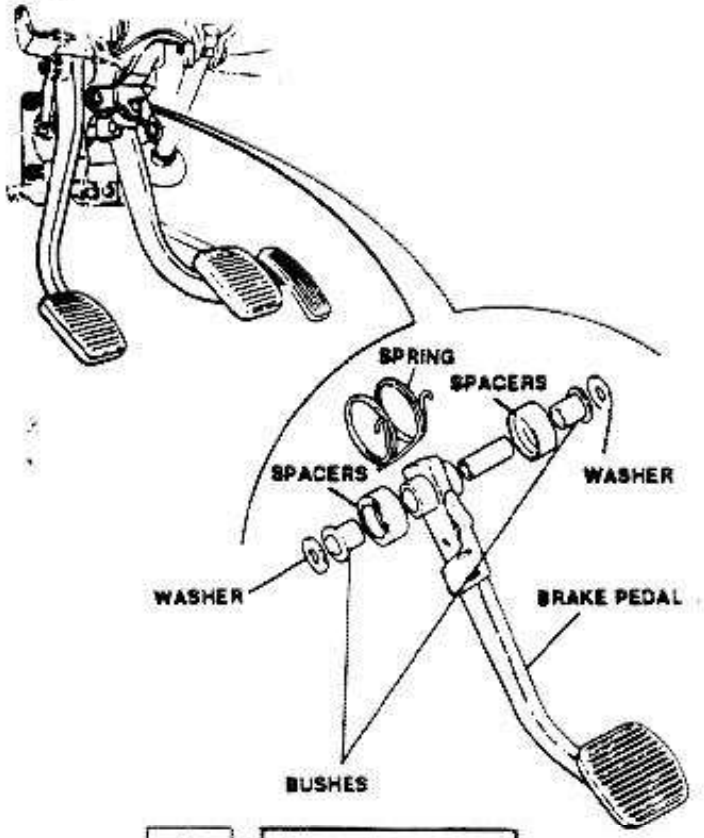




DISASSEMBLY/REASSEMBLY

1. Remove washers, bushes, spacers, spring and brake pedal.

Lubricate affected parts with grease prior to definitive reassembly.



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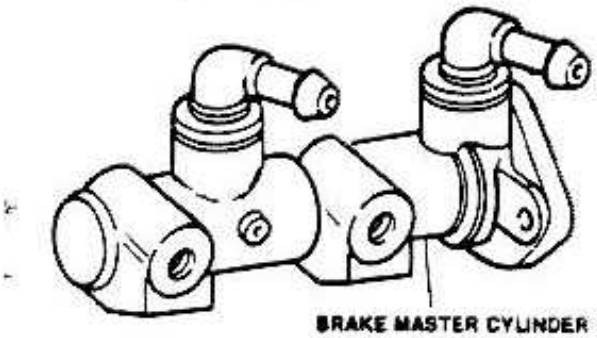
BRAKE MASTER CYLINDER

The dual-stage brake master cylinder, bolted onto the brake servo unit, is composed mainly by a steel cylinder which contains a piston.
The brake master cylinder is connected by rigid pipes to the brake calipers and to the brake fluid tank; it assures operation of one circuit in case of failure in the system.
Overhaul of brake master cylinder can not be performed replace master cylinder in case of failure.



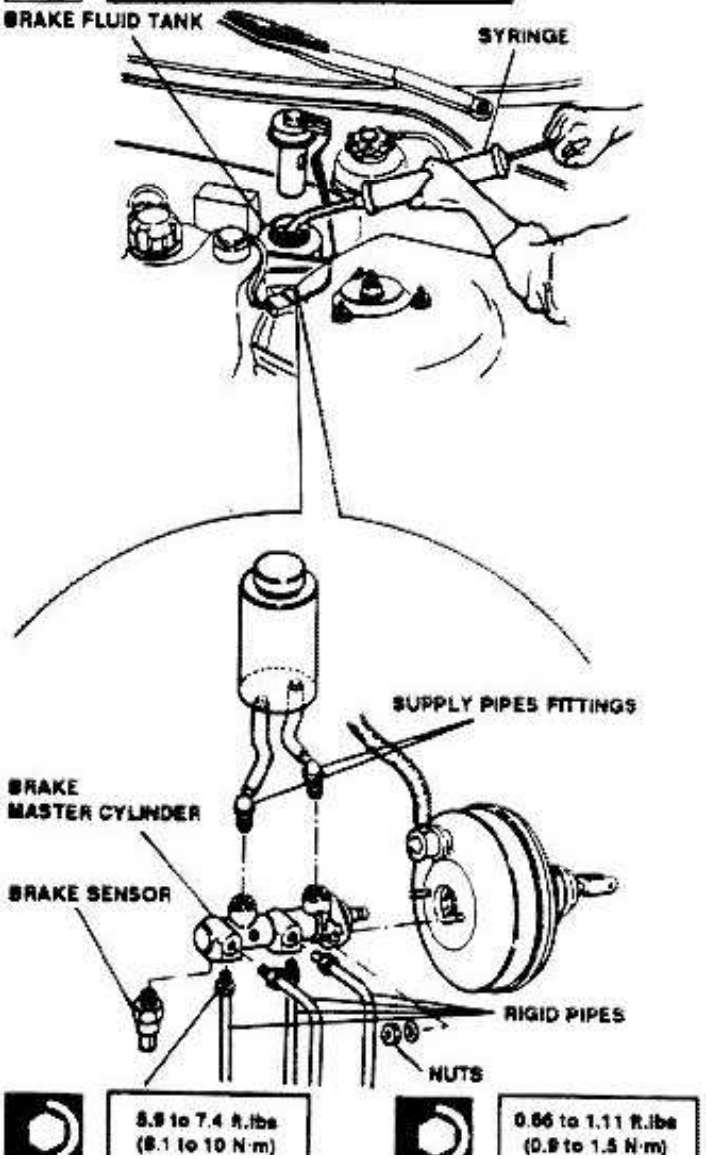
REMOVAL/INSTALLATION

1. Drain brake fluid tank by sucking out fluid with a syringe; remove tank.
2. Disconnect fittings of brake master cylinder supply pipes.
3. Disconnect fittings of brake master cylinder delivery rigid pipes.
4. Remove attaching nuts, and remove brake master cylinder.

After brake master cylinder installation, bleed trapped air from brake system.

5. On "S" versions only: remove brake sensor from brake master cylinder.

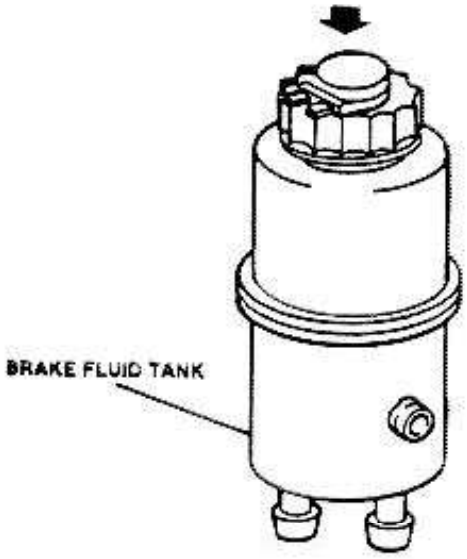
Alfa Romeo BRAKE FLUID super DOT 4
AGIP BRAKE FLUID DOT 4



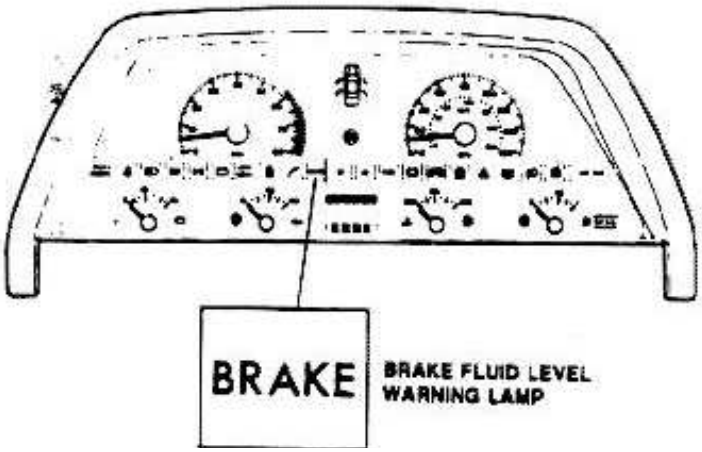
1. Drain brake fluid tank by sucking out fluid with a

BRAKE FLUID TANK

The brake fluid tank supplies hydraulic fluid to the brake system and to the clutch actuating system.
The tank consists of two separate and independent chambers that assure constant presence of fluid even in the event of failure of the system.



The tank, located above the brake master cylinder, includes a device on the cap that turns on a warning lamp on the instrument panel in case the level of the brake fluid decreases to an unsafe level. This device is located inside a damping cylinder to prevent generation of abnormal signals during driving (turns or bounces).
Total capacity of the system is of 0.6 liters (0.15 Gals); on vehicles equipped with Anti Lock Brake System (ABS) the capacity is of 0.8 liters (0.21 Gals).



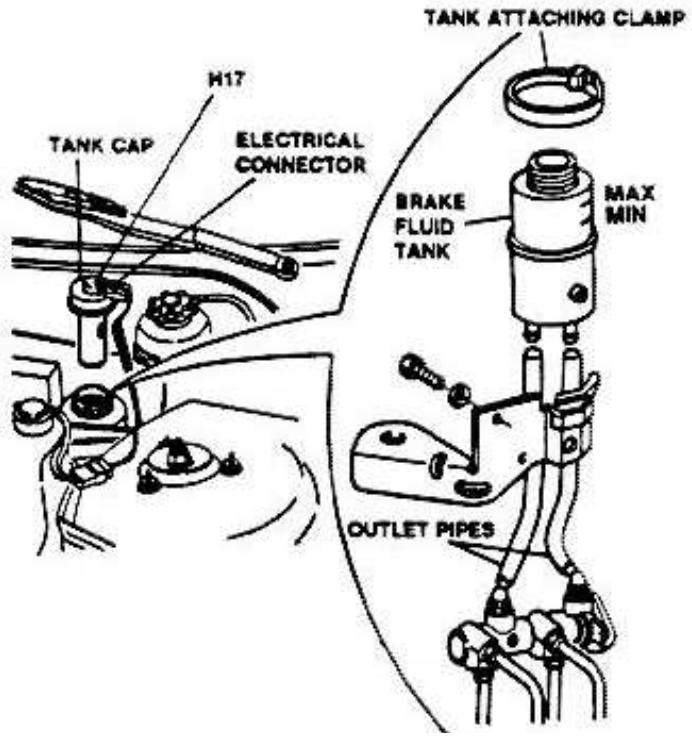
REMOVAL/INSTALLATION

1. Disconnect electrical connector and remove cap from tank.
2. Drain brake fluid tank by sucking fluid with a syringe.

CAUTION:
The brake/clutch fluid is harmful for the body work. Pay extreme care to prevent fluid from contacting painted surfaces and subsequent damage.

CAUTION:
The brake fluid is hygroscopic, and then it easily absorbs water when exposed to umid environment.
Always use for top-up fluid contained in sealed cans, opened only just before use.

3. Remove attaching clamp and tank after outlet pipes have been disconnected from lower side of tank.



NOTE: Any time a component of the system is removed, bleed air from the system.

NOTE: Periodically check the operation of the fluid low level sensor pressing on top of tank cap (in the direction shown in the illustration); with the ignition key rotated to the first position, the brake fluid level warning lamp on instrument panel will simultaneously illuminate.

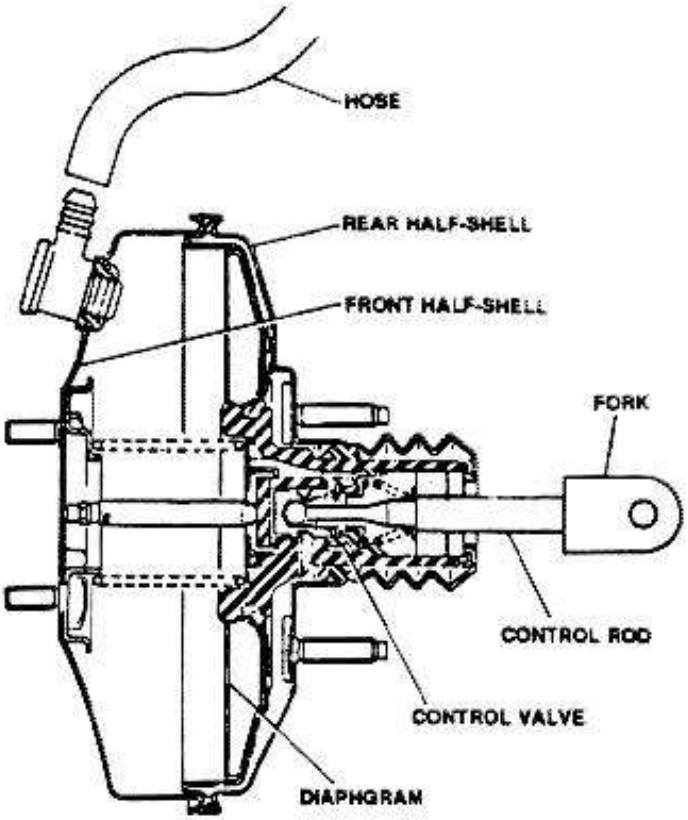
4. Carry-out installation of tank by reversing the order of removalprocedure.

NOTE: Check brake fluid level with the vehicle standing on a flat and level surface.

BRAKE SERVO UNIT

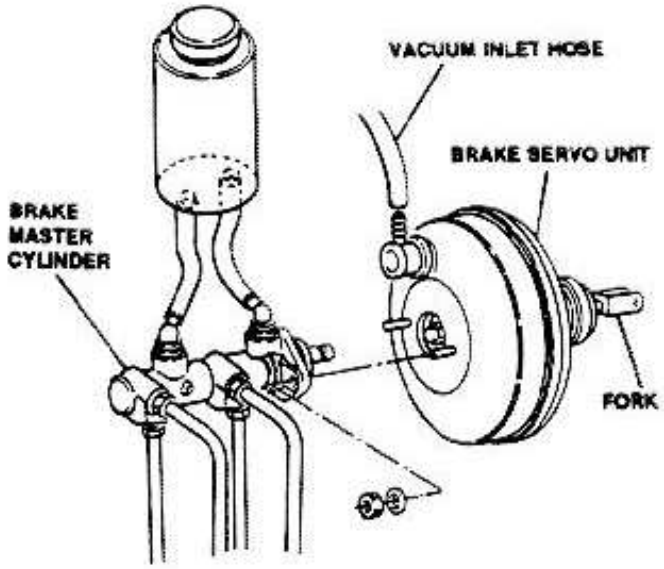
The vacuum brake servo unit includes a unidirectional valve connected by a hose to the engine intake manifold.
This valve allows passage of ambient air from the servo unit to the manifolds, and not in reverse direction, thus permitting to maintain always the maximum vacuum inside the servo unit when not in use.
The servo unit consists essentially of two-shells, a diaphragm that separates two chambers, a control rod directly connected to the brake pedal, and a control valve.
Overhaul of the servo unit can not be performed: replace the unit in case of failure.

WARNING:
In the event of a collision or maintenance of the body, check integrity of the servo unit since even a minor surface dent of the outer body could prevent normal operation of the braking system, thus demanding as a consequence a higher pressure on brake pedal.



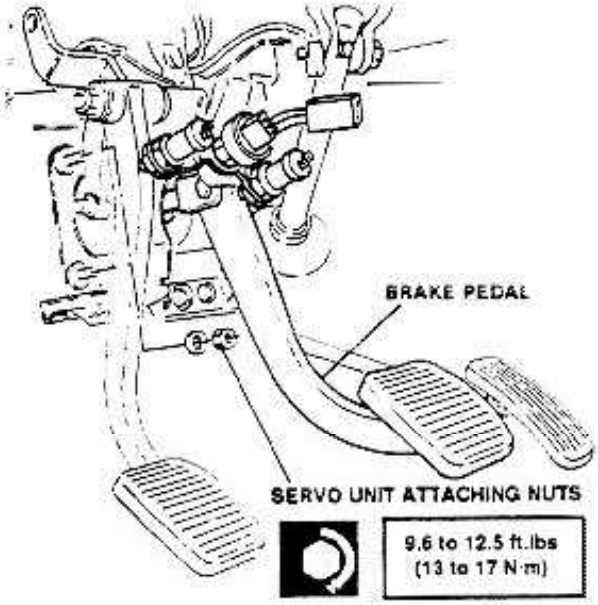
REMOVAL/INSTALLATION

1. Disconnect vacuum inlet hose from servo unit (engine compartment).
2. Remove brake master cylinder.



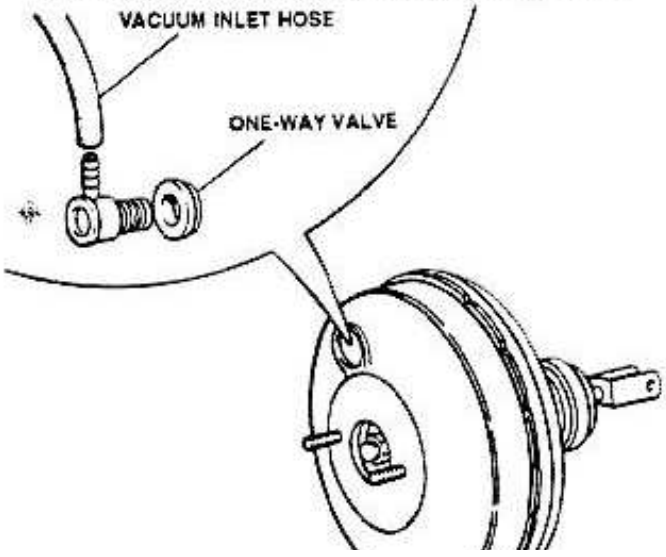
3. Disconnect brake pedal from brake master cylinder control fork (from vehicle interior).
4. Remove nuts attaching the servo unit to pedals group support (from vehicle interior), then remove the servo unit from engine compartment.

After installation, bleed the brake system.

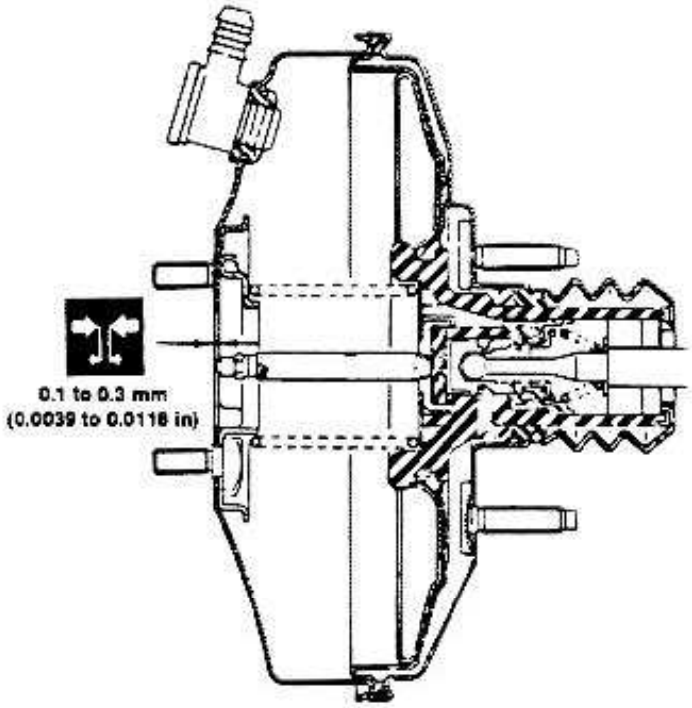


CHECKS AND INSPECTIONS

1. Check proper operation of brake servo unit. In case of abnormal operation, check integrity of vacuum inlet hose and operation of the one-way valve.



2. Check servo unit for proper adjustment. When unit is not in use, the end of adjustment screw must be 0.1 to 0.3 mm (0.0039 to 0.0118 in) lower than plane of the front cover.

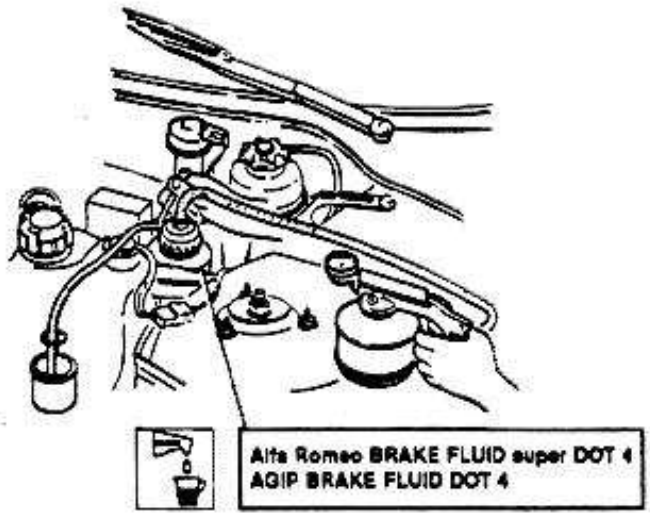


BLEEDING THE BRAKE SYSTEM

CAUTION:
- **During bleeding operations check that fluid level does not decrease below minimum level.**
- **Do not re-use fluid drained during bleeding operations.**
- **Prevent contact of fluid with painted surfaces to avoid damaging of paintwork.**
- **Bleeding operations must be carried-out simultaneously on front and rear brake calipers of the same side of vehicle, than perform bleeding on calipers of opposite side.**

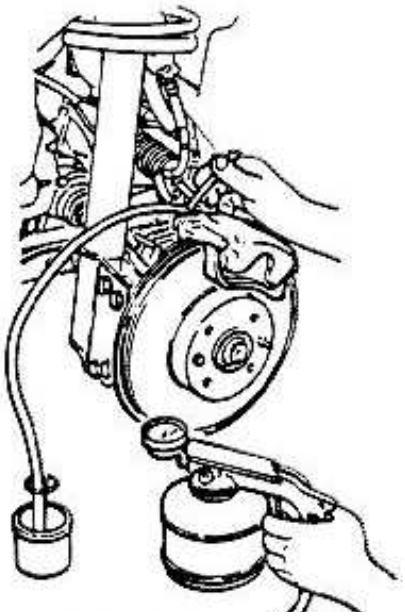
As an alternative to the traditional method, the "pre stop"

tool can be used as indicated below:



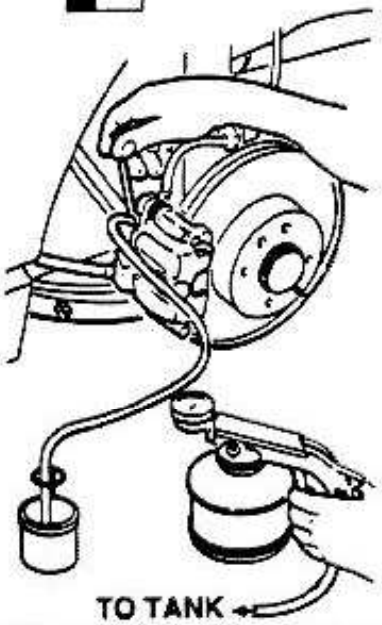
1. Place vehicle on auto lift.
2. If necessary, fill up the brake fluid tank with prescribed fluid.
3. Lift vehicle and remove dust plugs from bleed screw on brake calipers.
4. Fit a section of hose onto the bleed screws and immerse hose end in a container full of prescribed brake fluid.

FRONT BRAKES



5. Loosen bleed screws and press repeatedly the brake pedal, making sure the pedal is returned to initial position after each application and an interval of a few seconds is observed between subsequent brake pedal pressures. Repeat the process until brake fluid flowing into the container is free of air bubbles, then press the brake pedal completely and tighten bleed screws.

REAR BRAKES



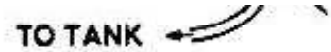
6. Remove the hose sections, re-install the dust plugs and top-up brake fluid in tank, if required.
7. If bleeding of the system has been carried-out properly, the pedal response will be free on any spongy reaction after an initial idle travel.

CAUTION:
For bleeding of rear brakes it is necessary to compress the rear suspension so that the load proportioning valve is actuated.

BRAKE SYSTEM PIPING

CHECKS AND INSPECTIONS

Check piping of the brake system (rigid pipes and hoses) for absence of distortions, cracks and evidence of exterior



oxidation.

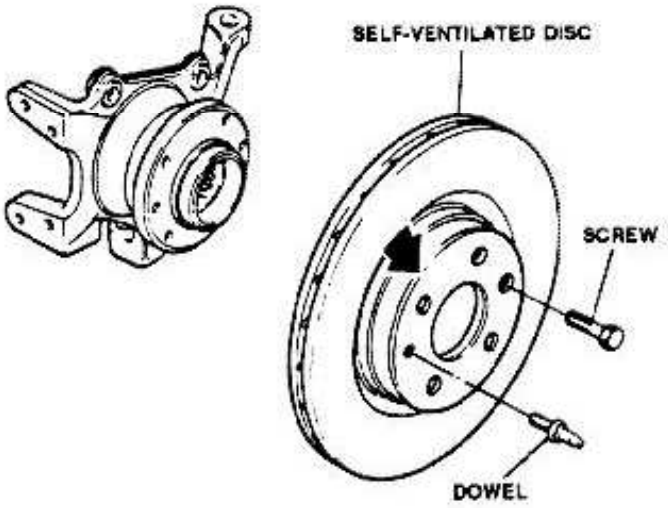
CAUTION:
- In the event of removal and installation of brake piping, suck fluid from brake and clutch fluid tank using a syringe.
- Any time pipes or hoses an removed, plug ends to prevent entry of foreign matter.
- After re-installation, make sure the front and rear hoses are not twisted.
- When installation is completed top-up fluid in tank and bleed the system (refer to paragraph "BLEEDING THE BRAKE SYSTEM").

CAUTION:
The rigid pipes are fragile and must not be twisted or bent.

FRONT BRAKES

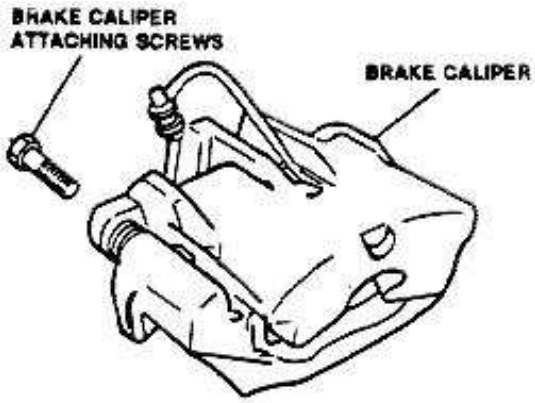
FRONT BRAKE DISCS

The front brake discs are of the self-ventilating type to provide improved dissipation of heat.
The discs have a diameter of 284 mm (11.18 in) and a thickness of 22 mm (0.87 in).
The discs are fixed in position on the hub flange by two screws (one of the two screws also acts as dowel for centering of the wheel rim) and are attached to the hub flange by means of the wheel attaching screws.
The outer edge of discs is engraved with a minimum allowable wear limit mark as shown by the arrow in the illustration.
The wear limit is 20.2 mm (0.795 in).

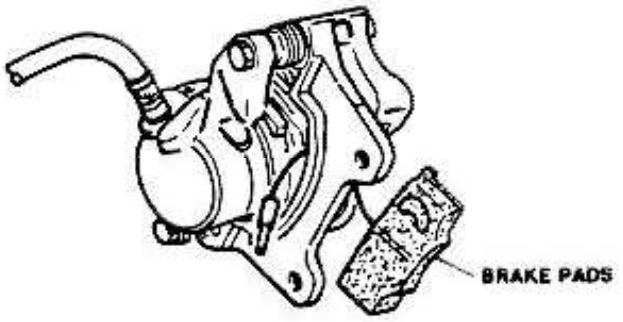


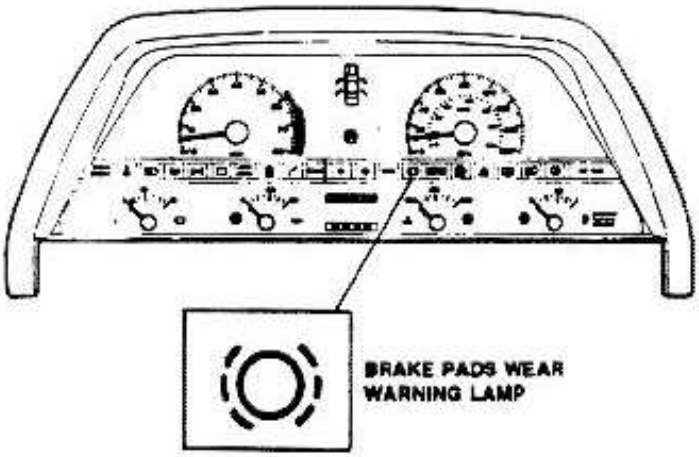
FRONT BRAKE CALIPERS

The front brake calipers are of the single-cylinder floating type (GIRLING).
The caliper includes two brake pads, with gaskets made of anti-pollution material (free of asbestos) with a total braking surface of 50 cm^2 (7.75 sq.in). The inner diameter of the cylinder is of 54 mm (2.12 in).
The caliper body attaching screws are of self-locking type, and must be replaced any time they are loosened or removed.
Overhaul of brake calipers can not be performed: operations allowed on brake calipers are limited to replacement



The inner brake pad (in contact with caliper cylinder) includes a wear sensor that provides an input signal for the illumination of a warning lamp on instrument panel when the pad wear limit is exceeded.

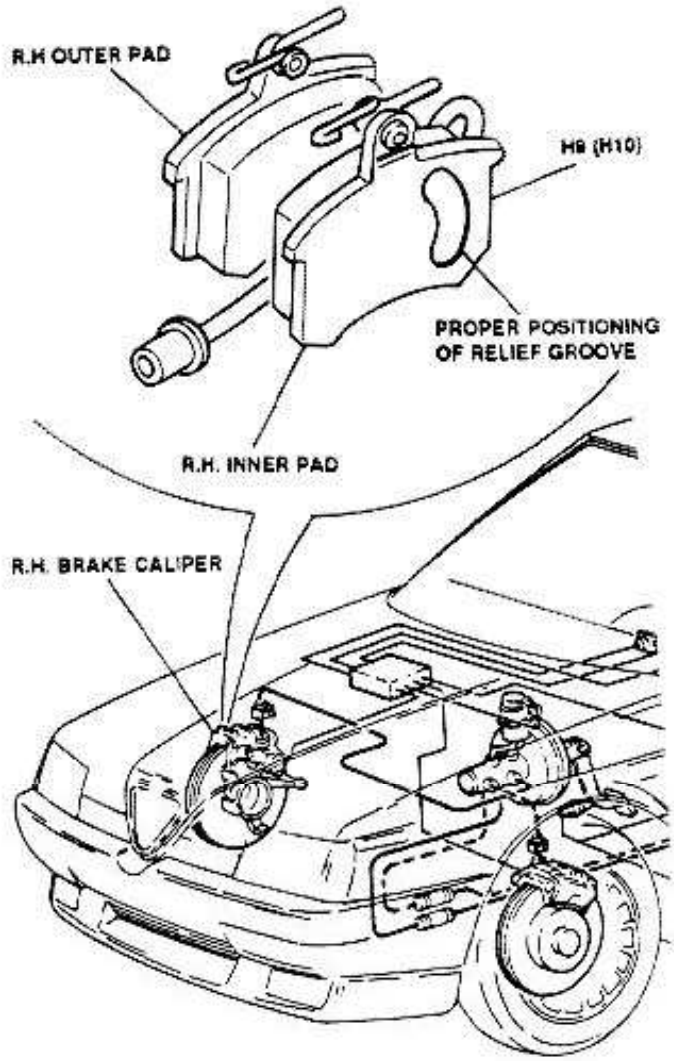


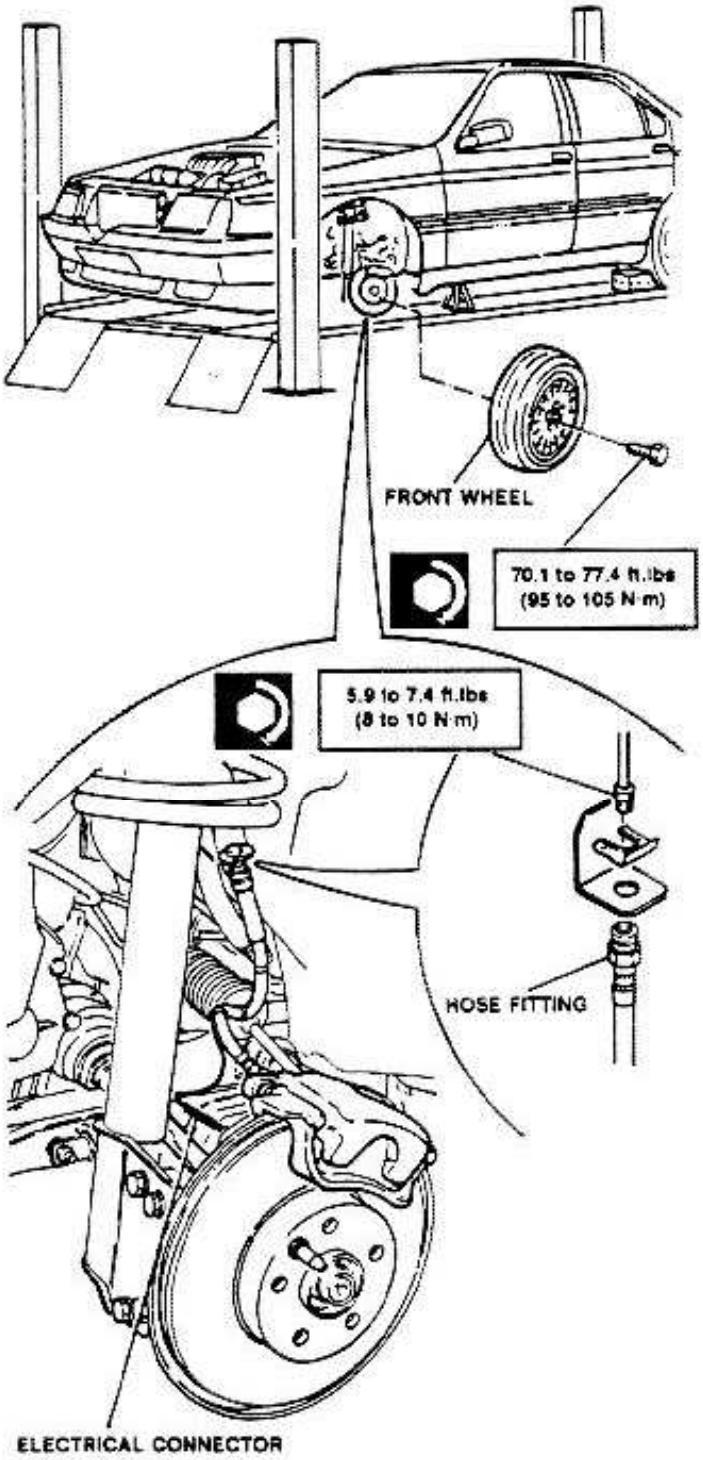


NOTE: **At reassembly, install brake pad provided with wear sensor on inner side of disc (on piston side of brake caliper).**
Furthermore, position inner brake pad with relief groove faced towards the rear end of vehicle; no mounting direction is required

of inner seal ring and of dust bellow.

for the outer brake pad.





REMOVAL/INSTALLATION

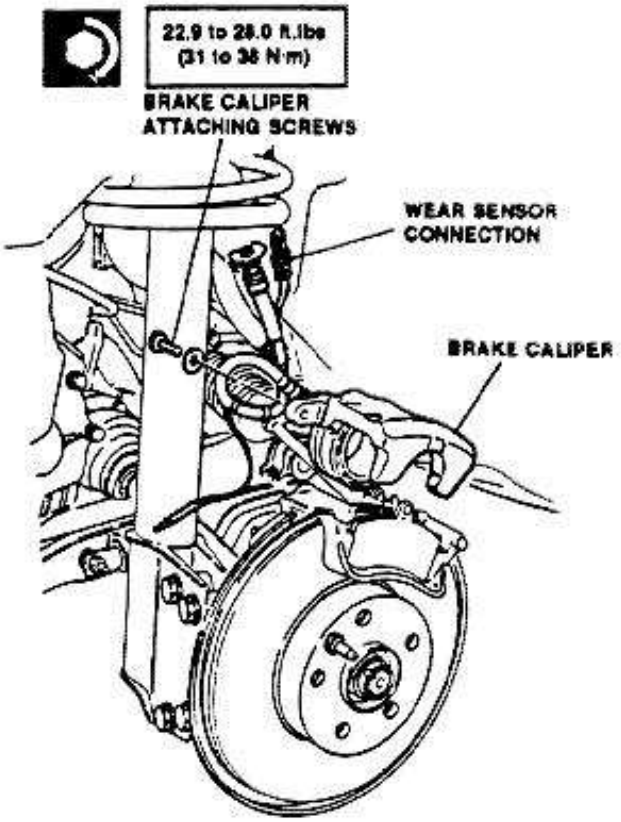
1. Remove front wheel.
2. Disconnect fitting and hose from valance

Bleed the brake system after installation.

4. Disconnect electrical connector from brake pad wear sensor.
5. Remove attaching screw and remove brake caliper.

At installation, replace brake caliper body at-

3. Disconnect electrical connection from brake pad  taching screws.



6. Remove brake pads.

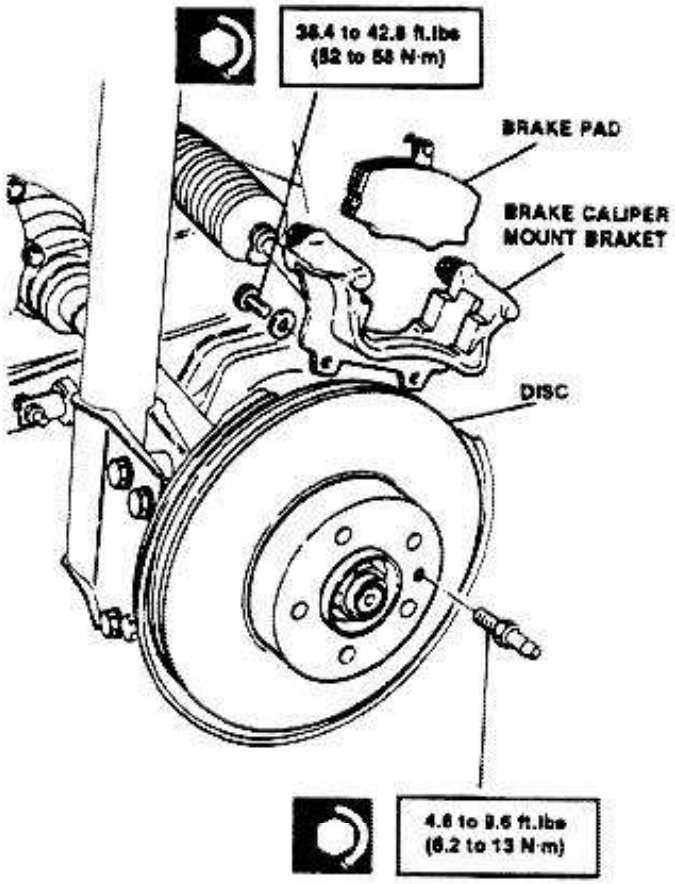
NOTE: For re-installation, refer to paragraph "BRAKE PADS REPLACEMENT".

7. Remove brake caliper mount bracket.

At installation, check for integrity of dust bellows; replace bellows if damaged.

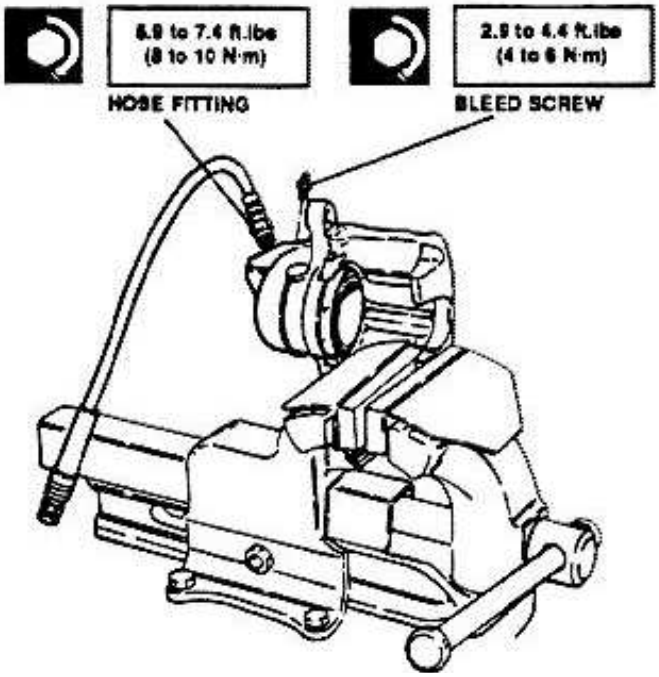
8. Remove brake disc.

At installation, remove any trace of rust to assure perfect disc to hub perpendicularity.



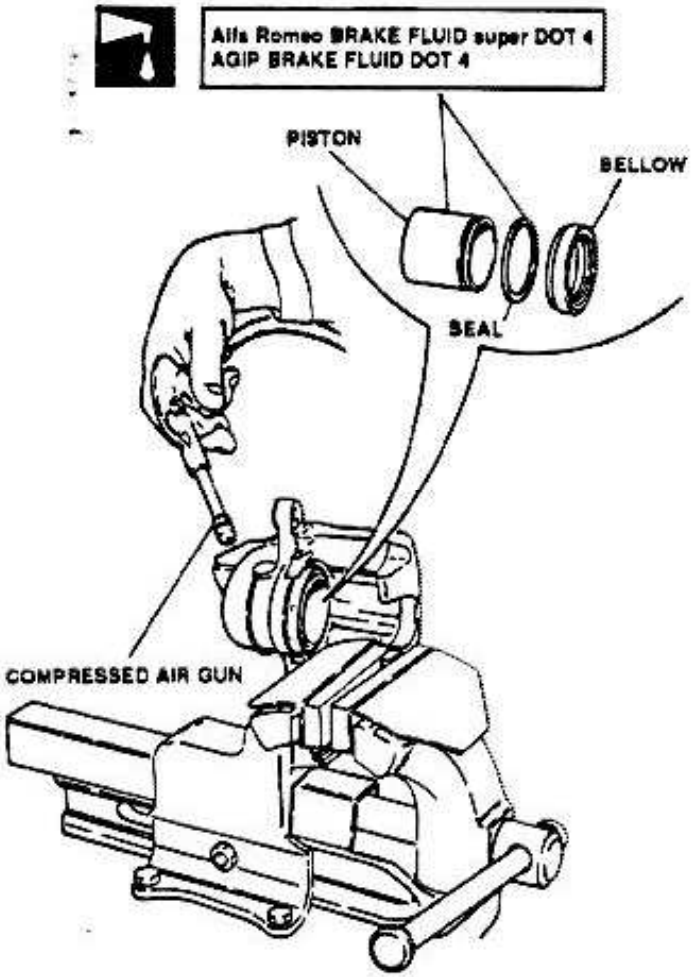
DISASSEMBLY/REASSEMBLY

1. Disconnect hose fitting from brake caliper.
2. Removal bleed screw.



3. Blow compressed air into inlet port to press out caliper cylinder.
4. Remove piston, seal and bellow.

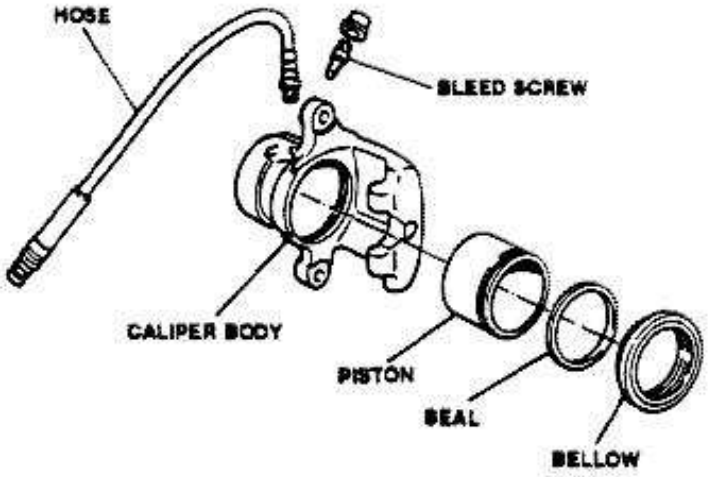
At reassembly, lubricate parts with brake fluid.



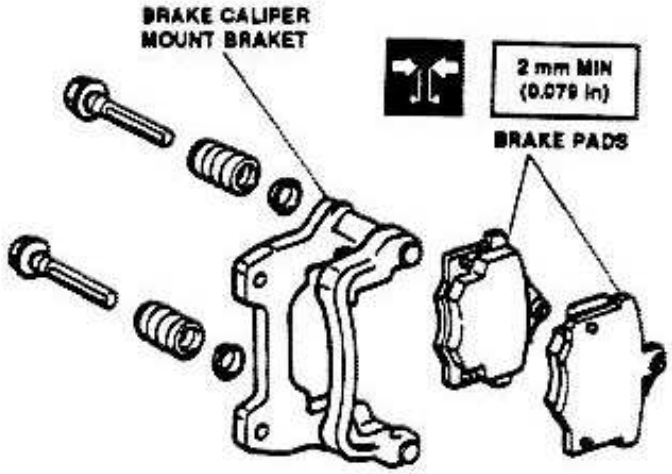
CHECKS AND INSPECTIONS

Brake caliper and pads

1. Check brake caliper body and piston for absence of abrasions and seizing: replace caliper complete of piston if damages are found.
2. Make sure the bleed screw is unobstructed.
3. Check hose for absence of swelling and cracks.



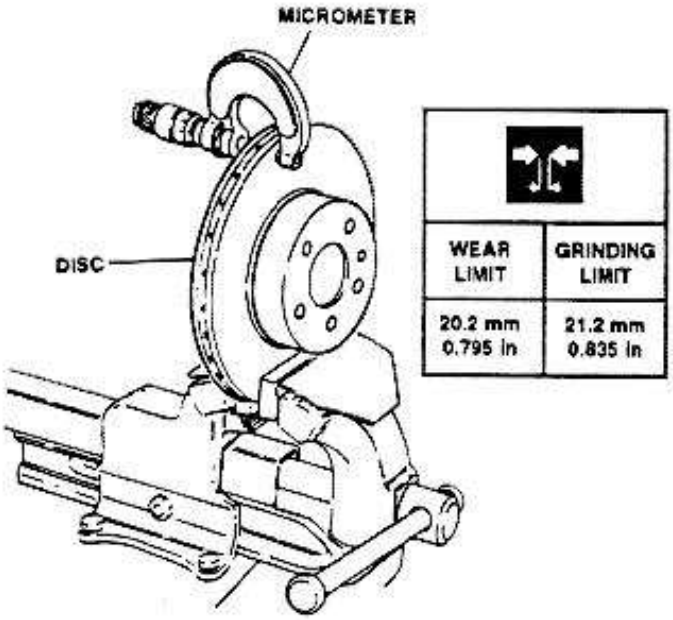
4. Replace brake pads if thickness is lower than 2 mm (0,079 in).
5. Check caliper mount bracket for absence of cracks or distortions.



CHECKS AND INSPECTIONS

Brake disc

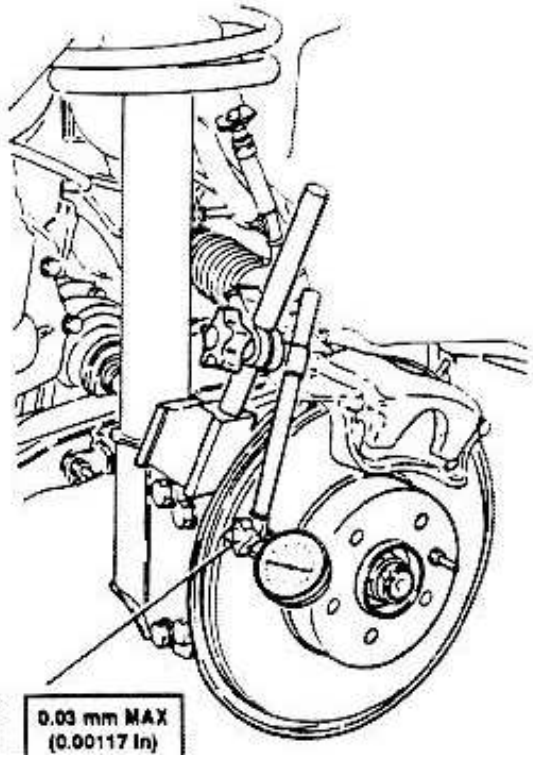
1. Check disc thickness using a micrometer, and inspect the work surfaces for absence of deep scoring or porosit. Grind the disc within specified limits, if necessary.



WEAR LIMIT	GRINDING LIMIT
20.2 mm 0.795 in	21.2 mm 0.835 in

2. If only the brake pads are replaced, check disc misalignment with respect to rotation axis does not exceed 0.15 mm (0.0059 in).

NOTE: Measure misalignment 2 mm (0.078 in) at disc outer diameter.



0.03 mm MAX (0.00117 in)

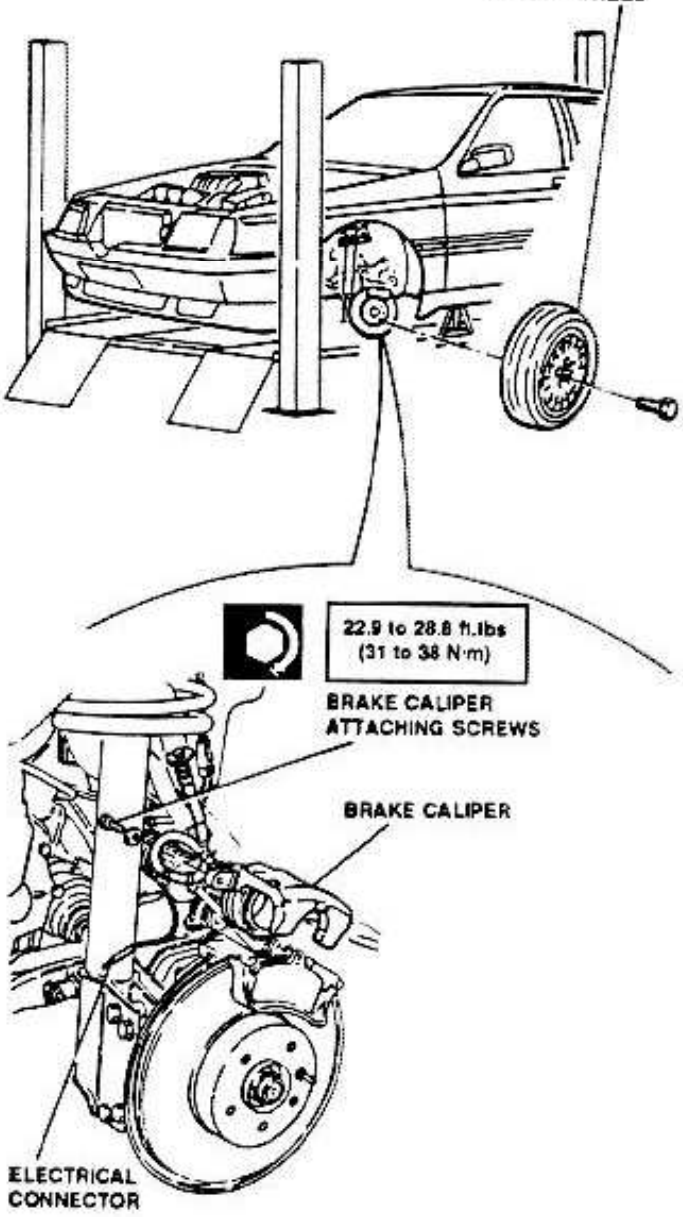
BRAKE PADS REPLACEMENT

1. Remove front wheel.
2. Disconnect electrical connector from brake pad .
3. Remove securing screws and brake caliper.

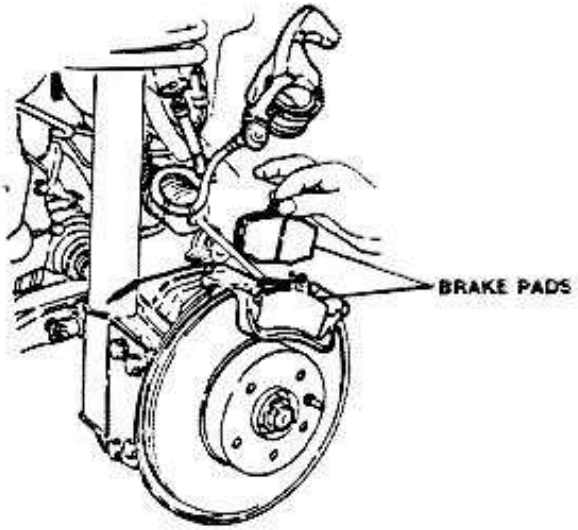
At installation, replace screws securing caliper body.

70.1 to 77.4 ft.lbs (95 to 105 N·m)

FRONT WHEEL



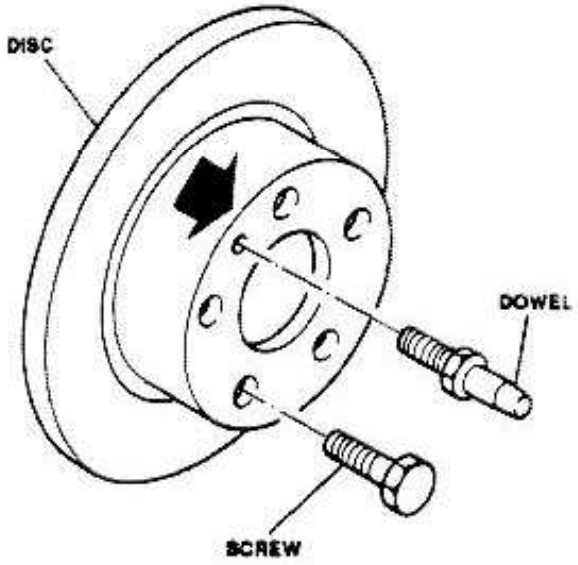
4. Press manually on caliper piston until fully in.
5. Replace brake pads.



REAR BRAKES

REAR BRAKE DISCS

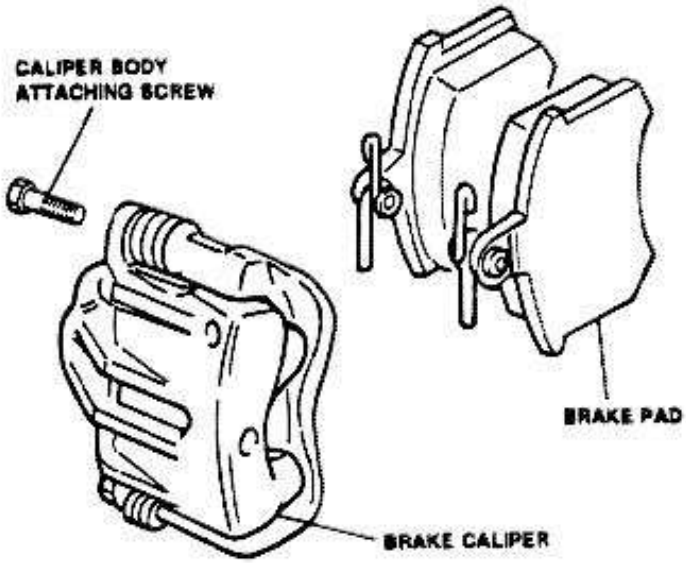
The rear brake discs have a diameter of 251 mm (9.88 in) and a thickness of 10 mm (0.39 in).
The discs are fixed in position on the hub flange by two screws (one of the two screws also acts as dowel for centering of the wheel rim) and are attached to the hub flange by means of the wheel attaching screws.
The outer edge of discs is engraved with a minimum allowable wear limit mark as shown by the arrow in the illustration.
The wear limit is 9 mm (0.35 in).



REAR BRAKE CALIPERS

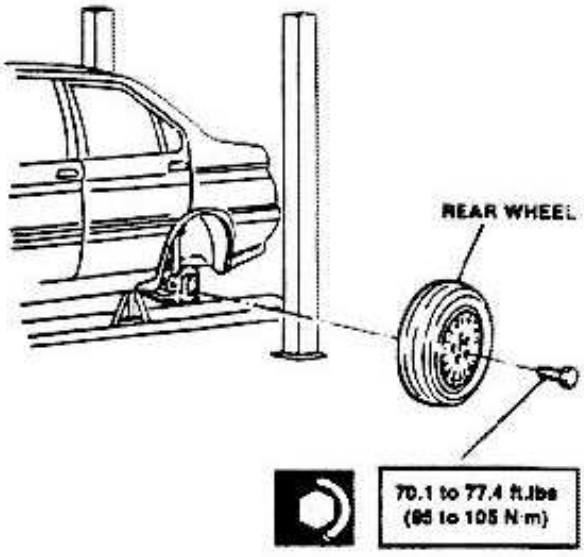
The rear brake calipers are of the GIRLING single-cylinder floating type, with automatic slack take-up of the parking brake.
The caliper includes a cylinder with a diameter of 36 mm (1.42 in) and two brake pads, with gaskets made of anti-pollution material (free of asbestos) with a total braking surface of 30 cm² (4.65 sq.in).
The caliper body attaching screws are of self-locking type, and must be replaced any time they are loosened or

Overhaul of brake calipers can not be performed: operations allowed on brake calipers are limited to replacement of inner seal ring and of dust bellow.



REMOVAL/INSTALLATION

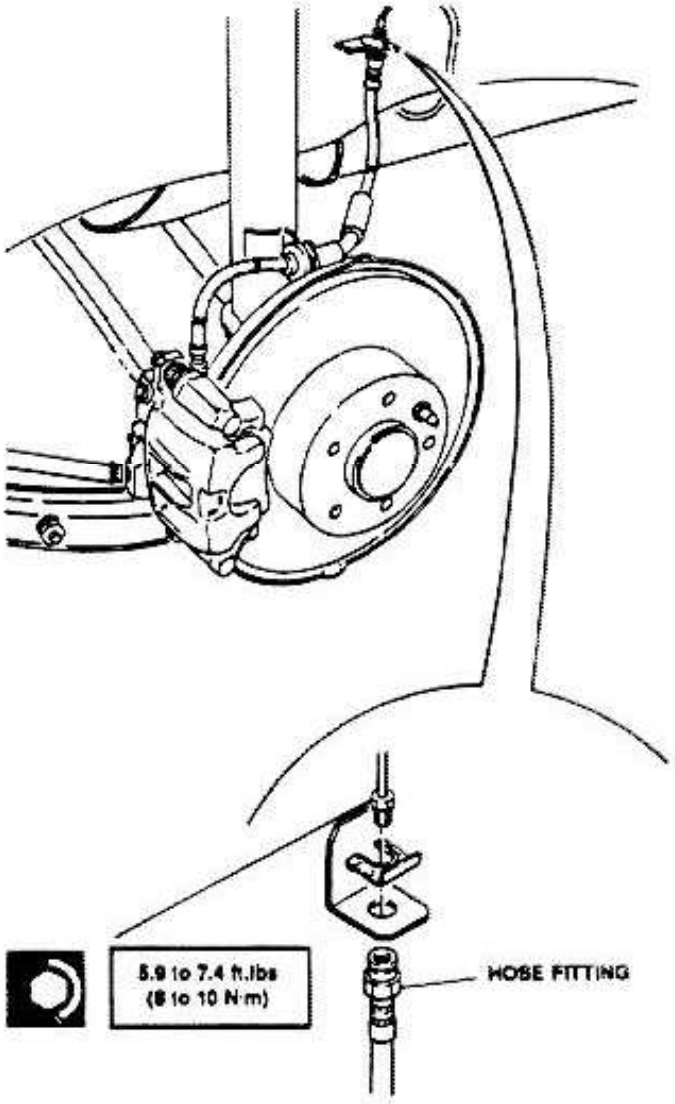
1. Remove rear wheel.



removed.

2. Disconnect fitting and hose.

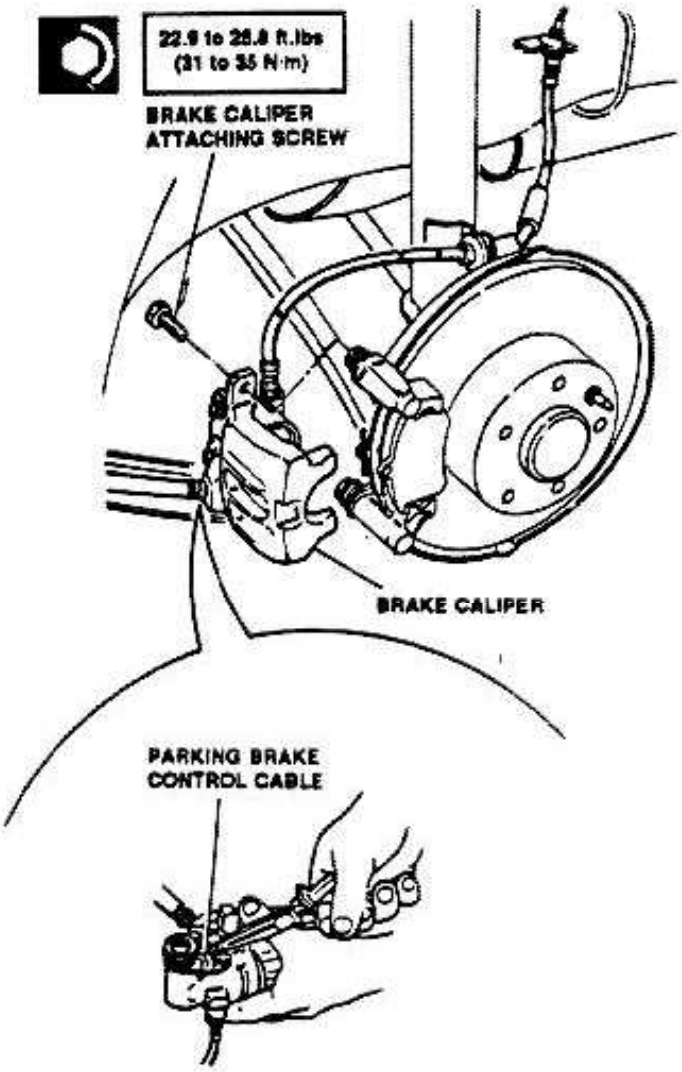
Bleed the brake system after installation.



3. Remove attaching screw and remove brake caliper.

At installation, replace brake caliper body at-

4. Disconnect parking brake control cable from brake caliper.



5. Remove brake pads.

NOTE: No mounting direction is required for rear brake pads.

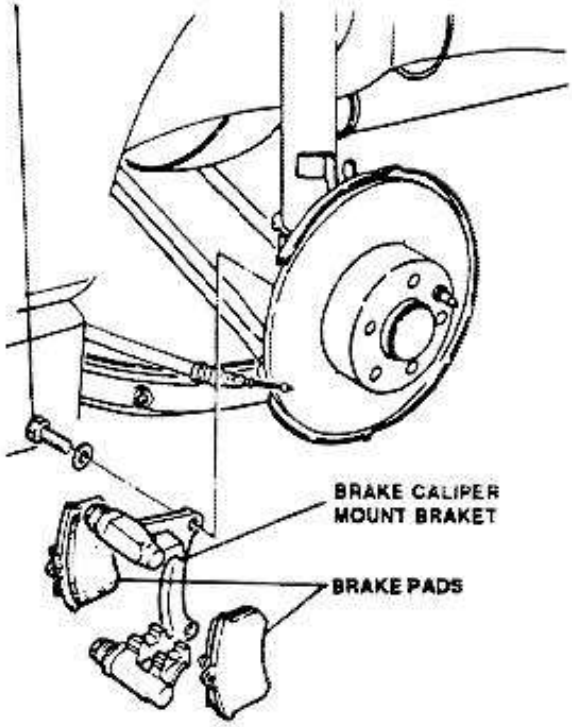
6. Remove brake caliper mount bracket.

At installation, check for integrity of dust bel-

taching screws.

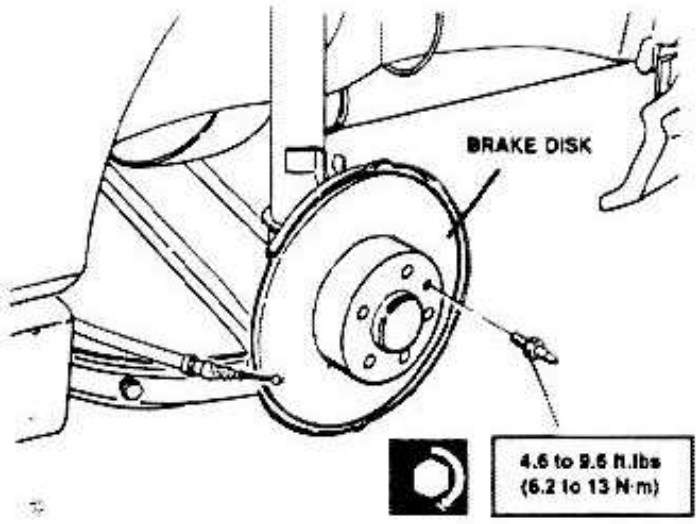
lows; replace bellows if damaged.

32.7 to 36.1 ft.lbs (44.3 to 49 N·m)



7. Remove brake disc.

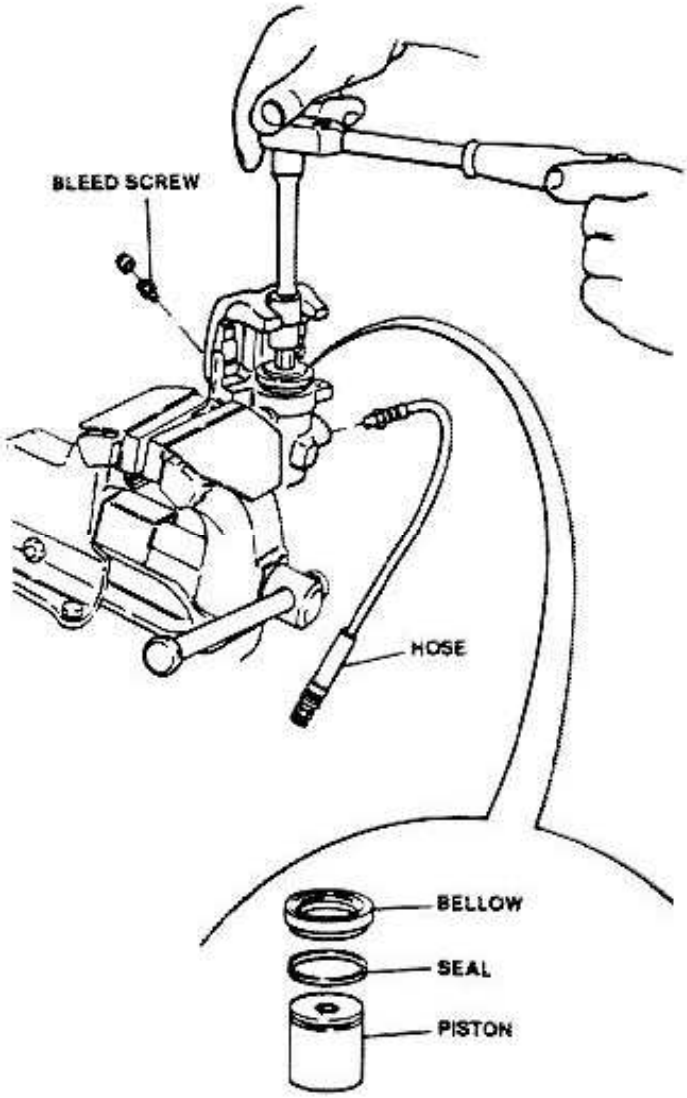
At installation, remove any trace of rust to assure perfect disc to hub perpendicularity.



4.6 to 9.6 ft.lbs (6.2 to 13 N·m)

DISASSEMBLY

1. Disconnect hose fitting from brake caliper.
2. Removal bleed screw.
3. Remove piston, seal and bellow.

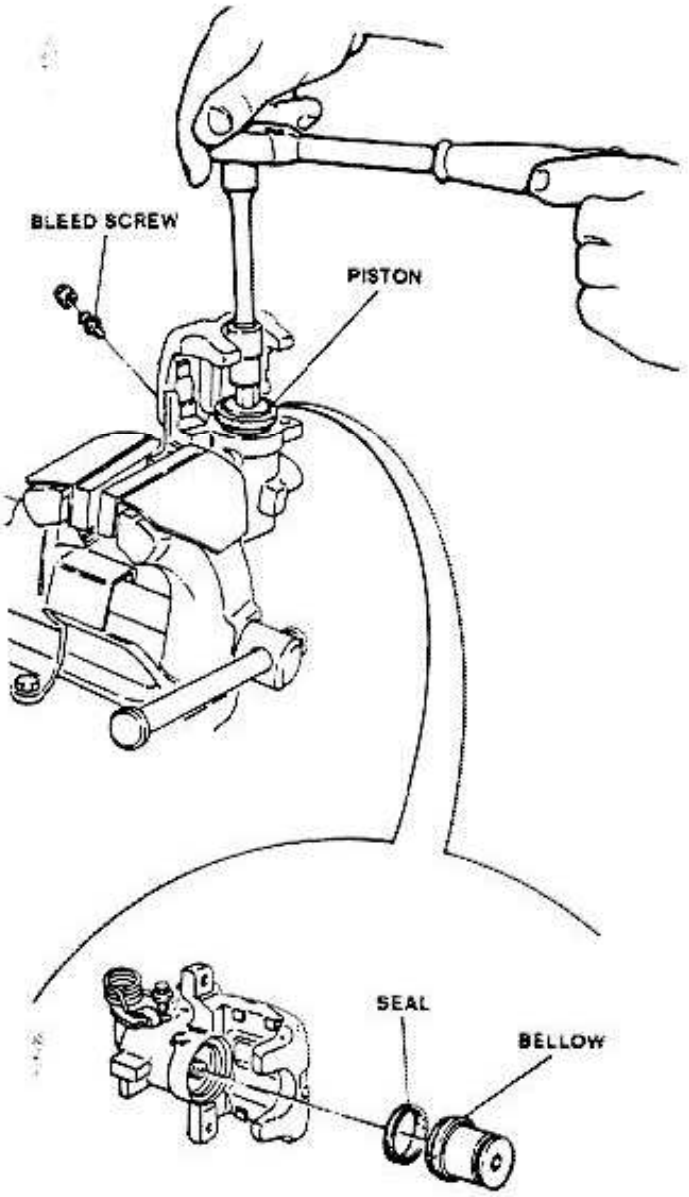


REASSEMBLY

1. Install seal into brake caliper body.
2. Position bellow on rear end of piston.
3. Insert piston in caliper body.

NOTE: The inner side of piston includes a self-adjusting telescopic device that automatically takes-up the slack of parking brake as the wear of brake pads increases. Being submerged in fluid, this device is not subject to wear, and does not require repair.

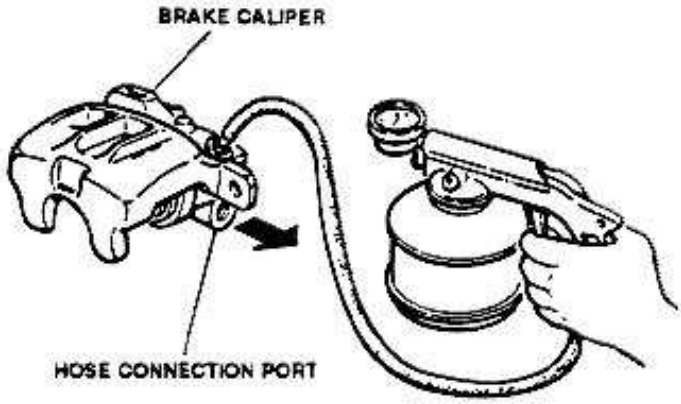
4. Install bleed screw.



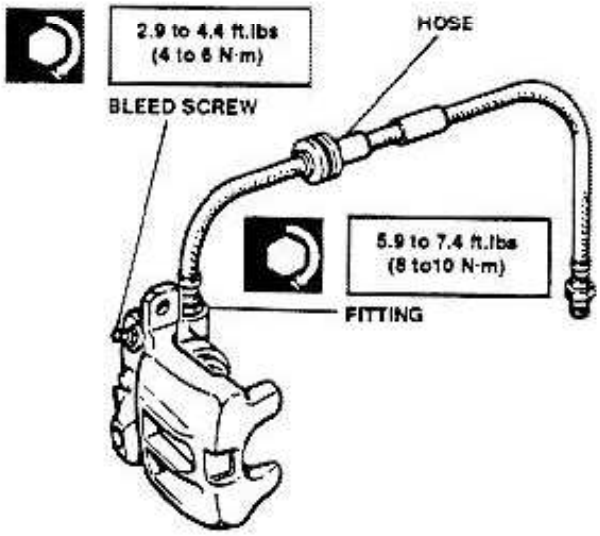
After restoring of brake caliper, and prior to installation on the vehicle, replenish caliper as follow:

5. Remove bleed screw and insert end of a section of

6. Fill brake caliper with prescribed brake fluid until fluid free of any air bubbles flows from the section of tube.



7. Install bleed screw and tighten to prescribed torque.
8. Connect hose and tighten fitting to the prescribed torque.



CHECKS AND INSPECTIONS

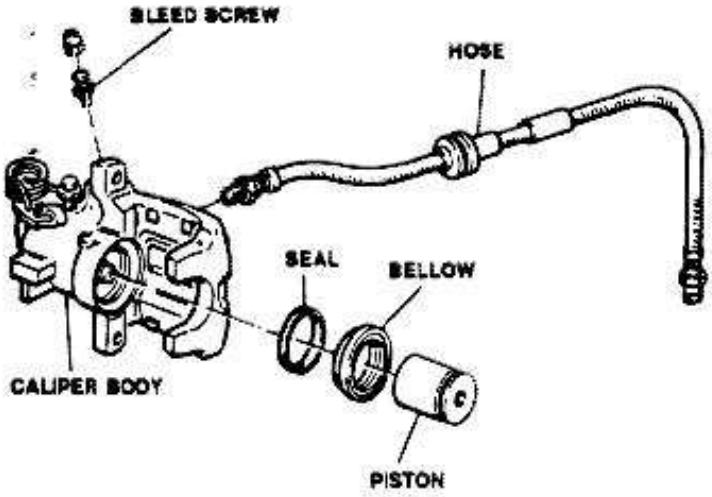
Brake caliper and pads

1. Check brake caliper body for absence of abrasion and seizing: replace caliper complete of piston if damages are found.

tube into screw hole.

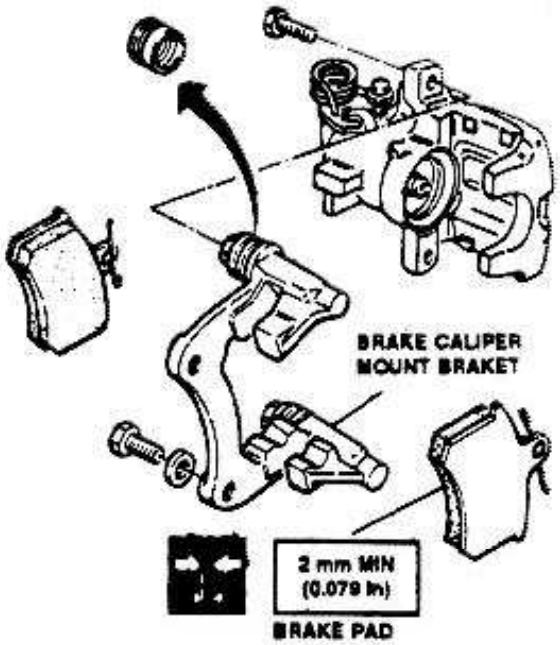
2. Make sure the bleed screw is unobstructed.

3. Check hose for absence of swelling and cracks.



4. Replace brake pads if thickness is lower than 2 mm (0,079 in).

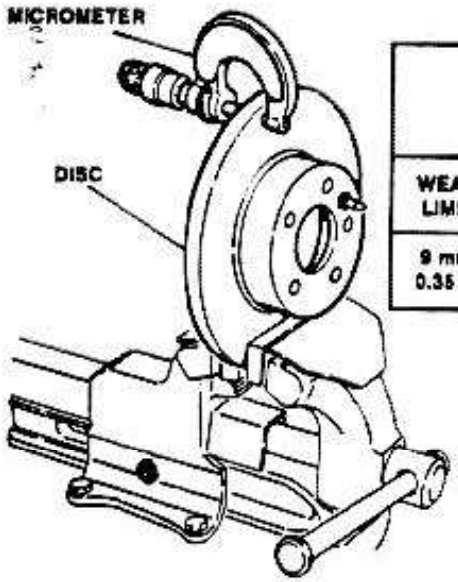
5. Check caliper mount bracket for absence of cracks or distortions.



CHECKS AND INSPECTIONS

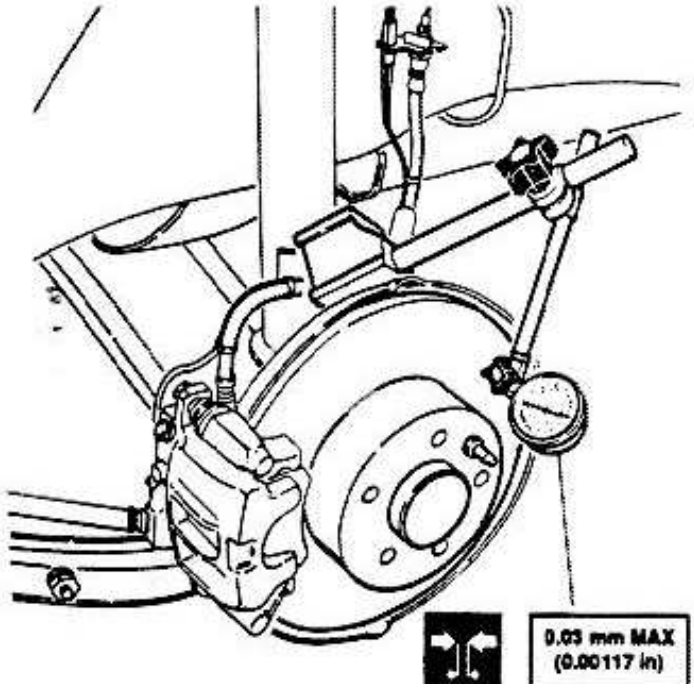
Brake disc

1. Check disc thickness using a micrometer, and inspect the work surfaces for absence of deep scoring or porosity. Grind the disc within specified limits, if necessary.



WEAR LIMIT	GRINDING LIMIT
9 mm 0.35 in	8.5 mm 0.37 in

2. If only the brake pads are replaced, check disc misalignment with respect to rotation axis does not exceed 0.15 mm (0.0059 in).



0.03 mm MAX (0.00117 in)

NOTE: Measure misalignment 2 mm (0.078 in) at disc outer diameter.

BRAKE PADS REPLACEMENT

1. Remove rear wheel.
2. Remove securing screws and brake caliper.

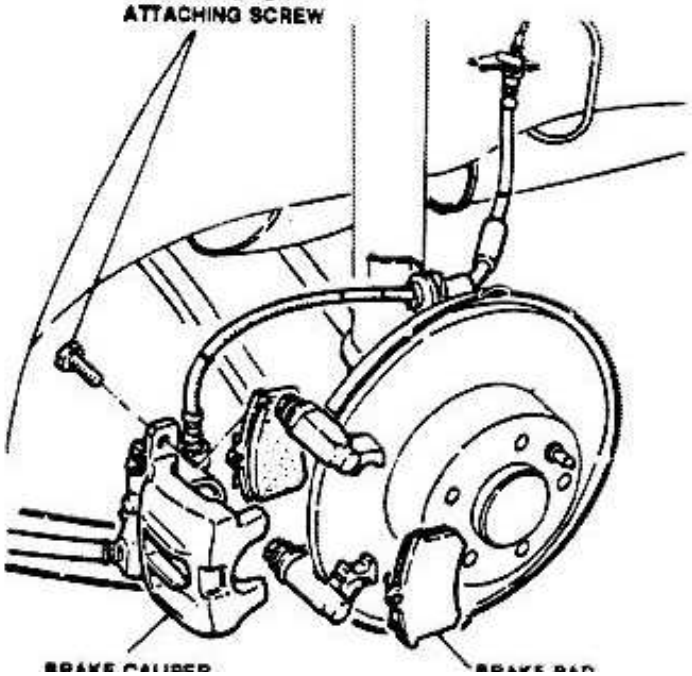
At installation, replace screws securing caliper body.

3. Replace brake pads.

NOTE: Prior to position the new brake pads press manually on caliper piston until fully in, then start the engine and press brake pedal several times to restore automatic slack take-up of parking brake; subsequently, adjust parking brake acting on the control lever.

22.9 to 25.8 ft.lbs (31 to 35 N·m)

BRAKE CALIPER ATTACHING SCREW



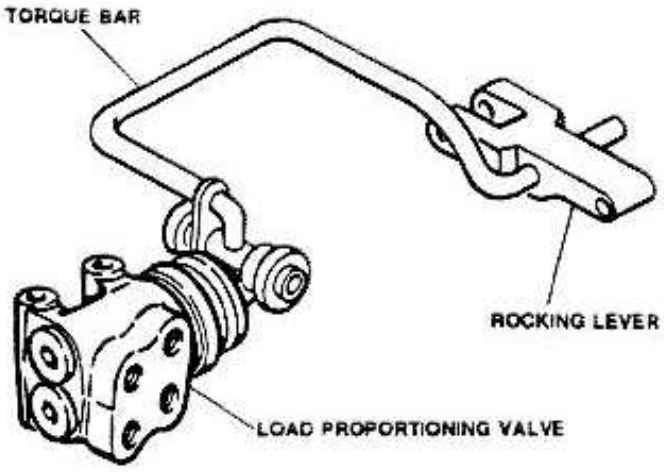
LOAD PROPORTIONING VALVE

The load proportioning valve regulates the pressure of fluid which operates the rear brakes as a function of the load on the vehicle rear axle; the load is measured instant per instant by measuring the distance between the rear wheels axle and the vehicle body.

As the load increases, with consequent reduction of rear axle to body distance, the grip of rear wheels is inproved, and a higher braking action can be obtained without locking the wheels.

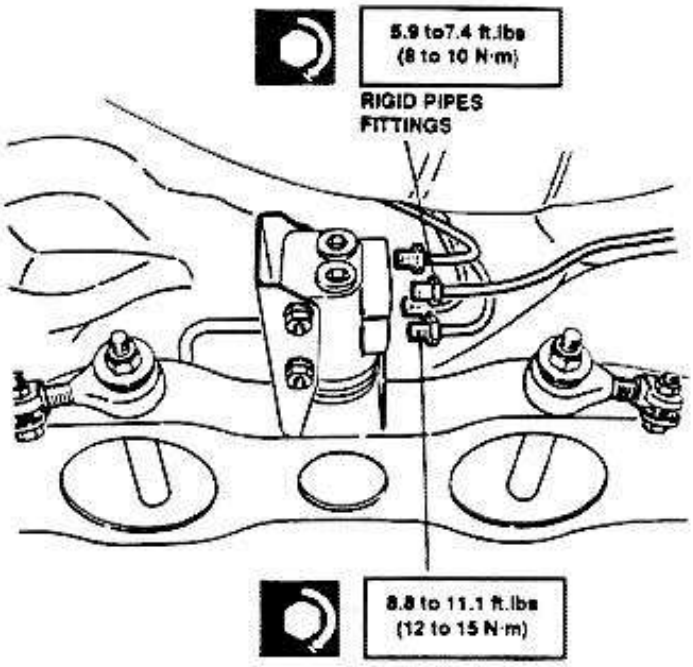
The load proportioning valve is secured to the rear cross beam, and is connected through a torque bar and a rocking lever, to the rear suspension cross arms in order to measure, by the angle of the torque bar, the load acting on both the left and right rear suspensions.

Overhaul of the load proportioning valve cannot be performed; therefore, replace load proportioning valve in case of failure.



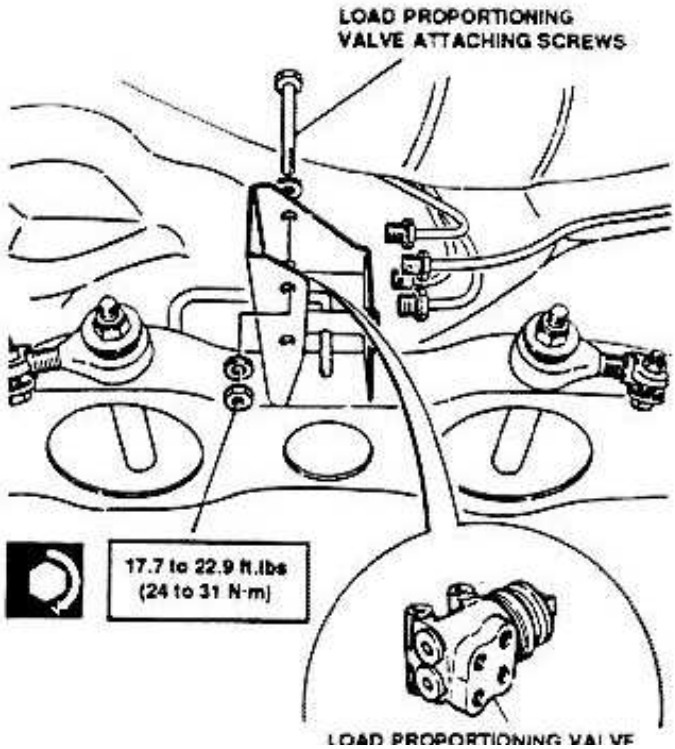
REMOVAL/INSTALLATION

1. Disconnect fittings of rigid lines



2. Remove attaching screws and remove load proportioning valve.

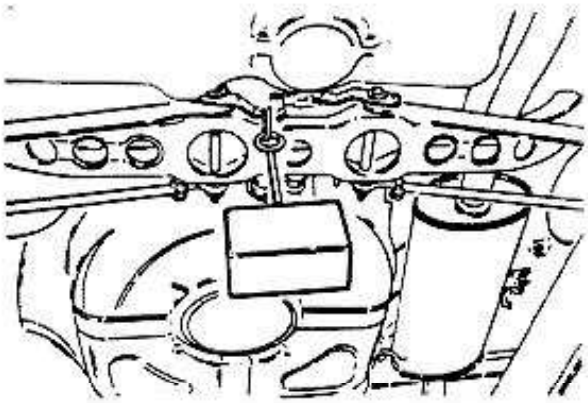
After installation, bleed the brake system.



1. Disconnect fittings of rigid lines.

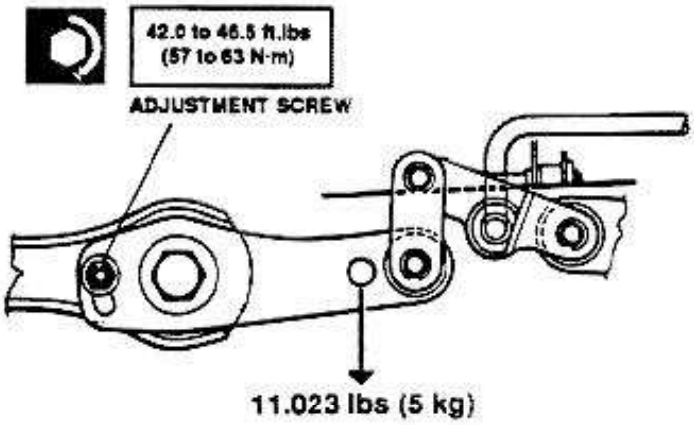
ADJUSTMENT

1. Settle rear suspension.
2. Place vehicle in running order on a level surface, with wheels touching the ground.
3. Place a 75 Kg (165.3 lbs) load in the trunk and fill fuel tank to capacity.
4. Check load proportioning valve linkage for freedom of movement.



5. Loosen adjustment screw.
6. Apply a weight of 5 Kg (11.02 lbs) to lever hole.
7. Lock adjustment screw.

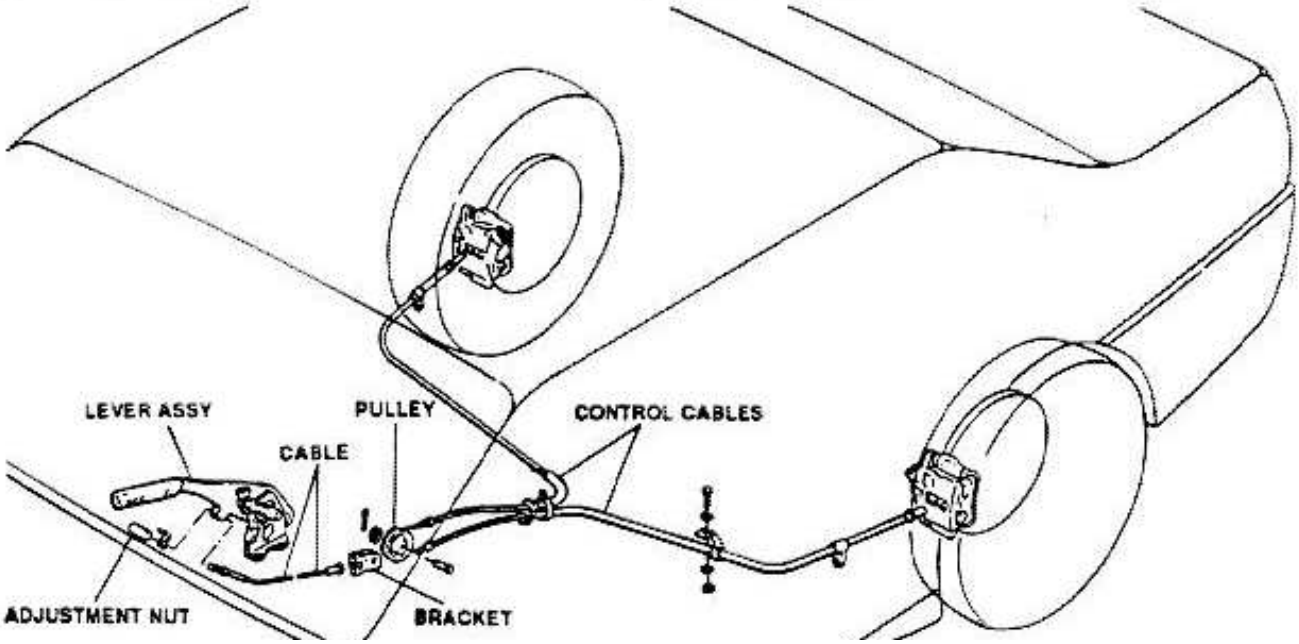
Replace load proportioning valve if not operating properly.



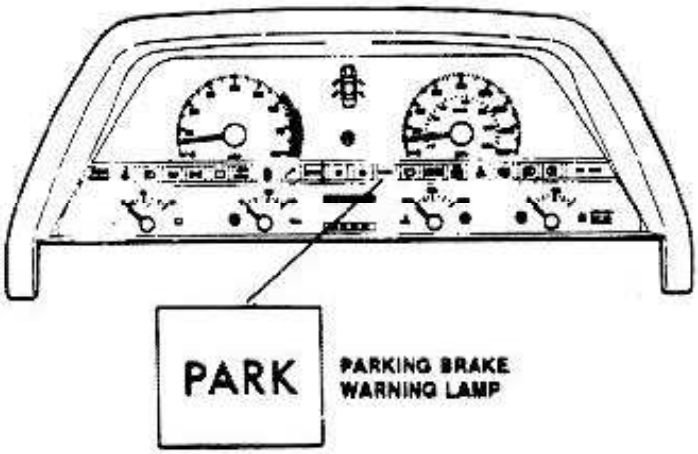
PARKING BRAKE

The parking brake acts on rear brakes of vehicle through a mechanical connection.

In case of failure of the hydraulic circuit of brakes system, the parking brake allows simultaneous locking of both rear wheels since the two hydraulic systems are separate and independent.



The main components of the parking brake system are the control lever, control cables and the automatic slack take-up device.
The control lever is located in cabin between the two front seats, and prevents movement of the vehicle when parked.
The control cables are made of steel and are connected to the control lever by a cable and pulley.
Tension of control cables can be adjusted acting on an adjustment nut.
With the ignition key rotated to first position, a switch located below the control lever turns on the parking brake warning lamp on instrument panel when ever the control lever is moved from rest position.



PARKING BRAKE AUTOMATIC SLACK TAKE-UP DEVICE

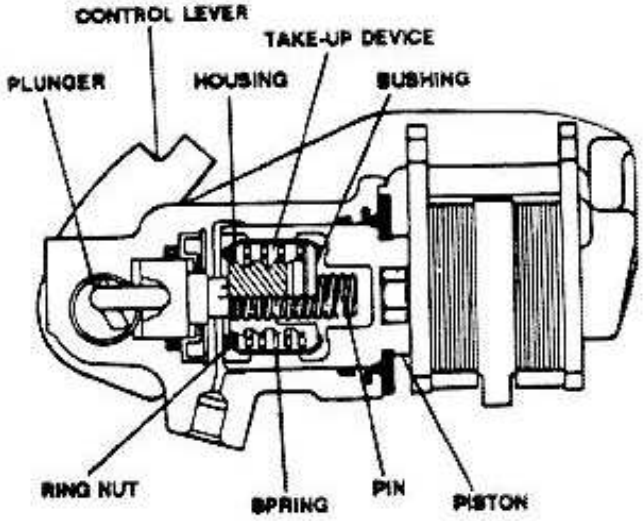
The parking brake automatic slack take-up device is located inside the rear brake calipers; the function of this device is to maintain constant the travel of parking brake lever, which could tend to increase as the brake pads wear up.
If gap between brake disc and pads exceeds the initial prescribed gap, due to wear of the pads, the plunger of the device moves forward to ensure proper braking effect.
In these conditions the device is actuated to take-up the slack and restore the initial prescribed gap as follows:

- Advancement of plunger due to brake application causes an increase of pressure that overcomes the force of spring, and consequent movement of the device housing.

- The housing drags the ring nut that, being locked by the tapered seat of housing, forces the bushing to unscrew on the pin.

- When the brake is released, the return of spring to rest position drags the ring nut which, being no longer locked from the housing, rotates on the bushing, which remains steady, and returns to the initial position.

- Unscrewing of the bushing on the pin determines a different positioning of these items, which in turn takes-up the slack due to wear of brake pads, and maintain the gap to a constant value.

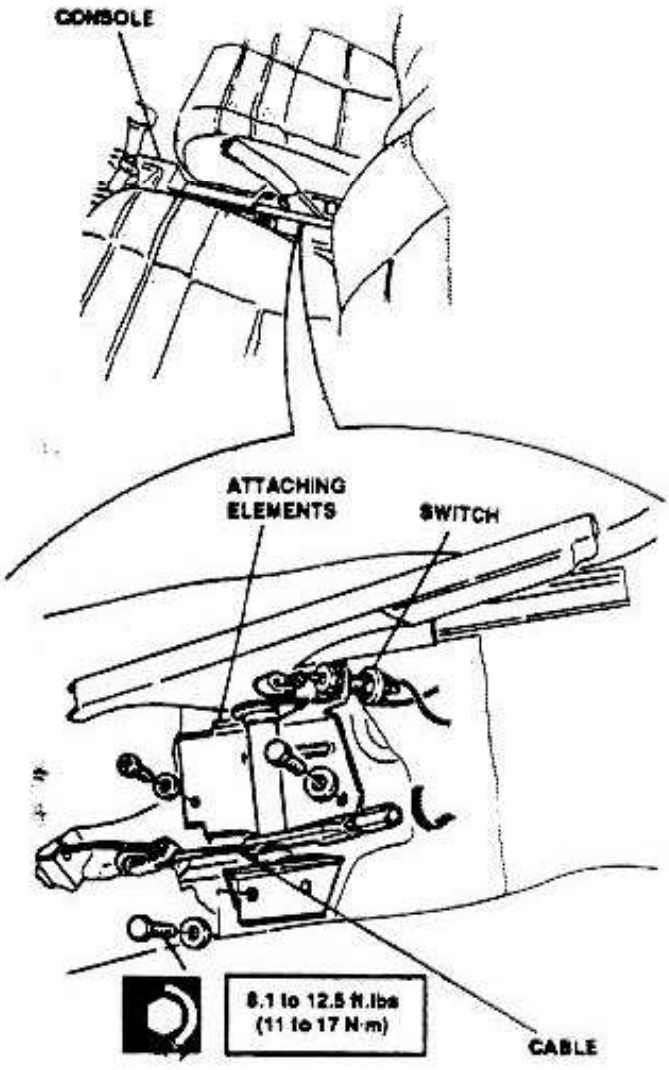


CONTROL LEVER

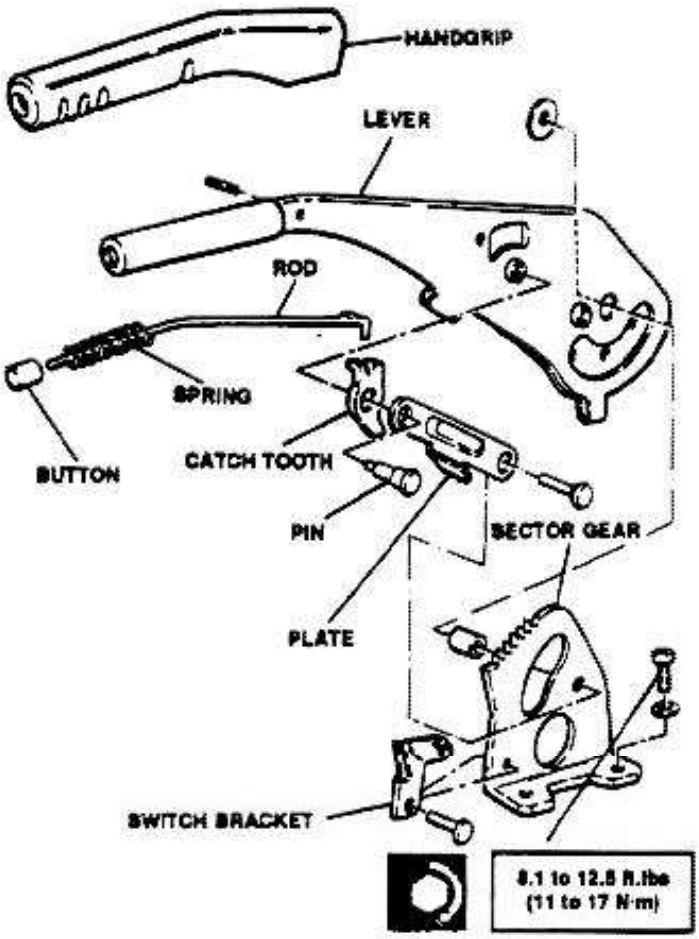
REMOVAL/INSTALLATION

1. Remove center console surrounding the gear shift lever (refer to Group 56).
2. Remove parking brake switch.
3. Disconnect cable from bracket.
4. Remove attaching elements and remove control lever.

After installation, adjust the parking brake system.



DISASSEMBLY/REASSEMBLY



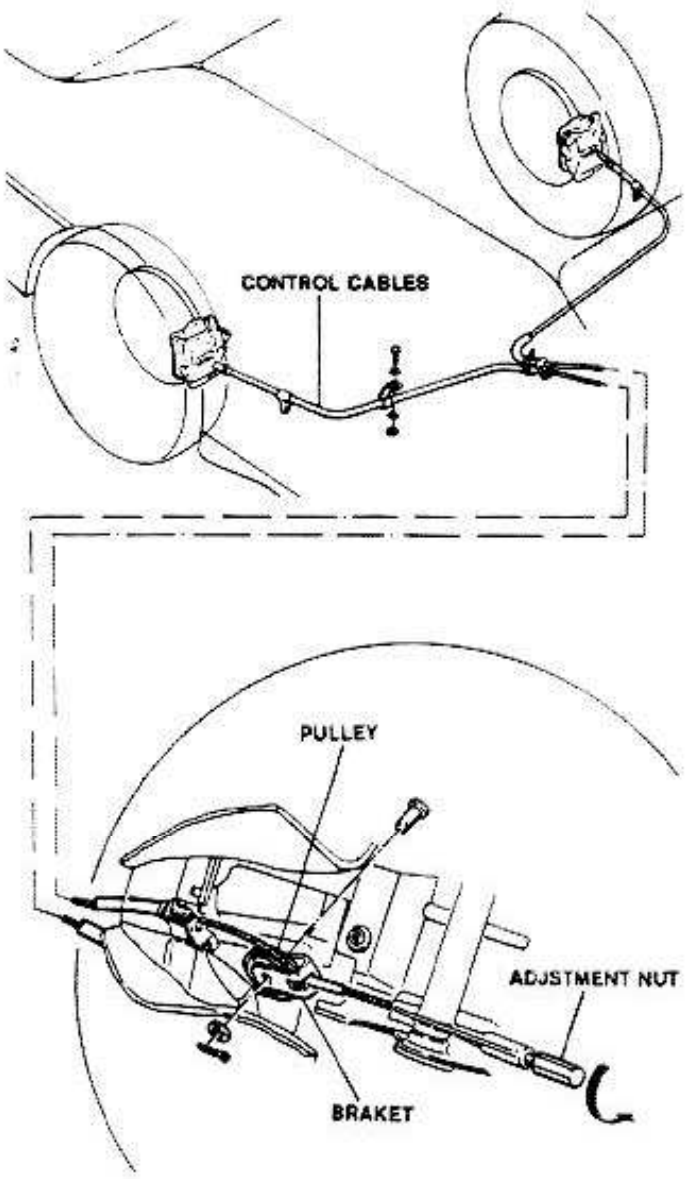
CONTROL CABLES

REMOVAL/INSTALLATION

NOTE: Check each component for proper operation, and sliding of cable into its sheath. Replace affected components in case of wear or binding.

1. Remove gear shift lever console (refer to Group 56).
2. Loosen adjustment nut.
3. Disconnect pulley from bracket.
4. Disconnect control cables from brake calipers (refer to paragraph "REAR BRAKES: REMOVAL/INSTALLATION") and from fasteners under the vehicle body.

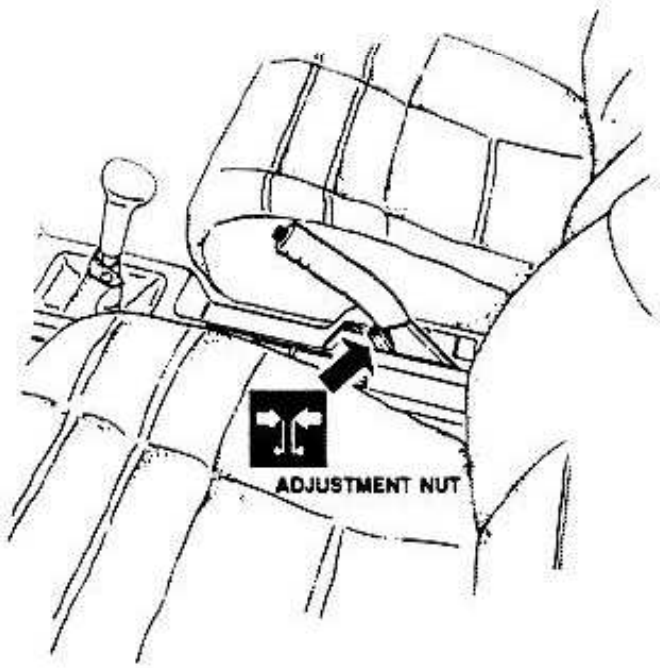
After installation, adjust the parking brake system.



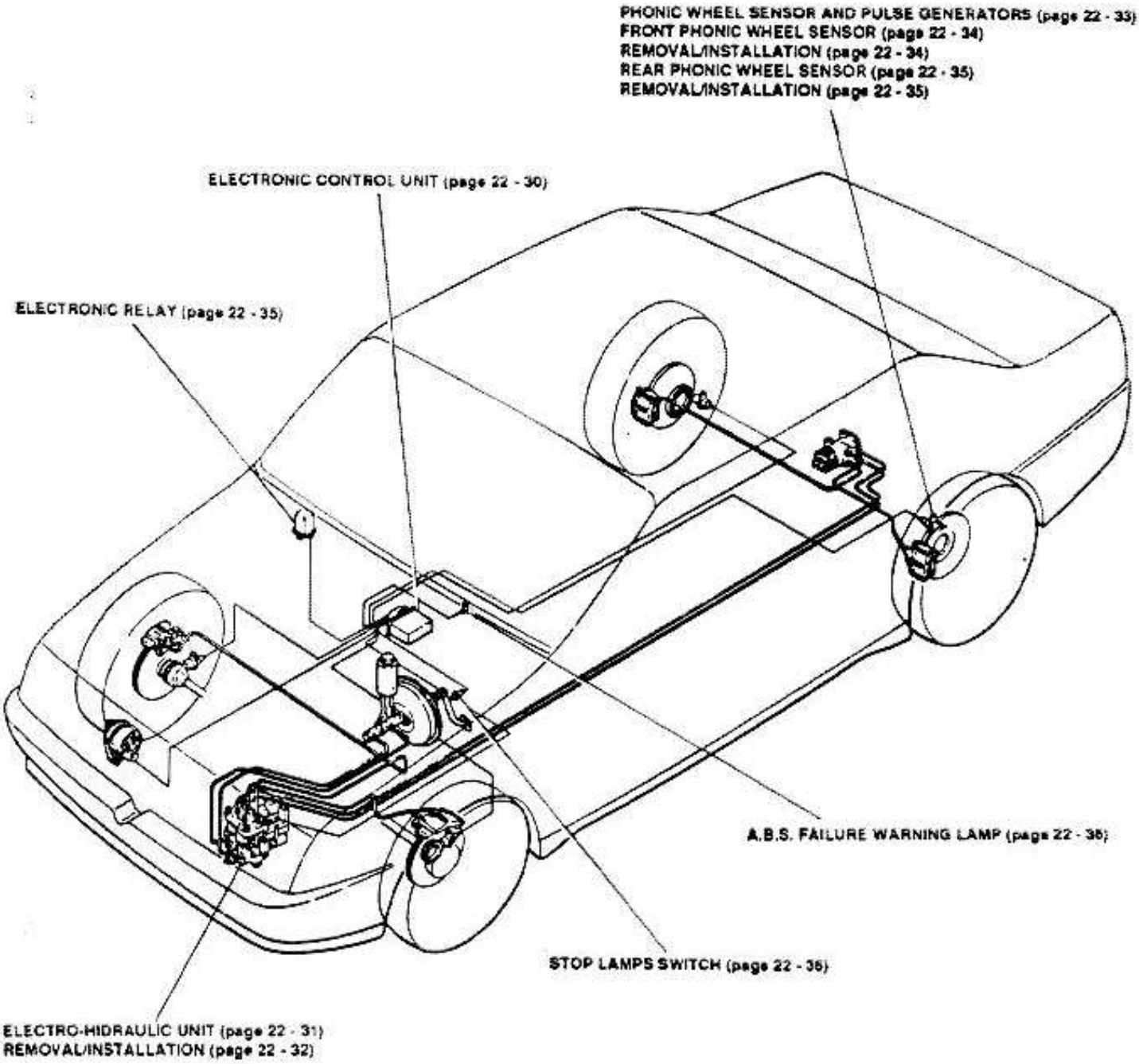
PARKING BRAKE ADJUSTMENT

Parking brake adjustment must be carried-out only after the brake pads, the cable or the brake caliper have been replaced, since take-up of slack is automatic.

1. With parking brake control cables disconnected from brake calipers, perform at least 10 powerful applications of brake pedal to allow the automatic slack take-up device to resume the normal operating position.
2. Connect control cables to brake calipers.
3. Set parking brake control lever to third detent of sector gear.
4. Act on the adjustment nut until the wheels are blocked.
5. Actuate control lever 4 or 5 times with a force of about 40 Kg (88.2 lbs) and check that:
   - The sector gear does not trip more than 7 teeth when a force of about 40 Kg (88.2 lbs) is applied to the control lever.
   - The wheels are free when the control lever is in rest position.



ANTI LOCK BRAKE SYSTEM (ABS)
ILLUSTRATED INDEX



DESCRIPTION AND OPERATION

The A.B.S. is a high-safety device that prevents locking of the wheels during braking when pressure on the brake pedal is excessive with respect to the grip of tires on the ground (e.g. in case the surface is frozen, covered with snow or slippery for any other reason).

The operation of the ABS is based on continuous detection of wheels angular speeds, that decrease during braking.

If in case the tire grip is lost, and the wheel tends to lock, its angular deceleration increases with respect to the remaining wheels.

The phenomenon is detected and the ABS reduces instantaneously the pressure on the brake caliper of the affected wheel.

Therefore, the wheel will continue to rotate, and the tire will not loose its grip on the surface.

As soon as the angular deceleration has resumed the value of the other wheels, pressure is restored on the affected wheel.

The cycle can be repeated indefinitely with a frequence of 10 cycles per second. In this way the grip of the tire on the road surface is assured continuously, and the average braking pressure is maintained to the maximum value compatible with tire grip, even if pressure applied on brake pedal is excessive.

Even abrupt braking is possible when the grip of two wheels is satisfactory (on tarmac), and grip of the two other wheels is poor (e.g. on frozen surface), since locking of the two wheels having a poor grip is prevented.

To optimize maintaining of the direction even when braking in extreme tire grip conditions, the A.B.S. has been designed with a 3 channel scheme.

In other words, the two front wheels are monitored separately since subject to the maximum brake force and the two rear wheels are monitored collectively; this feature permits maintaining of the direction during braking.

During the start phase, the ABS performs the self-test of all its functions on the basis of memory programs.

During this phase, simulated signals are generated and transmitted to the electro-hydraulic unit that verifies proper operation of the system.

Following the start, the whole logic sequence of the signals is performed automatically and values are verified. Failure of the sensors , of the control unit and of the electro-hydraulic unit causes automatic disengagement of the A.B.S., and the brake system will continue to operate in the conventional mode.

Any failure of the system is indicated by the illumination of the relevant warning lamp on the instrument panel.

When braking in normal conditions, the A.B.S. is not actuated and the vehicle behaves as if the A.B.S. was not installed.

On the opposite, when the A.B.S. is actuated since the grip of a tire is nearly lost, the driver will feel slight pulses on the brake pedal: in this condition the A.B.S. is checking the pressure.

The A.B.S. has been adjusted to engage at vehicle speeds above 3.1 MPH (5 Km/h).

The A.B.S. consists of the following components in addition to those of the conventional brake system:

- ELECTRONIC CONTROL UNIT
- ELECTRO-HYDRAULIC UNIT
- PHONIC WHEEL SENSOR AND PULSE GENERATORS
- ELECTRONIC RELAY
- A.B.S. FAILURE WARNING LAMP

ELECTRONIC CONTROL UNIT

The electronic control unit is a microprocessor that receives and processes sensor signals according to a pre-determined logic, and supplies control signals to the solenoid valves located on the electro-hydraulic unit.

The control unit is located below the instrument panel, in the proximity of the central tunnel, and is secured to a bracket with two screws.

When the driver presses the brake pedal, the wheels decelerate, even with different rates among each other.

From combining of the speed of each single wheel, a datum speed is processed, stored and continuously updated to indicate the vehicle's speed at each instant of braking.

Comparison between speed of each single wheel and datum speed allows continuous monitoring of skidding signals of each wheel.

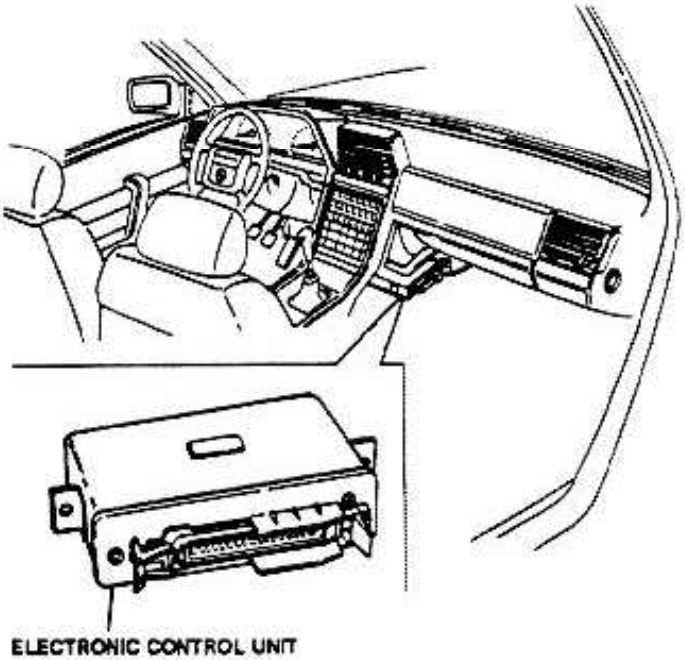
The control unit includes a safety circuit that monitors the efficiency of system before engine start and during the run.

In case a malfunction is detected, the safety circuit disables the A.B.S., but normal braking with traditional brake system is anyway assured.

The driver is alerted of disabling of the A.B.S. by the illumination of the relevant warning lamp on the instrument panel.

The safety circuit continuously monitors also the battery voltage, and disables the A.B.S. in case of over or under voltage.

Overhaul of the control unit can not be performed: replace the unit in case of malfunction.



ELECTRONIC CONTROL UNIT

RECOMMENDATIONS

- Prior to any arch welding operation on the vehicle disconnect electrical connector from control unit.
- During painting operations of vehicle the control unit can be exposed to temperature of 95 °C (203 °F) only for a short time, and for a longer time (about 2 hours) to the maximum temperature of 85 °C (185 °F)

ELECTRO-HYDRAULIC UNIT

The function of the electro-hydraulic unit is to change, by means of solenoid valves, the brake fluid pressure to the brake caliper piston in accordance with input signals delivered by the electronic control unit.

The four solenoid valves, one for each wheel, are of the three-position type; they receive from the electronic control unit a current signal to control the A.B.S., as follows:

0A = pressure loading position

1.9 to 2.3A = pressure hold position

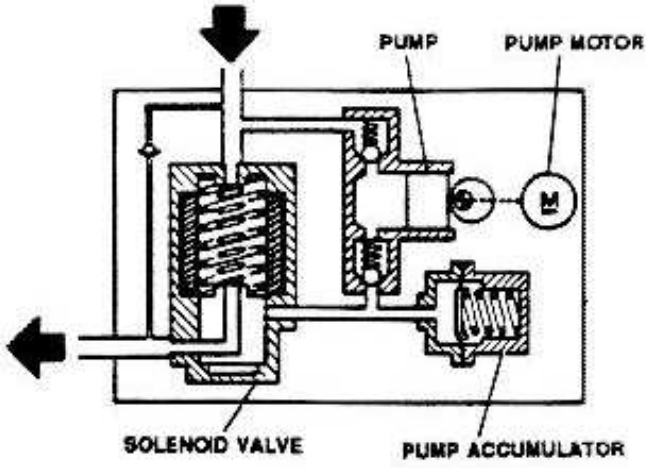
4.5 to 6A = pressure relief position

The scavenge pump is activated through the relevant relay by the electronic control unit when the A.B.S. is actuated.

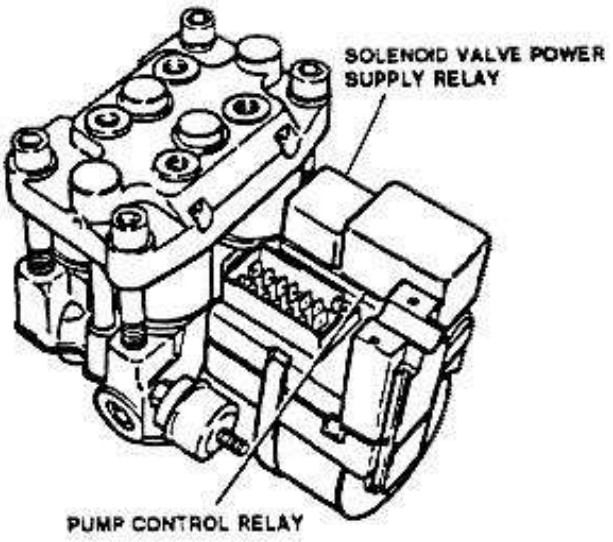
The pump allows scavenge of brake fluid during the pressure reduction phase, and transfers it upstream the solenoid valve to be re-used during subsequent pressure loading phase.

The solenoid valves power supply relay is energized directly by the electronic control unit; the solenoid valves are therefore de-energized in case of total disabling of the A.B.S.

Furthermore, the peculiar connection of the relay with a safety diode allows illumination of the A.B.S. warning lamp on instrument panel independently from the inputs of the electronic control unit.



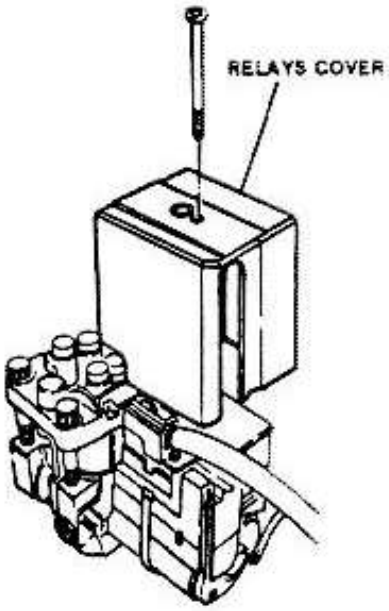
to the maximum temperature of 85° C (185° F).



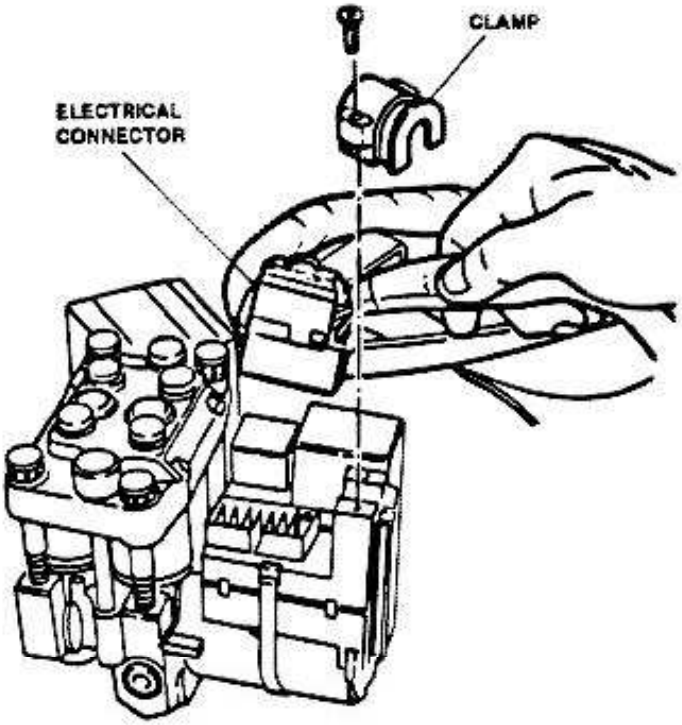
The electro-hydraulic unit can not be overhauled: replace complete unit if a malfunction has been identified. Replacement units are supplied fully serviced with brake fluid and with solenoid valves open; therefore, bleeding and servicing of the brake system can be carried out in analogy to that of a conventional brake system.

REMOVAL/INSTALLATION

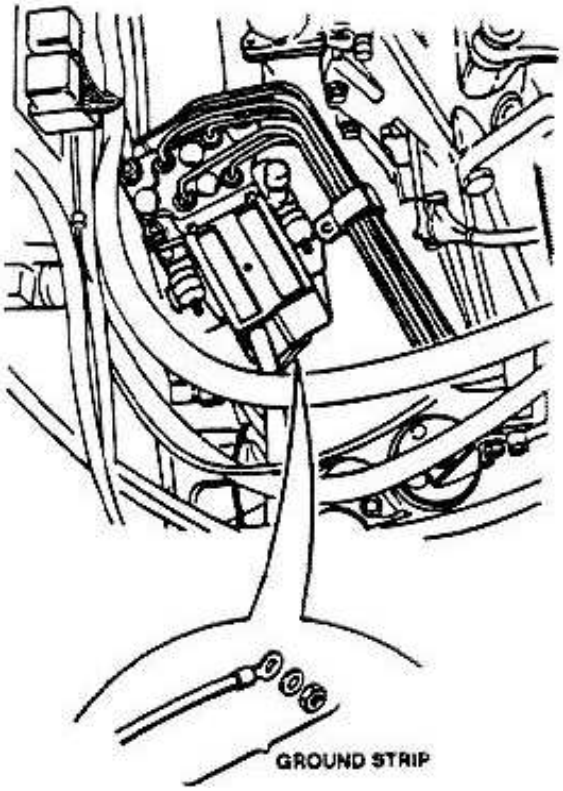
1. Remove relays cover.



2. Remove clamp securing harness.
3. Disconnect harness connector.



4. Disconnect ground strip.



5. Disconnect the two front pipes delivering fluid to the electro-hydraulic unit.
6. Disconnect the four upper pipes delivering fluid to brakes.

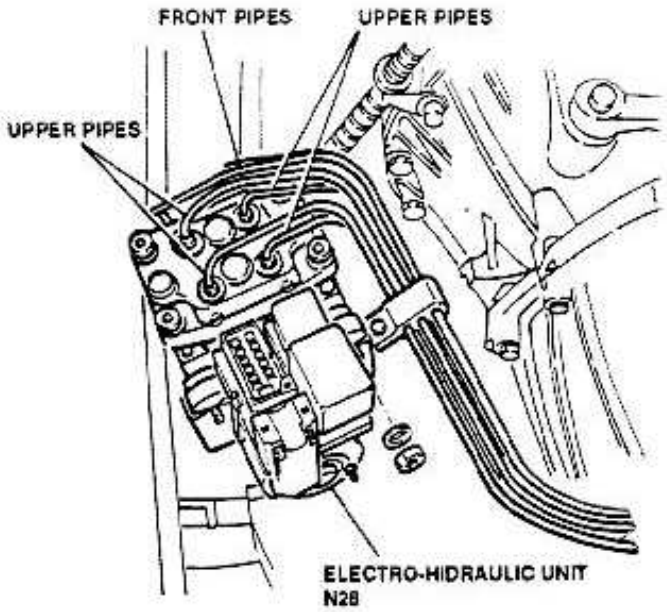
CAUTION:
Operate with precaution to prevent damaging the rigid tubes that could be easily cracked.

NOTE: Plug pipes and ports on the electro-hydraulic unit as they are disconnected using suitable plugs.

7. Remove the electro-hidraulic unit from the support.

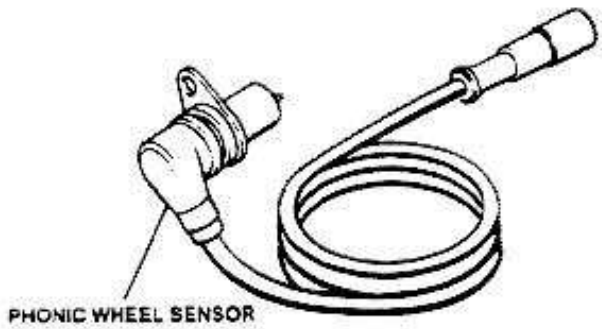
Bleed the brake system after installation.

8. At installation, reverse the removal procedures.

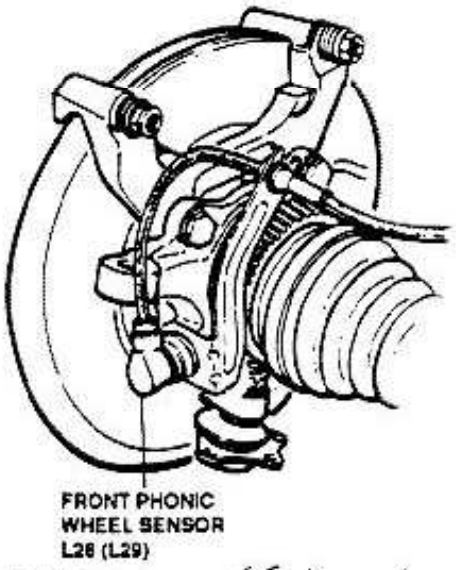


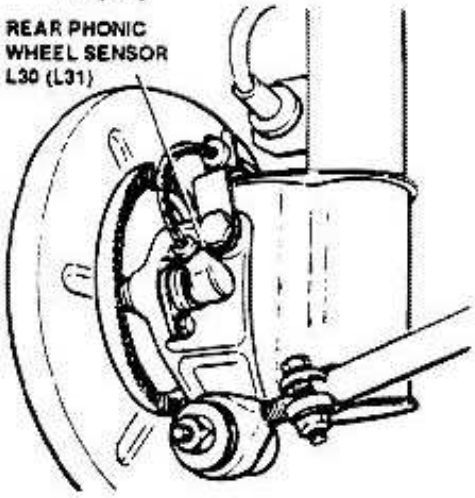
PHONIC WHEEL SENSOR AND PULSE GENERATORS

The phonic wheel sensor supply with due continuity the electronic control unit with all information necessary for proper piloting of the electro-hydraulic unit.



The sensors measure the vehicle speed, and deceleration, acceleration and skidding of the wheels.
The sensors are installed on wheel spindles.



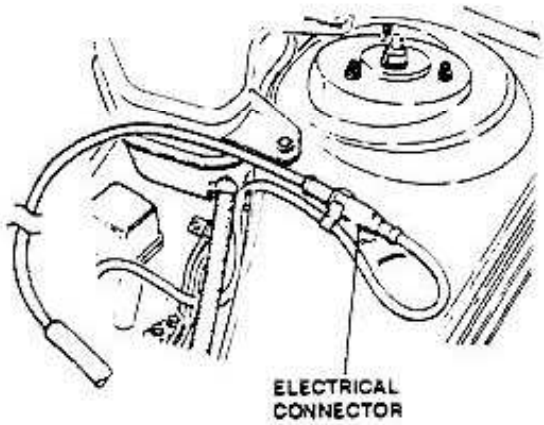


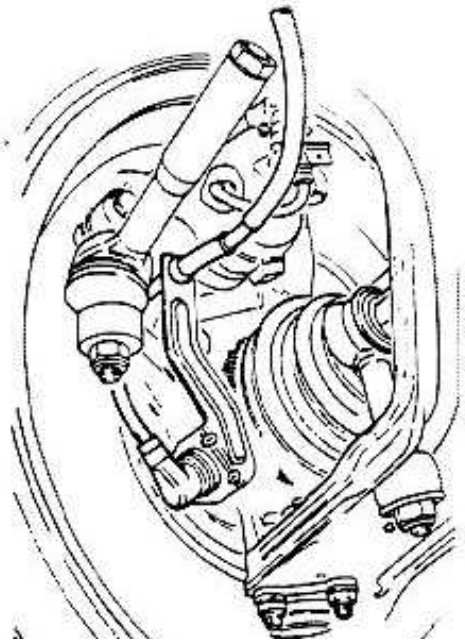
The magnetic field lines close through the tooth of a toothed wheel (pulse generator) facing the sensor and driven by the vehicle wheels. The passage from "solid to void" due to the presence or absence of the tooth determines a variation of the magnetic field sufficient to generate an induced electromotive force at sensor terminals, and therefore to generate an alternate electric signal to the electronic control unit.

FRONT PHONIC WHEEL SENSOR

REMOVAL/INSTALLATION

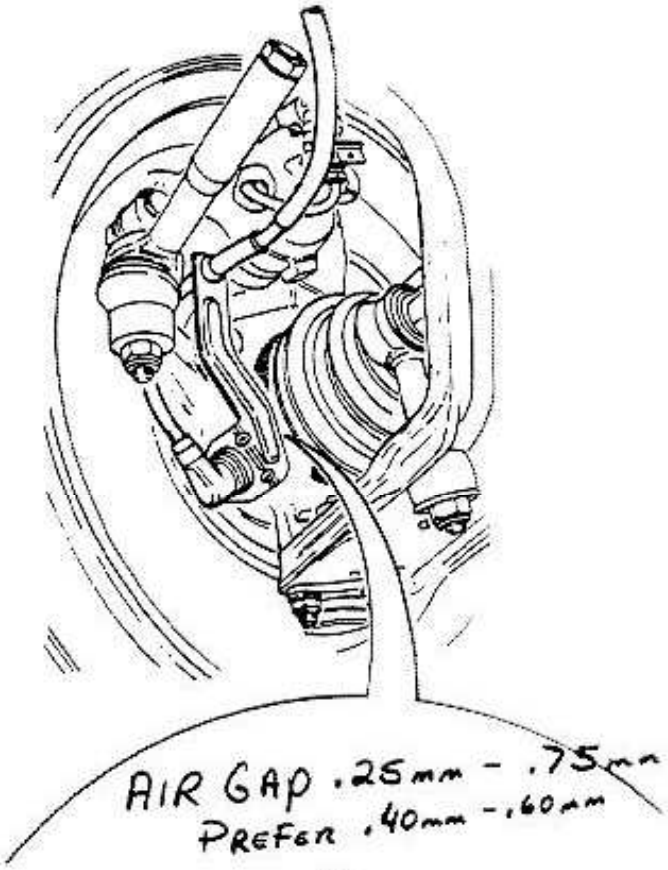
1. Disconnect electrical connector aside left wheel.

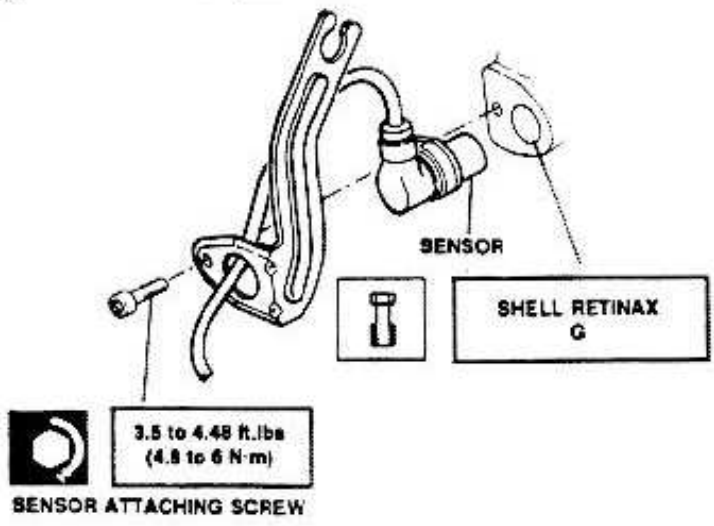




2. Remove attaching screws.
3. Remove sensor.

NOTE: At installation, wipe seating of sensor with prescribed grease.

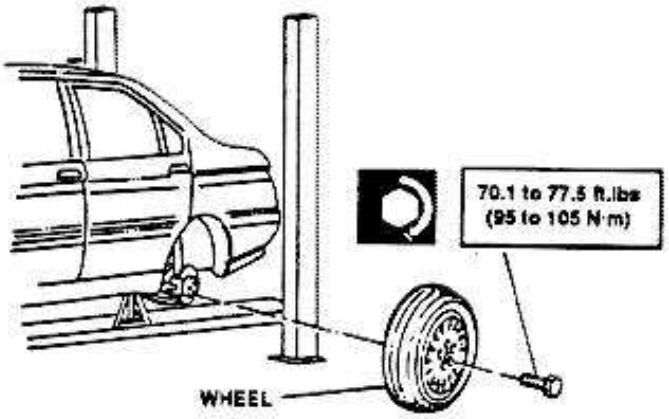




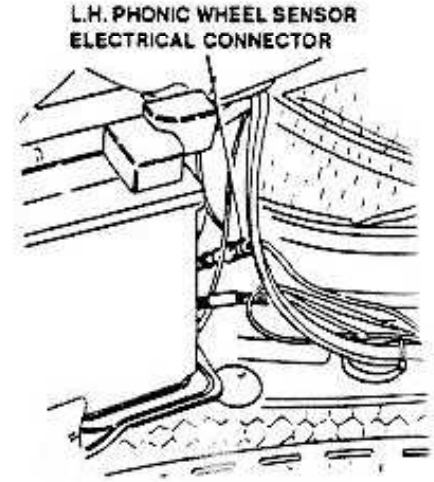
REAR PHONIC WHEEL SENSOR

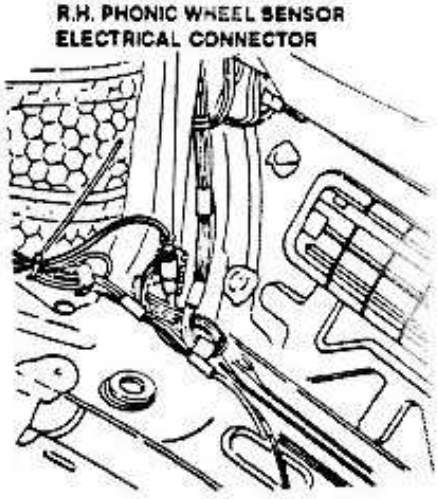
REMOVAL/INSTALLATION

1. Remove wheel.



2. Disconnect electrical connector located in the trunk.

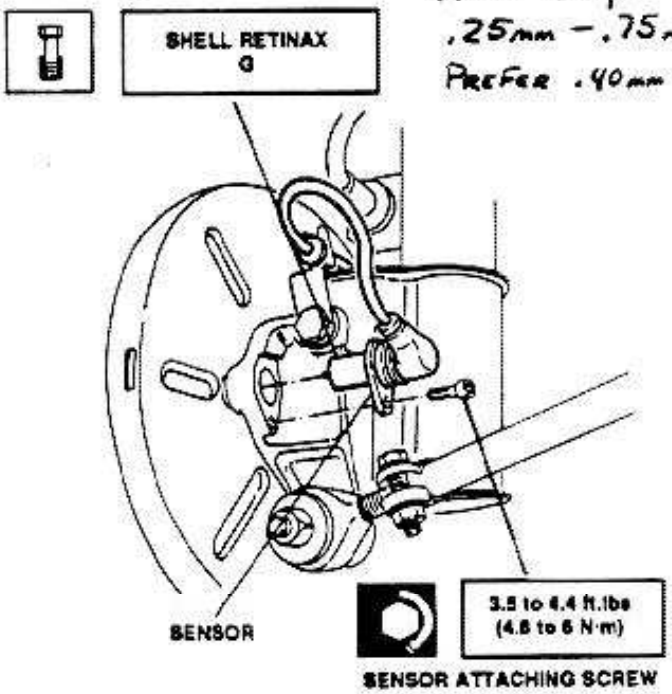




3. Remove attaching screw.
4. Remove sensor.

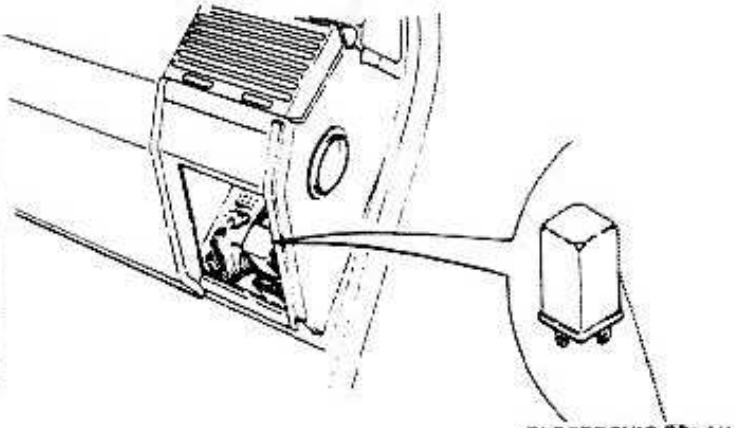
NOTE: At installation, wipe sensor housing with prescribed grease.

AIR GAP
.25mm - .75mm
PREFER .40mm - .6



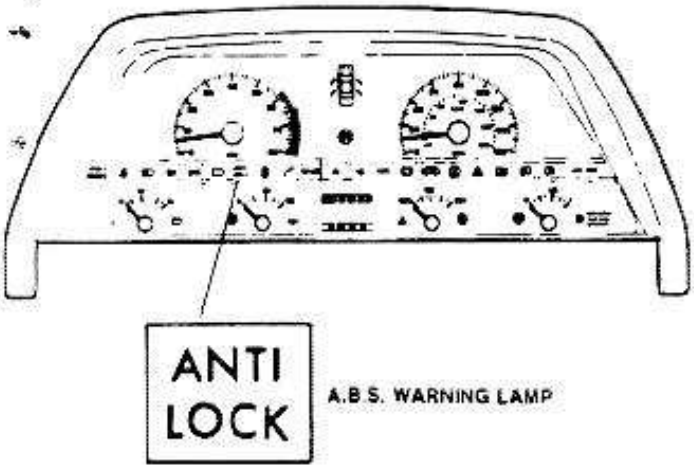
ELECTRONIC RELAY

When the ignition key is rotated to first position, the A.B.S. electronic relay allows energization of the electronic control unit and of the two other relay of the system.
The electronic relay contains a protection device that breaks the outer protection fuse in case of excessive voltage of power supply that could damage the electronic control unit (refer to **Group 40**).



A.B.S. FAILURE WARNING LAMP

The A.B.S. warning lamp is located on the instrument panel and is identified by the labeling "ANTI LOCK". With the ignition key rotated to first position the red warning lamp illuminates; the warning lamp extinguishes as the engine is started.



A.B.S. WARNING LAMP

The alternator supplies the electronic control unit with a signal indicating that engine is running.
The warning lamp remains off if all the A.B.S. components are operational; otherwise the warning lamp is switched on; the A.B.S. in automatically disabled if answer-back is negative and braking is performed in the conventional mode.
During this phase the warning lamp remains illuminated.

STOP LAMPS SWITCH

With gear engaged and brake pedal pressed, the electronic control unit receives a signal that the driver has applied the brake, and the A.B.S. is engaged.
This information is particularly useful when driving on uneven surface roads (wavings, steps, etc.), that could cause variations of wheels speed not due to braking actions, to prevent erroneous signals being delivered to the electronic control unit.

TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

BRAKE MASTER CYLINDER

	Benditalia	
Type		
Diameter	22.22 mm	0.875 in
Stroke	17.75 mm	0.699 in

BRAKE SERVO

	Benditalia	
Type		
Operating cylinder diameter		9 in

FRONT BRAKE CALIPERS

	Girling	
Type		
Piston diameter	54 mm	2.12 in
Brake pad area	50 cm²	7.75 sq.in
Brake pad nominal thickness	18.3 mm	0.72 in

REAR BRAKE CALIPERS

	Girling	
Type		
Piston diameter	38.1 mm	1.4859 in
Brake pad area	30 cm²	4.65 sq.in
Brake pad nominal thickness	16.4 mm	0.646 in

FLUIDS AND LUBRICANTS

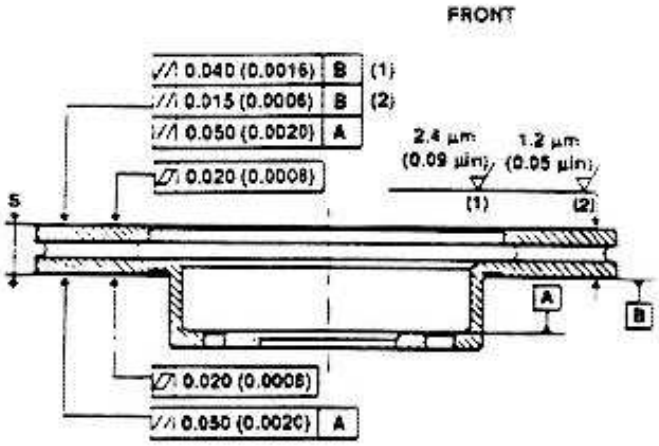
Application	Type	Name
Pedal bushes and joints	GREASE	SHELL RETINAX G
Brake/clutch hydraulic system refill	FLUID *	Alfa Romeo BRAKE FLUID super DOT4 AGIP BRAKE FLUID DOT4
Brake master cylinder seal ring	GREASE	ATE - Bremszylinder Paste DBA Paste
Seat for anti-lock front/rear phonic wheel sensor	GREASE	SHELL RETINAX G

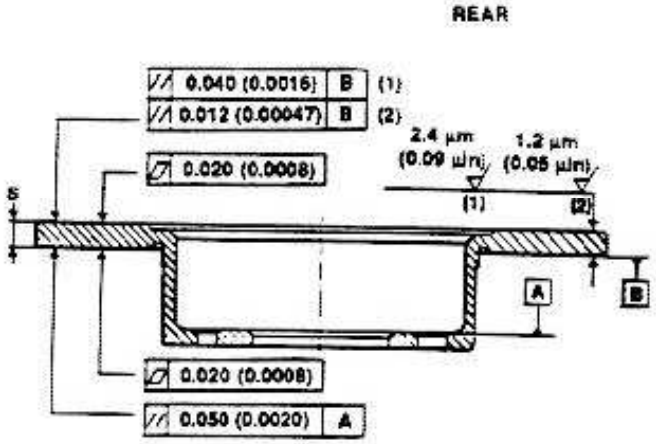
* - 0.6 l. or 0.5 Kg (0.15 Gals or 1.1 lbs)
- 0.8 l. or 0.7 Kg (0.21 Gals or 1.5 lbs) with A.B.S.

CHECKS AND ADJUSTMENTS

Brake disk	Front	Rear
Min. operating thickness	20.2 mm (0.795 in)	9.0 mm (0.354 in)
Min. thickness after grinding	21.2 mm (0.835 in)	9.5 mm (0.374 in)
Max. out-of-parallel	0.03 mm (0.00117 in)	0.03 mm (0.00117 in)

BRAKE DISK GRINDING DIMENSIONS: mm (in)





(1) Radial

(2) Circumferential

PARKING BRAKE LEVER TRAVEL ADJUSTMENT:
Number of free notches on sector gear before wheels lock: 3

TIGHTENING TORQUES

Nut securing pedals to support	31.0 to 38.4 ft.lbs	42 to 52 Nm
Pipe fitting on brake master cylinder	5.9 to 7.4 ft.lbs	8 to 10 Nm
Nut securing brake master cylinder	0.66 to 1.1 ft.lbs	0.9 to 1.5 Nm
Nut securing brake servo to pedal support	9.6 to 12.5 ft.lbs	13 to 17 Nm
Columns (screws) securing front and rear wheels	70.0 to 77.4 ft.lbs	95 to 105 Nm
Screw securing front brake calipers	22.9 to 28.0 ft.lbs	31 to 38 Nm
Screw securing front brake calipers bracket	38.3 to 42.8 ft.lbs	52 to 58 Nm
Screw with dowel securing front and rear brake discs	4.6 to 9.6 ft.lbs	6.2 to 13 Nm
Screw securing front and rear brake discs	4.6 to 9.6 ft.lbs	6.2 to 13 Nm
Bleed screw on brake calipers	2.9 to 4.4 ft.lbs	4 to 6 Nm
Fitting connecting hoses to brake calipers	5.9 to 7.4 ft.lbs	8 to 10 Nm
Screw securing rear brake calipers	22.9 to 25.8 ft.lbs	31 to 35 Nm
Screw securing rear brake calipers bracket	32.7 to 36.1	44.3 to 49 Nm
Screw securing load proportioning valve to rear crossmember	17.7 to 22.9 ft.lbs	24 to 31 Nm
Fitting connecting pipes to load proportioning valve (M10 x 1 / M12 x 1)	5.9 to 7.4 / 8.8 to 11.1 ft.lbs	8 to 10 / 12 to 15 Nm
Nut securing load proportioning valve control lever	42 to 46.5 ft.lbs	57 to 63 Nm
Screw securing parking brake to body	8.1 to 12.5 ft.lbs	11 to 17 Nm
Screw securing front and rear phonic wheel sensor	3.5 to 4.4 ft.lbs	4.8 to 6 Nm

TROUBLESHOOTING PROCEDURE

PRELIMINARY CHECKS

- Check tires inflation pressure and wear.
- Check wheels attitude and characteristic angles.
- Check that brake fluid is of the approved type.

TROUBLES AND SYMPTOMS	FAULT ISOLATION	TEST REFERENCE
EXCESSIVE PEDAL TRAVEL	When pedal is depressed, travel is longer than normal.	A
DAMPENED PEDAL TRAVEL	When pedal is depressed, dampening is found at end of travel; the braking action is reduced.	B
STIFFENING OF PEDAL TRAVEL	The pedal travel becomes stiff during normal use of brakes.	C
INSUFFICIENT BRAKING	Braking is not proportional to force applied to pedal.	D
CAR DRIFTS DURING BRAKING	Car pulls to one side (right or left) during braking.	E
VIBRATIONS DURING BRAKING	Vibrations are felt in cabin during braking.	F
SQUEAK OR CREAKING DURING BRAKING	Squeak or creaking, coming from pad-to-disc contact area, is heard during braking.	G
JAMMING OF REAR BRAKES	Rear brakes jam when brakes are actuated.	H

(Cont.d)

TROUBLESHOOTING PROCEDURE

TROUBLES AND SYMPTOMS	FAULT ISOLATION	TEST REFERENCE
INEFFICIENT PARKING BRAKE	Rear wheels are not locked when parking brake is actuated.	I
REAR BRAKES REMAIN JAMMED WHEN PARKING BRAKE IS RELEASED		J

EXCESSIVE PEDAL TRAVEL	TEST A

TEST STEPS	RESULTS	REMEDY
A1 FLUID LEAKAGE VISUAL CHECK - Visually check for fluid leakage from brake pump, brake regulator, lines and fittings of brake system	OK ▶ ~~OK~~ ▶	Carry-out step A2 Tighten fittings or replace damaged parts
A2 TRAPPED AIR CHECK - Check for presence of air trapped into brakes hydraulic circuit	OK ▶ ~~OK~~ ▶	Carry-out step A3 See TEST B
A3 SLACK ADJUSTER CHECK - Check slack adjuster of parking brake for proper operation	~~OK~~ ▶	Replace affected rear brake caliper

End of test A

End of Test A

DAMPENED PEDAL TRAVEL	TEST B

TEST STEPS	RESULTS	REMEDY
B1 TRAPPED AIR CHECK - Check for presence of air trapped into brakes hydraulic circuit	OK ▶ ~~OK~~ ▶	Carry-out **step B2** **Purge trapped air** from circuit
B2 HOSES CHECK - Check that hoses are not bulged due to deterioration	OK ▶ ~~OK~~ ▶	Carry-out **step B3** Replace **hoses** and **purge trapped air** from circuit
B3 CALIPERS CHECK - Check that seals of brake calipers are not worn	OK ▶ ~~OK~~ ▶	Carry-out **step B4** Replace affected **brake caliper**
B4 BRAKE FLUID CHECK - Check that brake fluid is of approved type and quantity	~~OK~~ ▶	Replace with approved **brake fluid** and **purge trapped air** from circuit

End of test B

STIFFENING OF PEDAL TRAVEL	TEST C

TEST STEPS	RESULTS	REMEDY
C1 ONE-WAY VALVE CHECK - Check that one-way valve is not damaged	OK ▶ ~~OK~~ ▶	Carry-out **step C2** Replace **one-way valve**
C2 CALIPERS CHECK - Check integrity of vacuum line (from servo-unit to intake manifold)	OK ▶ ~~OK~~ ▶	Carry-out **step C3** Replace **vacuum-level**
C3 FITTINGS AND CLAMPS CHECK - Check fittings and clamps of servo-unit vacuum line for integrity	~~OK~~ ▶	Replace defective parts. If trouble remains, replace **servo-unit**

INSUFFICIENT BRAKING	TEST D

TEST STEPS	RESULTS	REMEDY
D1 TRAPPED AIR CHECK - Check for presence of air trapped into brakes hydraulic circuit	OK ▶ ~~OK~~ ▶	Carry-out **step D2** Purge **trapped air** from circuit
D2 BRAKE PADS SURFACE CHECK - Check for presence of grease, oil, mud or water on pads surface	OK ▶ ~~OK~~ ▶	Carry-out **step D3** Clean and check pads; eliminate causes of trouble; replace **pads** if necessary
D3 DISCS AND PADS CHECK - Check discs and pads for wear or damage; check that pads are of approved type	OK ▶ ~~OK~~ ▶	Carry-out **step D4** Replace **pads**, grind or replace **discs**, as necessary
D4 PEDAL TRAVEL CHECK - Check brake pedal for overtravel	OK ▶ ~~OK~~ ▶	Carry-out **step D5** See **TEST A**

(Cont.d)

INSUFFICIENT BRAKING	TEST D

TEST STEPS		RESULTS	REMEDY
D5	CALIPERS PISTON CHECK		
▸ Check calipers pistons for wear or seizing		OK ▶	Replace calipers

CAR DRIFTS DURING BRAKING	TEST E

TEST STEPS	RESULTS	REMEDY
E1 TIRES INFLATION PRESSURE CHECK - Check that tires are inflated to correct pressure	OK ▶ ~~OK~~ ▶	Carry-out step E2 Restore correct inflation pressure
E2 BRAKE PADS SURFACE CHECK - Check for presence of grease, oil, mud or water on pads surface	OK ▶ ~~OK~~ ▶	Carry-out step E3 Clean and check pads; eliminate causes of trouble; replace pads if necessary
E3 BRAKE PADS WEAR CHECK - Check pads installed on same axle for different wear	OK ▶ ~~OK~~ ▶	Carry-out step E4 Replace pads and check calipers for proper operation; replace calipers if necessary
E4 DISCS CHECK - Check that discs are of same manufacturer and dimension	OK ▶ ~~OK~~ ▶	Carry-out step E5 Replace discs

(Cont'd)

CAR DRIFTS DURING BRAKING	TEST E

TEST STEPS	RESULTS	REMEDY
E5 LOAD PROPORTIONING VALVE CHECK - Check that load proportioning valve is serviceable and properly adjusted	OK ▶ ~~OK~~ ▶	Carry-out **step E6** Adjust or release **load proportioning valve** as necessary
E6 WHEEL ALIGNMENT CHECK - Check that wheel alignment is correctly adjusted	~~OK~~ ▶	Adjust **wheel alignment** (see **Group 21**)

End of test E

VIBRATIONS DURING BRAKING	TEST F

TEST STEPS	RESULTS	REMEDY
F1 BRAKE DISCS CHECK - Check that brake discs are not buckled or oxidated	OK ▶ ~~OK~~ ▶	Carry-out step F2 Grind or replace affected disc, as necessary
F2 DISCS OVERHEATING CHECK - Check discs for overheating (due to excessive stress)	~~OK~~ ▶	Replace pads; grind or replace discs as necessary

End of test F

SQUEAK OR CREAKING DURING BRAKING	TEST G

TEST STEPS	RESULTS	REMEDY
G1 BRAKE PADS SURFACE CHECK		
- Check that braking surfaces of pads are not "vetrificated"	OK ▶	Carry-out step G2
	~~OK~~ ▶	Replace pads and check disc
G2 BRAKE PADS CHECK		
- Check that brake pads are of approved type	~~OK~~ ▶	Replace with approved-type pads

End of test G

JAMMING OF REAR BRAKES	TEST H

TEST STEPS		RESULTS	REMEDY
H1	LOAD PROPORTIONING VALVE CHECK		
- Check load proportioning valve for proper operation		OK ▶	Replace load proportioning valve

End of test H

INEFFICIENT PARKING BRAKE	TEST I

TEST STEPS	RESULTS	REMEDY
I1 ADJUSTMENT CHECK - Check that adjusting nut is properly set	OK ▶ ~~OK~~ ▶	Carry-out step I2 Re-adjust by nut located under parking brake
I2 CONTROL CABLE CHECK - Check control cable for damage or breaking	OK ▶ ~~OK~~ ▶	Carry-out step I3 Replace control cable
I3 CABLE CONNECTION CHECK - Check cable connection for damage	~~OK~~ ▶	Check and eliminate cause of trouble

End of test I

REAR BRAKES REMAIN JAMMED WHEN PARKING BRAKE IS RELEASED	TEST J

TEST STEPS	RESULTS	REMEDY
J1 CONTROL CABLE TRAVEL CHECK - Check return travel of cable for freedom of movement	OK ▶	Carry-out **step J2**
	~~OK~~ ▶	Eliminate any interference or replace **control cable**
J2 LEVER PUSHBUTTON CHECK - Check pushbutton for freedom of movement	OK ▶	Carry-out **step J3**
	~~OK~~ ▶	Disassemble and repair **pushbutton**; replace entire **lever** if necessary
J3 CABLE CONNECTION - Check cable connection for damage	~~OK~~ ▶	Replace **cable**

Clutch

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GROUP 12

CLUTCH

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GROUP 12

CLUTCH

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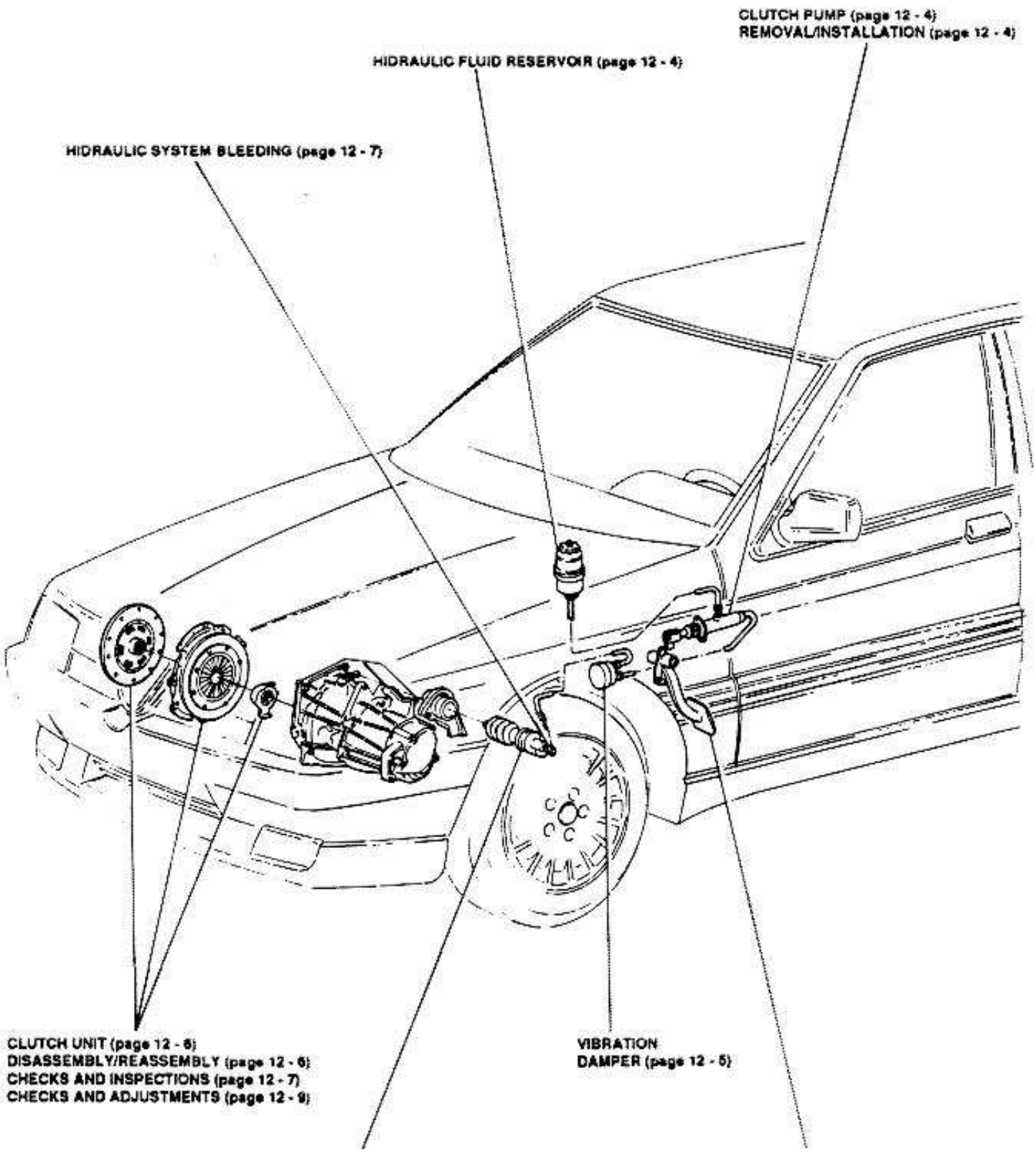
ILLUSTRATED INDEX



CLUTCH MASTER CYLINDER (page 12 - 5)
REMOVAL/INSTALLATION (page 12 - 5)

CLUTCH PEDAL (page 12 - 3)
REMOVAL/INSTALLATION (page 12 - 3)

CLUTCH

DESCRIPTION

The clutch includes all those elements that transmit the mechanical power of engine crankshaft to the gearbox-differential and to the drive wheels. This mechanical connection is realized using the friction force developed between surfaces faced and pressed against each other by a spring.

The Alfa 164 model is equipped with a hydraulically actuated dry single-disc clutch, with throw-out bearing; the throw-out bearing acts on a diaphragm spring and enables engagement and disengagement of the driven disc.

The main components of the clutch are: the clutch pedal, the pump, the master cylinder and the clutch unit.

The clutch pedal actuates the pump through a mechanical linkage.

Pressurized fluid is delivered to the master cylinder through a suitable hydraulic circuit.

The actuating cylinder, seated into its support, actuates the clutch disengagement fork through a plunger; the throw-out bearing overcomes the reaction of the diaphragm spring and backs the clutch pressure plate body, thus disengaging the clutch.

Engagement of the clutch is performed in a similar manner.

When the clutch pedal is released, the clutch diaphragm spring determines a pressure of the clutch disc on engine flywheel.

The friction force that creates is sufficient to drive into motion all the mechanical devices involved in the drive system and vehicle movement.

The hydraulic fluid flows back to clutch pump through the same hydraulic circuit, and depressurizes the clutch master cylinder.

The hydraulic fluid reservoir supplies both the brakes and clutch systems, to maintain both systems efficient.

Specific characteristics of the clutch are as follows:

- Hydraulic actuation that maintains the throw-out bearing in contact with the diaphragm spring regardless of driven disc wear, and provides automatic and progressive take-
- Clutch unit provided with a disc free of asbestos fibers conforming to actual anti-pollution regulations

The "S" version vehicles are equipped with an oversize clutch unit to match the increased power of the engine; nevertheless, the disassembly and reassembly procedures remain unchanged.

Clutch unit controls (control lever and fork) act on the throw-out bearing pulling, and not pushing, the Belleville washer of disc pressure plate, and therefore press the clutch disc against the flywheel.

CLUTCH PEDAL

The clutch pedal is the point of application of pressure applied by the driver.

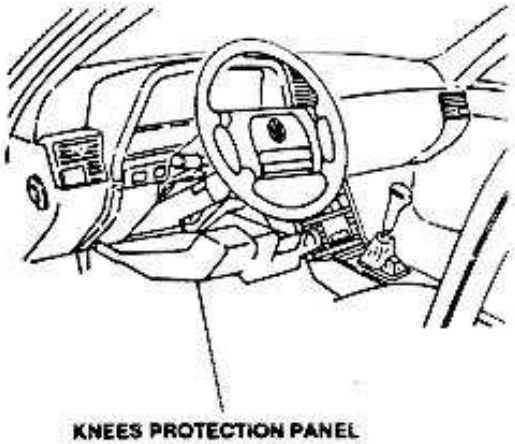
The pedal is hinged to the pedals group and is mechanically connected to the clutch pump piston through a lever and fork linkage.

A spiral spring allows the driver to apply a lower pressure on the pedal during clutch actuation.

In the event of failure of the system, with consequent loss or decrease of pressure in the clutch hydraulic circuit, the clutch pedal is moved to bottom of travel by the action of the spring, thus evidencing the presence of a malfunction.

REMOVAL/INSTALLATION

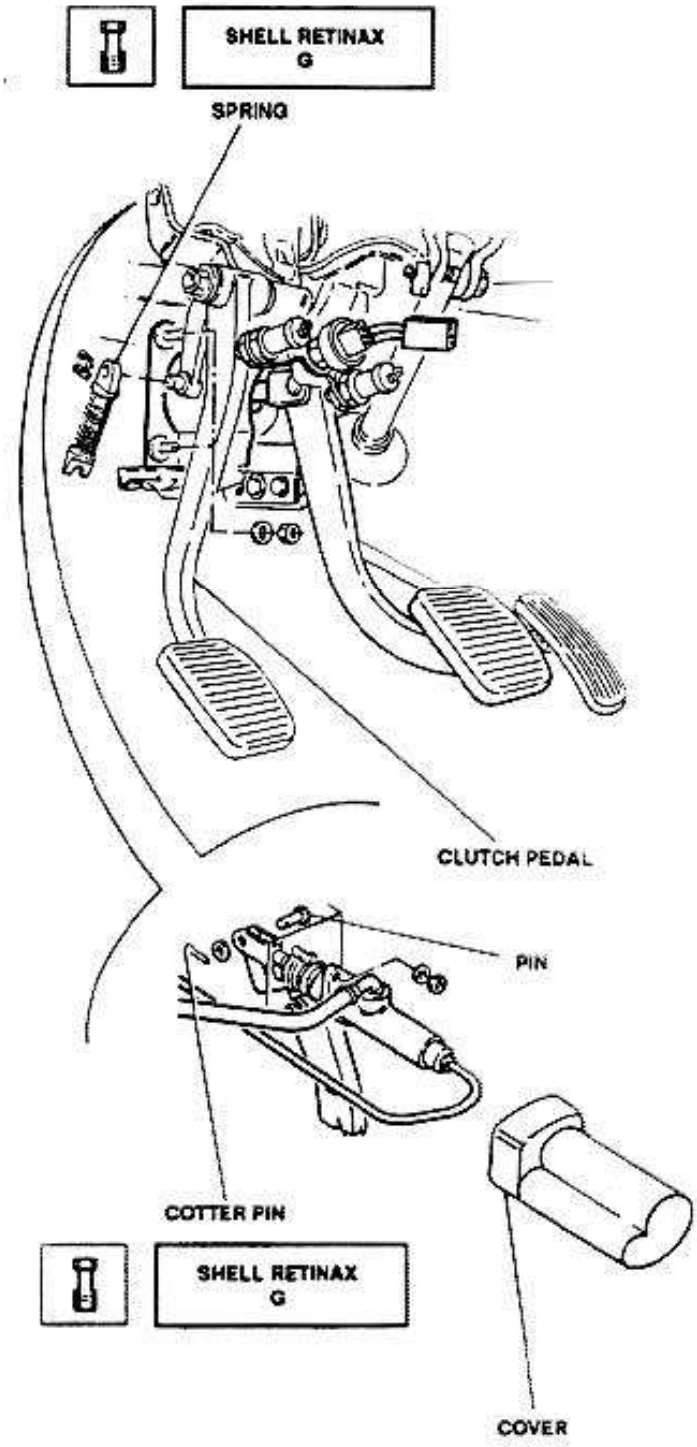
1. Remove knees protection panel from driver's side.



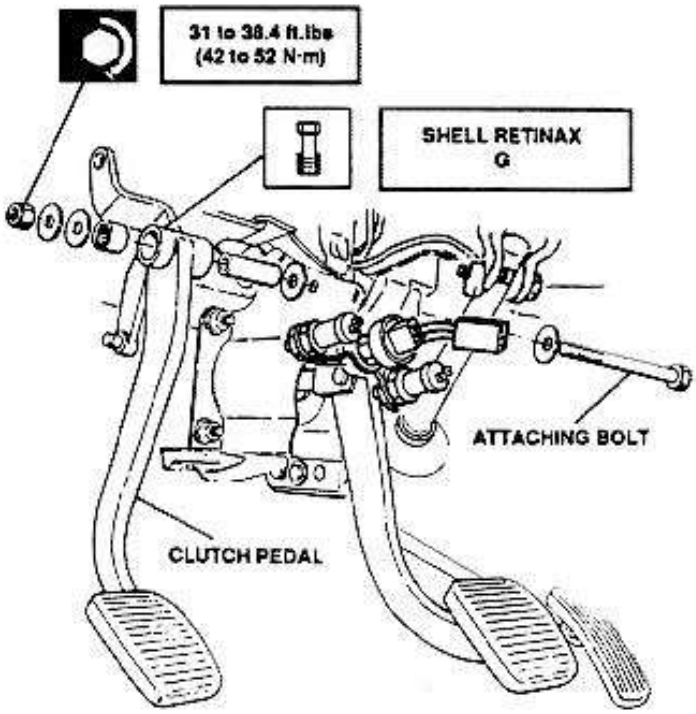
KNEES PROTECTION PANEL

up of slack.
Therefore, no adjustment of the clutch is required.

2. Remove clutch pump cover.
3. Remove clutch servo unit mechanism spring.
4. Remove cotter pin and withdraw pin securing pump-clutch pedal.



5. Remove nut and withdraw bolt securing pedals group to support.



HYDRAULIC FLUID RESERVOIR

Refer to **Group 22.**

CLUTCH PUMP

The clutch pump consists of a piston seated inside of a cylinder and connected to the clutch pedal by means of a lever and fork linkage. The pressure applied on clutch pedal produces an increase of pressure of the hydraulic fluid; the fluid is delivered to the clutch master cylinder through a hydraulic circuit. Overhaul of the clutch pump can not be performed: therefore, replace pump if defective.

REMOVAL/INSTALLATION

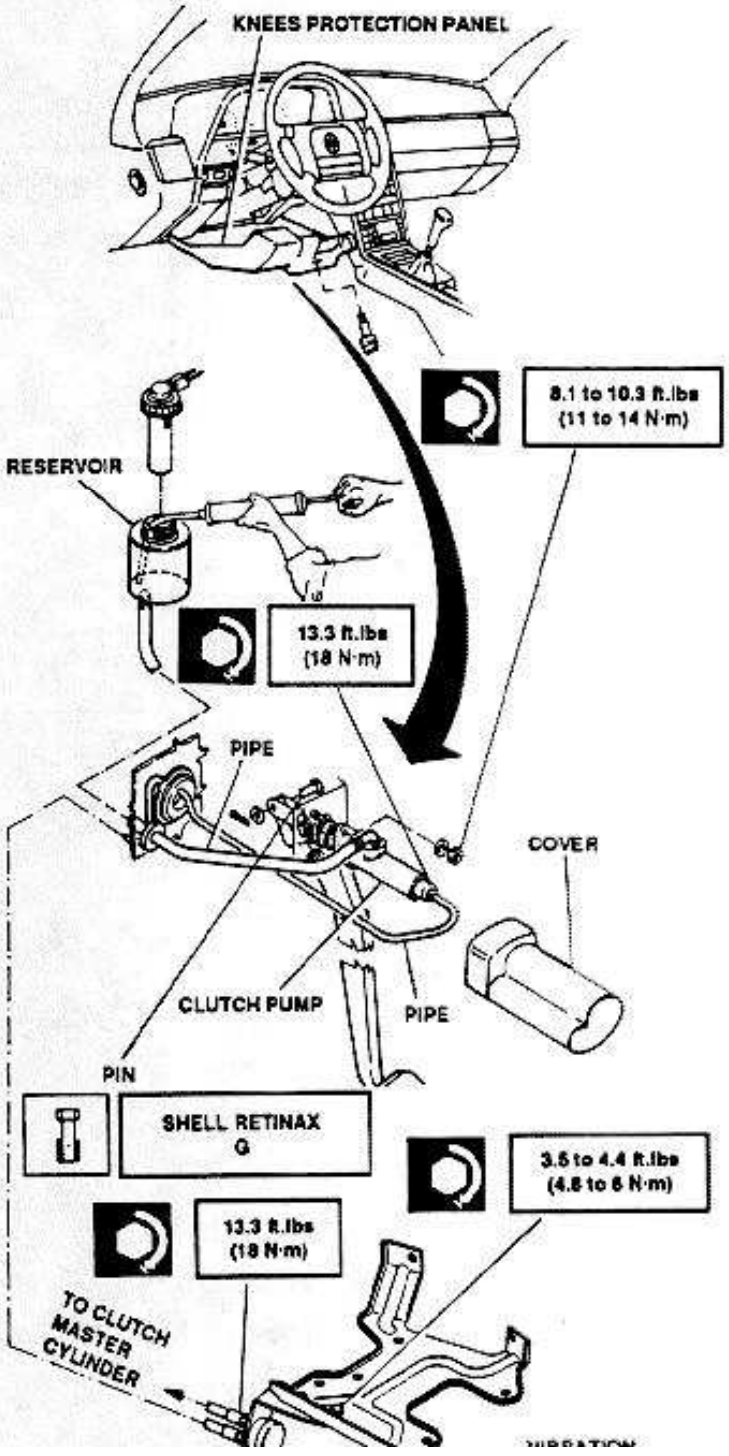
1. Empty reservoir by sucking hydraulic fluid with a syringe.
2. Remove knees protection panel, driver's side.
3. Remove clutch pump plastic cover.
4. Remove cotter pin and withdraw pin securing clutch pump-pedal.
5. Disconnect piping from pump, paying attention to

6. Remove clutch pedal.

prevent draining of hydraulic fluid.

6. Remove nuts and remove clutch pump.
7. Disconnect the vibration damper hoses.
8. Unscrew the fixing screws and remove the vibration damper from the air filter support.

Following installation of the pump and the vibration damper, bleed air trapped in system (Refer to: **"HYDRAULIC SYSTEM BLEEDING"**).

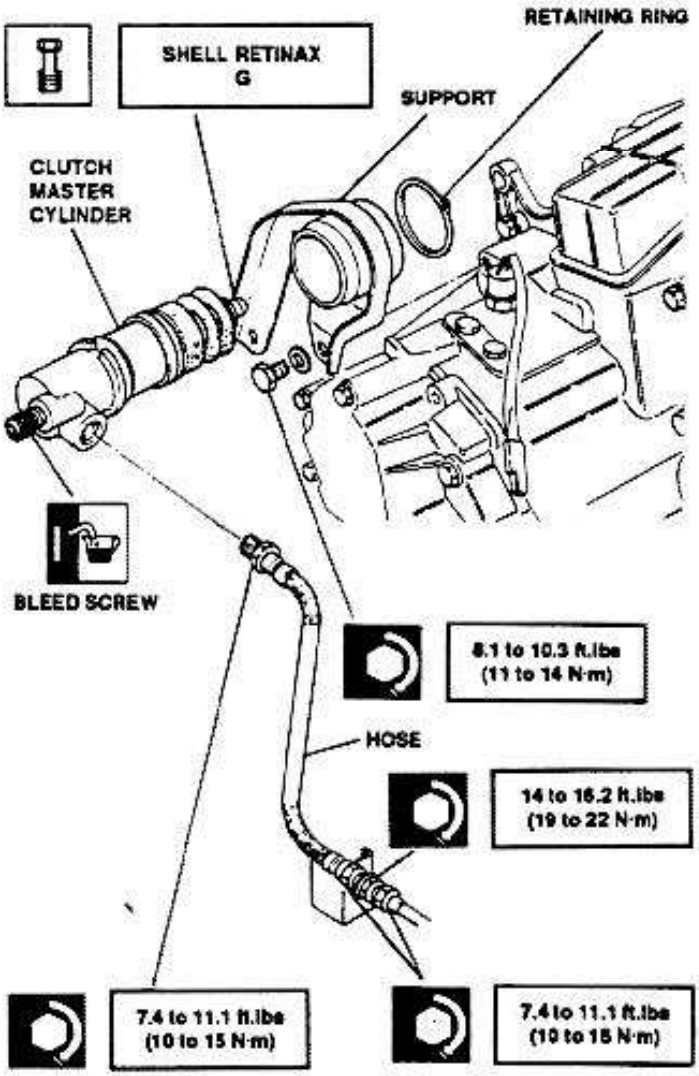


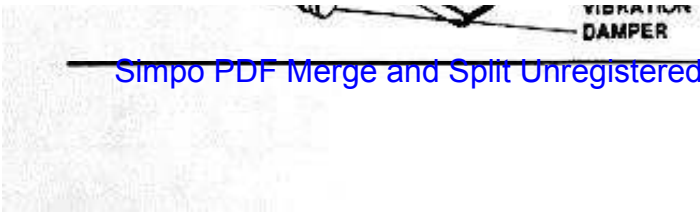
CLUTCH MASTER CYLINDER

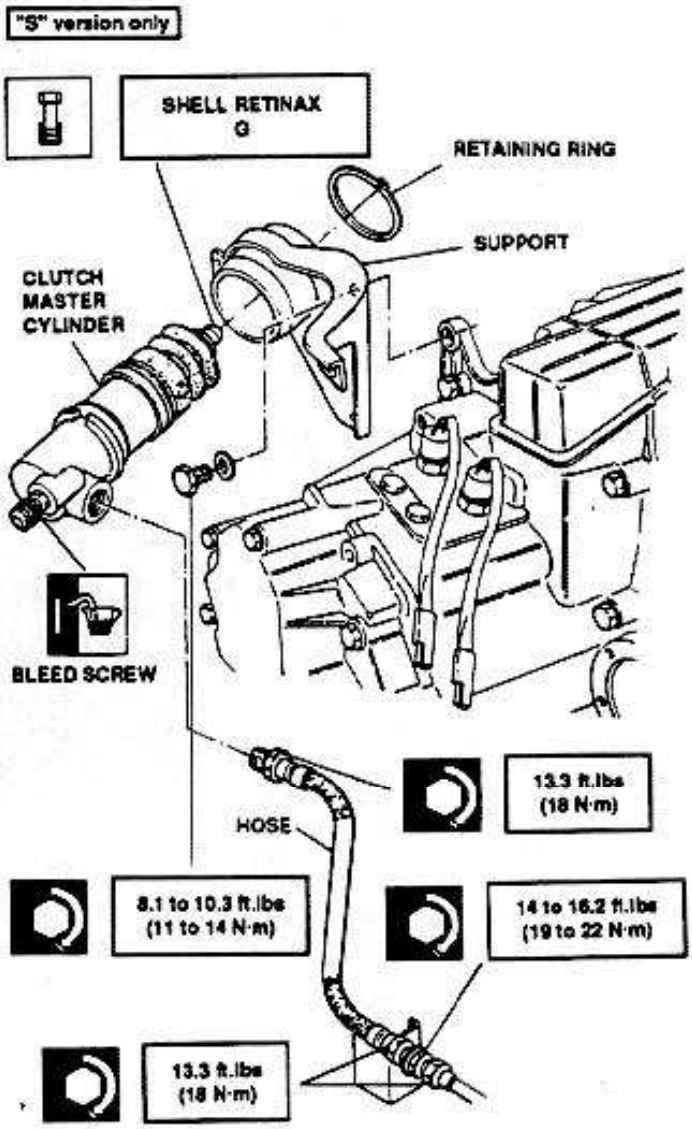
The clutch master cylinder engages and disengages the clutch by the pressure of fluid delivered by the clutch pump. The cylinder acts directly on clutch control lever. Overhaul of the clutch master cylinder can not be performed: therefore, replace cylinder if defective.

REMOVAL/INSTALLATION

1. Remove retaining ring.
2. Extract clutch master cylinder from its support.
3. Disconnect hose and plug openings.
4. If required, remove three attaching nuts and remove support.
5. Following installation, bleed air trapped in system (Refer to: **"HYDRAULIC SYSTEM BLEEDING"**).





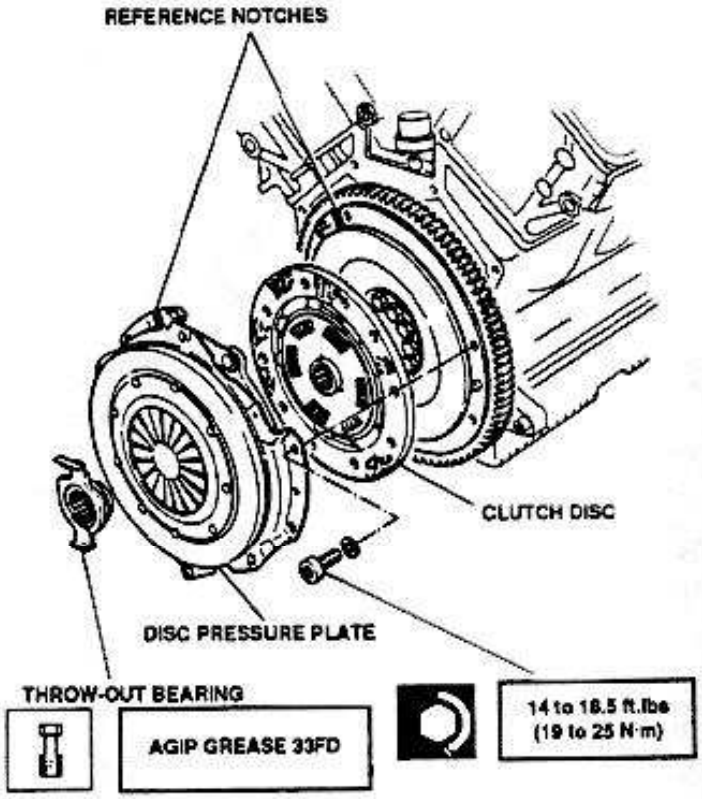


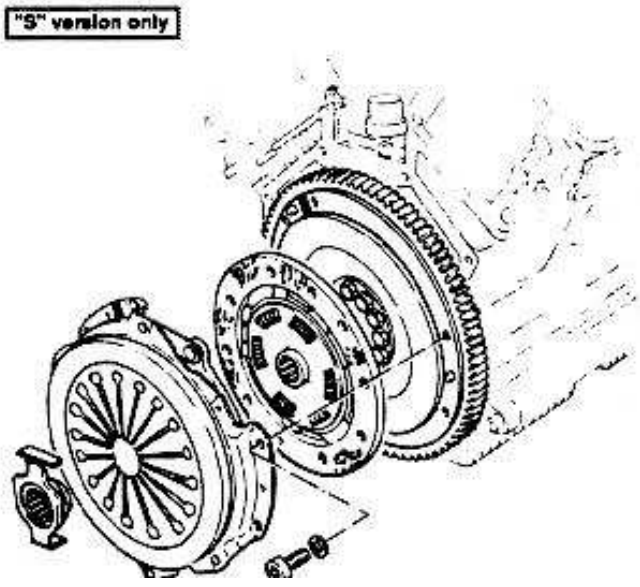
CLUTCH UNIT

The clutch unit mechanically connects the engine crankshaft (flywheel) to the driven shaft (gearbox main shaft) by means of the friction forces developed by the flywheel and clutch disc surfaces which are faced and pressed one against the other by the diaphragm spring.
The main components of clutch unit are: the clutch disc, disc pressure plate, throw-out bearing and thrust bearing control rod.

DISASSEMBLY/REASSEMBLY

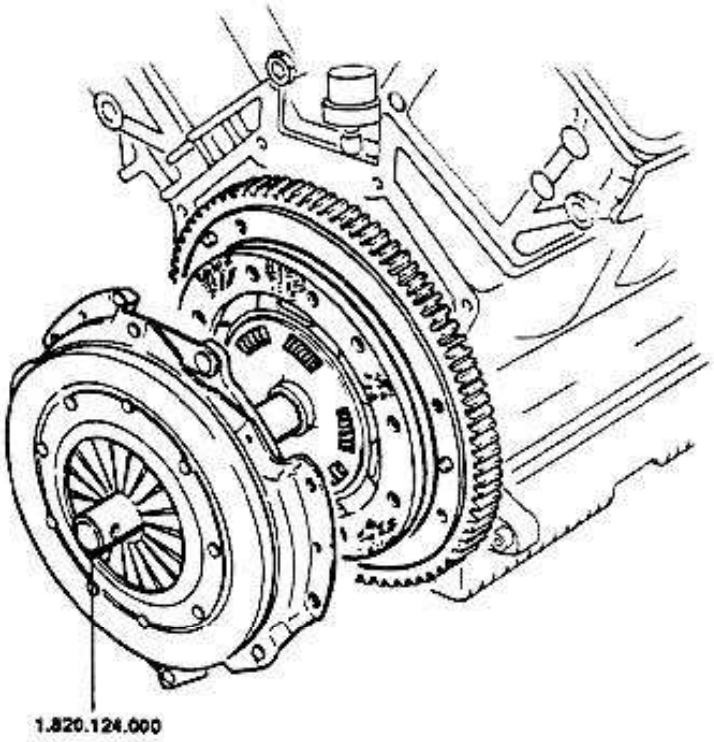
1. Remove gearbox (refer to Group 23).
3. Remove attaching screws, then remove disc pressure plate and clutch disc.
4. Release springs and remove throw-out bearing - (on "S" version only). Remove throw-out bearing using tool No. 1.821.215.000.

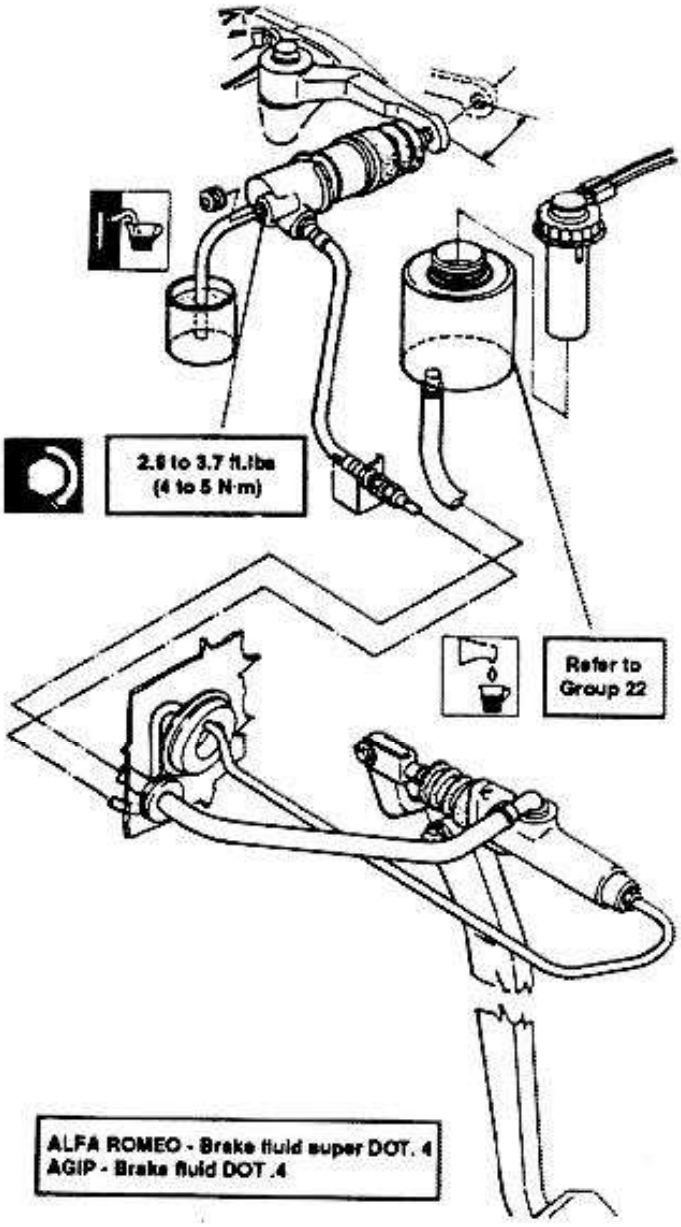




2. Countermark flywheel and disc pressure plate.

5. At reassembly, center clutch disc using tool No. 1.820.124.000.





HYDRAULIC SYSTEM BLEEDING

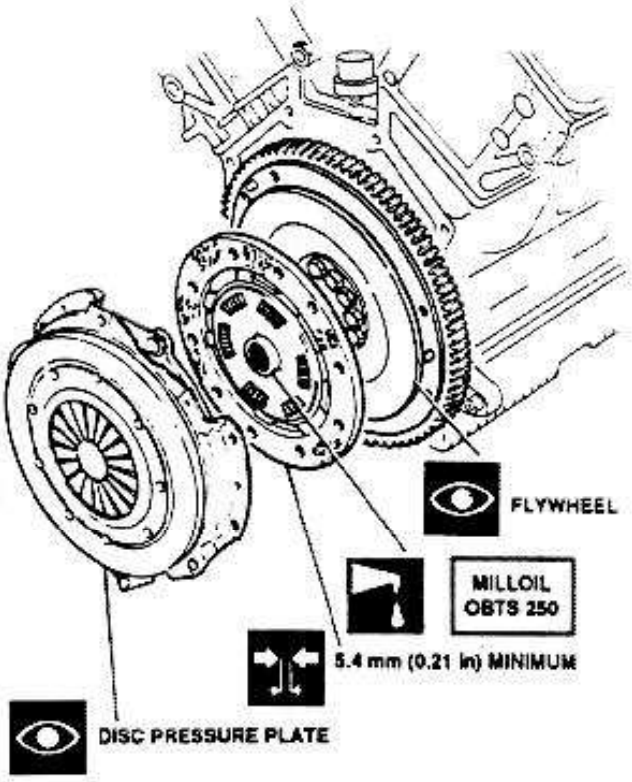
PRECAUTIONS:

- Never re-use hydraulic fluid drained during bleeding.
- During bleeding, maintain level of fluid in reservoir above "MIN" mark.
- Take any precaution to prevent hydraulic fluid from contacting the paintwork.
- After bleeding has been accomplished, check for proper disengagement of clutch and engagement of speeds.
  If required, check disengagement travel of clutch control lever.

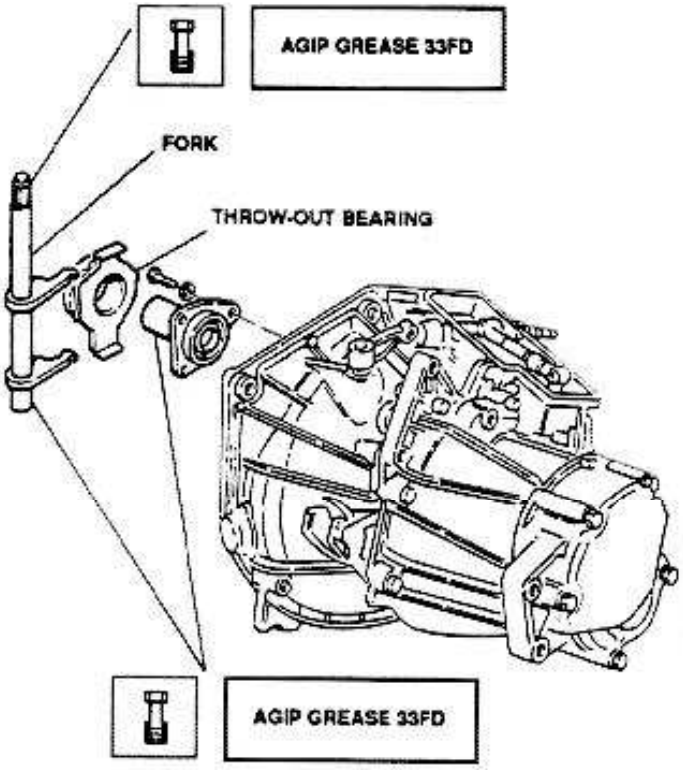
CHECKS AND INSPECTIONS

1. Check clutch disc for even wear of friction gaskets and minimum thickness, absence of burns or traces of vetrification; check fastening devices for proper riveting and cushioning springs for integrity.
   Check clutch disc hub for integrity, freedom of movement and absence of excessive play of coupling onto drive quill shaft.

2. Check work surfaces of flywheel and disc pressure plate for traces of overheating, abnormal wear, nicks or removed material. If necessary, replace disc pressure plate and/or grind the flywheel (refer to **Group 01**).



3. Check throw-out bearing for noisy operation, excessive play and freedom of movement onto guide sleeve.
4. Check fork for cracks, distortion, freedom of movement and excessive wear of work surfaces.



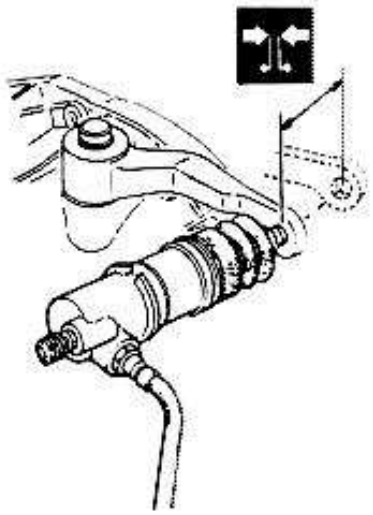
TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

FLUIDS AND LUBRICANTS

Application	Type	Name
Pin connecting clutch pedal to clutch master cylinder	GREASE	SHELL RETINAX G
Spherical seating in clutch control lever plunger of clutch master cylinder	GREASE	SHELL RETINAX G
Throw-out bearing seating and clutch control lever shaft	GREASE	AGIP GREASE 33 FD
Clutch hydraulic system servicing	FLUID	ALFA ROMEO Brake fluid super DOT 4 AGIP Brake fluid DOT 4
Clutch disc spline	OIL	MILLOIL OBTS 250

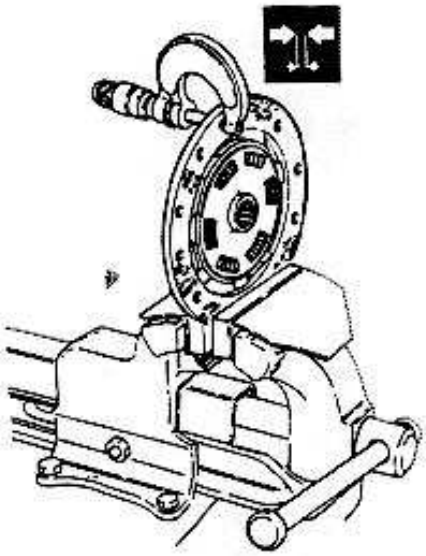
CHECKS AND ADJUSTMENTS

CLUTCH CONTROL



Clutch control lever disengagement stroke	15.5 to 18.0 mm (0.61 to 0.71 in)
Clutch control lever disengagement stroke ("S "version)	12.6 to 14.1 mm (0.50 to 0.55 in)
Control lever maximum stroke with clutch disc to wear limit ("S" version)	19.27 to 20.77 mm (0.76 to 0.82 in)

CLUTCH DISC



Disc thickness (new)	7.4 to 8.0 mm (0.29 to 0.31 in)
Disc thickness to wear limit	5.4 mm (0.21 in)
Disc thickness (new) ("S" version)	7.1 to 7.7 mm (0.28 to 0.30 in)
Disc thickness to wear limit ("S"version)	5.4 mm (0.21 in)

TIGHTENING TORQUES

Disc pressure plate to flywheel attaching screws	14 to 18.4 ft.lbs	19 to 25 Nm
Clutch master cylinder support to gearbox attaching screw	8.1 to 10.3 ft.lbs	11 to 14 Nm
Clutch pump attaching nuts	8.1 to 10.3 ft.lbs	11 to 14 Nm
Clutch master cylinder bleed screw	2.9 to 3.6 ft.lbs	3.9 to 4.9 Nm
Hydraulic system fitting nuts	7.4 to 11 ft.lbs	10 to 15 Nm
Clutch master cylinder fitting	14 to 16.2 ft.lbs	19 to 22 Nm
Vibration damper fitting	13.3 lbs	18 Nm
Vibration damper to air filter support	3.5 to 4.4 lbs	4.8 to 6 Nm

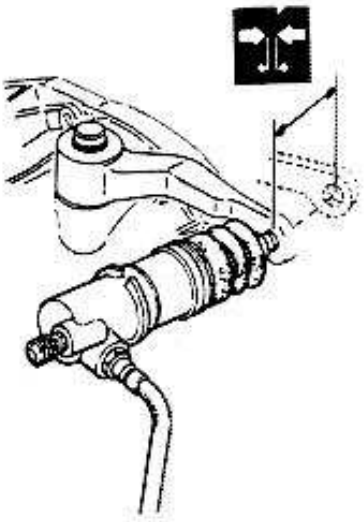
SPECIAL TOOLS

Tool number	Description
1.820.124.000	Disc clutch centering mandrel
1.821.215.000	Throw-out bearing puller

TROUBLESHOOTING PROCEDURE

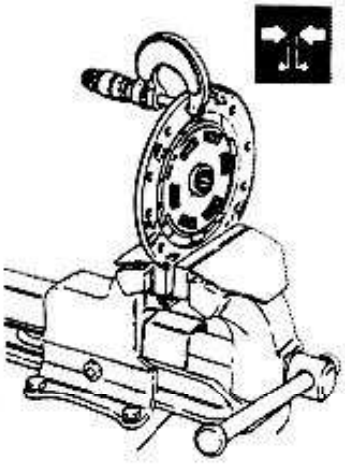
TROUBLES AND SYMPTOMS	FAULT ISOLATION	TEST REFERENCE
CLUTCH SLIPS During acceleration, engine revs increase, without corresponding increase of vehicle speed.	- Start engine. - Apply parking brake. - Press clutch pedal and shift into 4th gear. - Accelerate and release clutch pedal gradually; the vehicle does not move or moves slightly and engine does not stop.	**A**
CLUTCH DOES NOT DISENGAGE PROPERLY Sticking or noises are noted during shifting to a lower gear or to reverse gear.	- Start engine. - Press clutch pedal and engage 1st gear after 1 to 2 seconds; noise is noted during gear shift.	**B**
CLUTCH VIBRATES OR JERKS Clutch pedal vibrates during pedal release.	- Start engine. - Press release clutch pedal; vehicle does not begin moving smoothly, by it jerks and vibrates.	**C**
CLUTCH IS NOISY	- Start engine. - Press and release clutch pedal: noise is noted during pedal actuation.	**D**
EXCESSIVE PRESSURE REQUIRED TO ACTUATE CLUTCH PEDAL Clutch requires excessive pedal pressure.		**E**

CLUTCH SLIPS	TEST A

TEST STEPS	RESULTS	REMEDY
A1 PEDAL CHECK - Check that clutch pedal returns to proper rest position when released	OK ▶ ~~OK~~ ▶	Carry-out step A3 Carry-out step A2
A2 CLUTCH MASTER CYLINDER CHECK - Check that clutch master cylinder pin returns to proper rest position; furthermore, visually check the exterior of master cylinder body for absence of oil leakage through the piston inner seal	OK ▶ ~~OK~~ ▶	Carry-out step A3 Replace clutch master cylinder; if fault persists replace clutch pump
A3 CONTROL LEVER CHECK - Check that clutch control lever disengagement travel is within limits  15.5 to 18 mm (0.6 to 0.7 In) for "S" version only: 12.6 to 14.1 mm (0.5 to 0.55 In)	OK ▶ ~~OK~~ ▶	Carry-out step A4 Overhaul clutch unit

(Cont.d)

CLUTCH SLIPS	TEST A

TEST STEPS	RESULTS	REMEDY
A4 CLUTCH DISK CHECK		
- Check wear of clutch disk lining  **for all versions: min. 5.4 mm (0.21 in)**	OK ▶ ~~OK~~ ▶	Carry-out **step A5** Replace **clutch disk**
A5 OIL OR GREASE CONTAMINATION CHECK		
- Check for presence of oil or grease on the disk surfaces	OK ▶ ~~OK~~ ▶	Carry-out **step A6** Replace **clutch disk** and **gearbox main shaft oil seal**
A6 FLYWHEEL AND DISK PRESSURE PLATE CHECK		
- Check working surfaces of flywheel and disk pressure plate for traces of overheating, uneven wear, nicks and removed material	~~OK~~ ▶	Replace **disk pressure plate** and/or grind **the flywheel material** (refer to **Group 01**)

End of test A

CLUTCH DOES NOT DISENGAGE PROPERLY — TEST B

TEST STEPS	RESULTS	REMEDY
B1 FLUID LEAKAGE CHECK - Visually check for fluid leakage from clutch actuating cylinder, pump or lines	OK ▶ ~~OK~~ ▶	Carry-out step B2 Replace defective items
B2 PUMP INTERNAL LEAKAGE CHECK - Press clutch pedal slowly, and simultaneously check that fluid does not flow back to the reservoir - Start engine, press clutch pedal, engage first gear and hold the clutch pedal pressed; wait for about 30 seconds and verify the vehicle does not tend to move	OK ▶ ~~OK~~ ▶	Carry-out step B3 Replace clutch pump
B3 TRAPPED AIR CHECK - Check for presence of air trapped into the hydraulic circuit by verifying that clutch control lever disengagement travel is within limits	OK ▶ ~~OK~~ ▶	Carry-out step B4 Purge trapped air from the circuit
B4 SPLINED COUPLING CHECK - Check for presence of dirt, rust or dents on splines of clutch disk hub and of gearbox main shaft	OK ▶ ~~OK~~ ▶	Carry-out step B5 Polish out any damage and clean the hub and main shaft splines; replace clutch disk, if necessary

(Cont.d)

GROUP 00

COMPLETE CAR

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GROUP 00

COMPLETE CAR

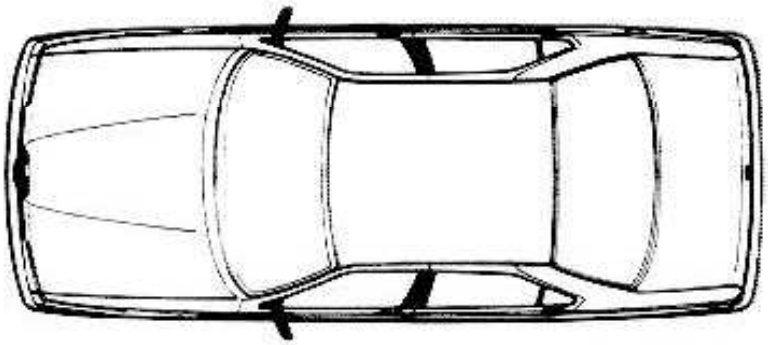
TABLE OF CONTENTS

COMPLETE CAR

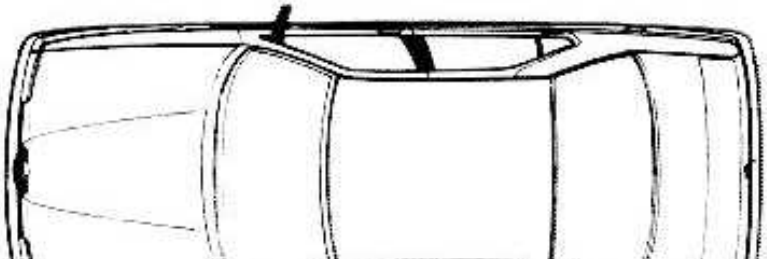
ALFA ROMEO 164

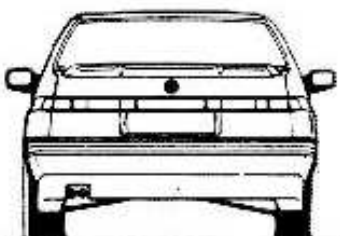
DIMENSIONS
mm (in)

164 - 164 L



164 S





WEIGHTS AND LOADS

			164 - 164 L (M.T.)	164 - 164 L (A.T.)	164 S
Curb weight		lbs kg	3300 1510	3395 1540	3395 1540
Useful load		lbs kg	937 425	937 425	937 425
Max allowable weight per axle:	- front	lbs kg	2320 1052	2320 1052	2320 1052
	- rear	lbs kg	2100 953	2100 953	2100 953
Max roof load		lbs kg	177 80	177 80	177 80
Trunk capacity		cu.ft dm³	17.8 504	17.8 504	17.8 504
Minimum turning diameter		ft m	35.4 10.8	41.0 (right) 38.0 (left) 12.5 (right) 11.6 (left)	35.4 10.8

WHEELS AND TIRES

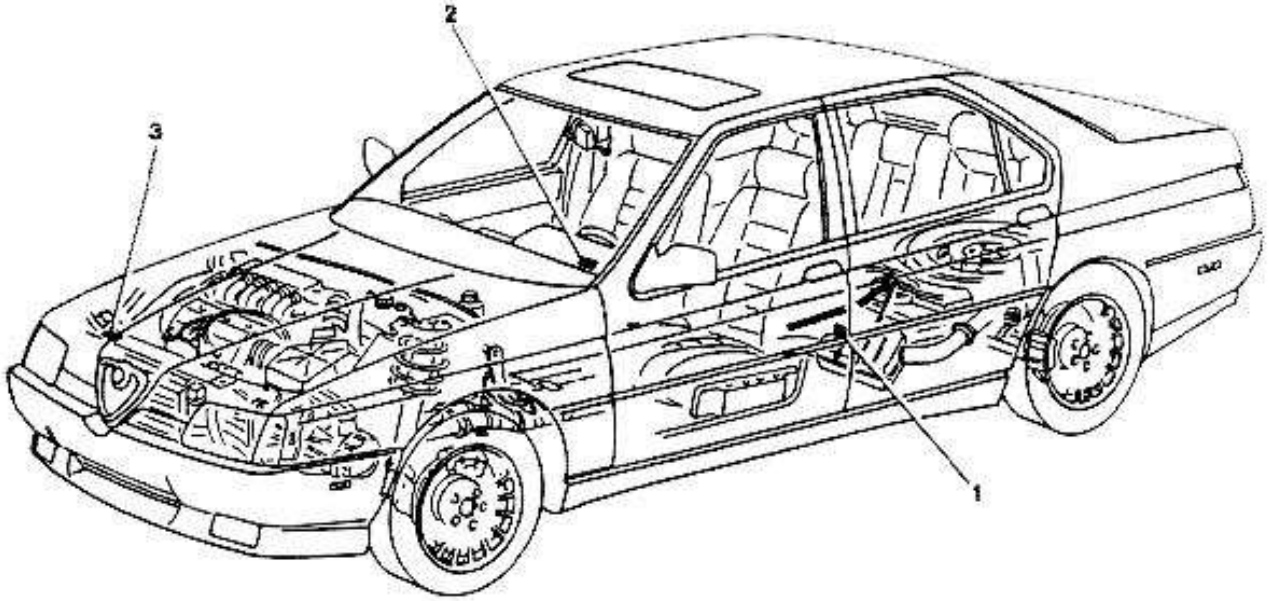
			164 - 164 L	164 S
Rims			6J x 15"	6J x 15 "
Tires			195/65 VR 15"	195/65 VR 15"
Make			PIRELLI P4000 GOOD YEAR EAGLE NCT	PIRELLI P4000 GOOD YEAR EAGLE NCT
Inflation pressure (cold tire) :				
- Reduced load, normal speed:				
	front	psi	31	31
		kPa	216	216
	rear	psi	28	28
		kPa	196	196
- Full load, high speed:				
	front	psi	35	35
		kPa	245	245
	rear	psi	35	35
		kPa	245	245
COMPACT SPARE WHEEL (1)				
Rim			4J x15"	4J x 15"
Tire			T 115/70 R 15"	T 115/70 R 15"
Inflation pressure (cold tire)		psi	60	60
		kPa	420	420

(1) Temporary use only. Max speed 50 mph - 80 km/h

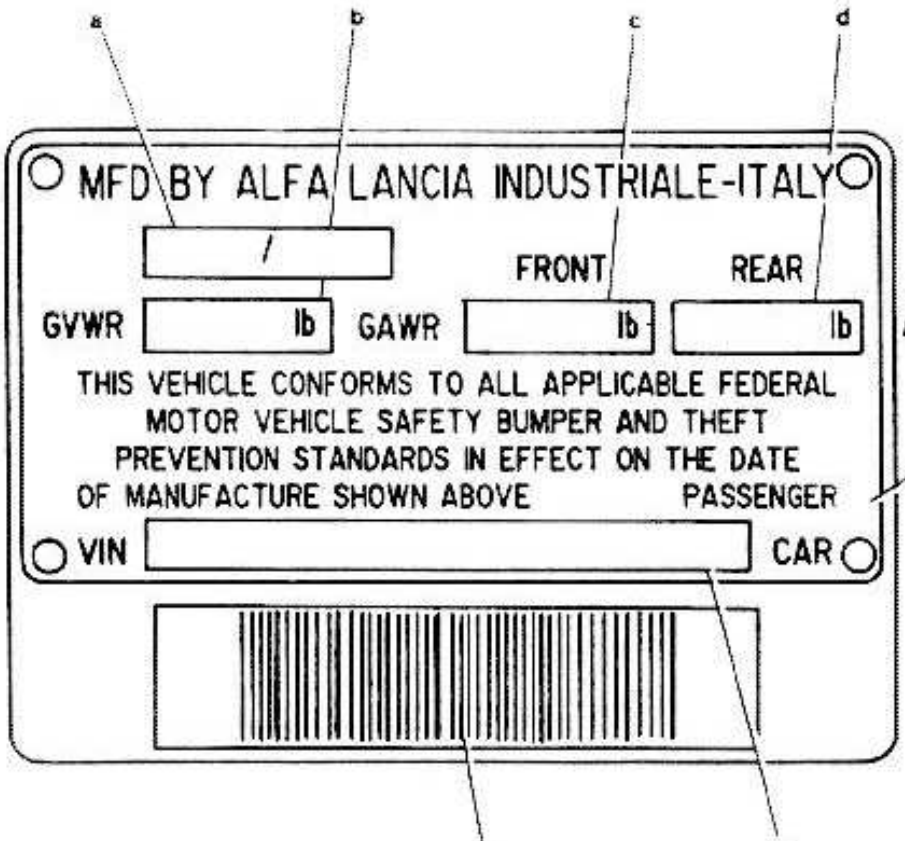
MODELS IDENTIFICATION

	164 Automatic Transmission	164 Manual Transmission	164 S
ENGINE FAMILY	LAR 3.0V5F6T5		MAR 3.0V5F6S5
CARLINE	1030		1030
ENGINE CODE	6412T1		6412T2
TRANS. CODE	6412 (M5)	6422 (A4)	6412 (M5)
EVAP. FAMILY	6412E1		6412E1
EVAP. CODE	6412E1.0		6412E1.0

VEHICLE IDENTIFICATION PLACARDS



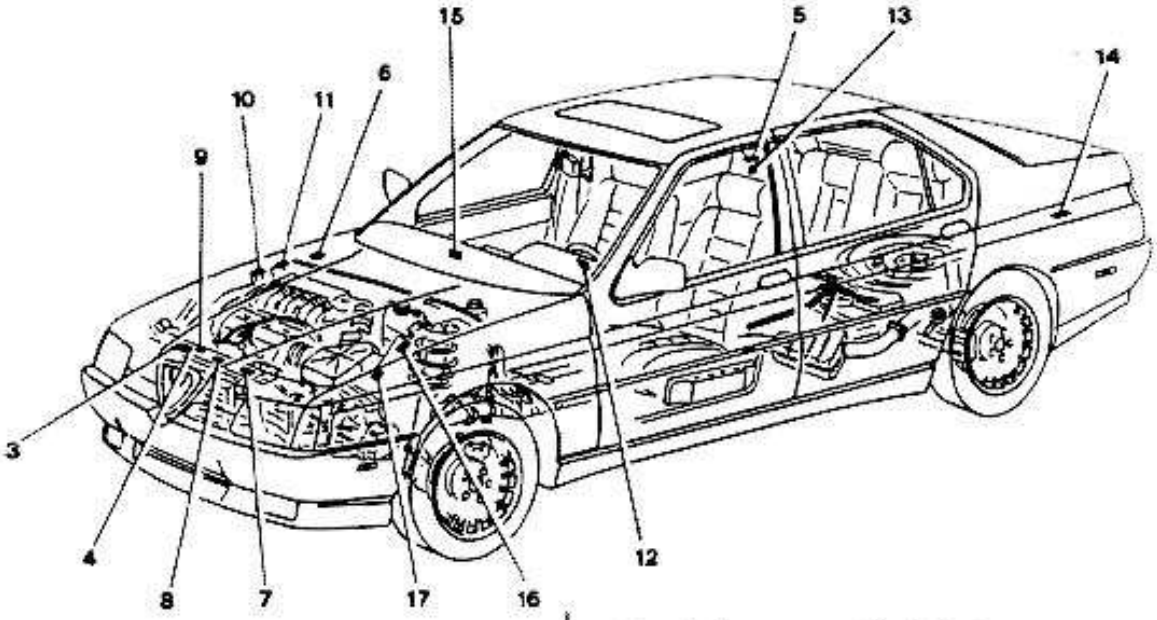
1 - D.O.T. certification and vehicle identification (V.I.N.) placard
2 - Vehicle identification number (V.I.N.) placard
3 - Engine tune-up label (see next page)



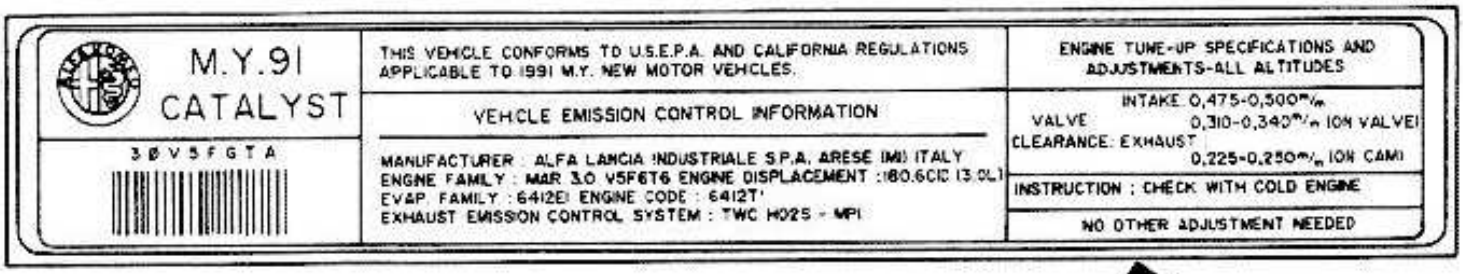
a - Month/year of manufacture
b - Maximum allowable load
c - Front axle maximum load
d - Rear axle maximum load
e - Number of passengers
f - Vehicle identification number (V.I.N.)

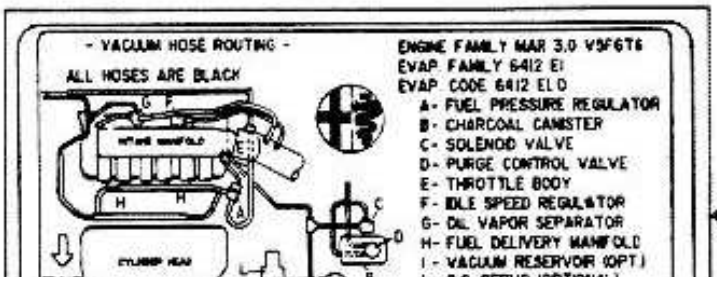
g f f - Vehicle identification number (V.I.N.)
g - V.I.N. bar code

MAINTENANCE AND WARNING LABELS



3 - Engine tune-up label
4 - Vacuum hose routing label
5 - Fuel requirement label
6 - Lubricants label
7 - Ignition system warning label
8 - Pressurized cap warning label
9 - Rotating units warning label
10 - Air conditioning fluid warning label
11 - Air bag warning label
12 - Air bag precaution label
13 - Tank cap opening label
14 - Battery label
15 - Tire pressure label
16 - Paintwork label
17 - Hood closing precaution label
— Anti-theft labels: set of 14 labels located on fenders (4), bumpers (2), doors (4), engine hood and trunk lid (2), engine (1) and gearbox (1)





Engine tune-up label

Vacuum hose routing label

SPECIAL TOOLS

The special tools play a very important role in the maintenance of the vehicle since they are essential to guarantee accurate, reliable and fast service.
It must be noted that the duration time of the various operations has been determined considering the use of the special tools.
This manual contains a list and the illustrations of the special tools designed by the vehicle manufacturer to carry-out overhaul, maintenance and repair activities of the car.
The tool identification code, which is the Part Number, consists of ten digits as specified below:

1.820.093.000 Tool, valves clearance check.

1.821.123.000 Puller, camshaft pulley

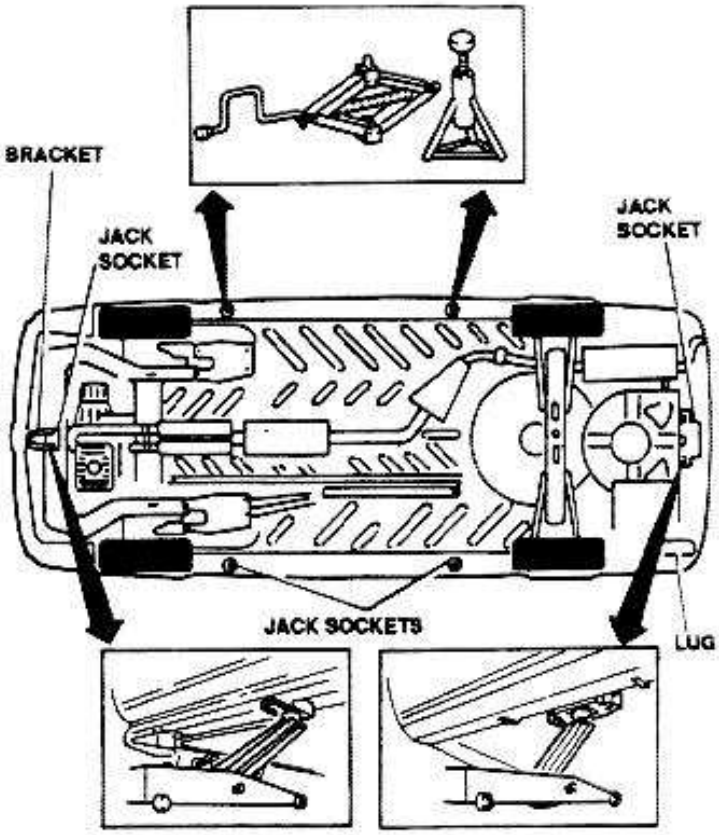
The tools in this manual are identified with the above shown Part Number, and are listed in a table located at the end of each Group.
Provisioning of the special tools can be performed by the assistance network following the procedures already existing by each Alfa Romeo Dealer.

JACKING AND TOWING POINTS

WARNING:

a. After the vehicle has been lifted on jacks, support it using suitable safety stands.

b. Before lifting the rear (front) side of the vehicle, block the wheels placing suitable chocks before (after) the front (rear) wheels.



TOWING INSTRUCTIONS

Since the towing sling is the most commonly used piece of lifting and towing equipment, all the following instructions must be observed.
If the vehicle is to be towed on its drive wheels, the transmission and differential must be operational.
Place the transmission to NEUTRAL; move the vehicle only within the manufacturer's recommended speeds and distances.
If any doubt exists about the condition of the transmission or differential, tow with the drive wheels off the ground, or use a wheel dolly.
Even on a drive-wheels-raised tow, the transmission must be in NEUTRAL, and the parking brake released.
During any tow, the raised wheels might contact the road or other ground surfaces so they need to rotate freely.
Before towing a vehicle from the rear (with the rear wheels lifted), unlock the steering wheel with the ignition key.

Safely position the jacks and safety stands in the locations shown in the illustration.

Then secure the steering wheel with a steering wheel clamping device, designed for towing service.

The anti-theft steering column lock is not strong enough to withstand shocks transmitted from the wheels while towing.

When locked vehicles must be moved and keys are not available, the front of the car should be lifted to prevent damage to the steering column anti-theft lock.

Locked rear-wheel drive cars should be moved with a wheel dolly under the drive wheels.

As an alternative to the wheel dolly the drive shaft can be disconnected, with parking brake released.

Do not tow over 50 mph for any reason. Safe operating speeds depend on weather, road, traffic, and visibility conditions, as well as the conditions of the towed vehicle. This applies in all cases of towing with a conventional tow truck, with or without the use of a towing dolly.

A tow truck is an emergency vehicle to be used to move disabled vehicles to a suitable place of repair and should not be used for long distances.

Sharp rises, such as curbs, should be crossed at 45° angle to minimize the possibility of scraping the underbody of the towed vehicle. Insure adequate ground clearance when towing over rough terrain or when crossing sharp rises such as curbs.

Ground clearance can be increased by removing the wheels from the lifted end of the disabled vehicle.

"Panic" or "fast" stops during towing should be avoided because many vehicles tend to ride up the sling. When this happens the vehicles may come in contact with rigid portions of the wrecker or sling, considerably damaging the towed vehicle and the wrecker.

To minimize the chances for ride-up, make sure the towbar end sling spacer bars is lower than the wrecker end of the spacer bars.

Towed vehicles should be raised until wheels are a minimum of six inches from the ground and there is adequate clearance at the opposite end of the lifted vehicles. Increased ground clearance may be obtained by using a dolly.

Lift the end of the disabled vehicle just as if towing. Never attempt to rock or pivot the vehicle on jack stands to allow positioning of the dolly.

important to use a safety chain system completely independent of the primary lifting and towing attachments. During installation of safety chains, be careful not to damage lights, bumpers, or painted surfaces.

Do not lift or tow any vehicle by attaching towing chains or hooks to rear springs, shock absorbers, stabilizer bars, front strut rods or the down eyes.

Position J-hooks and chains cautiously to prevent damage to brake lines located on the dedion axle tube.

When towing using the grab hook ends of the chains (commonly called "short-chaining"), pass the hook over then back under the chassis member before attaching the hook in the chain.

The hook will remain engaged in the event the chain becomes slack.

Regular use of silicone lubricant (aerosol spray or grease forms) will keep sling belts from weathering and deteriorating.

Such lubrication also helps prevent damage to rubber bumper strips and rubber-faced bumper guards. Inspect points of attachment to the disabled vehicle.

If they appear to be damaged select other attachment points at a substantial structural member of the frame. Do not allow the fuel tank to support any of the vehicle's weight during towing.

In addition, bumper-to-towbar restraint straps may be required to prevent fuel tank damage from sudden stops.

Before moving the vehicle, remove any loose or protruding parts of damaged vehicles.

The operator should be familiar with the specific towing equipment being used and follow the manufacturer's recommendations.

State and local laws regarding such items as warning signals, night illumination, speed, etc., must be followed.

Do not go under the vehicle while it is lifted by the towing equipment. Never allow passengers in a towed vehicle.

The safety of the operator and others in the vicinity of the wrecker or the towed vehicle must be considered at all

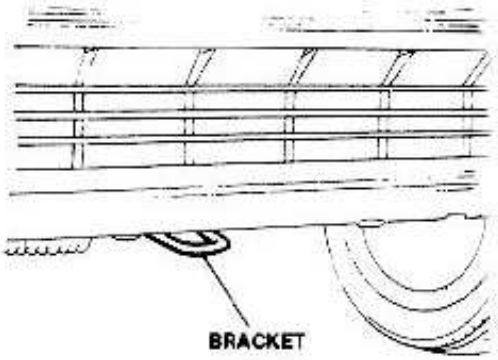
Serious operator injury or vehicle damage may result. It is | times.

TOWING THE VEHICLE

Not recommended with conventional sling-type equipment. Sling-type equipment may damage the front airdam. If the vehicle must be towed from the front, wheel lift or flat bed equipment is recommended.

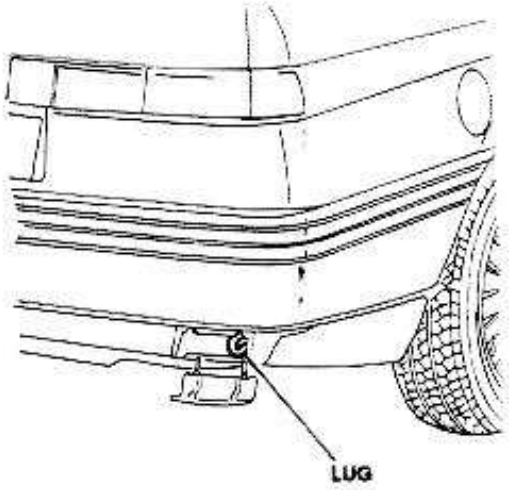
NOTE: When towing, local laws and regulations in effect locally should be strictly adhered to. When being towed, secure the rope to brackets. Turn the steering lock/ignition switch key to the position 0 (stop).

NOTE: Never withdraw the key from the steering lock/ignition switch because it is possible for the steering lock to engage accidentally.



While the car is being towed, no power assistance is available to the brake system; a substantially greater foot pedal effort will therefore be needed to obtain comparable braking effect.

NOTE: Under no circumstances must towing be attempted by attaching chain or cables to the bumpers. The bumpers are mounted on energy absorbing units that can easily be damaged by towing and render ineffective their low speed protective characteristics. When towing another vehicle, secure the rope to the hole in



VARIANTS FOR VEHICLES EQUIPPED WITH AUTOMATIC TRANSMISSION

a) "Flat Bed" towing is recommended over the conventional (tow trunk) method if possible.

b) If "Flat Bed" transportation is not available, it is recommended to tow the car with the front wheels off the ground to avoid excessive drive train wear/damage.

If recommendations a) and b) above are not available, the car may be towed for less than (30 miles) with the selector lever in N at speeds of 50 Km/h (30 mph) or less.

NOTE: For longer towing distances 1 Kg (2 lbs) of prescribed oil should be added to the automatic transmission.
Towing speed must never be higher than 50 Km/h (30 mph). This additional quantity of fluid must however be drained off when towing is over.

When towing do not start the engine. If the above towing instructions are not strictly observed, severe damage to

the lug at the underside of trunk.

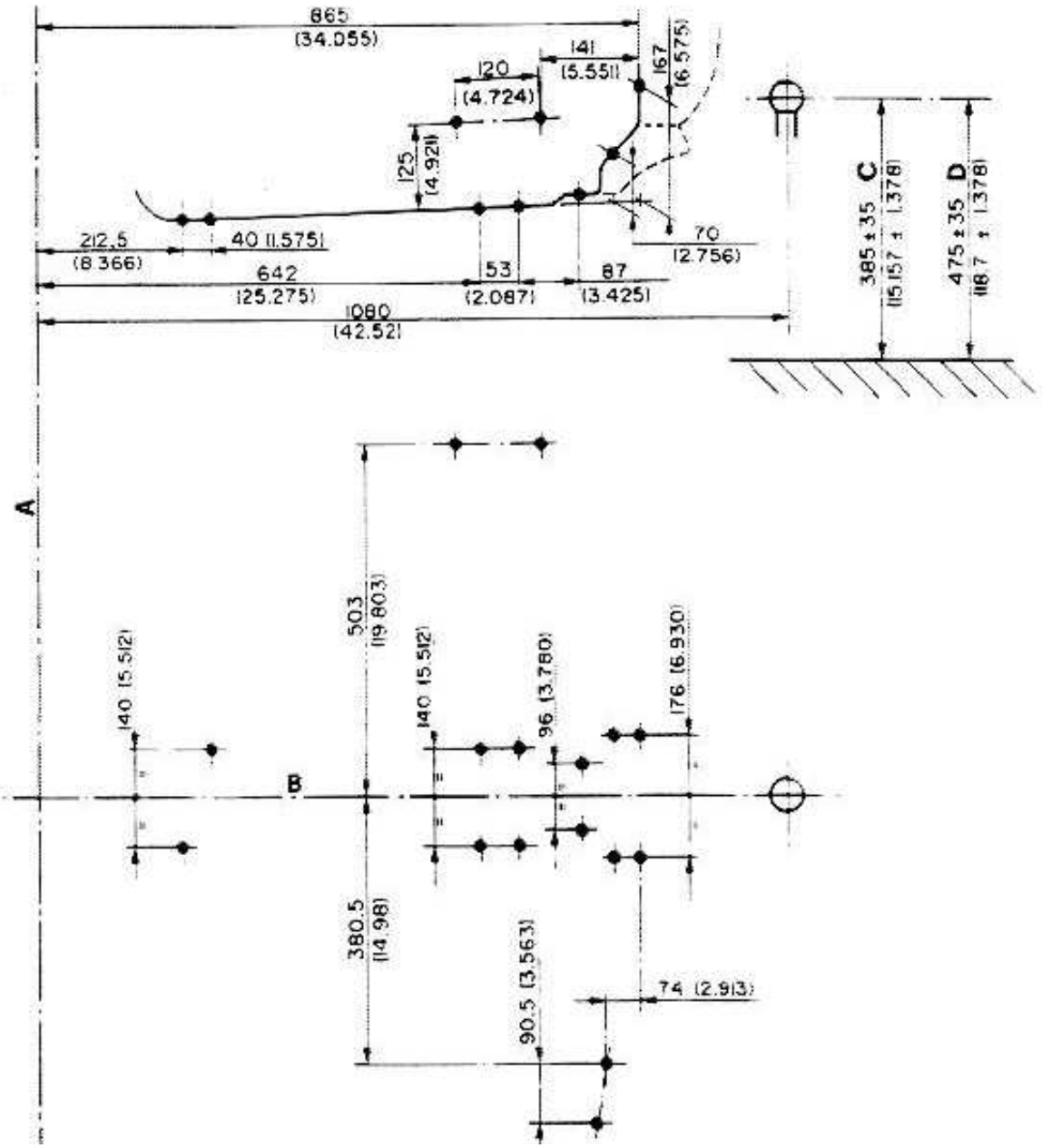
automatic transmission will result.

TOW HOOK

The vehicle is enabled to tow a trailer by applying a suitable tow hook.
Alfa Romeo supplies a tow hook complying with the local safety rules.
The following scheme shows the attachment points to the car body, which do not vary according to the tow hook shape and dimension.
The electrical junction for the trailer electrical connection must be applied to the hook supporting arm, in the most suitable position.

CAUTION:
After performing drilling operations, protect the involved steel sheet area by using a suitable product which will avoid direct contact with atmospheric agents, and consequent oxidation.

mm (in)



A - Rear wheel centre line
B - Vehicle centre line
C - Static load
D - Unladen

PRE-DELIVERY CHECKS

INTRODUCTION

This paragraph lists all checks to be carried-out on the Alfa Romeo 164 model prior to delivery. The pre-delivery checks consist of a series of inspections to be carried-out on new vehicles before delivery to a customer with the aim of identifying any possible malfunction. At the receipt of vehicles, the dedicated personnel must anyway visually inspect it to determine:

- The vehicle is in running conditions, in particular for what the lubricants, fluids, etc. are concerned.
- The vehicle is free of dents, scratches or any other defect of the body and of the upholstery.
- The presence of all the applicable equipment.

PRE-DELIVERY CHECKS

TOPPING UP (Levels)

1 Engine Coolant
2 Engine oil
3 Gearbox/differential oil
4 Brake and clutch fluid
5 Power steering fluid
6 Windshield washer fluid

CHECKS

7 Tyre pressures
8 Wheel nut tightening
9 Tool kit and spare wheel

OPERATION

10 Battery
11 Engine starting
12 Engine controls
13 Engine cooling fan
14 Clutch and brake pedals, gear shift lever
15 Instrument panel
16 Leaks from all systems
17 Heating and air conditioning
18 Headlights, warning lights and electrical accessories
19 Windshield wiper and washer
20 Locks and hinges, power window lift.
21 Seat adjustment, seatbelts, steering wheel adjustment and outside mirrors
22 Inspect body for water seepage
23 Road test

BODY

24 External and internal cleanliness
25 Paintwork
26 Interior and exterior trimming

SAFETY DEVICES

ACTIVE SAFETY

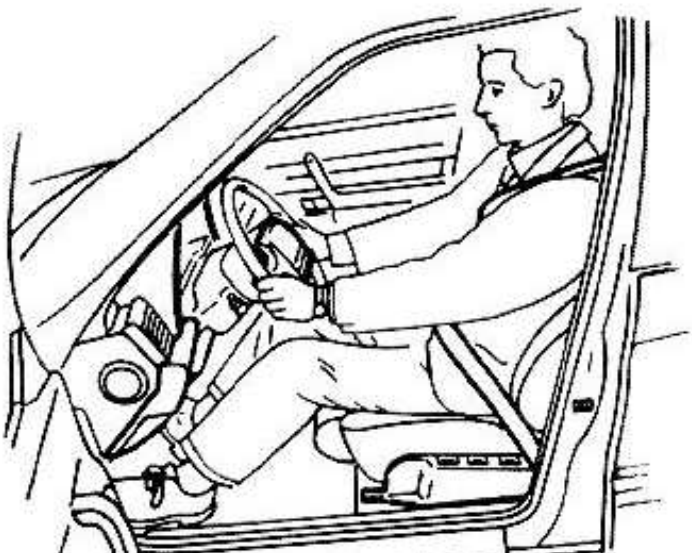
The active safety is a new design philosophy that provides effective means to prevent accidents in addition to already known passive safety devices that intervene after a collision.
The most significant results of this new philosophy are:

- Brake system with A.B.S.
- High stiffness of vehicle body, and in particular of the passenger compartment.
- Optimized suspensions for a high road holding.
- High visibility from driver's place.
- Travel comfort (soundproofing, air conditioning).
- Weight distribution and vehicle's attitude.

PASSIVE SAFETY

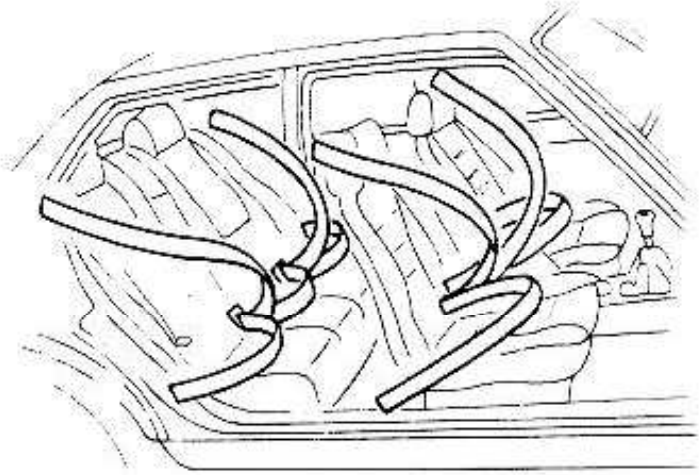
To provide occupants with highest grade of passive safety, an integrated restraint system has been designed, as follows:

- Seat belts.
- High energy absorption knees protections properly located below the dashboard.
- Air Bag (Supplementary Restraint System - S.R.S.).



SEAT BELTS

The front seats are provided with three-point type automatic reeling belts (inertial reel belts); the belt upper attachment point can be adjusted to fit occupant height.
The belts conform to the most restrictive regulations.
The two lateral rear seats are provided with three-point type automatic reeling belts (inertia reel belts), whilst the central seat is provided with a lap belt.



TECHNICAL DATA

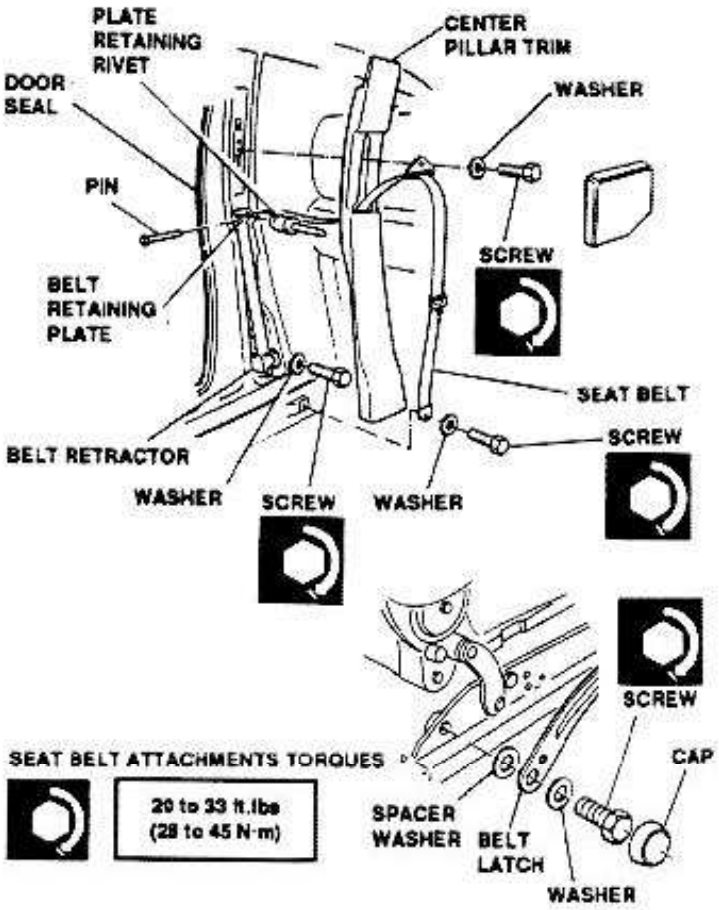
Minimum strength offered by seat belts (according to current regulations: FMUSS N. 209).

- Stretching at 9.8 kN (2200 lbs) = 6 to 8%
- Breaking load ≥ 28 kN (6300 lbs)

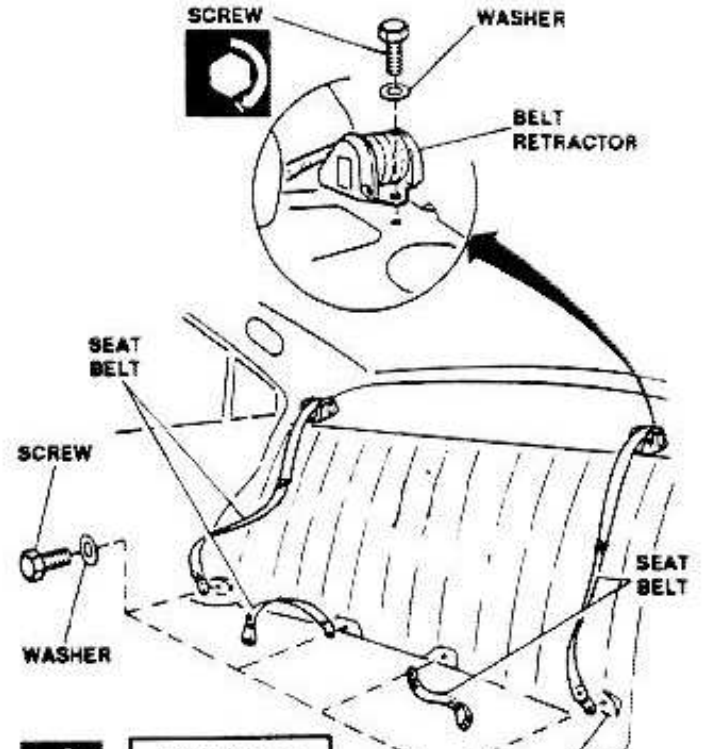
REMOVAL/INSTALLATION

(Refer to **Group 66 - SEAT BELTS**).

FRONT SEAT BELTS



REAR SEAT BELTS

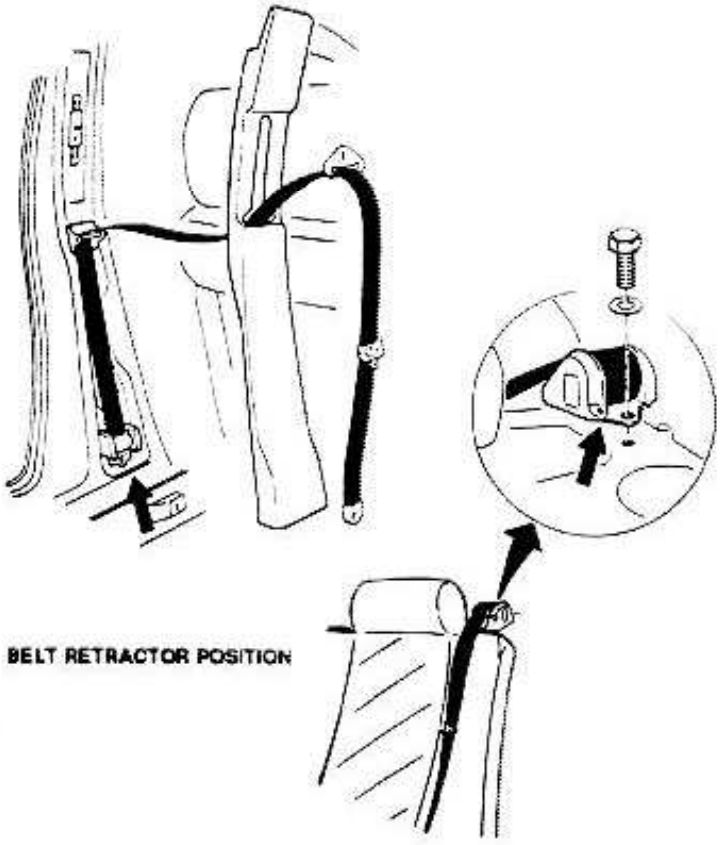


CHECKS AND INSPECTIONS

Carefully check the belts for absence of damages, wear or fraying. Replace belts if any of these damages is found. Check proper operation of the automatic belt reeling device:

- The belt retracts regularly when reeled out smoothly.
- The belt locks when reeled out quickly and with force.

Check proper positioning of retractor in case of abnormal operation: proper operation could be prevented even by a small displacement from design and installation angle: restore correct position of retractor , or replace if necessary.



BELT RETRACTOR POSITION

NOTE: **In case of accidents or violent collision, it is recommended to replace the seat belts, the attachments, retractors and securing screws.**
Even if the belts shown no evident damage, their original strength could have been

20 to 32 ft.lbs
(28 to 44 N m)

LOWER
ATTACHMENTS

weakened.

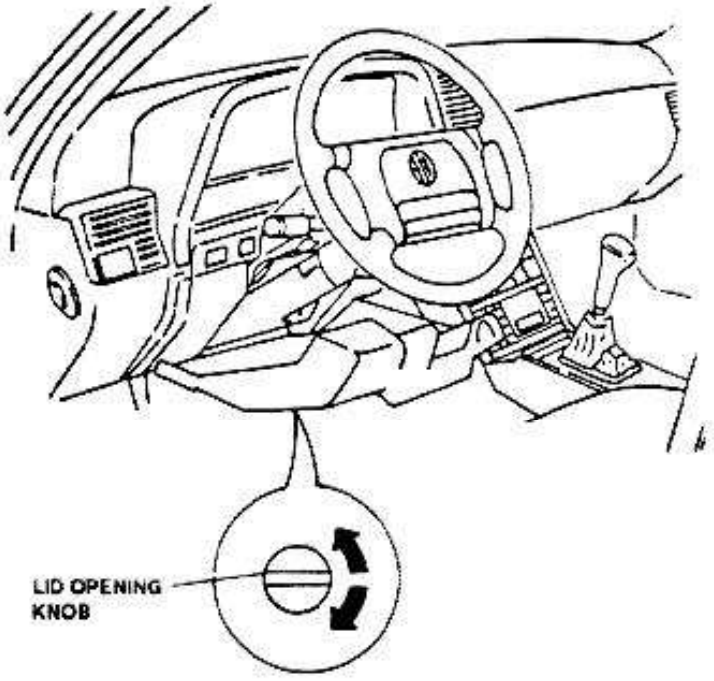
SEAT BELT ATTACHMENTS TORQUES

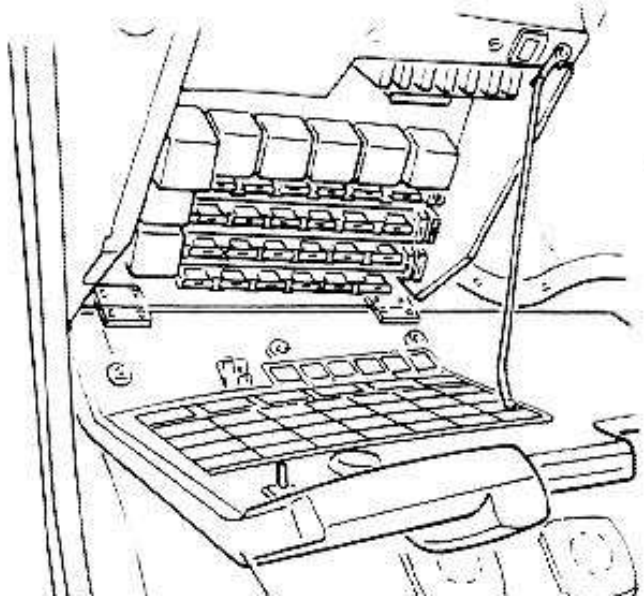
KNEES PROTECTIONS

REMOVAL/INSTALLATION

Driver's knees protection

1. Open fusebox lid integrated with the knees protection acting on relevant knob.
2. Remove knees protection acting on attachment screws.





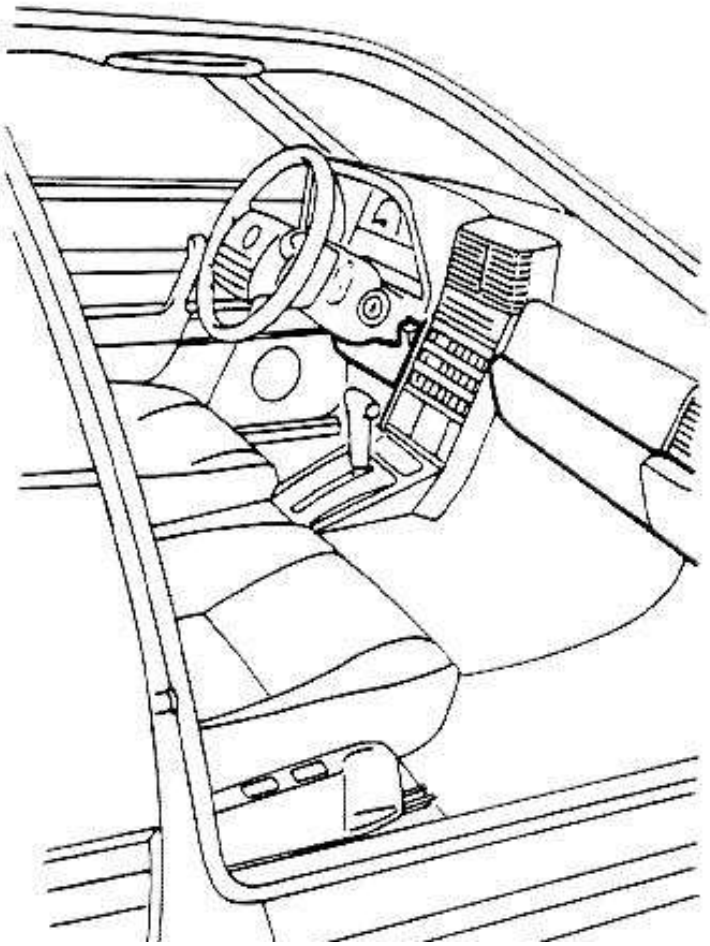
CHECKS AND INSPECTIONS

Carefully check the knees protections for absence of distortion or breakage, even of minor entity. Replace knees protections if damaged.
Furtherly, check attachments for absence of damages.

NOTE: In case of accidents or violent collision, always remove and carefully inspect the knees protections.

Passenger's knees protection

The front passenger's knees protection is integrated in the dashboard.
Refer to **Group 66 "DASHBOARD, REMOVAL AND INSTALLATION".**

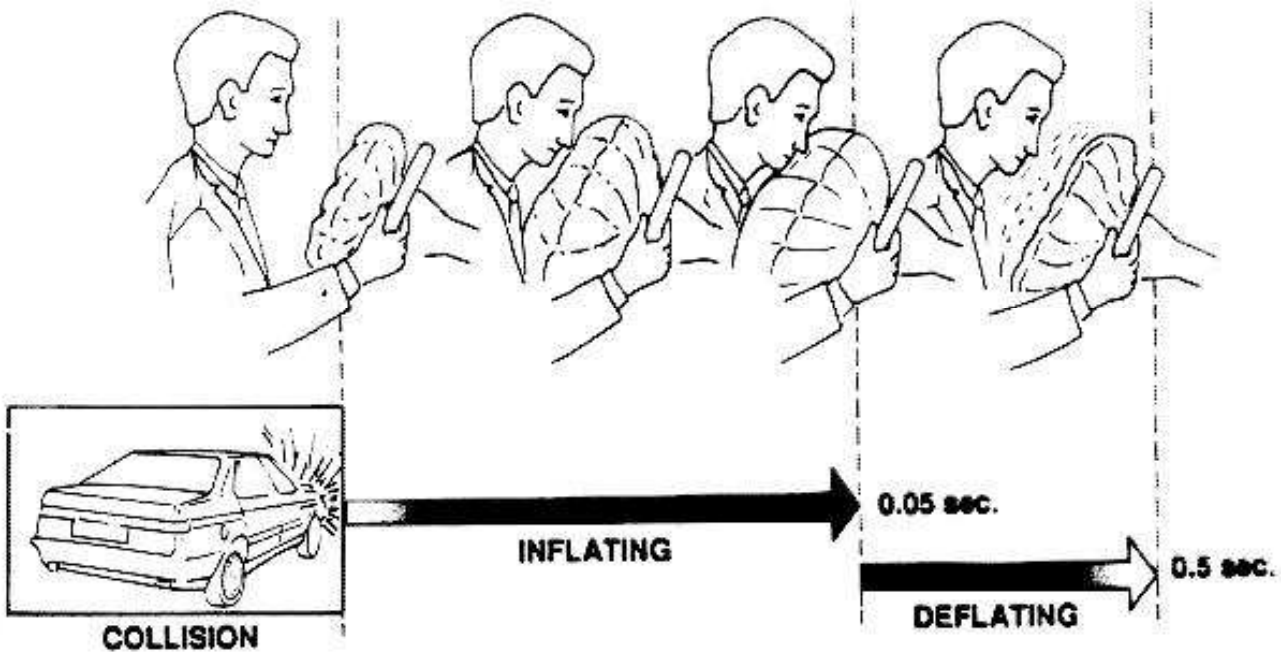


AIR BAG (Supplementary Restraint System - S.R.S.)

The driver's safety has been furtherly implemented with the installation of the Air Bag, which prevents the driver from hitting the steering wheel in the event of a violent collision.

OPERATION

The air bag consists of an electronically controlled device that actuates a bag stowed inside the steering wheel, that "blasts" in case of violent collision and inflates between the driver and the steering wheel.
Inflation of the air bag is almost instantaneous, as weel as its deflation to allow the driver to recover control of the vehicle.
Furthermore, the geometry and size of the steering wheel are such as to direct the bag towards th driver's chest, thus preventing a dangerous "punch" on his chin or face that could dangerously stun him.

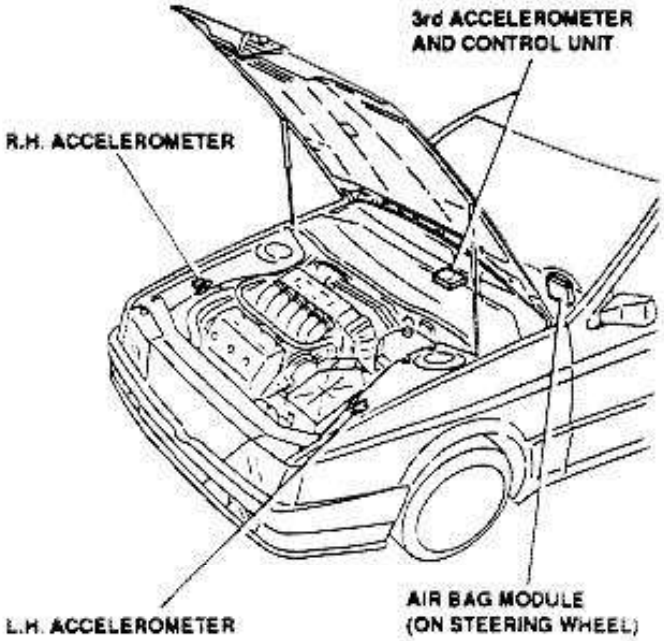


DESCRIPTION

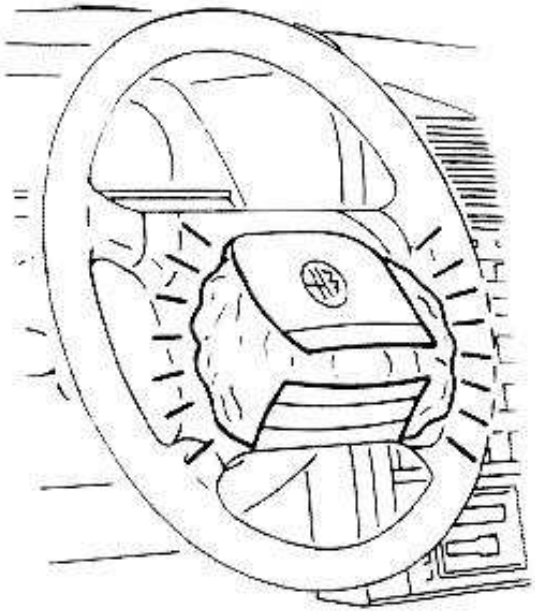
The air bag system consists of:

- **Three accelerometers**: two are located on right and left sides of engine compartment and one is located on the control unit.
  Setting of the accelerometers is such that a signal is supplied to the control unit is case of a very high deceleration.
  The accelerometer on the control unit has a function of control and monitoring to prevent the actuation of the air bag in case of lateral collisions, sudden bounces or other accidental reasons.
- The **control unit** receives the collision signals from the accelerometers and, after the signal has been verified, it delivers in real time a current signal to the air bag module.
  The control unit monitors the proper operation of the system through a safety circuit, and alerts of any malfunction to the system switching on the relevant warning lamp on the instrument panel.
  Furthermore, this safety circuit will send the current signal to the air bag module even if the control unit is malfunctioning or in failure.

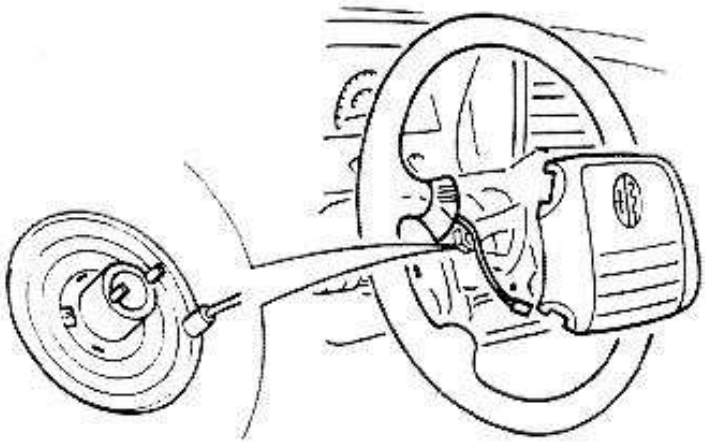
- The **air bag module**, located in the steering wheel, contains a blasting charge (squib). In case of a collision, the current signal delivered by the control unit actuates the squib which will produce the gas necessary to inflate the bag; the bag remains inflated for a few instants, then deflates discharging the gas through calibrated holes.



The cover of the air bag module has been designed with particular sections (of lower thickness) that facilitate breaking in pre-determined positions, thus preventing the cover to be jettisoned towards the driver.



The electric contact between the steering wheel and the horn is realized by means of a circular spiral spring that provides a proper transmission of the electric signals under any condition.



TECHNICAL DATA

Actuation times

- Bag inflation < 0.05 sec.
- Bag deflation < 0.5 sec.
- Squib actuating current = 650 to 1750 mA
- Total bag volume = 18 Gals (67 l.)

MAINTENANCE AND REPAIR

NOTE: The electronic system is provided with a built-in self-diagnosis circuit that alerts of any malfunction to the system by means of a warning lamp on the instrument panel. In addition, the **"WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS" Book** contains a detailed troubleshooting procedure that enable the operators to isolate any possible malfunction.

WARNING:
Before carrying-out any operation on the air bag system, it is essential to prevent accidental actuation of the bag performing the following operations:

- **Disconnect (+) and (-) leads from the battery.**
- **Insulate (-) lead.**

steering column that transmits the signals for the air bag

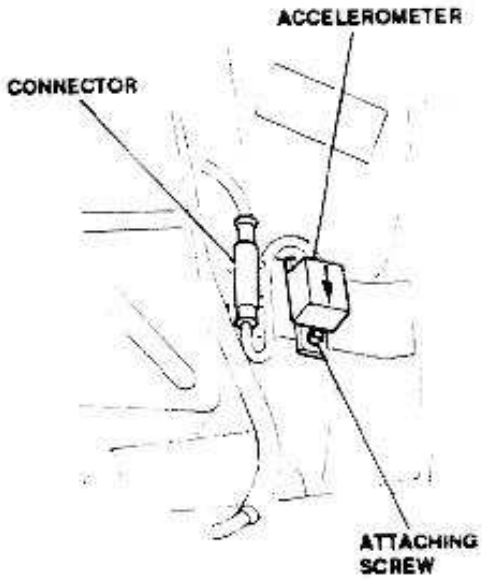
ACCELEROMETERS

ACCELEROMETERS IN ENGINE COMPARTMENT

REMOVAL/INSTALLATION

1. Operate inside the engine compartment and disconnect accelerometer connector.
2. Remove accelerator acting on two attaching screws.
3. Install accelerometer acting in reverse order, and verify that the cable is free of any damage or improperly connected wires before reconnecting the accelerometer cables.

NOTE: The accelerometers have a definite mounting direction shown by the arrow and "FORWARD" label.



CHECKS AND INSPECTIONS

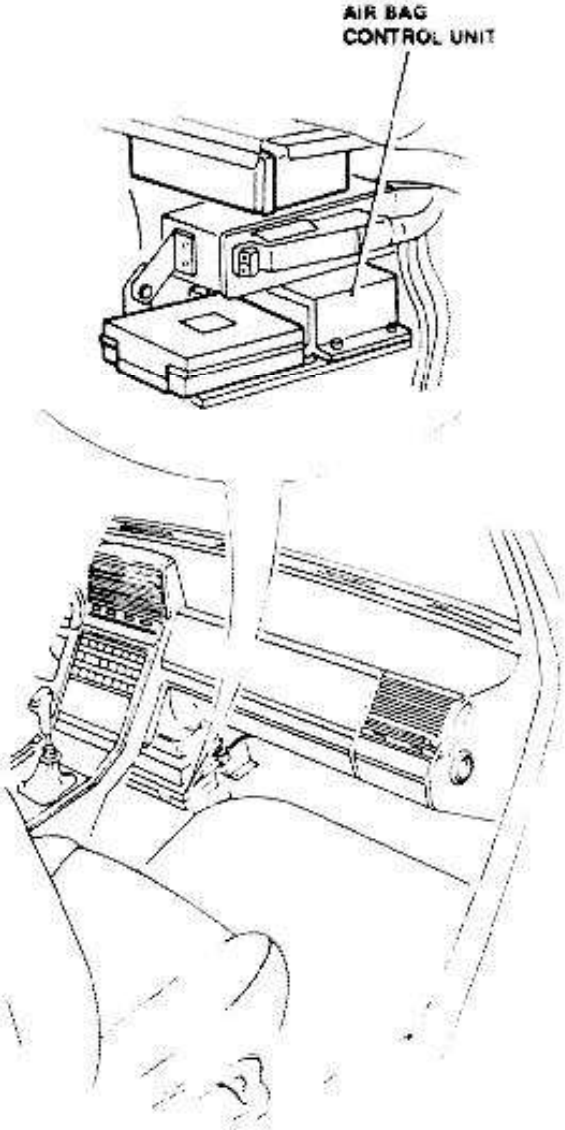
Check proper operation and adjustment of accelerometers (refer to **"WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS" Book**).

ACCELEROMETER ON CONTROL UNIT

Proceed in analogy to instructions given for the two

ELECTRONIC CONTROL UNIT

For a detailed description and maintenance of the control unit (operating logics, removal and installation, checks and inspections) refer to the **"WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS" Book**).



Proceed in analogy to instructions given for the two accelerometers in engine compartment.

AIR BAG MODULE

CAUTION:
Before carrying-out removal or installation of the steering wheel or the air bag, ensure the wheels are perfectly straight.

REMOVAL/INSTALLATION

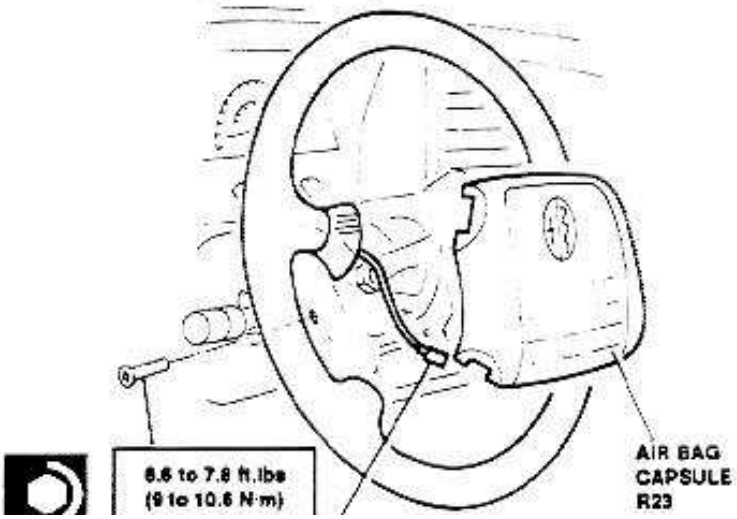
WARNING:
Operate with precaution! The air bag module contains a blasting charge that produces gas.

1. Remove two screws securing the module to the steering wheel using a suitable wrench (Torsen No.30).

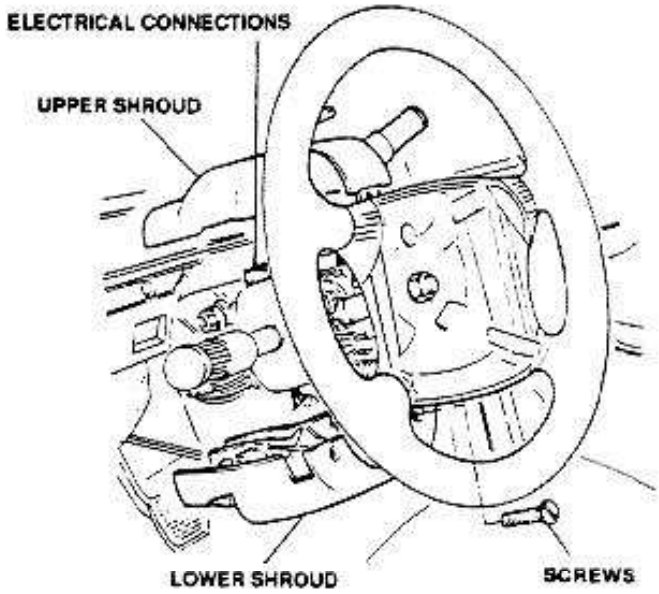
Replace screws at any removal.

2. Partially extract air bag from steering wheel and disconnect electrical connector.
3. Remove air bag capsule.

NOTE: **Stow the air bag module in the relevant safety container just after removal.**

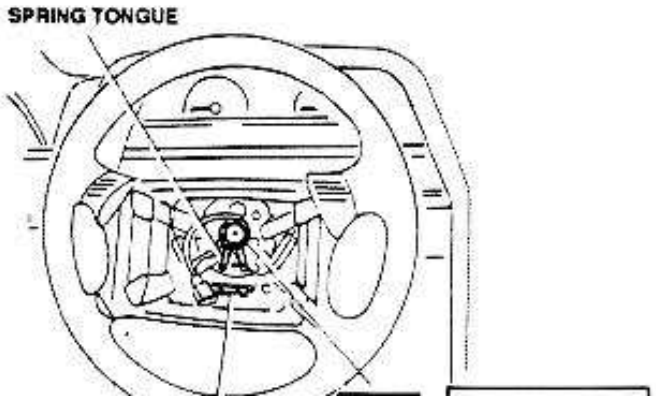


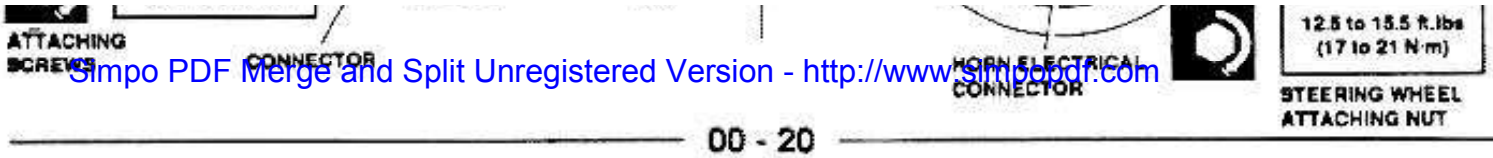
4. Rotate the steering wheel by 90° leftwards, and remove the left-side shrouds fixing screws, then rotate it by 180° rightwards and remove the right-side fixing screw.
5. Disconnect electrical connections and remove shrouds.

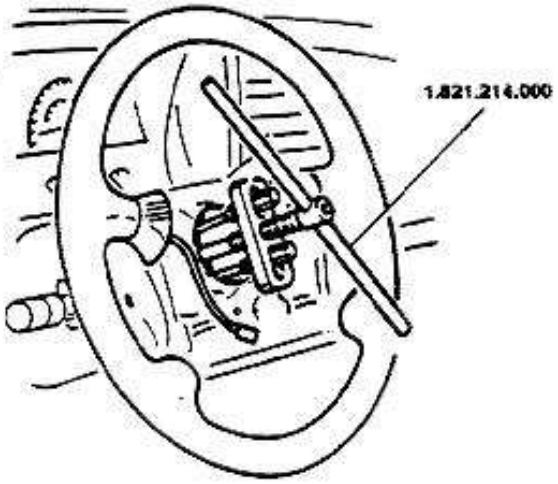


6. Disconnect horn electrical connector.
7. Loosen central nut securing steering wheel to steering column.
8. Remove spring tongue.
9. Remove steering wheel using tool 1.821.214.000.

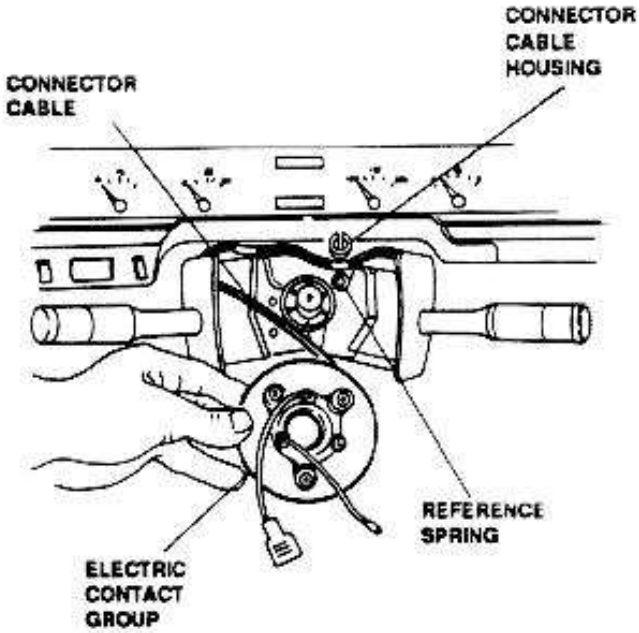
CAUTION:
Do not rotate steering wheel whilst performing this operation to prevent breakage of steering wheel electric contact spiral spring.







10. Extract the electric contact group, paying attention not to damage the reference spring.
11. Disconnect the connector cable.



On reassembly, ensure the electric contact group reference spring is properly positioned, and the cable of electric connector is seated in its housing.

NOTE: Ensure the wheels are perfectly straight before carrying-out the following operations.

NOTE: After installation of air bag module, the warning lamp will indicate a malfunction; reset the warning lamp as indicated in the "WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS" Book.

CHECKS AND INSPECTIONS

The air bag module cannot be repaired: replace in case of malfunction (refer to troubleshooting procedure in the **"WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS" Book**).

WARNING:
Ensure the gas producer is removed by specialized and authorized operators!

If for any reason the air bag module has been disassembled into its components, do not reinstall it, but fit a new one on the vehicle.

NOTE: In case of accidents or violent collision which caused the air bag blasting, replace the air bag module and check with maximum care all air bag system components. Furthermore check for proper operation the steering system (refer to Group 23).

WARNING:
A check of the car component ground connection has to be carried out every 2 years. Only an efficient grounding ensures a correct operation of the Air bag system. Therefore, pay the utmost attention to prevent corrosion of grounding points and to correctly tighten the fixing nuts.

MAINTENANCE OPERATIONS

The maintenance operations consist of checking and restoring the efficiency of those parts of the vehicle subject to wear and misadjustment during normal operation of the vehicle. The table below lists all the operations to be performed at various mileages; the same table is contained in the Maintenance Program Book supplied with the vehicle. The coupons must be signed and stamped by the dealer to assure that the prescribed maintenance activities have been carried-out.
As for the pre-delivery, where the checks indicate the need of topping or change of fluids already described in the text, the operation shall be considered as integral part of the maintenance activity. In case of activities (malfunctions) which differ from those stated, it shall be necessary to proceed to the eventual adjustment or repair in accordance with the current applicable rules concerning both the technical and administrative aspects.

CAUTION:
- **Improper maintenance can lead to operational problems of the vehicle.**
- **Improper maintenance during the warranty period will void all rights stated in the warranty statement.**

WARNING:
Precautions to be observed prior to maintenance operations. The engine compartment locates many rotating parts, high temperature parts and high voltage cables that could be dangerous.
Carefully adopt the following precautions:
- **Shut-down engine and wait until cool.**
- **Do not smoke or use free flames. The presence of fuel could start a fire.**
- **Ensure a fire extinguisher is always available.**
- **Do not lift the vehicle using the vehicle jack.**

SCHEDULED MAINTENANCE

The scheduled maintenance operations listed and described in the following refer to normal use of the vehicle in normal operating conditions.
For proper operation of the vehicle is also necessary to observe the following recommendations:

- **Engine oil and filter.**
  Change at the prescribed mileage. Change once a year in case of limited mileage.

- **Air filter.**
  Check filter at intervals shorter than those stated in case of operation in dusty areas.

- **Brake pads.**
  In case of definite sporting driving, or frequent use on particular roads or mountains, check pads more frequently than stated.
  Being the brake pads subject to different grades of use and wear, it is recommended to check them between a maintenance activity and the subsequent one.

- **Brake/clutch fluid.**
  The brake/clutch fluid is highly hygroscopic (it absorbs humidity).
  Change fluid once a year to prevent abnormal braking regardless of mileage.

- **Anti-freezing mixture.**
  Change every two years.
  It is suggested to top-up level with anti-freezing mixture to maintain the protective characteristics of mixture.

NOTE: **In particular operating conditions (such as driving on roads spread with anti-frost salt and/or corrosive materials, uneven surfaces, etc.) frequently check the drive shafts and steering box boots, and cleanliness of articulation points, hinges, door, hood and trunk lid locks,**

etc.

FLUIDS AND LUBRICANTS

If in case of an emergency are used fuels, lubricants and/or fluids having characteristics different from those required by Alfa Romeo, it is suggested to replace the affected fluid and filters as soon as possible.

ENGINE PERFORMANCE

To provide best vehicle performance and lowest vehicle emission, it is of most importance that the tune-up be done accurately, using the specifications listed on the Vehicle Emission Control Information label in the engine compartment.

EMISSION CONTROL SYSTEM

The American legislation in matter of atmospheric pollution (Clean Air Act), amended Sect. 203, prohibits tampering of components of the anti-pollution system, or to alter the system's characteristics.

"Tampering" could be defined as any intervention that alters or modifies the characteristics specified in this manual. All ALFA ROMEO produced vehicles are certified and, before leaving the factory, are subject to a final check aiming to ensure they conform to such characteristics. The vehicles non conforming to such specifications because misadjusted or non properly tuned-up, or modified with respect to the certified type, will possibly be non conforming to the law requirements on vehicles emission, and also have a higher fuel consumption.
The characteristics and data contained in this manual have been registered at the competent American Authority.
These characteristics and data are referred to during the conformity to certified type cheks.

FIRST COUPON SERVICE

The First Coupon service (F.C.) is carned-out under warranty coverage by an authorized Alfa Romeo Dealer at 1500 miles.

VEHICLE MAINTENANCE SCHEDULE (*)

N°	Description of the operations	MILEAGE COVERED MILES x 1000 (Tick each item at the respective mileage) F.C.= First Coupon						
		F.C.	10	20	30	40	50	60
1	Change engine oil (or once a year whichever occurs first)	•	•	•	•	•	•	•
2	Change engine oil filter	•	•	•	•	•	•	•
3	Change air cleaner element				Δ			Δ
4	Change spark plugs				Δ			Δ
5	Change engine coolant mixture (or every two years whichever occurs first)				•		•	
6	Replace exhaust gas sensor (oxigen sensor)							Δ
7	Replace timing belt						•	
8	Replace fuel filter						•	
9	Change alternator, coolant pump, power steering pump and air conditioner compressor belts				Δ			
10	Check alternator, coolant pump, power steering pump and a/c compressor drive belts for soundness and tension							Δ
11	Check valves clearance	Δ			Δ			Δ
12	Check cylinder head nuts for proper torque	Δ						
13	Check protective boots half-shafts, steering box and steering knuckle pivots for soundness	•	•	•	•	•	•	•
14	Inspect brake system for leaks	•	•	•	•	•	•	•
15	Check brake pads		•	•		•	•	•
16	Change brake pads				•			
17	Check brake, clutch fluid level (change every 12 months)	•	•	•	•	•	•	•
18	Check handbrake travel	•	•	•	•	•	•	•
19	Check fluid level in power steering	•	•	•	•	•	•	•
20	Check level of gearbox and differential oil				•		•	
21	Change gearbox and differential oil					•		•
22	Check electrical connections in engine compartment (conditions and positioning of connectors and caps)					•		•
23	Lubricate door & lid hinges; grease lid latches				•		•	•
24	Test vehicle	•	•	•	•	•	•	•

• RECOMMENDED MAINTENANCE

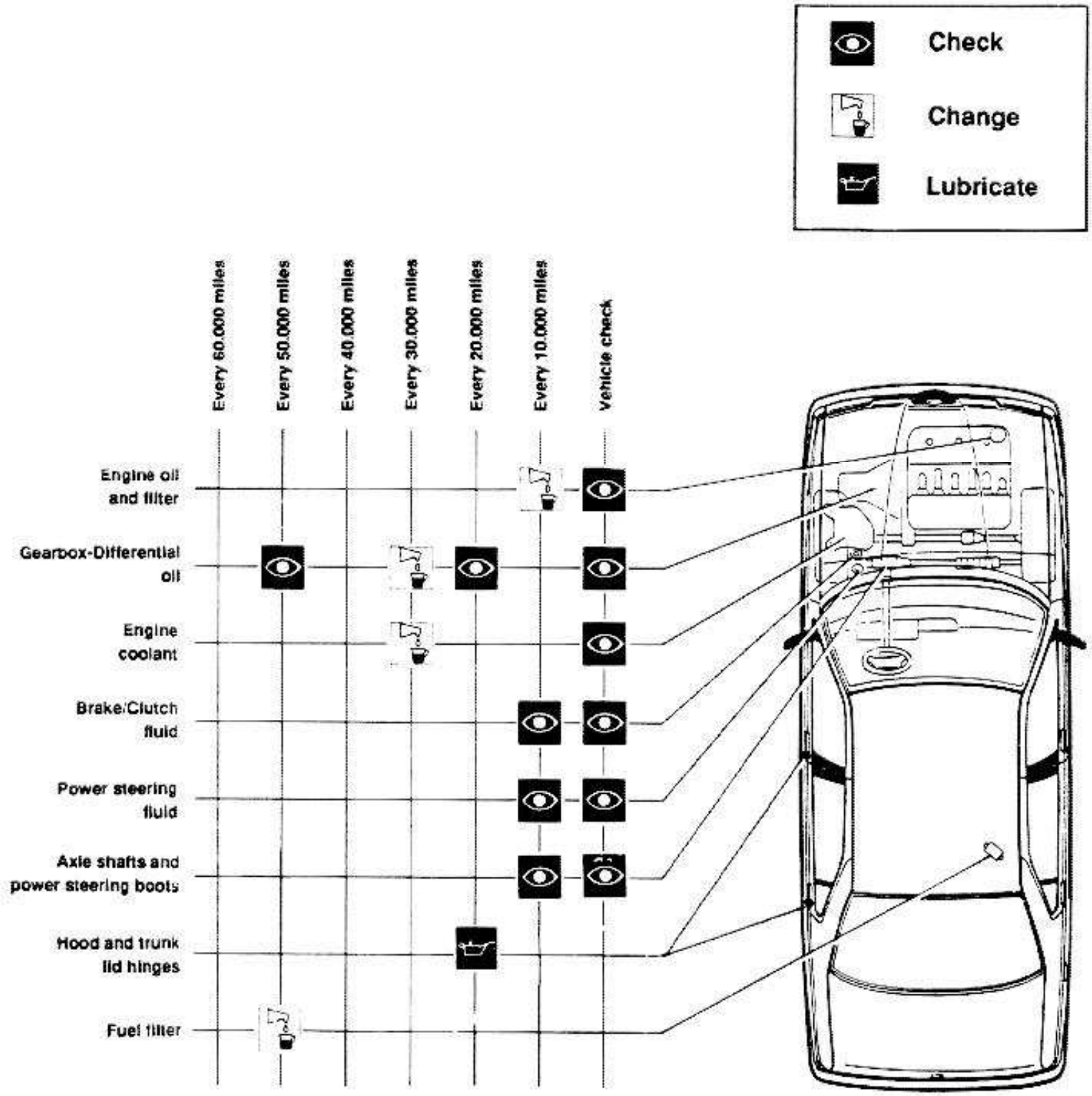
- = RECOMMENDED MAINTENANCE

Δ = MAINTENANCE REQUIRED FOR PROPER OPERATION OF EMISSION CONTROL SYSTEM PERFORMANCE

(*) Operation here listed will be illustrated in the next paragraphs following the reference number

FLUIDS AND LUBRICANTS

SCHEDULED CHECKS AND SERVICING



SUMMARY TABLE

Type	Application	Classification	Name
OIL	Engine - 01	SAE: 10W/40 API SG CCMC G5	AGIP NUOVO SINT 2000 10W/40 SHELL Fire & Ice Motor Oil 10W/40
			ISECO Molykote A
	Gearbox - 13 Automatic Transmission -16 Steering - 23	DEXRON II	AGIP DEXTRON II SHELL ATF DEXRON II
	Air Conditioning - 80		SUN OIL COMPANY Suniso 46
GREASE	Engine - 01		ISECO Molykote BR2
	Ignition - 05		ISECO Molykote BR2
	Cooling System - 07		R. GORI: Never Seez
	Clutch - 12		AGIP Grease 33 FD
			SHELL Retinax G

(Cont.d)

SUMMARY TABLE

Type	Application	Classification	Name
GREASE	Gearbox - 13		AGIP Grease 33 FD
			ISECO Molykote Longterm N. 2
	Drive Shafts - 17		Optimol - Olistamoly 2LN 584 Molykote VN 2461/C
	Suspension - 21		AGIP Grease 30 SHELL Alvania Grease 3
	Brakes - 22		ATE - Bremszylinder Paste DBA Paste
			SHELL Retinax G
	Steering - 23		SPCA Spagraph ISECO Ergon Rubber Grease 3 REINACH Sferul B2 AR
			ISECO Molykote Paste G
FLUID	Engine - 01		MILLOIL: Lubricant for elastomer seals UNION CARBIDE CHEM. Co. UCON Lubricant 50 HB-5100

(Cont.d)

SUMMARY TABLE

Type	Application	Classification	Name
FLUID	Cooling System - 07		Alfa Romeo ANTIFREEZE SUPER Alfa Romeo CLIMA FLUID PERMANENT
	Brakes - 22 Clutch - 12		Alfa Romeo BRAKE FLUID SUPER AGIP BRAKE FLUID DOT 4
	Wheels and Tires - 28		MILLOIL SC 40/K Lubricant for elastomer seals MASCO 203 SVA
	Windshield - 75		e.g. "WINDSHIELD WASHER SOLVENT", Union Carbide Corp., 1209-34 Protection up to -40°C/-40°CF
	Air Conditioning - 80		MILLOIL SC 40/K Lubricant for elastomer seals MASCO 203 SVA
		FREON	RIVOIRA Freon 12

FUEL

OCTANE NUMBER

The octane number of a fuel defines it resistance to detonation. Use of fuel with the proper octane number is essential to prevent the detonation phenomenon that could be dangerous for the engine of the vehicle. The higher the octane number, the greater the anti-detonation capacity. Normal fuels have an octane number that ranges from 91 to 95 RON (Research Octane Number), or from 86 to 90 PON (Pump Octane Number).
The Pump Octane Number PON is shown at U.S.A. filling stations. This number is determined as follows:

$$\frac{RON + MON^{*}}{2} = PON$$

* Motor Octane Number

NOTE: **The Pump Octane Number PON is normally 5 points lower than Research Octane Number RON:**
91 RON = 86 PON
95 RON = 90 PON

PRESCRIBED FUEL

The Alfa Romeo 164 model has been designed to operate on Premium unleaded gasoline having a minimum Pump Octane Number (PON) of 90 (Equivalent to 95 RON).
The 164 model can be modified by the manufacturer on request to operate on unleaded gasoline having a minimum Pump Octane Number (PON) of 86 (Equivalent to 91 RON).

FUELING

All Alfa Romeo vehicles sold in the U.S. are equipped with catalytic converters.
The use of unleaded fuel is required in order for the converter to work at maximum efficiency.
Lead deposits coat the surface of the catalyst and hamper efficient operation thus defeating the catalyst's purpose of controlling harmful exhaust emissions. Reminder label is located near the fuel filler.
Smaller than normal fuel filler necks are installed which prevent the use of a regular (leaded) fuel nozzle.

USE OF GASOLINE/ALCOHOL BLEND

Blends of unleaded gasoline and ethanol (grain alcohol) not containing over 10% ethanol may be used without affecting your Alfa Romeo Limited Warranty.
Should gasohol cause driveability problems, a return to unleaded gasoline is suggested.
Blends containing methanol (wood alcohol) are not recommended unless they also contain cosolvents and corrosion inhibitors.
DO NOT USE GASOHOL EXCLUSIVELY. TESTS HAVE SHOWN THAT CORROSION TO FUEL SYSTEMS CAN RESULT FROM EXCLUSIVE USE OF GASOHOL.
Some problems are currently associated with the use of gasoline/alcohol blends.
Fuel economy may be reduced, and driveability may suffer.
Greater potential exists for cold weather hesitation, staffing and vapor lock.

APPROXIMATE SERVICING CAPACITIES

Fuel tank			l. (Gals)	65 (17.5)
Fuel reserve			l. (Gals)	8 (2.2)
Engine oil	Total capacity		l. (Gals)	7.5 (2)
	Partial capacity (Filter + oil sump) for scheduled change		l. (Gals)	7 (1.9)
	Sump capacity only (refer to MAX/MIN marks on dipstick)	MAX	l. (Gals)	6.5 (1.7)
		MIN	l. (Gals)	4.5 (1.2)
	Camshaft support sumps		l. (Gals)	0.5 (0.14)
Gearbox differential oil			l. (Gals)	1.8 (0.5)
Automatic gearbox oil			l. (Gals)	9 (2.4)
Power steering system fluid			kg (lbs)	0.9 (2)
Brake and clutch system fluid			kg (lbs)	0.5 (1.1) 0.7* (1.6)*
Cooling system			l. (Gals)	9.5 (2.55)

(*) With A.B.S.

MAINTENANCE OPERATION

**THE FOLLOWING PAGES CONTAIN ALL THE SCHEDULED MAINTENANCE OPERATIONS.
THE SEQUENCE NUMBER SHOWN IS THE SAME STATED IN THE "VEHICLE MAINTENANCE SCHEDULE".**

1-2 - ENGINE OIL AND FILTER CHANGE

WARNING:
The engine oil is harmful for your skin: reduce to minimum contact of used oil with your skin; wash out with water and soap.

OIL LEVEL CHECK

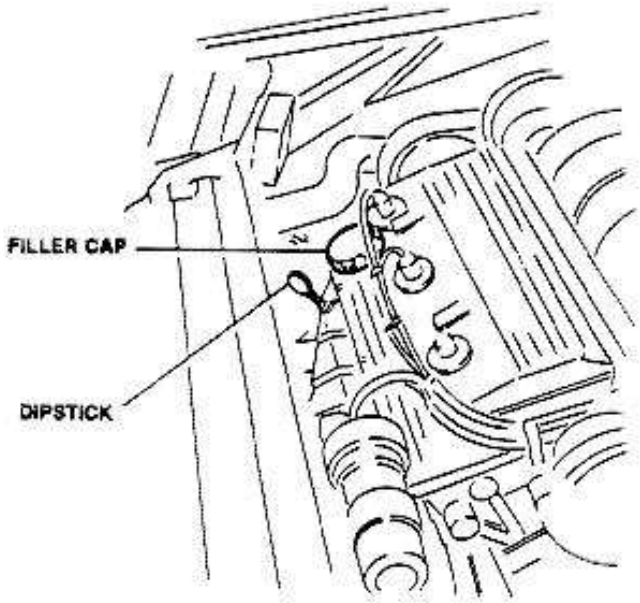
1. Check oil level using dipstick: the level shall be between the MIN and MAX marks on the dipstick.

- Carry-out check of oil level with vehicle on a level surface.
- Due to detergent additives, the oil will show dark even after a short period of use: in any case, this does not mean that it must be changed before the scheduled interval.
- Presence of whitish matter indicates leaks of coolant.
- Low viscosity is due to dilution with fuel.

OIL AND FILTER CHANGE

- Operate on warm engine.

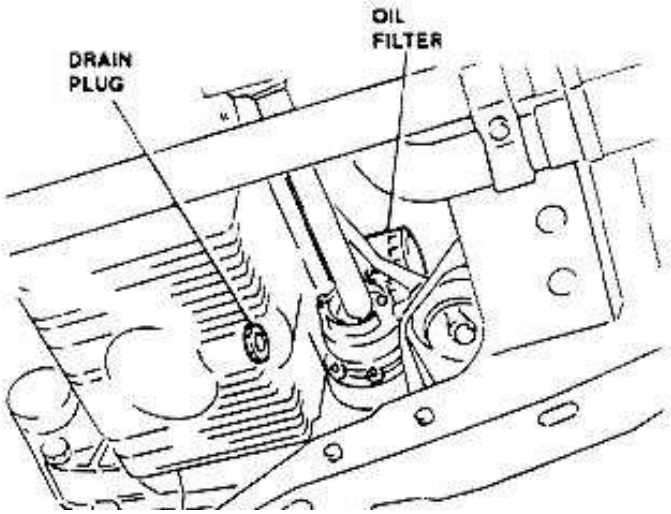
1. Remove filler cap.
2. Remove oil dipstick.



3. Remove drain plug and leave oil to drain completely for at least 15 minutes.

WARNING:
Do not disperse used oil in the ambient, since indiscriminate dispersion of oil will cause damage to the ambient; investigate where used oil is safely collected in your area.

4. Remove oil filter using suitable wrench.



5. Thoroughly clean the drain plug and screw it on the sump together with relevant seal.
6. Wipe seal of a new filter with engine oil, then hand screw new filter on engine; finally, tighten filter using a suitable wrench.

NOTE: **Use filter from those approved by Alfa Romeo.**

7. Service with prescribed quantity of approved oil.

Engine oil	**AGIP NUOVO SINT 2000 10W/40 SHELL Fire & Ice Motor Oil 10W/40**
Quantity	**7 l. (1.9 Gals)**

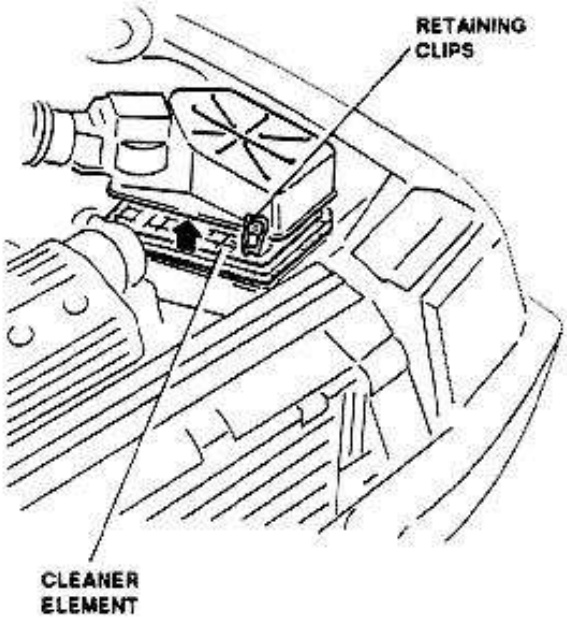
8. Check oil level using the dipstick.

CAUTION:
Oil level above MAX mark could cause excessive oil evaporation and loss of pressure.

9. Install filter cap and operate engine at idle speed for about 2 minutes; shut-down the engine, wait a few moments then re-check oil level. Check for absence of leaks.

3 - AIR CLEANER ELEMENT CHANGE

1. Release retaining clips.



3. Thoroughly clean air cleaner box.
4. Position new air cleaner element with screen faced upwards.
5. Install cover ensuring it is correctly positioned, then engage securing clips.

CAUTION:
Any cleaning operation could damage the air cleaner element, thus jeopardizing proper operation of engine supply system.

NOTE: **If filter shows traces of oil, check for possible seepage in the whole air intake system.**

4 - SPARK PLUGS CHANGE

The spark plugs installed at factory (GOLDEN LODGE 2HL for 164-164L, NGK PGR6A for 164S) are of the surface discharge type, with four peripheral points and central electrode: **this type of spark plugs does not**

2. Remove air cleaner element.

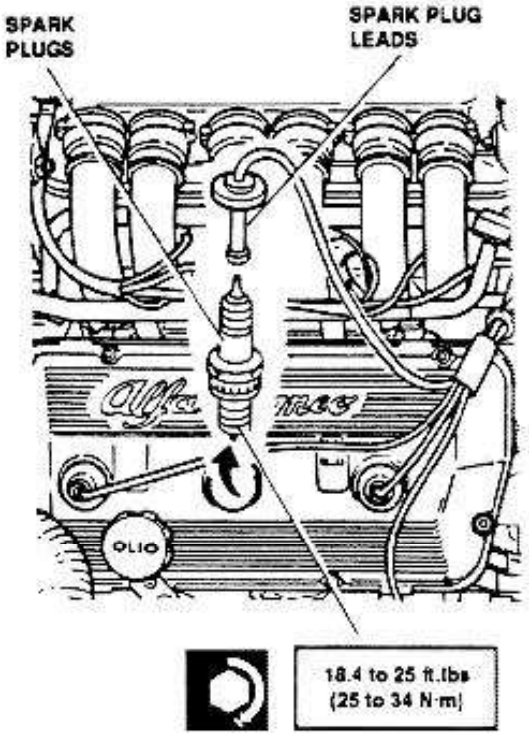
require adjustment of gap between electrodes.

NGK PGR6A-1645
GAP 0.024-0.028" (.6-.7mm)

CHANGE

- Operate with cold engine.

1. Disconnect spark plug leads.
2. Blow air in spark plug seatings to remove any foreign matter and dirt.
3. Remove spark plugs.



- Always change spark plugs if the ceramic insulator is broken or if the electrodes are worn.

4. Lubricate spark plug threads with **ISECO Molykote A** oil and torque to prescribed value.

CAUTION:
Use of spark plugs having different characteristics or size could seriously damage the engine and alter the emission level of harmful exhaust gases.

5. Ensure of a good mechanical and electrical connection between the spark plugs and relevant fittings.

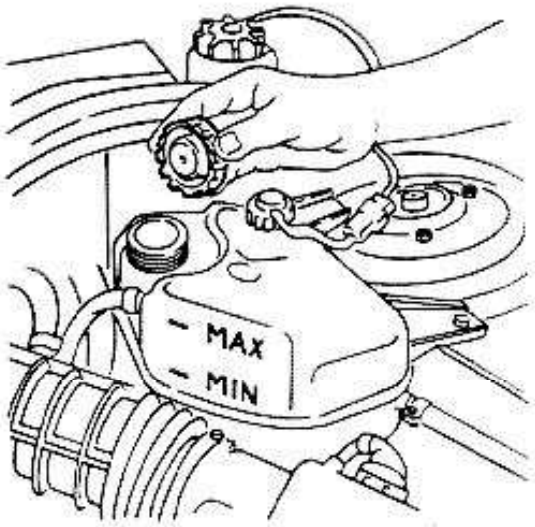
NOTE: Spark plug leds must be connected following the firing order: 1-4-2-5-3-6

5 - ENGINE COOLANT CHANGE

Coolant level and circuit check

- Check coolant level when engine is cold.

1. Check that level of coolant in header tank is between MIN and MAX marks.



2. Check circuit for integrity and absence of leaks.
3. Check efficiency of pressurized cap springs, seal and valves.
4. Carry-out tightness check of pressurized cap (refer to **Group 07**).
5. Carry-out tightness check of hydraulic circuit (refer to **Group 07**).

Change

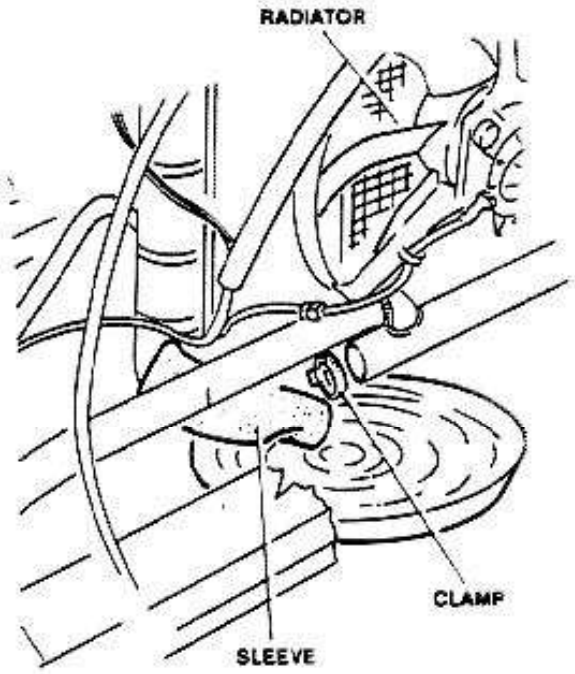
CAUTION:
The anti-freezing mixture used as engine coolant is harmful for the paintwork: prevent any contact with painted surfaces.

6. Connect spark plug leads.

1. Unscrew and remove cap from header tank.

WARNING:
NEVER REMOVE CAP when engine is warm!

2. Loosen clamp and disconnect radiator outlet sleeve.
3. Drain coolant in a suitable container placed below the vehicle.



4. Re-connect radiator outlet sleeve
5. Service circuit through header tank using approved fluid in the quantities shown in the table below, and in any case to MAX level mark.

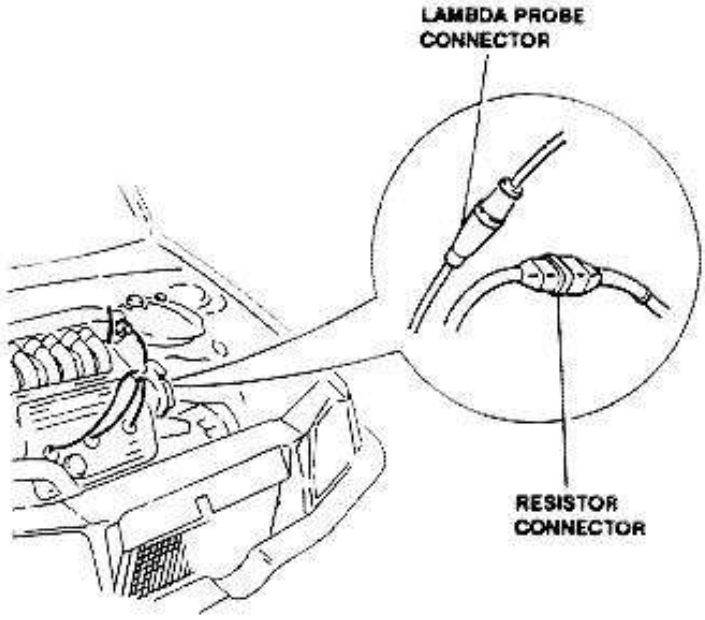
Minimum Outside temperature	**°F °C**	**-4 -20**	**-40 -40**
Concentrated anti-freeze	**l. Gals**	**4.3 1.15**	**7.1 1.9**
Dilution Distilled water	**l. Gals**	**8.7 2.35**	**5.9 1.6**
Anti-freeze mixture - Ready for use	**l. Gals**	**13 3.5**	**— —**

NOTE: The quantities shown in the above table refer to the total capacity of the cooling circuit. It must be noted that servicing capacity of circuit is 9.5 l. (2.55 Gals).

6. Start engine and bring to normal operating temperature until opening of thermostat reliefs residual air trapped in the circuit.
7. With cold engine, top-up coolant level to MAX mark.
8. Install header tank cap.

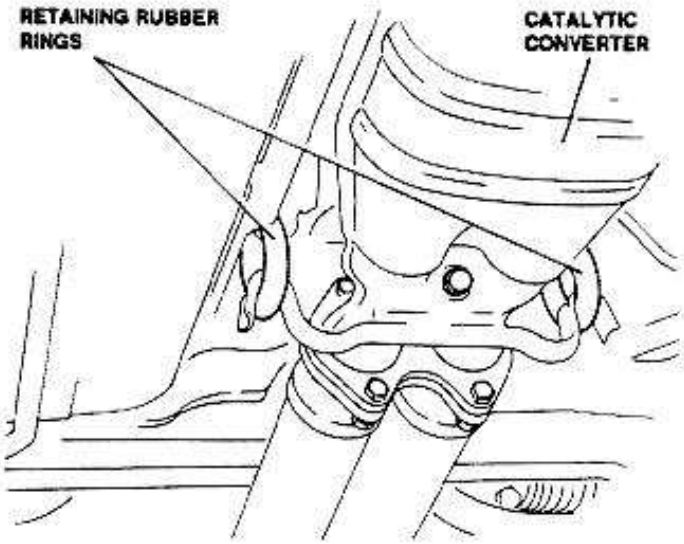
6 - EXHAUST GAS SENSOR REPLACEMENT (LAMBDA PROBE - OXIGEN SENSOR)

1. Place vehicle on auto-lift.
2. Disconnect battery (-) lead.
3. Remove air cleaner cover-air flow meter assembly (refer to **Group 04**).
4. Disconnect lambda probe and heating resistor electrical connector.



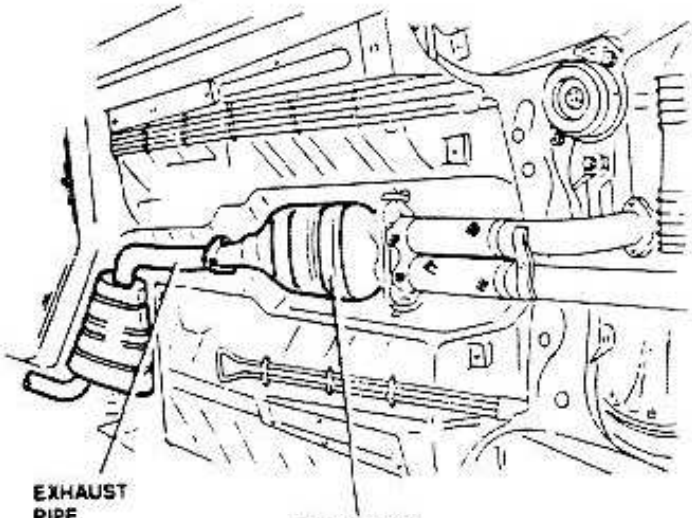
5. Lift the vehicle
6. Disengage rubber rings securing catalytic con-

verter.

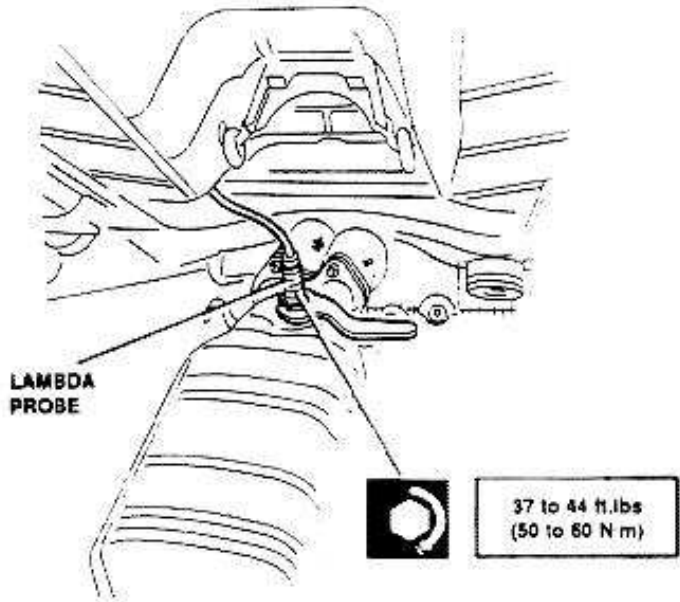


WARNING:
The catalytic converter reaches a high temperature during operation. Therefore, allow sufficient time to cool off after engine has been shut down before attempting any operation on the catalytic converter.
NEVER touch the catalytic converter unless adequate protective equipment has been previously worn (gloves, etc.)
DO NOT APPROACH any easily flammable material to the catalytic converter!

7. Disconnect catalytic converter from center section of exhaust pipe.



8. Remove lambda probe using suitable wrench-tool.



9. Wipe thread of new lambda probe with anti-seizing compound **(R. GORI never seez)**, then install probe.
10. Torque lambda probe to prescribed torque.
11. Connect two electrical connectors and install air cleaner.

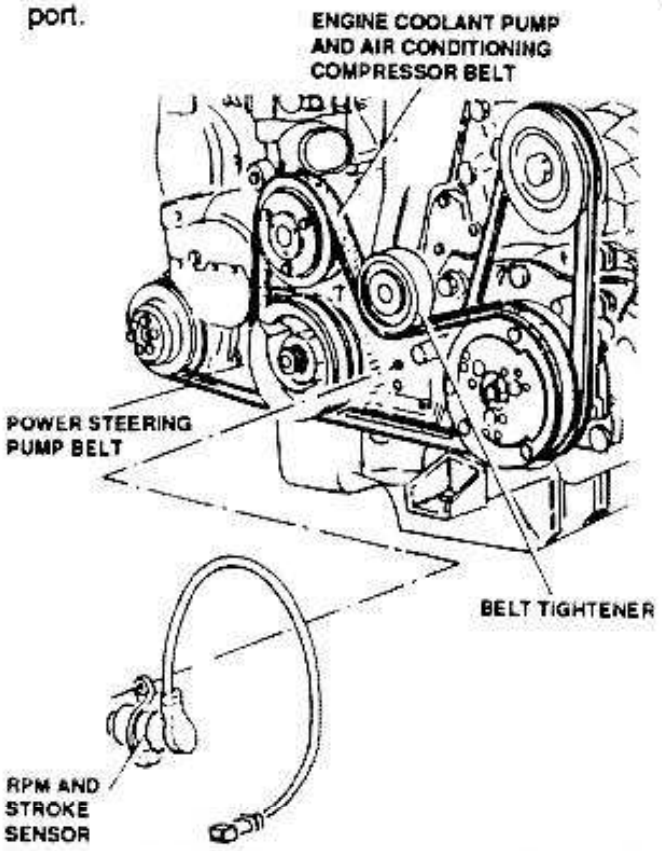
NOTE: The catalytic converter and exhaust pipe of "S" versions have a different shape, but the maintenance procedures are identical to those stated above.

7 - TIMING BELT REPLACEMENT

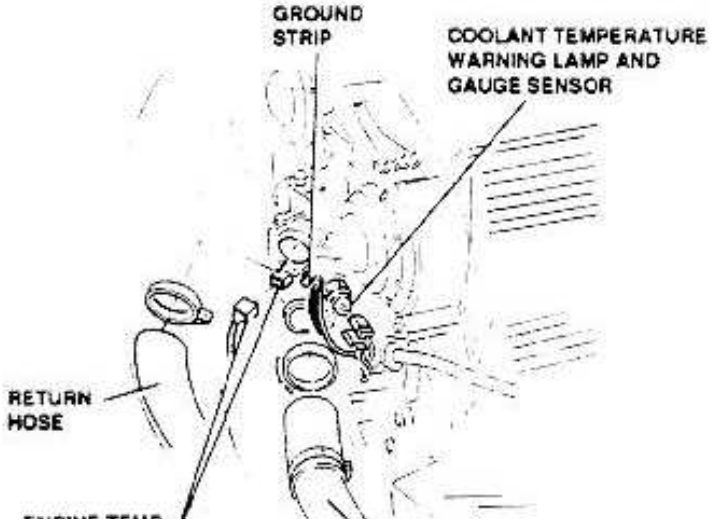
Disassembly

1. Disconnect battery (-) lead.
2. Remove right front wheel and two fenders (front and rear).
3. Remove coolant pump and air conditioning compressor drive belt, together with hydraulic belt tightener and steering pump drive belt (refer to subsequent **No. 9** operation).

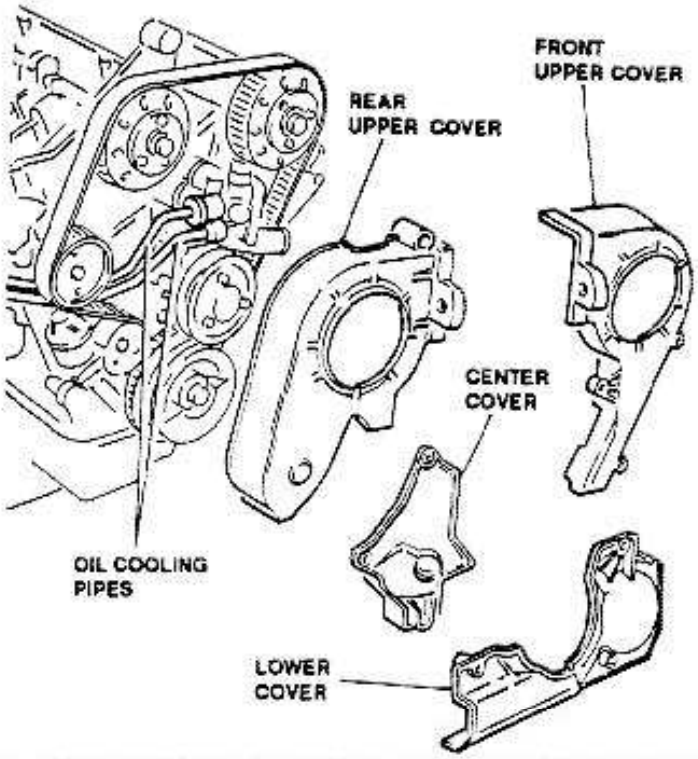
4. Remove RPM and stroke sensor and relevant support.



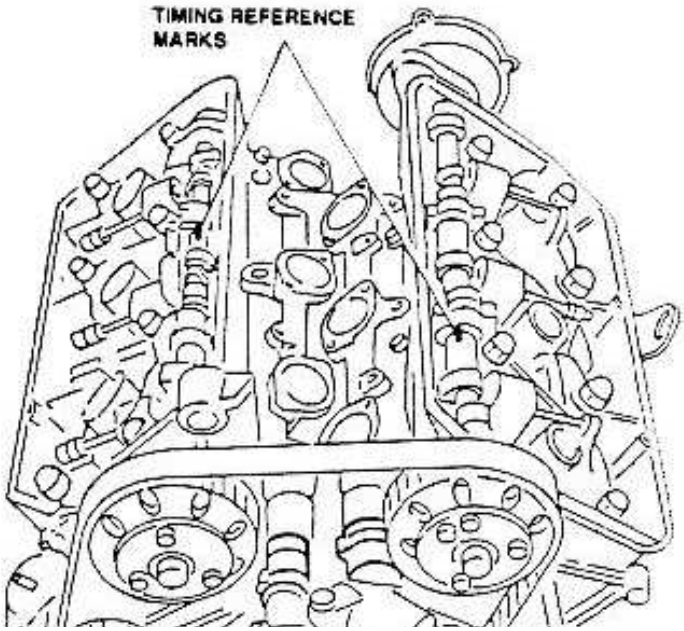
5. Remove both timing system covers (refer to subsequent **No. 10** operation).
6. Partially drain hydraulic circuit (refer to previous **No. 4** operation).
7. Disconnect coolant delivery hose from thermostat unit.
8. Disconnect sensors electrical connectors and ground strip.
9. Disconnect return hose from coolant pump.



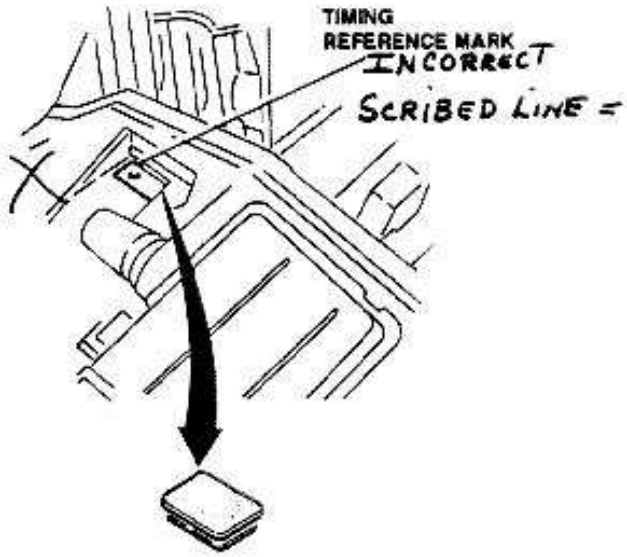
10. **(Only for vehicles equipped with water-oil heat exchanger).** Disconnect oil cooling pipes.
11. Remove four covers protecting the timing belt.



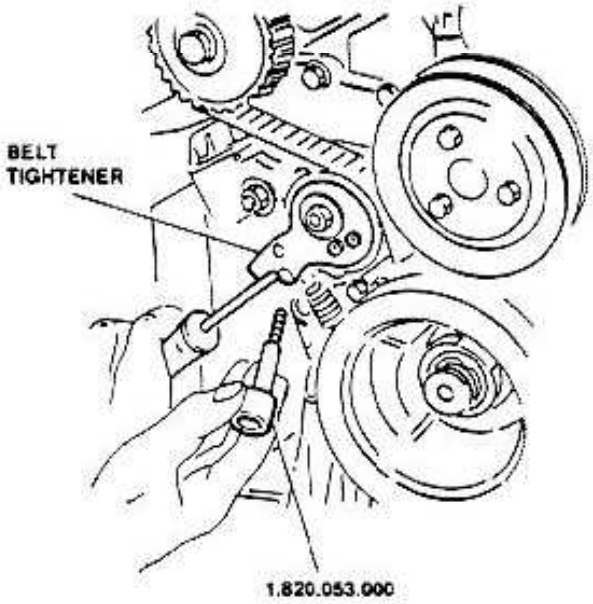
12. Clean spark plug seatings, remove spark plugs and plug holes to prevent entry of foreign matter.
13. Engage highest gear speed (D, with automatic transmission) and move vehicle forwards to rotate the crankshaft until notches engraved on camshafts align to notches engraved on relevant caps.



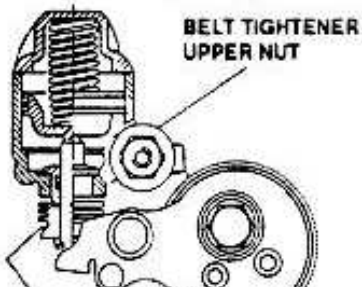
14. In this position (No.1 cylinder at T.D.C. in firing phase), the SCRIBED LINE on the flywheel must match the notch engraved on the gearbox cone.



15. Lift belt tightener arm and insert tool 1.820.053.000 into arm hole.

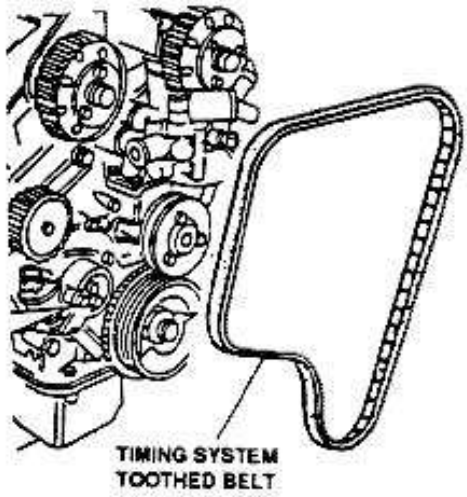


16. Loosen nuts and push belt tightener downwards to bottom of travel; torque upper nut.



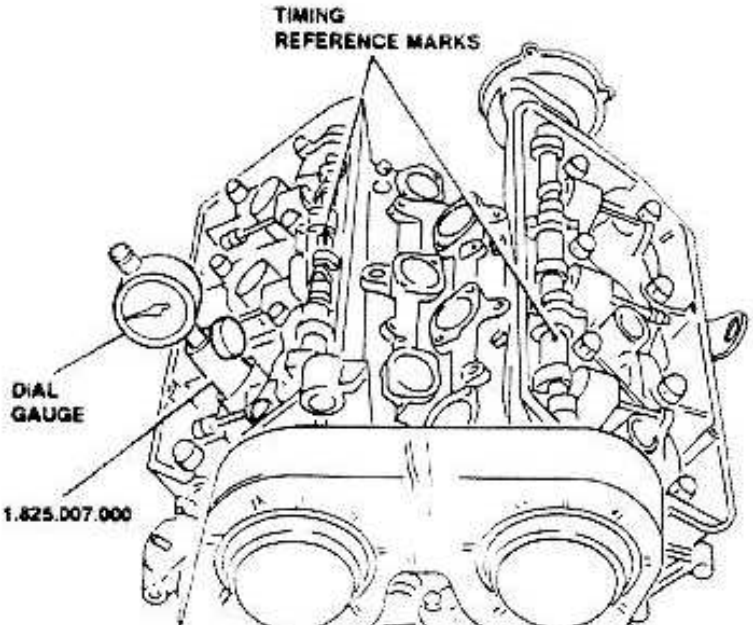
17. Remove toothed belt.

WARNING:
Contact of oil or solvents with the toothed belt could affect elasticity of belts rubber, and cause slipping of teeth.



Reassembly

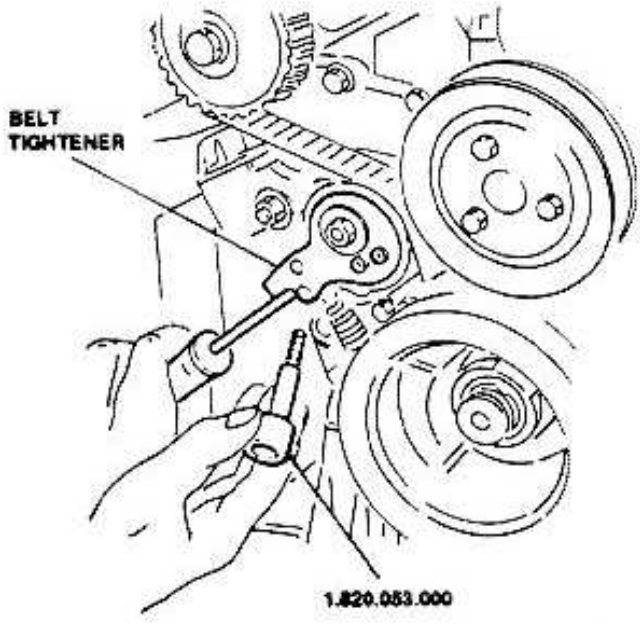
1. Install tool 1.825.007.000 and dial gauge into seating of No. 1 cylinder spark plug.
2. Verify alignment of notches engraved camshafts and relevant caps.



3. Ensure the hole on flywheel is aligned to notch engraved on gearbox cone.

- **During the whole belt reassembly procedure, check that conditions stated at steps 2 and 3 are continuously met.**

4. Install toothed belt maintaining under tension the stretched arms, and observing the following reassembly order:
   - Crankshaft toothed pulley.
   - Left cylinder head toothed pulley.
   - Right cylinder head toothed pulley.
   - Oil pump toothed pulley.
   - Belt tightener pulley.
5. Loosen nuts securing belt tighteners.
6. Engage highest gear speed (D, with automatic gear) and move vehicle forwards to rotate crankshaft of two revolutions; stop movement when piston of No. 1 cylinder is at T.D.C. position in firing phase (timing notches aligned, as previously indicated).
7. Keep belt under tension, press tightener pulley against belt and tighten two nuts securing the belt tightener.
8. Slightly lift tightener arm and remove pin **1.820.053.000**; release tightener arm.



9. Reinstall all remaining components by reversing the order of disassembly procedure.

Engine timing check and adjustment: refer to **Group 01**.

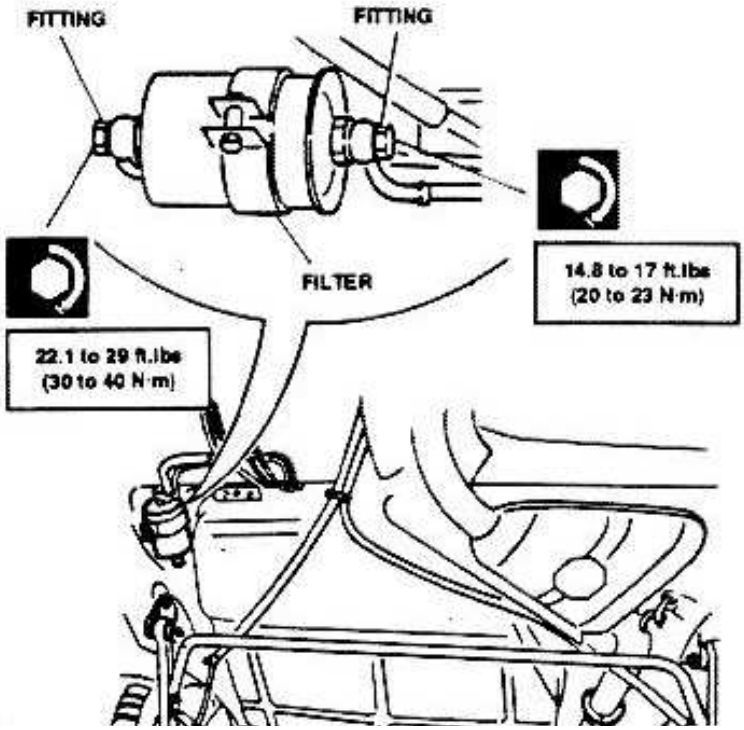
Timing belt tension check and adjustment: refer to

8 - FUEL FILTER REPLACEMENT

WARNING:
Carefully follow the instructions below when acting on fuel system components:
- **Ensure the workshop is provided with prescribed safety equipment (fire extinguishers, etc.)**
- **Disconnect battery (-) lead.**
- **Store fuel drained from the system into a suitable container with safety cap.**
- **The fuel system could be pressurized: operate with precaution.**
- **Do not smoke.**

1. Start engine.
2. Disconnect fuel pump main relay (refer to **Group 40**) and wait until engine stops for loss of supply.
3. Unscrew two fittings of filter.
4. Collect drained fuel into a suitable container, then plug fitting without bending or twisting rigid pipes.
5. Remove fuel filter.
6. Install new fuel filter and new copper seals on fittings.

NOTE: Direct arrows engraved on filter cup towards sense of fuel delivery.



9 - DRIVE BELTS TENSION CHECK

NOTE: When checking belts for proper tension, **always check visually for integrity of belt**, and in particular for absence of:

- cuts.
- cracks.
- superficial wear of fabric (appearing smooth and bright).
- Dry or hardened parts (loss of adhesion).

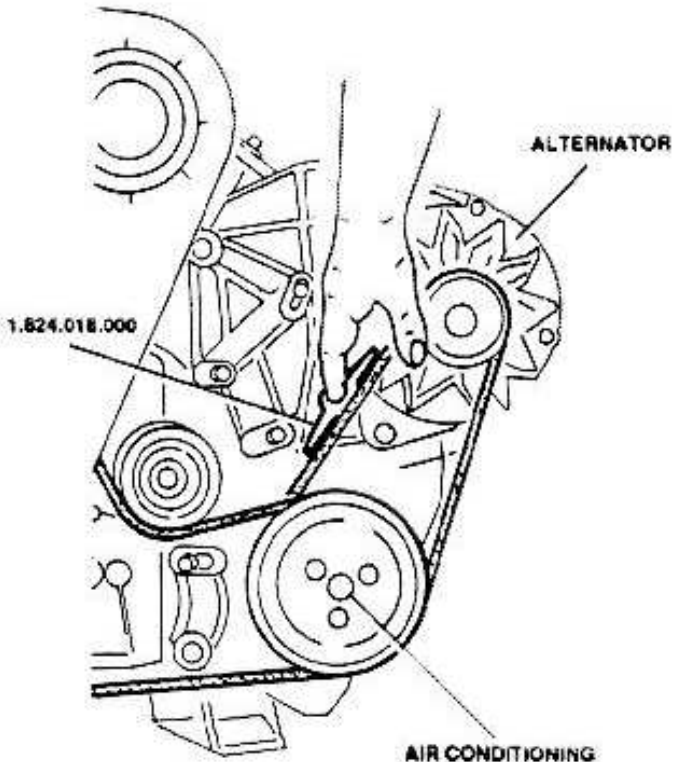
In all the above-mentioned cases, replace the belt.

CAUTION:
Contact of oil or solvents with the belts could affect elasticity of belt rubber, and reduce belt adhesion.

a) Alternator belt.

- **Check:**

1. Acting in the engine compartment, insert tool **1.824.018.000** as depicted in the illustration.

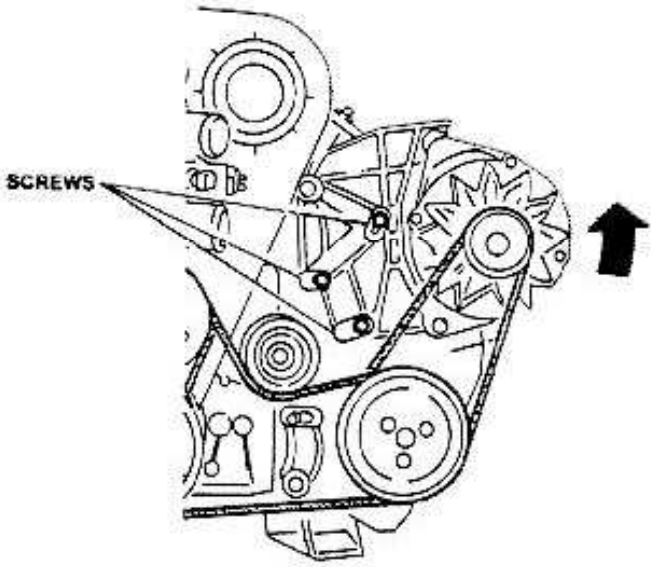


2. Check that the minimum (cold) belt tension is the prescribed one

Alternator belt	
Minimum tension (cold)	**300 N 67.5 lbs**

- **Retensioning:**

1. Remove complete right headlamp unit.
2. Loosen securing screws and move alternator upwards to increase belt tension.

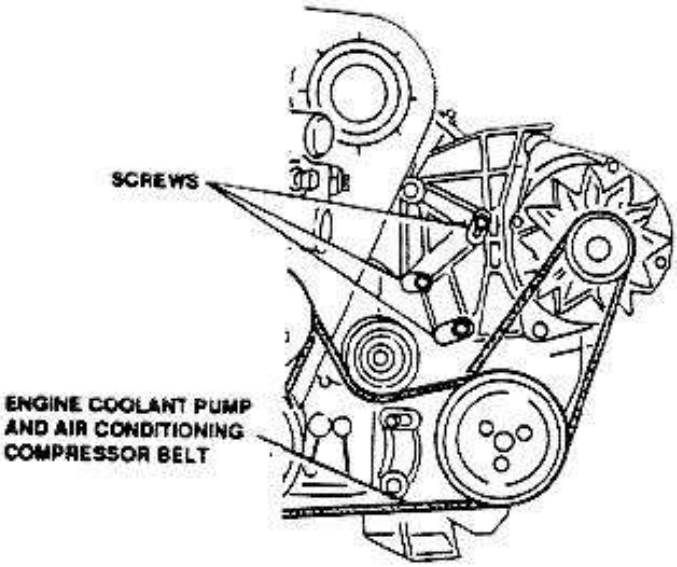


3. Torque one screw and check belt tension.
4. Torque remaining screws when belt tension is correct.

Alternator belt	
Retensioning	**300 to 350 N 67.5 to 78.7 lbs**

- **Replacement:**

1. Remove coolant pump and air conditioning compressor belt (refer to following step b.).
2. Loosen screws securing alternator.



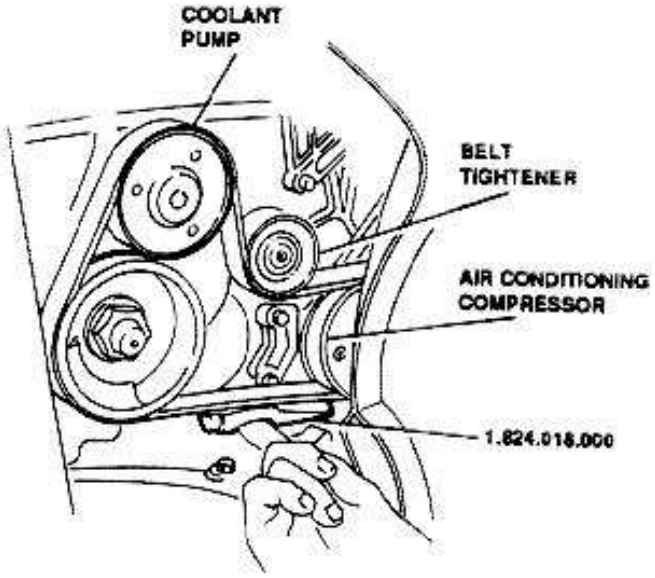
3. Remove worn belt.
4. Install new belt.
5. Install coolant pump and air conditioning compressor belt (refer to following step b.).
6. Stretch the alternator driving belt to the assembly value.
7. Perform a short run-in according to the following procedure:
   - Let the engine reach its operating temperature (water at 80°C)
   - Let the engine idle for 10 minutes
   - Let the engine cool down.
8. Adjust the belt tension to the prescribed value.

Alternator drive belt	
Tension (Assembly)	400 to 450N 90 to 101.2 lbs
Retensioning (after run-in)	300 to350N 67.5 to78.7 lbs

b) Coolant pump and air conditioning compressor belt.

- **Check:**

1. Remove right front wheel and relevant front fender.

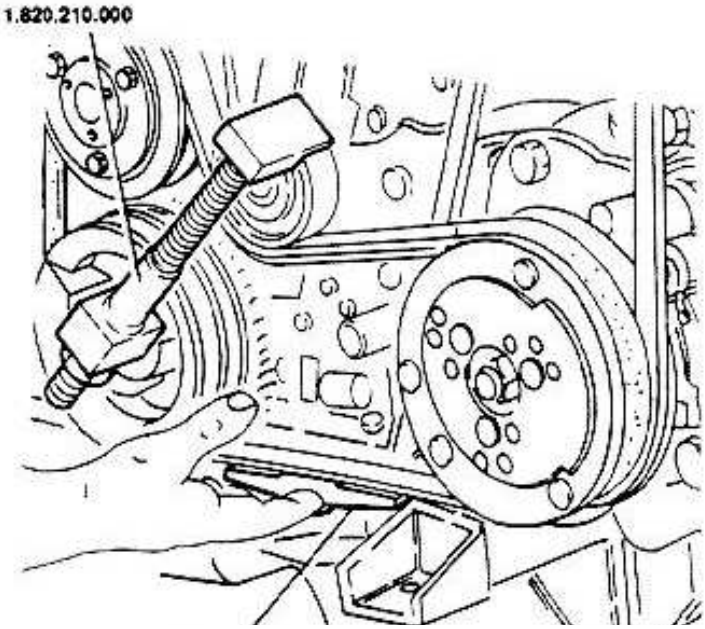


- **Check that minimum (cold) tension is the prescribed one.**

Conditioner compressor and water pump drive belt	
Minimum tension (cold)	550 N 124 lbs

- **Retensioning:**

1. Loosen screws securing belt tightener.
2. Install tool **1.820.210.000** and act on tightener by pulling the tool until correct tension is obtained (measured with tool **1.824.018.000**).



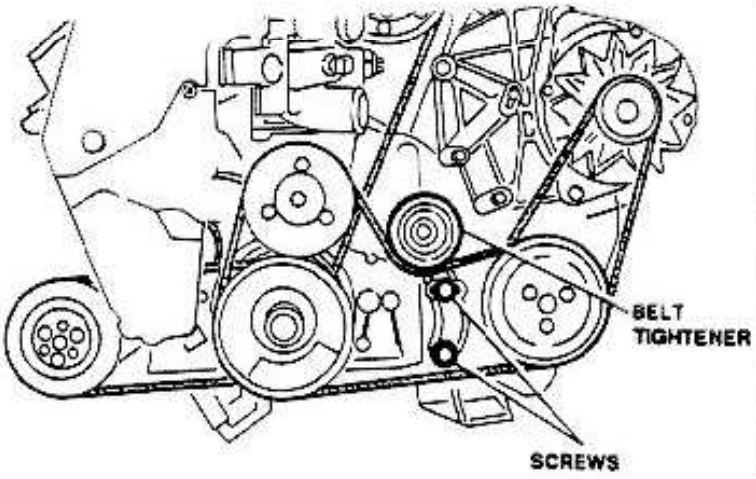
2. Insert tool 1.824.018.000.

Conditioner compressor and water pump drive belt	
Retensioning	550 to 600 N 124 to 135 lbs

3. Tighten screws securing belt tightener.

- **Replacement:**

1. Loosen tightener and remove worn belt.
2. Install new belt (in case of difficulties, remove upper screw securing tightener).



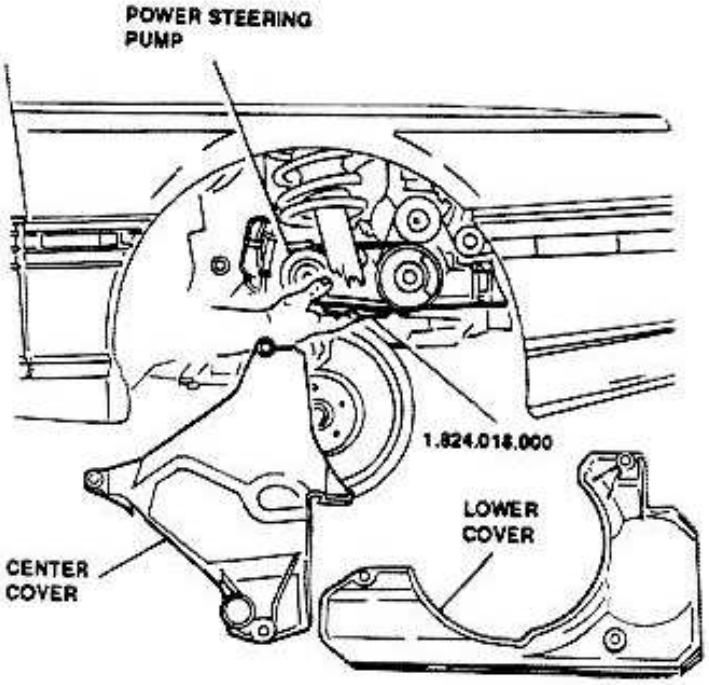
3. Stretch the conditioner compressor and water pump driving belt to the assembly value.
4. Perform a short run-in according to the following procedure:
   - Let the engine reach its operating temperature (water at 80°C)
   - Let the engine idle for 10 minutes
   - Let the engine cool down.
5. Adjust the belt tension to the prescribed value.

Conditioner compressor and water pump drive belt	
Tension (Assembly)	650 to 700 N 146 to 157 lbs
Retensioning (after run-in)	550 to 600 N 124 to 135 lbs

c) Power steering pump belt.

- **Check:**

1. Remove right front wheel and relevant front fender.
2. Lift rear fender and remove central cover.
3. Loosen coolant pump and air conditioning compressor belt tightener, and remove lower cover.
4. Insert tool **1.824.018.000.**



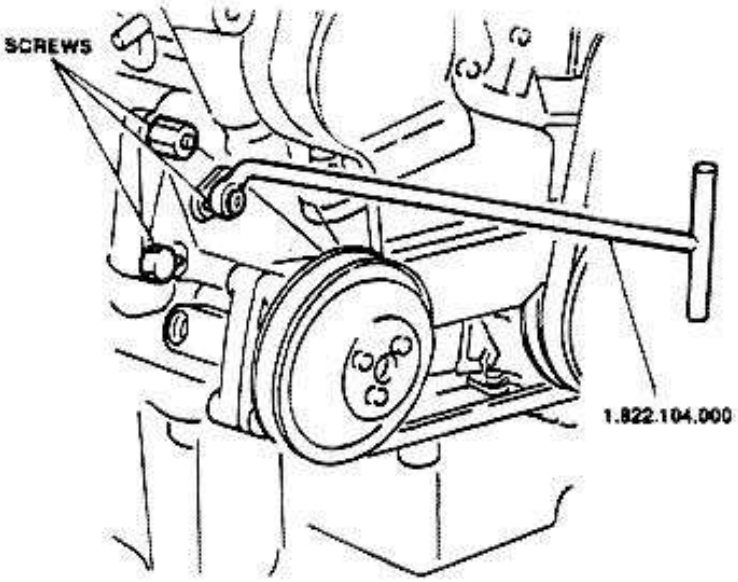
- **Check that minimum (cold) tension is the prescribed one.**

Power steering pump drive belt	
Minimum tension (cold)	250 N 56.2 lbs

5. Adjust the belt tension to the prescribed value.

- **Retensioning:**

1. Loosen attaching screws using tool **1.822.104.000**.

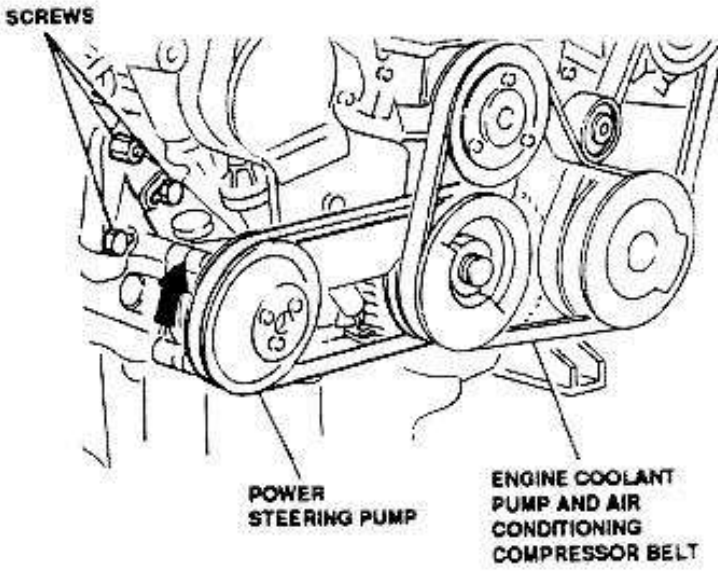


2. Move power steering pump outwards to increase belt tension.
3. Tighten one attaching screw and check belt tension.
4. Tighten remaining attaching screw after correct belt tension is obtained.

Power steering pump drive belt	
Retensioning	300 to 350 N 67.5 to 78.7 lbs

- **Replacement:**

1. Remove coolant pump and air conditioning compressor belt (refer to preceding step b.).



3. Remove worn belt.
4. Fit new belt.
5. Install coolant pump and air conditioning compressor belt, and adjust belt tension (refer to preceding step b.)
6. Adjust power steering pump belt tension as indicated above to the assembly value.

Power steering pump drive belt	
Tension (Assembly)	400 to 450 N 90 to 101.2 lbs

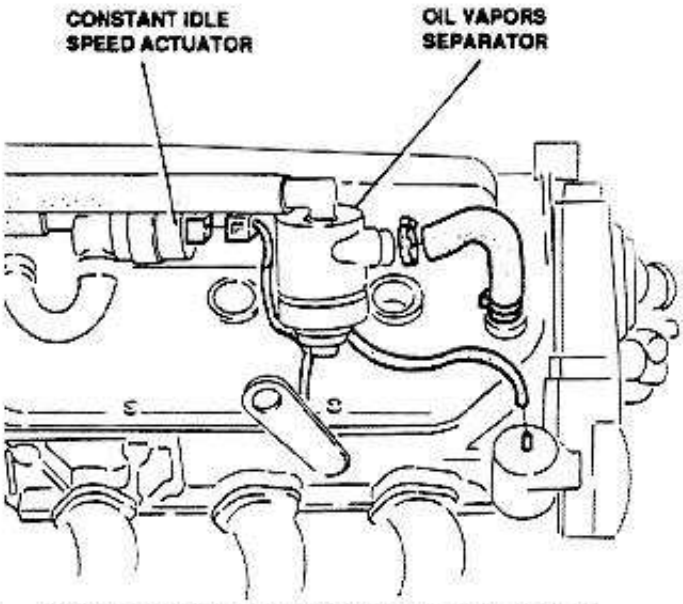
10 - VALVE CLEARANCE CHECK AND ADJUSTMENT

WARNING:
All the operations described below must be performed with COLD ENGINE.

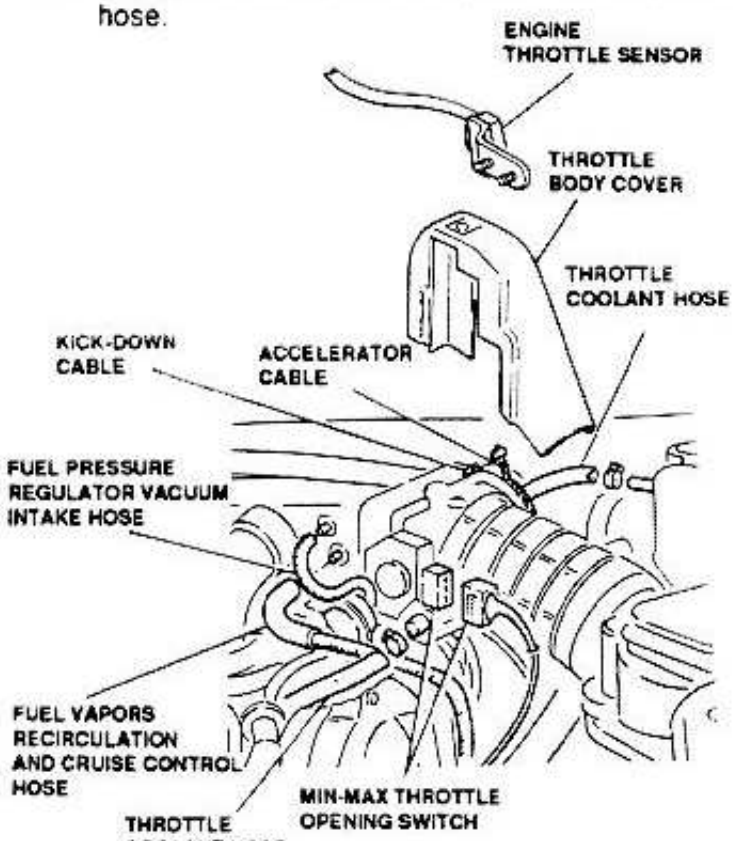
Right timing system cover removal.

1. Disconnect battery (-) lead.
2. Disconnect constant idle speed actuator connector.

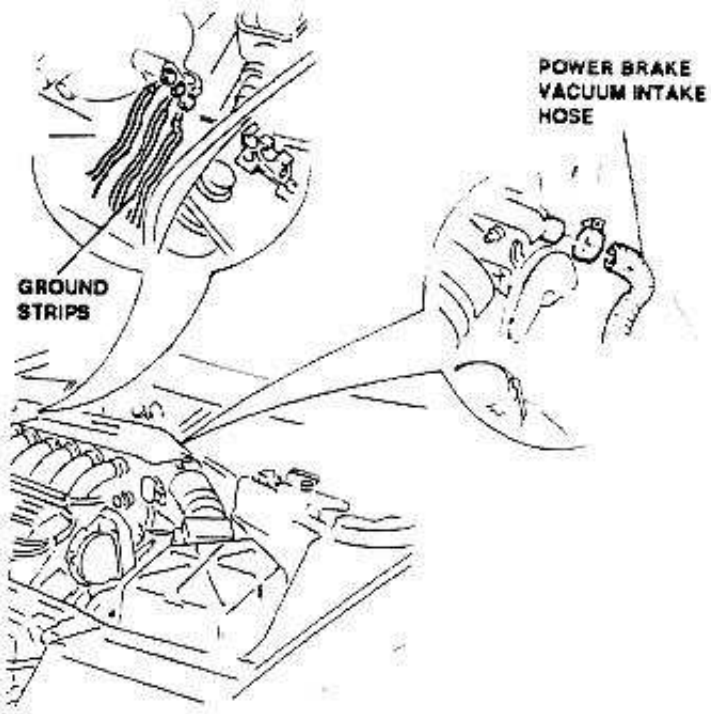
2. Loosen screws securing power steering pump.
3. Disconnect oil vapor recirculation pipes.



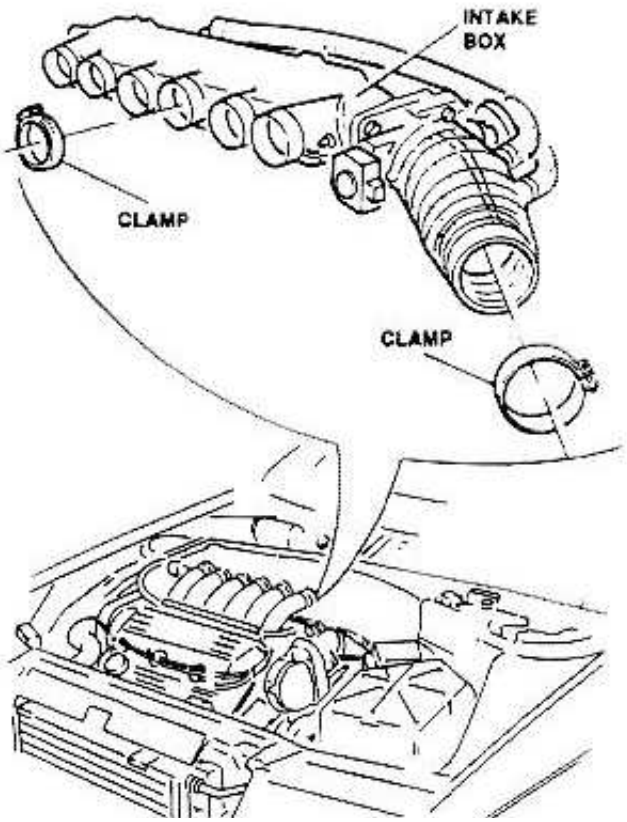
4. Disconnect Min-Max throttle opening switch.
5. Remove throttle body cover.
6. Disconnect accelerator cable.
7. **(Vehicles with automatic transmission only)**. Disconnect kick-down cable.
8. **("S" version only)**. Remove engine throttle sensor.
9. Disconnect throttle coolant hoses.
10. Disconnect fuel vapor recycling and cruise control hose.
11. Disconnect fuel pressure regulator vacuum intake hose.



12. Disconnect power brake vacuum intake hose.
13. Disconnect ground strips.

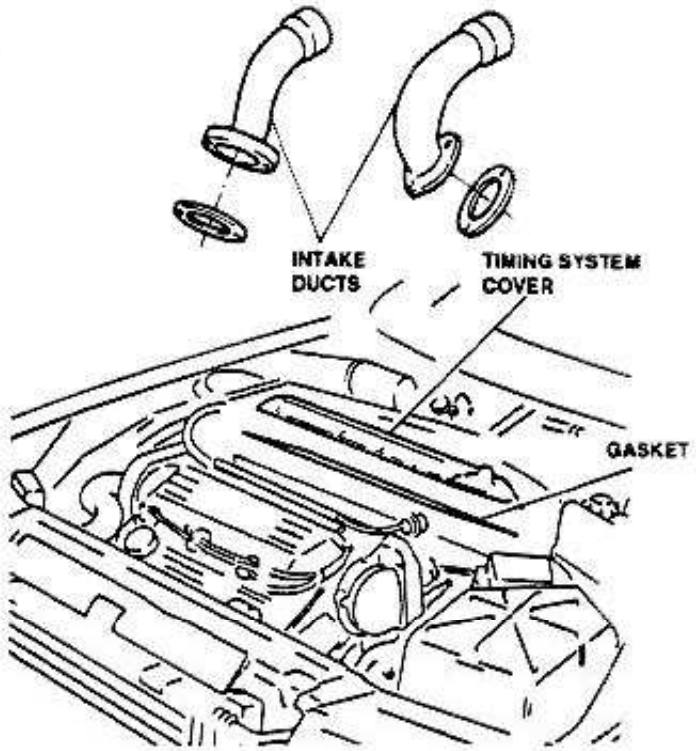


14. Remove air intake box acting on three attaching screws and intake duct clamps.



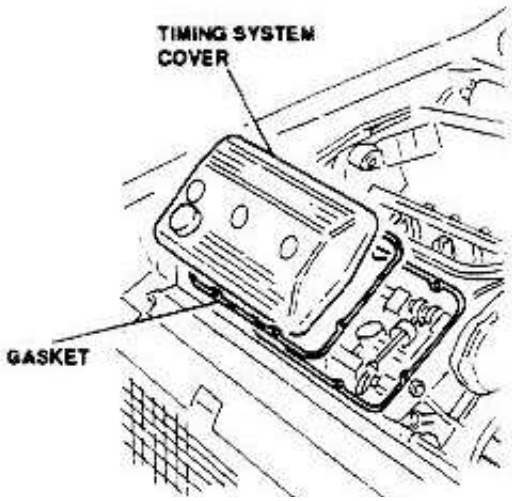
COOLANT HOSE

15. Disconnect spark plug leads of cylinders No. 1,2 and 3.
16. Remove intake ducts and relevant gaskets.
17. Remove right timing system cover and relevant gasket.



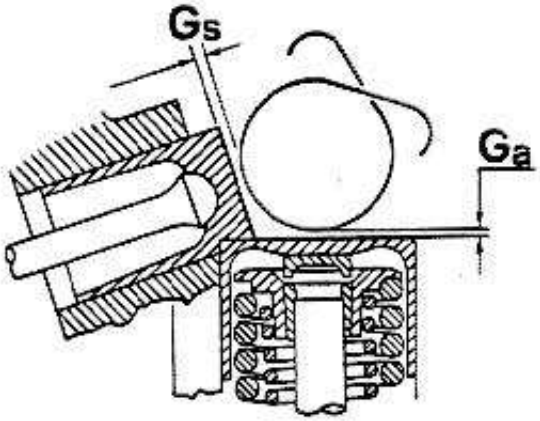
Left timing system cover removal.

1. Disconnect spark plug leads of cylinders No. 4, 5 and 6.
2. Remove left timing system cover and relevant gasket.



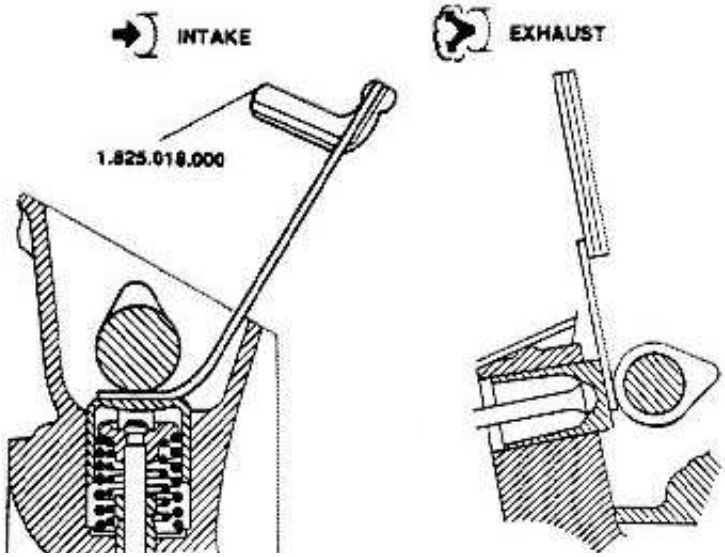
Valve clearance check.

1. Suck oil from cylinder head sumps and re-introduce it into engine sump.
2. Clean spark plug seatings, remove spark plugs and cap holes to prevent entry of foreign matter.
3. **WITH COLD ENGINE**, check clearance between cams rest angle and top of valve caps is within prescribed limits.



Valve clearance (engine cold)
G_a = 0.475 to 0.500 mm 0.0187 to 0.0197 in
G_s = 0.225 to 0.250 mm 0.0088 to 0.0098 in

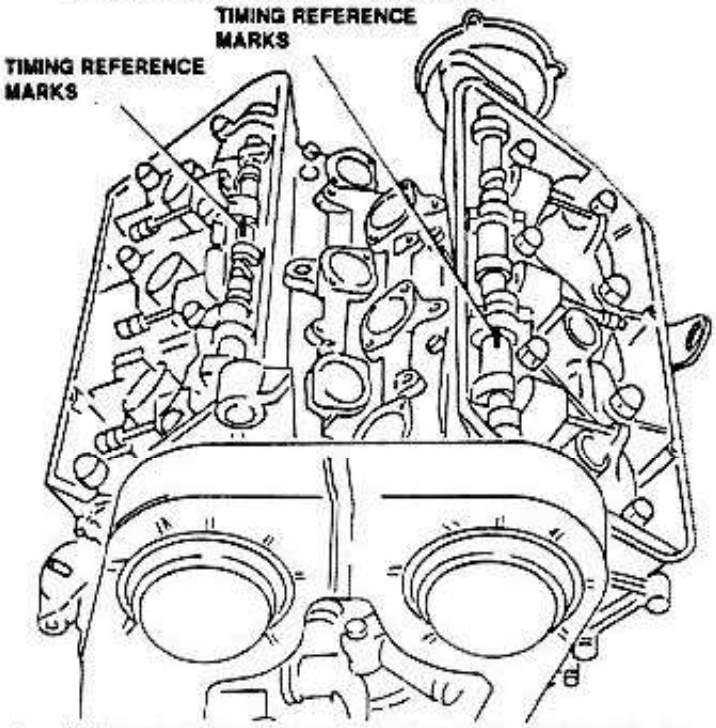
NOTE: Check intake valve clearance using feeler gauge 1.825.018.000.



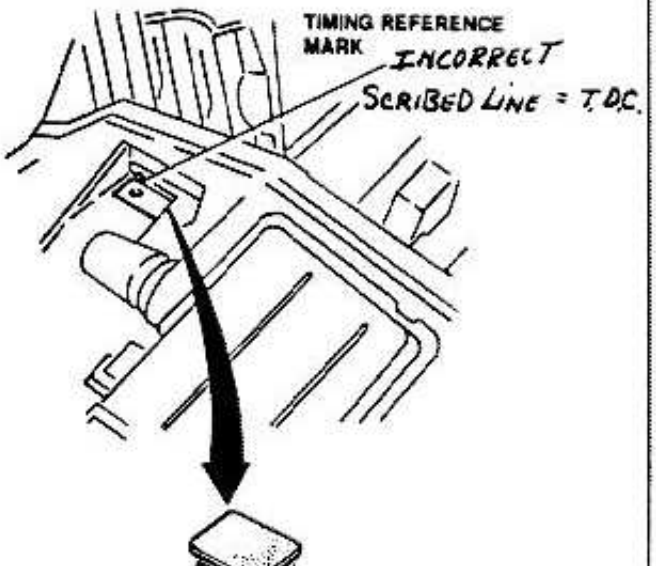
- If valve clearance is not within prescribed limits, adjust clearance as indicated below.

Valve clearance adjustment - Intake side.

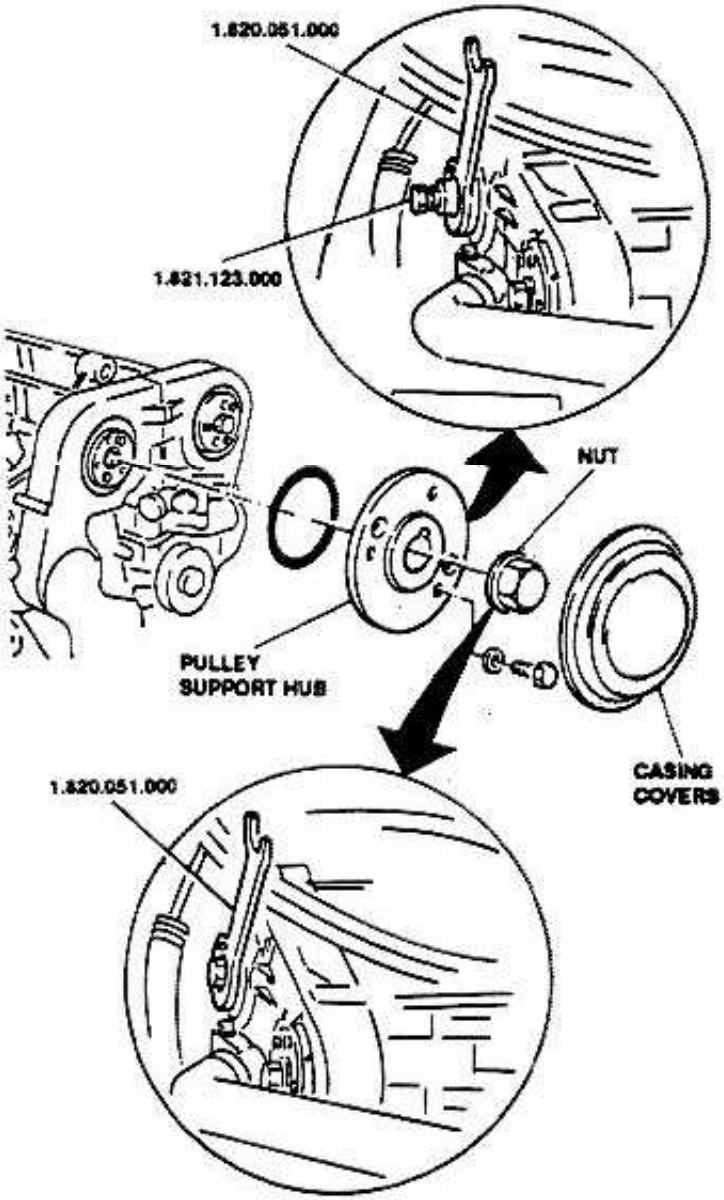
1. Engage highest gear speed (D, with automatic gear) and move vehicle forwards to rotate crankshaft until timing notches engraved on camshafts are aligned to those engraved on relevant caps.



2. When in this position (cylinder No. 1 at T.D.C. in firing phase), the SCRIBED LINE on the flywheel should match the notch engraved on gearbox cone.

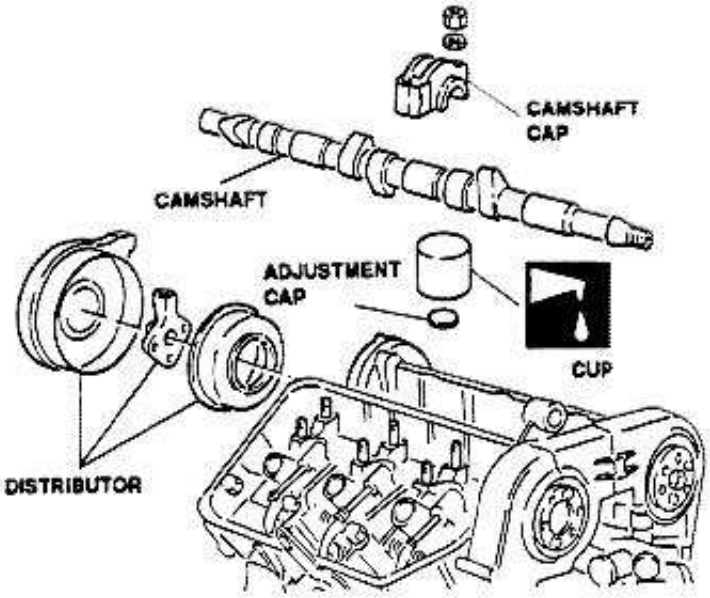


3. Remove covers from timing belt casing.
4. Remove securing nut using torque reactor **1.820.051.000**.
5. Remove three screws securing toothed pulley support hub.
6. Extract support hub and relevant seal using puller **1.821.123.000** and torque reactor **1.820.051.000**.



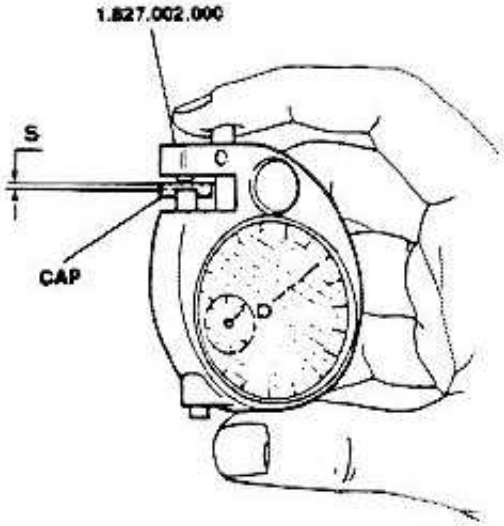
7. Remove camshaft caps.
8. (Left cylinder head only). Remove distributor cap, rotor arm and body.
9. Withdraw camshaft lifting from rear end.

10. Withdraw a valve cup and relevant adjustment cap.



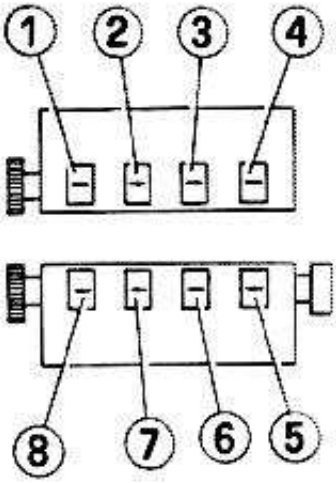
11 Measure thickness S using feeler gauge **1.827.002.000**; select new cap of proper thickness.

12. Lubricate new cap with engine oil and install together with valve cup.
Operate in analogy on the remaining cap-cup pairs.



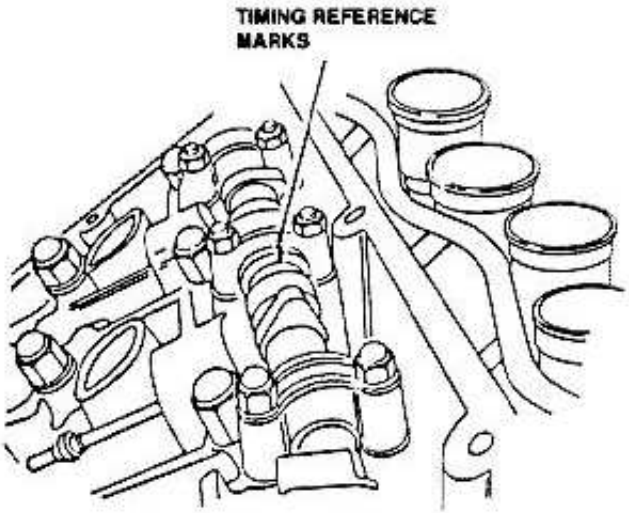
13. Position camshaft and install relevant caps.

NOTE: Observe the numbering and arrow engraved on caps.

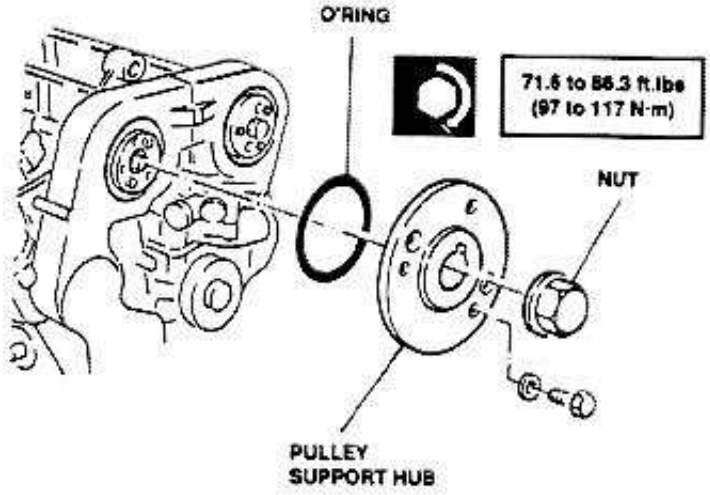


11.8 to 13.2 ft.lbs (16 to 18 N·m)

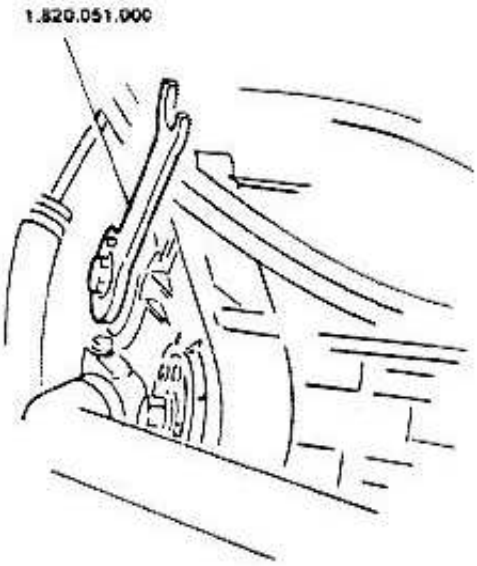
14. Tighten nuts securing cap to prescribed torque.
15. Rotate camshaft to align notches on camshaft to those engraved on relevant cap, and check alignment of flywheel hole with notch engraved on gearbox cone.



16. Install toothed pulley support hub complete of a new seal and screw without tightening the attaching screws.
17. Install nut securing toothed pulley to camshaft.

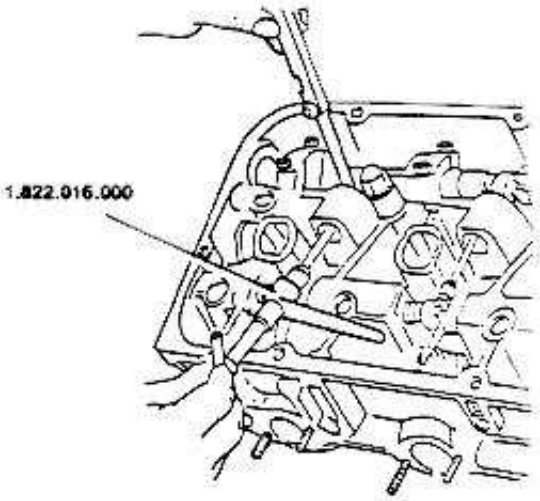


18. Prevent rotation of pulley using tool 1.820.051.000 and lock nut to prescribed torque.
19. Torque completely screws securing hub.
20. (Left cylinder head only). Re-install distributor assembly.

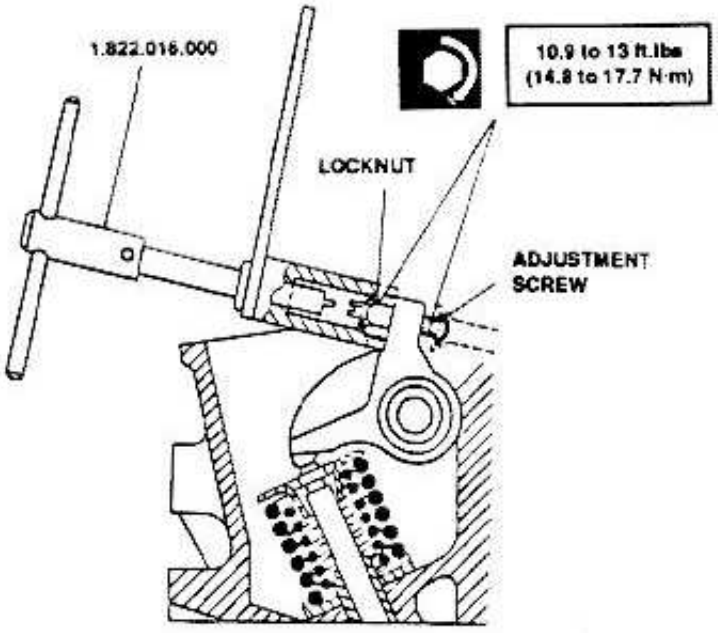


Valve clearance adjustment-exhaust side.

1. Loosen locknut using tool 1.822.016.000 and acting on intermediate lever of tool.

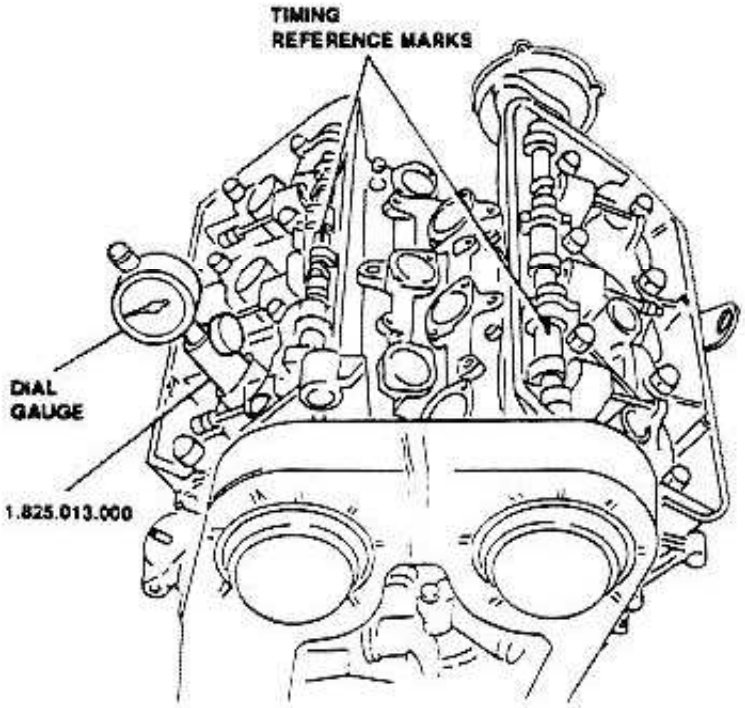


2. Using the same tool, act on adjustment screw until the prescribed clearance is obtained.
3. Tighten locknut and check again valve clearance.



- Prior to proceed to reassembly, position camshafts properly as follows:

4. Install feeler pin **1.825.013.000** and dial gauge into seating of cylinder No.1 spark plug.
5. Engage the highest gear speed (D, with automatic transmission), and rotate the crankshaft to align timing notches on camshaft to notches on relevant caps.
6. When in this position (No. 1 cylinder at T.D.C. in firing phase), the hole on flywheel must be aligned to notch engraved on gearbox cone.



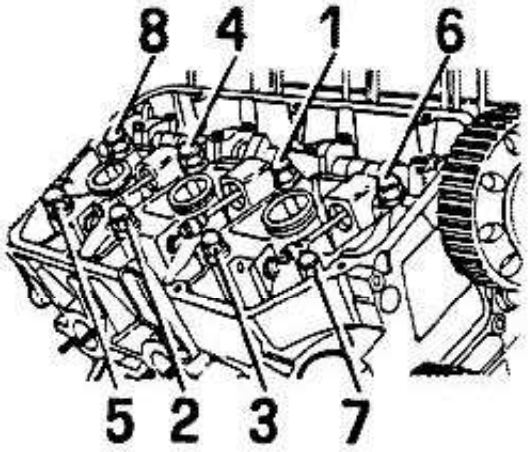
Reassembly

- Perform reassembly by reversing order of disassembly procedure. Ensure of correct positioning of gaskets.

11 - CYLINDER HEAD NUTS TIGHTENING

- Perform operation with cold engine.
1. Remove timing system covers. (Refer to proceeding step 10).
2. Loosen nuts of one turn in the sequence shown in illustration; wipe with engine oil the surface between washer and nut, then torque to following value:

72.2 to 79.8 ft.lbs (97.8 to 108.2 N·m)



NOTE: The sequence shown refers to the R.H. cylinder head. Operate in analogy for the L.H. cylinder head.

3. Perform reassembly in reverse order.

NOTE: In case of **disassembly and reassembly of cylinder heads**, perform a first torquing to following value:

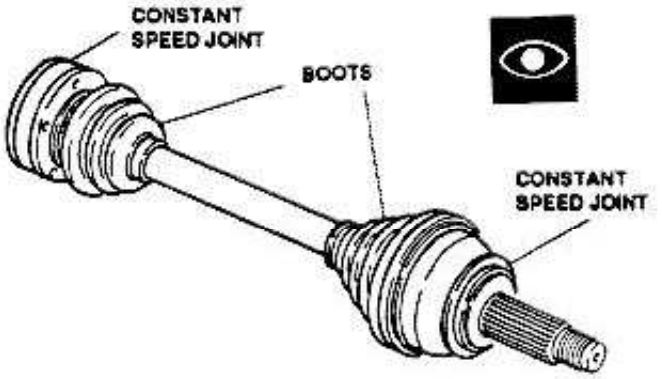
65.3 to 72.2 ft.lbs (88.5 to 97.8 N·m)

Repeat operation stated at steps 1. and 2. above after about 650 miles covered.

12 - INTEGRITY CHECK OF AXLE SHAFTS, STEERING BOX AND STEERING KNUCKLE JOINTS PROTECTIVE BOOTS

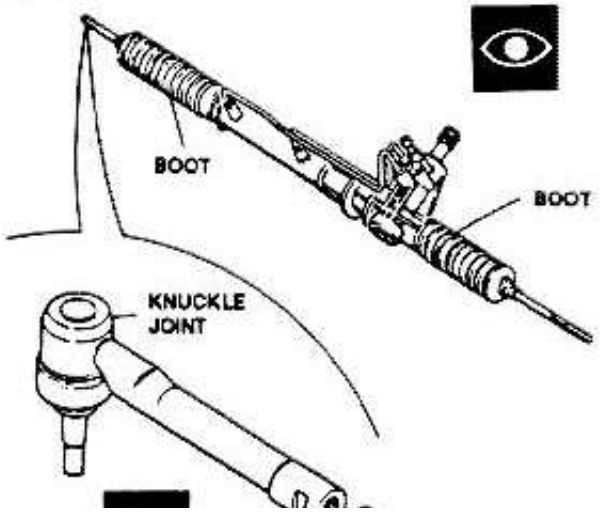
AXLE DRIVE SHAFTS

1. Check rubber protective boots for absence of damages and traces of grease seepage from the boot. Overhaul the complete joint if any breakage is found, since foreign matter could have been trapped and cause severe failure.
2. Visually check constant speed joints for condition.
3. Refer to **Group 17** if some components require overhaul.



STEERING RODS

1. Check rubber protective boots for integrity; replace boots if cracks or nicks are found.
2. Check knuckle joints for absence of damage or wear.
3. Refer to **Group 23** to replace components, when required.



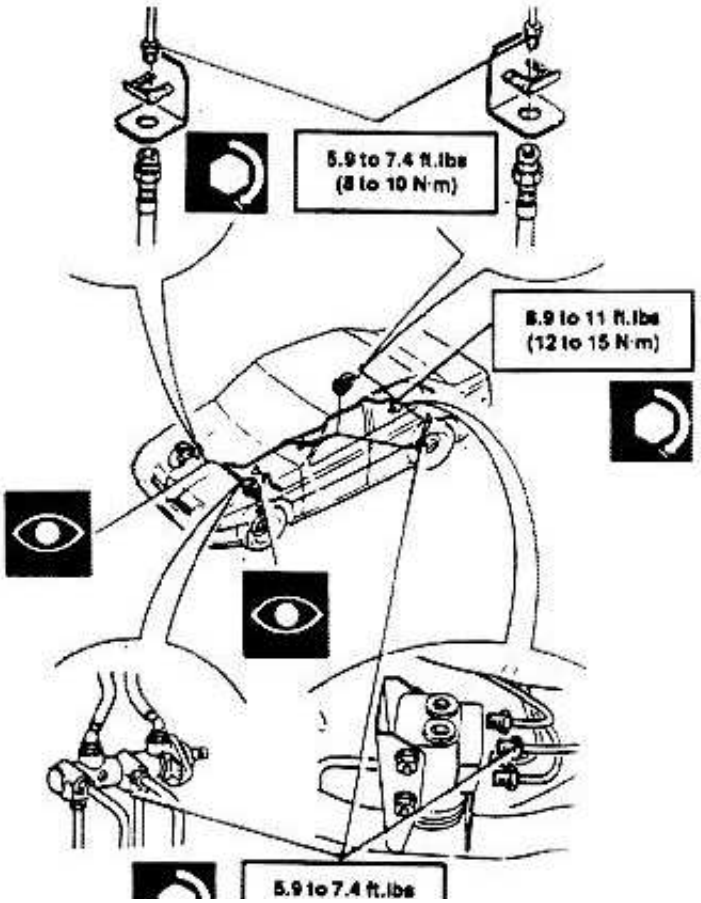
13 - BRAKE CIRCUIT PIPING TIGHTNESS CHECK

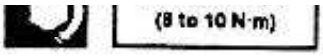
1. Check tubes and hoses: no damages, swelling and oxidation are allowed. Check tubes and hoses for proper and safe installation.
2. Check fittings: no leaks are allowed; torque to prescribed value, if necessary.
3. Check power brake vacuum hose for absence of flaws or chokes, and for proper connection.

- Replace defective items. In this event, bleed brake system. (Refer to **Group 22**).

CAUTION:
The brake/clutch fluid is harmful for the vehicle's body. Operate with precaution.

NOTE: Bleed the brake system (refer to **Group 22**) any time a part of the system is removed or replaced.

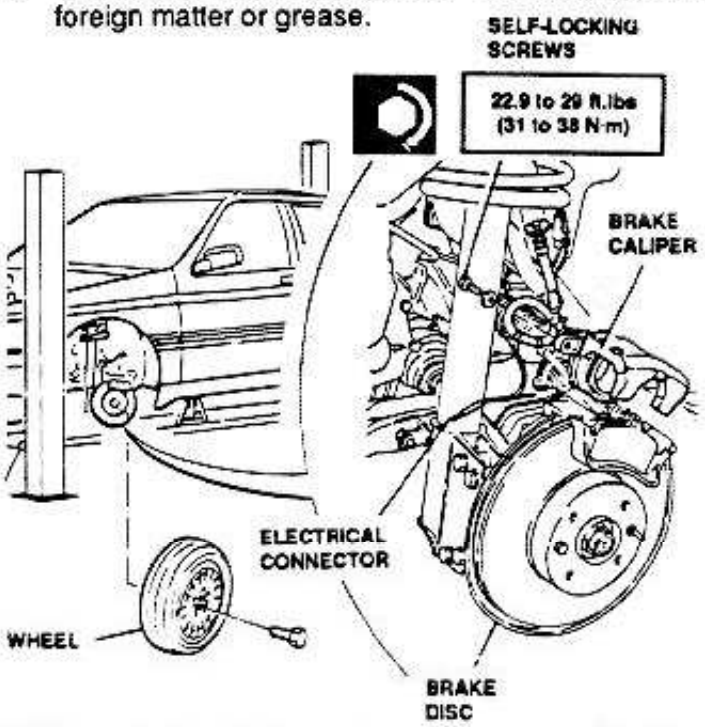




14 - BRAKE PADS WEAR CHECK

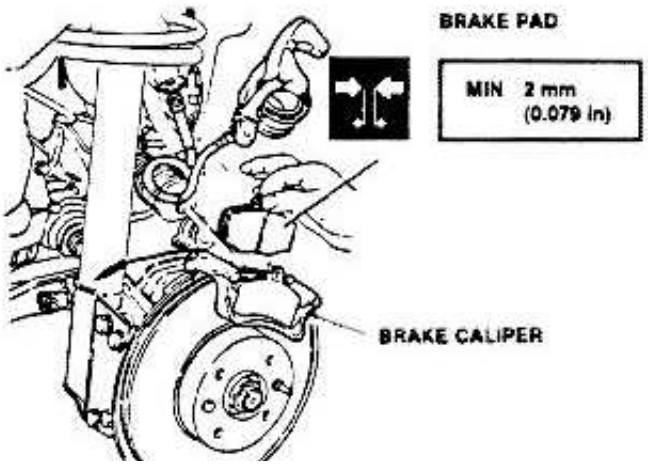
FRONT BRAKES

1. Remove front wheel.
2. Disconnect brake pad electrical connector.
3. Remove brake caliper acting on attachment screws.
4. Thoroughly clean disc surface from any trace of foreign matter or grease.



NOTE: On installation, always use new self-locking screws securing brake caliper body; torque screws to prescribed value.

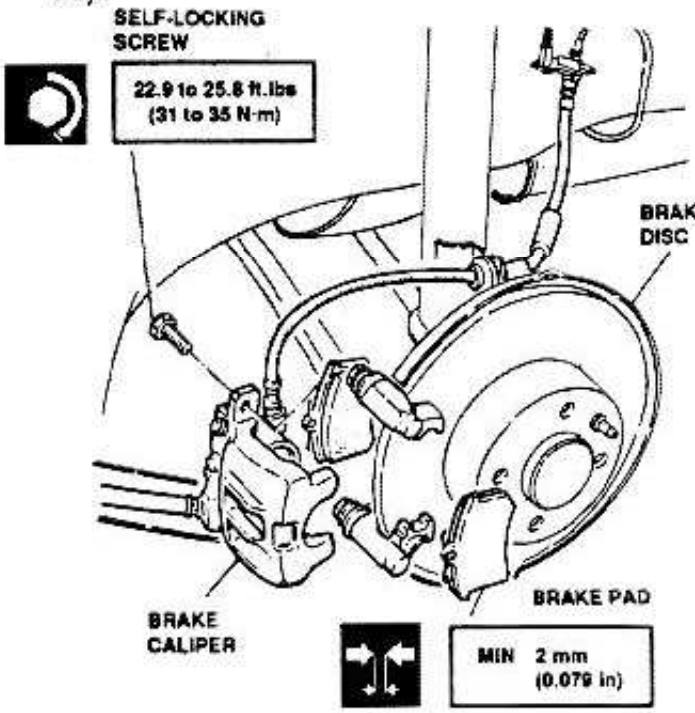
5. Check brake pads: replace if gasket thickness is lower than **0.079 In (2 mm)**.
- Check brake disc wear, if required (refer to **Group 22**).



6. On installation, inner brake pad must be positioned with relief groove faced towards rear end of vehicle. Install brake pad with wear sensor on inner side of disc.

REAR BRAKES

1. Remove rear wheel.
2. Remove brake caliper acting on attaching screws.
3. Thoroughly clean disc surface from any trace of foreign matter or grease.
4. Check brake pads: replace if gasket thickness is lower than **0.079 In (2 mm)**.
- Check brake disc wear, if required (refer to **Group 22**).



NOTE: On installation, always use new self-locking screws securing brake caliper body; torque screws to prescribed value.

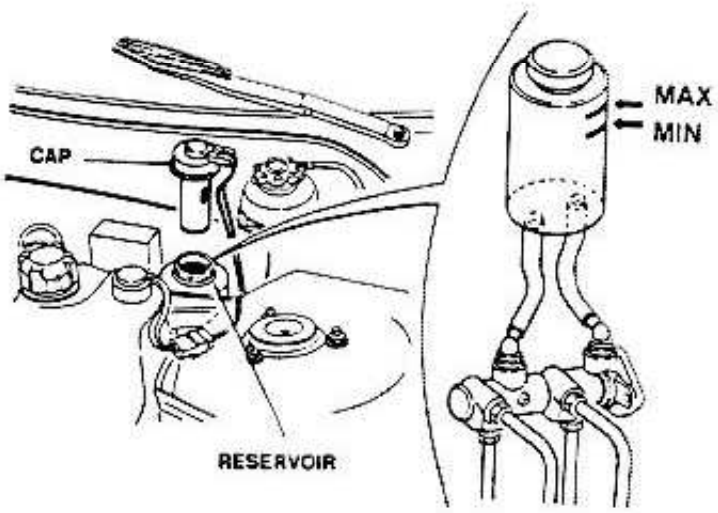
5. Retract cylinder into brake caliper by pressing manually before installation of brake caliper.
6. After reassembly, start engine and press brake pedal several times, to restore automatic parking brake slack take-up.
- Road test the vehicle by applying brakes several times to eliminate any trace of residual matter and to verify proper efficiency of brake system.

15 - BRAKE/CLUTCH FLUID LEVEL CHECK

CAUTION:
The brake/clutch fluid is harmful for the vehicle's body. Operate with precaution to prevent fluid from contacting painted surfaces, and subsequent damage.

NOTE: Check fluid level with vehicle on a level surface.

1. Remove reservoir cap, paying attention not to disconnect electrical connector.
2. Ensure the level is at **MAX** mark on reservoir.



3. Top-up with prescribed fluid, if necessary.

Alfa Romeo	BRAKE FLUID SUPER DOT 4
AGIP BRAKE FLUID DOT 4	

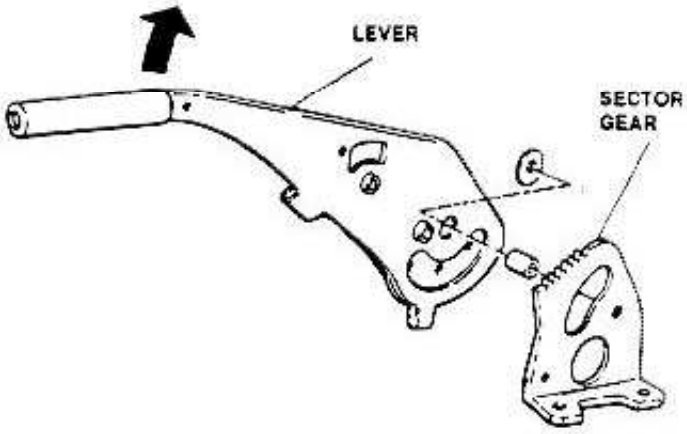
4. If level is too low, carefully check tightness of brake system (refer to preceding operation 13).

CAUTION:
The brake/clutch fluid is hygroscopic, in other words its easily absorbs water when in contact with humid environment.
Top-up using only fluid from sealed containers opened just before use.

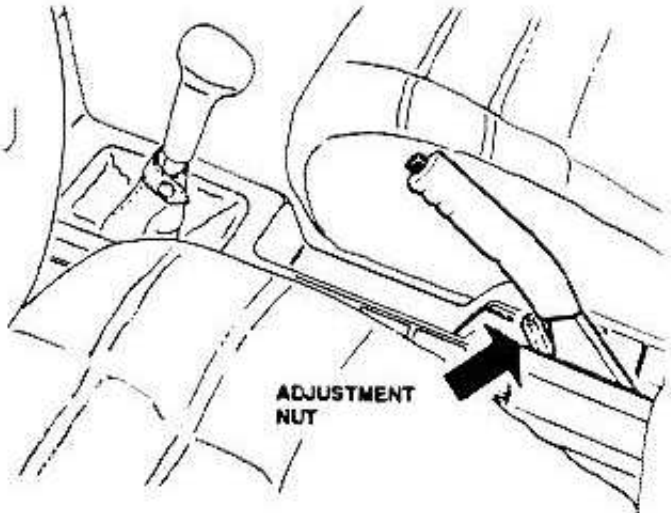
NOTE: Bleed the brake system (refer to **Group 22**) any time a component of system is removed or replaced.

16 - PARKING BRAKE TRAVEL CHECK

1. Set parking brake lever to third detent on sector gear.



2. Act on adjustment nut until wheels are blocked.



system (refer to preceding operation 13).

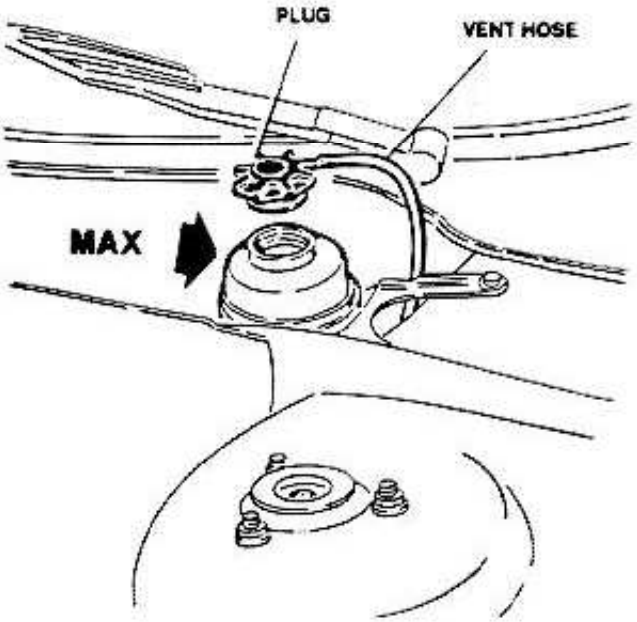
3. Act on the lever and verify that:

   - The lever performs a travel of about seven detents when a force of about **80 lbs (40 kg)** is applied.
   - The wheels are free when lever is in rest position.

17 - POWER STEERING FLUID LEVEL CHECK

NOTE: Check level with vehicle on a level surface.

1. Remove vent hose and plug.
2. Check fluid level is at **MAX** mark.



3. Top-up with prescribed fluid, if necessary.

AGIP DEXRON II D 21103
SHELL ATF DEXRON II D 20137

4. Start engine and wait until fluid level stabilizes rotating the steering wheel completely several times.

18 - GEARBOX AND DIFFERENTIAL OIL LEVEL CHECK

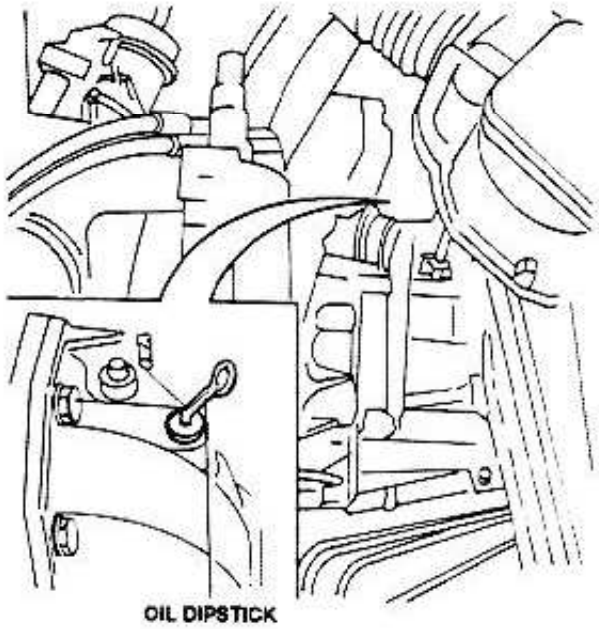
NOTE: Check level with vehicle on a level surface.

a) Manual transmission

- Operate with cold engine.

1. Pull-out dipstick and check that oil level is at max notch on dipstick.

CAUTION:
Clean dipstick using a lint-free cloth. Fabric hair or threads could damage the gearbox.



2. Top-up with prescribed oil, if required.

AGIP DEXRON II 21103
SHELL ATF DEXRON II 20137

b) Automatic transmission

WITH COLD ENGINE

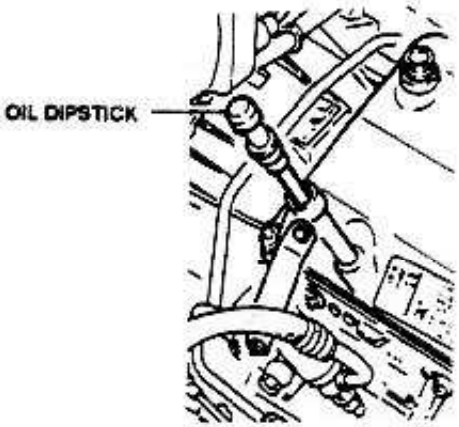
1. Engage parking brake.
2. Position gear selector lever to "P" (Parking).

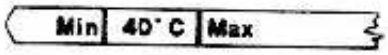
5. Top-up fluid to **MAX** mark and plug reservoir.

2. Position gear selector lever to "P" (Parking)

3. Start engine.
4. Apply brake pedal and, with engine at idle, select all remaining gear speeds, proceeding from "P" to "1" and viceversa; hold about two seconds in each position.
5. Position lever again to "P" and check level of gearbox oil is at **MIN** mark for temperature of **40°C (104°F)**.

CAUTION:
Clean dipstick using a lint-free cloth. Fabric hair or threads could damage the gearbox.





Dipstick-Right side

6. Top-up with prescribed oil, if required.

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SHELL ATF DEXRON II D 20137

WITH WARM ENGINE

1. With engine at normal operating temperature, idle speed and selector lever to position "P" (Parking), check level of oil in gearbox is between **MIN** and **MAX** marks for temperature of **80°C (176°F)**.

2. Top-up with prescribed fluid, if required.

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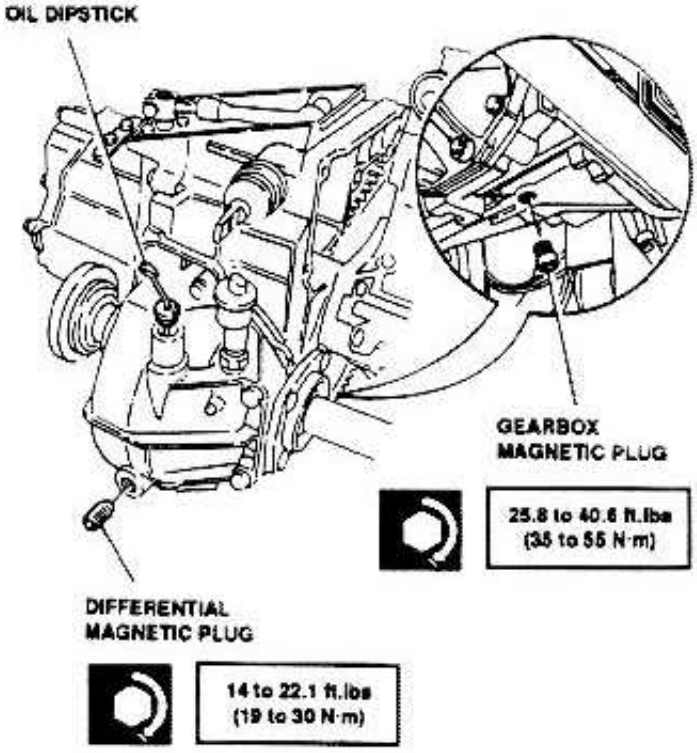
SHELL ATF DEXRON II D 20137

NOTE: In both cases, top-up oil level with selector lever to "P" (parking) and engine at idle.

19 - GEARBOX AND DIFFERENTIAL OIL CHANGE

a) Manual transmission

1. Place vehicle on autolift.
2. Remove magnetic plug from gearbox and plug from differential.
3. Leave oil to drain for at least 15 minutes.
4. Re-install plugs and service with prescribed oil to maximum level.

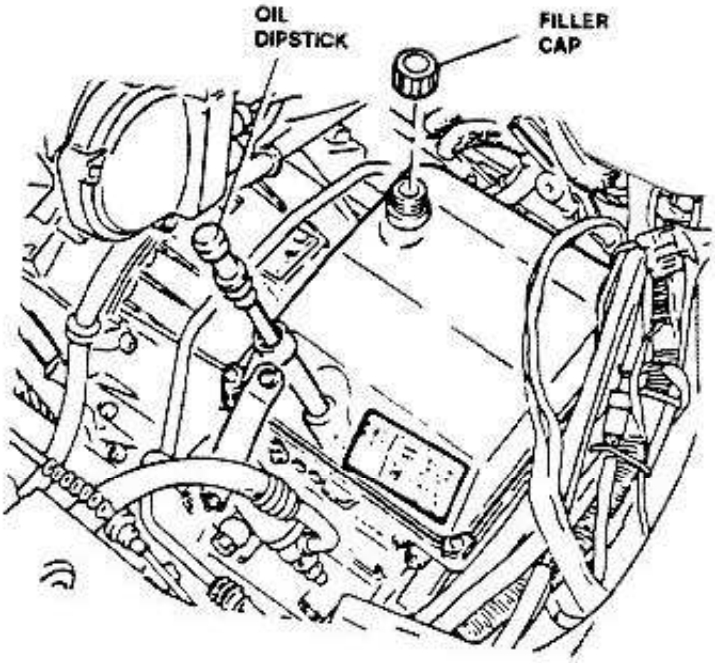


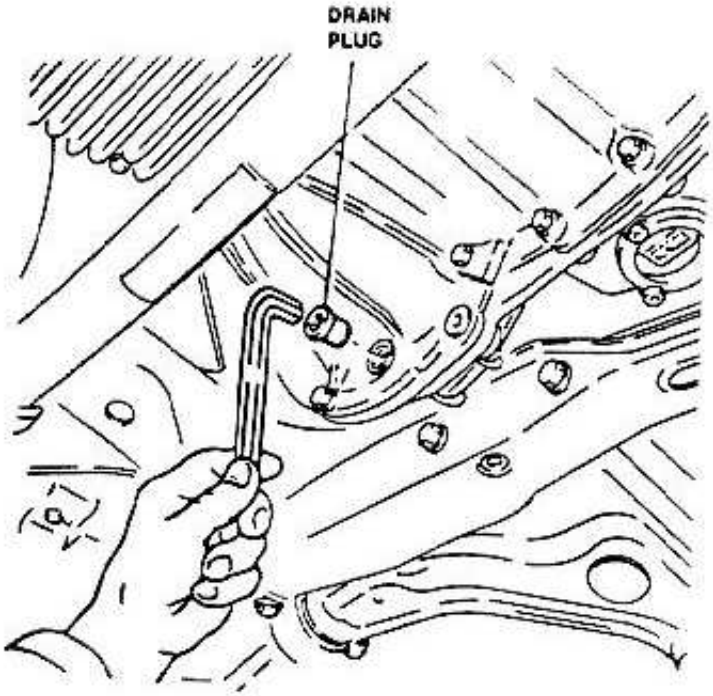
Dipstick - Left side

NOTE: Clean plugs before installation.

b) Automatic transmission

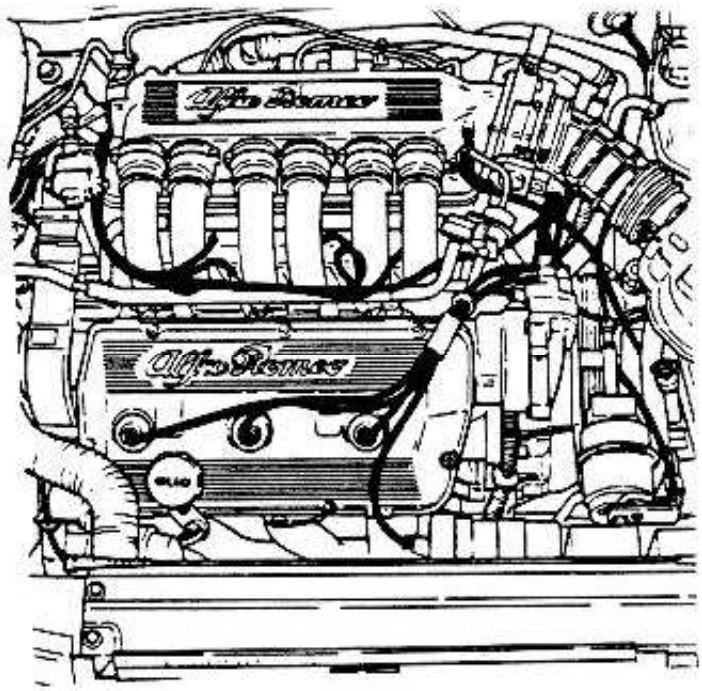
1. Place vehicle on auto lift.
2. Remove magnetic plug
3. **Operate with warm gearbox group**, and leave oil to drain for at least 15 minutes.
4. Reinstall plug and service with prescribed oil.





20 - ENGINE COMPARTMENT ELECTRIC CONNECTIONS CHECK

1. Check condition and positioning of connectors and covers.
2. Check connectors are properly connected.
3. Check cables and wires are not peeled, cut or worn, and properly secured to attaching clamps.



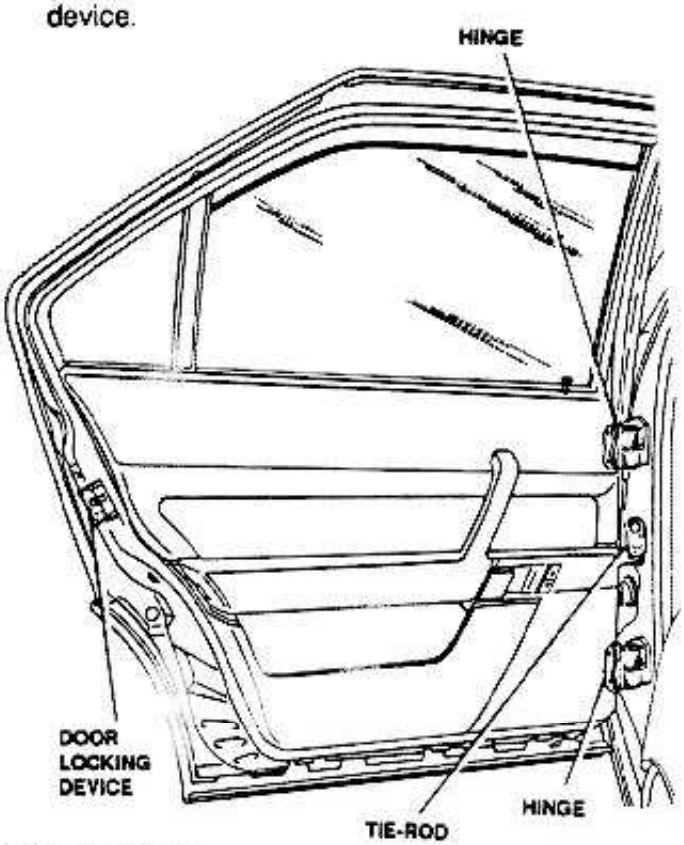
21- DOOR, HOOD AND TRUNK LID HINGES LUBRICATION; HOOD AND TRUNK LID LATCHES GREASING

Apply a sufficient quantity of grease on parts listed below to avoid wear and oxidation:

- Clean affected items.
- Apply grease.
- Remove excess grease.

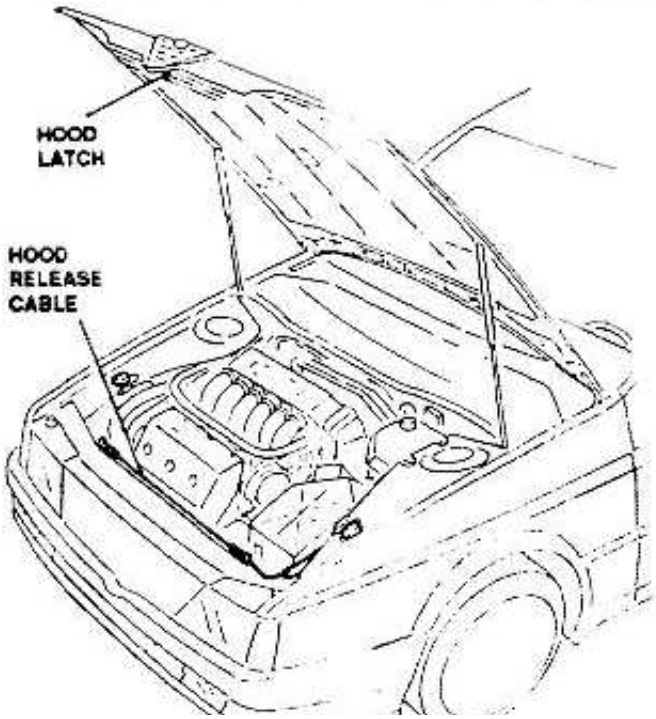
DOORS

- Lubricate hinges, tie-rod and door locking device.



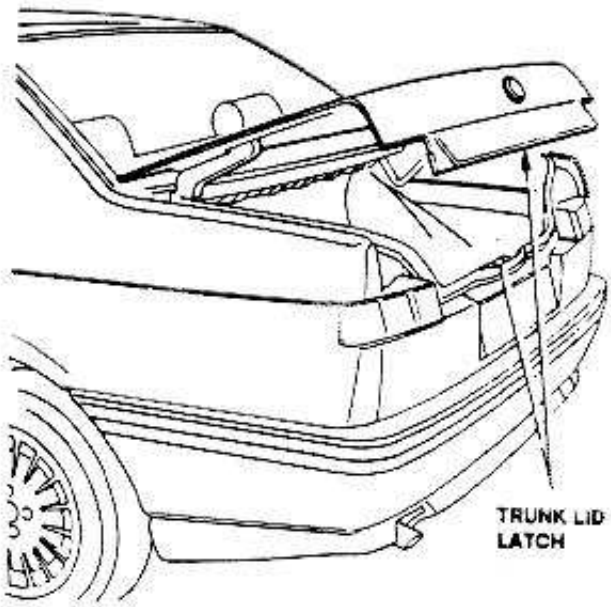
ENGINE HOOD

- Lubricate hood latch mechanism and release cable.



TRUNK-LID

- Lubricate lid latch mechanism.



22 - VEHICLE TESTING

Road test the vehicle. Ascertain proper operation of all systems and component which have been subject to maintenance and/or repair activities.

TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

(Data required to carry-out maintenance activities)

BELT TENSIONING

NOTE: Carry-out belts tensioning using tool 1.824.018.000

ALTERNATOR BELT

On installation	400 to 450 N	90 to 101.2 lbs
Minimum (Cold engine)	300 N	67.5 lbs
Retensioning (Cold engine)	300 to 350 N	67.5 to 78.7 lbs
Retensioning (after run-in)	300 to 350 N	67,5 to 78,7 lbs

POWER STEERING PUMP BELT

On installation	400 to 450 N	90 to 101.2 lbs
Minimum (Cold engine)	250 N	56.2 lbs
Retensioning (Cold engine)	300 to 350 N	67.5 to 78.7 lbs
Retensioning (after run-in)	300 to 350 N	67,5 to 78,7 lbs

COOLANT PUMP AND AIR CONDITIONING COMPRESSOR BELT

On installation	650 to 700 N	146 to 157 lbs
Minimum (Cold engine, after Run-in)	550 N	124 lbs
Retensioning (Cold engine)	550 to 600 N	124 to 135 lbs

VALVES CLEARANCE

NOTE: Check/Adjust valves clearance only with cold engine

INTAKE	0.475 to 0.500 mm	0.0187 to 0.0197 in
EXHAUST	0.225 to 0.250 mm	0.0088 to 0.0098 in

BRAKE SYSTEM

Minimum brake pads thickness	2 mm	0.079 in

PARKING BRAKE

Number of free teeth on sector gear before	N. 3

wheels are locked

FLUIDS AND LUBRICANTS

Type	Application	Name	Quantity
OIL	Engine oil servicing	AGIP NUOVO SINT 2000 10W/40 SHELL FIRE & ICE MOTOR OIL 10W/40	7.5 l 2 gals
OIL	Manual gearbox oil servicing	AGIP DEXRON II SHELL ATF DEXRON II	1.8 l 0.5 gals
OIL	Automatic gearbox oil servicing	AGIP DEXRON II SHELL ATF DEXRON II	9 l 2.4 gals
OIL	Power steering oil servicing	AGIP DEXRON II SHELL ATF DEXRON II	0.9 kg 2 lbs
FLUID	Brake/clutch system servicing (*) With ABS	Alfa Romeo BRAKE FLUID SUPER DOT 4 AGIP BRAKE FLUID DOT 4	0.5 kg 1.1 lbs 0.7* kg 1.6* lbs
FLUID	Engine cooling system servicing	Antifreezing ALFA ROMEO Climafluid Permanent - Ready for use	13 l 3.5 gals
OIL	Spark plugs tightening	ISECO Molykote A	–
ANTISEIZING COMPOUND	Lambda probe tightening	R.GORI Never Seez	–

TIGHTENING TORQUES

ENGINE

Cylinder head nuts:		
- on cylinder heads assembly (lubricated)	65.3 to 72.2 ft.lbs	88.5 to 97.8 Nm
- after about 650 miles (cold engine, lubricated)	72.2 to 79.8 ft.lbs	97.8 to 108.2 Nm
Camshaft cap nuts (lubricated)	11.8 to 13.2 ft.lbs	16 to 18 Nm
Spark plugs (lubricated with ISECO Molykote A oil)	18.4 to 25 ft.lbs	25 to 34 Nm
Camshaft front hub nut	71.6 to 86.3 ft.lbs	97 to 117 Nm
Lambda probe	37 to 44 ft.lbs	50 to 60 Nm
Rocker arm adjustment nut-screw	10.9 to 13 ft.lbs	14.8 to 17.7 Nm
Fuel filter fitting	21.1 to 29 ft.lbs	30 to 40 Nm
Fuel filter fitting	14.8 to 17 ft.lbs	20 to 23 Nm

GEARBOX (M.T.)

Differential oil drain plug	14 to 22.1 ft.lbs	19 to 30 Nm
Gearbox magnetic plug	25.8 to 40.6 ft.lbs	35 to 55 Nm

BRAKE SYSTEM

Rigid pipe fitting on brake pump	5.9 to 7.4 ft.lbs	8 to 10 Nm
Hose fitting on brake caliper	5.9 to 7.4 ft.lbs	8 to 10 Nm
Front brake calipers attaching screws	22.9 to 28 ft.lbs	31 to 38 Nm
Rear brake calipers attaching screws	22.9 to 25.8 ft.lbs	31 to 35 Nm
Rigid pipe fitting on load proportioning valve	8.9 to 11 ft.lbs	12 to 15 Nm

SPECIAL TOOLS

Tool number	Description
1.820.051.000	Tool, camshaft pulley turning
1.820.053.000	Pin, hydraulic belt tightener lock
1.820.210.000	Tool, coolant pump and air conditioning compressor belt tightener lock
1.821.123.000	Puller, camshaft pulley
1.822.016.000	Wrench, exhaust side timing system adjustment
1.822.104.000	Wrench, power steering pump secure
1.827.001.000	Dial gauge, valve caps check.
1.824.018.000	Tool, belt tensioning check
1.825.013.000	Tool, T.D.C. check
1.825.018.000	Feeler gauge, valves clearance check

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GROUP 07

COOLING SYSTEM

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GROUP 07

COOLING SYSTEM

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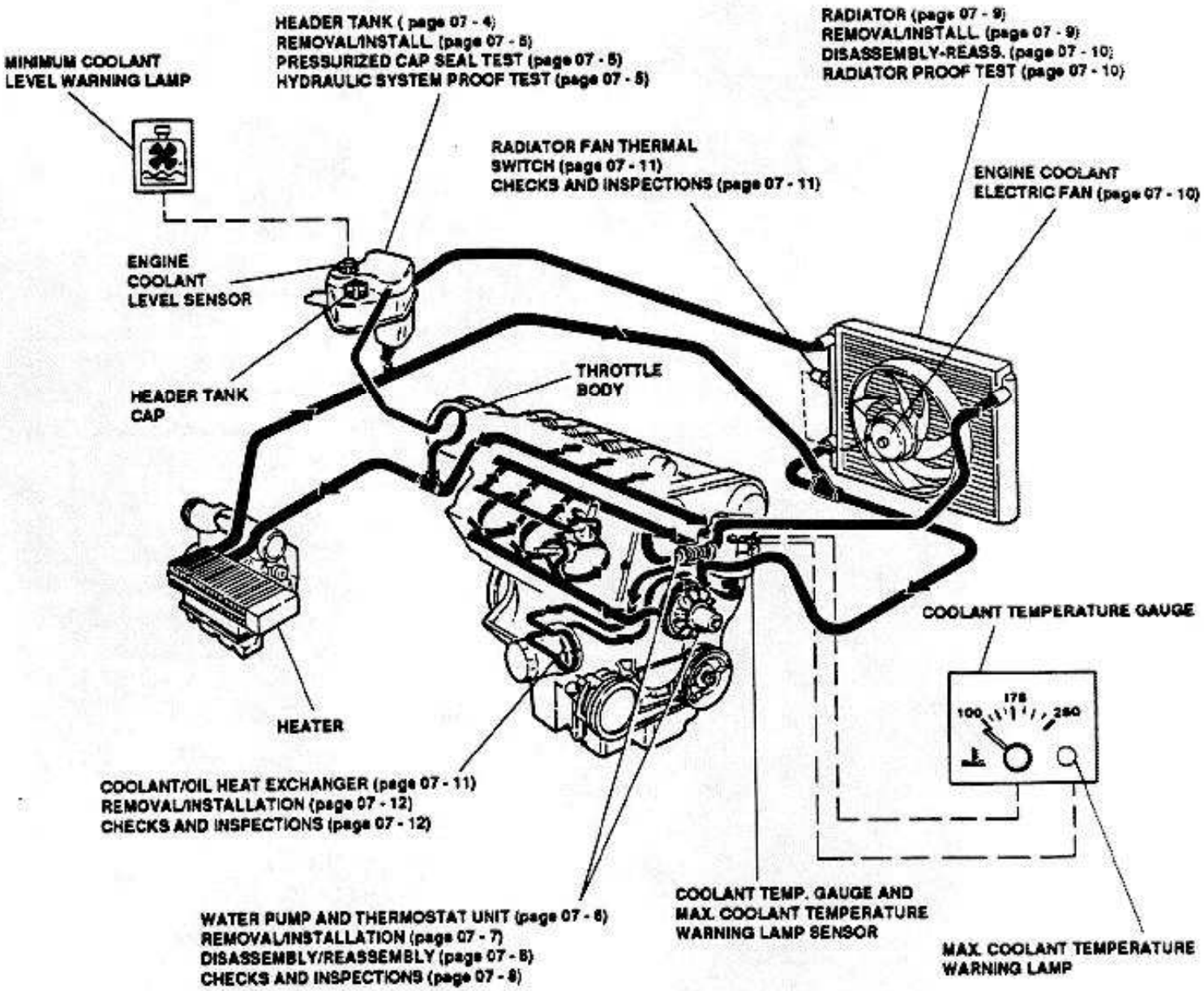


COOLING SYSTEM

DESCRIPTION

The cooling system is of the sealed type. The coolant flow is forced by a centrifugal pump driven by the crankshaft through a poly-V type belt.
A thermostat maintains the engine temperature within optimum values; the thermostat opens when the coolant temperature reaches about 87°C (188°F).
The coolant is cooled in the radiator by means of ram air effect and by a two-speed electric fan controlled by a radiator mounted thermal switch; an additional resistor and a relay select the higher speed of the electric fan in case of excessive temperature.
The header tank tops-up the cooling system in case of low coolant level, and absorbs the changes of coolant volume due to changes in temperature; the header tank also enables to bleed the air from the system.
The cooling system also includes a coolant temperature sensor which controls the maximum temperature warning lamp on the instrument panel. The warning lamp turns on when the coolant temperature increases above 115°C (239°F).
A further sensor on the header tank monitors the coolant minimum level and directs level signals to the relevant warning lamp on the instrument panel.

SYSTEM OPERATION

After the engine has been cooled, the coolant flows to the thermostat unit. If the temperature is below 87°C (188°F) the coolant is directed to the pump; if the temperature is above the limit value, the coolant is directed to the radiator. After cooling, the coolant returns to the pump and is then directed to the engine.
Moreover, a cooling system offtake maintains the throttle body to a constant temperature; a second offtake is also provided to cool the engine oil through a heat exchanger located below the oil filter.
Two vent pipes connect the highest points of the system (radiator and throttle body) to the header tank, and allow bleeding in the header tank of any air that could be trapped in the system.
A further offtake supplies the air conditioning heater, which provides heating of the vehicle interior (refer to Group 80).

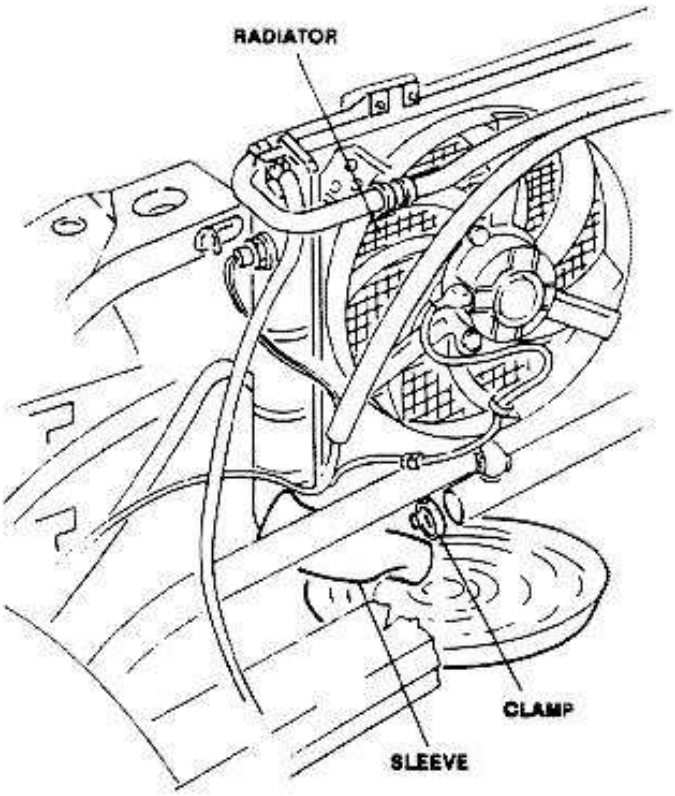
CAUTION:
The anti-freezing mixture is harmful for the paintwork. Avoid any contact with painted surfaces.

DRAINING OF THE HYDRAULIC SYSTEM

1. Disconnect (-) lead from the battery.
2. Unscrew and remove header tank cap.

WARNING:
Do not absolutely remove the header tank cap while the engine is warm.

3. Loosen clamp fixing the radiator outlet sleeve, and disconnect sleeve from the radiator; drain and collect coolant in a suitable container located underneath the vehicle.



SERVICING OF THE HYDRAULIC SYSTEM

1. Connect radiator sleeve and any other hose previously disconnected; check that all clamps are properly tightened.
2. Service the system to the MAX level mark on the header tank.
   The type and approximate quantity of coolant are indicated in the table below:

Minimum outside temperature	**°C °F**	**-20 -4**	**-40 -40**
Concentrated Anti-freeze	**liters Gals.**	**4.3 1.15**	**7.1 1.9**
Distilled water (Dilution)	**liters Gals.**	**8.7 2.35**	**5.9 1.6**
Anti-freeze mixture (Ready for use)	**liters Gals.**	**13 3.5**	**- -**

NOTE: The quantities shown in the above table are referred to the total capacity of the cooling system. Note that servicing capacity is 9.5 liters (2.55 Gals.).

3. Start engine and bring to normal operating temperature range, so that opening of thermostat will vent any air trapped in the system.
4. With cold engine, top-up coolant to the MAX level mark on the header tank.
5. Screw and tighten the header tank pressurized cap.

NOTE: To increase protection from -20°C (-4°F) to -40°C (-40°F) without draining the system completely, replace about 4 liters (1.1 gals) of freezing mixture with the same quantity of the specified concentrated anti-

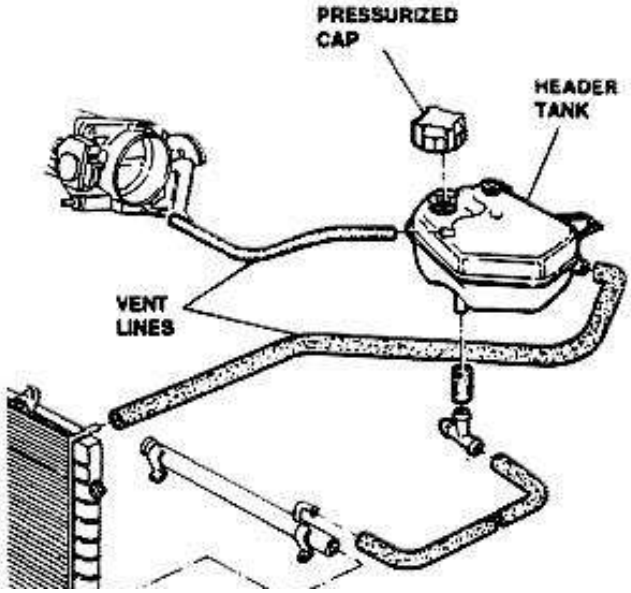
CAUTION:
It is recommended not to mix anti-freeze fluids of different types or brands.
Do not use anti-rust additives, which could be not compatible with the anti-freeze used in system.

HEADER TANK

The header tank provides the following functions:

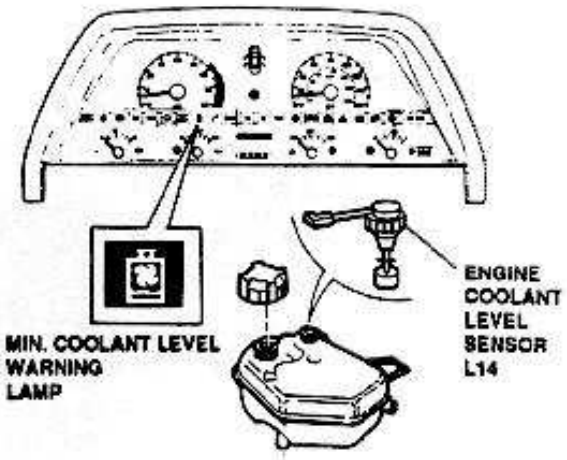
- Supply the system with coolant in case the level decreases.
- Expansion box for the absorption of coolant changes of volume due to the variations of temperature during engine operation.
- Bleeding of air bubbles trapped in the system by means of two lines connected to the highest points of the system.

A pressurized cap allows sealing of the header tank; anyway, if excessive pressure builds-up in the tank, a relief valve opens and discharges the excess pressure.
Relief valve setting: 100 kPa (14.5 p.s.i.)
The header tank is made of plastic.



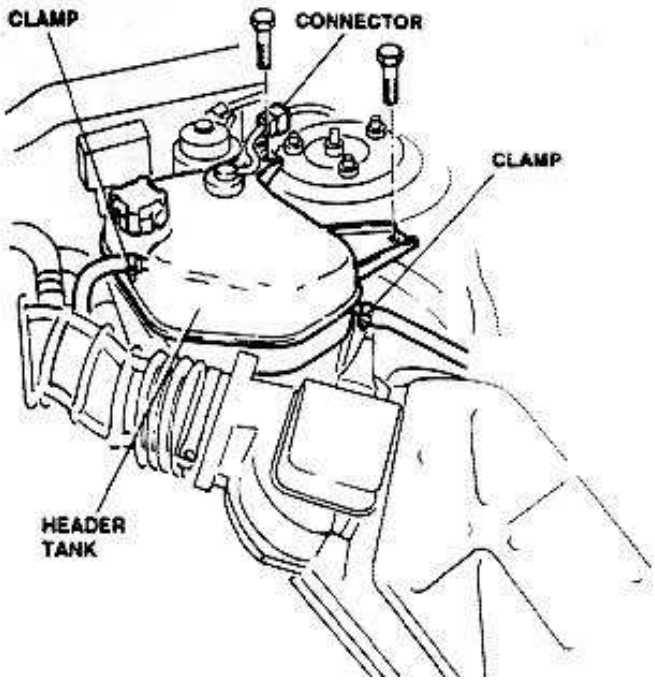
quantity of the specified concentrated anti-
freeze.

A sensor installed on the header tank controls a warning lamp on the instrument panel to alert when the level of coolant in the tank is insufficient.



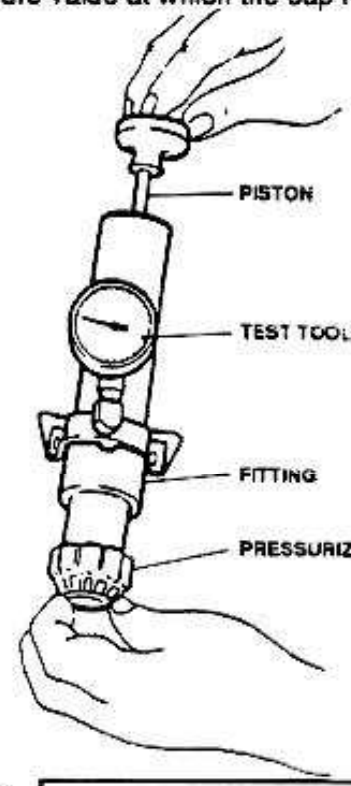
REMOVAL/INSTALLATION

1. Drain the hydraulic system (refer to page 7-3).
2. Disconnect electric connector from the engine coolant level sensor.
3. Loosen clamps and disconnect all lines from the header tank.
4. Remove header tank.



PRESSURIZED CAP SEAL TEST

1. Perform test using the seal test tool.
2. Screw fitting to lower end of test tool.
3. Install the pressurized cap of header tank on test tool fitting.
4. Manually actuate the test tool piston and pressurize the pressurized cap; read on the test tool gauge the pressure value at which the cap relief valve opens.

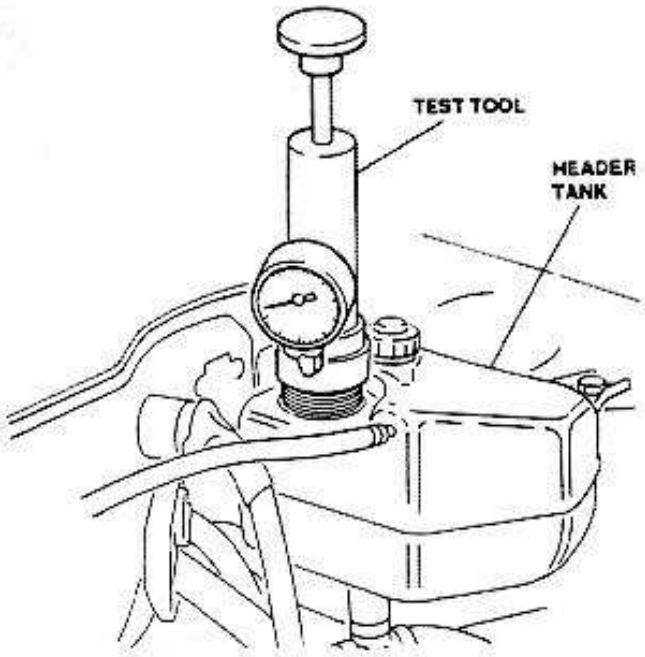


Pressurized cap setting
100 kPa (14.5 p.s.i.)

HYDRAULIC SYSTEM PROOF TEST

1. Unscrew and remove pressurized cap from header tank.
2. Screw hydraulic system proof test tool and relevant fitting onto header tank filler.
3. Manually pressurize the system and check on proof test tool gauge that pressure remains to the prescribed value. If pressure decreases, check for leaks through the sleeves or radiator

leaks through the sleeves of radiator.



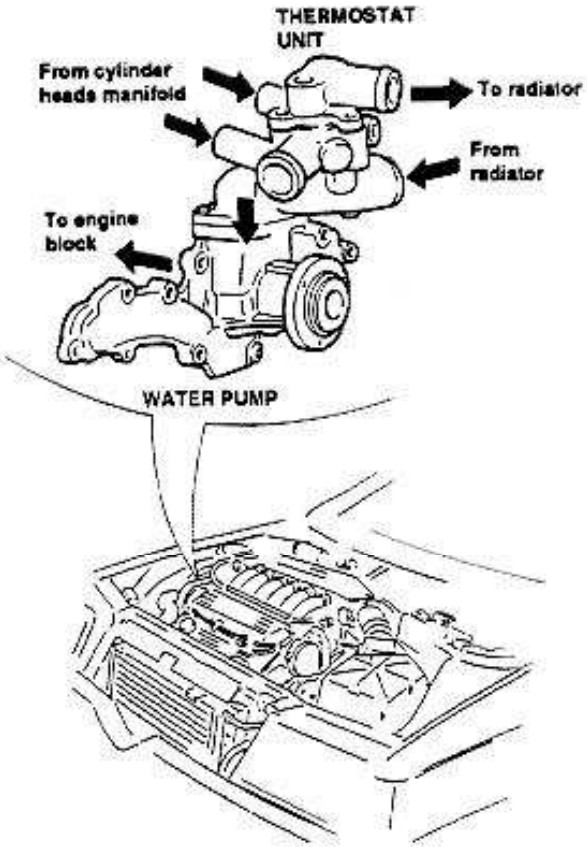
Hydraulic system test pressure
107.9 kPa (15.6 p.s.i.)

WARNING:
Due to safety reasons, never exceed the pressure of 138 KPa (20 psi) during tests described above.

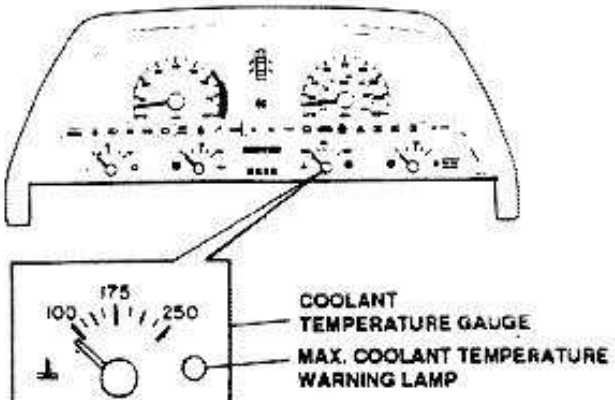
PUMP AND THERMOSTAT UNIT

The water pump is of the vane centrifugal type; the pump body is made of a special aluminum alloy, and the impeller is made of cast iron.
The pump is fixed to the engine block front side by means of nine screws.
A gasket is installed between the engine block and the pump.
The pump is driven by the crankshaft through a "poly-V" type belt; continuous operation of the pump ensures a continuous flow of coolant.
The thermostat unit is located just above the pump body.

the normal operating limits; the thermostat valve directs the coolant to the pump when the coolant temperature is below 87°C (188°F); when the coolant temperature exceeds the above limit, the thermostat valve opens and directs the coolant to the radiator.



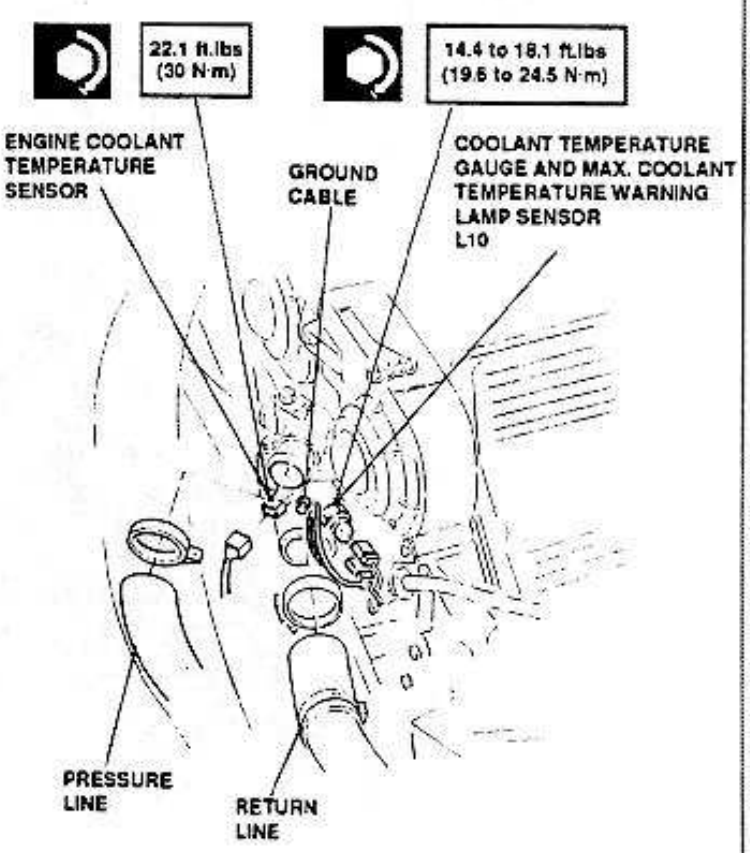
The thermostat unit includes a coolant temperature sensor which supplies temperature signals to the coolant temperature gauge and coolant maximum temperature warning lamp on the instrument panel.



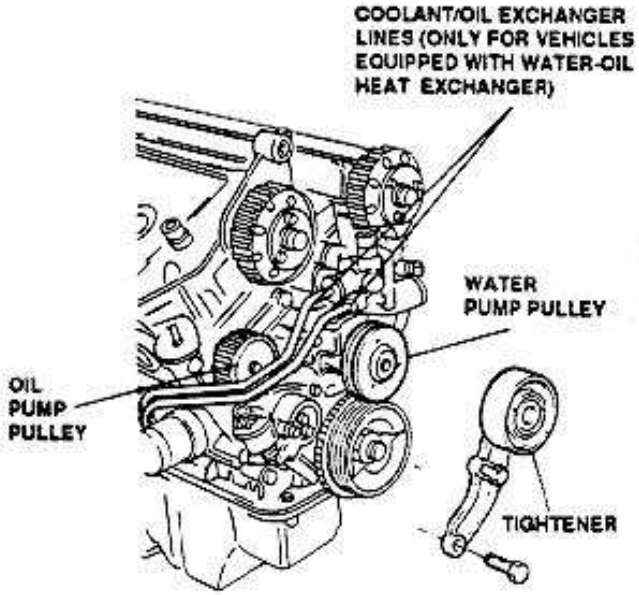
The thermostat maintains the engine temperature within

REMOVAL/INSTALLATION

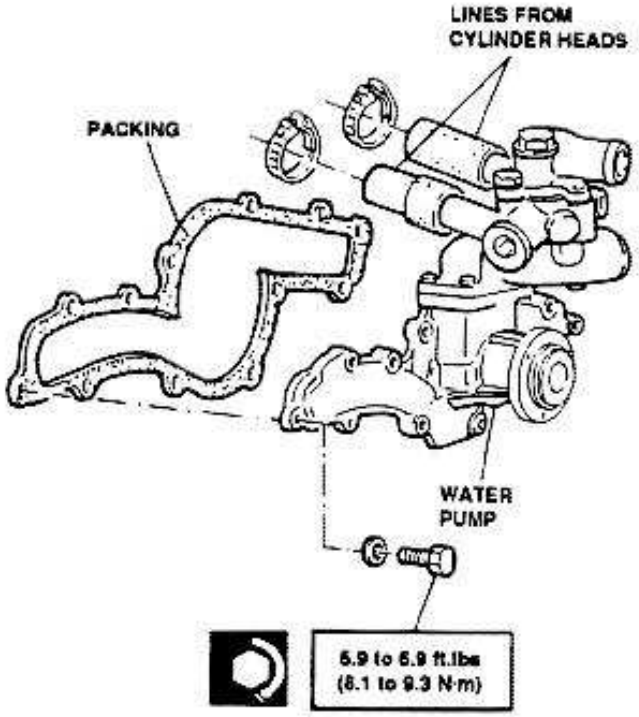
1. Disconnect (-) lead from battery.
2. Drain hydraulic system (refer to page 7-3).
3. Disconnect pressure line from thermostat unit.
4. Disconnect the engine coolant temperature sensor connector (for signals to the control unit).
5. Disconnect ground cable.
6. Remove gauge and warning lamp temperature sensor (for signals to the instrument panel).
7. Disconnect the return line from the pump.
8. Remove the water pump and air conditioning compressor drive belt (refer to **Group 00**).
9. Remove the engine timing belt (refer to **Group 00**).



10. Disconnect coolant/oil exchanger lines (only for vehicles equipped with water-oil heat exchanger).
11. Using the torque reactor N. **1.820.051.000**, remove the oil pump pulley.
12. Remove the coolant pump and air conditioning compressor belt tightener.
13. Remove water pump pulley.



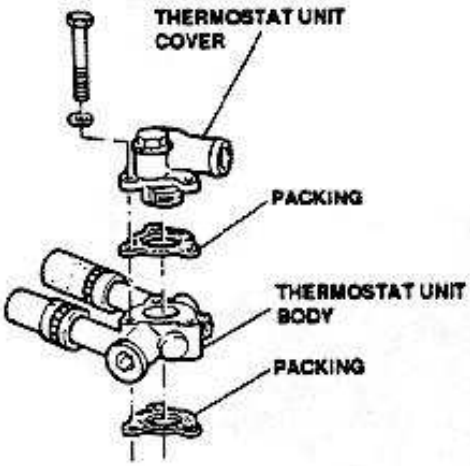
14. Remove clamps from lines from cylinder heads to thermostat unit.
15. Remove the water pump complete of thermostat unit.
16. Remove the gasket.
17. Reinstall the parts by reversing the order of the above steps; torque fixing parts to the prescribed values.

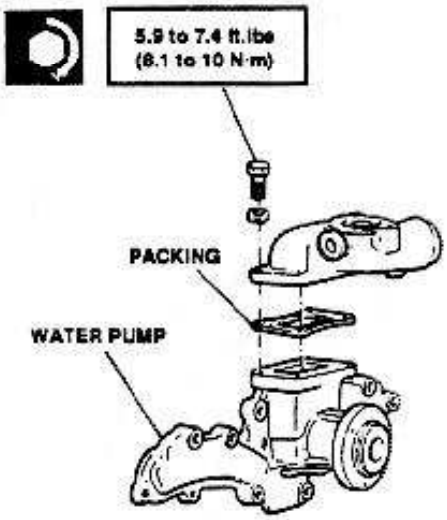


When the installation is completed, check belt tension (refer to **Group 00**); service the hydraulic system (refer to page 07- 4) and check for absence of leaks.

DISASSEMBLY/REASSEMBLY

1. Disassembly the pump and thermostat unit into parts shown in the figure below.





2. Reassembly the pump and thermostat unit by reversing the order of disassembly procedure; replace all packings and torque parts to the prescribed values.

CHECKS AND INSPECTIONS

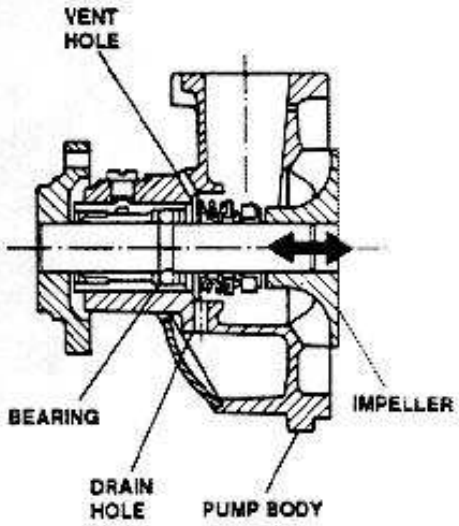
Water Pump

1. Check pump body and impeller for proper conditions and absence of oxidation and corrosion traces.
2. Check for excessive axial play of impeller.
3. Check pump front packing for proper conditions and

NOTE: Light leaks through the drain holes are normal.

4. Check bearing for wear of races, balls and rollers.

Replace the pump if any the above defects is detected.



Thermostat unit

Check thermostat setting as follows.

1. Suspend thermostat in a container filled with water; heat the water.
2. Using a thermometer, check that beginning of opening, and completion of opening, happen at the values shown in the table below.

CAUTION:
Ensure that both the thermometer and the thermal switch do not contact the bottom of container

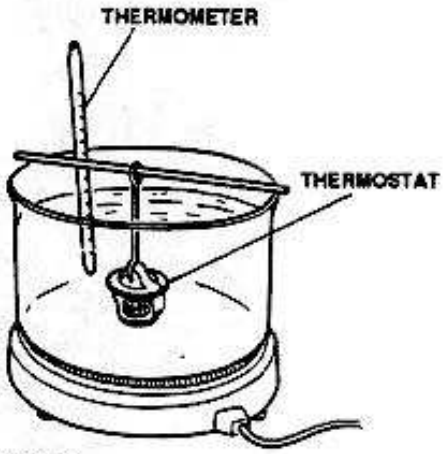
Check that the total bulb travel ranges within the values shown in the table below.

Thermostat setting		
Beginning of opening	87 ± 2 C°	188 ± 4°F
Fully opening	99 C°	210°F
Total bulb travel	> 7.5 mm	> 0.3 in

sealing.

Total bulb travel	≥ 7.5 mm	≥ 0.3 in

Replace thermostat if correct values are not obtained.

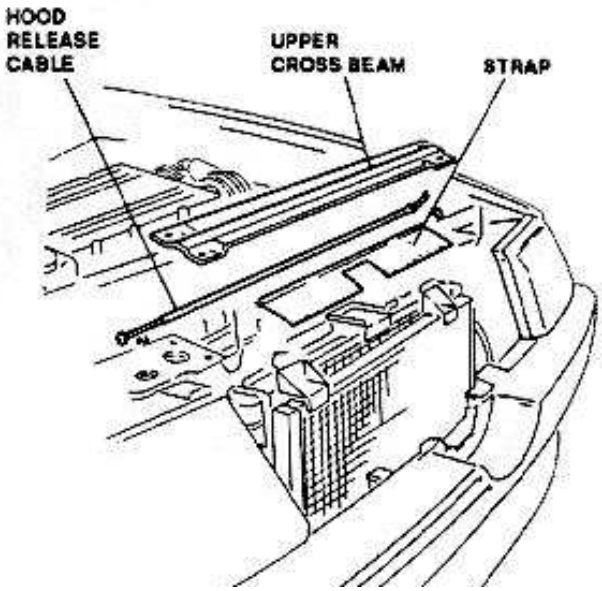


RADIATOR

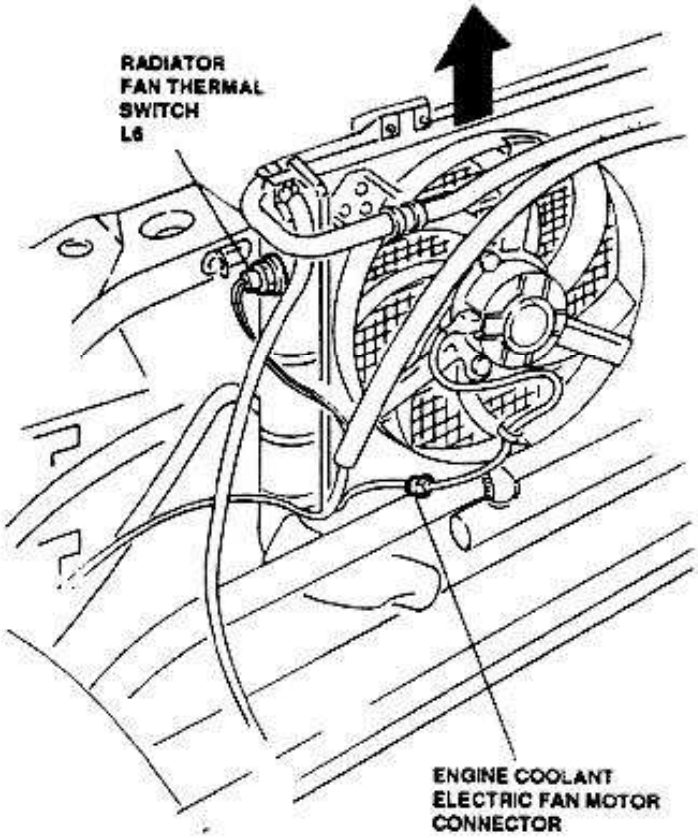
The radiator capability is such that proper cooling of the engine in ensured in the various operating conditions. The radiator consists of a heat exchange unit (total heat exchange surface 21.5 sq. dm (333 sq. in)) and of two lateral chambers, each provided with fittings for the inlet and outlet of coolant. Pipes and fins of the heat exchange unit are made of aluminum; the lateral chambers are made of plastic.

REMOVAL/INSTALLATION

1. Disconnect (-) lead from battery.
2. Drain the hydraulic system (refer to page 7- 3).
3. Disconnect engine hood release cable.
4. Remove upper cross beam.
5. Remove strap.



6. Disconnect lines from radiator.
7. Disconnect radiator fan thermal switch connector.
8. Disconnect engine coolant electric fan motor power supply connector.
9. Remove radiator by sliding it upwards.
10. Remove and retain shims between radiator and support frame (only for vehicles equipped with spacers between engine support frame and bodywork).
11. Reinstall the radiator by reversing the order of the above procedure.

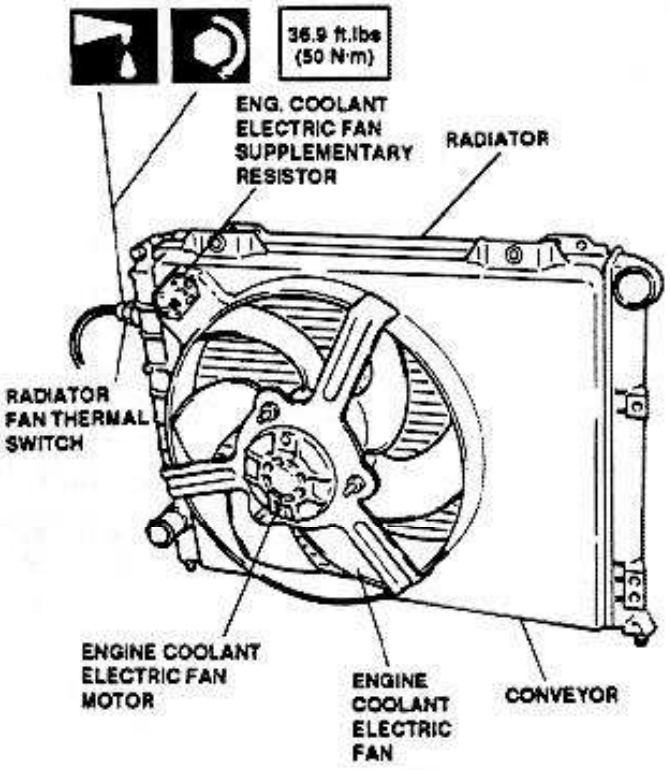


After radiator has been reinstalled, service the hydraulic system (refer to page 7-4) and check for absence of leaks.

CAUTION:
Torque line clamps carefully to avoid damaging of the lateral chambers. Avoid hitting the radiator and the lateral chambers with wrenches or other tools.

DISASSEMBLY/REASSEMBLY

1. Remove the air conveyor and the engine coolant electric fan from the radiator, if required, as illustrated below.

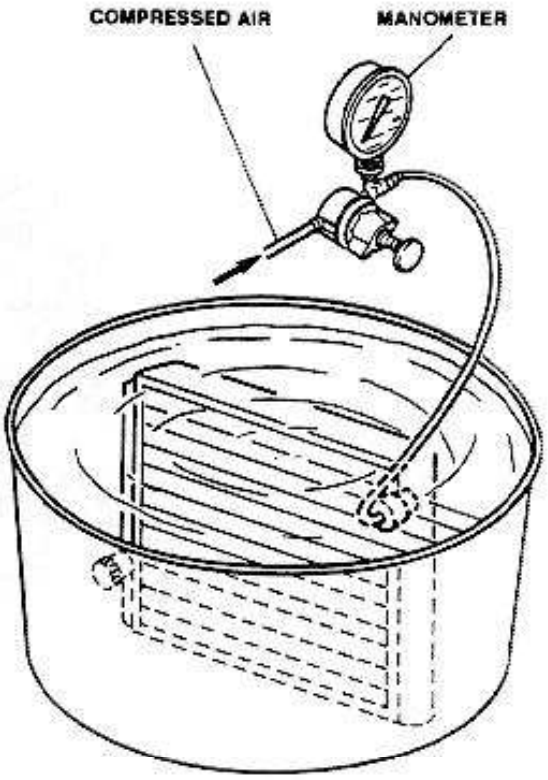


2. Reassembly the parts by reversing the order of disassembly procedure; torque parts to the prescribed values.

Wipe radiator fan thermal switch thread with anti-seizure compound (R. GORI Never Seez) at reassembly.

RADIATOR PROOF TEST

1. Carefully cap all coolant inlet and outlet fittings.
2. Dip radiator in a container filled with water.
3. Pressurize the radiator to 111 KPa (16.2 p.s.i.) with compressed air through a suitable fitting installed on one of the filler caps.
4. If air bubbles are noted, the radiator is not service-



Radiator test pressure
111 kPa (16.2 p.s.i.)

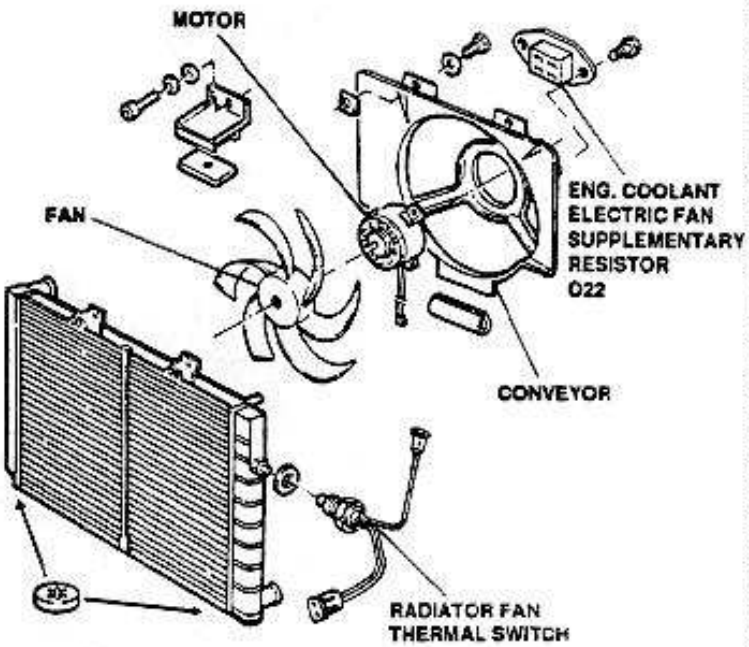
ENGINE COOLANT ELECTRIC FAN

The two-speed electric fan increases the radiator heat exchange capability; when the temperature in the radiator reaches a pre-set value (92°C/198°F) a thermal switch actuates the electric fan.
An additional contact on the thermal switch and resistor will select the fan high speed if the temperature tends to increase furtherly (above 97°C/206°F).

NOTE: For the troubleshooting in case of a malfunction of the electric fan, and for the checks and inspections of the other components (supplementary resistor, relays, etc...) refer to the **"WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS".**

able and must be replaced since repair is not allowed.

The thermal switch setting check is however indicated in the following paragraph.



RADIATOR FAN THERMAL SWITCH

CHECKS AND INSPECTIONS

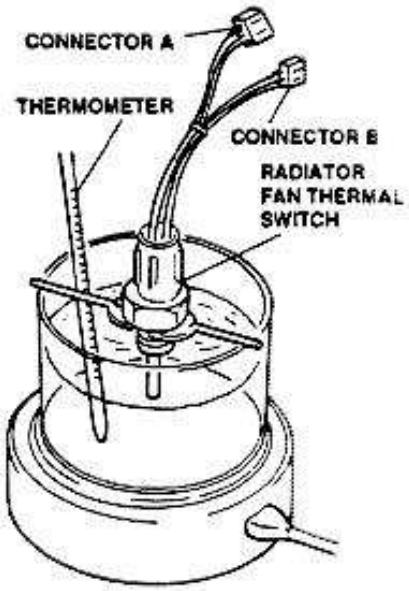
Check the thermal switch setting as follows:

1. Suspend the thermal switch in a container filled with water; heat the water.
2. Using a thermometer and a multimeter, check that thermal switch triggers (the circuit closes at the two pins of connector A) at the temperature corresponding to the first speed of the electric fan.
3. Check in analogy that the thermal switch triggers (the circuit closes between a pin of connector A and pin of connector B) at the temperature corresponding to the second speed of the electric fan.

CAUTION:
Ensure that both the thermometer and the thermal switch do not contact the bottom of container.

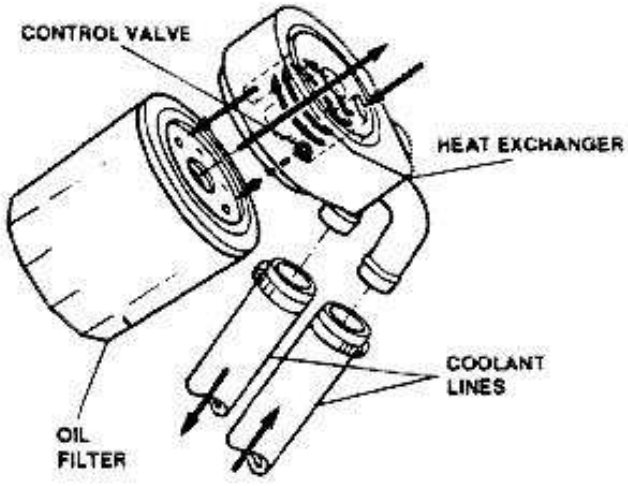
Electric fan actuation temperatures	
1st speed:	92°C (198°F)
2nd speed:	97°C (206°F)

Replace thermal switch if correct values are not obtained.



COOLANT/OIL HEAT EXCHANGER

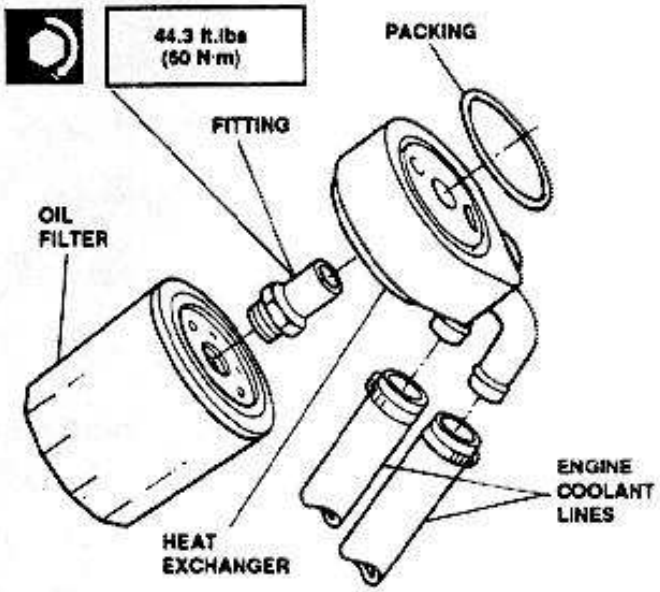
On "S" version vehicles the increased engine power demands a better cooling of the engine. Improvement of engine cooling has been obtained with several devices and modifications that include a heat exchanger for the engine oil cooling.
The coolant/oil exchanger, located below the oil filter, provides a noticeable cooling of engine oil, thus increasing the oil cooling and lubricating characteristics.



The oil cools up flowing through a series of passages in the heat exchanger before reaching the oil filter, and returns directly in flow through the central passage.
When the engine is cold, and oil density is higher, the control valve opens and allows a higher oil flow, that does not cross the exchanger passages, but reaches the oil filter directly.

REMOVAL/INSTALLATION

1. Remove oil filter using the relevant tool.
2. Unscrew fitting between filter and heat exchanger.
3. Disconnect engine coolant supply and return lines.
4. Remove the heat exchanger.
5. Remove and retain packing.
6. Reinstall by reversing the order of the above steps; torque fixing parts to the prescribed values.



CHECKS AND INSPECTIONS

Thoroughly clean the heat exchanger from any trace of dirt and oil; carefully inspect the cooling passages for obstructions.

TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

COOLING SYSTEM

Hydraulic system test pressure	107.9 kPa	15.6 p.s.i.
Pressurized cap pressure setting	100 kPa	14.5 p.s.i.
Radiator proof test pressure	111 kPa	16.2 p.s.i.

THERMOSTAT

Temperature at beginning of opening	87±2 °C	188±4 °F
Temperature at full opening	99 °C	210 °F
Total bulb travel	7.5 mm	0.3 in

ELECTRIC FAN

Actuating temperature, 1st speed	92 °C	198 °F
Actuating temperature, 2nd speed	97 °C	206 °F

COOLANT

Minimum outside temperature	-20 °C (-4 °F)		-40 °C (-40 °F)	
Concentrated anti-freeze	4.3 liters	1.15 gals	7.1 liters	1.9 gals
Dilution distilled water	8.7 liters	2.35 gals	5.9 liters	1.6 gals
Ready-for-use anti-freeze mixture	13 liters	3.5 gals	—	—

NOTE: Servicing capacity 9.5 liters (2.55 Gals)

FLUIDS AND LUBRICANTS

Application	Type	Name
Thermal switch thread	Anti-seizure compound	R. GORI Never Seez

TIGHTENING TORQUES

Water pump to engine block attacking screws	5.9 to 6.9 ft.lbs	8.1 to 9.3 Nm
Thermostat to pump attaching screws	5.9 to 7.4 ft.lbs	8.1 to 10 Nm
Radiator fan thermal switch to radiator attachments	36.9 ft.lbs	50 Nm
Coolant temperature sensor attachments	14.4 to 18.1 ft.lbs	19.6 to 24.5 Nm
Engine coolant temperature sensor attachments	21.1 ft.lbs	30 Nm
Oil filter fitting attachments	44.3 ft.lbs	60 Nm

SPECIAL TOOLS

Tool number	Description
1.820.051.000	Tool, oil pump pulley removal/installation

TROUBLESHOOTING PROCEDURE

TROUBLES AND SYMPTOMS	FAULT ISOLATION	TEST REFERENCE
LEAKS OF COOLANT - (If evidenced by low coolant level and white-green sediments in the leaking area).	- If the leak is not evident carry-out the **"HYDRAULIC SYSTEM PROOF TEST".**	**A**
ENGINE OVERHEATING	- Start engine and bring to normal operating temperature. - Excessive temperature is indicated by the temperature warning lamp and gauge on instrument panel. **NOTE:** In case of malfunction of the temperature warning lamp and gauge, a valve is provided on the header tank to relief the high pressure steam generated within the cooling system. ⚠ **CAUTION: Frequent operation on dusty or muddy roads, or in presence of flower pollen or small insects, can cause excessive obstruction of the engine cooler front area, thus reducing its cooling capability and causing consequent engine overheating.**	**B**

LEAKAGE OF COOLANT	TEST A

TEST STEPS	RESULTS	REMEDY
A1 CLAMPS CHECK - Check that clamps are not loose, damaged, improperly installed or of a size different from that required	OK ▶ ~~OK~~ ▶	Carry-out **step A2** Tighten or replace affected **clamps**
A2 PUMP AND THERMOSTAT UNIT CHECK - Check pump and thermostat unit body for cracks or other defects	OK ▶ ~~OK~~ ▶	Carry-out **step A3** Replace defective items
A3 OIL CONTAMINATION CHECK - Check that the coolant has not contaminated the engine oil; such faulty condition is confirmed by traces of a whitish substance in the engine oil	OK ▶ ~~OK~~ ▶	Carry-out **step A4** Tighten the cylinder head screws to the prescribed torque; should malfunction be recurring, replace the cylinder head gaskets
A4 GAS PRESENCE CHECK INSIDE THE CIRCUIT - Using a special instrument applied to the expansion tank, check for absence of gas (Co + HC) inside the cooling circuit	~~OK~~ ▶	Tighten the cylinder head screws to the prescribed torque; should malfunction be recurring, replace the cylinder head gas-

		kets

End of test A

ENGINE OVERHEATING	TEST B

TEST STEPS	RESULTS	REMEDY
B1 WARNING LAMP AND GAUGE CHECK - Check proper operation of coolant temperature warning lamp and gauge on instrument panel, and of transmitters on engine (refer to **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS**)	OK ▶ ~~OK~~ ▶	Carry-out **step B2** Repair or replace affected items
B2 COOLANT LEVEL CHECK - Check level of coolant	OK ▶ ~~OK~~ ▶	Carry-out **step B3** Service coolant to **proper level; proof test the system**
B3 ENGINE OIL LEVEL CHECK - Check level of engine oil	OK ▶ ~~OK~~ ▶	Carry-out **step B4** Service **engine oil to proper level** (refer to **Group 00**)
B4 BELT CHECK - Check water pump drive belt for proper tension and condition	OK ▶ ~~OK~~ ▶	Carry-out **step B5** Tighten **belt** to proper value, or replace belt if damaged or excessively worn (refer to **Group 00**)

ENGINE OVERHEATING	TEST B

TEST STEPS	RESULTS	REMEDY
B5 ENGINE COOLANT ELECTRIC FAN CHECK - Check operation of engine coolant electric fan wiring system (refer to **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS**)	OK ▶ ~~OK~~ ▶	Carry-out **step B6** Replace **electric fan** or unserviceable parts of relevant wiring system
B6 THERMAL SWITCH CHECK - Check setting of cooling fan thermal switch (contacts close at 198°F; 92°C)	OK ▶ ~~OK~~ ▶	Carry-out **step B7** Replace **thermal switch**
B7 HOSE CHECK - Check coolant hoses for obstructions, visually inspect that sleeves are not squeezed or bent	OK ▶ ~~OK~~ ▶	Carry-out **step B8** Replace **hoses**
B8 COOLANT FLOW CHECK - Check that coolant flows freely through the hoses by manually pumping the hoses, and noting swashing in the header tank	OK ▶ ~~OK~~ ▶	Carry-out **step B9** Replace **hoses**

(Cont.d)

ENGINE OVERHEATING	TEST B

TEST STEPS	RESULTS	REMEDY
B9 RADIATOR CHECK - Check radiator for absence of fouling or foreign matter	OK ▶ ~~OK~~ ▶	Carry-out step B10 Wash radiator with specific cleaners; make sure the engine radiator is of the approved type
B10 WATER PUMP CHECK - Check water pump for condition and proper operation	OK ▶ ~~OK~~ ▶	Carry-out step B11 Replace water pump and gasket
B11 THERMOSTAT UNIT CHECK - Bring engine to normal temperature range, then touch hose between thermostat unit and radiator: verify the duct warms up gradually	OK ▶ ~~OK~~ ▶	Carry-out step B12 Replace thermostat unit and relevant gaskets
B12 THERMOSTAT UNIT SETTING CHECK - Check thermostat unit for proper setting (refer to CHECKS AND INSPECTIONS - Thermostat unit)	OK ▶ ~~OK~~ ▶	Carry-out step B13 Replace thermostat unit and relevant gaskets

(Cont.d)

ENGINE OVERHEATING	TEST B

TEST STEPS		RESULTS	REMEDY
B13	ENGINE IGNITION TIMING CHECK		
- Check engine ignition timing		OK ▶	Adjust engine ignition timing

End of test B

GROUP 55

DOORS

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GROUP 55

DOORS

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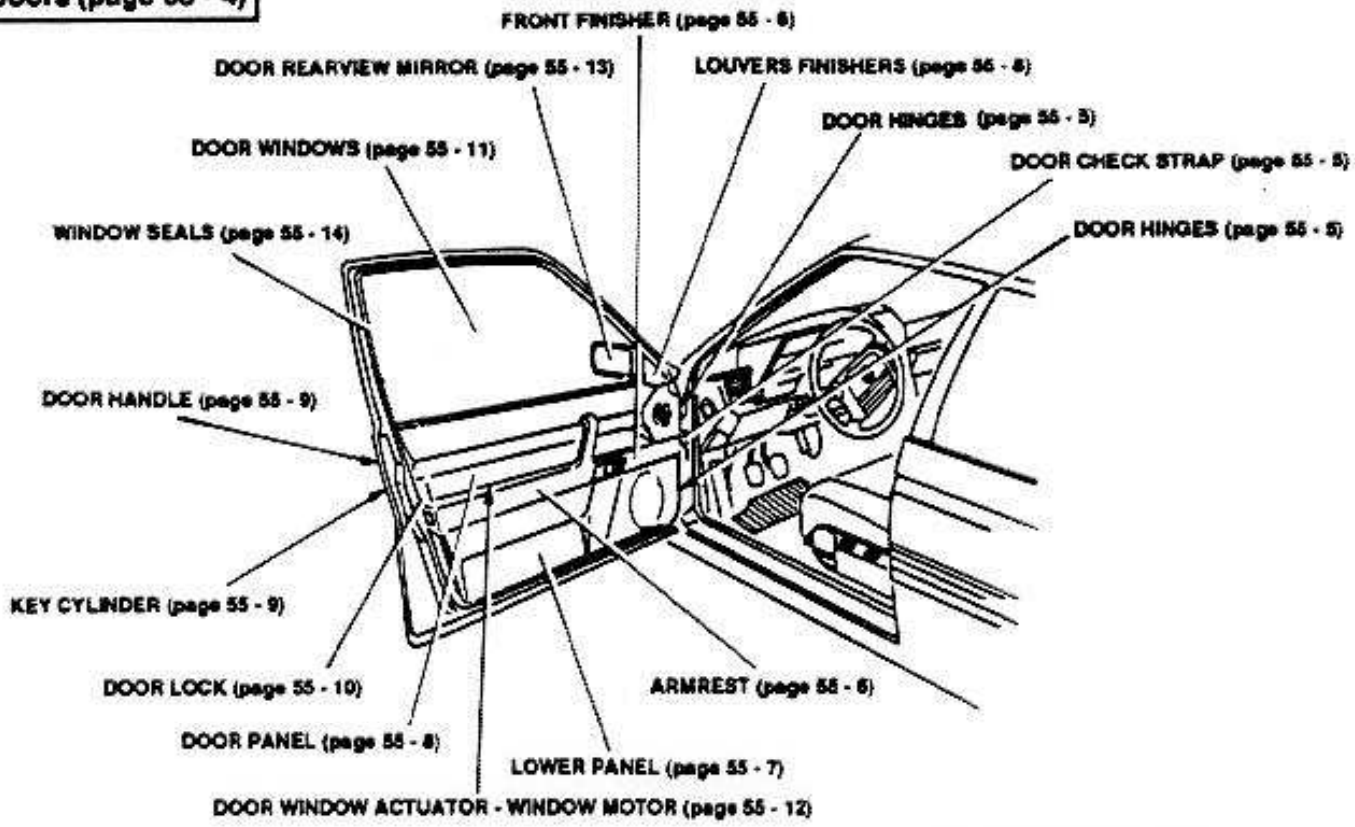
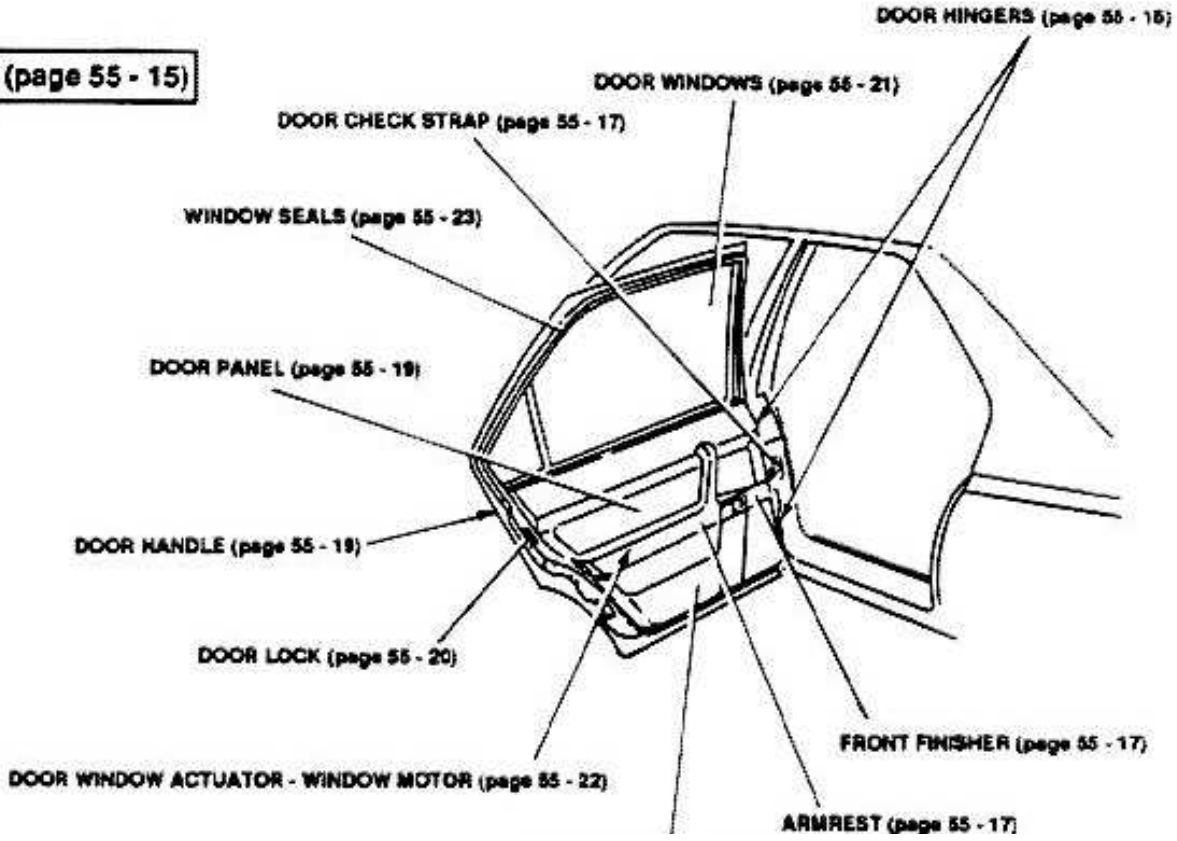
ILLUSTRATED INDEX

Front doors (page 55 - 4)



Rear doors (page 55 - 15)



DOORS

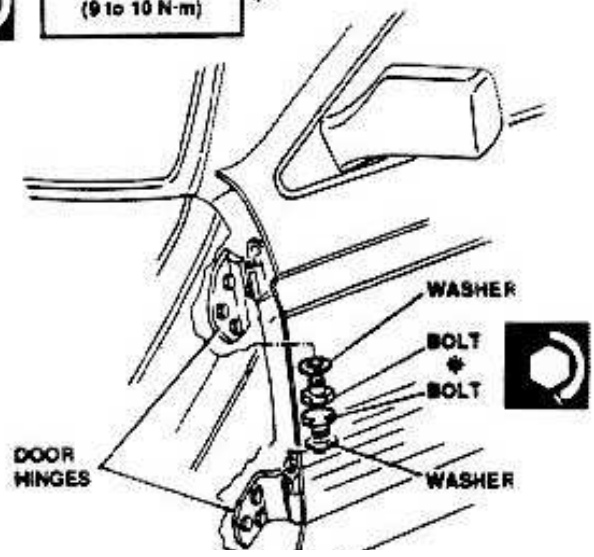
FRONT DOORS

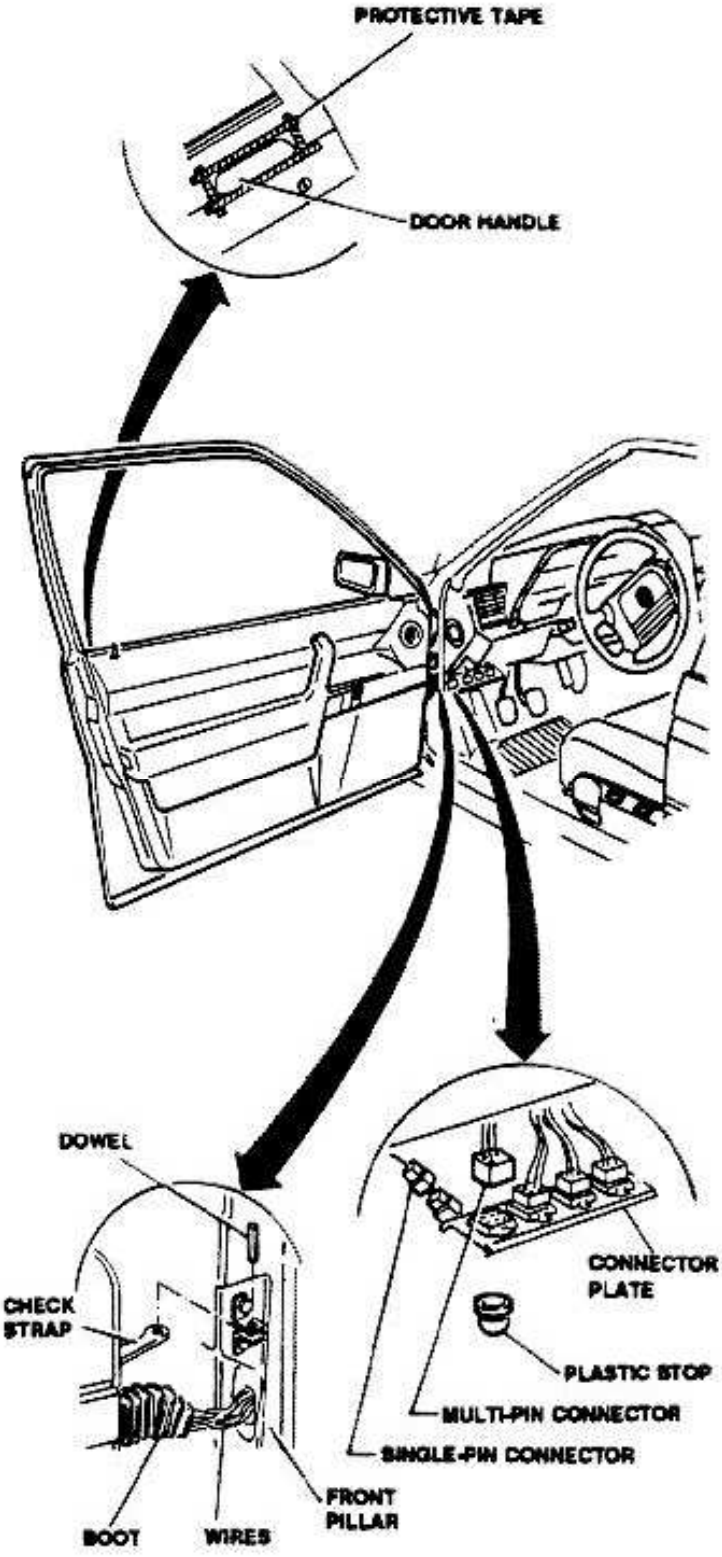
REMOVAL/INSTALLATION

NOTE: Avoid damage to body painting during removal and installation.

1. Disconnect negative (-) lead from battery.
2. Unscrew and remove plastic stop that secures connector plate.
3. Disconnect multi-pin connector of door electrical system.
4. Disconnect single-pin connector of door electrical system.
5. Apply adhesive tape all-around door handle to avoid damage to painting.
6. Remove bolts and washers securing upper and lower hinges.
7. Remove check strap dowel.
8. Half-close door to retract check strap, then open and lift door.
9. Hold door lifted to prevent it from dropping and remove boot; withdraw wires from front pillar.
10. Remove door.

6.64 to 7.38 ft.lbs (9 to 10 N·m) *





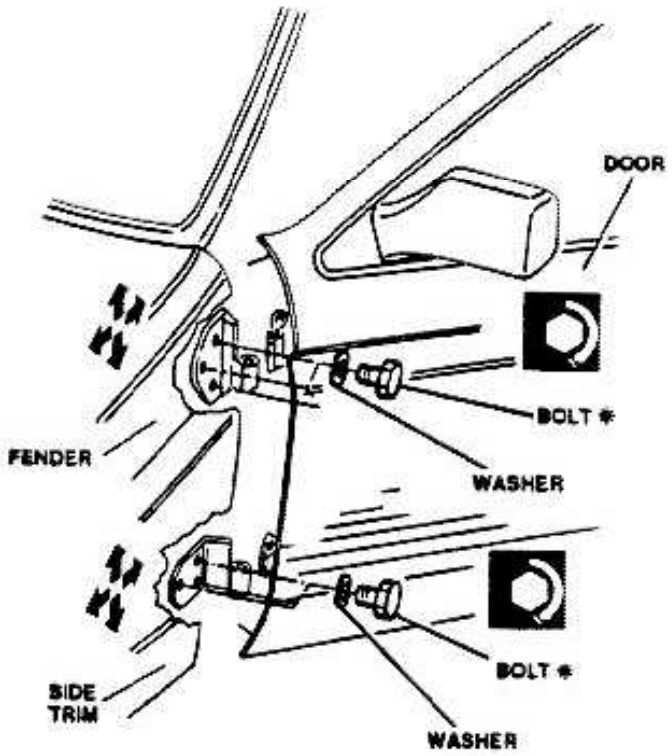
Check that wires are properly connected before connecting any electrical connector.

DOOR HINGES

DISASSEMBLY/REASSEMBLY

NOTE: Avoid damage to body painting during disassembly and reassembly.

1. Disconnect negative (-) lead from battery.
2. Remove front door.
3. Remove front side trim (see **Group 75**).
4. Remove fender (see **Group 49**).
5. Remove three bolts and washers securing each hinge to front pillar.



* 14.7 to 16.23 ft.lbs (19.9 to 22 N·m)

Proceed in reverse order for reassembly

- Apply anti-rust treatment (see **Group 49**) on hinge installation area before reassembly hinges.
- Adjust hinges position, as described below, before torquing hinge bolts.
- Apply anti-rust treatment (see **Group 49**) on hinge sides after reassembly.
- For components and/or parts described in other pages of same group or in other groups, refer to related reassembly procedures and informations.

ADJUSTMENT

1. Temporarily reassembly door.
2. With door closed, check for correct alignment and positioning of door: if misalignment is found, reposition hinges vertically and horizontally as required.
3. Temporarily reassemble fender.
4. Check that fender is correctly aligned with door: if misalignment is found, remove fender and reposition hinges vertically and horizontally as required.
5. Repeat check per step 2 above, temporarily reinstall fender then repeat check per step 4 above.
6. After adjustment has been completed, disassemble fender and door and torque hinges bolts to 14.7 to16.23 ft.lbs (19.9 to 22 N.m).

DOOR CHECK STRAP

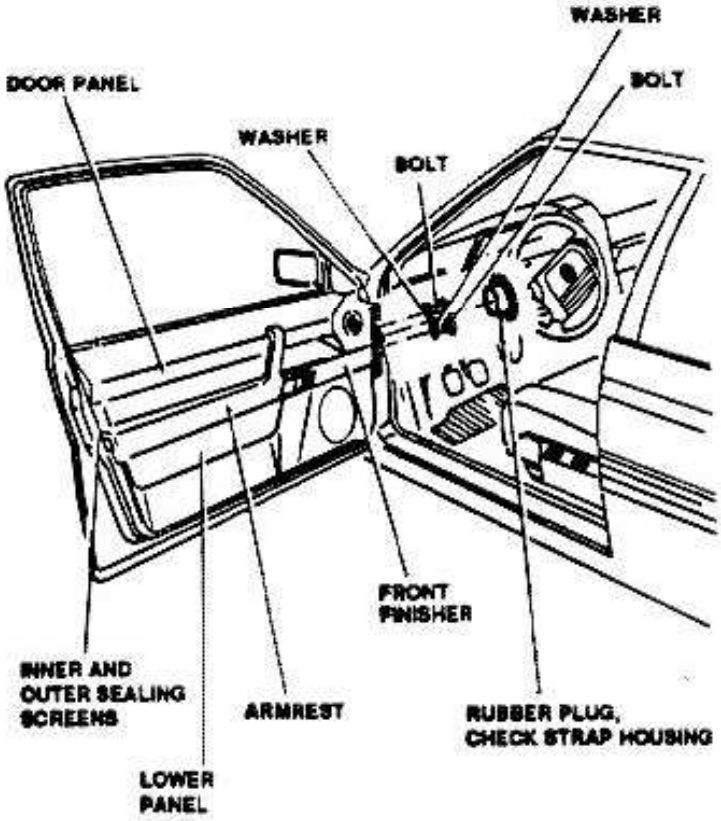
DISASSEMBLY/REASSEMBLY

NOTE: Avoid damage to body painting during disassembly and reassembly.

1. Lower door window.
2. Disconnect negative (-) lead from battery.
3. Withdraw dowel from check strap.
4. Remove front finisher.

5. Remove lower panel.

6. Remove lower finisher and door panel complete with armrest.
7. Remove inner and outer sealing screens.
8. Half-close door to retract check strap, then open door.
9. Remove check strap housing rubber plug.
10. Remove two bolts and screws securing check strap.
11. Remove check strap by pulling it from door interior.



Proceed in reverse order for reassembly.

- Apply anti-rust treatment (see **Group 49**) on check strap installation area before reassembly check straps.
- Apply anti-rust treatment (see **Group 49**) on check strap sides after reassembly.
- After inner and outer sealing screens have been installed, perform window functional check to ascertain proper installation and rigging.
- For components and/or parts described in other pages of same group or in other groups, refer to related reassembly procedures and informations.

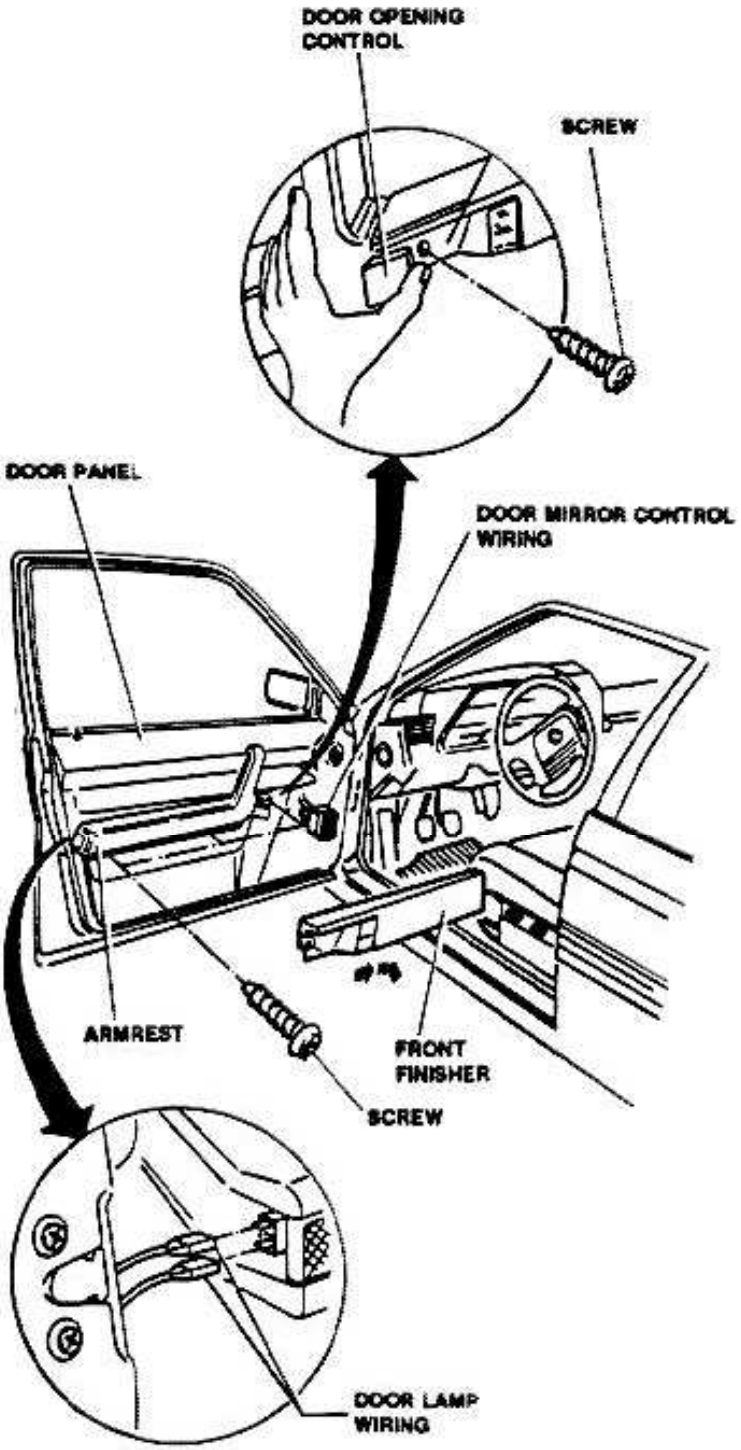
FRONT FINISHER AND ARMREST

DISASSEMBLY/REASSEMBLY

1. Disconnect negative (-) lead from battery.
2. Remove screw located under door opening control.
3. Slide forward front finisher until free from rear plastic pin.
4. Remove front finisher.
5. Disconnect door mirror control wiring.
6. Remove three screws securing armrest.
7. Move away rear end of armrest and disconnect door lamp wiring.

CAUTION:
Care must be exercised to avoid damage to armrest and to door panel.

8. Lift and remove armrest.



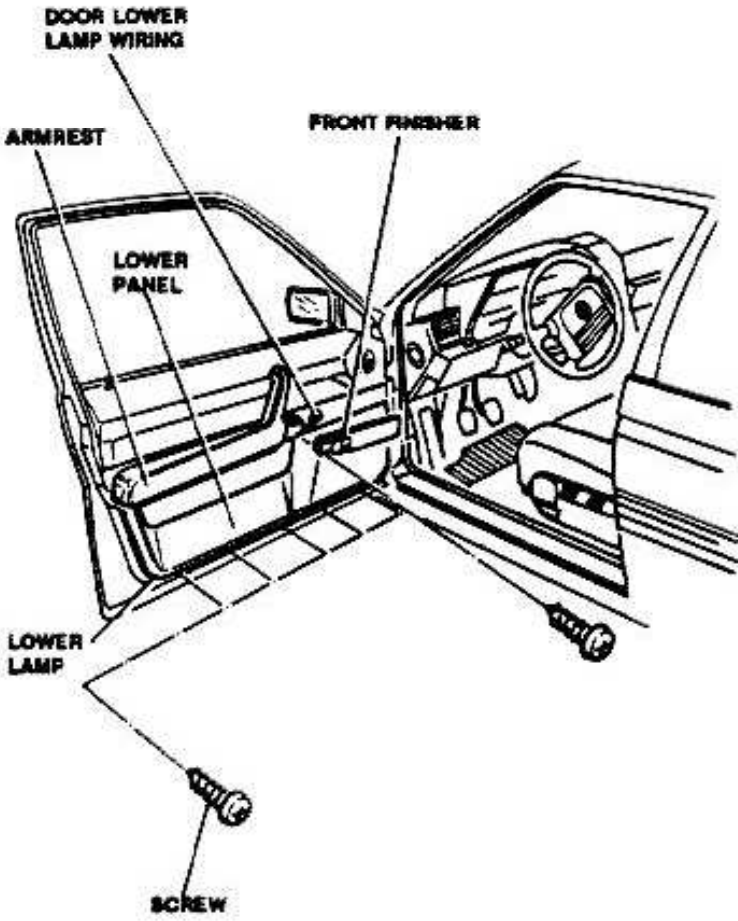
Proceed in reverse order for reassembly.

Check that wires are properly connected before connecting any electrical connector.

LOWER PANEL

DISASSEMBLY/REASSEMBLY

1. Disconnect negative (-) lead from battery.
2. Remove front finisher and screws securing armrest.
3. Disconnect lower lamp wiring.
4. Remove five screws securing lower panel.
5. Move-away lower panel from plastic catch and remove it.



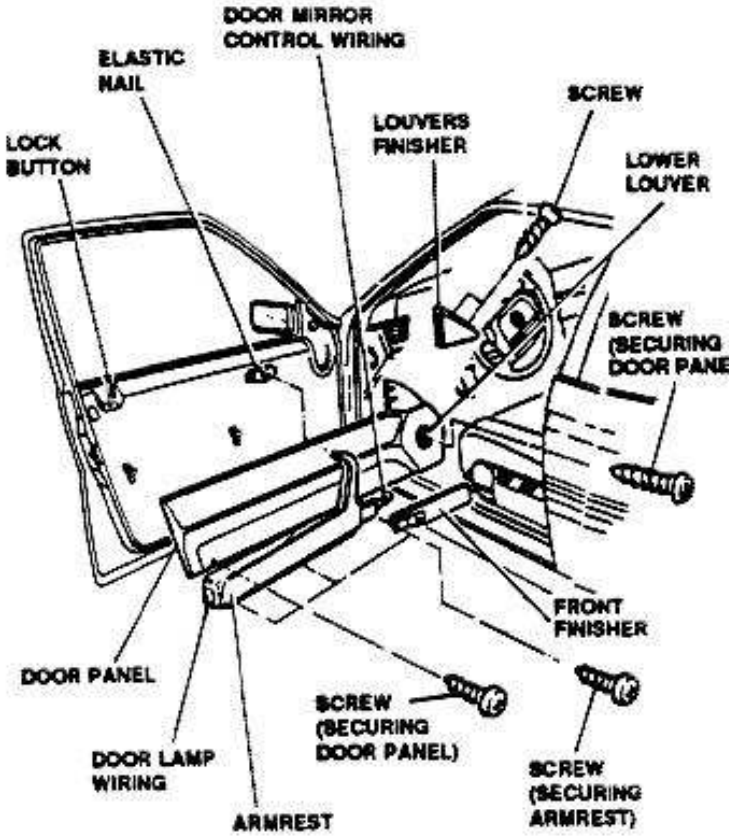
Proceed in reverse order for reassembly.

- Check that wires are properly connected before connecting any electrical connector.
- Check plastic catches on lower panel for integrity before reassembly.
- For components and/or parts described in other pages of same group or in other groups, refer to related reassembly procedures and informations.

DOOR PANEL AND LOUVERS FINISHERS

DISASSEMBLY/REASSEMBLY

1. Disconnect negative (-) lead from battery.
2. Remove screw securing louvers finishers.
3. Remove louvers finishers.
4. Remove front finisher.
5. Disconnect door mirror control wiring.
6. Remove three screws securing armrest.
7. Move away rear end of armrest and disconnect door lamp wiring.
8. Remove rear screw securing door panel.
9. Remove front screw securing door panel from inner of lower louver.
10. Lift armrest and door panel and disengage the lateral from elastic nail and lock button.
11. Remove door panel.
12. If required, remove armrest.



- Check that wires are properly connected before connecting any electrical connector.
- For components and/or parts described in other pages of same group or in other groups, refer to related procedures and informations.

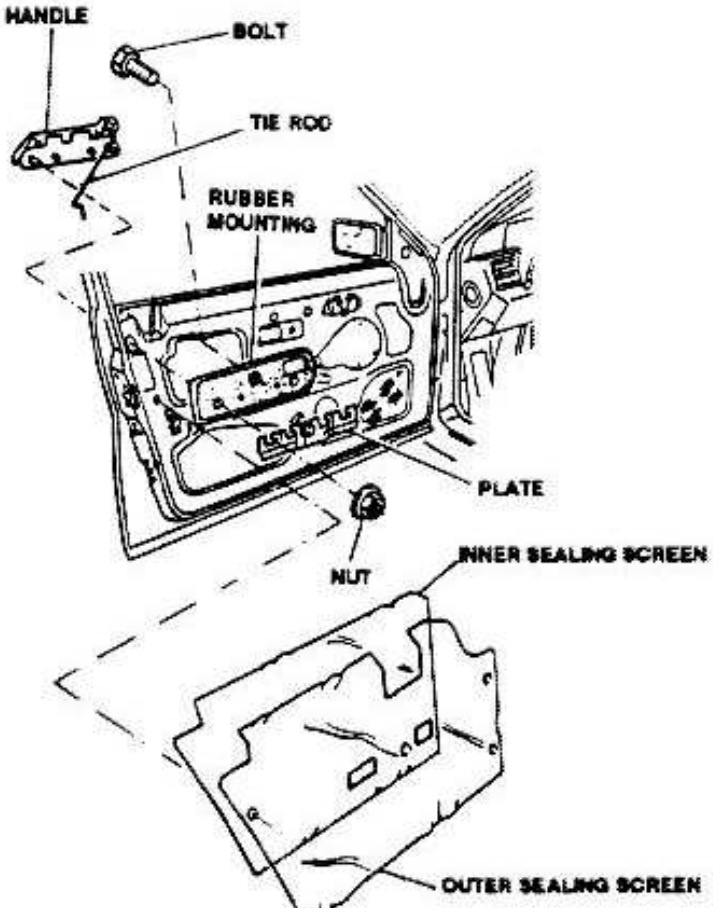
DOOR HANDLE

DISASSEMBLY/REASSEMBLY

1. Disconnect negative (-) lead from battery.
2. Remove front finisher.
3. Remove lower panel.
4. Remove louvers finishers and door panel complete with armrest.
5. Remove inner and outer sealing screens.
6. Remove two nuts securing handle.
7. Remove handle plate.

CAUTION:
Avoid damage to body painting.

8. Remove handle complete with tie-rod.
9. If required, remove securing bolt then remove rubber mounting.



Proceed in reverse order for reassembly.

- Adjust handle position, as described below, before torquing bolts.
- After inner and outer sealing screens have been installed, perform window functional check to ascertain proper installation.
- For components and/or parts described in other pages of same group or in other groups, refer to related procedures and informations.

ADJUSTMENT

1. After handle, handle plate and rubber mounting (if removed) have been installed, perform the following checks before torquing bolts:

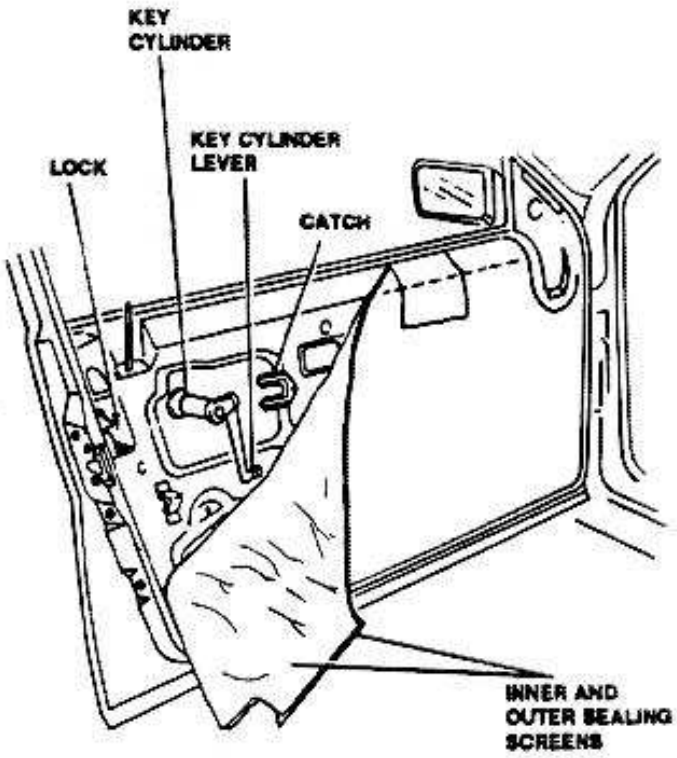
- Check handle for freedom of movement.
- Check that handle upper corners do not hit against handle recess.

2. Torque bolts.
3. Repeat check as per step 1 above.

KEY CYLINDER

DISASSEMBLY/REASSEMBLY

1. Disconnect negative (-) lead from battery.
2. Remove front finisher.
3. Remove lower panel.
4. Remove louvers finishers and door panel complete with armrest.
5. Detach upper side of inner and outer sealing screens.
6. Remove clip securing lever to key cylinder.
7. Remove lever from key cylinder.
8. Remove key cylinder from door exterior.



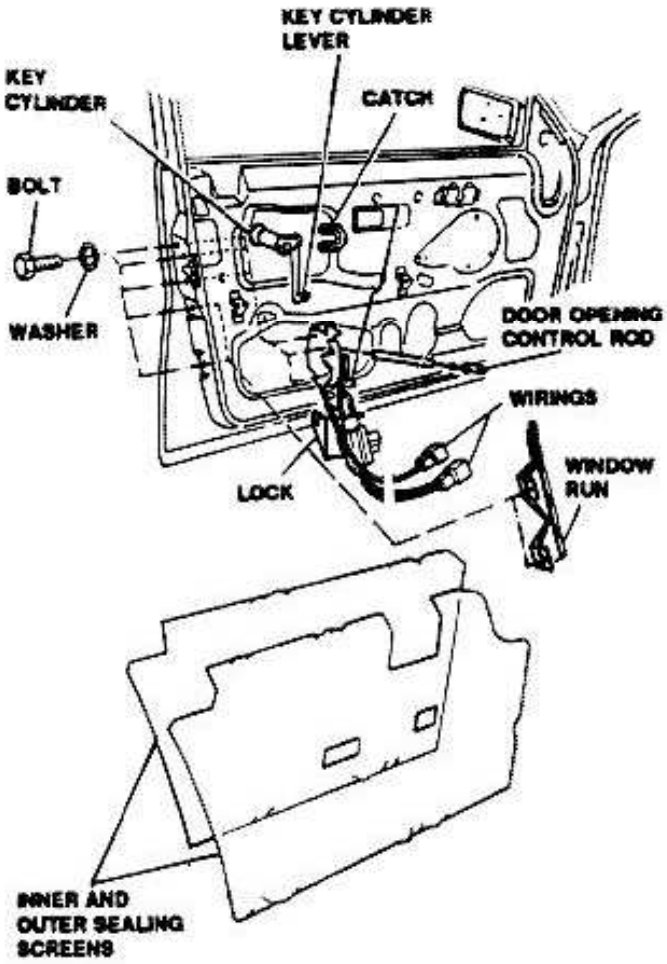
Proceed in reverse order for reassembly.

- After inner and outer sealing screens have installed, perform window functional check to as certain proper installation.
- For components and/or parts described in other pages of same group or in other groups, refer to related procedures and informations.

DOOR LOCK

DISASSEMBLY/REASSEMBLY

1. Disconnect negative (-) lead battery.
2. Remove front finisher.
3. Remove lower panel.
4. Remove louvers finisher and door panel complete with armrest .
5. Remove inner and outer sealing screens.
6. Remove clip securing lever to key cylinder.
7. Remove lever from key cylinder.
8. Disconnect door opening control rod end from attaching point on door.
9. Disconnect wiring from lock.
10. Remove five bolts and washers securing lock.
11. Remove window run.
12. Pull door lock downward and remove it.

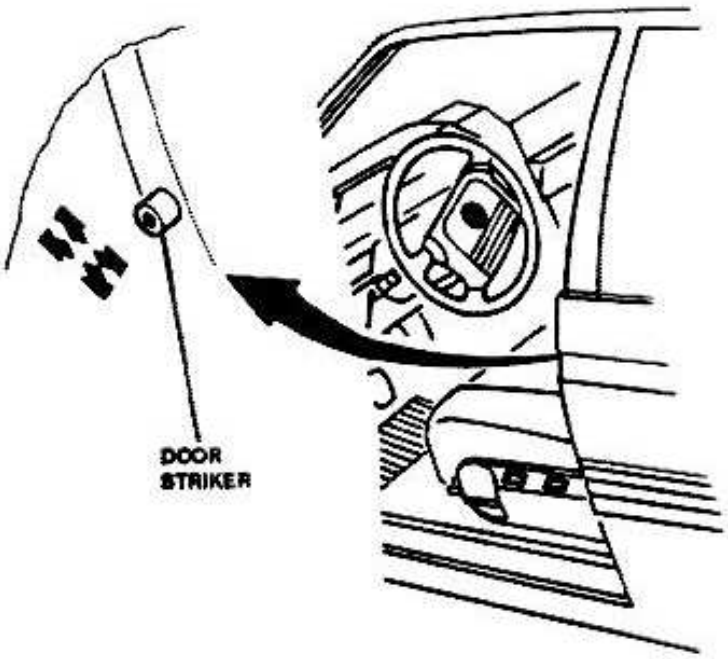


Proceed in reverse order for reassembly.

- Check that wires are properly connected before connecting any electrical connector.
- After inner and outer sealing screens have been installed, perform window functional check to ascertain proper installation.
- For components and/or parts described in other pages of same group or in other groups, refer to related procedures and informations.
- After reassembly, adjust door striker position on door pillar as required.

DOOR STRIKER ADJUSTMENT

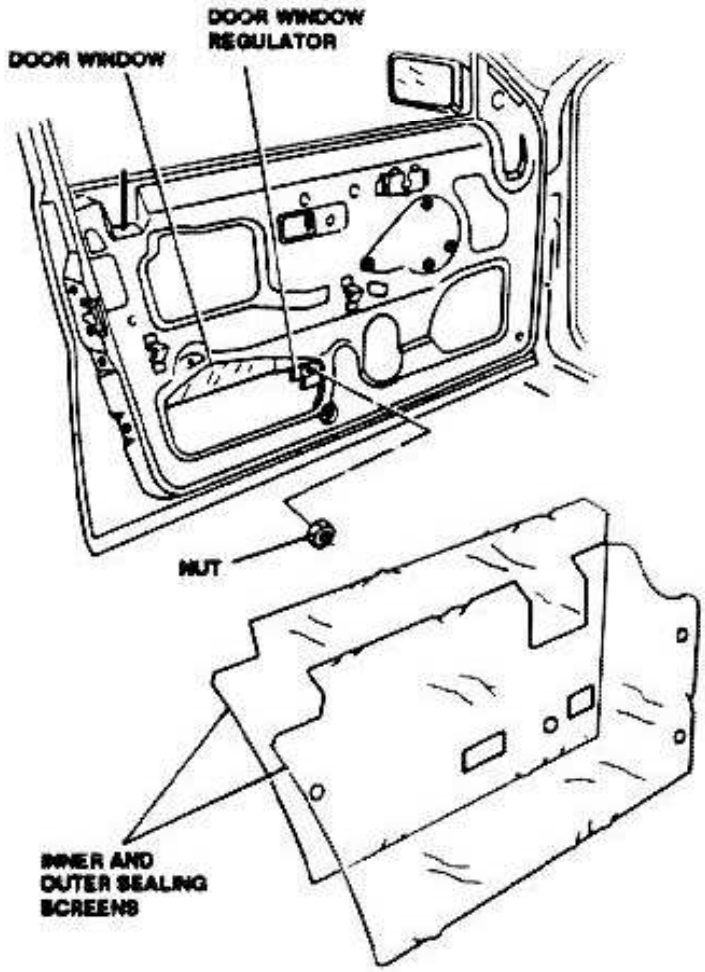
1. With door lock installed, loosen door striker on pillar.
2. Adjust door striker vertically and horizontally until door closes correctly.
3. Tighten door striker after correct position is achieved.



DOOR WINDOWS

DISASSEMBLY/REASSEMBLY

1. Open door window.
2. Disconnect negative (-) lead from battery.
3. Remove front finisher.
4. Remove lower panel.
5. Remove louver finisher and door panel complete with armrest.
6. Remove inner and outer sealing screens.
7. Remove two nuts securing door window to door window regulator.
8. Disconnect window from window regulator.
9. Slightly rotate window upward then remove it from door.



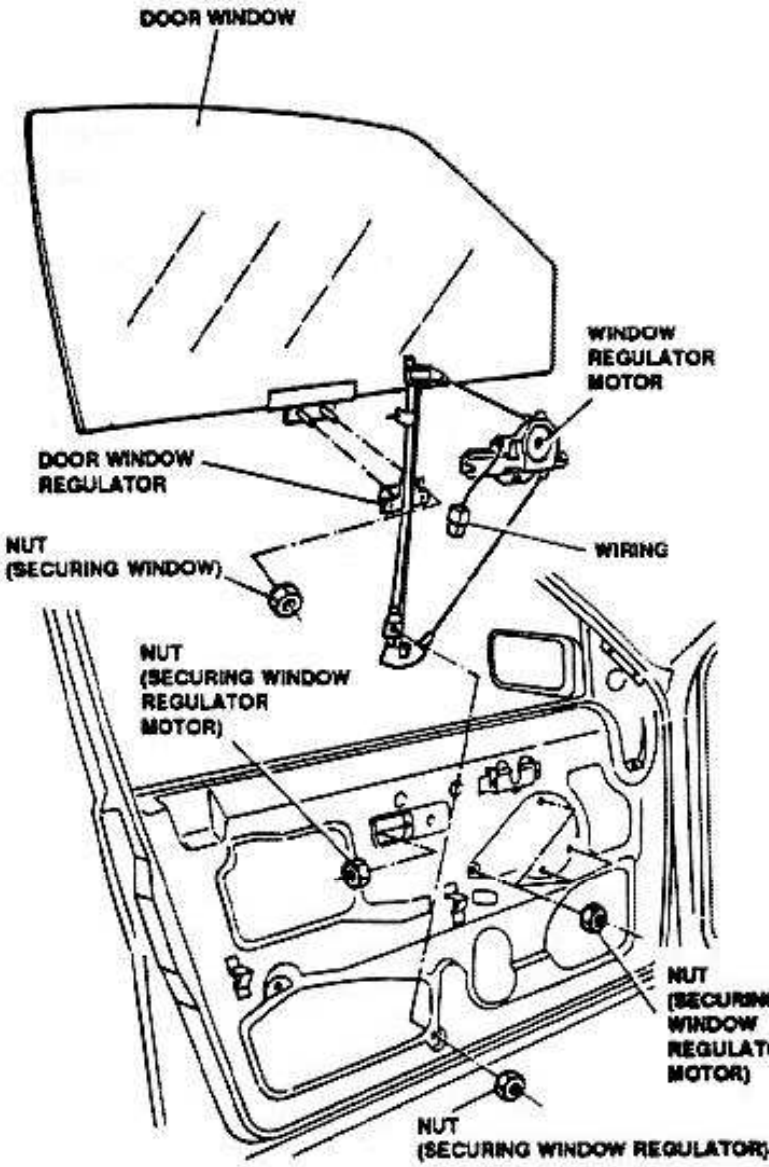
Proceed in reverse order for reassembly.

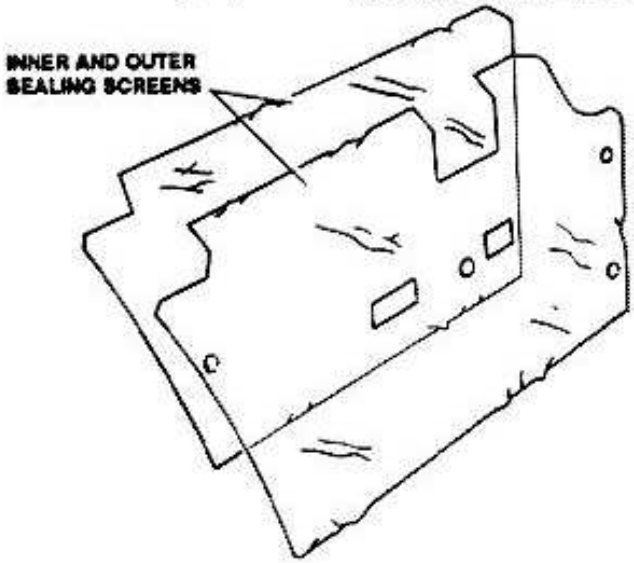
- After door window is positioned and partially secured, lift it and push against outer seals, then secure in position.
- Before reassembly remaining components, carry-out window functional check. Check also door window for smooth travel and interference.
- After inner and outer sealing screens have been installed, perform window functional check to ascertain proper installation.
- For components and/or parts described in other pages of same group or in other groups, refer to related procedures and informations.

DOOR WINDOW ACTUATOR - WINDOW MOTOR

DISASSEMBLY/REASSEMBLY

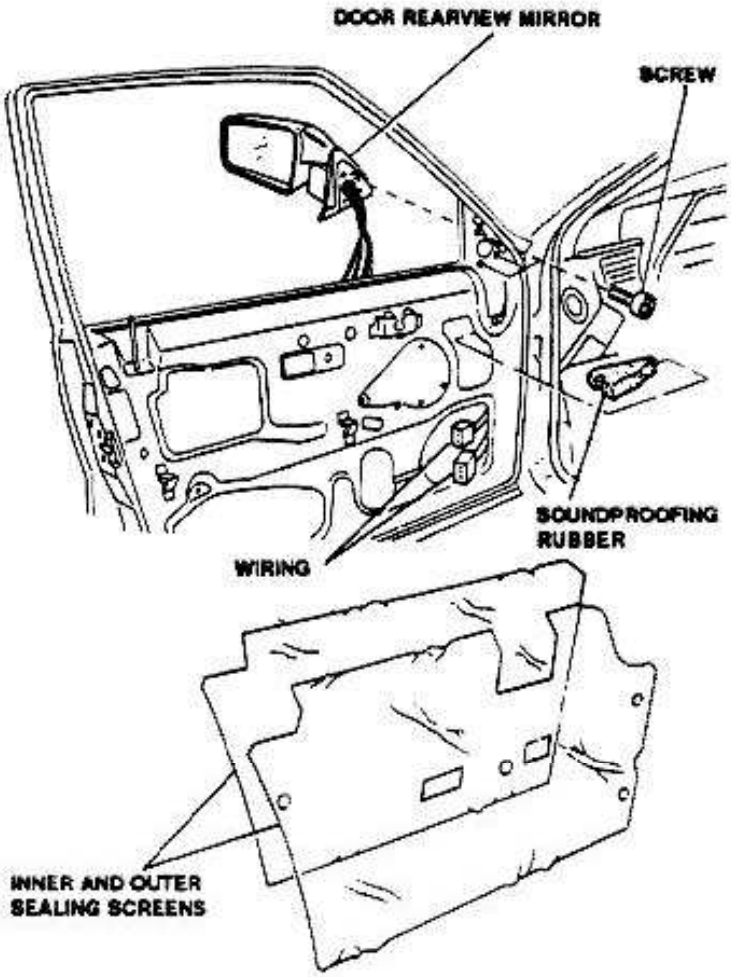
1. Lower window.
2. Disconnect negative (-) lead from battery
3. Remove front finisher.
4. Remove lower panel.
5. Remove louver finisher and door panel complete with armrest .
6. Remove inner and outer sealing screens.
7. Remove door window.
8. Disconnect wiring from window motor.
9. Remove five nuts securing window motor.
10. Remove lower nut securing window actuator.
11. Remove window actuator and motor from door.





Proceed in reverse order for reassembly.

- Check that wires are properly connected before connecting any electrical connectors.
- After door window is positioned and partially secured, lift it and push against outer seals, then secure in position.
- Before reassembly remaining components, carry-out window functional check. Check also door window for smooth travel and interference.
- After inner and outer sealing screens have been installed, perform window functional check to ascertain proper installation.
- For components and/or parts described in other pages of same group or in other groups, refer to related procedures and informations.



DOOR REARVIEW MIRROR

DISASSEMBLY/REASSEMBLY

1. Lower window.
2. Disconnect negative (-) lead from battery.
3. Remove front finisher.
4. Remove lower panel.
5. Remove louver finisher and door panel complete with armrest.
6. Remove inner and outer sealing screens.
7. Disconnect door rearview mirror control wiring.
8. Remove soundproofing rubber.
9. Remove three screws securing rearview mirror to door.
10. Remove rearview mirror from door, withdrawing wiring from door.

Proceed in reverse order for reassembly.

- Check that wires are properly connected before connecting connectors.
- Check that soundproofing rubber is correctly positioned to avoid excessive noise during vehicle's run.
- After inner and outer sealing screens have been installed, perform window functional check to ascertain proper installation.
- For components and/or parts described in other pages of same group or in other groups, refer to related procedures and informations.

ing from door.

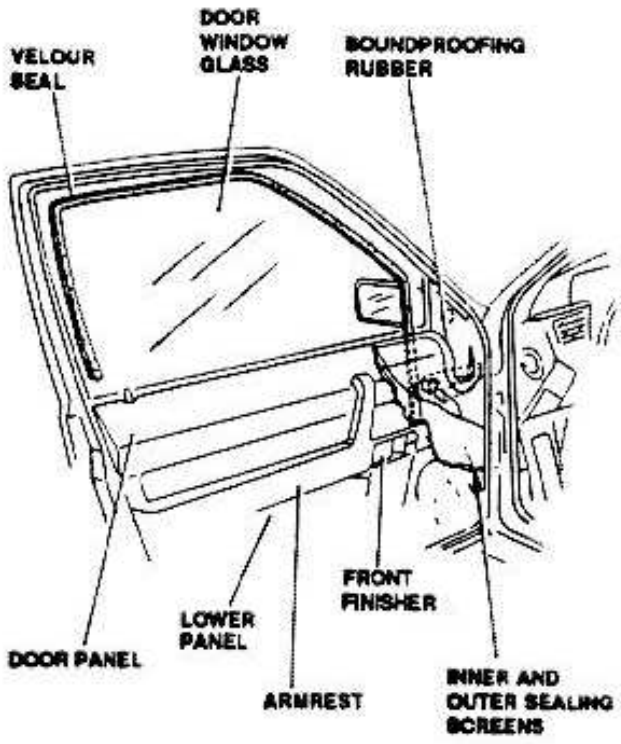
formations.

WINDOW SEALS

DISASSEMBLY AND REASSEMBLY OF VELOUR SEAL

1. Lower window.
2. Disconnect negative (-) lead from battery.
3. Remove front finisher.
4. Remove lower panel.
5. Remove louver finisher and door panel complete with armrest.
6. Remove inner and outer sealing screens.
7. Remove door window.
8. Withdraw and remove velour seal.

Proceed in reverse order for reassembly.



DISASSEMBLY AND REASSEMBLY OF OUTER SCRAPER SEAL

1. Lower window.
2. Disconnect negative (-) lead from battery.
3. Remove screw securing outer scraper seal.
4. Withdraw and remove outer scraper seal.

Proceed in reverse order for reassembly.

DISASSEMBLY AND REASSEMBLY OF UPPER OUTER SEAL

1. Lower window.
2. Disconnect negative (-) lead from battery.
3. Remove front finisher.
4. Remove lower panel.
5. Remove louver finisher and door panel complete with armrest.
6. Remove inner and outer sealing screens.
7. Remove door rearview mirror.
8. Withdraw velour seal as necessary to allow removal of upper outer seal.
9. Withdraw and remove upper outer seal.

Proceed in reverse order for reassembly.

DISASSEMBLY AND REASSEMBLY OF REAR OUTER SEAL

1. Lower window.
2. Disconnect negative (-) lead from battery.
3. Withdraw velour seal as necessary to allow removal of rear outer seal.
4. Withdraw and remove rear outer seal.

Proceed in reverse order for reassembly.

DISASSEMBLY AND REASSEMBLY OF INNER SCRAPER SEAL

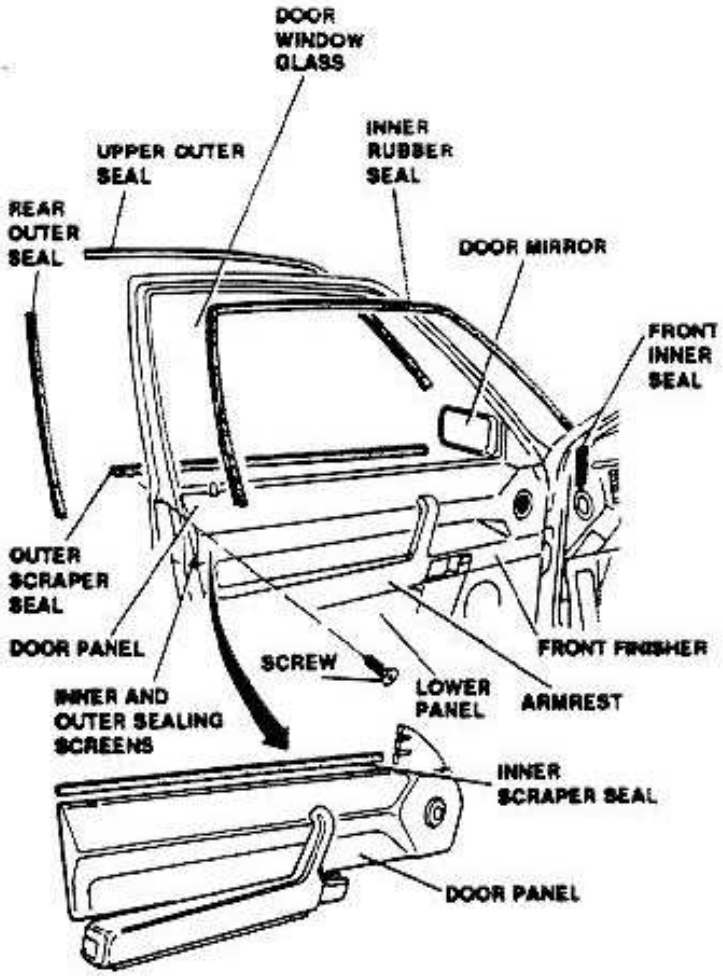
1. Lower window.
2. Disconnect negative (-) lead from battery.
3. Remove front finisher.
4. Remove lower panel.
5. Remove louver finisher and door panel complete with armrest.
6. Withdraw and remove inner scraper seal.

Proceed in reverse order for reassembly.

DISASSEMBLY AND REASSEMBLY OF INNER RUBBER SEAL AND FRONT INNER SEAL

1. Lower window.
2. Disconnect negative (-) lead from battery.
3. Remove front inner seal.
4. Withdraw and remove inner rubber seal.

Proceed in reverse order for reassembly.



- After velour seals has been installed, check that soundproofing seals are correctly positioned before installation of remaining components.
- After reassembly, check that each seal(s) is properly installed and flush with adjacent frame in order to avoid excessive noise during vehicle's run.
- After inner and outer sealing screen have been installed, perform window functional check to ascertain proper installation.
- For components and/or parts described in other pages of same group or in other groups, refer to related procedures and informations.

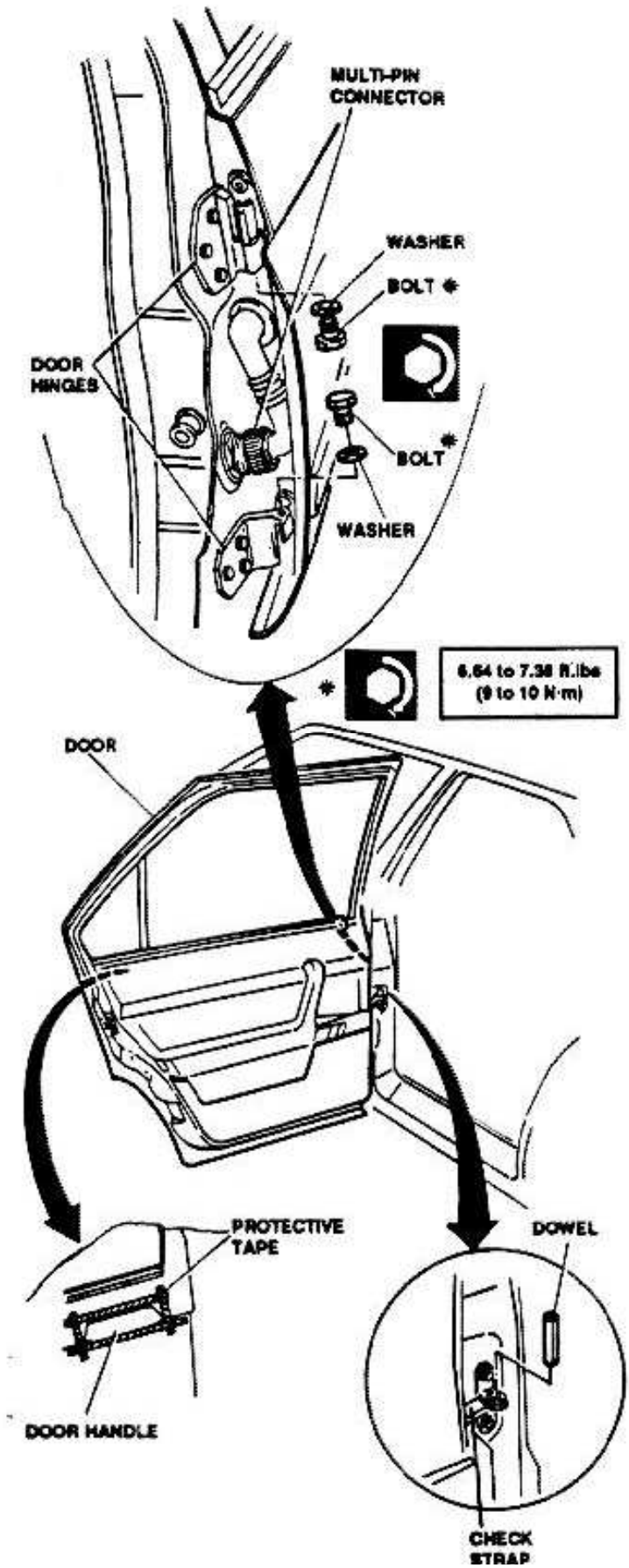
REAR DOORS

REMOVAL/INSTALLATION

NOTE: Avoid damage to body painting during removal and installation.

1. Disconnect negative (-) lead from battery.
2. Disconnect multi-pin connector of door electrical system.
3. Apply adhesive tape all-around door handle to avoid damage to painting.
4. Remove bolts and washers securing upper and lower hinges.
5. Remove check strap dowel.
6. Half-close door to retract check strap, then open and lift door.
7. Remove door.

7. Remove door.



Proceed in reverse order for installation.

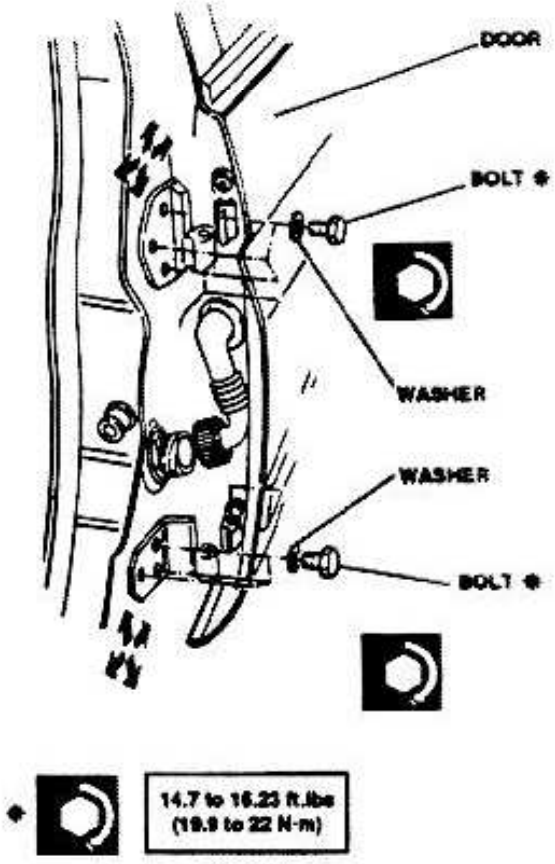
- Check that wires are properly connected before connecting any electrical connector.

DOOR HINGES

DISASSEMBLY/REASSEMBLY

NOTE: Avoid damage to body painting during disassembly and reassembly.

1. Disconnect negative (-) lead from battery.
2. Remove front door.
3. Remove three bolts and washers securing each hinge.



Proceed in reverse order for reassembly.

- Apply anti-rust treatment (see Group 49) on hinge installation area before reassembly hinges.
- Adjust hinges position, as described below, before torquing hinge bolts.
- Apply anti-rust treatment (see Group 49) on hinge sides after reassembly.
- For components and/or parts described in other pages of same group or in other groups, refer to related reassembly procedures and informations.

ADJUSTMENT

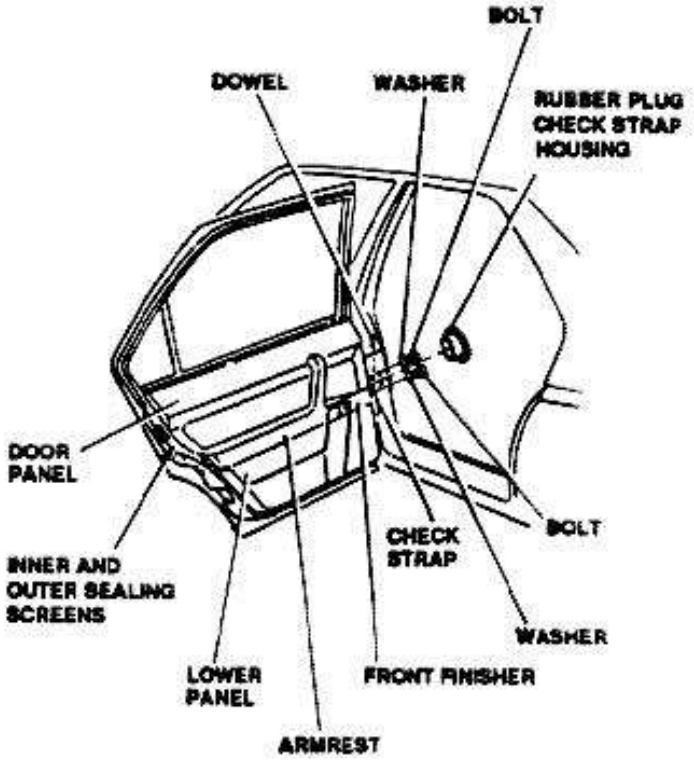
1. Temporarily reassembly door
2. With door closed, check for correct alignment and positioning of door: if misalignment is found, reposition hinges vertically and horizontally as required.
3. After adjustment has been completed, disassemble door and torque hinge bolts to 14.7 to 16.23 ft.lbs (19.9 to 22 N.m).

DOOR CHECK STRAP

DISASSEMBLY/REASSEMBLY

NOTE: Avoid damage to body painting during disassembly and reassembly.

1. Lower window.
2. Disconnect negative (-) lead from battery.
3. Withdraw dowel from check strap.
4. Remove front finisher.
5. Remove lower panel.
6. Remove door panel complete with armrest.
7. Remove inner and outer sealing screens.
8. Half-close door to retract check strap then open door.
9. Remove check strap housing rubber plug.
10. Remove two bolts and screws securing check strap.



Proceed in reverse order for reassembly.

- Apply anti-rust treatment (see Group 49) on check strap installation area before reassembly check straps.
- Apply anti-rust treatment (see Group 49) on check strap sides after reassembly.
- For components and/or parts described in other pages of same group or in other groups, refer to related reassembly procedures and informations.

FRONT FINISHER AND ARMREST

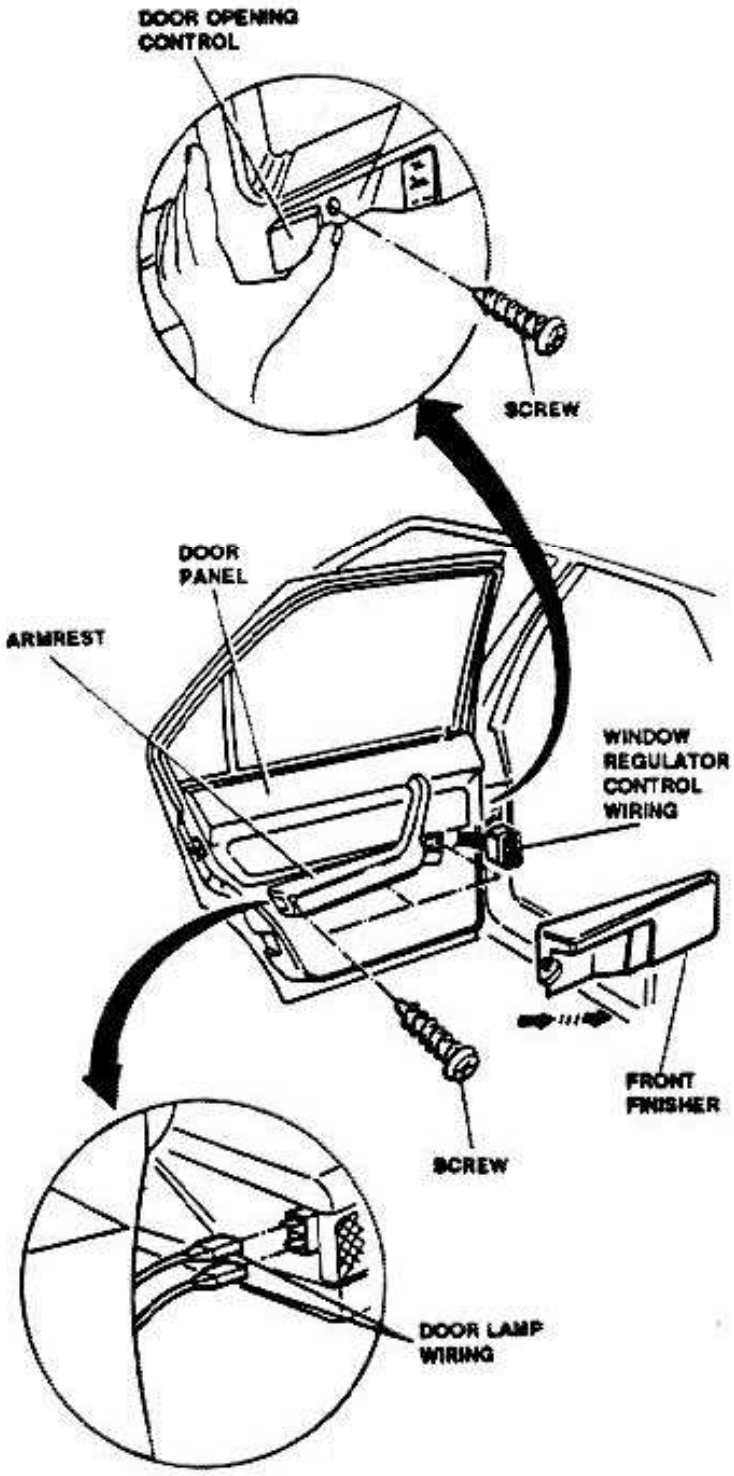
DISASSEMBLY/REASSEMBLY

1. Disconnect negative (-) lead from battery.
2. Remove screw located under door opening control.
3. Slide forward front finisher until is free from aft plastic pin.
4. Remove front finisher.
5. Disconnect power window control wiring.
6. Remove three screws securing armrest.
7. Move away rear end of armrest and disconnect door

11. Remove check strap by pulling it from door interior. | lamp wiring.

CAUTION:
Care must be exercised to avoid damage to armrest and to door panel.

8. Lift and remove armrest.

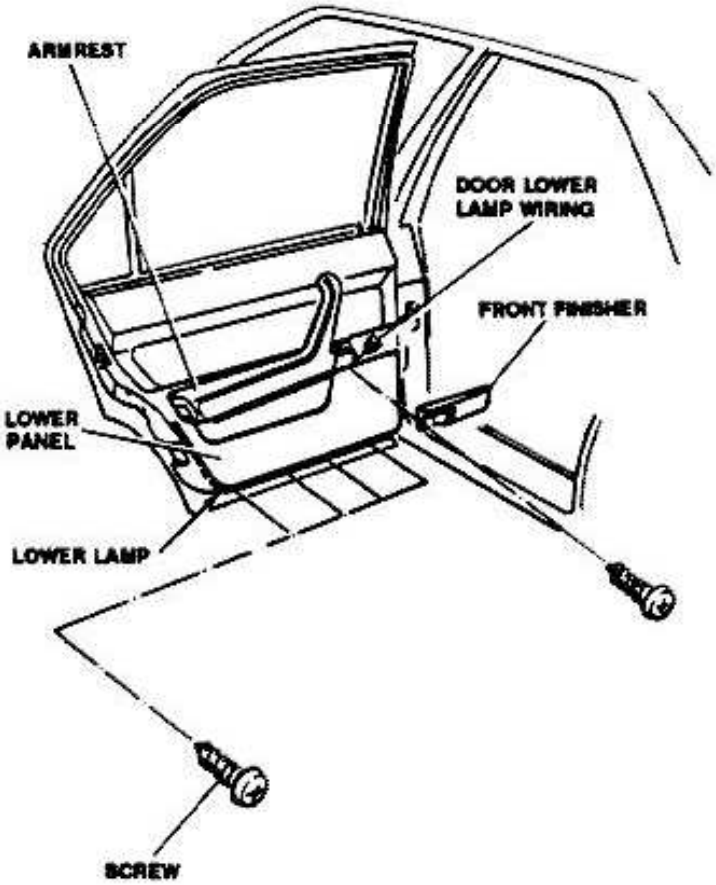


Proceed in reverse order for reassembly.
- Check that wires are properly connected before connecting any electrical connector.

LOWER PANEL

DISASSEMBLY/REASSEMBLY

1. Disconnect negative (-) lead from battery.
2. Remove front finisher and screws securing armrest.
3. Disconnect lower lamp wiring.
4. Remove four screws securing lower panel.
5. Move-away lower panel from plastic catch and remove it.

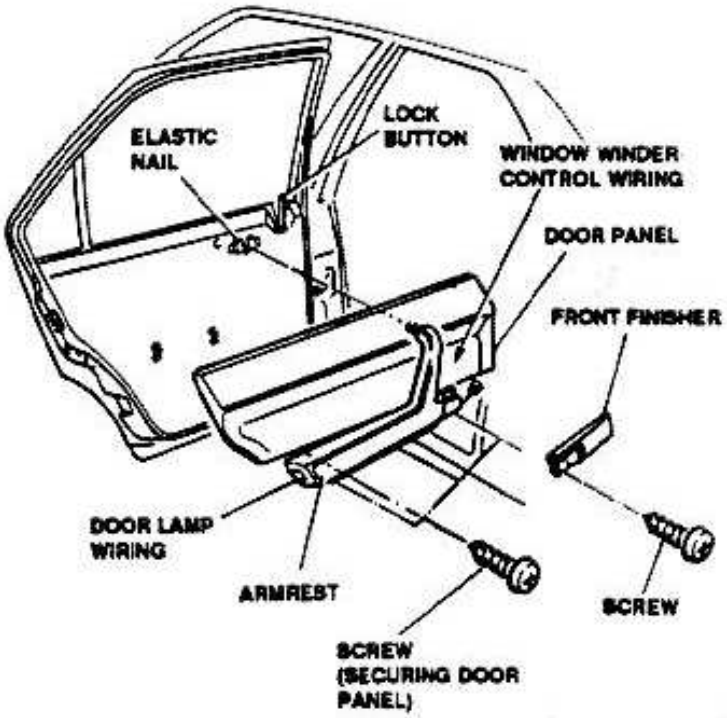


Proceed in reverse order for reassembly.
- Check that wires are properly connected before connecting any electrical connector.
- Check plastic catches on lower panel for integrity before reassembly.
- For components and/or parts described in other pages of same group or in other groups, refer to related reassembly procedures and informations.

DOOR PANEL

DISASSEMBLY/REASSEMBLY

1. Disconnect negative (-) lead from battery.
2. Remove front finisher.
3. Disconnect door mirror control wiring.
4. Remove three screws securing armrest.
5. Move away rear end of armrest and disconnect door lamp wiring.
6. Remove aft screw securing door panel.
7. Lift armrest and door panel and disengage the later from elastic nail and lock button.
8. Remove door panel.
9. If required, remove armrest.



Proceed in reverse order for reassembly.
- Check that wires are properly connected before connecting any electrical connector.
- For components and/or parts described in other pages of same group or in other groups, refer to related procedures and informations.

DOOR HANDLE

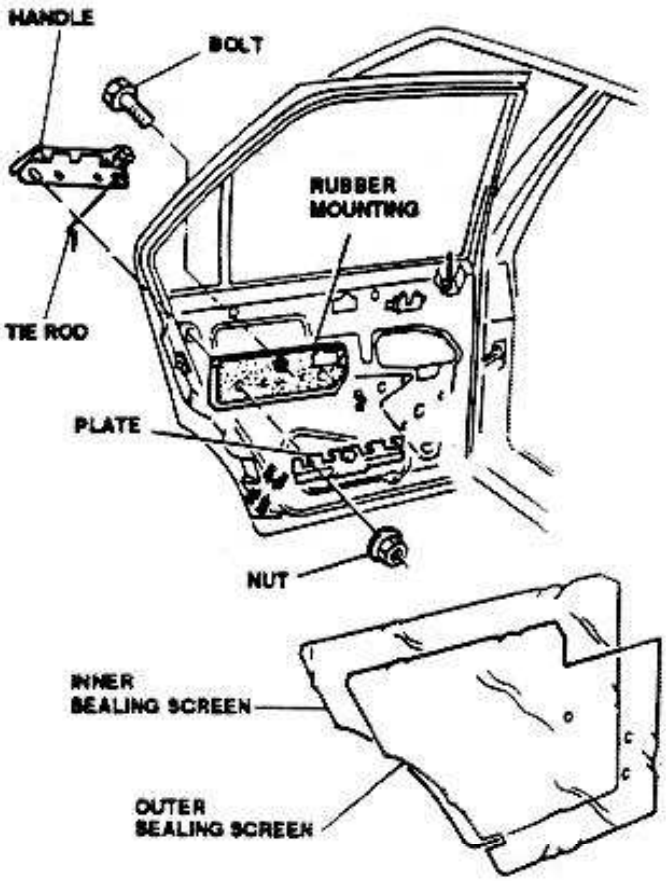
DISASSEMBLY/REASSEMBLY

1. Disconnect negative (-) lead from battery.
2. Remove front finisher.
3. Remove lower panel.
4. Remove door panel complete with armrest.
5. Remove inner and outer sealing screens.
6. Remove two nuts securing handle.
7. Remove handle plate.

CAUTION:
Avoid damage to body painting.

8. Remove handle complete with tie-rod.
9. If required, remove securing bolt then remove rubber mounting.

Proceed in reverse order for reassembly.
- Adjust handle position, as described below, before torquing bolts.
- After inner and outer sealing screens have been installed, perform window functional check to ascertain proper installation.
- For components and/or parts described in other pages of same group or in other groups, refer to related procedures and informations.



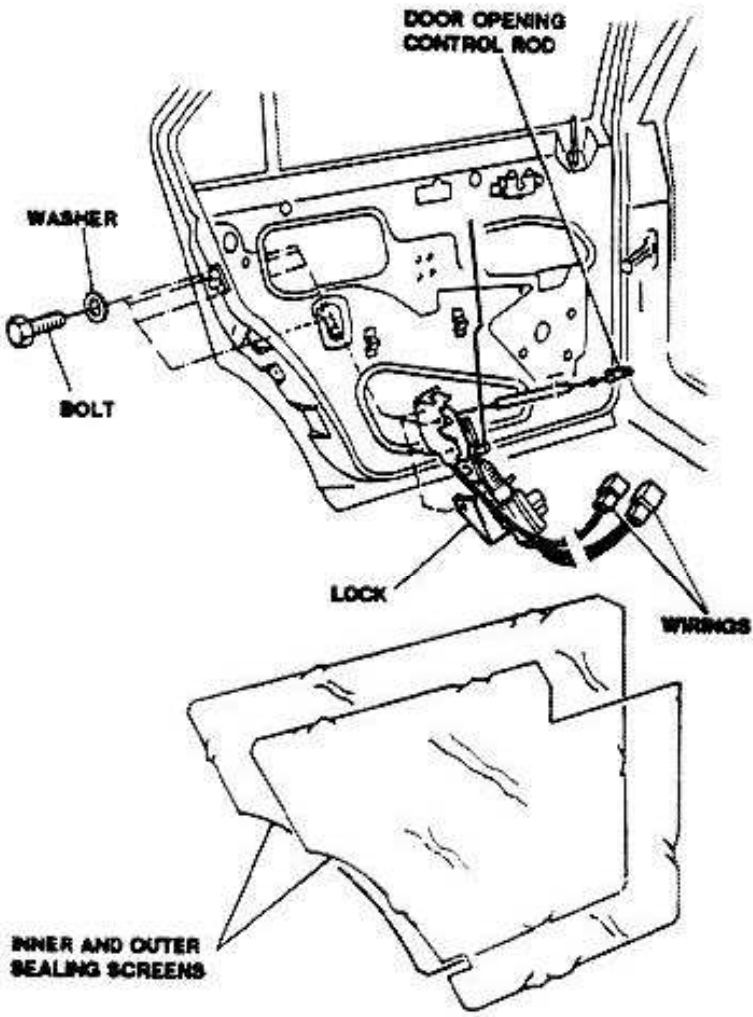
ADJUSTMENT

1. After handle, handle plate and rubber mounting (if removed) have been installed, perform the following checks before torquing bolts:
   - Check handle for freedom of movement.
   - Check that handle upper corners do not hit against handle recess.
2. Torque bolts.
3. Repeat check as per step 1 above.

DOOR LOCK

DISASSEMBLY/REASSEMBLY

1. Disconnect negative (-) lead from battery.
2. Remove front finisher.
3. Remove lower panel.
5. Remove inner and outer sealing screens.
6. Disconnect door opening control rod end from attaching point on door.
7. Disconnect wiring from lock.
8. Remove four bolts and washers securing lock.
9. Pull door lock downward and remove it.



Proceed in reverse order for reassembly.

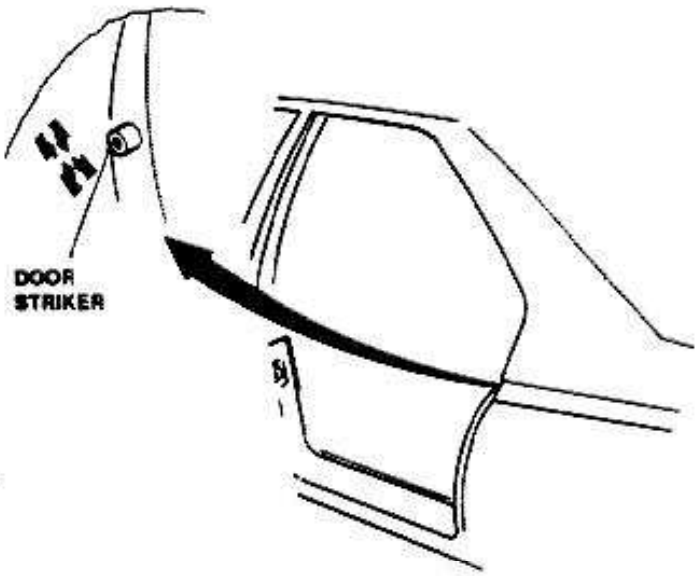
- Check that wires are properly connected before connecting any electrical connector.
- After inner and outer sealing screens have installed, perform window functional check to ascertain proper installation.
- For components and/or parts described in other pages of same group or in other groups, refer to related procedures and in-

4. Remove door panel complete with armrest.

formations.

DOOR STRIKER ADJUSTMENT

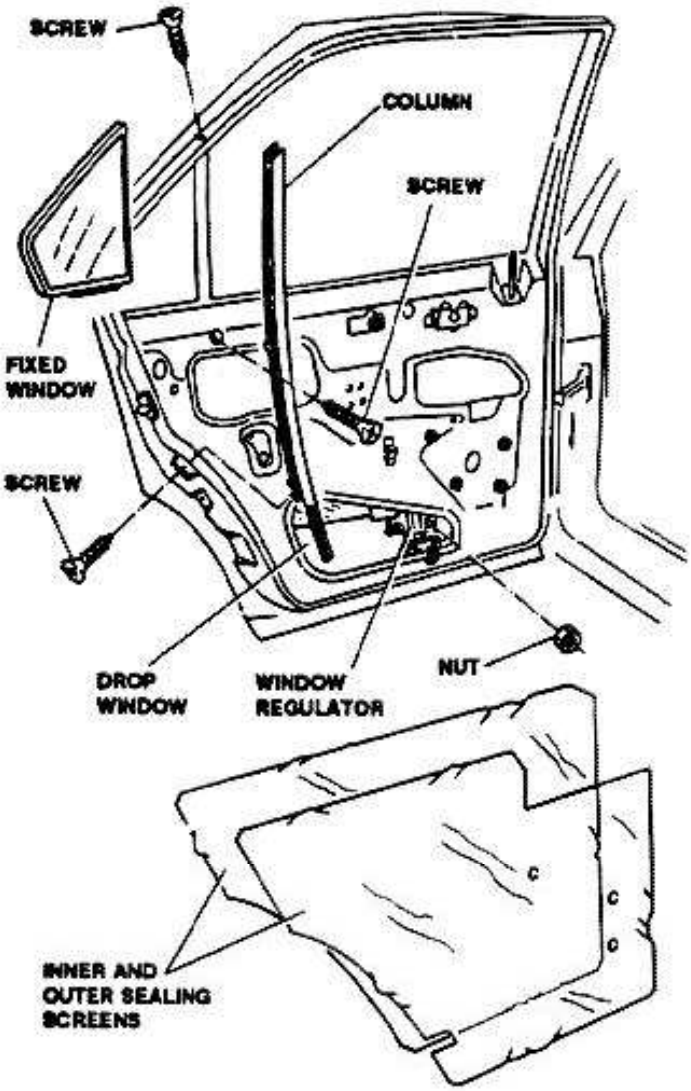
1. With door lock installed, loosen door striker on pillar.
2. Adjust door striker vertically and horizontally until door closes correctly.
3. Tighten door striker after correct position is achieved.



DOOR WINDOWS

DISASSEMBLY/REASSEMBLY

1. Open door window.
2. Disconnect negative (-) lead from battery.
3. Remove front finisher.
4. Remove lower panel.
5. Remove door panel complete with armrest.
6. Remove inner and outer sealing screens.
7. Remove three nuts securing door window column.
8. Remove column complete with seal.
9. Remove fixed window.
10. Remove two nuts securing door window to door window actuator.
11. Disconnect window from window actuator.
12. Slightly rotate window upward then remove it from door.



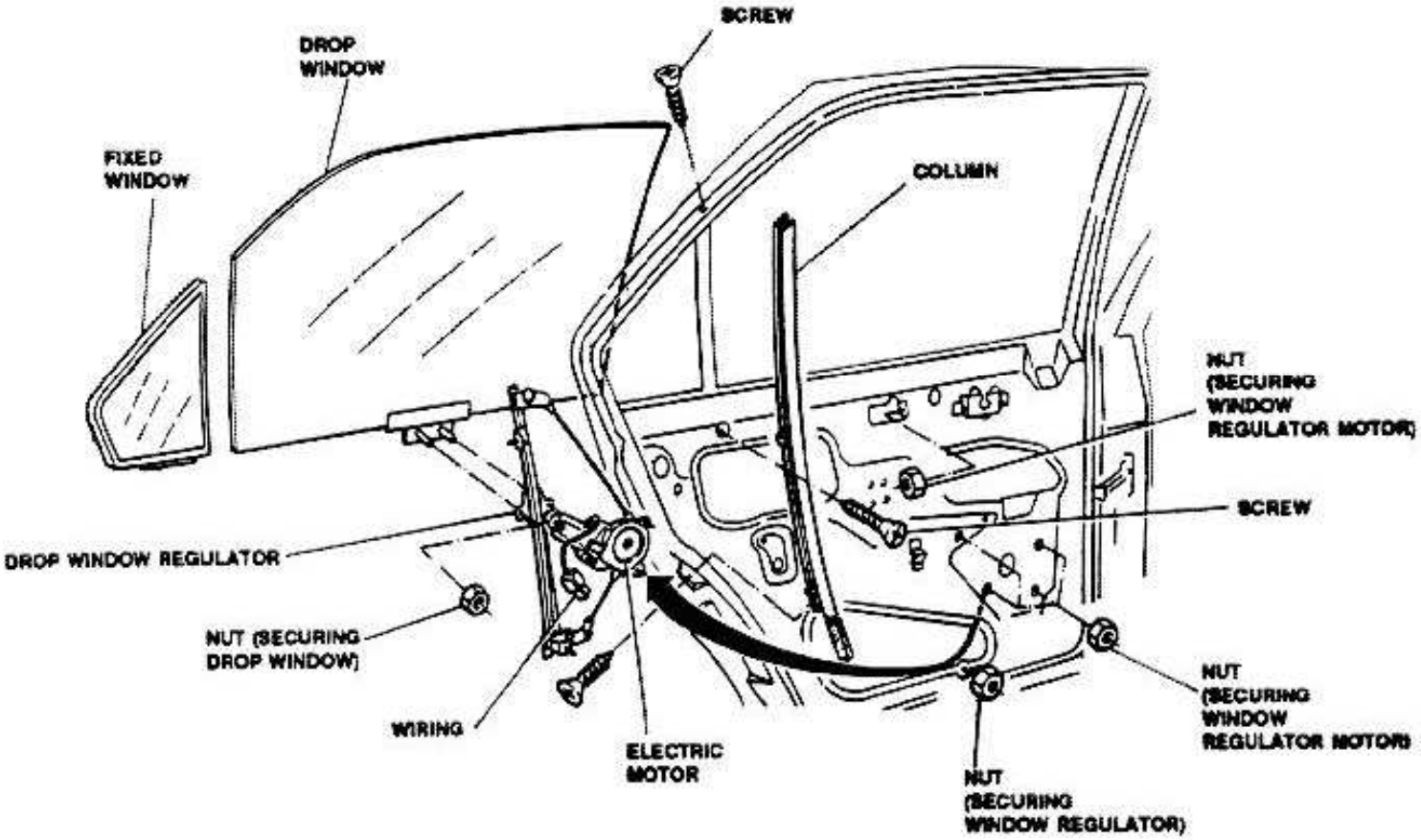
Proceed in reverse order for reassembly.

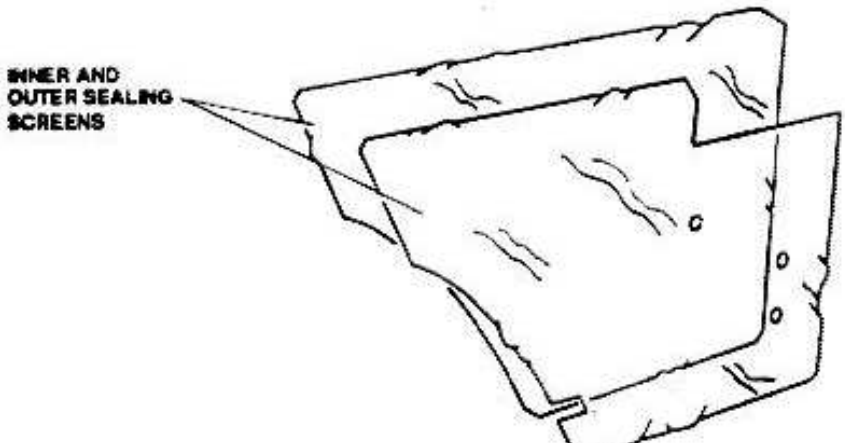
- After door window is positioned and partially secured, lift it and push against outer seals, then secure in position.
- Before reassembly remaining components, carry-out window functional check. Check also door window for smooth travel and interference.
- After inner and outer sealing screens have been installed, perform window functional checks to ascertain proper installation.
- For components and/or parts described in other pages of same group or in other groups, refer to related procedures and informations.

DOOR WINDOW ACTUATOR - WINDOW MOTOR

DISASSEMBLY/REASSEMBLY

1. Lower window.
2. Disconnect negative (-) lead from battery.
3. Remove front finisher.
4. Remove lower panel.
5. Remove door panel complete with armrest.
6. Remove inner and outer sealing screens.
7. Remove three screws securing window column.
8. Remove column complete with seal.
9. Remove fixed window.
10. Remove drop window.
11. Disconnect wiring from window motor.
12. Remove five nuts securing window motor.
13. Remove lower nut securing window actuator.
14. Remove window actuator and motor from door.





Proceed in reverse order for reassembly.

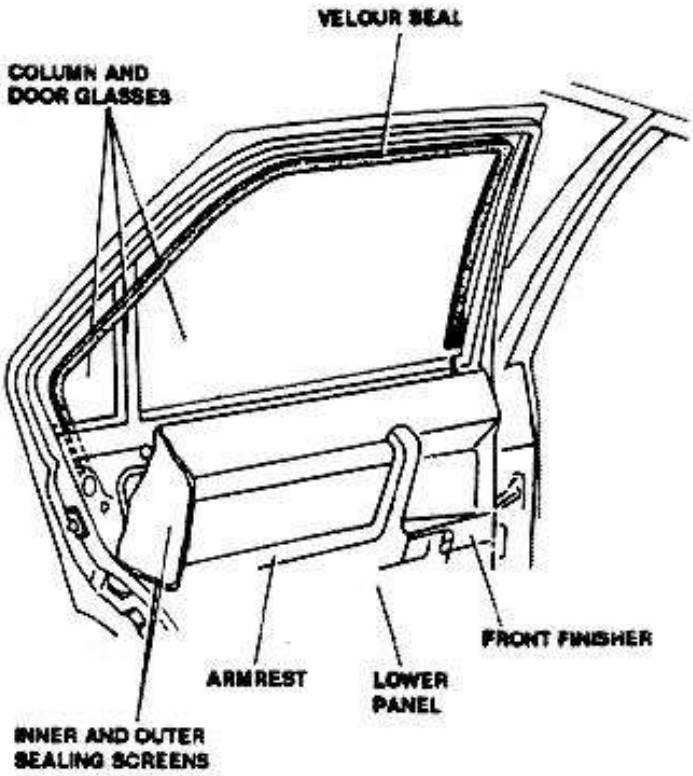
- Check that wires are properly connected before connecting any electrical connectors.
- After door window is positioned and partially secured, lift it and push against outer seals, then secure in position.
- Before reassembly remaining components, carry-out a window functional check. Check also door window for smooth travel and interference.
- After inner and outer sealing screens have been installed, perform window functional check to ascertain proper installation.
- For components and/or parts described in other pages of same group or in other groups, refer to related procedures and informations.

WINDOW SEALS

DISASSEMBLY AND REASSEMBLY OF VELOUR SEAL

1. Open drop window.
2. Disconnect negative (-) lead from battery.
3. Remove front finisher.
4. Remove lower panel
5. Remove door panel complete with armrest.
6. Remove inner and outer sealing screens.
7. Remove column and both fixed and drop window.
8. Withdraw and remove velour seal.

Proceed in reverse order for reassembly.



DISASSEMBLY AND REASSEMBLY OF OUTER SCRAPER SEAL

1. Lower window.
2. Disconnect negative (-) lead from battery.
3. Remove screw securing outer scraper seal.
4. Withdraw and remove outer scraper seal.

Proceed in reverse order for reassembly.

DISASSEMBLY AND REASSEMBLY OF UPPER OUTER SEAL

1. Lower window.
2. Disconnect negative (-) lead from battery
3. Remove front finisher.
4. Remove lower panel.
5. Remove door panel complete with armrest .
6. Remove inner and outer sealing screens.
7. Remove column and fixed wing.
8. Withdraw velour seal as necessary to allow removal of upper outer seal.
9. Withdraw and remove upper outer seal.

Proceed in reverse order for reassembly.

DISASSEMBLY AND REASSEMBLY OF FRONT OUTER SEAL

1. Lower window.
2. Disconnect negative (-) lead from battery.
3. Withdraw velour seal as necessary to allow removal of front outer seal.
4. Withdraw and remove front outer seal.

Proceed in reverse order for reassembly.

DISASSEMBLY AND REASSEMBLY OF INNER SCRAPER SEAL

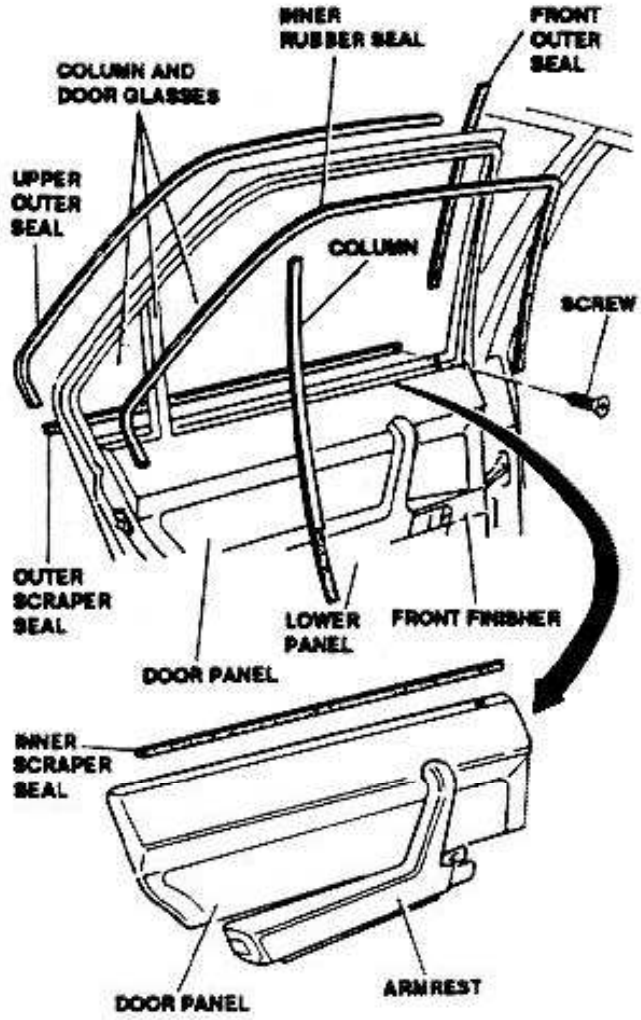
1. Lower window.
2. Disconnect negative (-) lead from battery.
3. Remove front finisher.
4. Remove lower panel.
5. Remove door panel complete with armrest .
6. Withdraw and remove inner scraper seal.

Proceed in reverse order for reassembly.

DISASSEMBLY AND REASSEMBLY OF INNER RUBBER SEAL

1. Lower window.
2. Disconnect negative (-) lead from battery.
3. Remove front finisher.
4. Remove lower panel.
5. Remove door panel complete with armrest.
6. Remove inner and outer sealing screens.
7. Remove column and fixed window.
8. Withdraw and remove inner rubber seal.

Proceed in reverse order for reassembly.



- After reassembly, check that each seal(s) is properly installed and flush with adjacent frame in order to avoid excessive noise during vehicle's run.
- After inner and outer sealing screen have been installed, perform window functional check to ascertain proper installation.
- For components and/or parts described in other pages of same group or in other groups, refer to related procedures and informations.

TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

FLUIDS AND LUBRICANTS

Application	Type	Name
Door lock	GREASE	AMECO-OPTIMOL Optimoly-Paste White T Compound 7 Rhône-Poulenc chimica S.p.A.
Seals	SYLYCONE SPRAY LUBRICANT	

TIGHTENING TORQUES

FRONT DOORS		
Hinge-to-body securing bolts	14.7 to 16.23 ft.lbs	19.9 to 22 N.m
Hinge-to-door securing bolts	6.64 to 7.38 ft.lbs	9 to 10 N.m
REAR DOORS		
Hinge-to-body securing bolts	14.7 to 16.23 ft.lbs	19.9 to 22 N.m
Hinge-to-door securing bolts	6.64 to 7.38 ft.lbs	9 to 10 N.m

TROUBLESHOOTING PROCEDURE

NOTE: One of the possible inconveniences caused by the doors consists in an aerodynamic rustling causing a disturbing noise at high speeds.
For a rapid solution, refer to the troubleshooting concerning noise problems, **Group 66 - INTERNAL TRIM**.

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GROUP 40

ELECTRICAL SYSTEM

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GROUP 40

ELECTRICAL SYSTEM

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ELECTRICAL SYSTEM

WARNING:
Before removing and installing any electrical component, read carefully the STANDARDS AND PRECAUTIONS at the beginning of each paragraph.

STANDARDS AND PRECAUTIONS

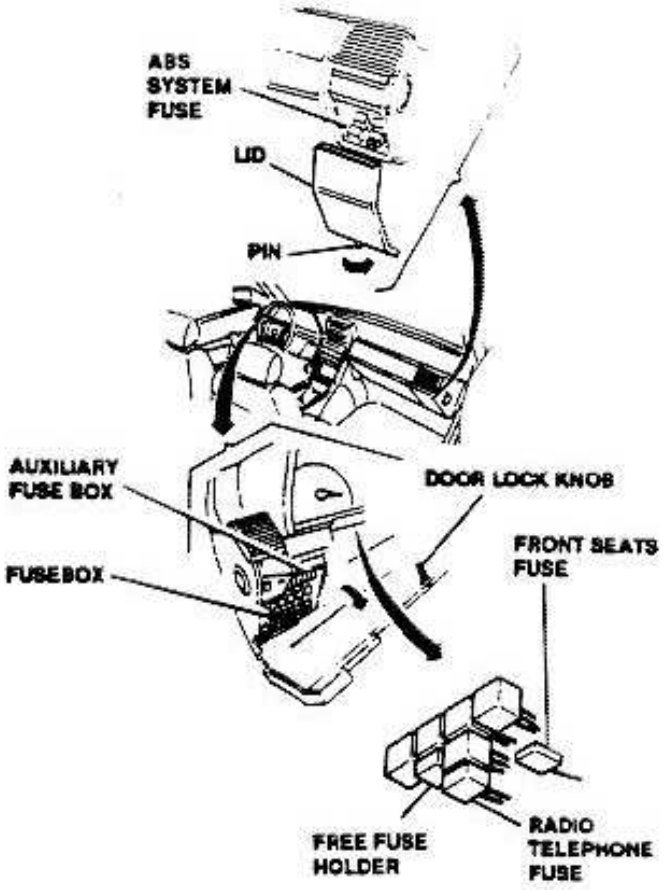
Before attempting any operation, ensure the ignition key is in "park" position and battery negative lead is disconnected; in any case:
- Never connect control units output directly to the load.
- Never operate directly on devices with wires connected to "positive" or to ground unless the control unit has been disconnected.
- Never short system sensors, unless otherwise specified.
- Before attempting any electrical welding operation on the vehicle disconnect control units to avoid possible damage to electronic components caused by induced currents.

NOTE: **- When working on the systems, foresee the eventual consequences and never carry-out any operation if the characteristics of the affected components are not perfectly known.**
- When assembling and/or installing, reverse the order of procedure described for disassembly and/or removal, unless otherwise stated. Reconnect the battery.
- Upon eventual replacement of any component of the system, it is advisable to use only genuine Alfa Romeo parts.
- Use of non Alfa Romeo parts, having slightly different characteristics, can reduce the relibility and safety of the vehicle.
- Never touch with bare hands the halogen bulbs glass (low beam high beam lamps). When replacing, always handle them always by the metal surface.

FUSES

LOCATION AND ACCESS WITHIN PASSENGER COMPARTMENT

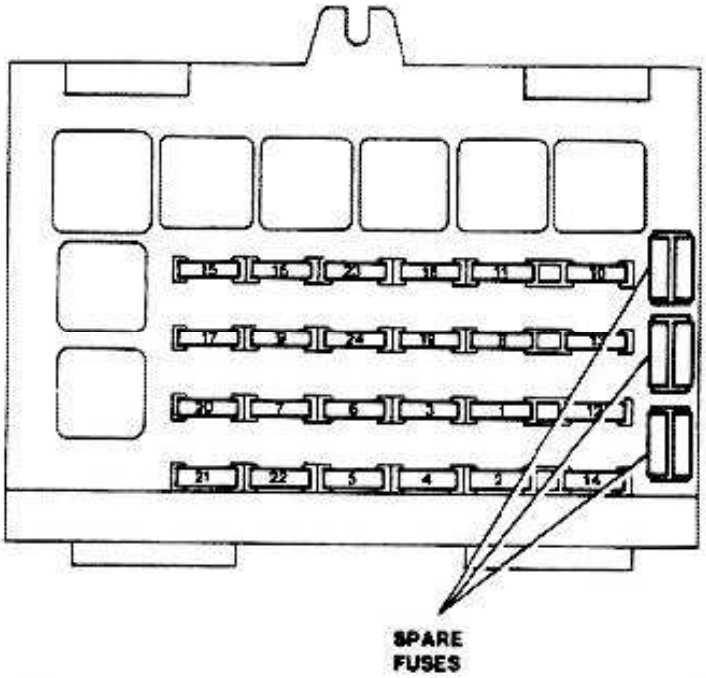
1. Before removing cover, loosen lid lock knob that, when operation is completed, shall be tightly screwed back.
2. Open cover and gain access to faulty fuse.
3. To gain access to ABS system fuse, rotate lid lock pin, remove lid and gain access to fuse.
4. To gain access to following fuses, remove front mark, remove electronic panel (see **Group 43**) and work from below the steering wheel:
   - Free fuse holder (7.5 A)
   - Radio telephone fuse (15A)
   - Front seats fuse (20A)

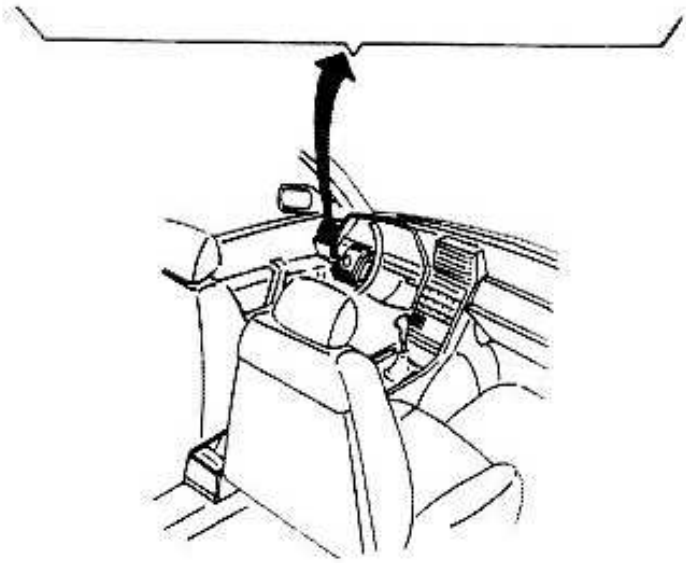


LOCATION WITHIN FUSEBOX

LEGEND FUSEL

No.	Val.	Function
1.	7.5	Right front and left rear position lamps license plate, underhood
2.	7.5	Left front and right rear position lamps, trunk, dome and panel switch, courtesy light
3.	10	Right low lamp (relay energized)
4.	10	Left low lamp (relay energized), warning lamp
5.	10	Right high lamp and warning lamp
6.	10	Left high lamp
7.	15	Front fog lamps and warning lamp
8.	7.5	Rear fog lamps and warning lamp
9.	10	External mirror defogging, rear window relay coil, warning lamp
10.	20	Back-up lamps, windshield washer
11.	7.5	Turn signal lamps, position lamps
12.	10	Air conditioning relay
13.	10	Rear cigar lighters
14.	7.5	Electric fan motor relay coil, test instrument, cruise control
15.	15	Stop lamps
16.	10	Electric door lock/unlock system
17.	20	Head lamps washer, hazard lamps
18.	30	Right front window lift
19.	30	Left front window lift
20.	30	Spare
21.	15	Front dome lamp, glovebox lamp, fuse box lamp, front cigar lighters
22.	15	Motor relay power
23.	20	Sun roof, head seat
24.	25	Spare

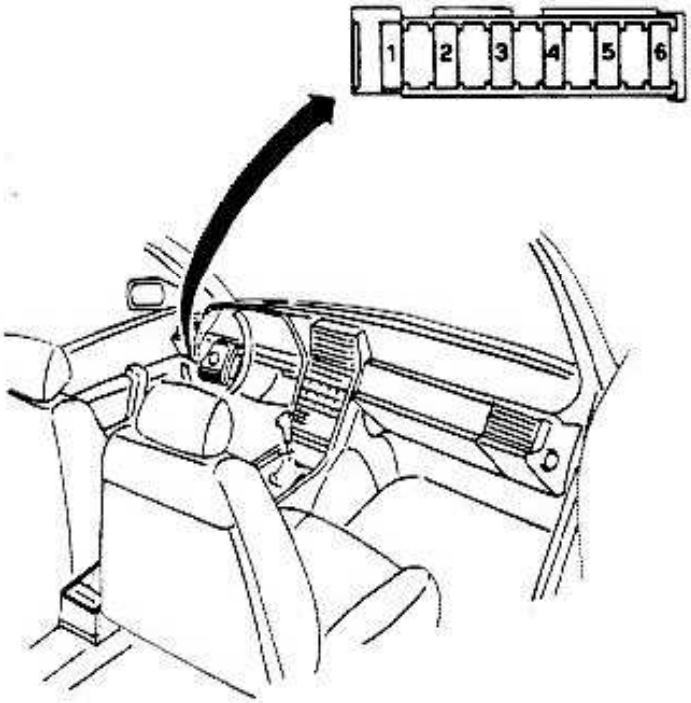




LOCATION WITHIN AUXILIARY FUSEBOX

FUSES TABLE

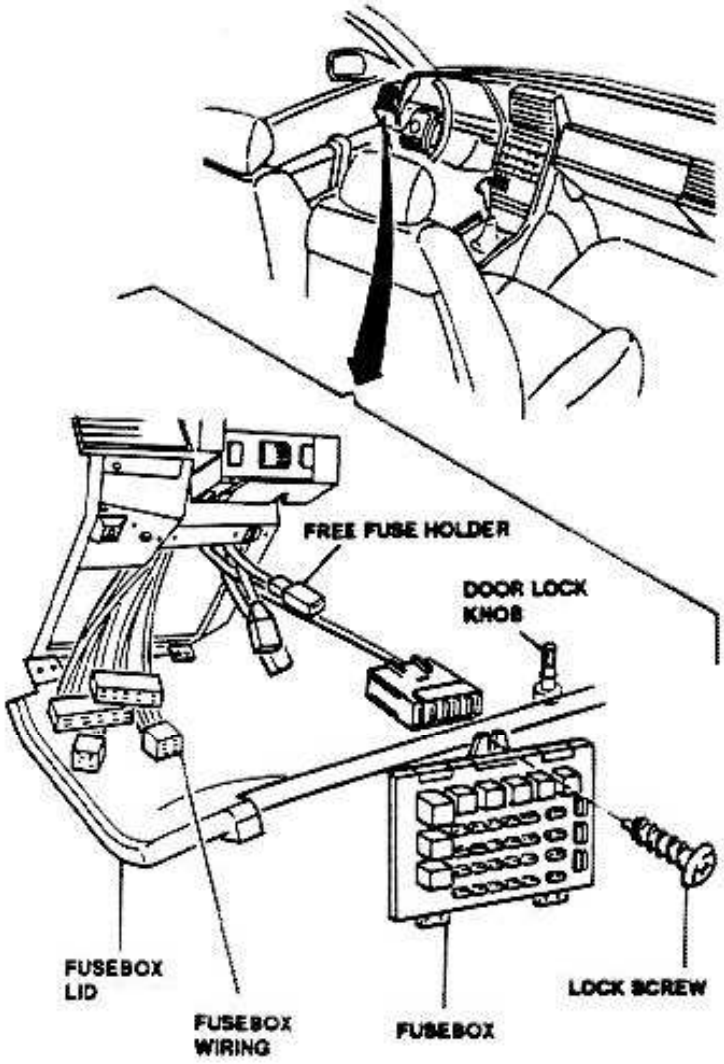
1. Control units direct power supply (7.5A)
2. Control units "Keyed" power supply-air mixing motor (7.5A)
3. Trunk opening (30A)
4. Spare (7.5A)
5. Ground illumination lamps, rear dome lamps, dome lamps relay (10A)
6. Dome lamps relay (7.5A)



FUSEBOX REMOVAL/INSTALLATION

1. Open fusebox lid upon loosening of lock knob.
2. Loosen fusebox lock screw.
3. Disconnect cables of affected fusebox.
4. Remove fusebox.
5. Manually withdraw auxiliary fusebox.
6. Disconnect wiring of fusebox and remove it.

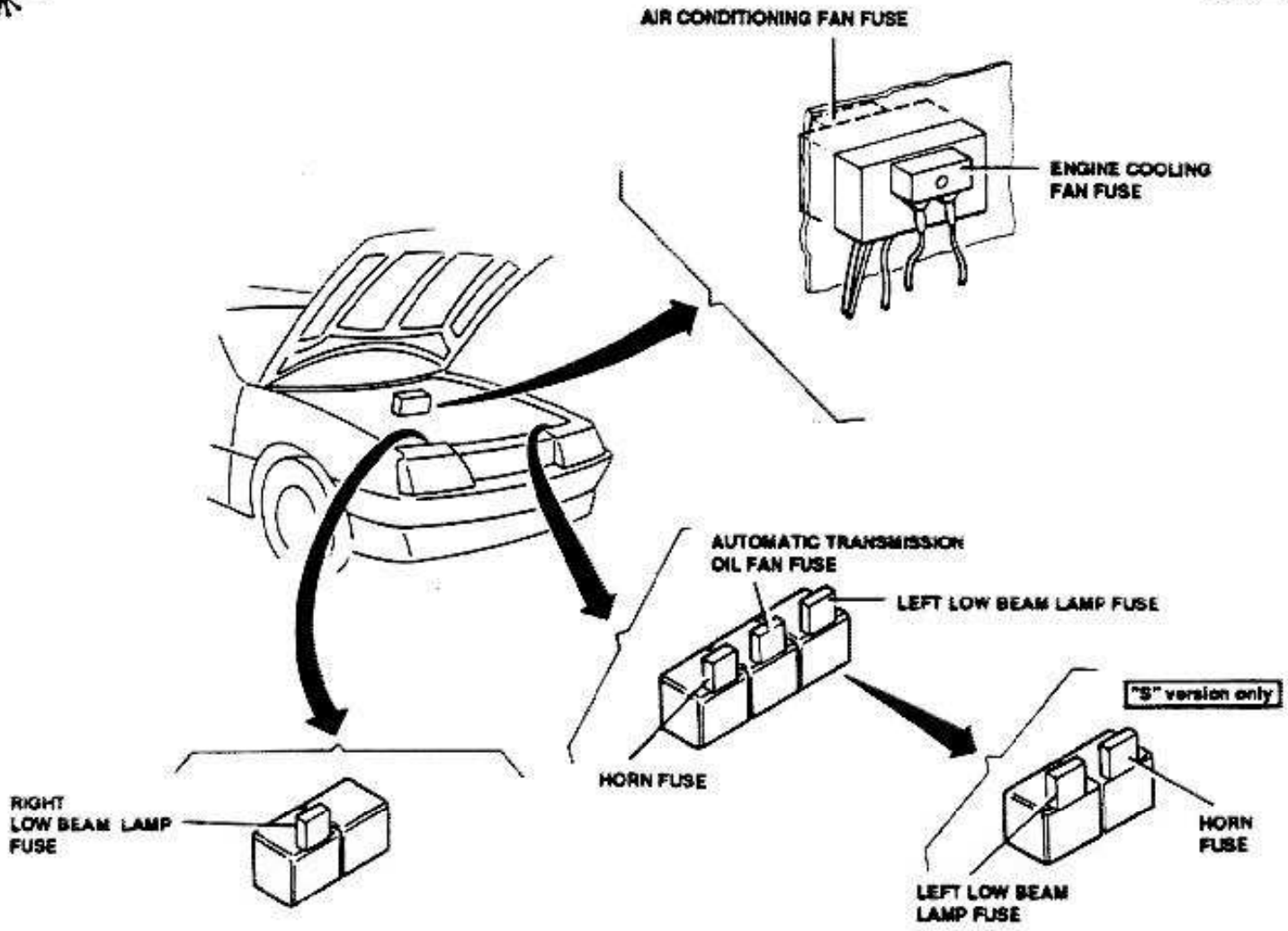
Install by reversing order of removal.



LOCATION WITHIN ENGINE COMPARTMENT

FUSES TABLE

1. Engine cooling fan (40A)
2. Horns (30A)
3. Air conditioner fan (40A)
4. Automatic transmission oil fan fuse

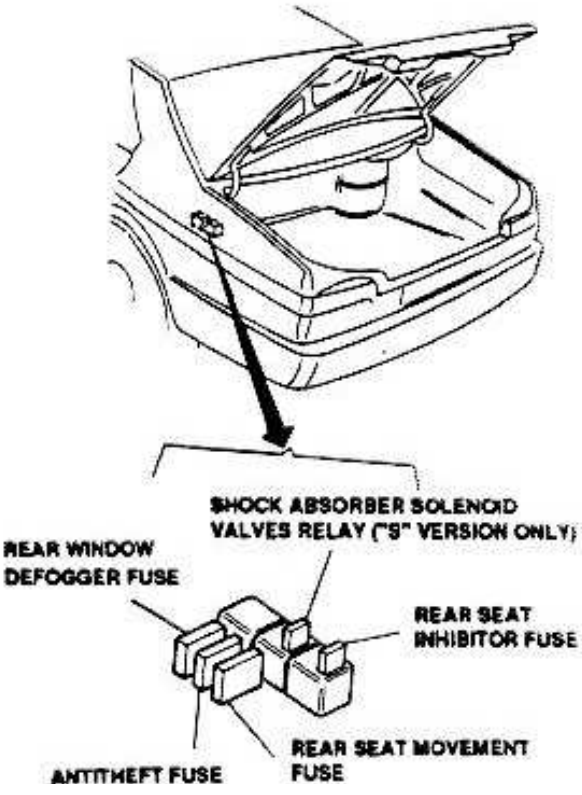


LOCATION WITHIN TRUNK

FUSES TABLE

1. Rear window defogger fuse (30A)
2. Antitheft fuse (15A)
3. Rear seat movement fuse (20A)
4. Rear seat inhibitor (30A)
5. Controlled damping suspensions relay ("S" version only) (20A)

NOTE: To gain access to fuses installed on relay, move trunk interior trim (see Group 66).



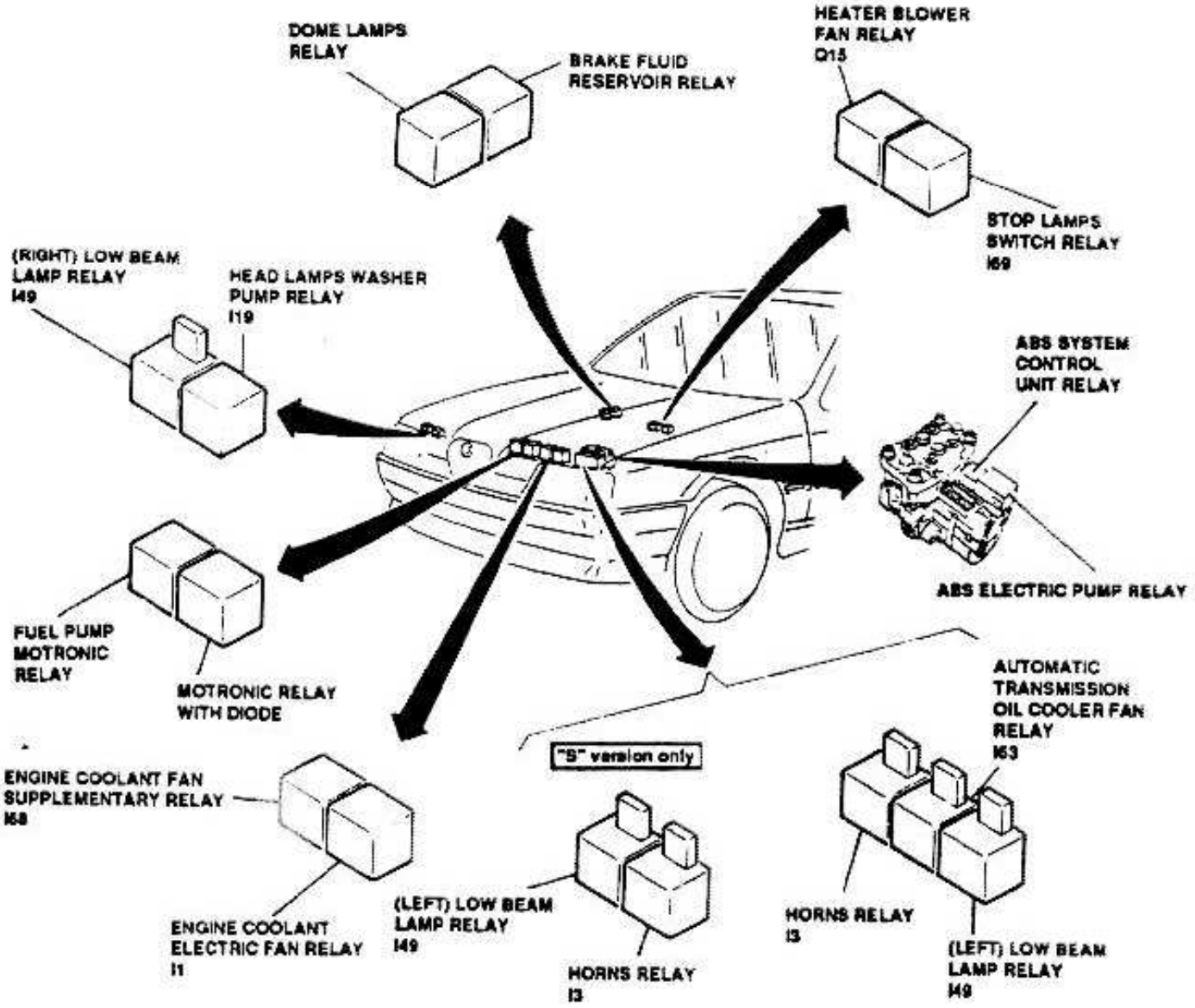
ELECTROMECHANICAL DEVICES AND FLASHER UNITS

LOCATION AND ACCESS WITHIN ENGINE COMPARTMENT

ELECTROMECHANICAL DEVICES TABLE

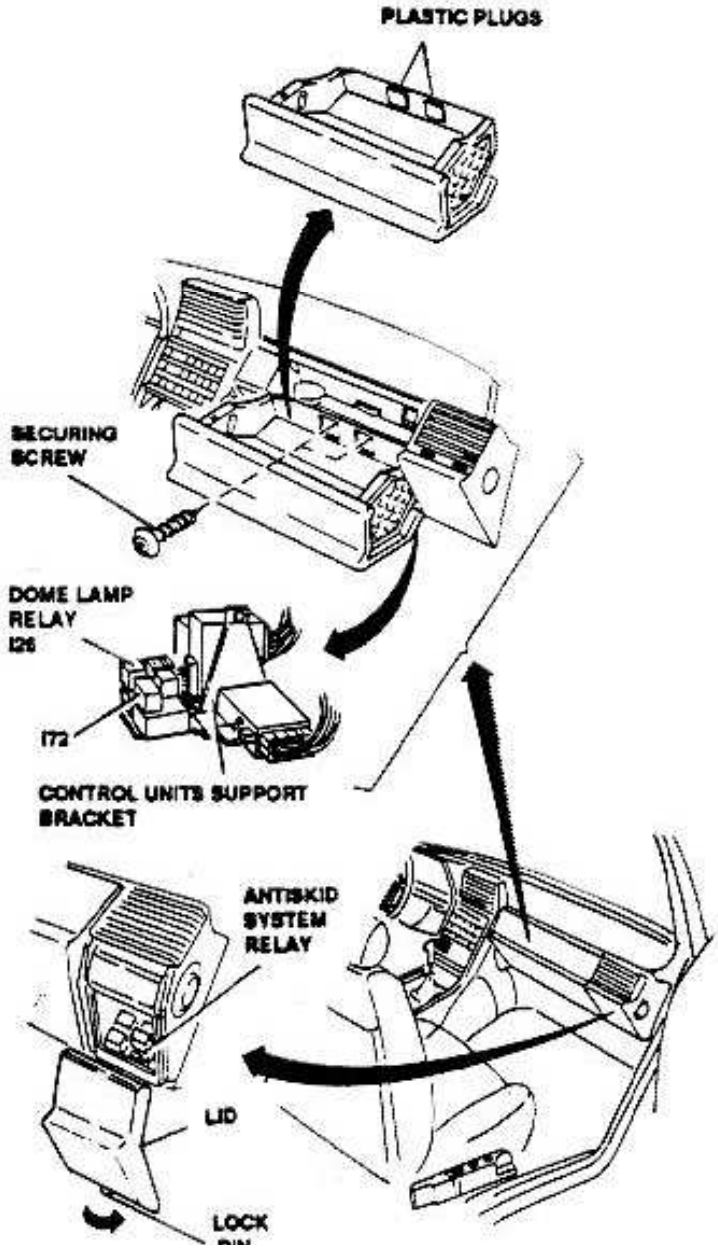
1. Headlamps washer pump relay.
2. (Right) low beam lamp relay.
3. Horns relay.
4. (Left) low beam lamp relay.
5. Automatic transmission oil cooler fan relay.
6. Engine coolant fan relay (50A).
7. Engine coolant fan supplementary relay.
8. Brake fluid reservoir relay.
9. Dome lamps relay.
10. Heater blower fan relay.
11. Stop lamps switch relay.
12. Fuel pump Motronic relay.
13. Motronic relay with diode.
14. ABS system control unit relay.
15. ABS electric pump relay.

NOTE: To gain access to devices illustrated in figure, previously remove protection cover.



LOCATION AND ACCESS WITHIN PASSENGER COMPARTMENT

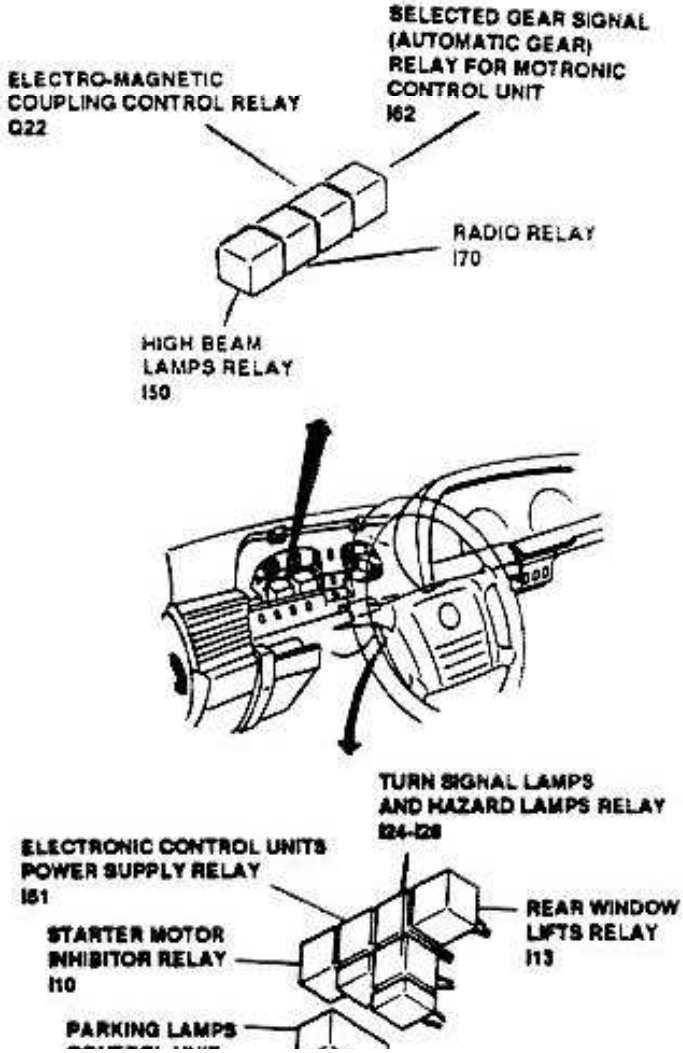
1. Open glovebox.
2. Manually remove plastic plugs at the back of internal bulkhead in order to gain access to control units support bracket securing screws.
3. Loosen both support bracket screws.
4. Manually lower the control units and safety belt buzzer support bracket.
5. Gain access to dome lamp relay.
6. Rotate door locking pin.
7. Remove door.
8. Gain access to antiskid system relay.



ELECTROMECHANICAL DEVICES TABLE

1. Radio relay.
2. Front window lifts relay.
3. Starter motor inhibitor relay.
4. High beam lamps relay.
5. Parking lamps control unit.
6. Selected gear signal (automatic transmission) relay for Motronic control unit.
7. Turn signal lamps relay and hazard lamps relay.
8. Rear window lifts relay.
9. Electro-magnetic coupling control relay.
10. Electronic control units power supply relay.
11. Power window lifts/sun roof relay.
12. Rear power window lifts/sun roof relay.

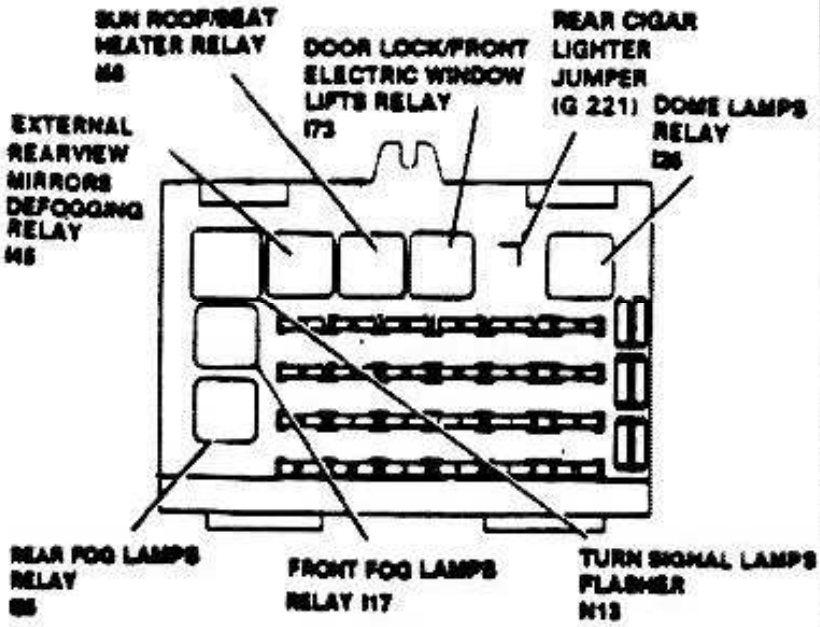
NOTE: To gain access to devices illustrated in figure, remove front mask and remove instrument panel (see Group 43).

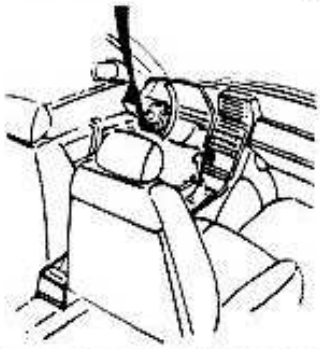


ELECTROMECHANICAL DEVICES TABLE

1. Rear fog lamps relay.
2. Fog lamps relay.
3. Turn signal lamps flasher.
4. Rear power window lifts relay.
5. External rear-view mirrors defogging relay.
6. Sun roof/Seats heater relay.
7. Front electric window lifts relay.
8. Dome lamps relay.

NOTE: To gain access to devices illustrated in figure, open fusebox door.

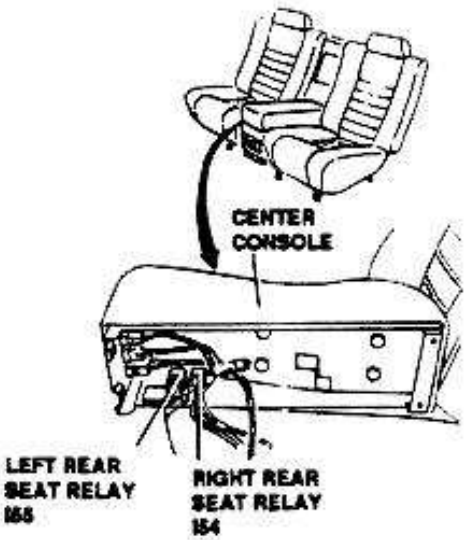




ELECTROMECHANICAL DEVICES TABLE

1. Rear right power seat relay.
2. Rear left power seat relay.

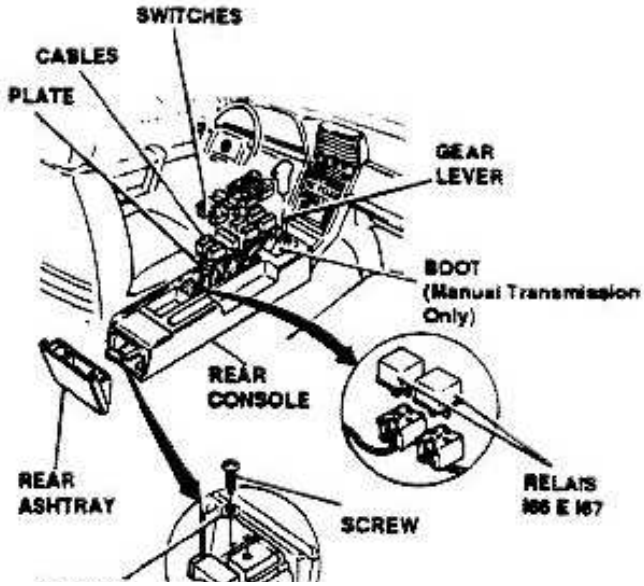
NOTE: To gain access to devices illustrated in figure, remove center console and work



DAY-LIGHT RELAYS (canada version only)

1. Disconnect battery (-) lead.
2. Remove rear ashtray.
3. Remove two screws and washers securing rea console.
4. Withdraw switches.
5. Disconnect cables from switches.
6. Remove plate.
7. Open button of gear shift lever boot (Manual trans mission versions only).
8. Remove gear shift lever knob.
9. Remove rear console.
10. Withdraw the relays from the relevant bases.

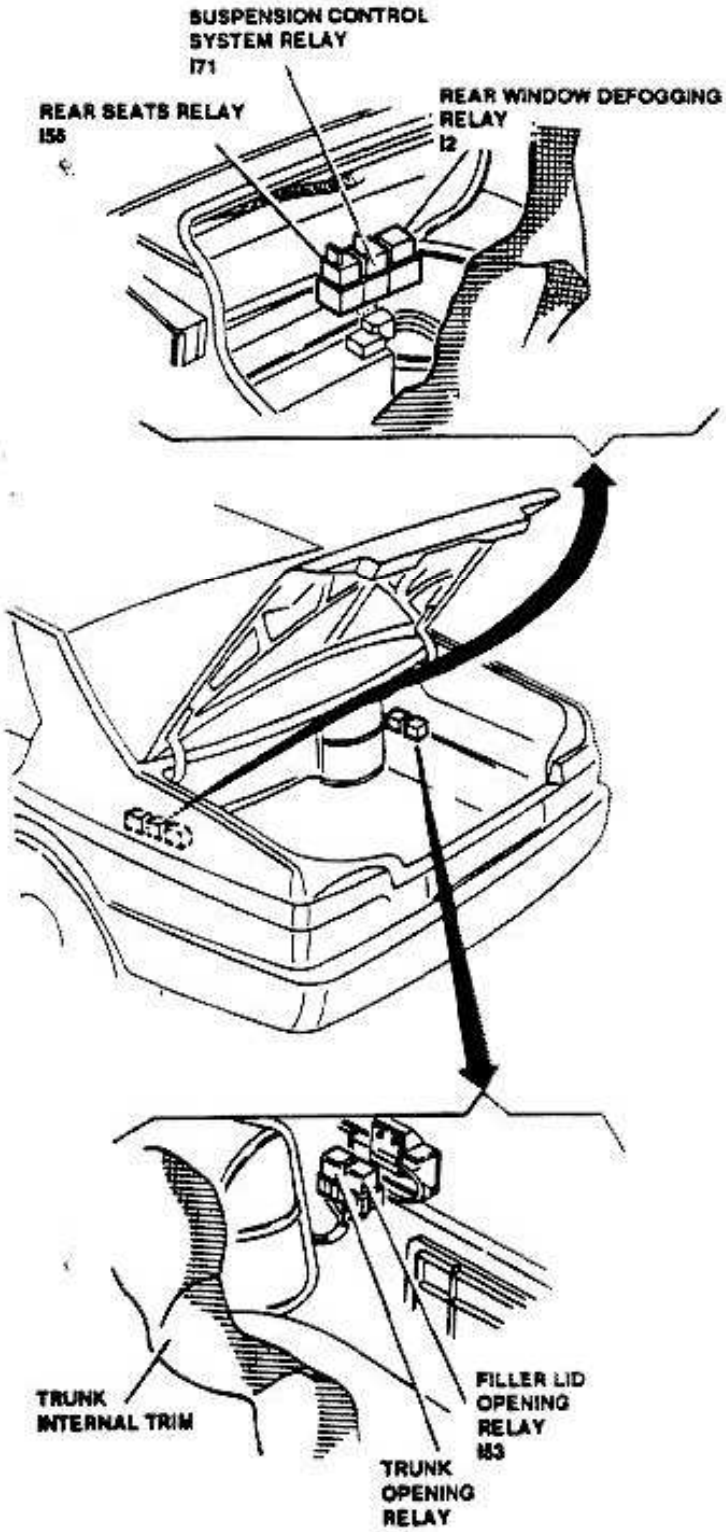
Install by reversing the order of removal.



below it.

4. Rear seats relay.
5. Suspension control system relay.

NOTE: To gain access to devices illustrated in figure, move trunk internal trim (see Group 66).



LIGHTING SYSTEM

The following table lists the various types of bulbs used in the lighting system, the power rating and use to which they are assigned.

Service	Power rating (W)	Type
Back-up lamps	21	B
Rear foglamps	21	B
License plate lamps	5	B
Side markers	3	D
Rear turnsignal lamps	21	B
Rear stop lamps	21	B
Tail lamps	10	B
H3 Foglamps	55	A
Front turnsignal lamps	21	B
Front parking lamps	-	D
H4 High/Low beam head lamps	-	A
Rear cargo lamp	5	C
Center stop lamp	21	B
Center stop lamp ("S" version)	5	C
Fusebox lighting lamp	5	C
Glovebox lamp	5	C
Courtesy mirror lamp	1.2	D
Front dome lights	5	C
Front and rear map lamps	1.2	D
Rear dome lamps	10	C
Door ground illumination lamps	5	C
Door open warning lamp	1.2	D
Front and rear cigar lighter lamps	1.2	D
Instrument panel lighting/warning lamps	1.2	D
Switches	1.2	D

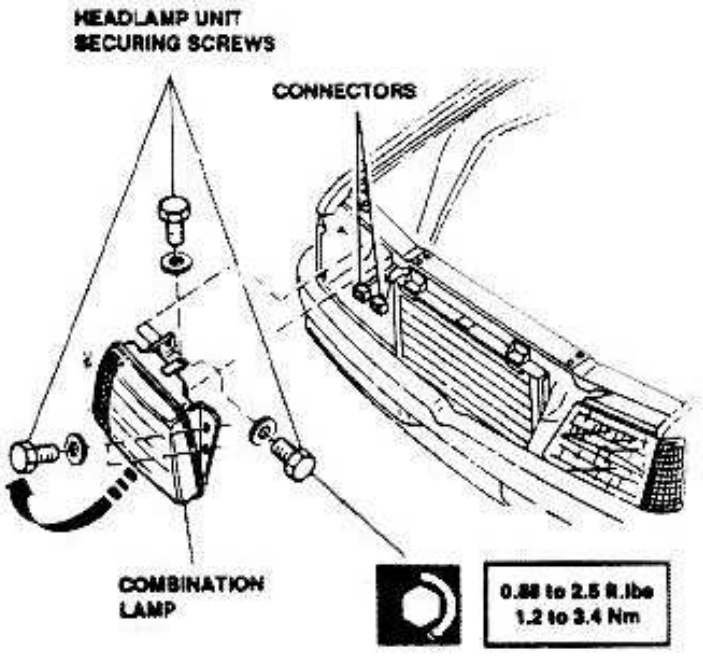
NOTE: When replacing, use bulbs of the same type.

Name	Type		Removal Procedure
Halogen Bulb	A		- Remove connector - Remove retaining spring
Halogen Bulb	A'		- Remove contact double spring - Release from two fixed points
Bayonet Bulb	B		- Push bulb downward inside socket - Turn counter-clockwise
Cylindrical Bulb	C		- Pull bulb outward
All-glass Bulb	D		- Pull bulb outward

FRONT HEAD LAMP

COMBINATION LAMPS REPLACEMENT

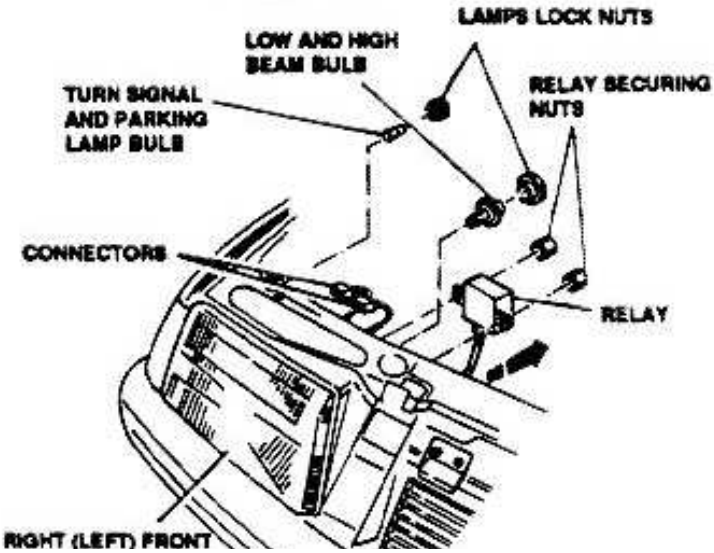
1. Loosen screws securing lamp to car body.
2. Withdraw assembly by rotating it upward.
3. Disconnect connectors.



REPLACEMENT OF PARKING, TURNSIGNAL, LOW AND HIGH BEAM LAMP BULBS

1. Loosen nuts securing relay assembly and remove it from head lamp unit.
2. Disconnect front head lamp unit connectors.
3. Remove bulbs locks.
4. Remove bulbs.

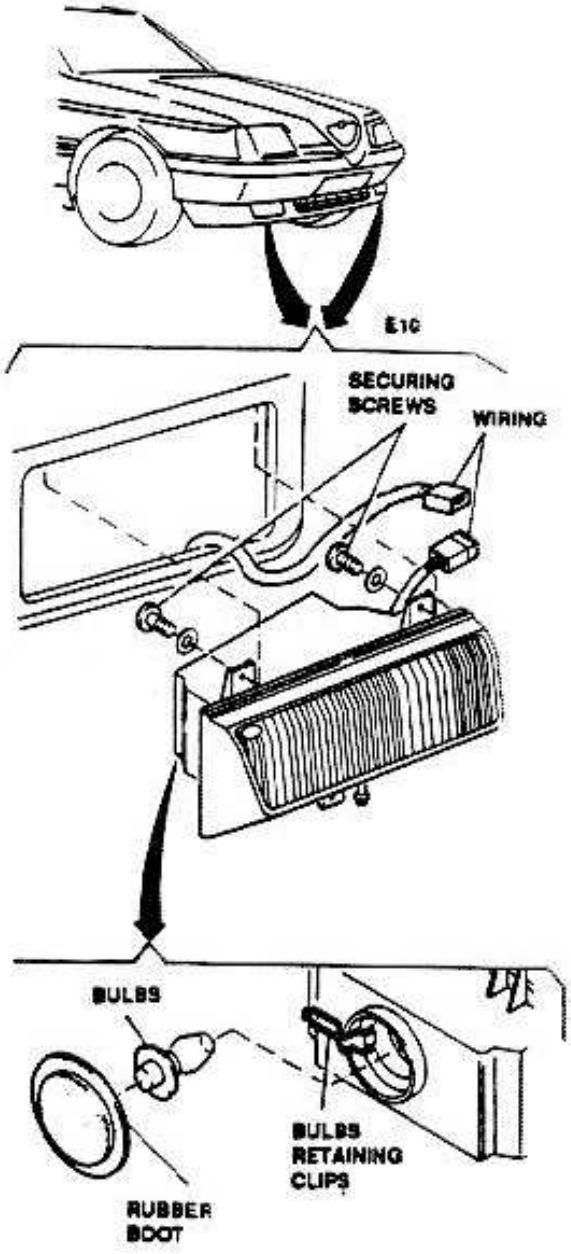
NOTE: **The low and high beam lamp bulbs are of the halogen type. NEVER TOUCH BULB GLASS WITH BARE FINGERS OR WITH OBJECTS THAT CAN LEAVE FOREIGN MATTERS ON IT.**



REPLACEMENT OF FOG LAMPS

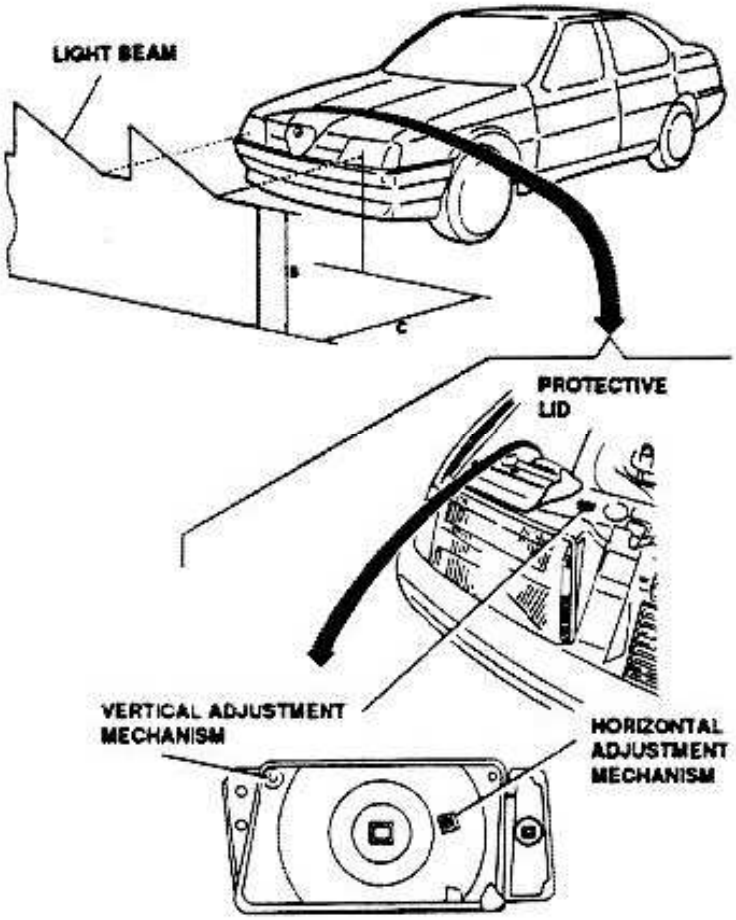
NOTE: To remove fog lamps assembly it is advisable to place vehicle on an auto lift.

1. Lift vehicle.
2. Disconnect wiring.
3. Loosen three screws securing fog lamps and withdraw them.
4. Manually remove rubber boot.
5. Manually disengage retaining clip of affected bulb and remove it.



HEAD LAMPS LOW BEAM ADJUSTMENT

1. Place vehicle on a level at distance "C" of 10 meters (32.81 ft) from a clear vertical surface.
2. Switch on low beam lamps and check that height "B" of beam is 500 mm (19.68 in).
   If this condition is not met, adjust as follows:
3. Lift the lamp unit protective lid.
4. Work on adjustment mechanism till the correct adjustment is obtained.

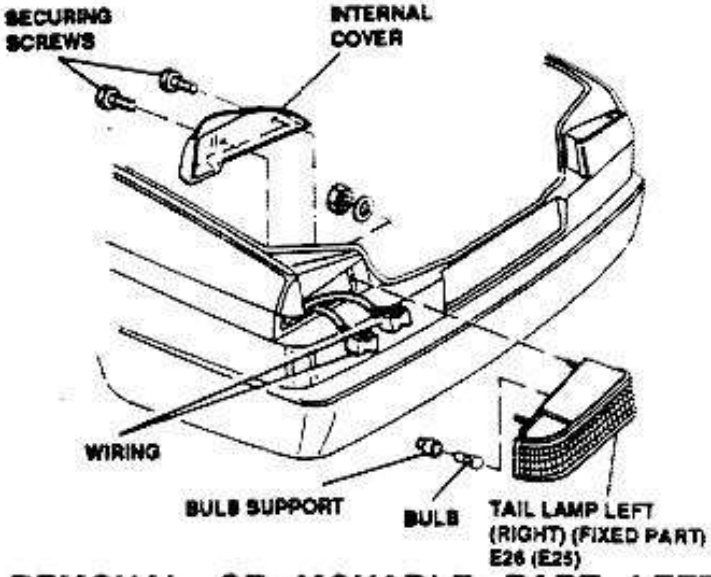


TAIL LAMP UNITS

REMOVAL OF FIXED PART

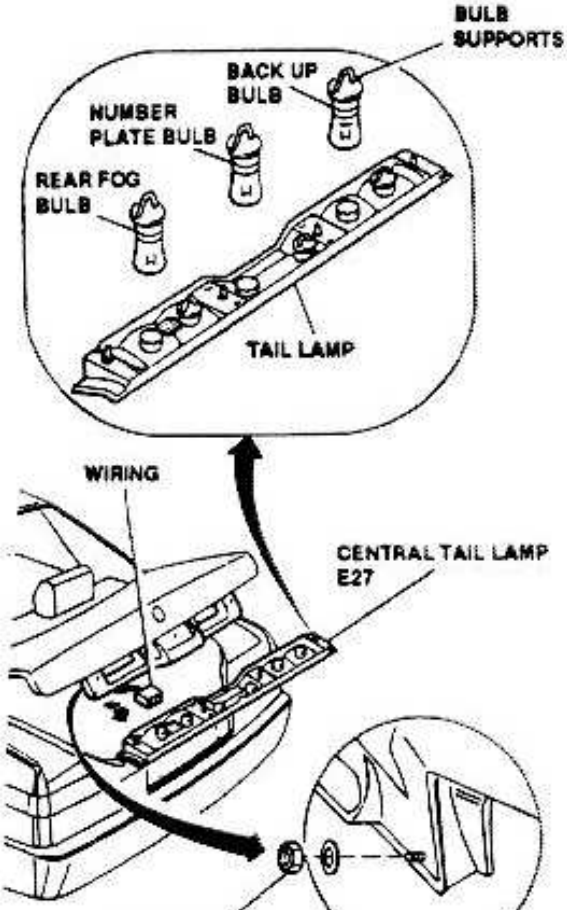
1. Loosen securing screws and remove lamp unit internal cover.
2. Loosen and remove lamp securing nuts.
3. Disconnect cables.
4. Withdraw tail lamp unit.
5. Withdraw bulb support.

6. Replace bulb.



REMOVAL OF MOVABLE PART LEFT (RIGHT)

1. Loosen four nuts securing tail lamp unit.
2. Manually remove lamp unit and disconnect wiring.
3. Withdraw bulbs support.
4. Remove bulbs.

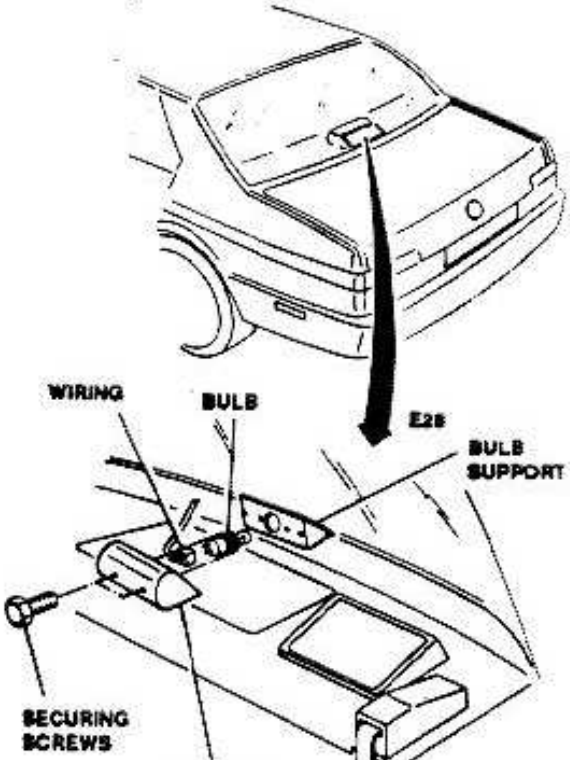


CENTER STOP LAMP REMOVAL

1. Loosen the fixing screws and remove the protection cap from the lamp-holder support of the 3rd stop lamp.
2. Considerably slacken (without removing) the two screws fixing the lamp-holder to the red transparent, in order to completely release the gasket from the load.
3. Carefully withdraw the lamp complete support, with its electric cables from the guide secured to the rear window glass
4. Remove the bulb.

CENTER STOP LAMP INSTALLATION

1. Position the lamp and insert in the guide the assy comprised of lamp-holder support, red transparent (with loosened screws) pay attention to the correct position of the gasket.
2. Tighten the two screws fixing the support to the transparent.
3. Install the protection cover and secure it to the support by means of the relevant screws.
4. Check the 3rd stop lamp lighting up by acting on the brake pedal.

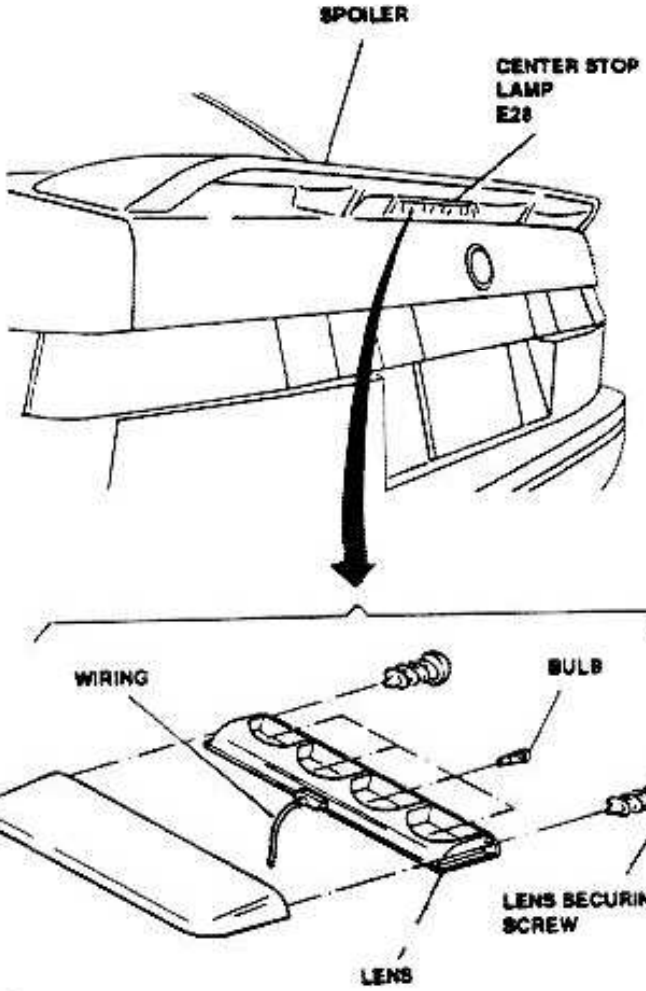


CENTER STOP LAMP REMOVAL ("S" VERSION)

NOTE: To remove 3rd stop lamp, remove first spoiler on trunk lead (see Group 75).

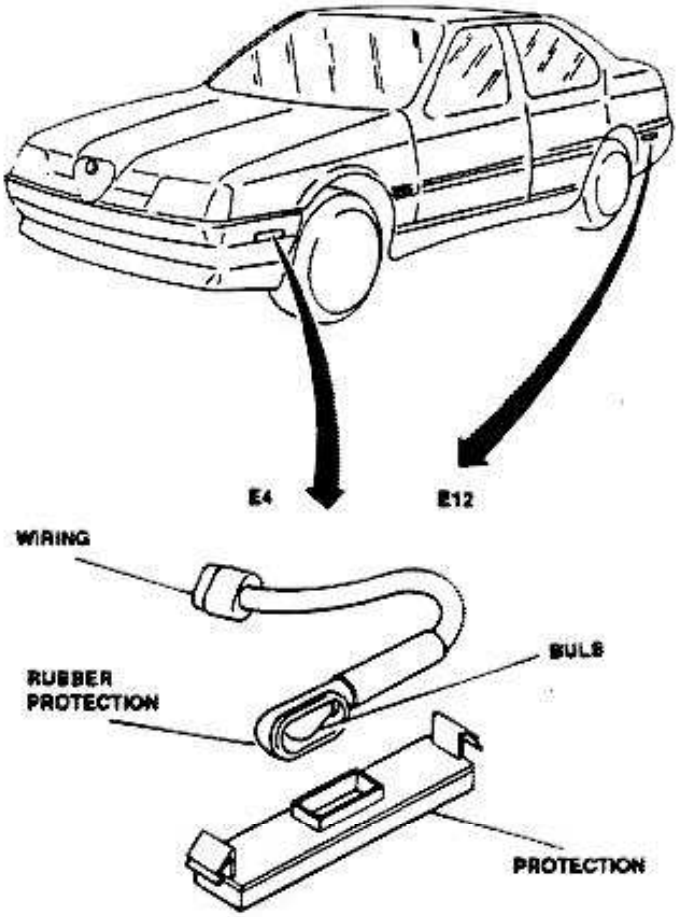
1. Loosen two screws securing lamp and remove it.
2. Loosen two screws securing lens to lamp.
3. Remove lens to gain access to bulbs.
4. Manually withdraw bulb.

Install by reversing the order of removal.



SIDE MARKER LAMPS REPLACEMENT

1. Remove side marker (grooved).
2. Disconnect cables.
3. Withdraw bulb from support by withdrawing rubber protection from cap.
4. Withdraw bulb.



DOORS LAMPS

NOTE: To remove door lamps bulbs it is advisable to place vehicle on an auto lift.

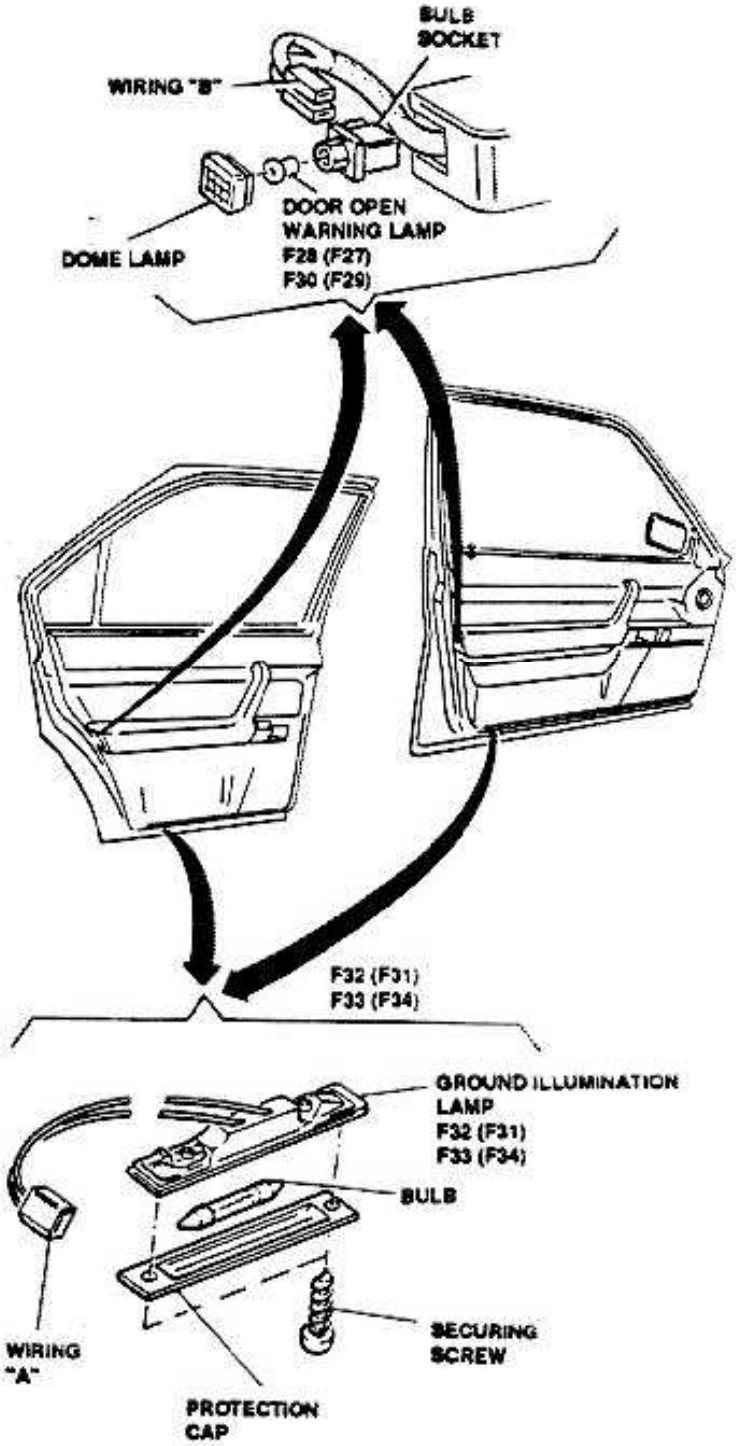
Ground illumination lamps:

1. Loosen two screw securing protection cap and lamp to door support.
2. Withdraw lamp.
3. Disconnect wiring (A).
4. Separate protection cap from lamp support.
5. Withdraw lamp

Door open warning lamps

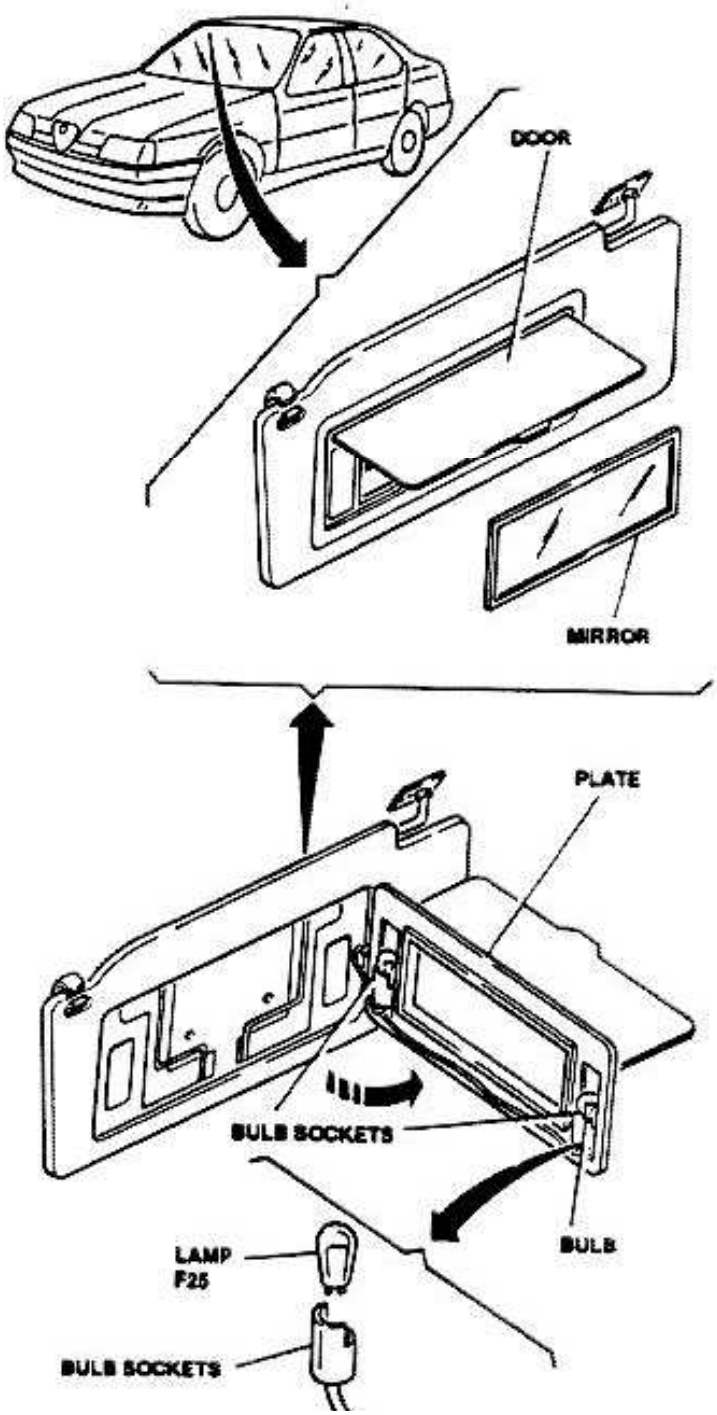
1. Manually withdraw lamp.

2. Disconnect wiring (B).
3. Manually withdraw lamp support.
4. Withdraw lamp.



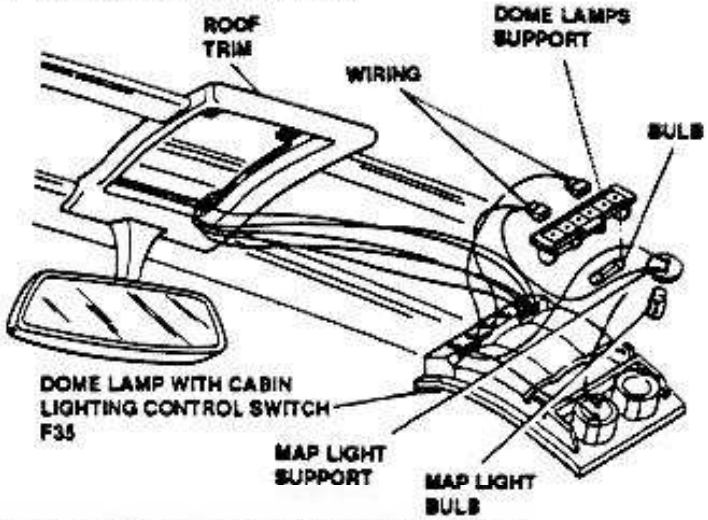
COURTESY MIRROR ILLUMINATION LAMP

1. Move lid toward right to gain access to mirror.
2. Manually withdraw mirror, maintaining lamp support close to lid.
3. Carefully rotate plate clockwise to avoid any damage to switch cable.
4. Withdraw lamp support from the plate.
5. Withdraw affected bulb.



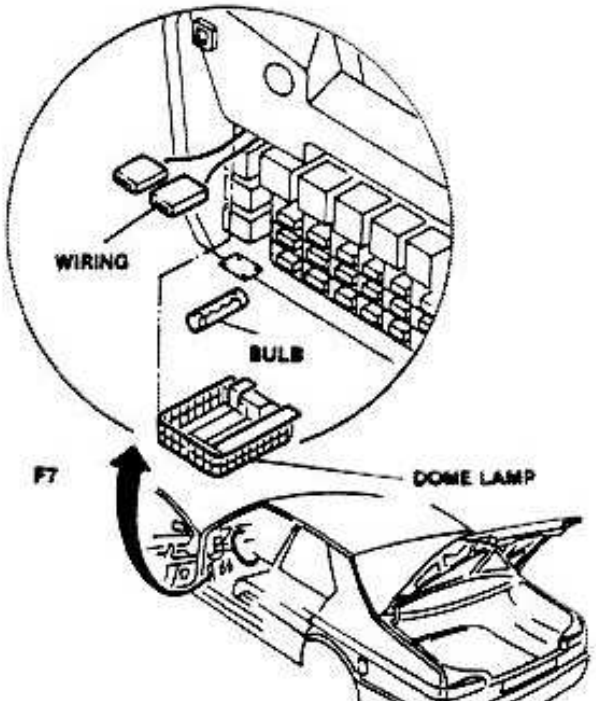
DOME LAMP WITH CABIN LIGHTING CONTROL SWITCH

1. Manually withdraw dome lamp assembly from roof trim.
2. Disconnect wiring.
3. Manually remove dome lamp support.
4. Rotate and lift map lamp support.
5. Withdraw affected bulbs.



FUSEBOX ILLUMINATION LAMP

1. Manually withdraw lamp.
2. Disconnect wiring.
3. Remove lamp.



GLOVEBOX AND SWITCH ILLUMINATION LAMP

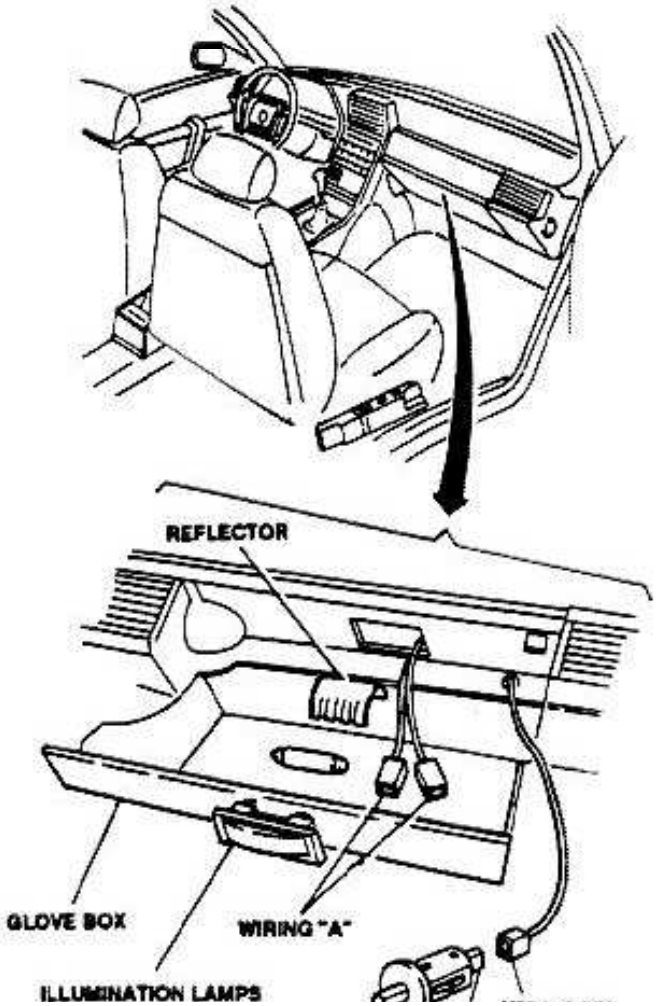
Glovebox illumination lamp

1. Manually open glovebox.
2. Manually withdraw lamp.
3. Disconnect wiring (A).
4. Manually withdraw reflector.
5. Withdraw lamp.

Glovebox illumination switch

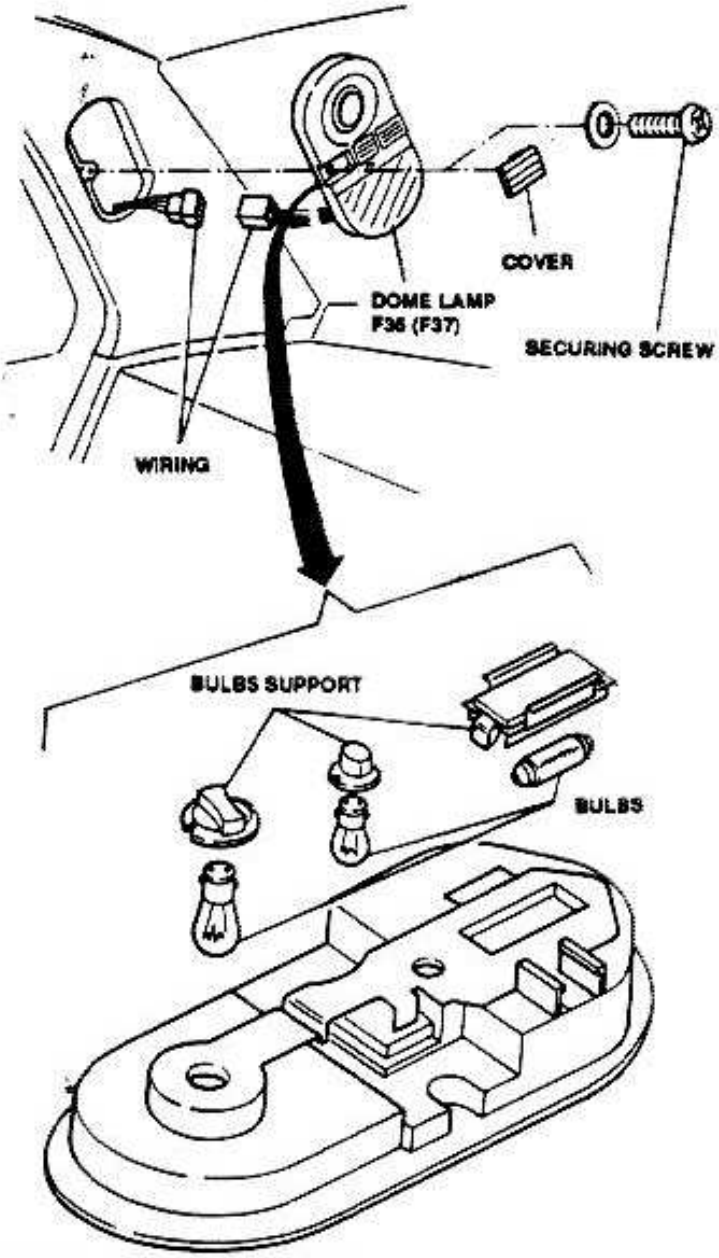
NOTE: To gain access to glovebox illumination switch, remove control unit support bracket.

6. Working from below instrument panel, push switch toward box interior.
7. Disconnect wiring and remove switch.



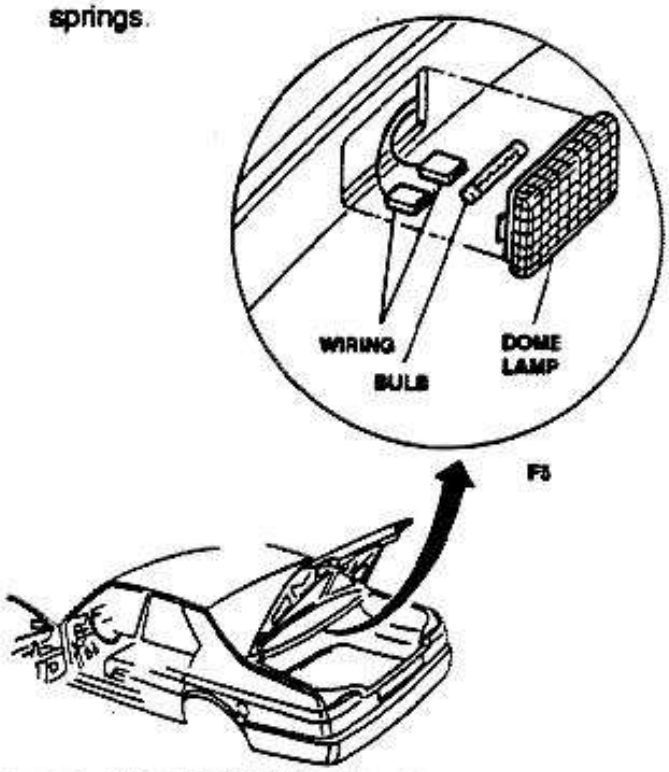
DOME LAMPS, CONTROL SWITCH ON REAR POST

1. Remove cover
2. Loosen screw securing lamp.
3. Withdraw lamp.
4. Disconnect wiring.
5. Manually withdraw support of affected lamp.
6. Remove affected lamp.



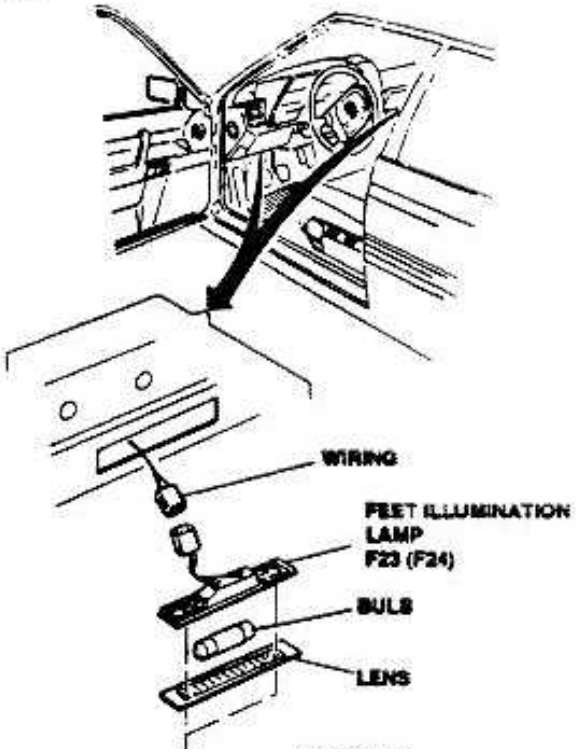
REAR CARGO LAMP

1. Push on lamp retaining tongue or working through the opening.
2. Manually clear lamp and withdraw it.
3. Replace bulb inserted between two retaining springs.



FEET ILLUMINATION LAMP, INTERIOR SIDE

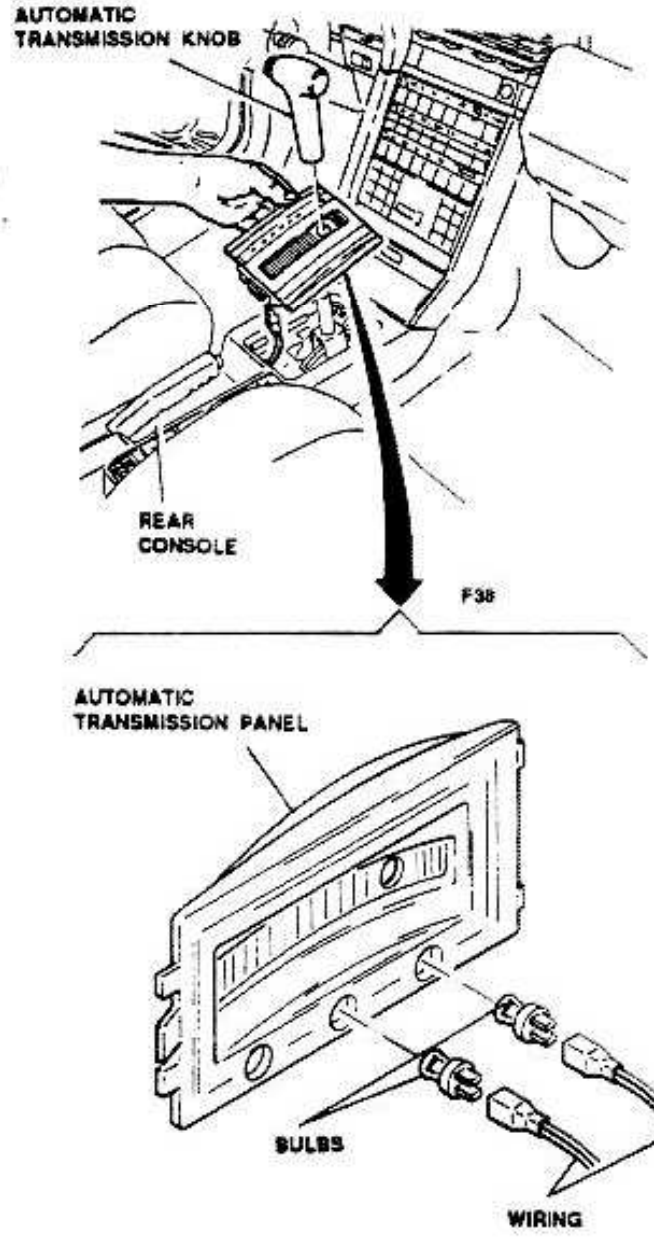
1. Loosen two screw securing lens and remove it.
2. Remove bulb inserted between two retaining springs.



AUTOMATIC TRANSMISSION SELECTOR ILLUMINATION LAMP

NOTE: To gain access to the two illumination lamps, remove first rear console (see Group 66).

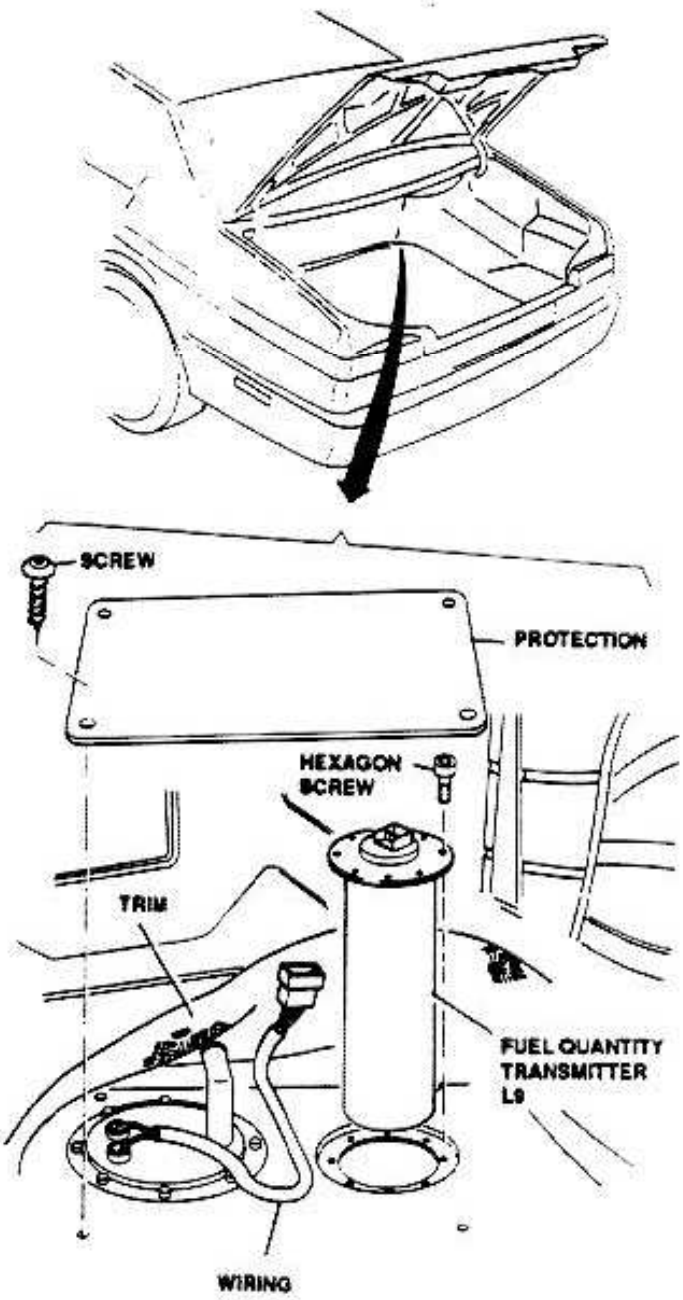
1. Move backward rear console.
2. Remove automatic transmission selector lever knob.
3. Lift automatic transmission panel.
4. Manually withdraw affected lamp pressure installed on the panel.
5. Disconnect wiring and replace bulb.



SENSORS AND TRANSMITTERS, WINDSHIELD WASHER AND WIPER, ELECTRICAL COMPONENTS

FUEL QUANTITY TRANSMITTER

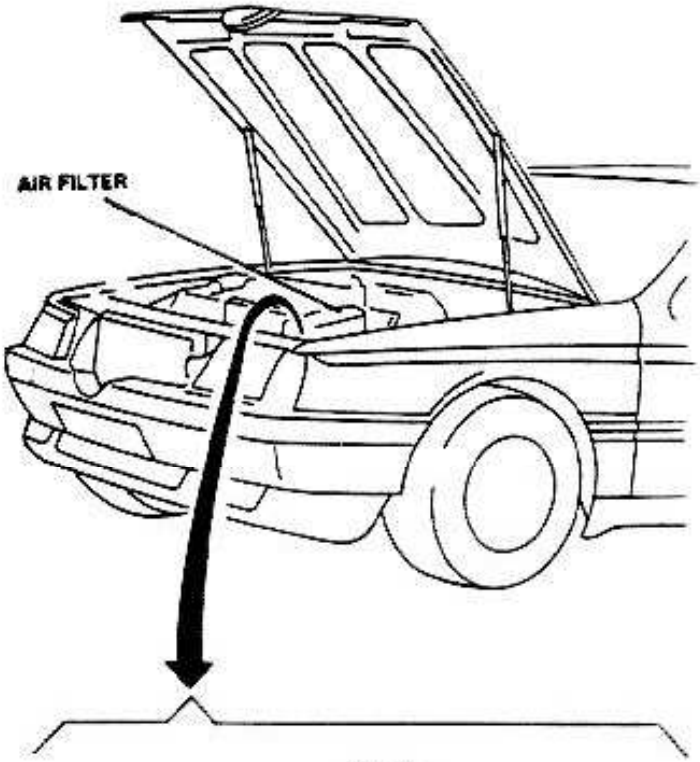
1. Manually remove trunk trim.
2. Remove protection cover, by loosening four screws.
3. Disconnect wiring
4. Loosen right exagon screws securing fuel quantity transmitter.
5. Withdraw transmitter from fuel tank.

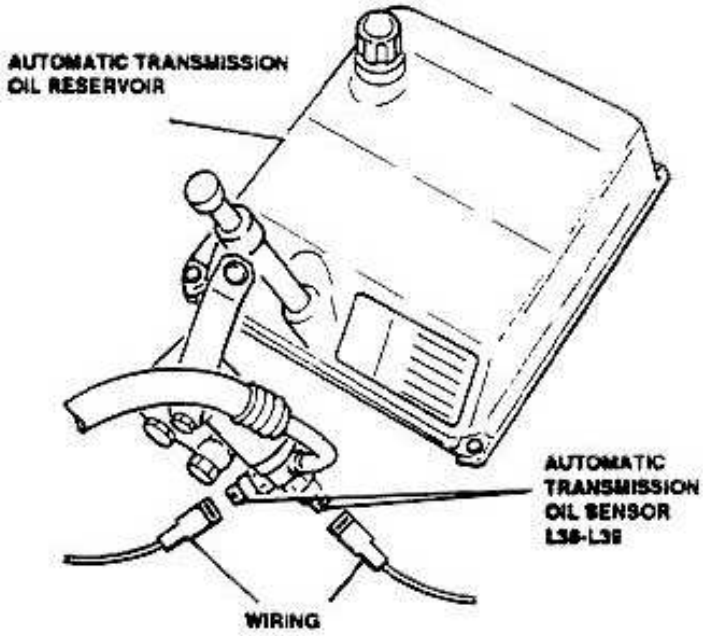


AUTOMATIC TRANSMISSION OIL TEMPERATURE SENSOR

NOTE: To gain access to sensor, first remove air cleaner and related support (see Group 04).

1. Disconnect wiring
2. Using a suitable wrench, loosen and remove affected sensor.





FRONT DOOR SENSORS

**NOTE: Sensors are installed inside door lock, together with door locking motors.
To replace them it is necessary to replace the complete door lock assembly (refer to : "FRONT DOORS LOCK").**

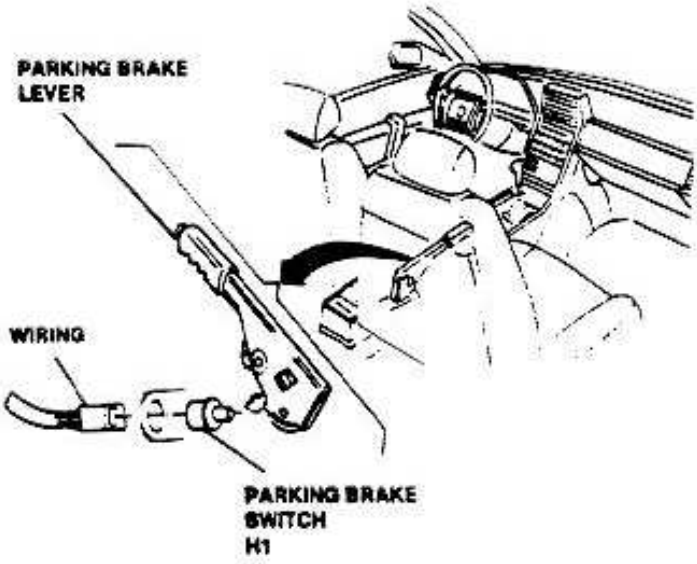
REAR DOOR SENSORS

**NOTE: Sensors are installed inside door lock, together with door locking motors.
To replace them it is necessary to replace the complete door lock assembly (refer to: "REAR DOORS LOCK").**

PARKING BRAKE SWITCH

1. Remove rear console.
2. Manually lift parking brake lever.
3. Disconnect wiring.
4. Manually withdraw switch.

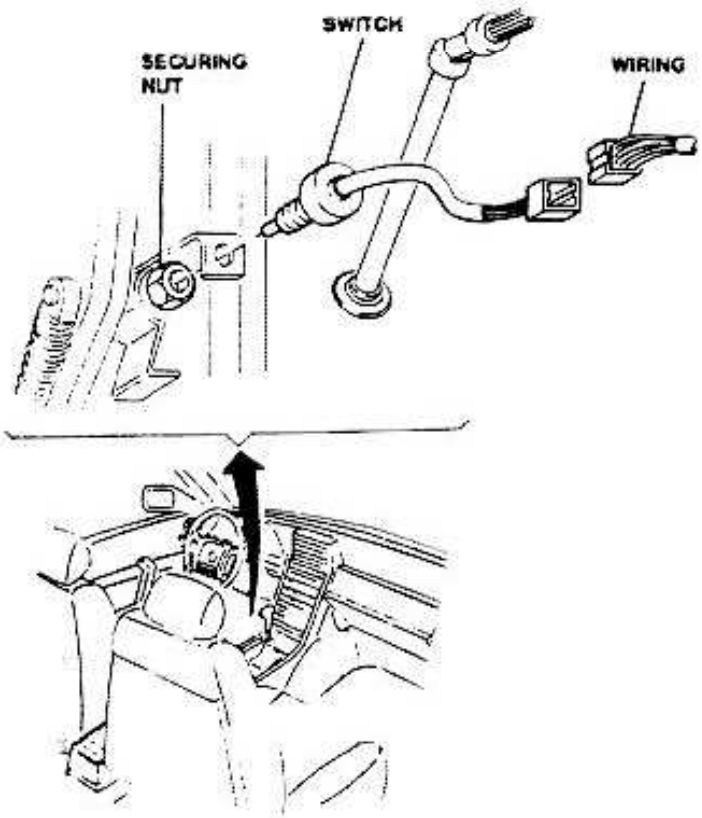
Install by reversing the order of removal.



STOP LAMPS SWITCH

NOTE: To find switch position refer to: "CONTROL SWITCHES - BRAKE SWITCH FOR CRUISE CONTROL (AUTOMATIC TRANSMISSION) AND STOP LAMPS SWITCH", & "CONTROL SWITCHES - CLUTCH BRAKE SWITCH FOR CRUISE CONTROL (MANUAL TRANSMISSION VERSION) AND STOP LAMPS SWITCH".

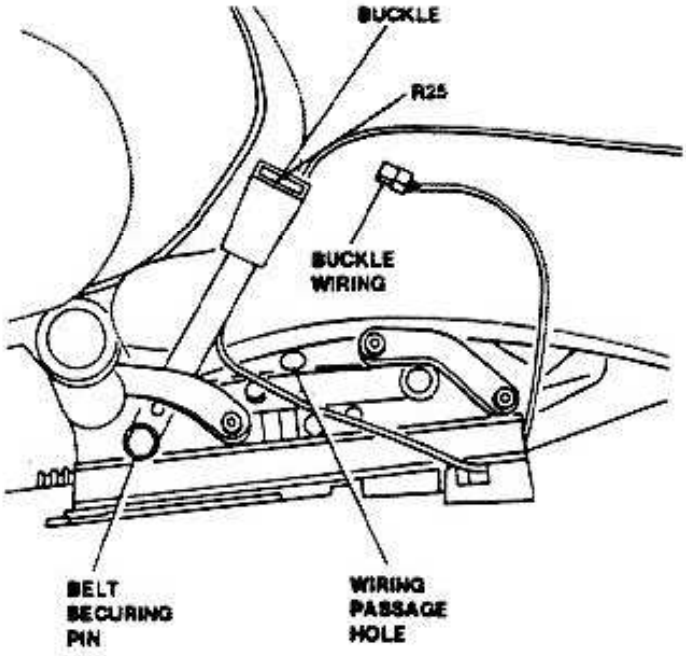
1. Disconnect wiring.
2. Loosen nut securing switch
3. Loosen and manually withdraw switch.



SAFETY BELT FASTENED SWITCH

NOTE: Switch is installed inside the buckle. To replace sensor it is necessary to replace the whole buckle.

1. Disconnect seat and buckle wirings.
2. Remove seat from vehicle (see Group 66).
3. Loosen and remove buckle securing pin.
4. Withdraw buckle from guide allowing wiring to slide through the appropriate hole.



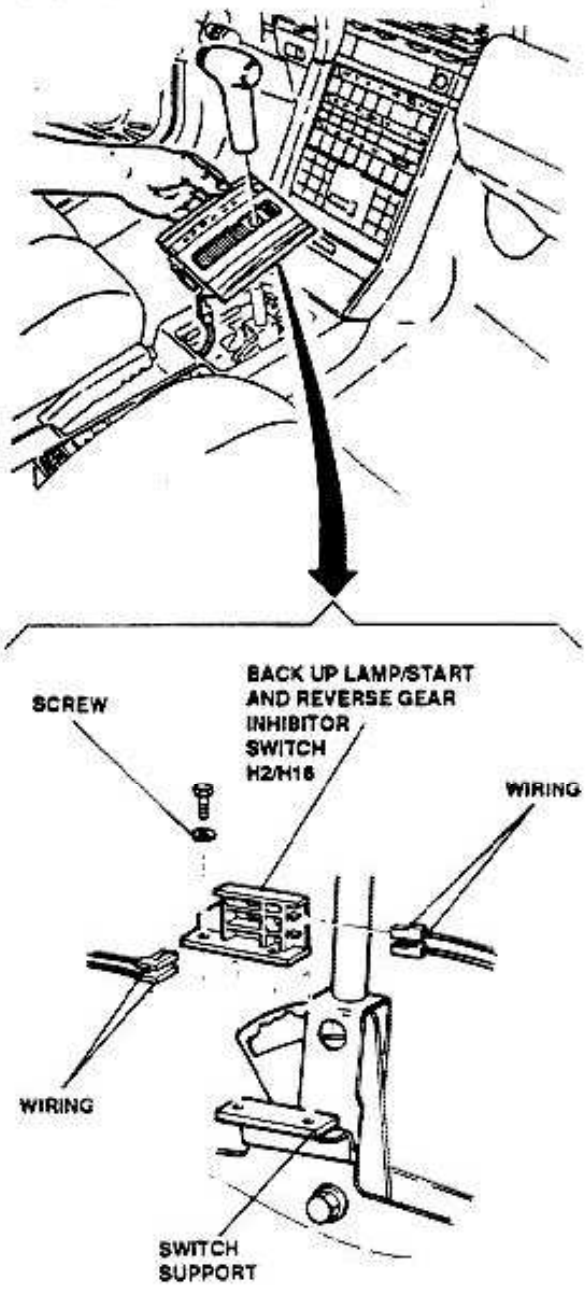
BACK-UP LAMP/START AND REVERSE GEAR INHIBITOR SWITCH (automatic transmission version)

NOTE: To gain access to switch, first remove gear lever knob move backward rear console (see Group 66) and remove gear selector panel.

1. Loosen and remove screws securing switch support.

2. Disconnect wiring.

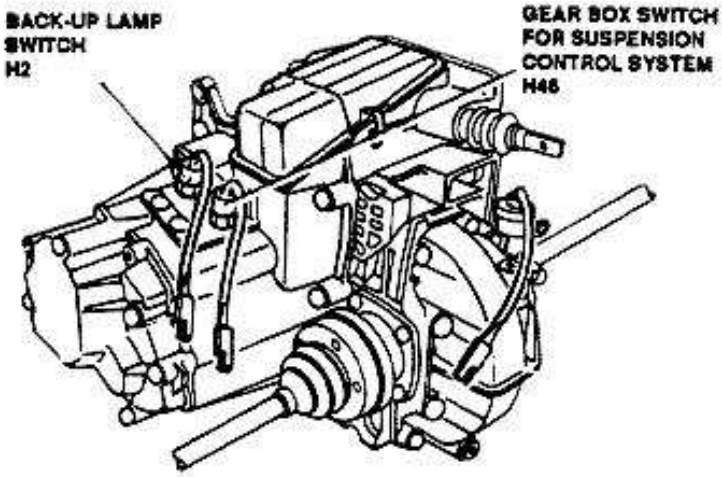
3. Remove back up lamp/start and reverse gear inhibitor switch.



BACK-UP LAMPS (manual transmission version) AND GEARBOX SWITCH FOR SUSPENSION CONTROL SYSTEM ("S" version)

NOTE: To gain access to switch, first remove air filter (refer to Group 04).

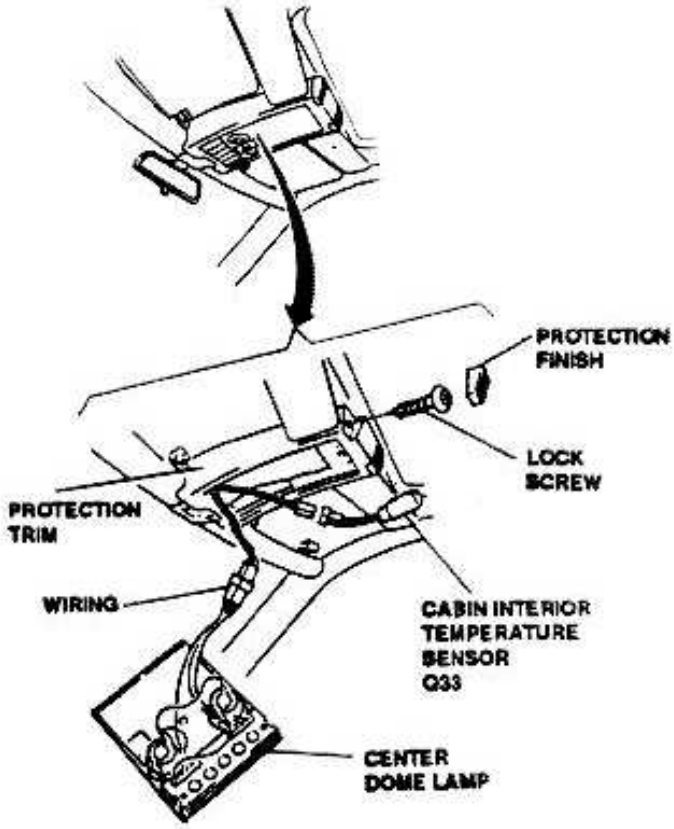
1. Disconnect wiring.
2. Remove switch.



CABIN INTERIOR TEMPERATURE, OUTSIDE AIR TEMPERATURE AND MIXED AIR TEMPERATURE SENSOR

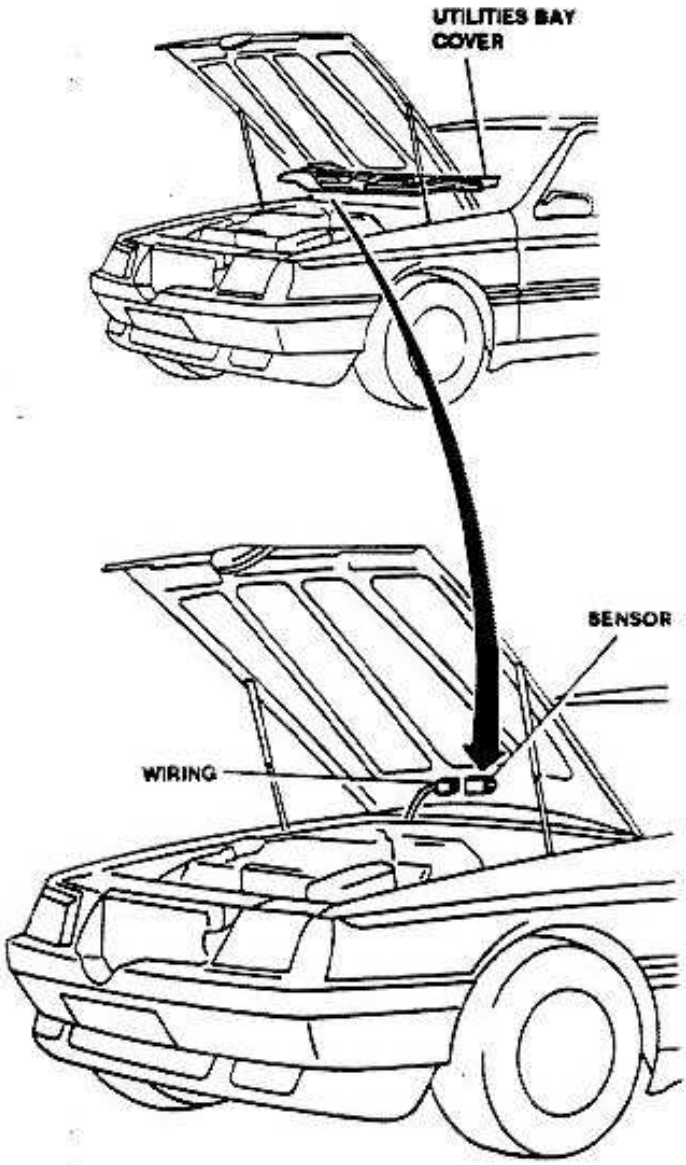
Cabin interior temperature sensor

1. Manually remove protection finish, of center dome lamp, which protects sensor lock screw.
2. Loosen sensor lock screw.
3. Remove dome lamp, pressure installed, to gain access to sensor wiring.
4. Disconnect sensor wiring and remove it.



Outside air temperature sensor

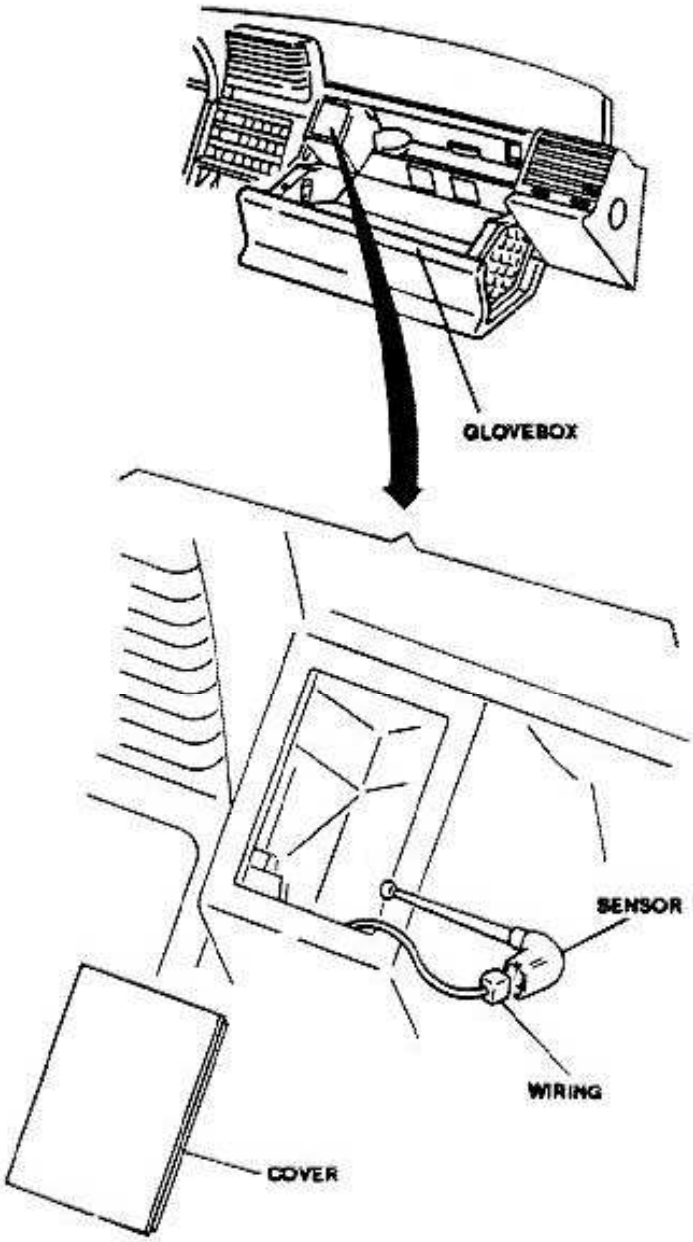
5. Working in the engine compartment upon removal of services bay cover, manually disconnect sensor wiring.
6. Loosen two nuts securing sensor.
7. Remove sensor.



Mixed air temperature sensor

8. Open glovebox.
9. Manually open pance on left side of glovebox.
10. Manually remove sensor, pressure installed, working with a screwdriver.
11. Disconnect wiring.

Install by reversing the order of removal.



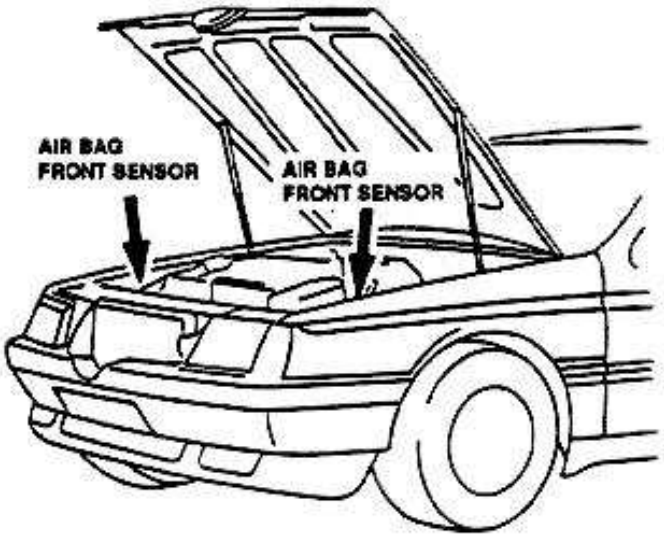
AIR BAG FRONT SENSORS

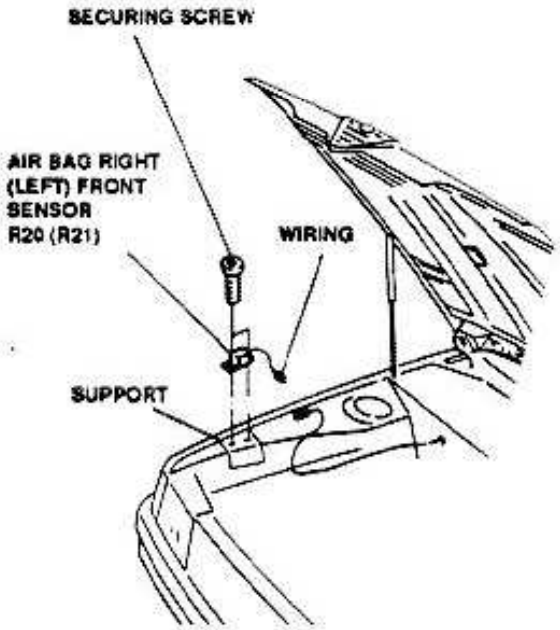
1. Disconnect wiring.
2. Loosen two screws securing affected sensor.
3. Withdraw sensor from support.

NOTE: Install by reversing the order of removal, ensuring that arrow labelled "FORWARDS"

12. Remove sensor.

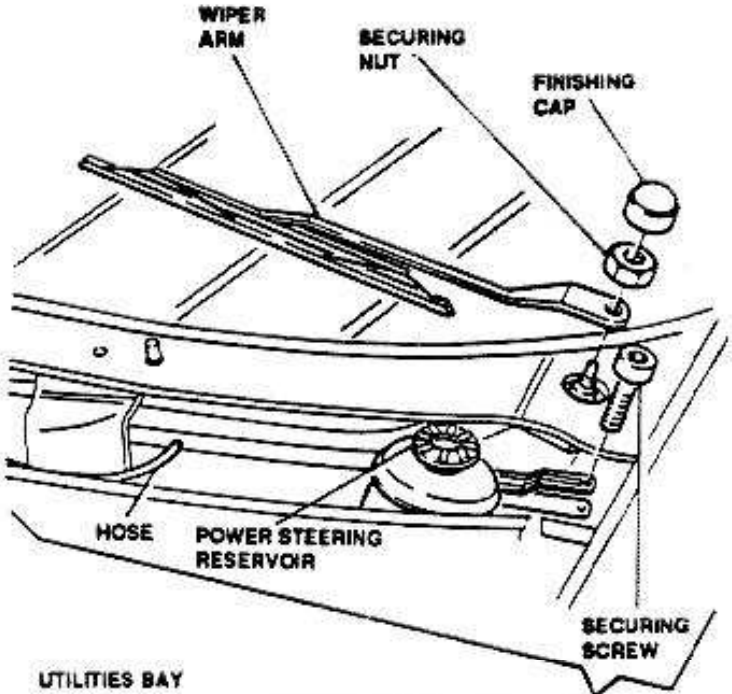
points toward vehicle front end.

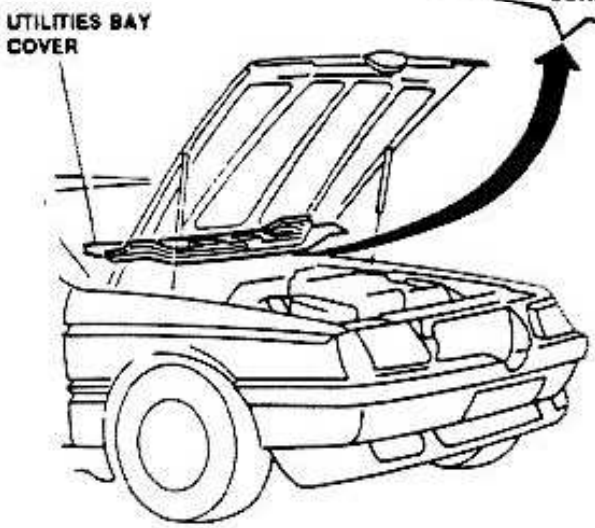




WINDSHIELD WIPER ASSEMBLY

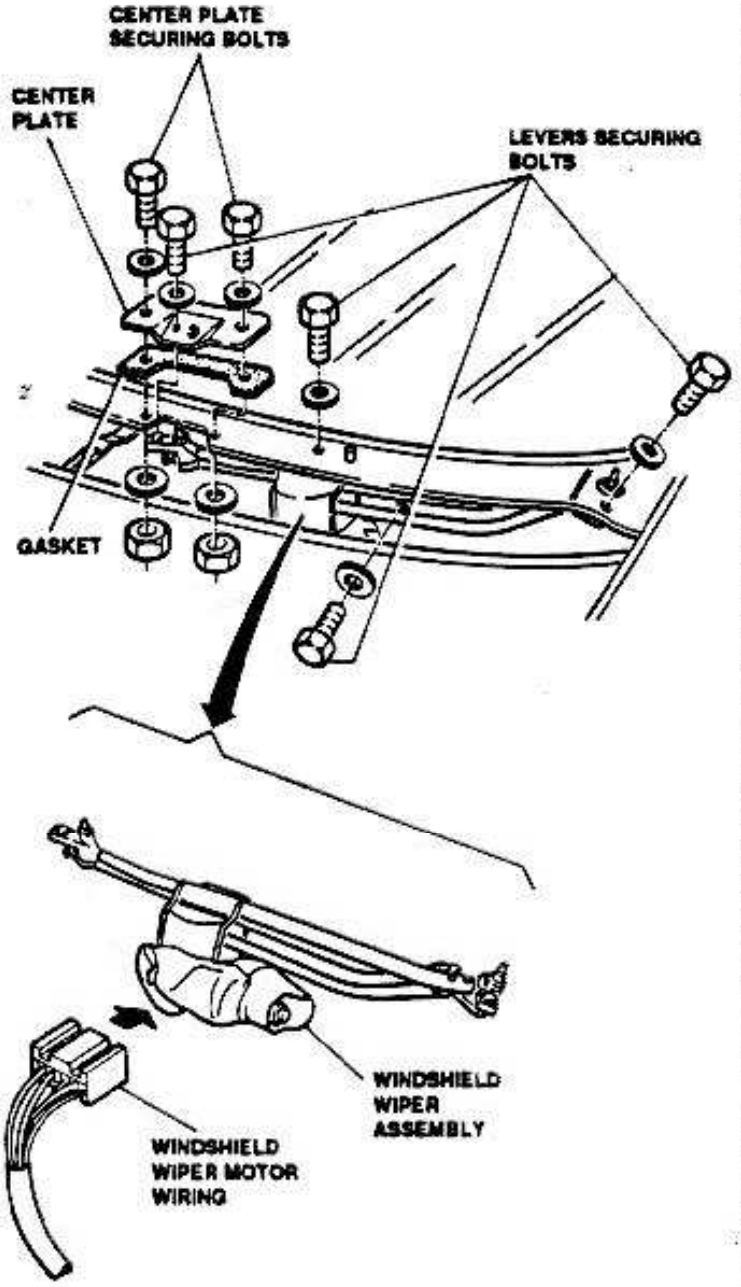
1. Remove utilities bay cover.
2. Manually remove finishing caps.
3. Loosen nuts securing wiper arms and remove them.
4. Manually disconnect hose for left windshield washer.
5. Loosen two screw securing power steering fluid reservoir as necessary to remove it from car body.





6. Loosen four bolts securing windshield wiper arms.
7. Loosen two screws securing center plate.
8. Remove center plate and related gasket.
9. Disconnect motor wiring.
10. Remove windshield wiper assembly.

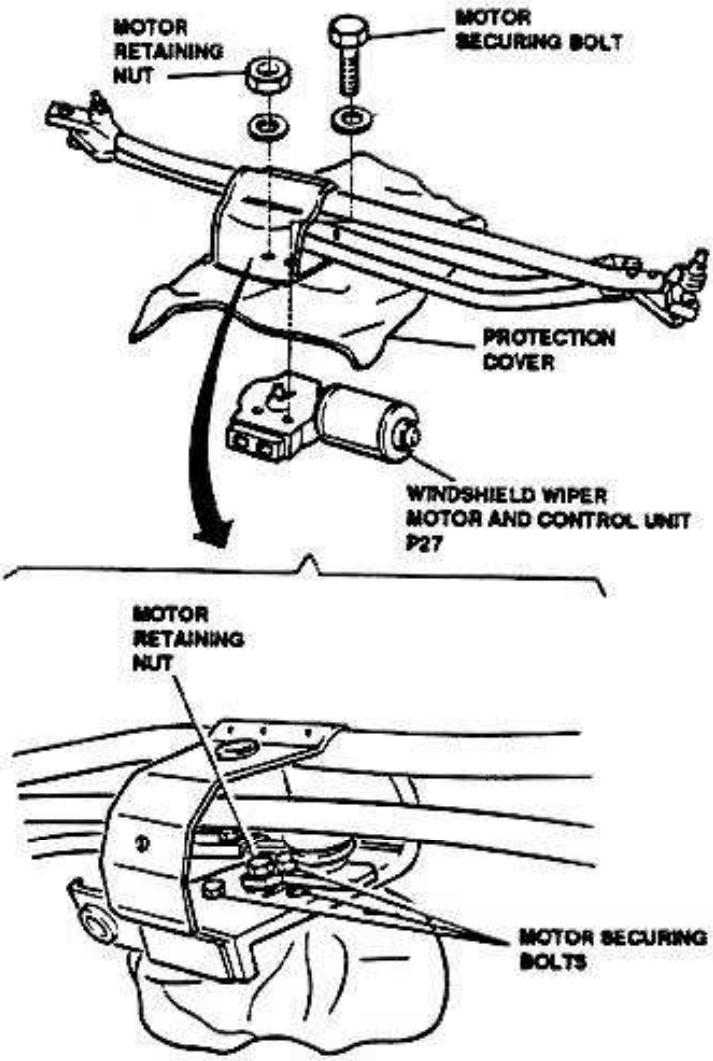
Install by reversing the order of removal.



WINDSHIELD WIPER MOTOR

NOTE: In order to remove windshield wiper motors, first remove windshield wiper assembly as indicated in the previous paragraph.

1. Open protection cover.
2. Loosen motor retaining nut.
3. Loosen three bolts securing motor.
4. Remove motor.



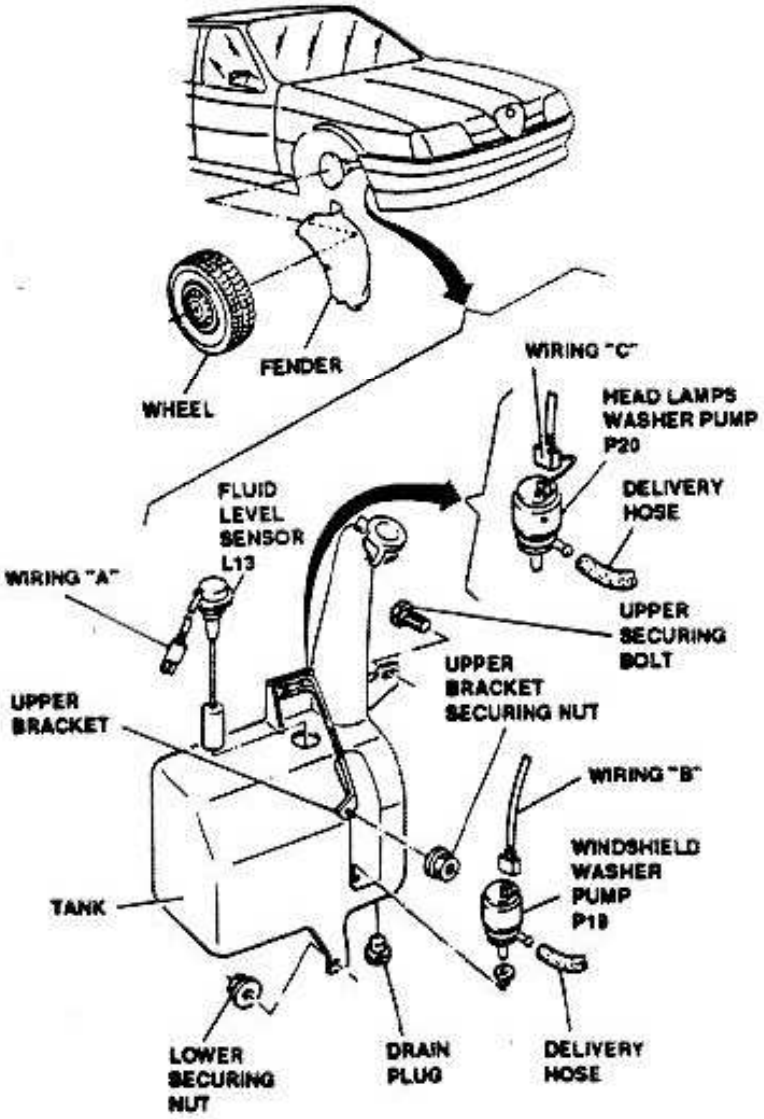
WINDSHIELD WASHER FLUID TANK, PUMP AND HEADLAMPS WASHER FLUID LEVEL SENSOR AND PUMP

1. Place vehicle on auto.
2. Remove front right wheel and fender.
3. Manually remove drain plug and drain fluid, if any, from tank.
4. Disconnect level sensor wiring (A) and wiring of windshield washer pump (B) and of head lamps washer pump (C) located behind the tank.
5. Disconnect delivery hose from windshield washer and head lamp washer pumps.
6. Working from engine compartment, loosen nut securing upper retaining bracket.
7. Working from fender opening, loosen nut securing

lower retaining bracket and loosen upper retaining bolt.

8. Remove windshield washer fluid tank.
9. If needed, manually remove windshield washer pump (pressure inserted).
10. If needed, manually remove fluid level sensor (pressure inserted).
11. If needed, manually remove headlamps washer pump (pressure inserted).

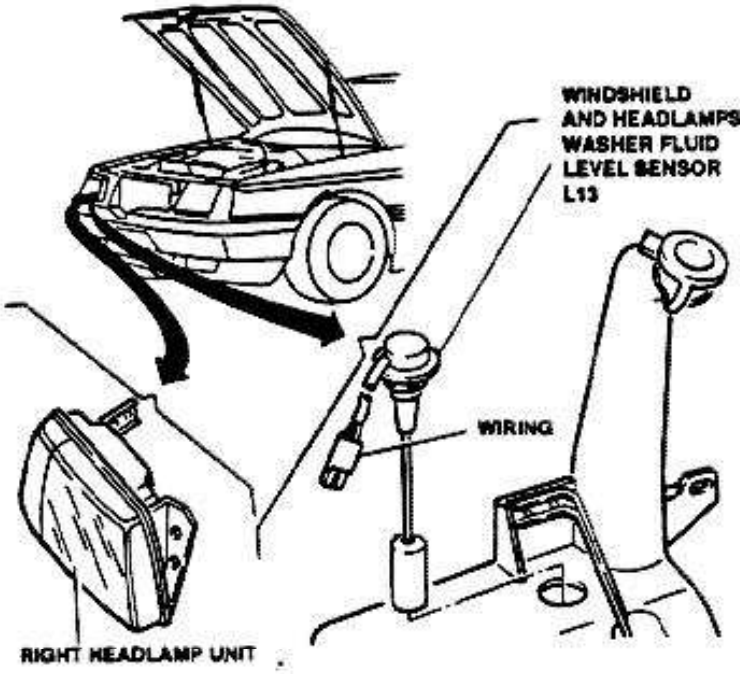
Install by reversing the order of removal.



WINDSHIELD AND HEADLAMPS WASHER FLUID LEVEL SENSOR

NOTE: The fluid level sensor may be removed without removing fluid tank as previously

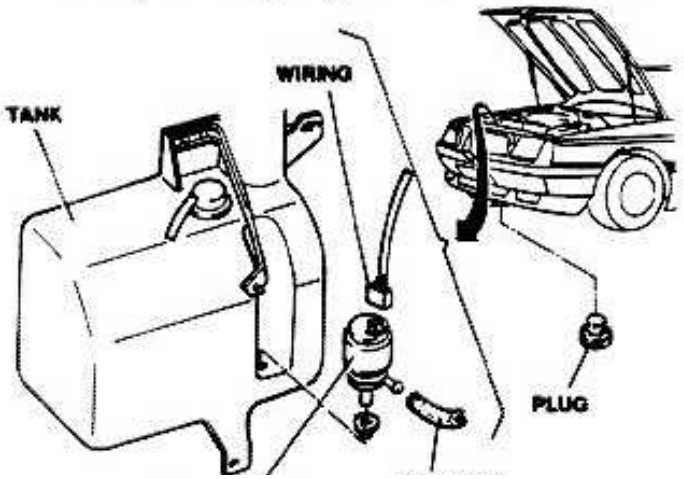
1. Remove right headlamp unit.
2. Working through headlamp unit seating, disconnect sensor wiring.
3. Manually remove pressure inserted sensor from tank.



WINDSHIELD WASHER PUMP

NOTE: The pump may be removed without removing fluid tank.

1. Remove right headlamp unit.
2. Remove drain plug on the tank and drain fluid.
3. Working through hole on fender, disconnect pump wiring.
4. Disconnect delivery hose from pump.
5. Manually remove pump pressure inserted on tank.

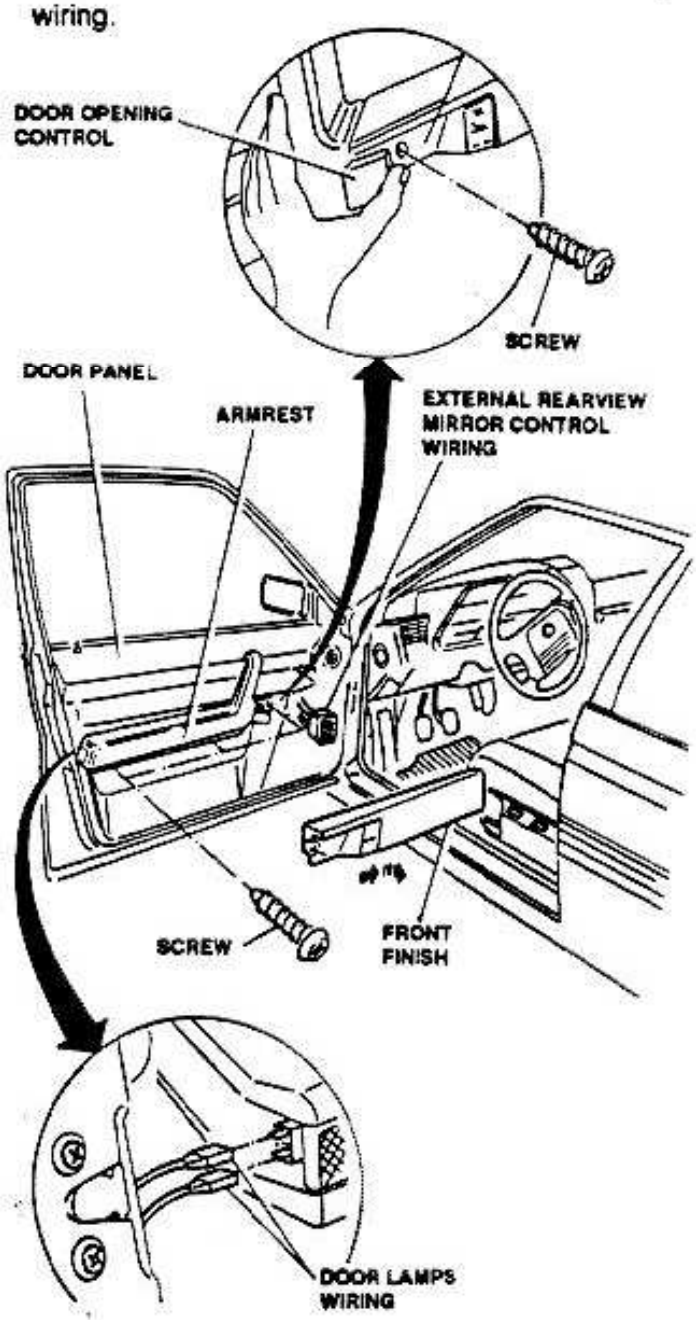


Indicated in paragraph .

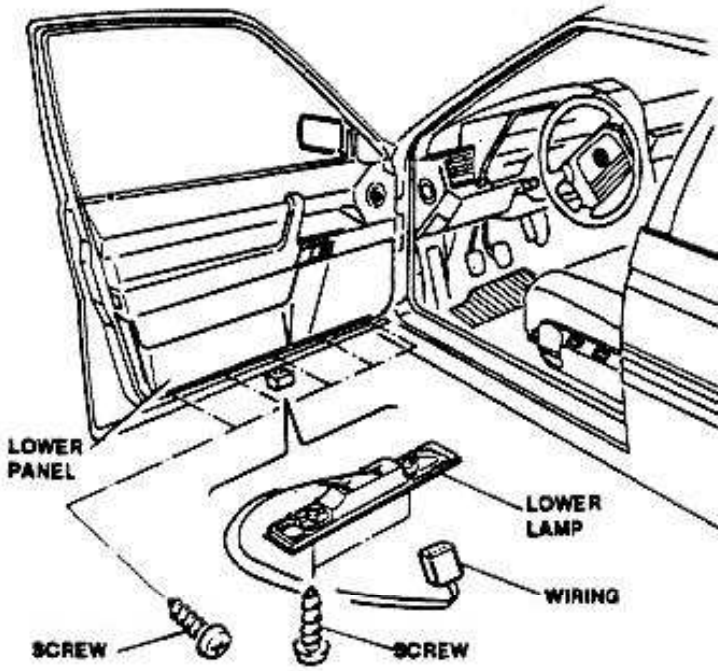
FRONT DOORS POWER WINDOW LIFT

NOTE: Lower window completely before starting any removal operation.

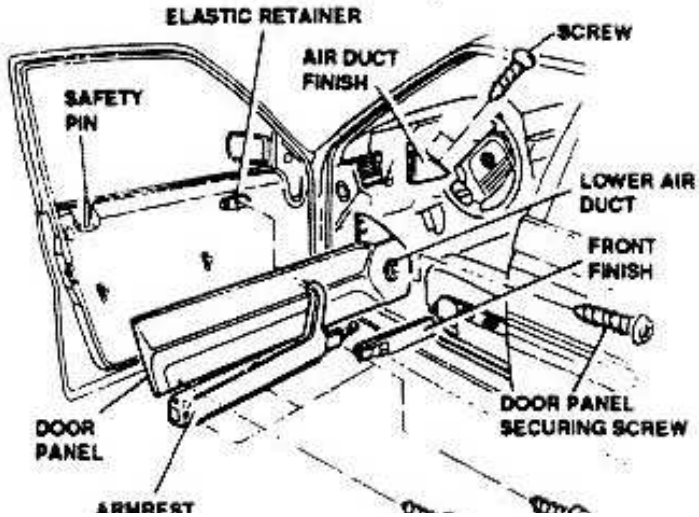
1. Loosen screw located below door opening control.
2. Slide forward front finish till it becomes free from rear retaining plastic pin.
3. Remove front finish.
4. Disconnect external rearview mirror wiring.
5. Remove three screws securing armrest.
6. Move backward armrest and disconnect door lamps wiring.



7. Loosen two screws securing ground illumination lamp.
8. Withdraw lamp and disconnect related wiring.
9. Remove lamp.
10. Loosen five screws securing lower panel.
11. Remove lower panel.

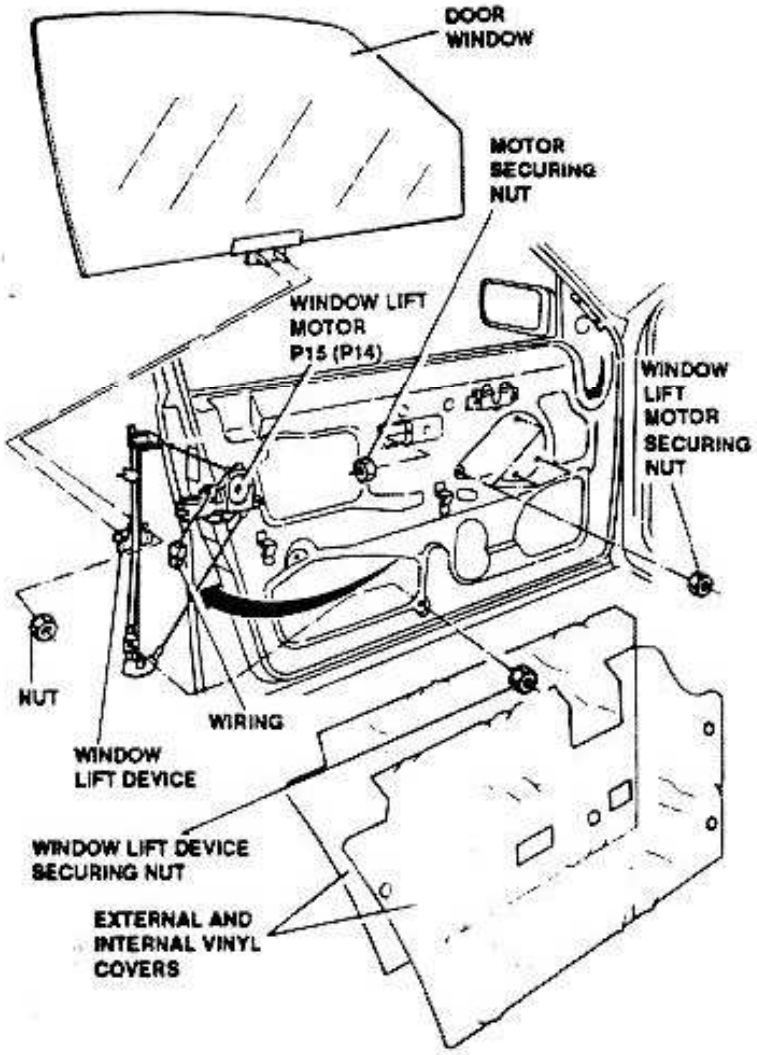


12. Loosen screw securing air ducts finish.
13. Remove air ducts finish.
14. Loosen aft screw securing door panel.
15. Loosen front screw located inside air duct, and securing door panel.
16. Lift armrest and door panel sliding it from elastic retainer and from safety pin.
17. Remove door panel completely.



18. Remove internal and external vinyl protections.
19. Remove door window.
20. Disconnect lift motor wiring.
21. Loosen and remove five bolts securing window lift.
22. Loosen and remove lower nut locking window lift assembly.
23. Slide window lift assembly together with motor from door and gain access to motor.

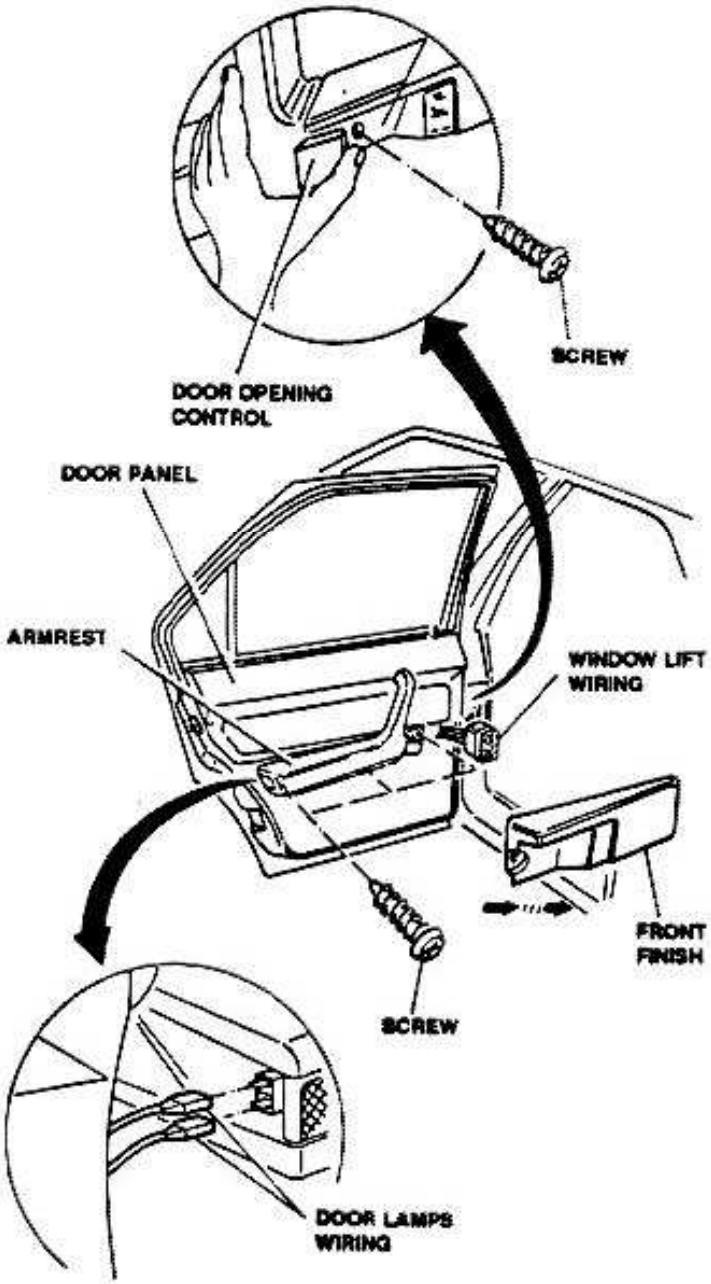
Install by reversing the order of removal.



REAR DOORS ELECTRIC WINDOW LIFT

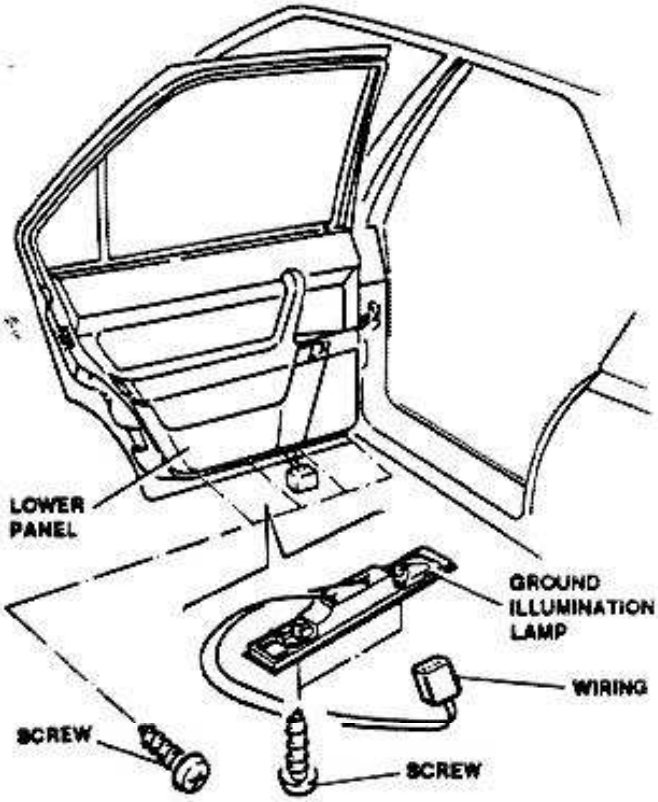
NOTE: Lower window completely before starting any removal operation.

1. Loosen screw located below door opening control.
2. Slide forward front finish till it becomes free from rear retaining plastic pin.
3. Remove front finish.
4. Disconnect window lift wiring.
5. Remove three screws securing armrest.
6. Move backward armrest and disconnect door lamps wiring.

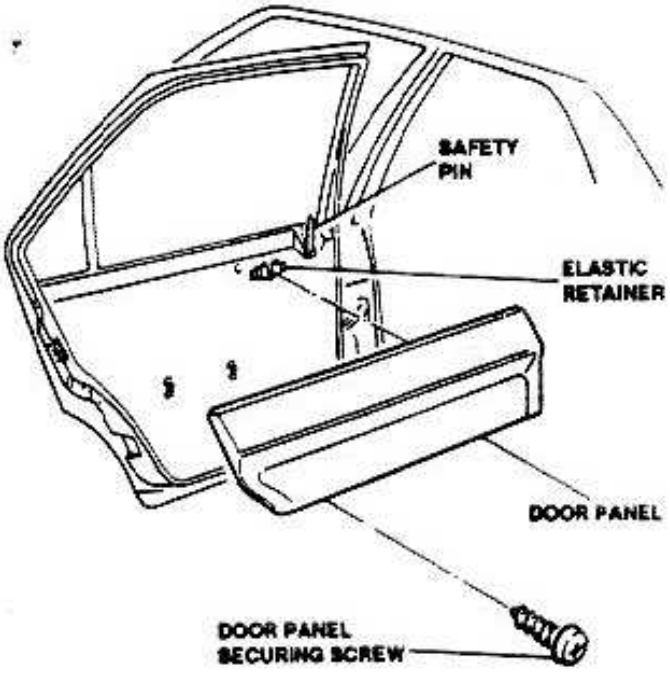


7. Loosen two screws securing ground illumination lamp.
8. Withdraw lamp and disconnect related wiring.

9. Loosen four screws securing lower panel.
10. Remove lower panel.

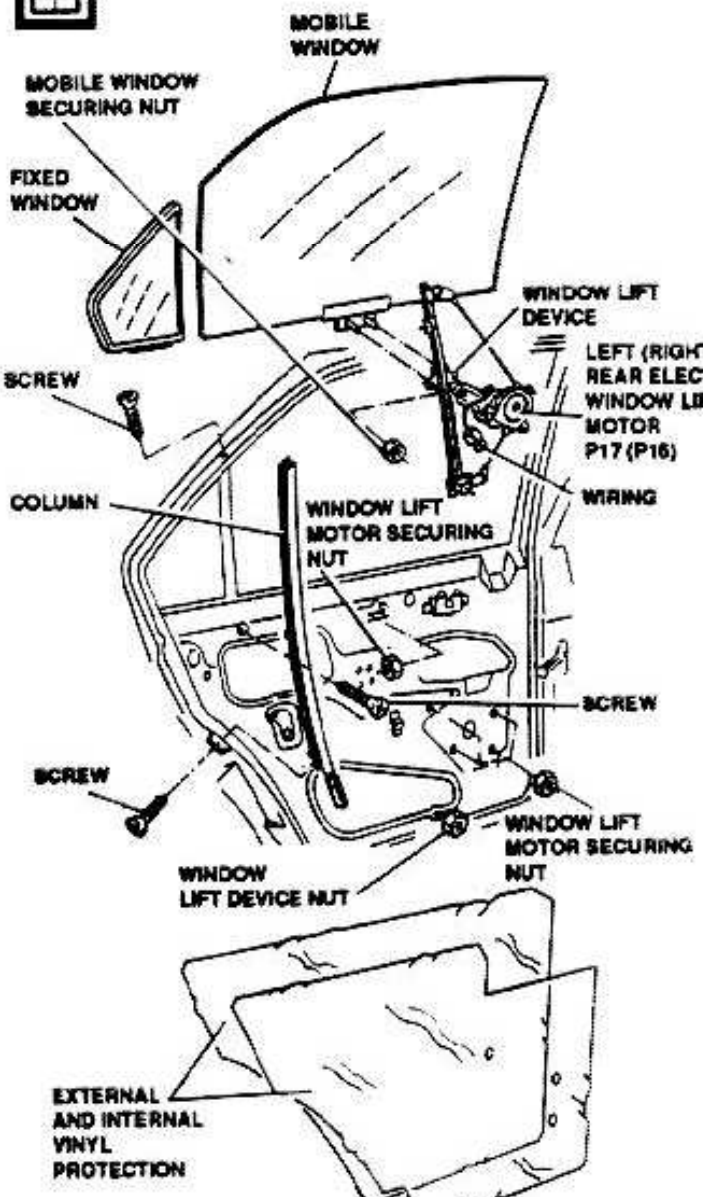


11. Loosen screw securing door panel.
12. Remove door panel withdrawing it from elastic retainer and from safety pin.



13. Remove internal and external vinyl protections.
14. Loosen three screws securing column.
15. Slide off column together with related gasket for mobile window.
16. Remove fixed window.
17. Remove mobile window (see Group 55).
18. Disconnect window lift motor wiring.
19. Loosen and remove five bolts securing window lift.
20. Loosen and remove lower nut locking window lift assembly.
21. Slide window lift assembly together with motor from door and gain access to motor.

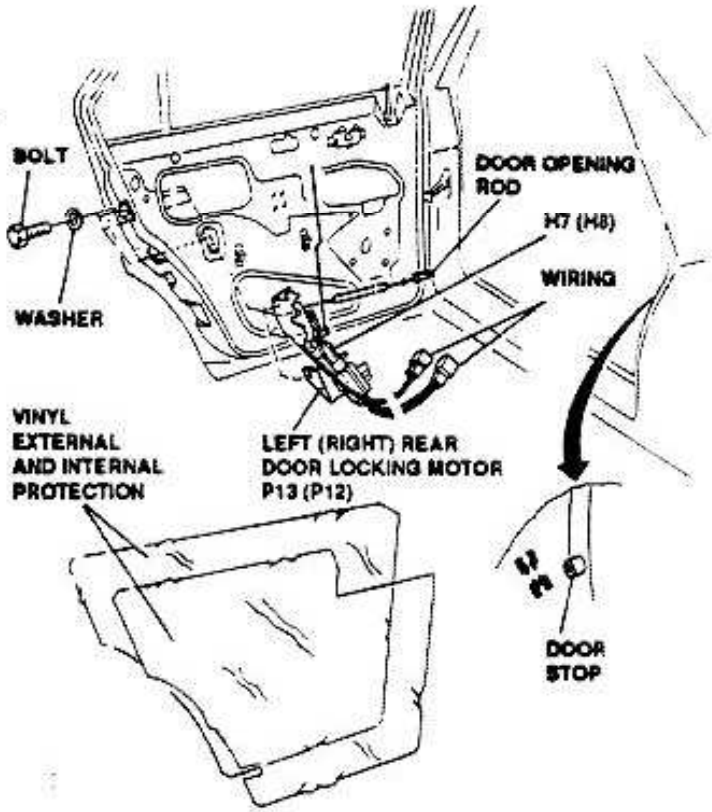
Install by reversing the order of removal.



REAR DOORS LOCKING MOTOR

NOTE: To remove rear doors lock, first remove front trim, lower panel, door panel and armrest as indicated in paragraph.

1. Remove internal and external vinyl protections.
2. Disconnect door opening rod end from door attachment.
3. Disconnect lock assembly wiring.
4. Loosen four bolts securing lock assembly and remove them.
5. Slide downward lock assembly and remove it.

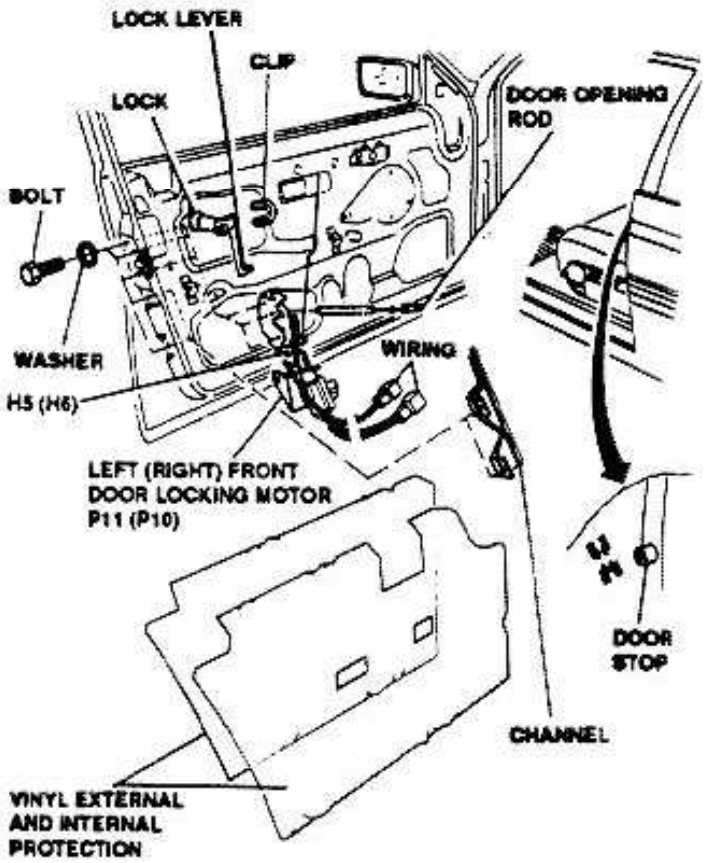


FRONT DOORS LOCKING MOTOR

NOTE: To remove front doors lock, first remove front trim, lower panel, door panel and armrest as indicated in paragraph :

1. Remove internal and external vinyl protections.
2. Slide off spring, securing door lock lever, from lock assembly.
3. Disconnect door opening rod end from door attachment.
4. Disconnect lock assembly wiring.
5. Loosen five bolts securing lock assembly and remove them.
6. Remove channel.
7. Slide downward lock assembly and remove it.

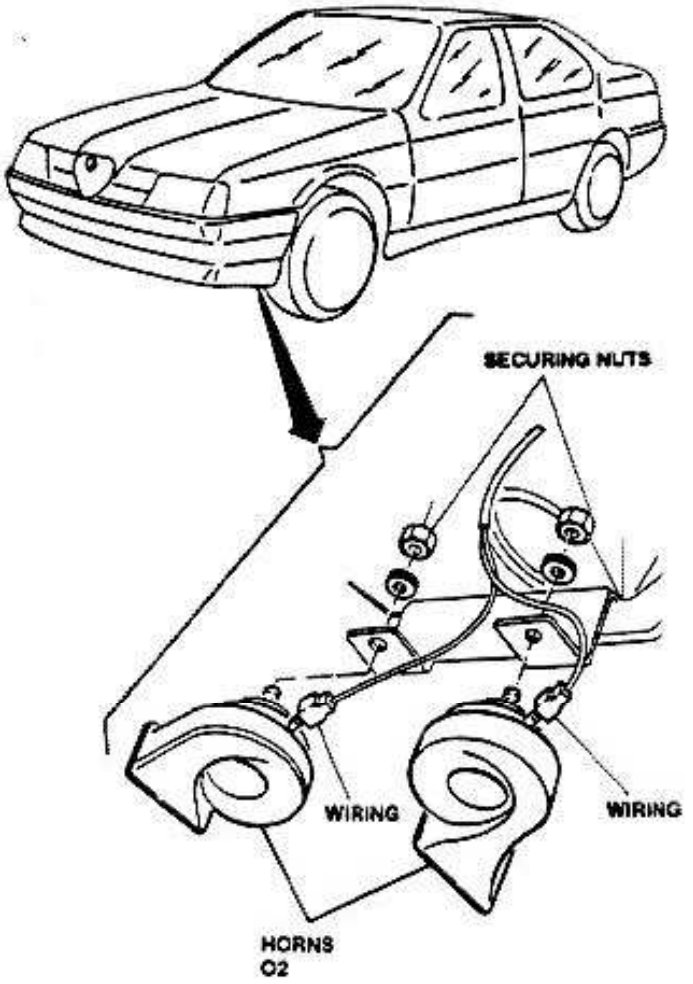
Install by reversing the order of removal.



HORNS

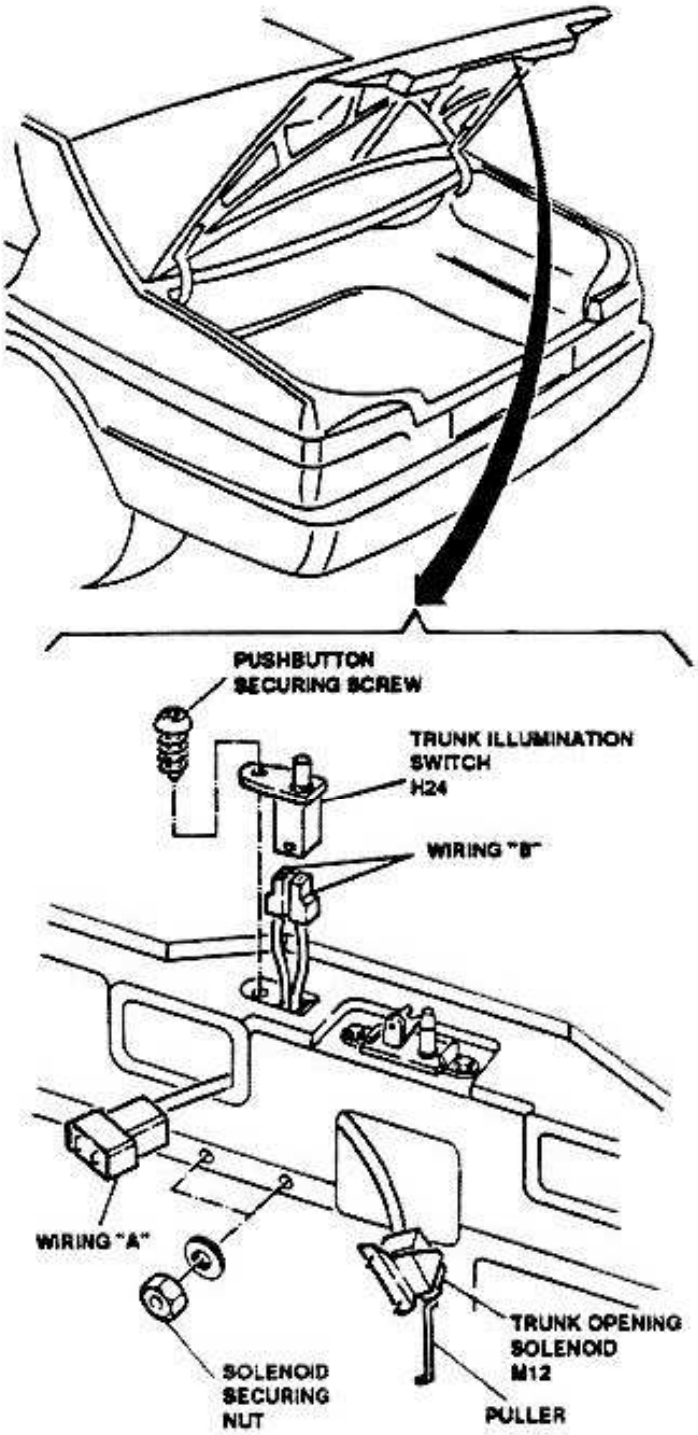
NOTE: To carry-out this operation it is advisable to

1. Disconnect horns wiring.
2. Loosen nuts securing horns and remove them.



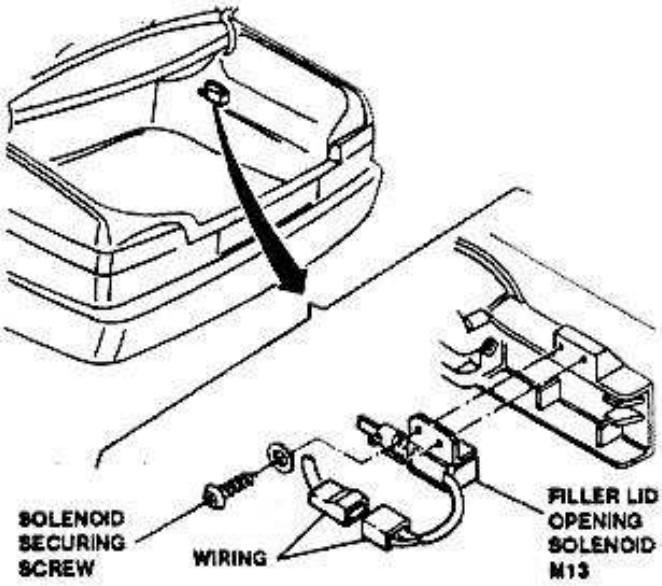
TRUNK OPENING SOLENOID AND TRUNK ILLUMINATION SWITCH

1. Remove trunk lid trim.
2. Loosen two nuts securing trunk opening solenoid.
3. Disconnect bracket securing solenoid.
4. Disconnect wiring (A).
5. Remove solenoid.
6. Loosen screw securing trunk illumination switch.
7. Remove wiring (B).
8. Remove illumination switch.



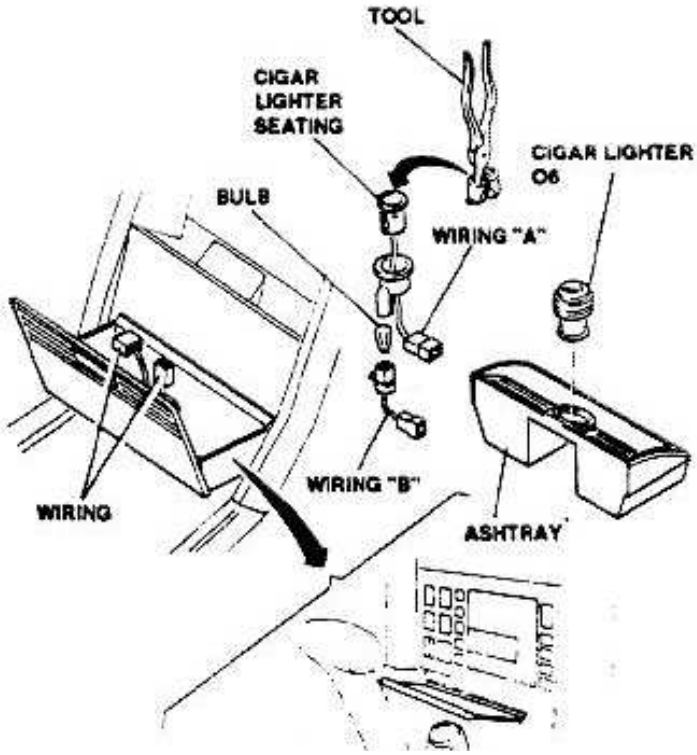
FILLER LID OPENING SOLENOID

1. Remove trunk side trim.
2. Disconnect wiring.
3. Loosen two screws securing fuel filler lid opening solenoid and remove it.



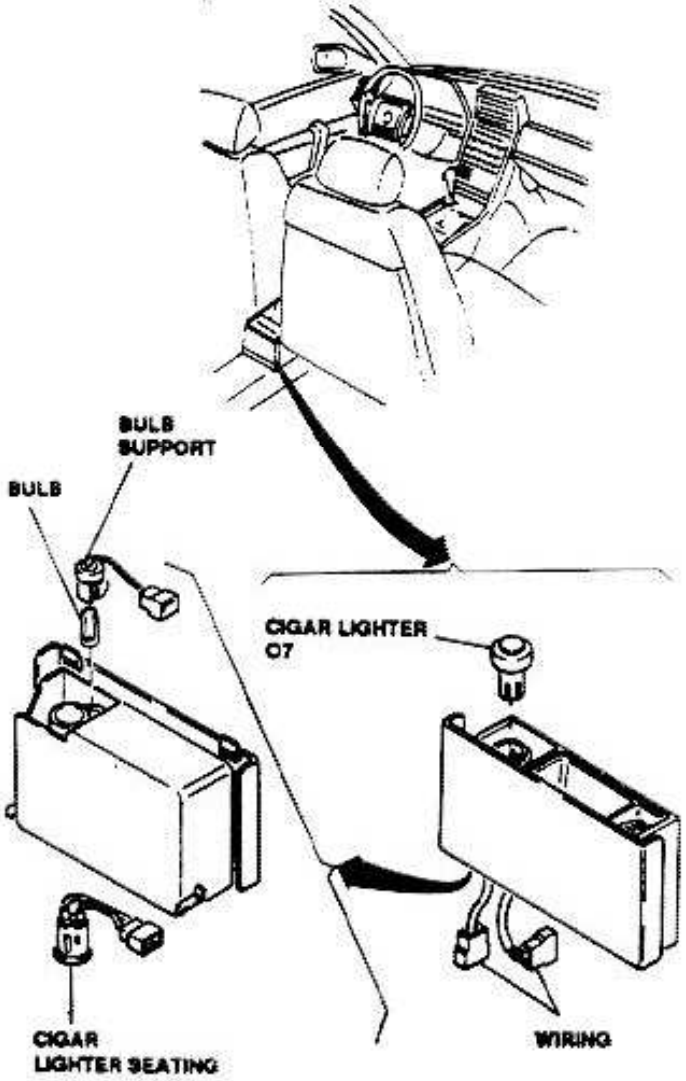
FRONT CIGAR LIGHTER AND ILLUMINATION LAMP

1. Open ashtray.
2. Remove cigar lighter and ashtray.
3. Using an appropriate tool rotate and withdraw cigar lighter.
4. Disconnect wiring (A).
5. Remove complete cigar lighter.
6. Disconnect wiring (B).
7. Manually withdraw lamp holder and bulb.



REAR CIGAR LIGHTER AND ILLUMINATION LAMP

1. Open and remove ashtray.
2. Disconnect wirings.
3. Manually withdraw cigar lighter.
4. Manually withdraw lamp holder.
5. Withdraw lamp.
6. Remove cigar lighter seat.



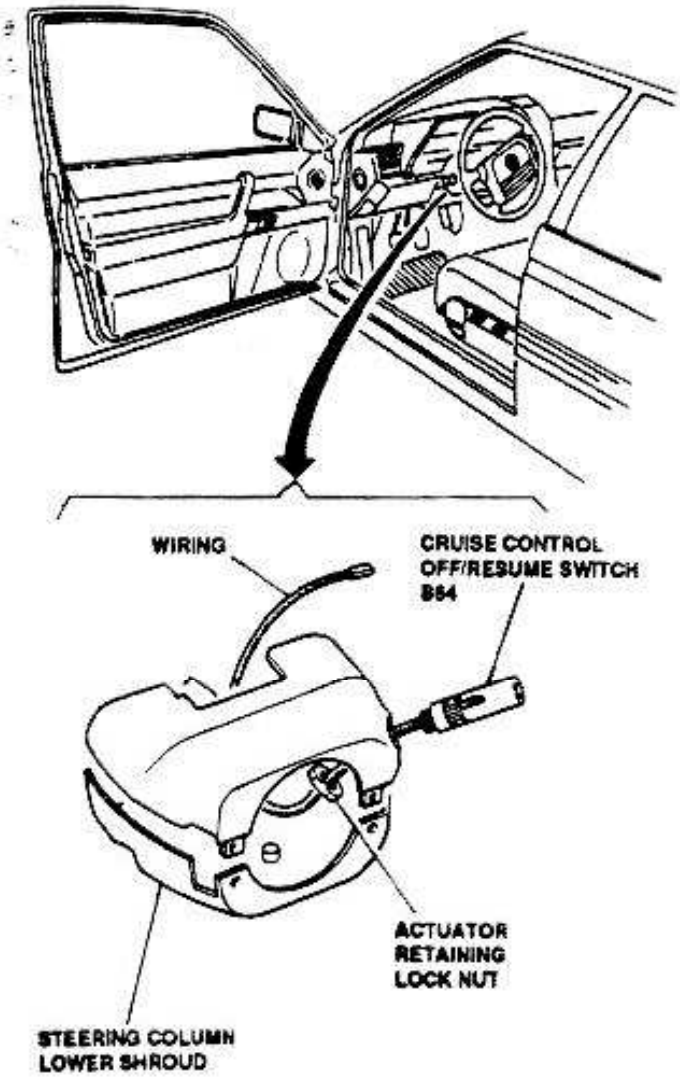
CRUISE CONTROL OFF/RESUME SWITCH

NOTE: To gain access to the off/resume switch first remove steering column shrouds (see Group 23).

1. Working from steering column lower shroud, loosen

lever nut.

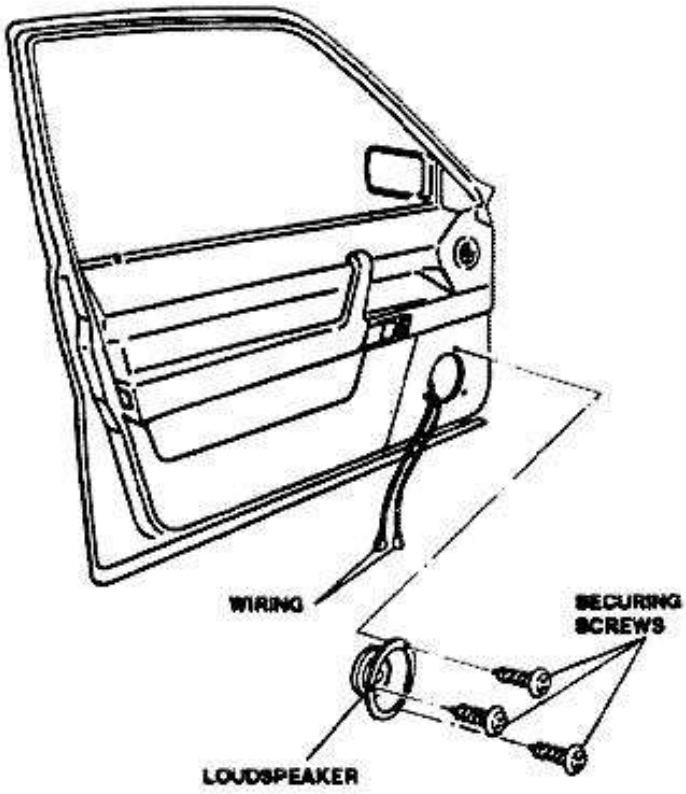
2. Manually withdraw lever from lower shroud.
3. Disconnect wiring and withdraw off/resume switch.



FRONT LOUDSPEAKERS

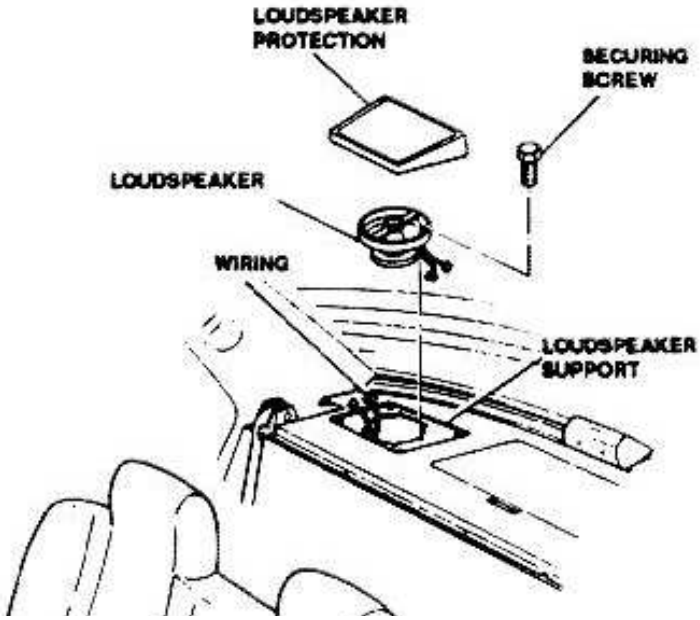
NOTE: To gain access to loudspeaker first remove lower panel.

1. Loosen three screws securing loudspeaker and withdraw it from support.
2. Disconnect wiring and remove loudspeaker.



REAR LOUDSPEAKERS

1. Remove loudspeaker plastic protection by loosening securing screws.
2. Loosen three screws securing loudspeaker and withdraw it from support.
3. Disconnect wiring and remove loudspeaker.



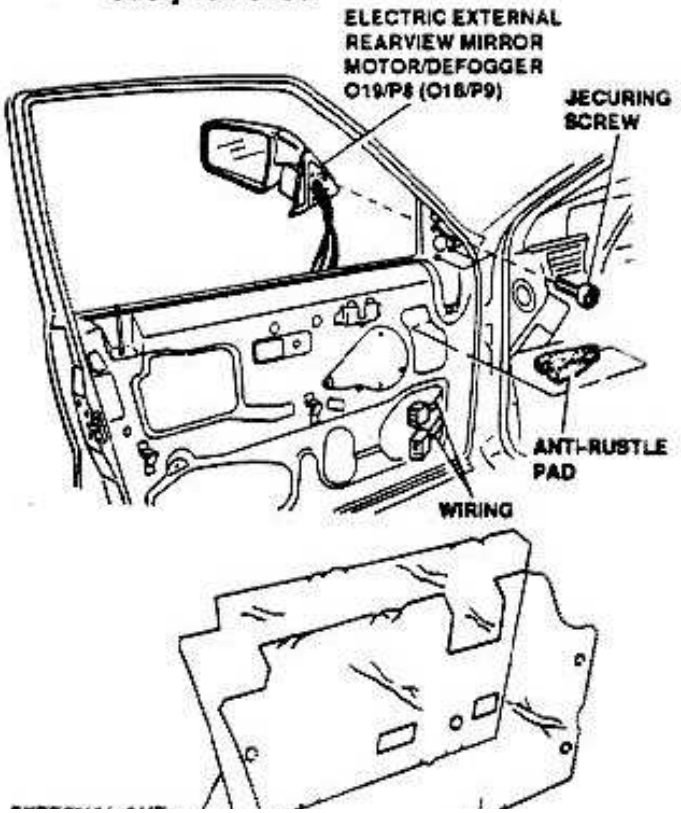
ELECTRIC EXTERNAL REARVIEW MIRRORS MOTORS

NOTE: Motors are installed inside external mirror body. If motors need replacement, the complete mirror assembly shall be replaced.

NOTE: To gain access to mirror securing screws and to related wiring, first remove front trim, armrest and lower panel (refer to:"FRONT DOORS POWER WINDOW LIFT").

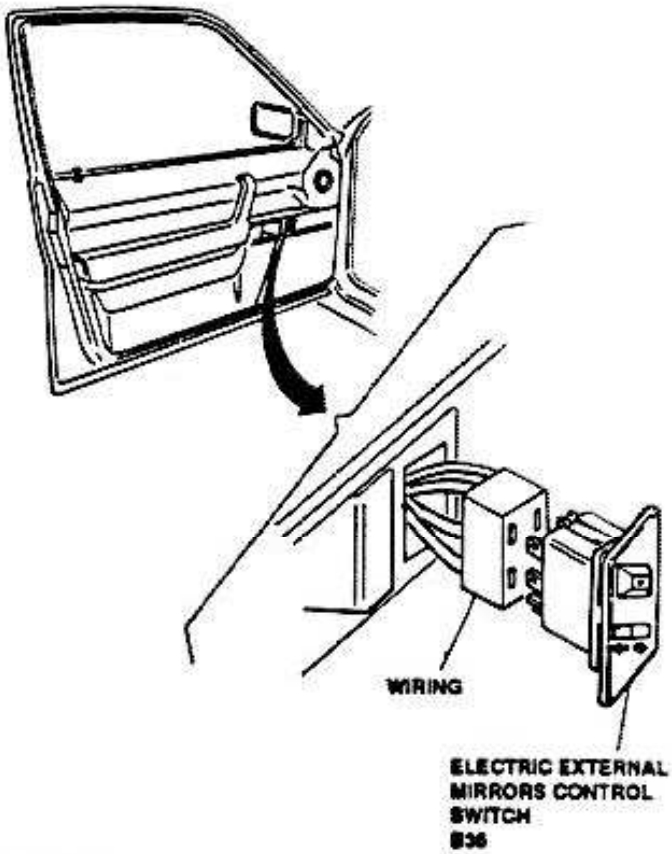
1. Remove internal and external vinyl protections to gain access to retaining clamps of mirror wiring.
2. Cut and remove affected clamps.
3. Disconnect wiring from mirror.
4. Working from inside, remove anti-rustle pad to free mirror wiring.
5. Loosen three screws securing mirror.
6. Remove mirror withdrawing wiring through its seat.

NOTE: Install by reversing the order of removal, taking care to install wiring clamps previously removed.



ELECTRIC EXTERNAL REARVIEW MIRRORS CONTROL SWITCH

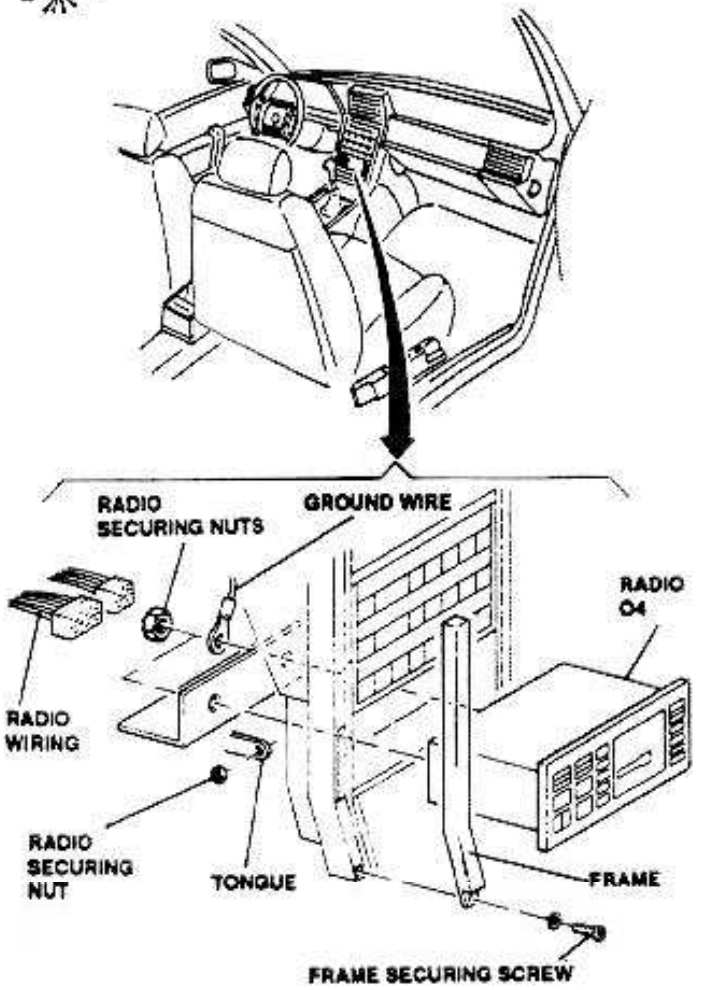
1. Remove front finish.
2. Disconnect wiring.
3. Remove switch by pressing wings securing it inside lower finish.



RADIO

1. Remove rear console and move it backward (see Group 66).
2. Remove tunnel left trim and lower finish to gain access to frame securing screw.
3. Loosen frame securing screw and remove frame.
4. Loosen nut securing radio lock and move it forward.
5. Loosen, working from behind radio, two nuts securing radio; ground is connected to one of them.
6. Remove ground wire and withdraw radio.
7. Disconnect radio wiring and remove it.

Install by reversing the order of removal, ensuring the ground wire is properly connected.



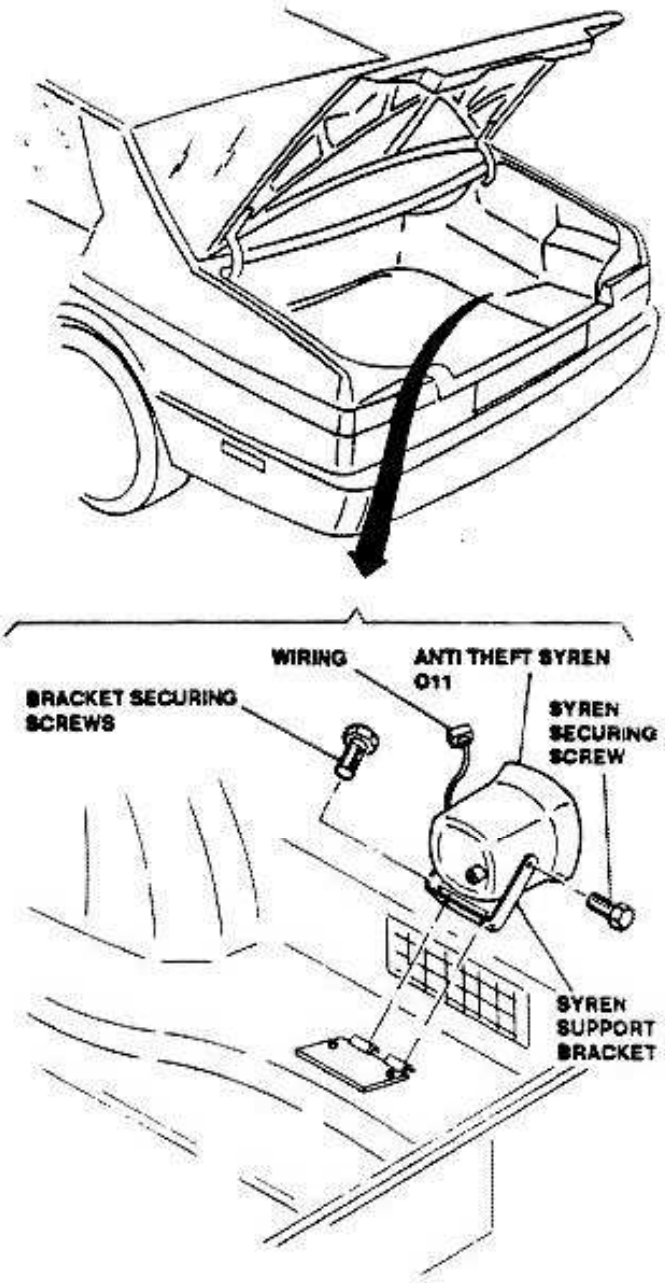
WINDSHIELD AND REAR WINDOW DEFOGGERS

NOTE: **To replace windshield and rear window, defoggers, it is necessary to replace complete windshield and/or rear window (see Group 75) upon disconnection of cables.**

ANTITHEFT SYREN

NOTE: **To gain access to antitheft syren first remove left side trim of trunk (see Group 66)**

1. Loosen two screws securing syren support bracket.
2. Loosen syren wiring.
3. Loosen two screws securing syren to its support bracket and remove syren.



IGNITION SWITCH

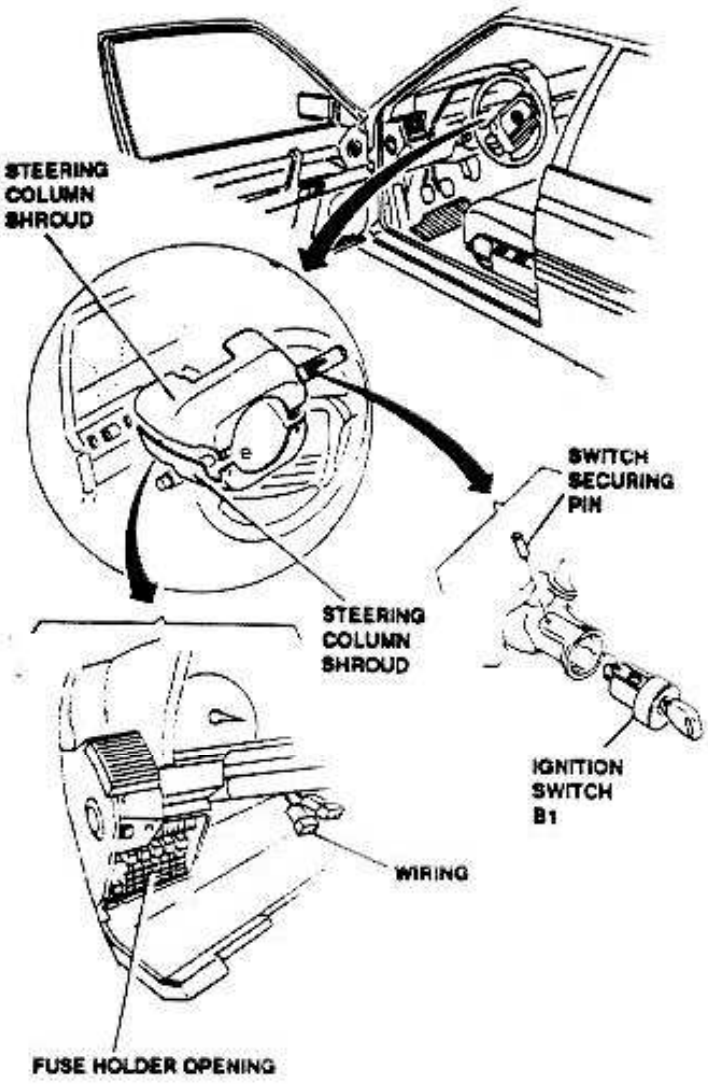
NOTE: **To gain access to switch first remove steering column shrouds (see Group 23).**

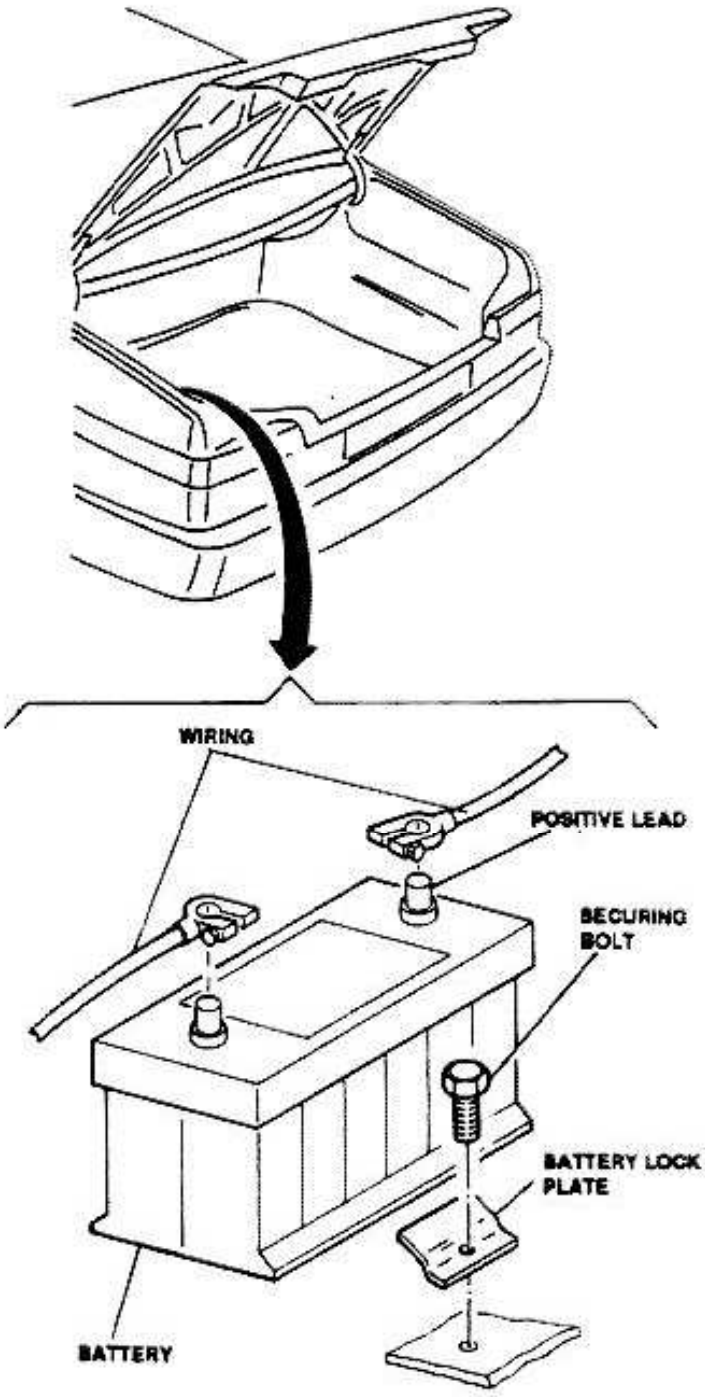
1. Using pin and hummer loosen switch locking pin.
2. Disconnect wiring, working through fuse holder opening.

bracket and remove syren.

opening.

3. Withdraw switch and remove it.





BATTERY

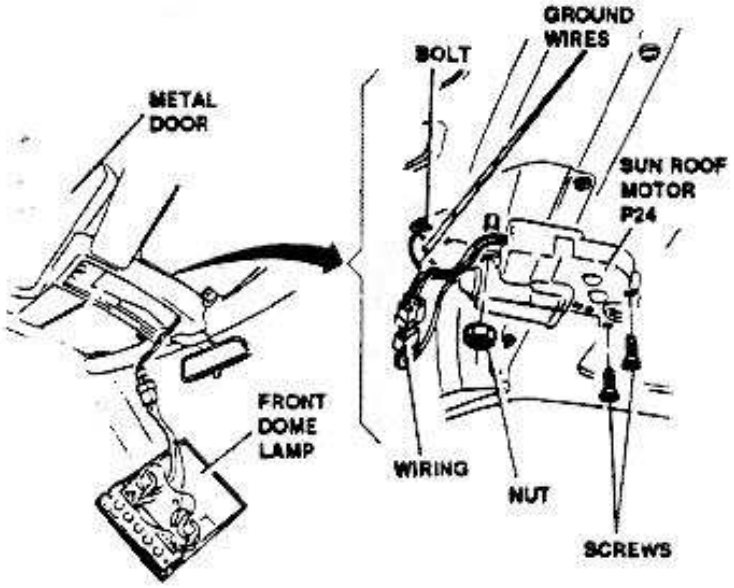
1. Move away trunk left side trim (see Group 66).
2. Disconnect both battery leads.
3. Loosen bolt securing battery lock plate.
4. Remove battery lock plate.
5. Remove battery.

SUN ROOF MOTOR

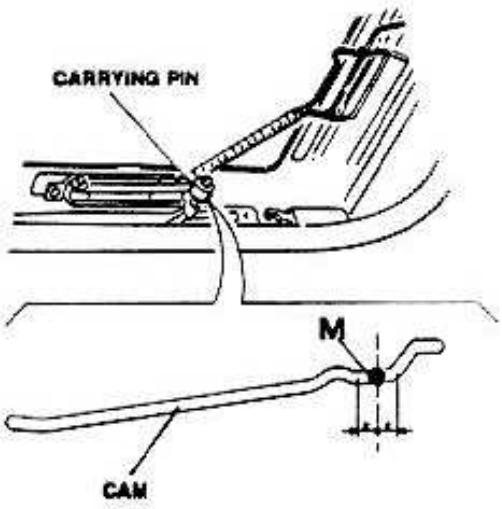
1. Remove metal door (see Group 75).
2. Loosen two aft screws securing motor.
3. Loosen forward nut securing motor.
4. Loosen bolt securing motor ground wires.
5. Disconnect motor wiring and ground wires.

6. Remove motor.

NOTE: Install by reversing the order of removal then carry-out following motor adjustment procedure.



7. Check, by connecting it to a battery, that motor is completely extended (sun roof closed).
8. Manually place both cams, on which carrying pins are sliding, to position "M" indicated in figure.
9. Install motor.

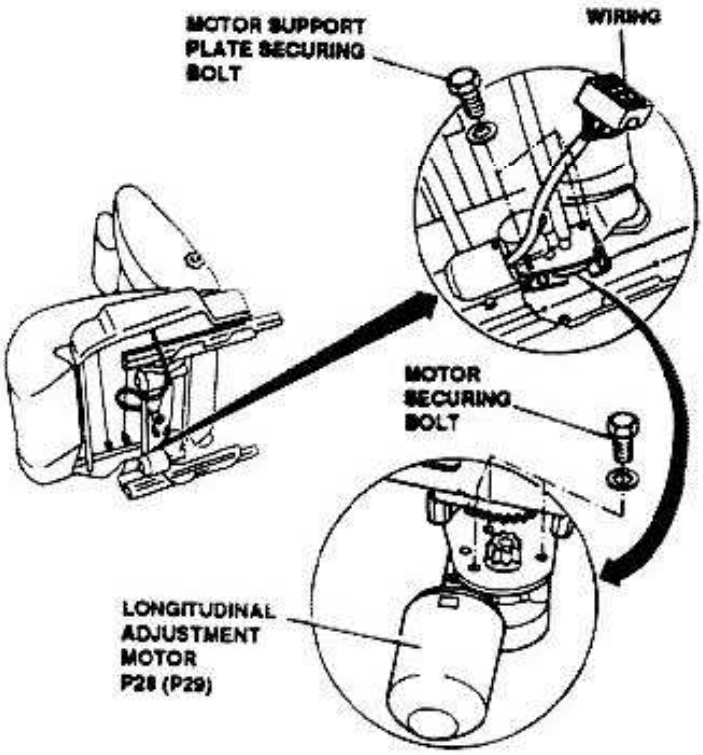


SEATS, CONTROL SWITCHES, ACCESSORIES

POWER FRONT SEATS - LONGITUDINAL ADJUSTMENT MOTOR

1. Remove seat from vehicle (see Group 66).
2. Disconnect motor wiring.
3. Loosen three screws securing motor support plate.
4. Manually rotate motor to gain access to related securing screws.
5. Loosen three screws securing motor and remove it from related support plate.

Install by reversing the order of removal.



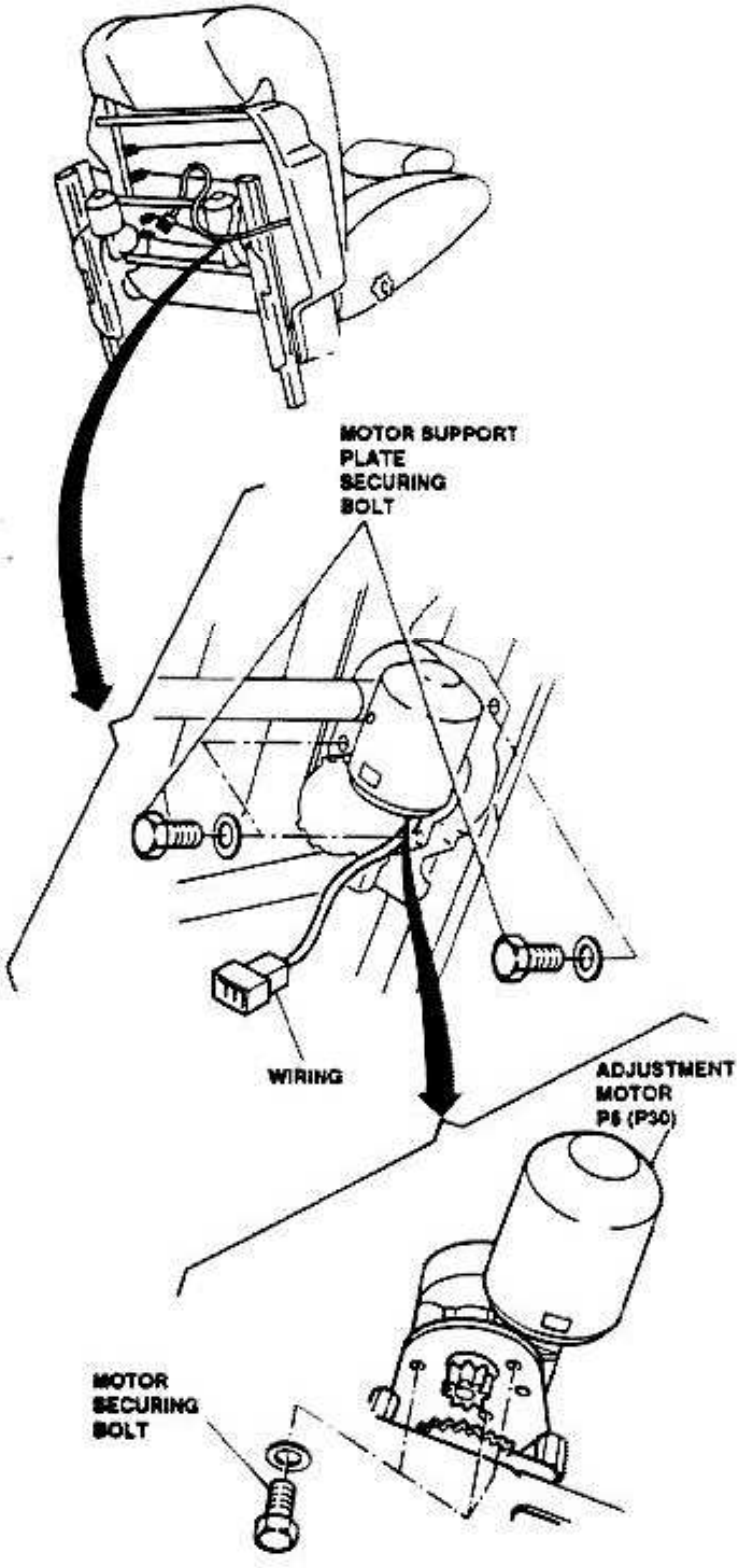
POWER FRONT SEATS - HEIGHT ADJUSTMENT MOTOR

1. Remove seat from vehicle (see Group 66).
2. Disconnect motor wiring.
3. Loosen three screws securing motor support plate.
4. Manually rotate motor to gain access to related

securing screws.

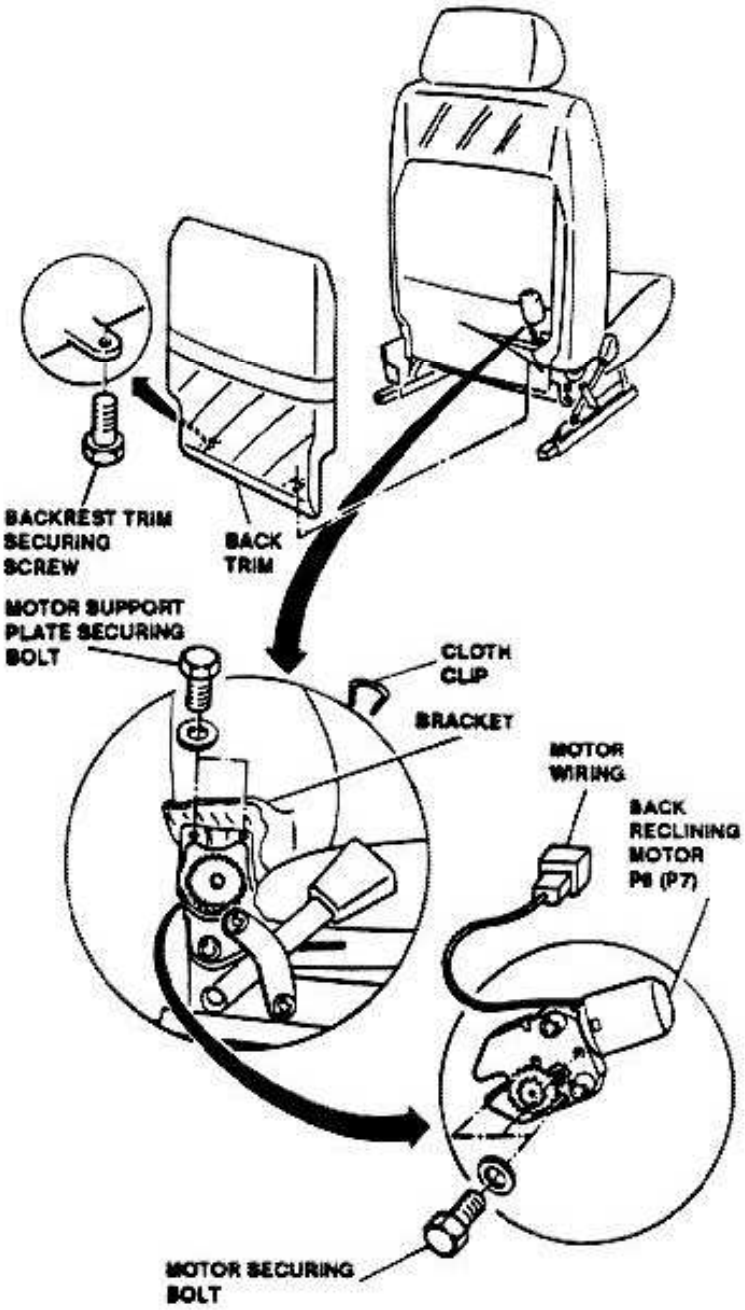
5. Loosen three screws securing motor to plate and remove it.

Install by reversing the order of removal.



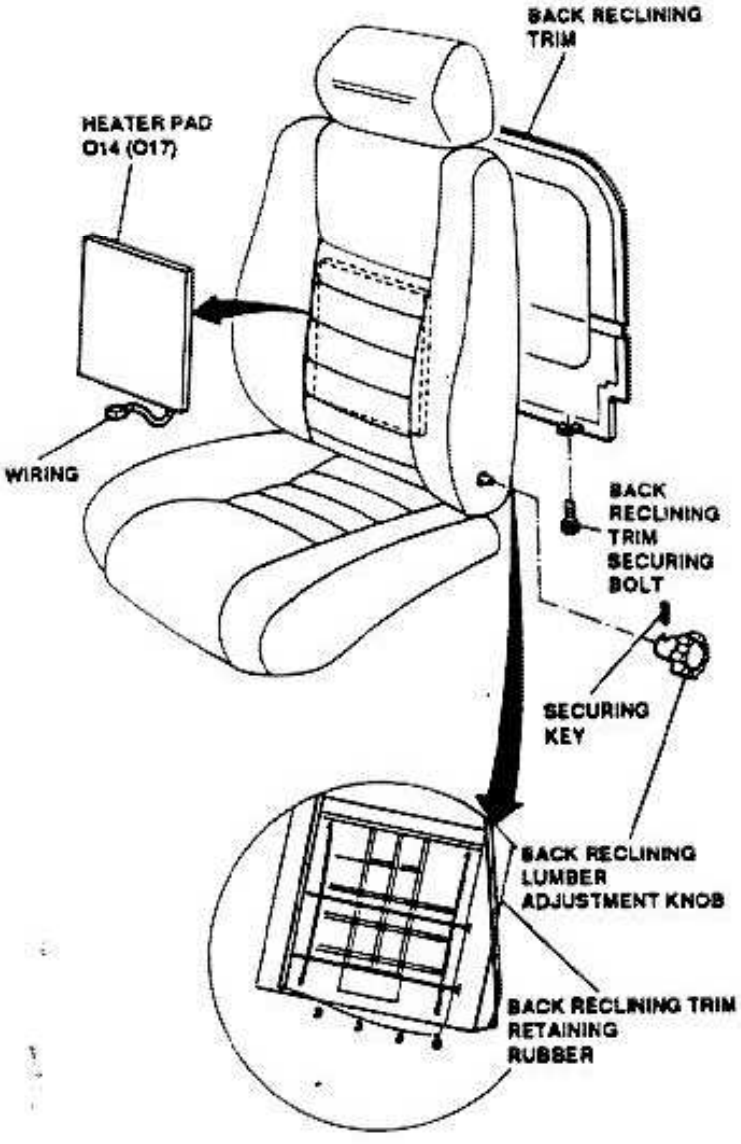
POWER FRONT SEATS - BACK RECLINING MOTOR

1. Remove seat from vehicle (see Group 66).
2. Loosen two screws securing seat back reclining trim and remove it.
3. Manually release cloth clips and move away cloth.
4. Disconnect motor wiring.
5. Loosen screws securing motor support plate and remove motor/plate assembly.
6. Loosen tree screws securing motor to plate and remove it.



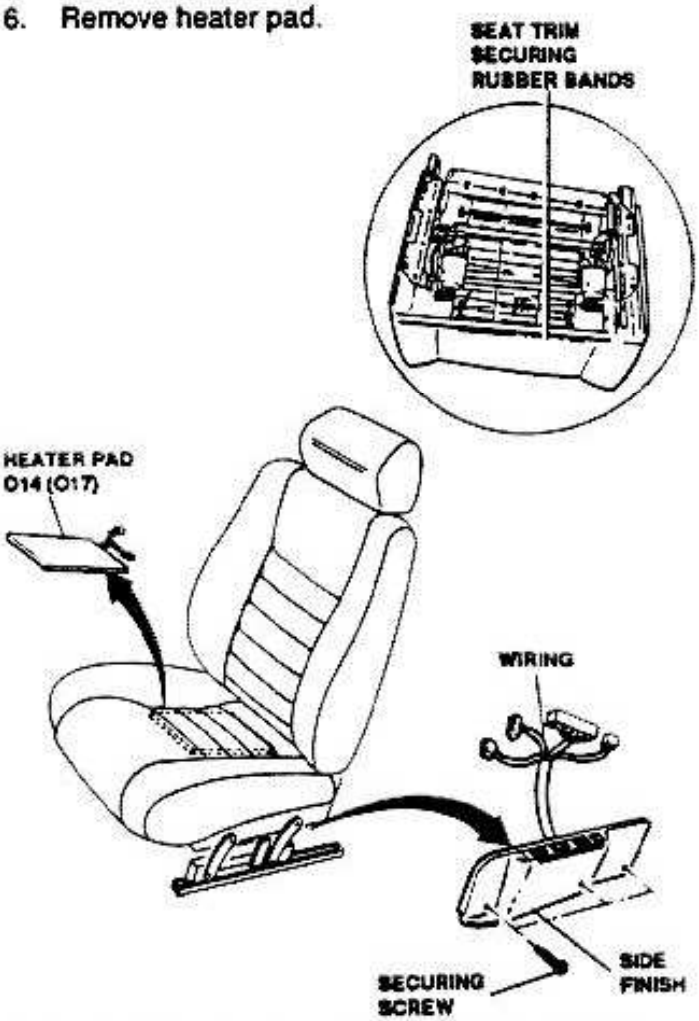
POWER FRONT SEATS - HEATER PAD (BACK RECLINING)

1. Remove seat from vehicle (see Group 66).
2. Loosen two screws securing back reclining trim and remove trim from seat.
3. Disconnect heat pad wiring.
4. Withdraw securing pin of seat back reclining lumbar adjustment knob and remove it.
5. Manually release clips, remove rubber bands from back trim.
6. Remove heater pad.



POWER FRONT SEATS - HEATER PAD (CUSHION)

1. Remove seat from vehicle (see Group 66).
2. Working from under the seat disconnect heater pad wiring.
3. Loosen three screws securing side finish.
4. Remove side finish.
5. Remove rubber bands securing trim and remove it from seat.
6. Remove heater pad.



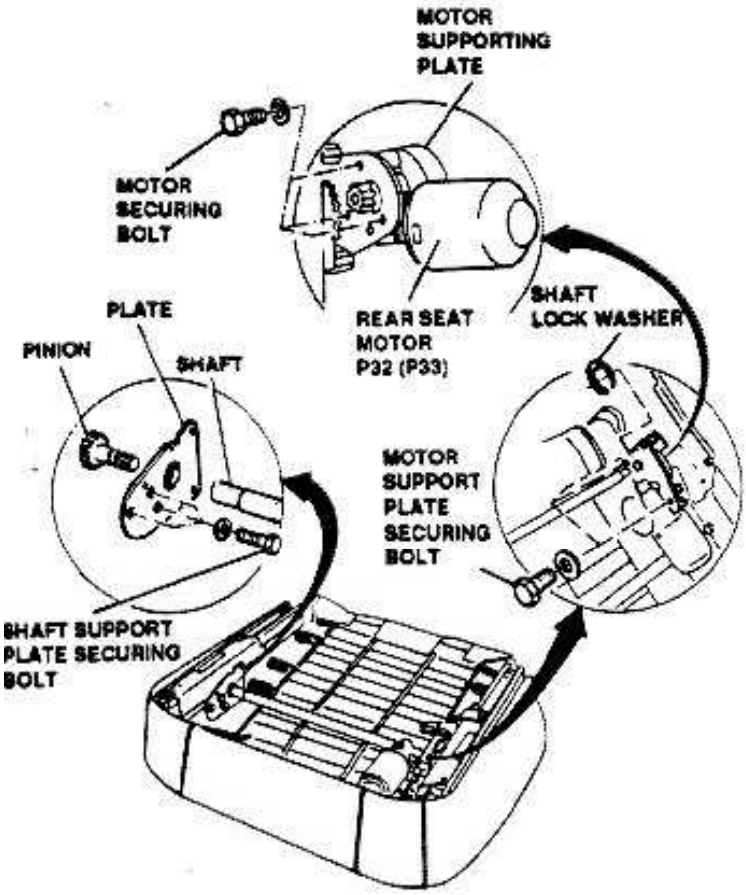
SPLIT REAR SEATS - LONGITUDINAL ADJUSTMENT MOTOR

1. Remove seal from vehicle (see Group 66).
2. Loosen three bolts securing shaft support plate.
3. Remove, by means of appropriate tool, lockwasher securing shaft.
4. Remove plate together with pinion and shaft.

4. Remove plate together with pinion and shaft.
5. Loosen three bolts of motor support plate.

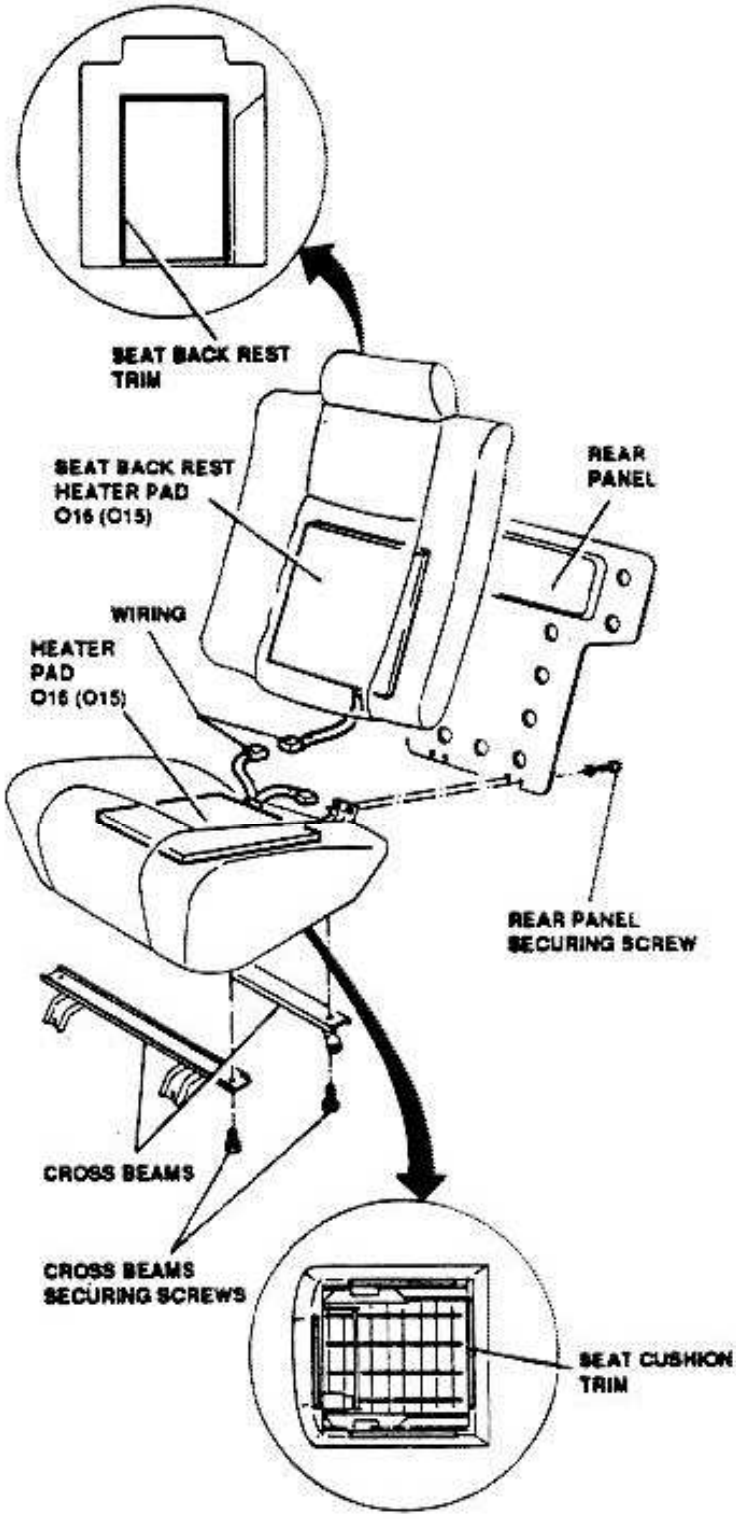
6. Manually rotate motor, secured to plate, to gain access to securing bolts.
7. Loosen three bolts securing motor and rempve it.

Install by reversing the order of removal.



SPLIT REAR SEATS - HEAT PADS

1. Remove seat from vehicle (see **Group 66**).
2. Disconnect affected heat pad wiring.
3. Loosen three screws securing rear panel.
4. Remove rear panel.
5. Remove trim from seat backrest.
6. Remove heat pad from seat backrest.
7. Working from under the seat, loosen four screws securing crossbeams.
8. Release clips and remove trim from seat.



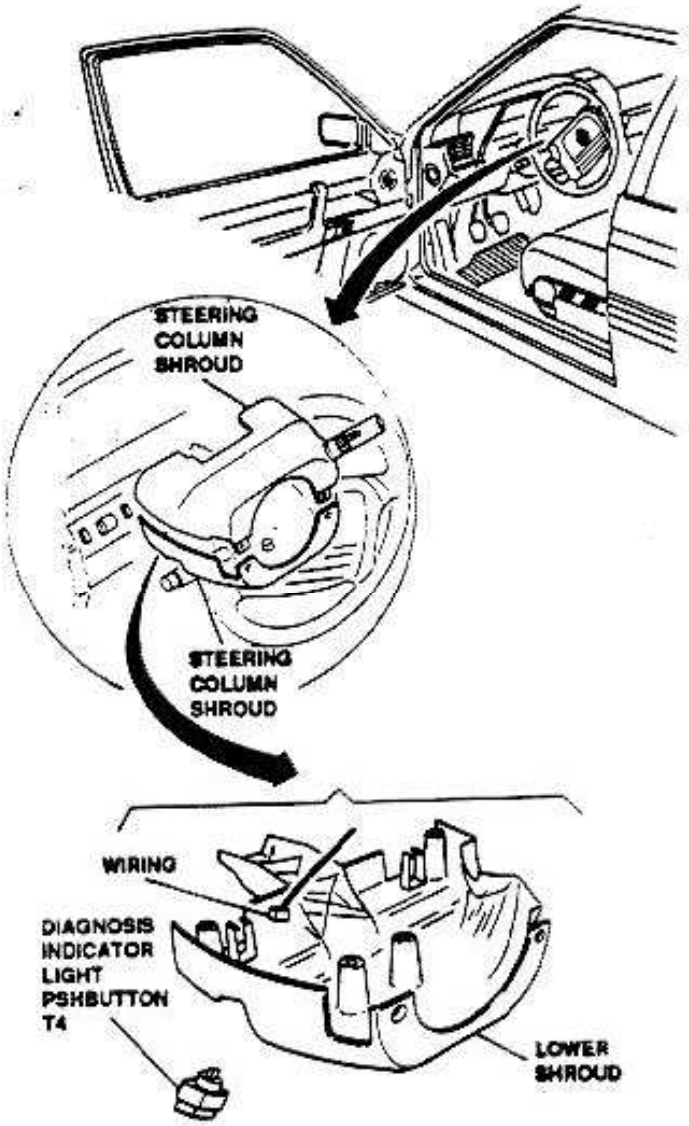
CONTROL SWITCHES - DIAGNOSIS INDICATOR LIGHT PUSHBUTTON

NOTE: To gain access to pushbutton first remove

9. Remove heat pad from seat cushion.

steering column shrouds (see Group 23).

1. Working on lower shroudr, disconnect pushbutton wiring.
2. Withdraw pressure installed pushbutton, working inside the shroud.
3. Remove pushbutton.

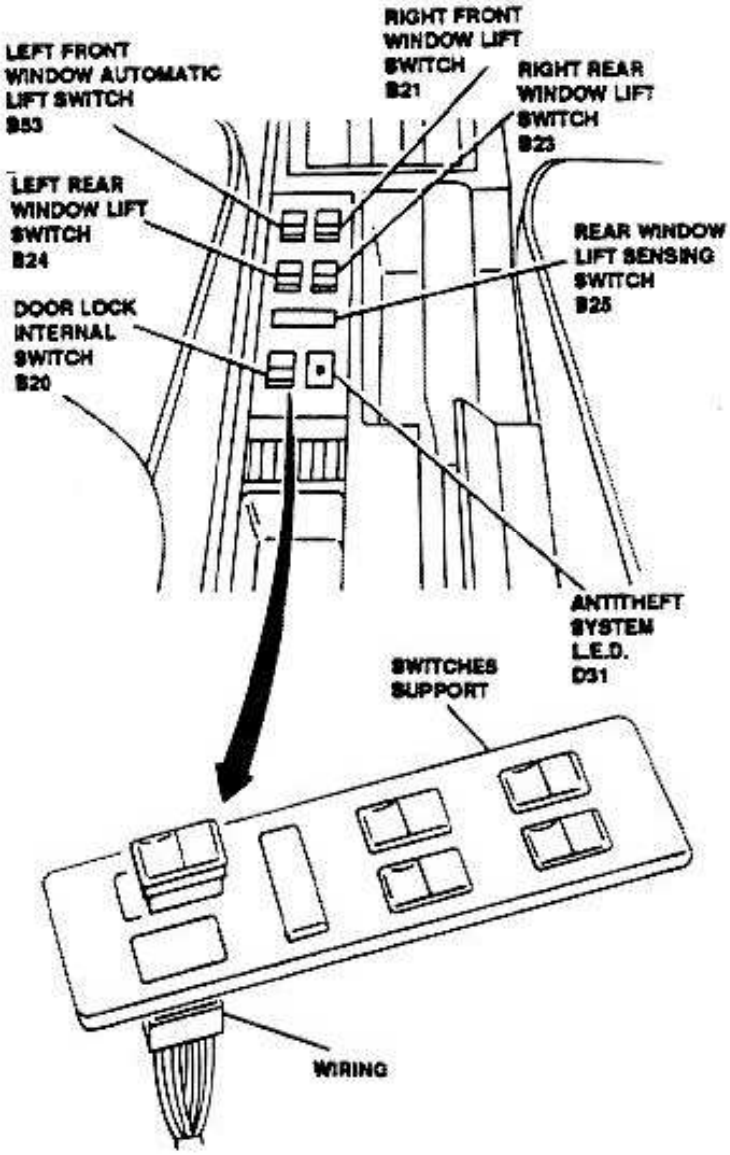


CONTROL SWITCHES - FRONT ELECTRIC WINDOW LIFT AND DOOR LOCK SWITCHES

NOTE: **The affected switches are the following:**
- **Front windows lift.**
- **Rear windows lift.**
- **Rear windows lift sensing.**
- **Door lock internal**

1. Manually lift switches support.
2. Disconnect wiring of affected switch.
3. Mechanically withdraw affected switch, (pressure installed) by pressing securing wings.
4. Remove switch.

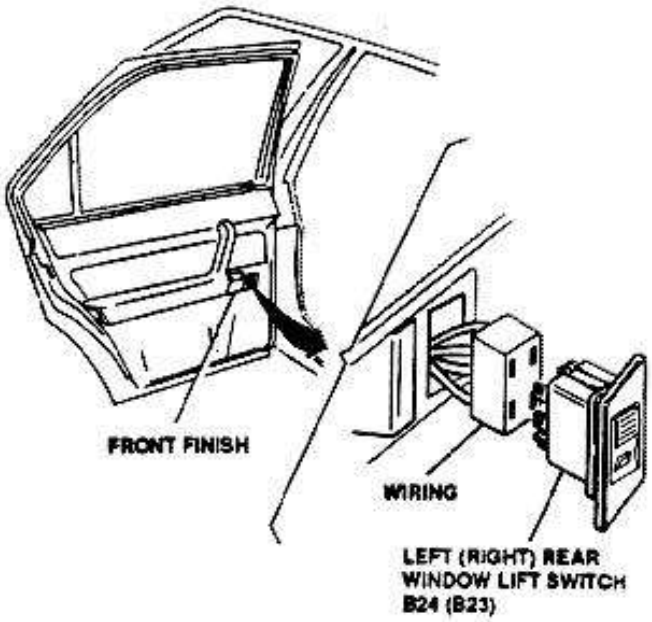
Install by reversing the order of removal.



CONTROL SWITCHES - REAR ELECTRIC WINDOW LIFT

1. Remove front finish.
2. Disconnect switch wiring.
3. Remove, by pressing securing wings, switch located inside front finish

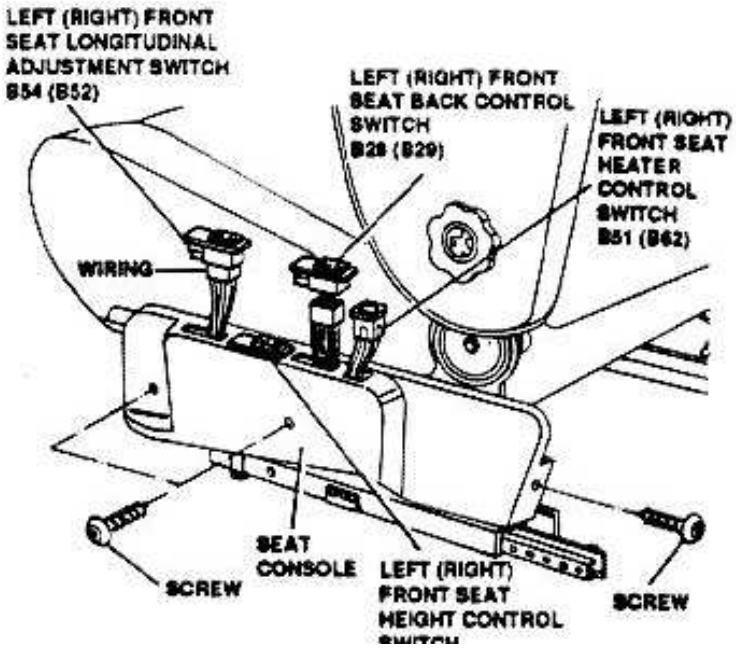
- Door lock internal.



CONTROL SWITCHES - FRONT SEATS ADJUSTMENT CONTROL SWITCHES

NOTE: The affected switches are the following.
- **Front seats back control switch.**
- **Front seats height control switch.**
- **Front seats heater control switch.**

1. Loosen three screws securing seat console.
2. Disconnect wiring.
3. Remove affected switch by pressing two securing wings.

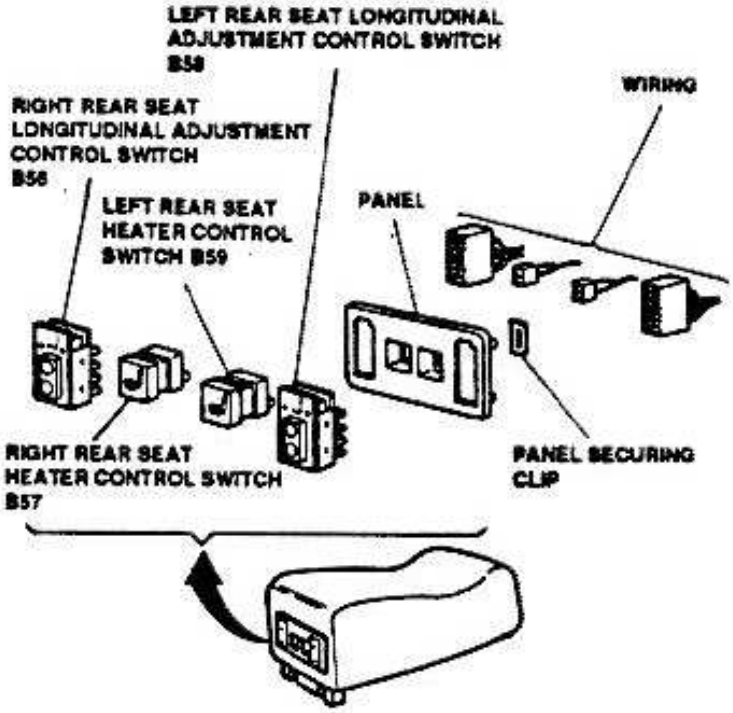


CONTROL SWITCHES - SPLIT REAR SEATS ADJUSTMENT SWITCHES

NOTE: The affected switches are the following:
- **Right rear seat heater control switch.**
- **Left rear seat heater control switch.**
- **Right seat longitudinal adjustment switch.**
- **Left seat longitudinal adjustment switch.**

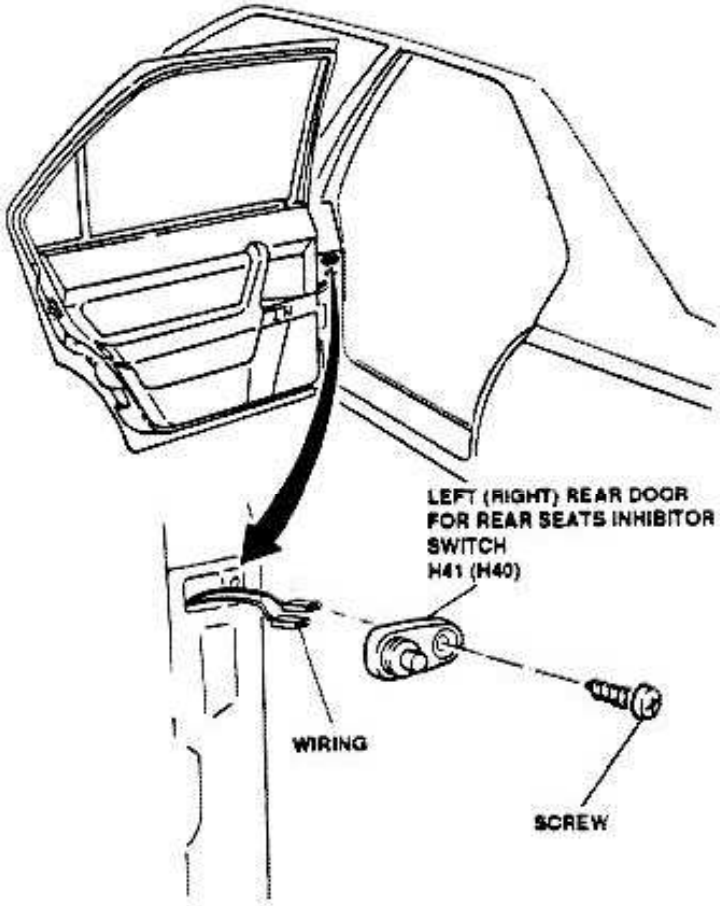
1. Remove rear console (see Group 66).
2. Remove switches securing springs working from inside console.
3. Disconnect affected switch wiring.
4. Manually withdraw switch.
5. Remove switch.

Install by reversing the order of removal.



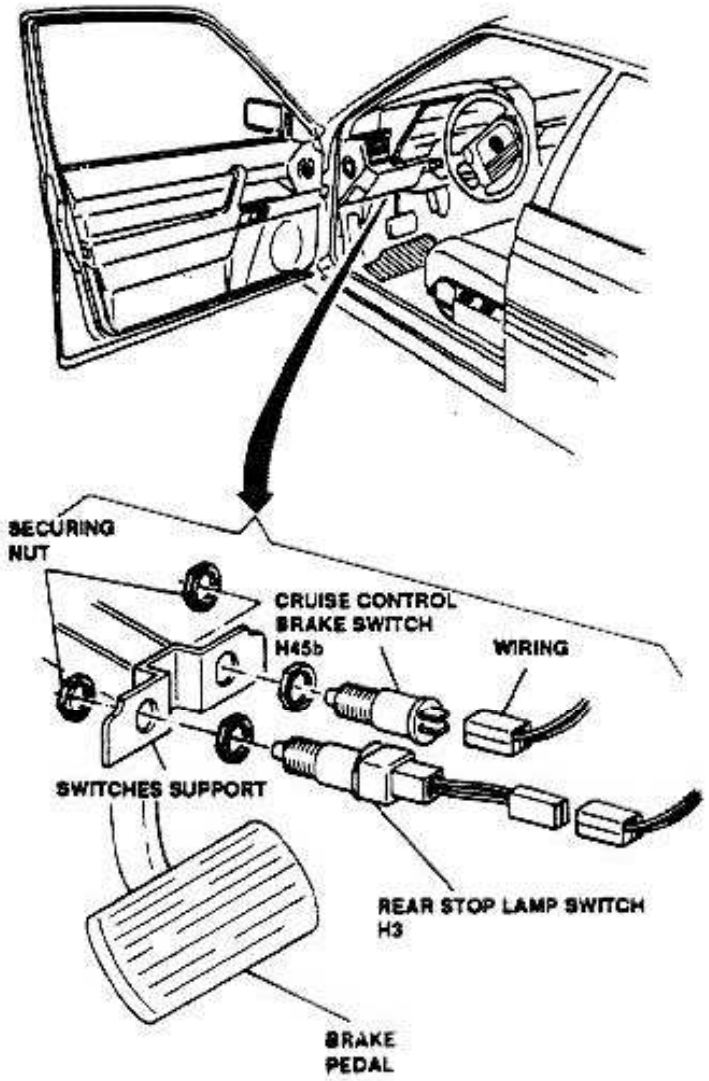
CONTROL SWITCHES - REAR DOORS PUSHBUTTONS

1. Loosen screw securing switch.
2. Withdraw switch.
3. Disconnect wiring.
4. Remove switch.



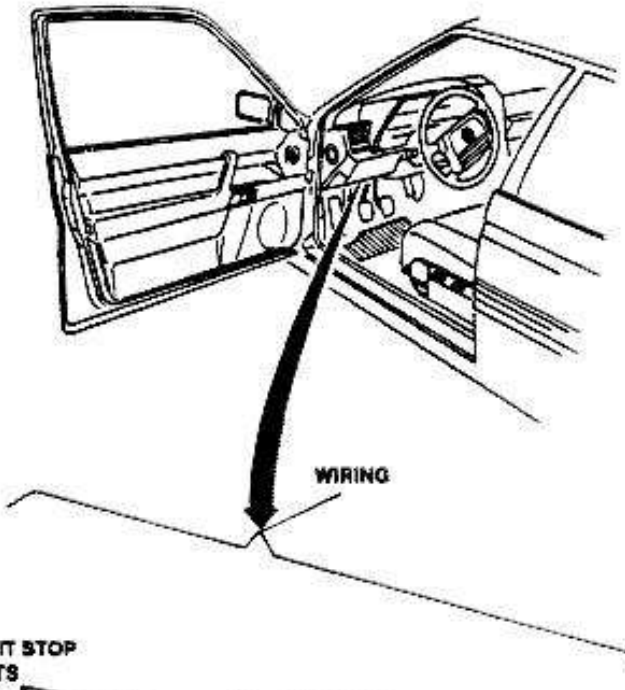
CONTROL SWITCHES - BRAKE SWITCH FOR CRUISE CONTROL (automatic transmission version) AND STOP LAMPS SWITCH.

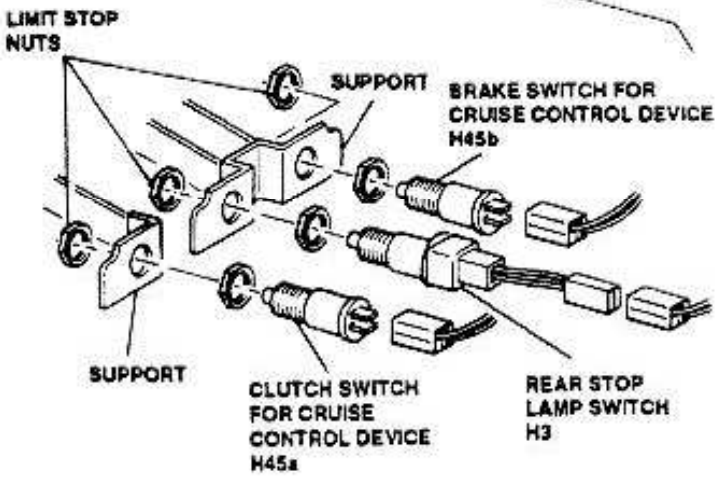
1. Working from under brake pedal, disconnect switch wiring.
2. Loosen nut securing affected switch and remove switch from support.



CONTROL SWITCHES - CLUTCH BRAKE SWITCH FOR CRUISE CONTROL (manual transmission version) AND STOP LAMPS SWITCH

1. Working from under brake pedal, disconnect affected switch wiring.
2. Loosen nut securing affected switch and remove switch from support.

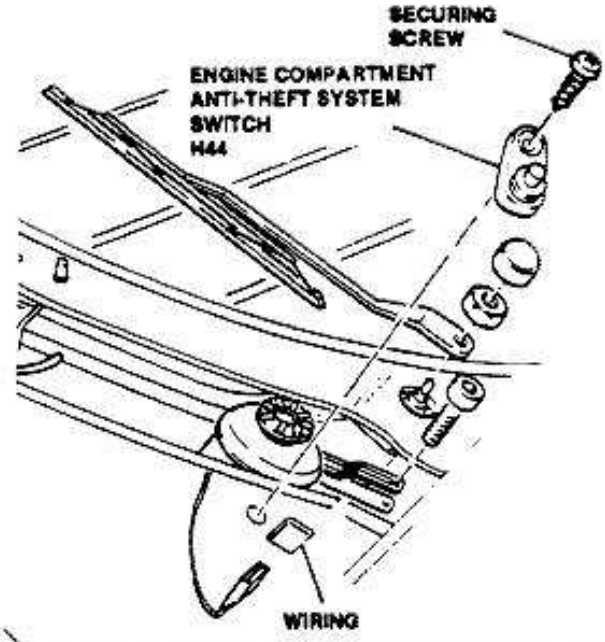


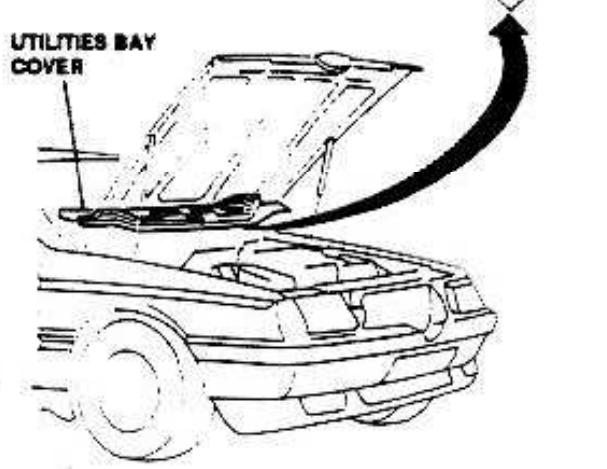


ACCESSORIES - ENGINE COMPARTMENT ANTI-THEFT SYSTEM SWITCH

NOTE: To gain access to pushbutton first remove utilities bay cover in engine compartment.

1. Remove utilities bay cover to gain access to switch wiring.
2. Working from engine compartment, loosen screw securing switch and withdraw it from its support.
3. Disconnect switch wiring.
4. Remove switch.



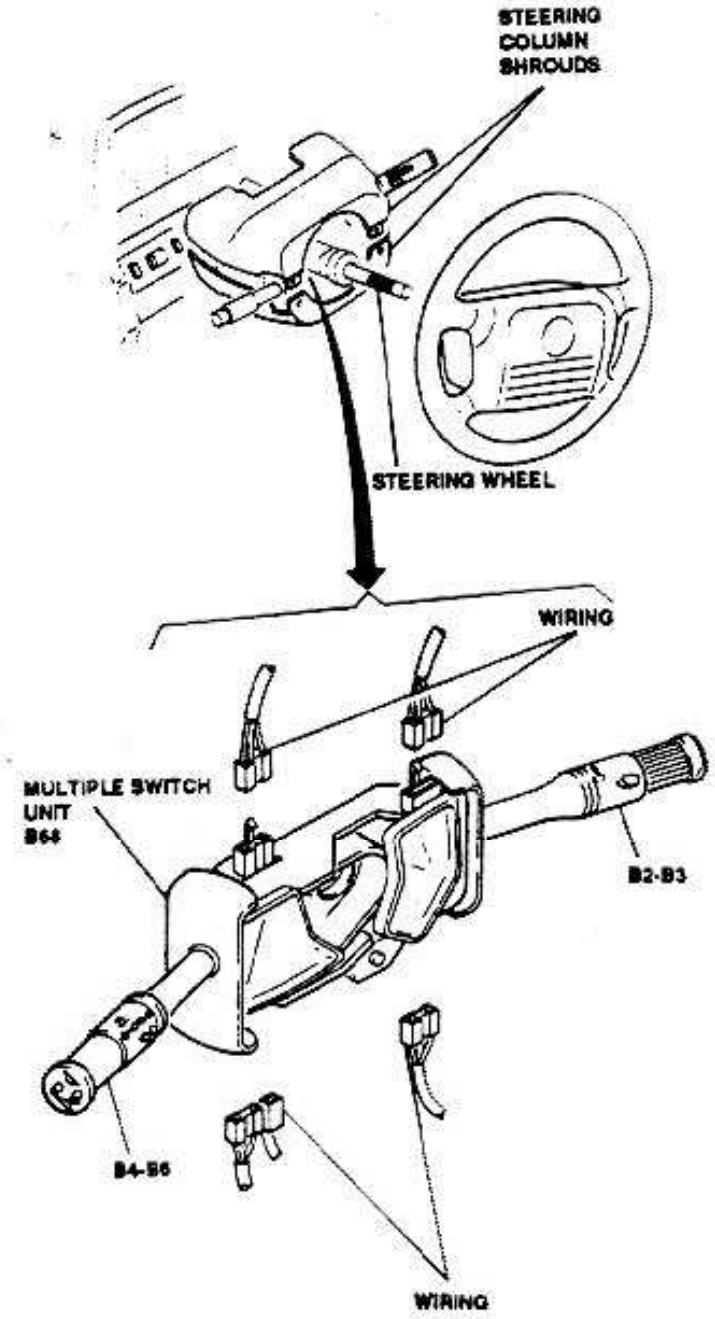


ACCESSORIES - MULTIPLE SWITCH UNIT

1. Remove steering wheel and steering column shrouds (see **Group 23**).
2. Disconnect multiple switch wiring.
3. Loosen two screw securing multiple switch.
4. Remove multiple switch unit.

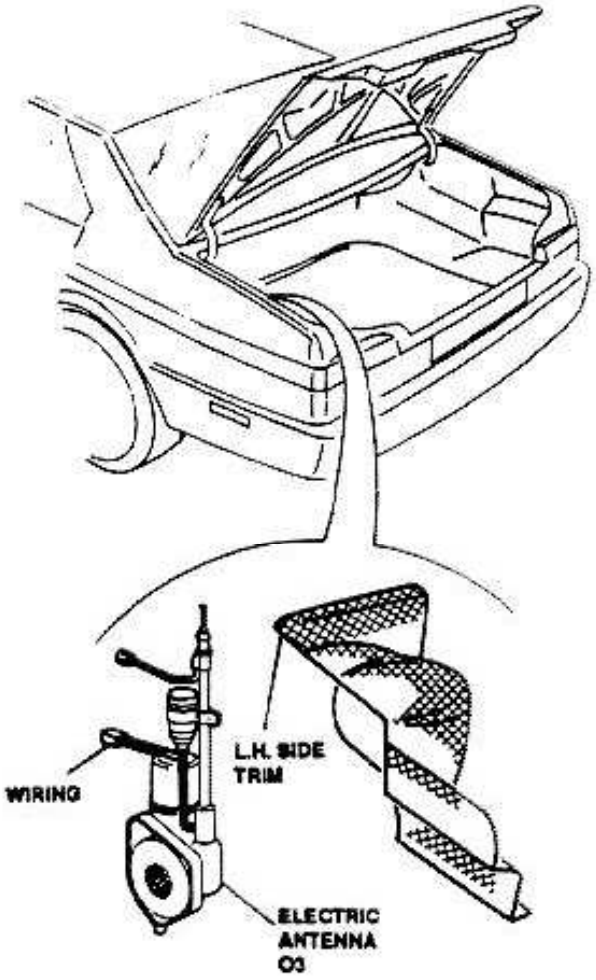
4. Remove switch.

4. Remove multiple switch unit.



ELECTRIC ANTENNA

1. Disconnect the battery negative cable (-).
2. By working in the trunk, remove the left-side.
3. Disconnect the wiring and remove the electric antenna from the trunk compartment.



TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

TIGHTENING TORQUES

HEAD LAMP UNIT: screws securing projector retaining bracket	0.88 to 2.51 ft.lbs	1.2 to 3.4 Nm

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GROUP 01

ENGINE

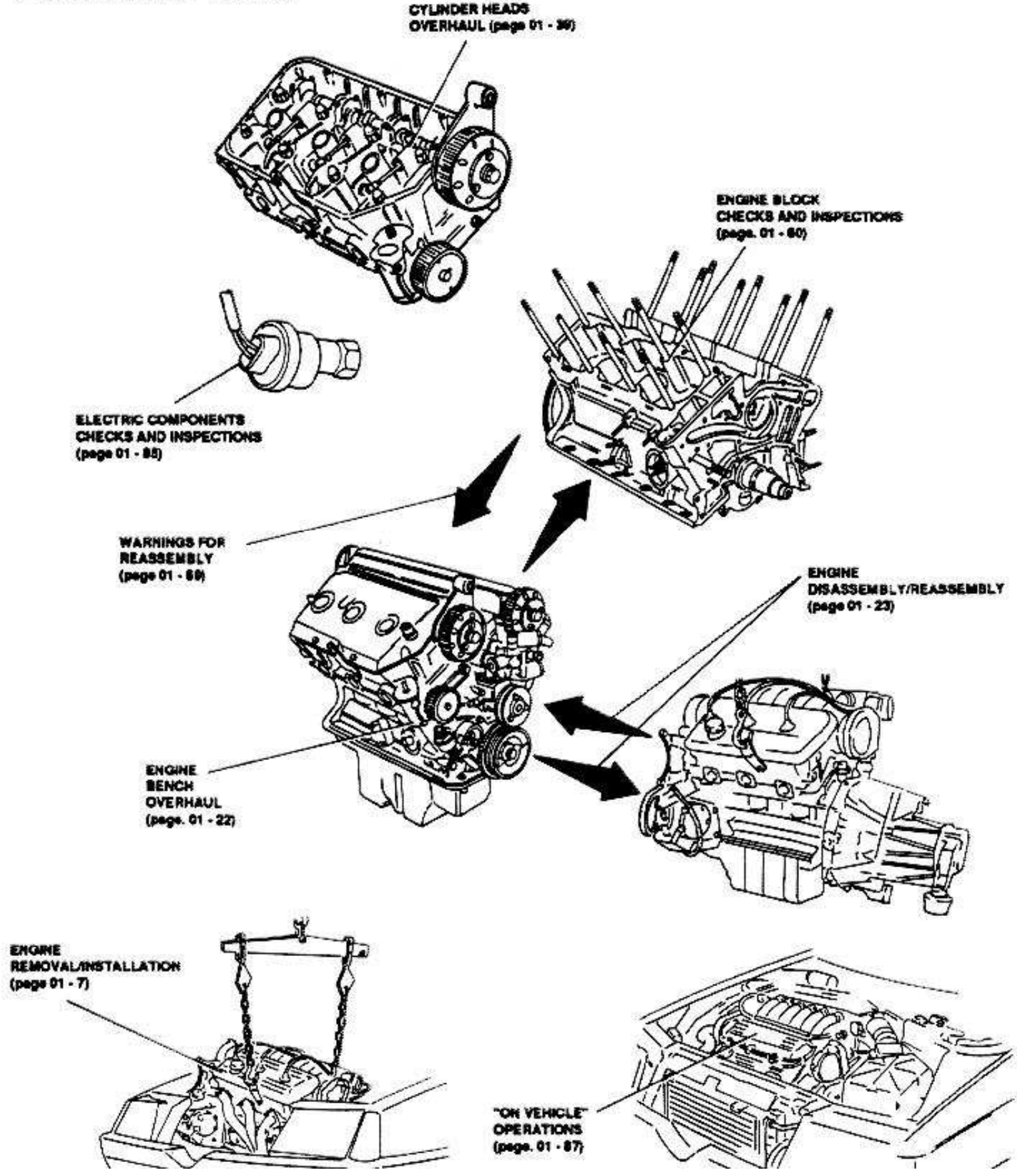
TABLE OF CONTENTS

GROUP 01

ENGINE

TABLE OF CONTENTS

ILLUSTRATED INDEX



ENGINE

ATTACHMENTS

The engine is installed on a support frame by means of three mounts.
Two mounts are of the hydraulic dampening type, the third mount is of the torque rod link type.
The upper part of the engine is attached to the car body by means of a link rod.

DISPLACEMENT

The engine has six 60° V mounted cylinders and a total displacement of 2.959 liters (183 cu. in).
The "V" arrangement and angle of 60° make the engine an extremely compact and well balanced unit from the dynamic point of view.
With a piston stroke of 72.6 mm (2.85 in) and bore of 93 mm (3.66 in) (unit displacement 493 cu. cm/30 cu. in), the engine is of the super square type (stroke and bore ratio lower than 1), and therefore allows a better arrangement of the valves and optimum filling of the cylinders (high volumetric ratio).

ENGINE CRANKSHAFT

The engine crankshaft, short and well balanced, is also provided with counter weights on the flywheel and on the driven pulley, thus obtaining optimum balancing.

ENGINE BLOCK AND CYLINDER HEADS

The engine block, with "wet" inserted cylinder liners, and the cylinder heads, are fully made of aluminum and silicon light alloy: this reduces the engine weight and allows an improved dissipation of engine heat.

TIMING

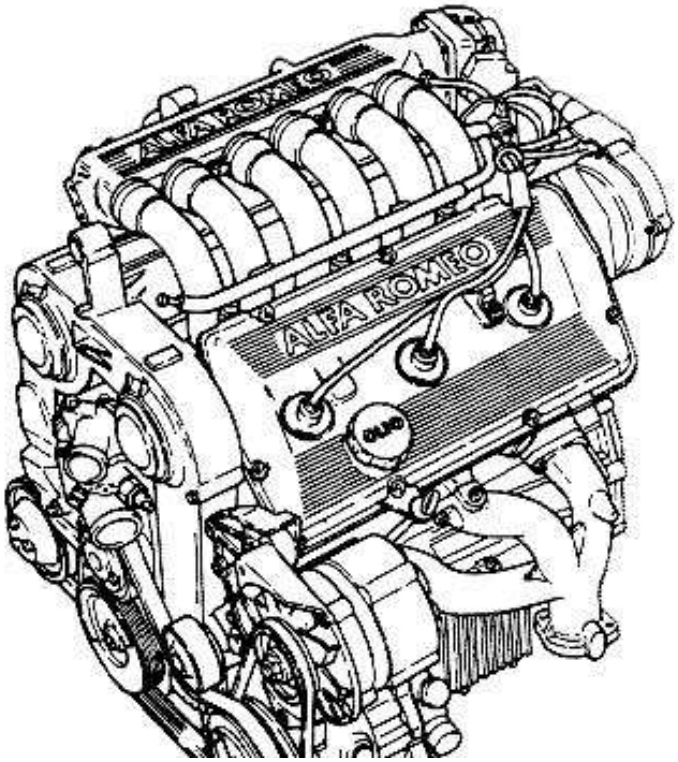
Engine timing is performed by means of two camshafts, one for each row of cylinders.
The camshafts are driven by a toothed belt with hydraulic tightener which automatically adjusts and maintains the belt tension.
The camshaft acts directly on the intake valves by means of the cams, and on the exhaust valves by means of short rods and rocker arms.

FUEL INJECTION AND IGNITION

Fuel injection and ignition are controlled in an integrated mode by the Bosch Motronic ML 4.1 system (refer to **Group 04**).

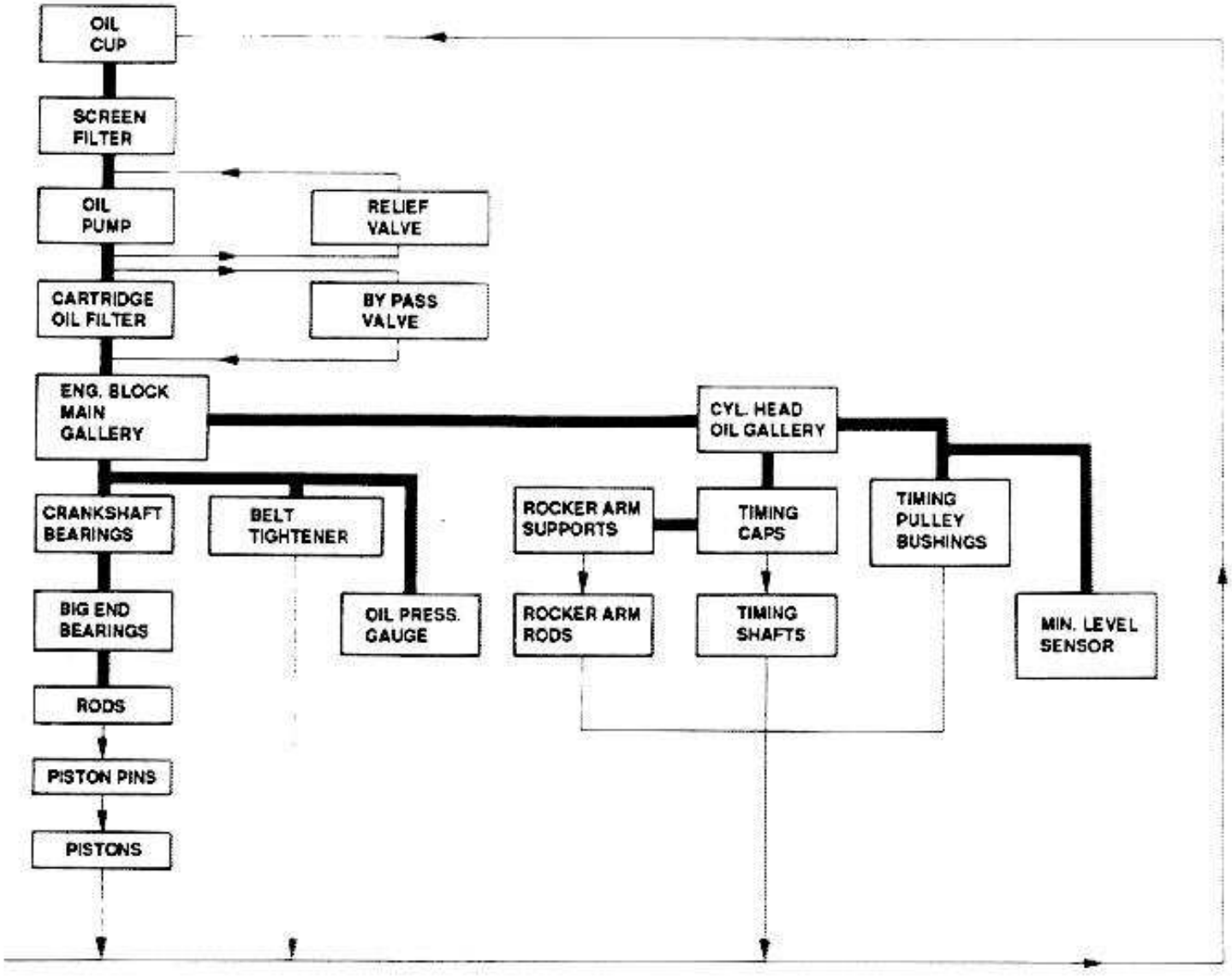
LUBRICATION

Engine oil flow is obtained by means of a rotating lobe type pump, attached to the lower inner side of engine block.
The oil pump is driven by the timing toothed belt through a pulley and a shaft.

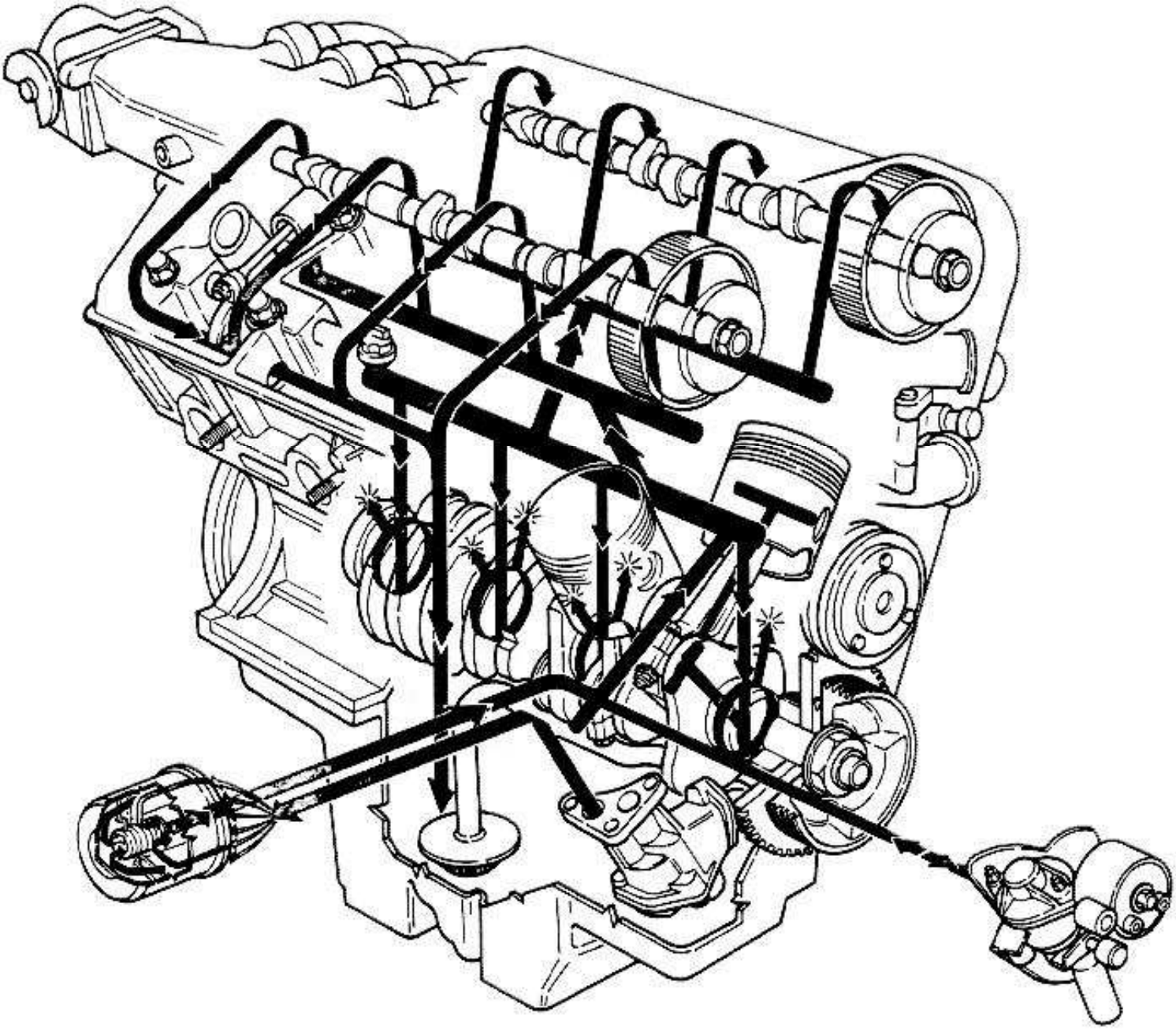


LUBRICATION

Engine lubrication is pressurized by a rotating lobe type pump fixed to the lower inner side of engine block. The pump is driven by the timing toothed belt through a pulley and a shaft. A relief valve controls the system pressure. The oil is filtered during suction by a screen filter on the suction body, and is subsequently filtered by a replaceable element filter on the supply line. The oil filter is provided with a by-pass valve that allows the oil to by-pass the filter when obstructed. A longitudinal central oil hole in the engine block allows to lubricate the crankshaft, the pistons and the connecting rods. Other two passages allow to lubricate the cylinder heads, and therefore all the components of engine timing system. Furthermore, the oil lubricates the timing toothed belt hydraulic tightener. A recirculation system and vapor separator allows recovering of oil vapors from the right cylinder head. The lubricating pressure is indicated by a pressure gauge on instrument panel, and a warning lamp alerts the driver when the oil pressure is too low. Pressure signals are supplied by a pressure switch and sensor located to the end of engine block longitudinal oil hole. An oil level sensor, located aside of the oil dipstick, provides input signal for the illumination of a low oil level warning lamp on the instrument panel. The oil filler cap is located on top of the front head.



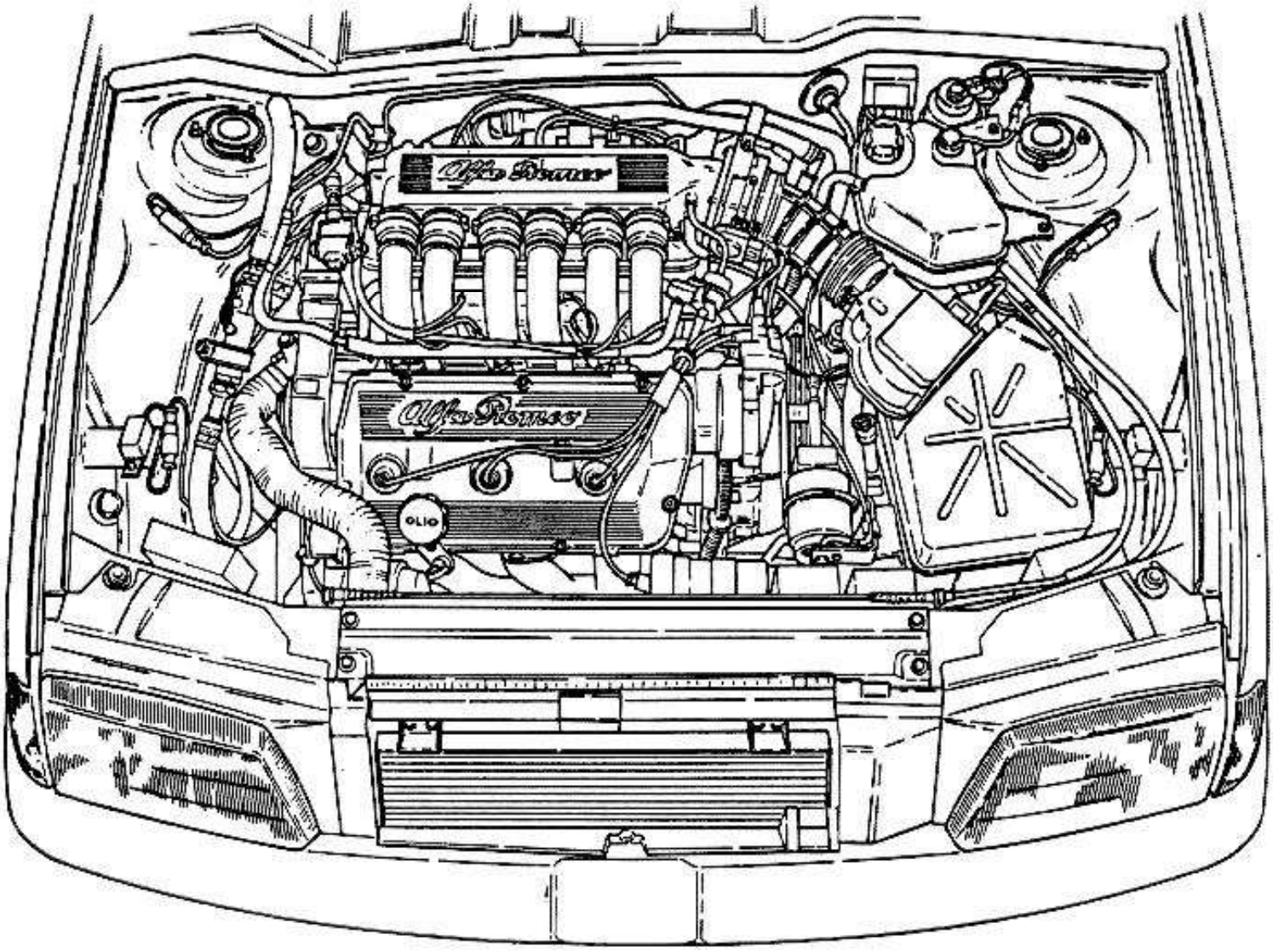
LUBRICATING SYSTEM



ENGINE REMOVAL/ INSTALLATION

The information and illustrations below allow a rapid removal of the complete engine from its housing in the engine compartment, and subsequent re-installation.

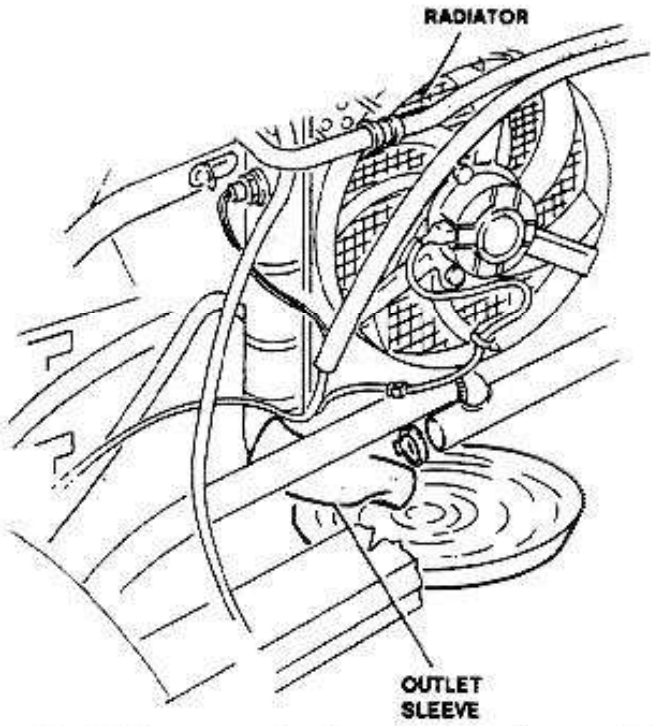
Bench disassembly of single engine components is described in a separate further chapter.
This procedure is considered as a unique and complete procedure; nevertheless, parts of the procedure can be used as required.
For further information and details refer to the chapters relevant to specific components or groups.



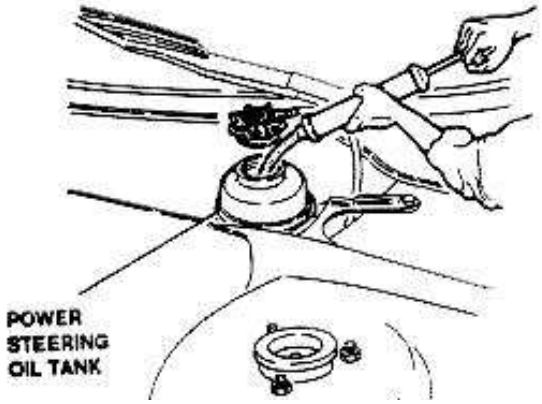
REMOVAL

- Remove header tank cap; disconnect radiator outlet sleeve and drain engine coolant in a suitable container.

CAUTION:
The anti-freezing mixture used as engine coolant is harmful for the paint work: avoid any contact of anti-freezing mixture with painted surfaces.



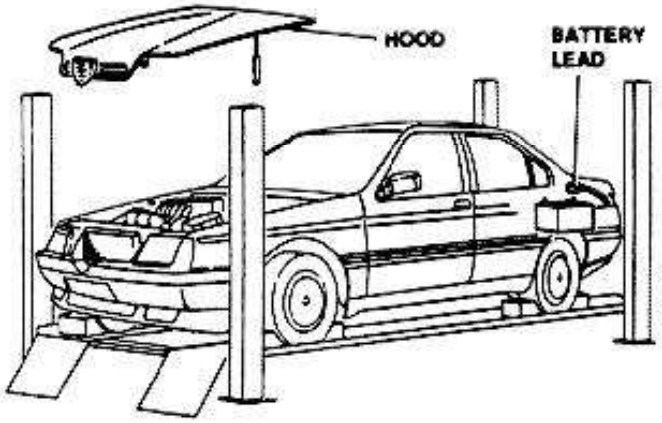
- Empty the power steering oil tank using a suitable syringe.



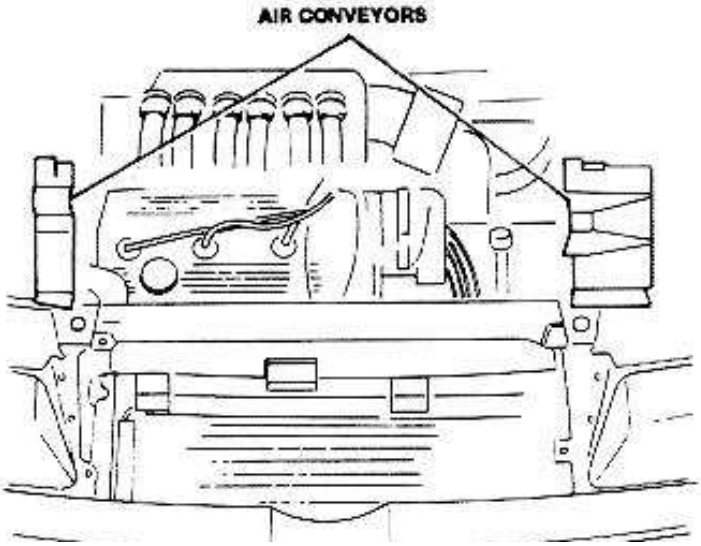
- Position vehicle on auto elevator, block wheels with suitable safety chocks and apply the parking brake.
- Disconnect battery (-) lead.
- Remove engine hood (refer to **Group 56**).

CAUTION:
Protect hood support area with cushioning material to avoid damaging the vehicle body.

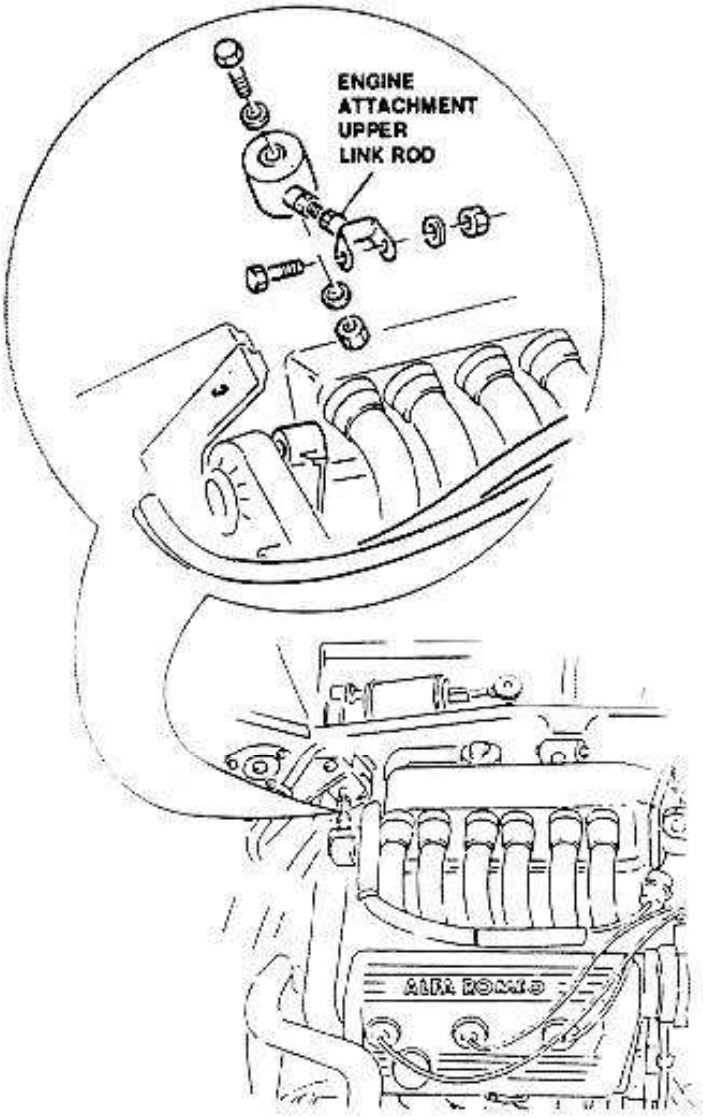
WARNING:
Whenever the engine is still warm, adopt any precaution to avoid scalds.



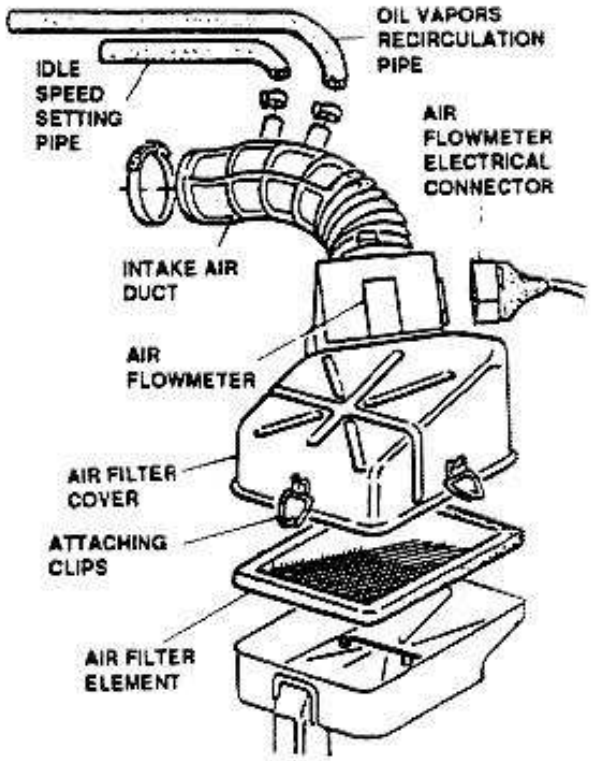
- Remove the two air conveyors located on sides of radiator



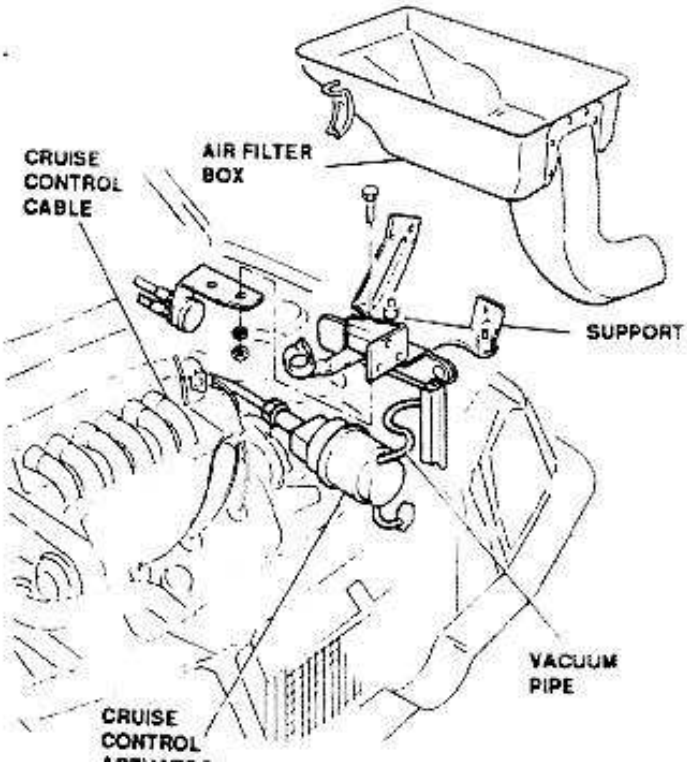
- Disconnect engine attachment upper link rod.



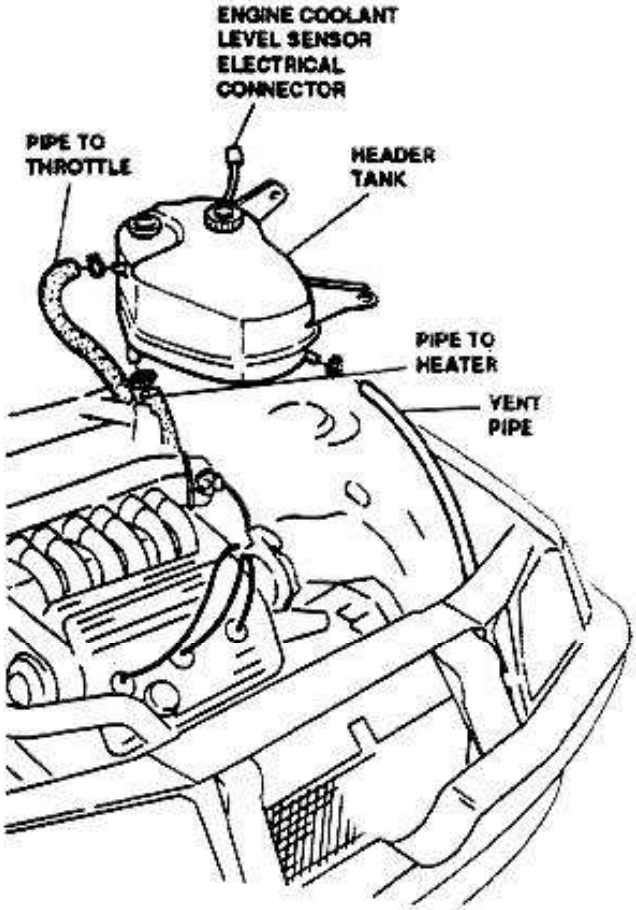
- Disconnect oil vapors recirculation pipe.
- Disconnect idle speed setting pipe.
- Remove clamp and separate duct from intake chamber.
- Disconnect air flowmeter electrical connector.
- Release air filter cover clips.
- Remove cover-air flow meter-intake duct assembly.
- Remove air filter element.
- Remove air filter box.
- Disconnect electrical connector and vacuum pipe, then remove Cruise Control actuator after it has been disconnected from the Cruise Control cable (refer to Group 04).



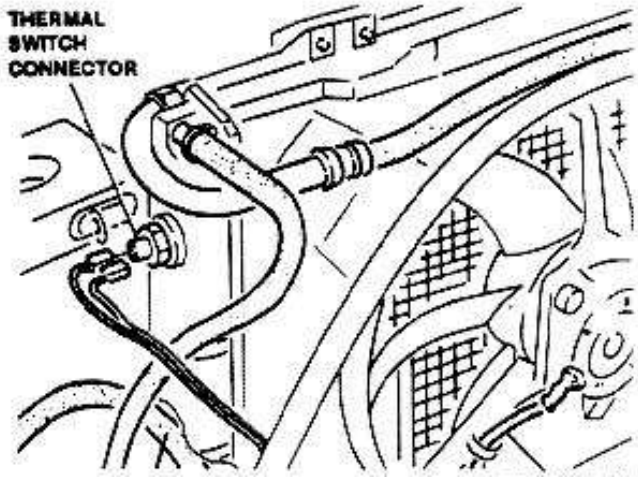
- If the vehicle is equipped with a vibration damper on the clutch circuit, detach the damper fixing bracket from the air filter support, and move it aside without disconnecting the pipes (refer to Group 12).
- Remove air filter support.



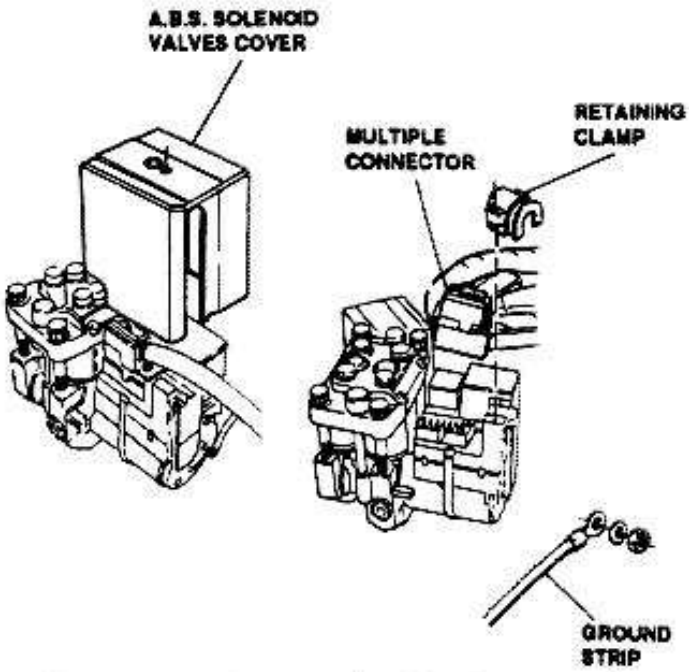
- Disconnect electrical connection of engine coolant level sensor.
- Disconnect vent pipe and pipes to throttle and heater from engine cooling header tank.
- Remove header tank.



- Disconnect radiator thermal switch electrical connector.
- Disconnect electrical cooling fan electrical connector.

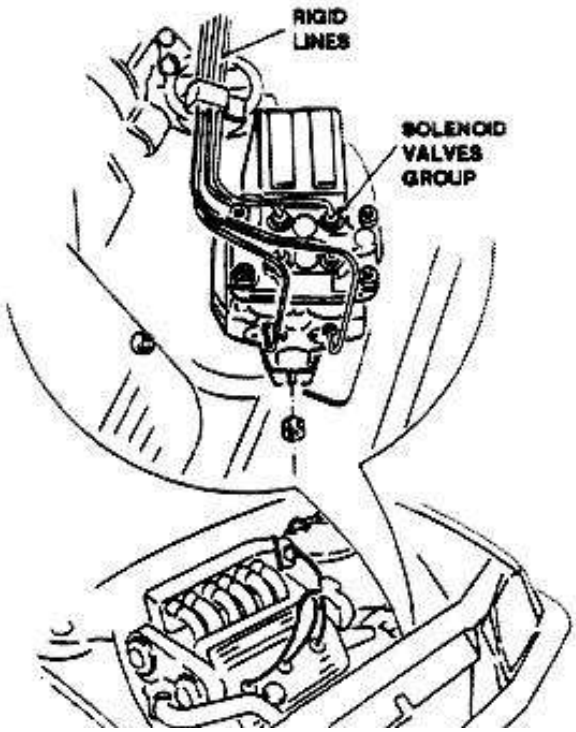


- Disconnect A.B.S. solenoid valves cover; disconnect multiple connector and ground strip; re-install cover.

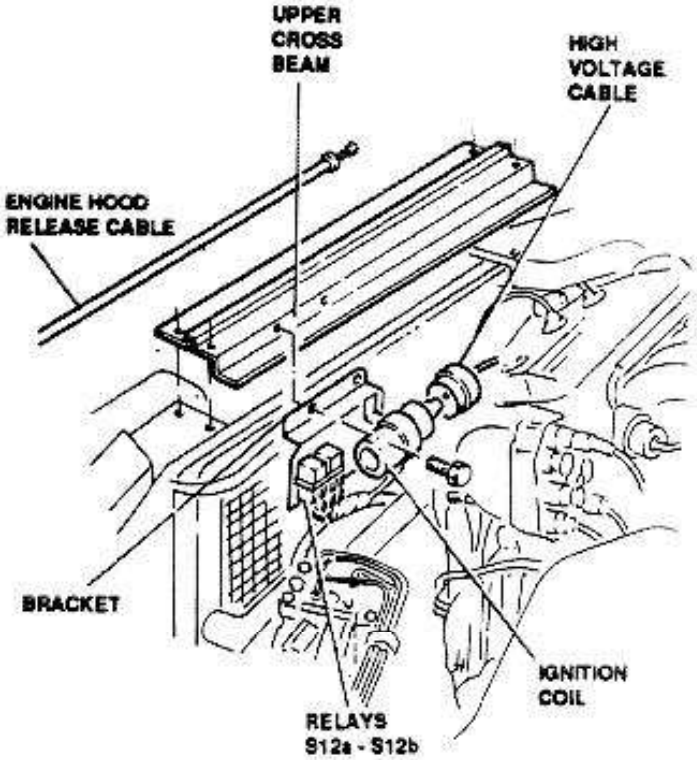


- Disconnect and move solenoid valves group to one side, without disconnecting rigid lines.

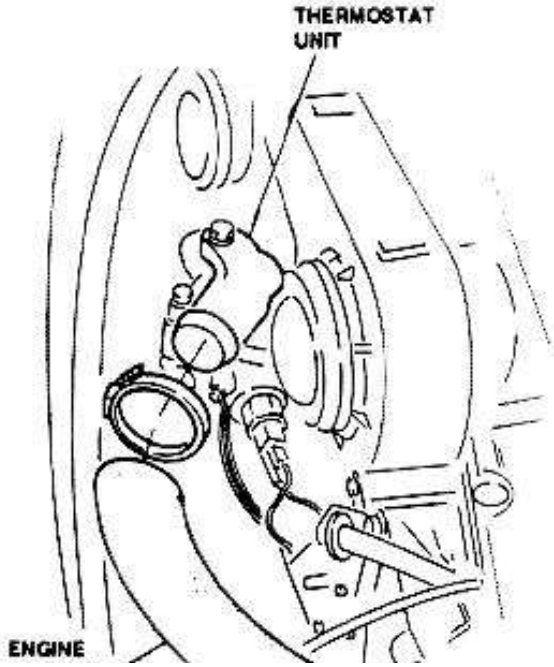
CAUTION:
Take care to prevent damaging the rigid lines.

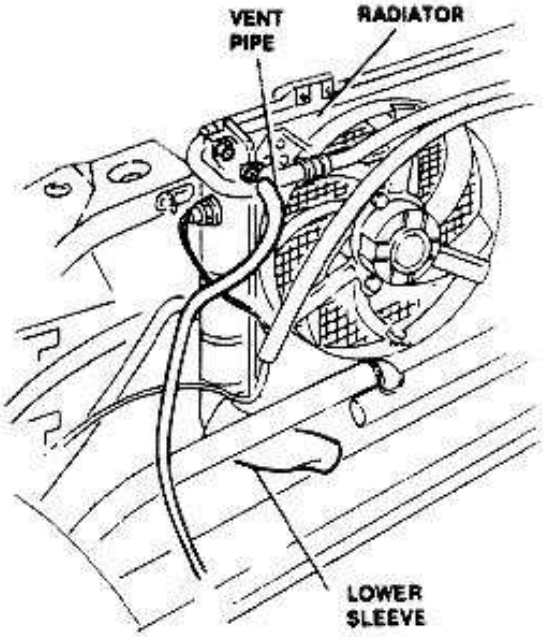


- Disconnect engine hood release cable.
- Disconnect high voltage cable from ignition coil.
- Disconnect ignition coil and relays bracket from upper cross beam and move it to one side.
- Remove upper cross beam.



- Disconnect radiator supply pipe from thermostat unit.
- Disconnect and remove lower sleeve from radiator, and disconnect vent pipe.

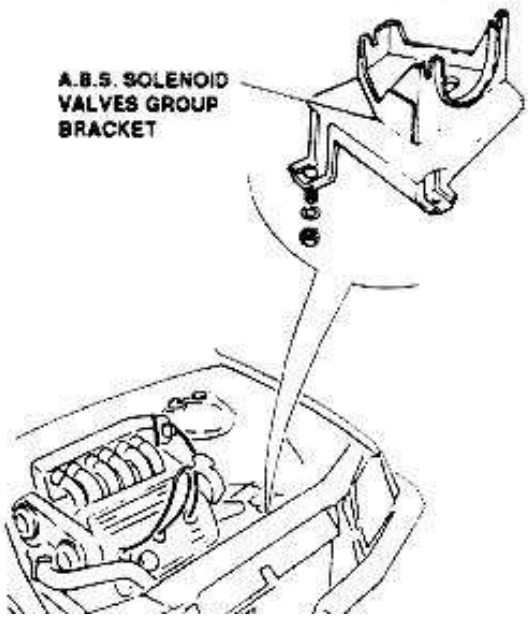




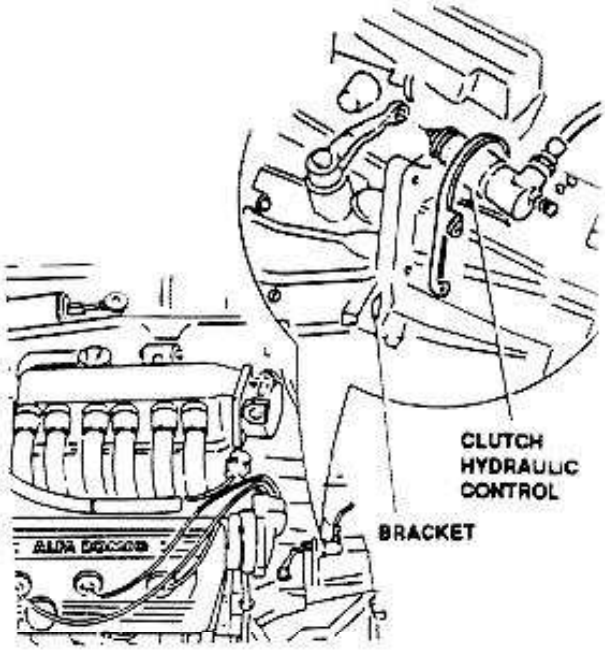
- Remove radiator together with electrical fan and conveyor.

CAUTION:
The air conditioning system condenser must not be removed; take care to prevent damaging its pipes whilst removing the radiator

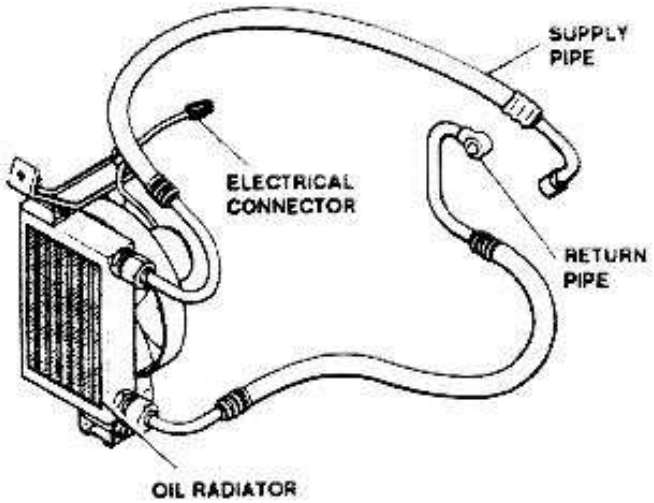
- **Only for vehicles equipped with spacers between engine support frame and bodywork:**
  - Remove shims located between radiator and support frame.
- Remove A.B.S. solenoid valves group bracket.



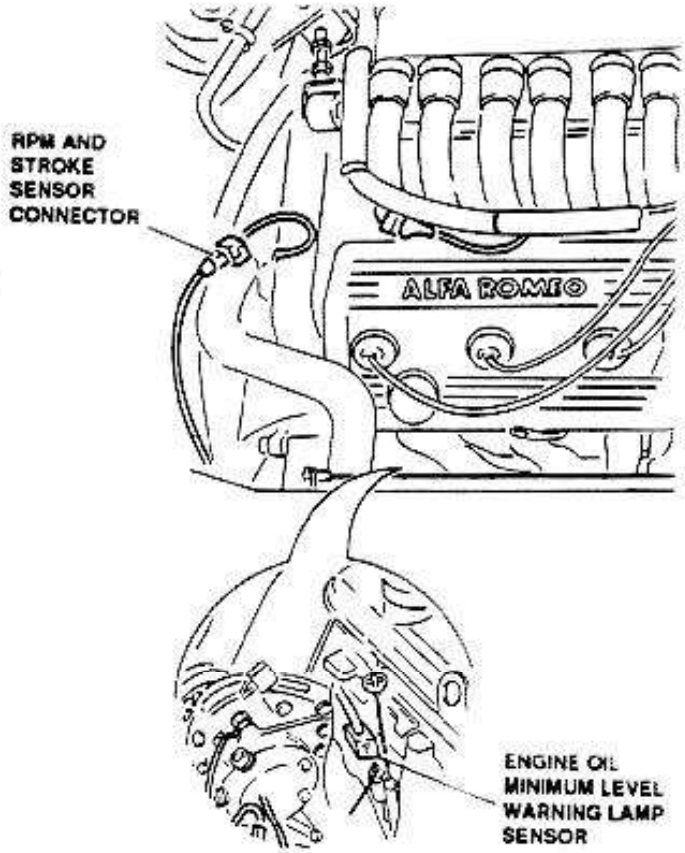
- **On vehicles equipped with Manual Transmission:**
  - Disconnect clutch hydraulic control.
  - Remove bracket together with control cylinder without disconnecting pipe.



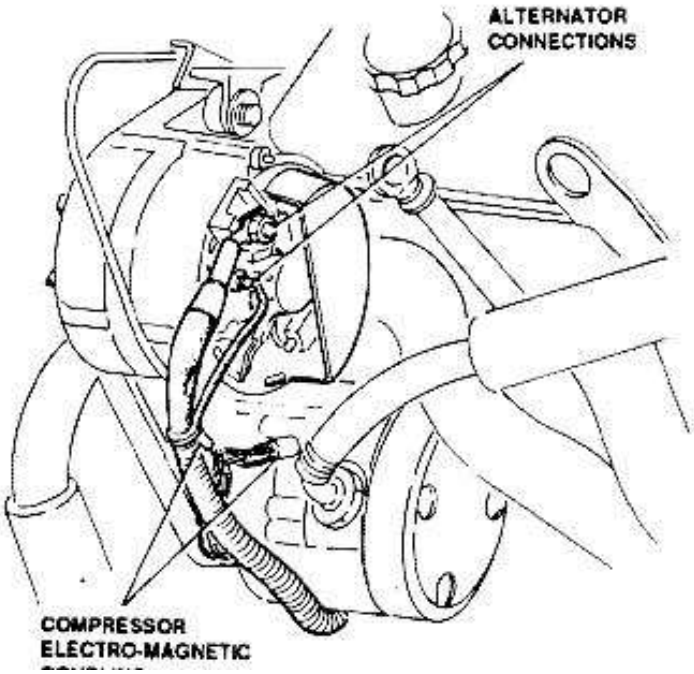
- **On vehicles equipped with Automatic Transmission:**
  - Disconnect oil radiator supply and return lines from automatic transmission.
  - Disconnect oil radiator cooling fan electrical connector.
  - Remove oil radiator.



- Disconnect RPM and stroke sensor electrical connector.
- Disconnect engine oil minimum level warning lamp sensor.

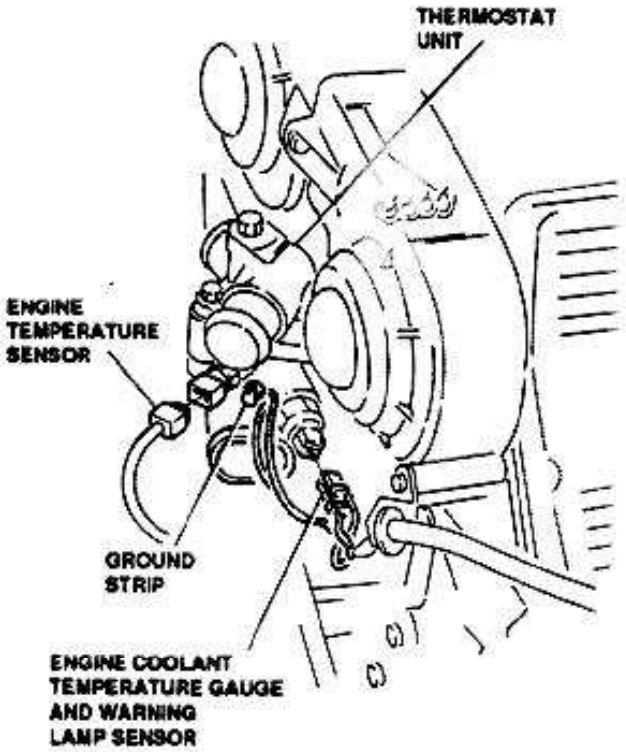


- Disconnect alternator and air conditioning compressor cables.

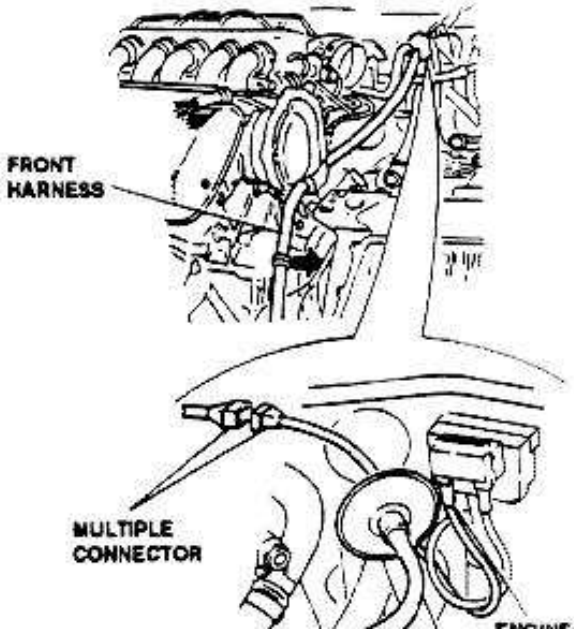


COUPLING
CONNECTOR

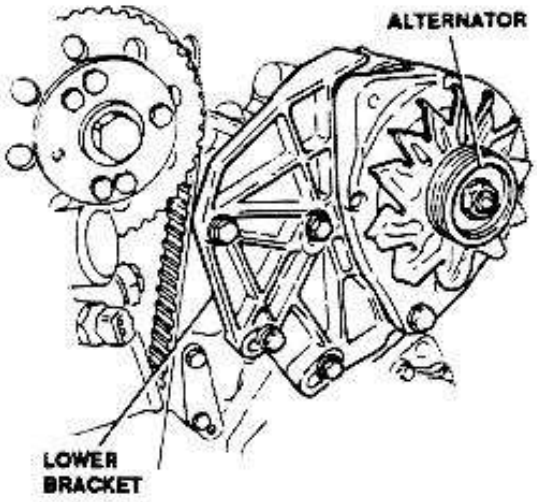
- Disconnect engine temperature sensor.
- Disconnect engine coolant temperature gauge and warning lamp sensor.
- Disconnect ground strip from thermostat unit.



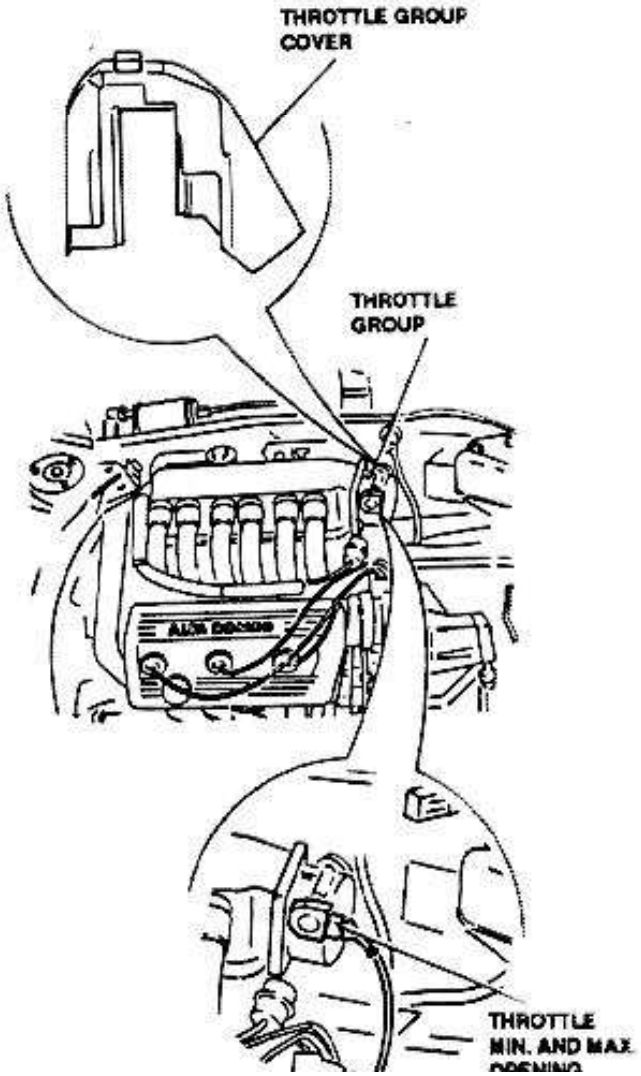
- Move front harness apart to clear access to engine.
- Disconnect multiple connector from inner side of bulkhead.
- Disconnect engine starter harness.



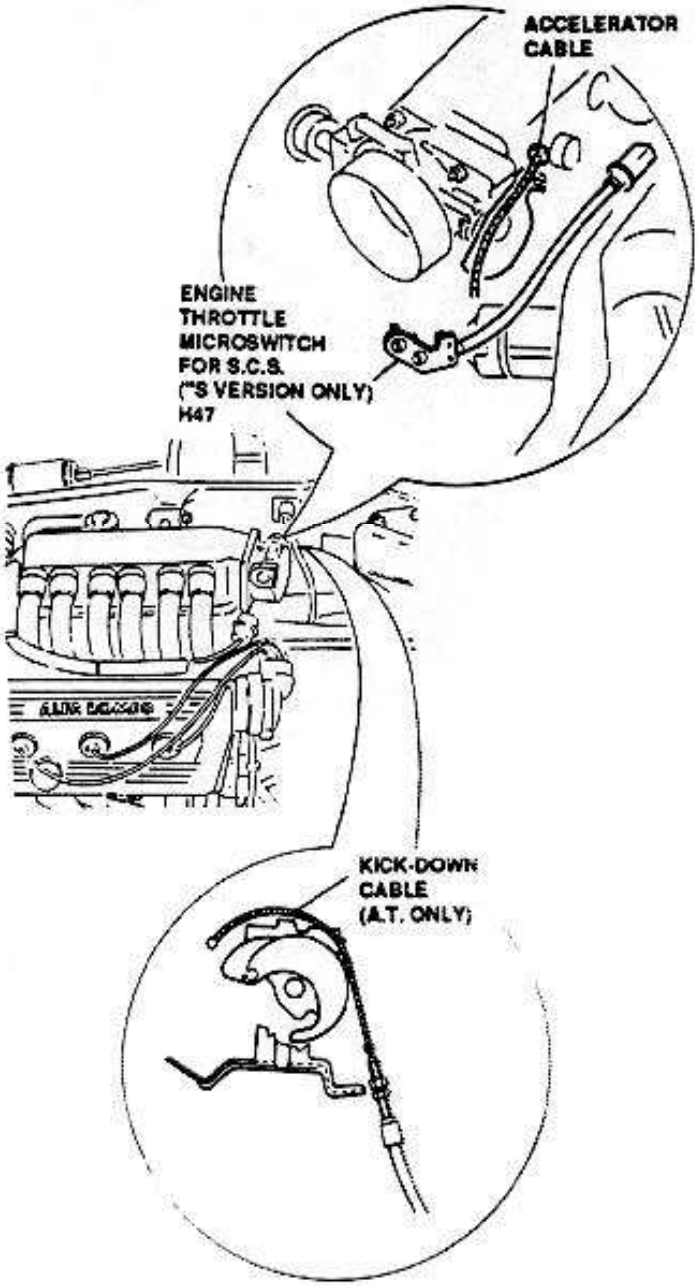
- Remove alternator.



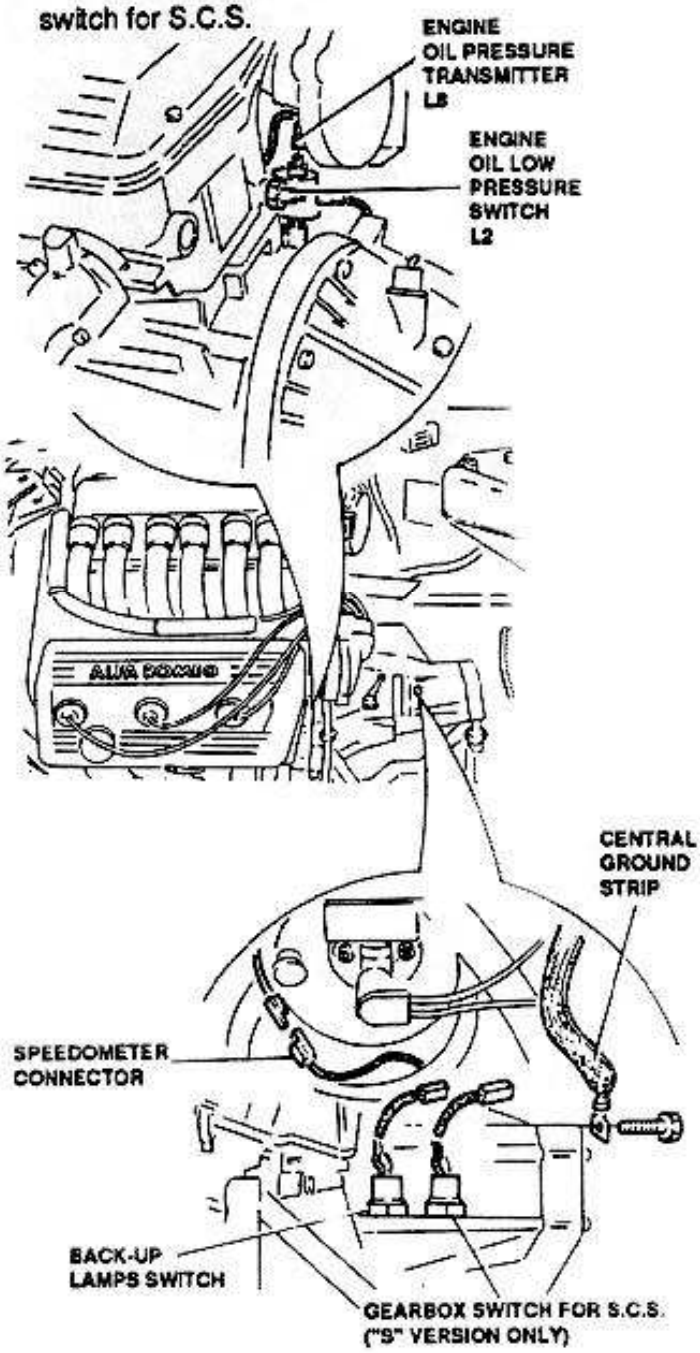
- Disconnect throttle minimum and maximum opening switch connector.
- Remove throttle group cover.



- Disconnect accelerator cable.
- **On vehicles equipped with Automatic Transmission:** disconnect "kick-down" cable.
- **On "S" Version Vehicles:** remove engine throttle microswitch for S.C.S.

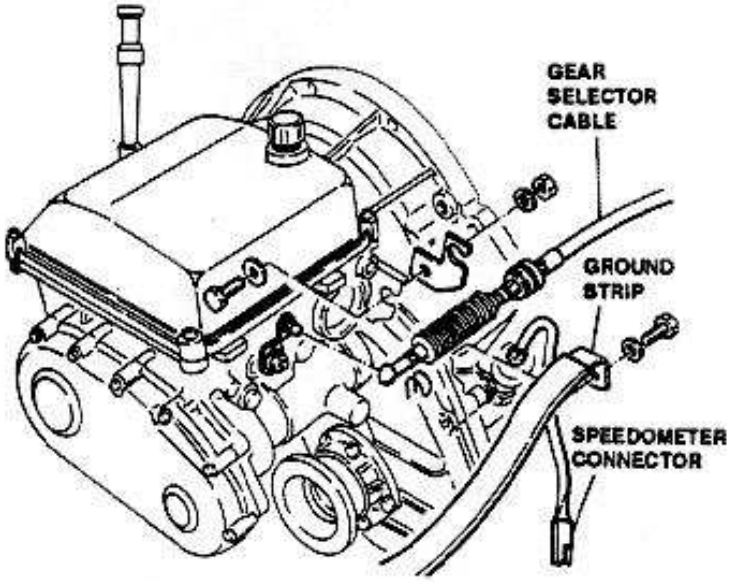


- Disconnect central ground strip.
- Disconnect engine oil low pressure switch electrical connector.
- Disconnect engine oil pressure transmitter.
- Disconnect rear ground strip on cylinder head.
- **On vehicles equipped with Manual Transmission:**
  - Disconnect back-up lamps switch connector.
  - Disconnect speedometer connector.
- **On "S" Version Vehicles:** disconnect gearbox switch for S.C.S.

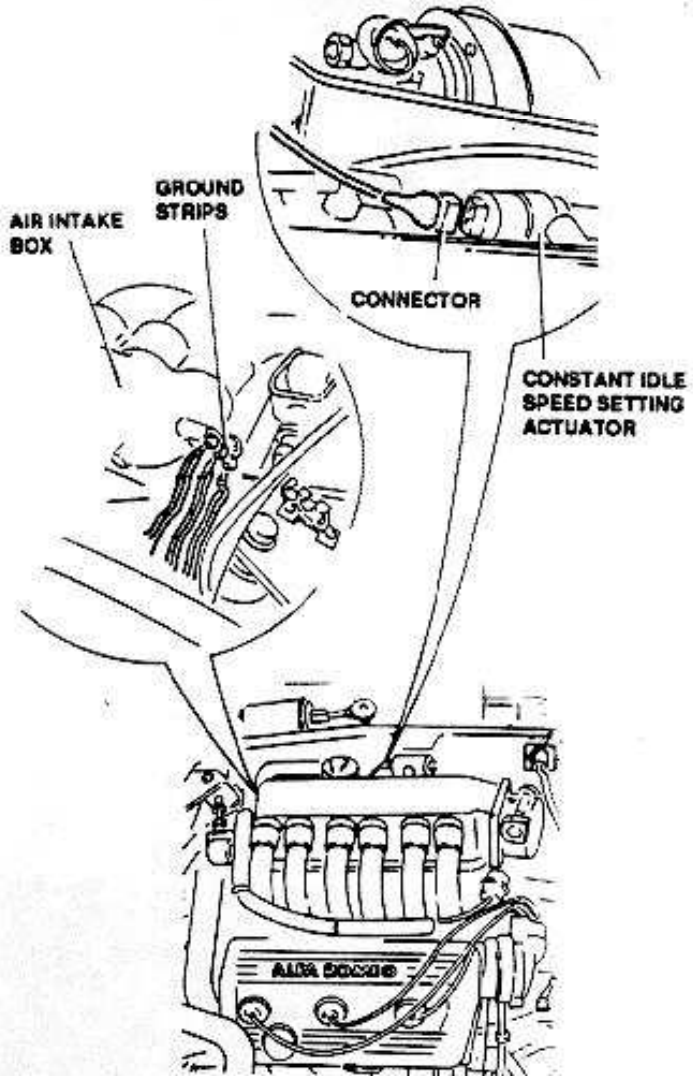


- **On vehicles equipped with Automatic Transmission:**
  - Disconnect gear selector cable.
  - Disconnect speedometer connector.
  - Disconnect gearbox case ground strip.

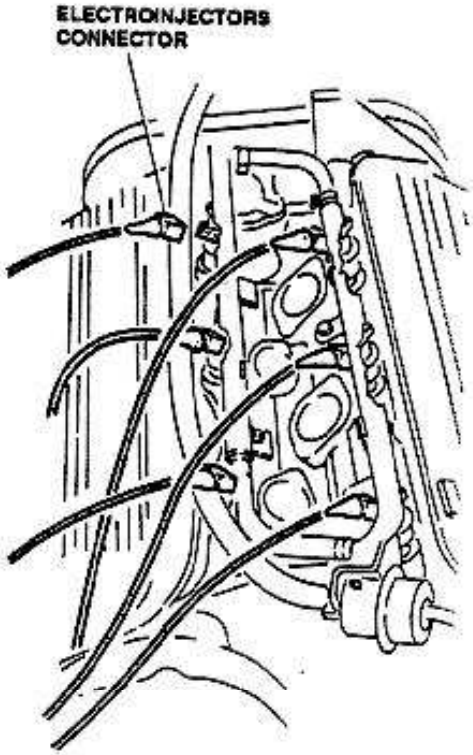
- Disconnect rear ground strip on cylinder head. Disconnect gearbox case ground strip.



- Disconnect constant idle speed setting actuator connector.
- Disconnect ground strips from air intake box.



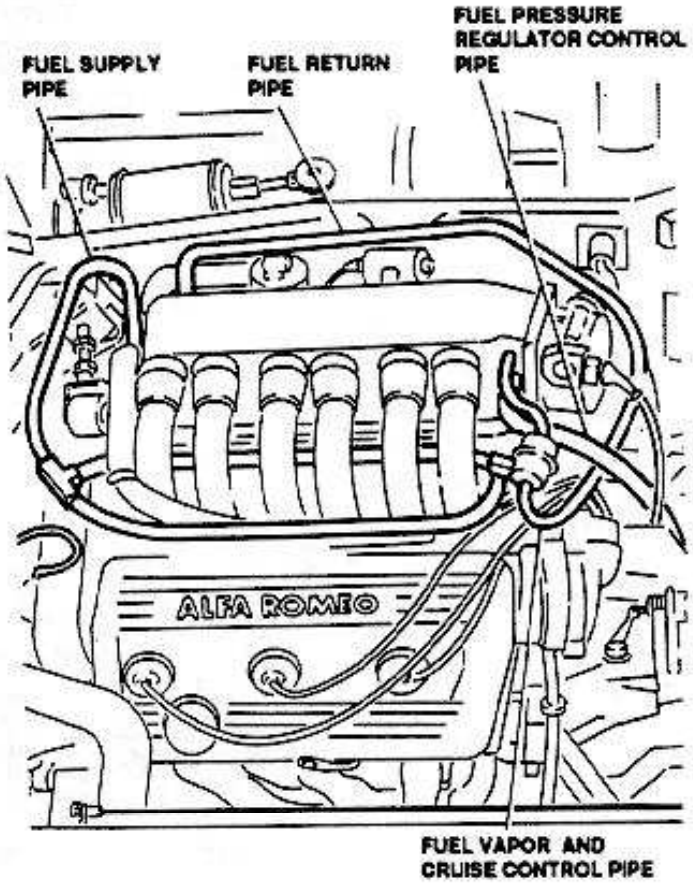
- Disconnect electroinjectors cables support bracket.
- Disconnect electronic injectors connector.



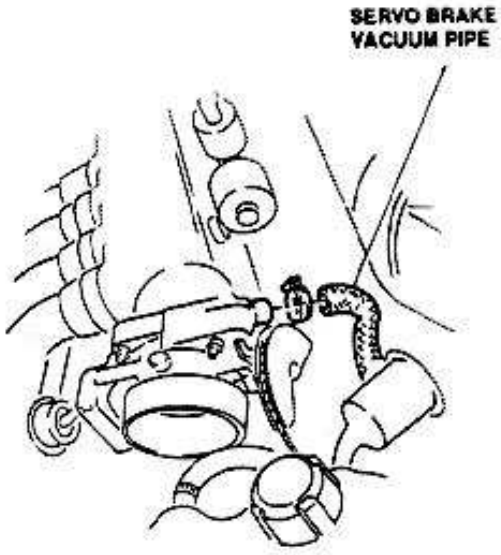
WARNING:
During any activity on fuel system components carefully observe the following precautions:

- **Ensure the workshop is provided with the prescribed safety equipment (fire extinguishers, etc.).**
- **Disconnect battery (-) lead.**
- **Collect fuel drained from the system in a suitable container provided with a safety cap.**
- **The fuel system could be pressurized: act with precaution.**
- **Do not smoke.**

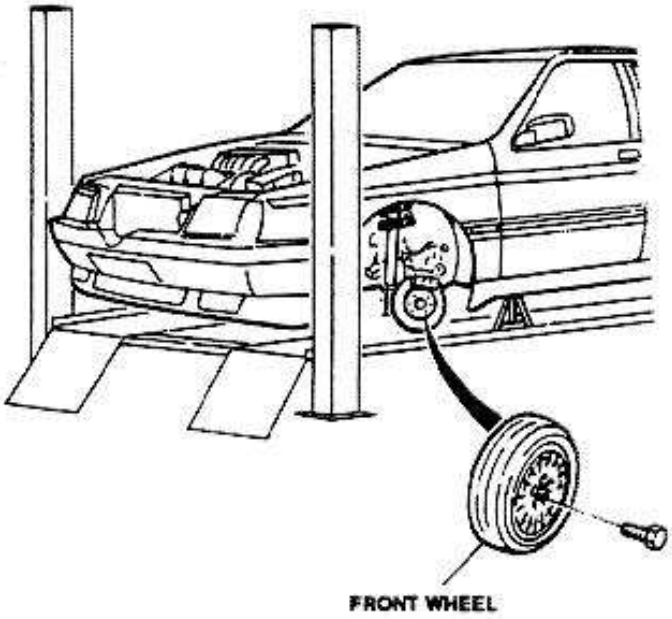
- Disconnect fuel vapor and Cruise Control pipe from air intake box.
- Disconnect fuel pressure regulator control pipe.
- Disconnect fuel supply and return pipes.



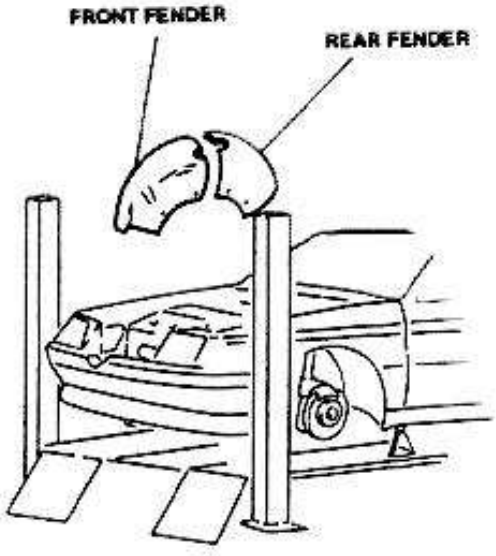
- Disconnect servo-brake vacuum pipe.



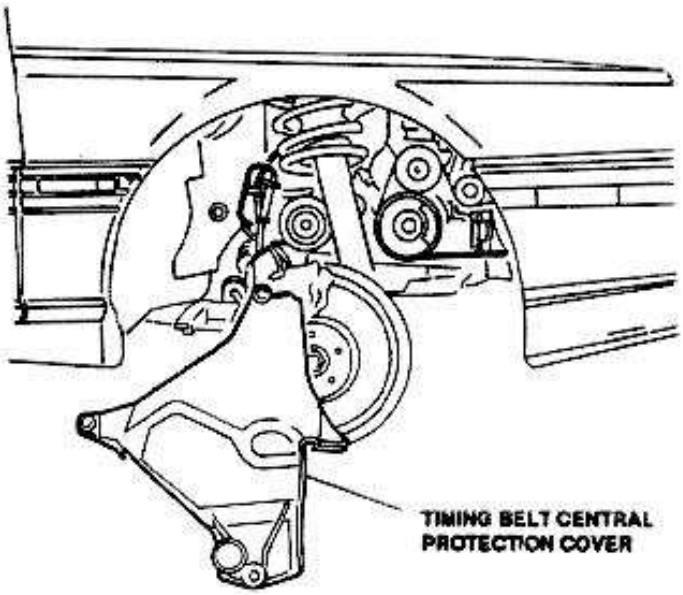
- Place vehicle on suitable jacks and remove front wheels.



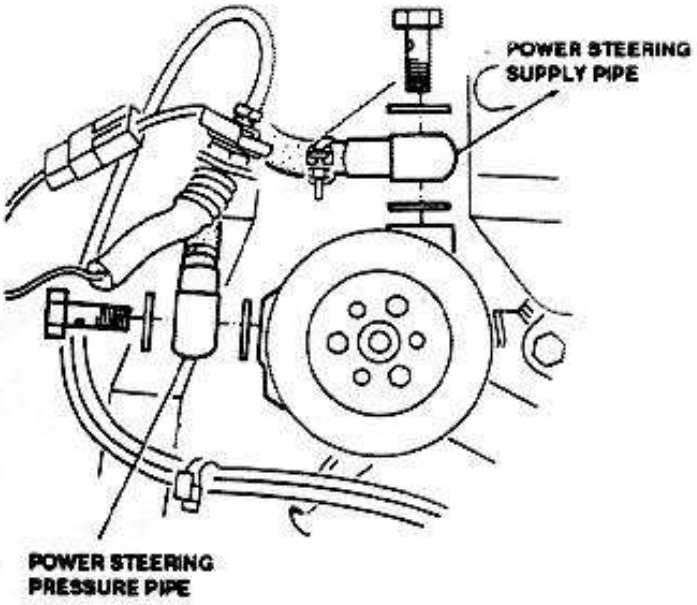
- Remove front and rear fender acting from right wheel bay.



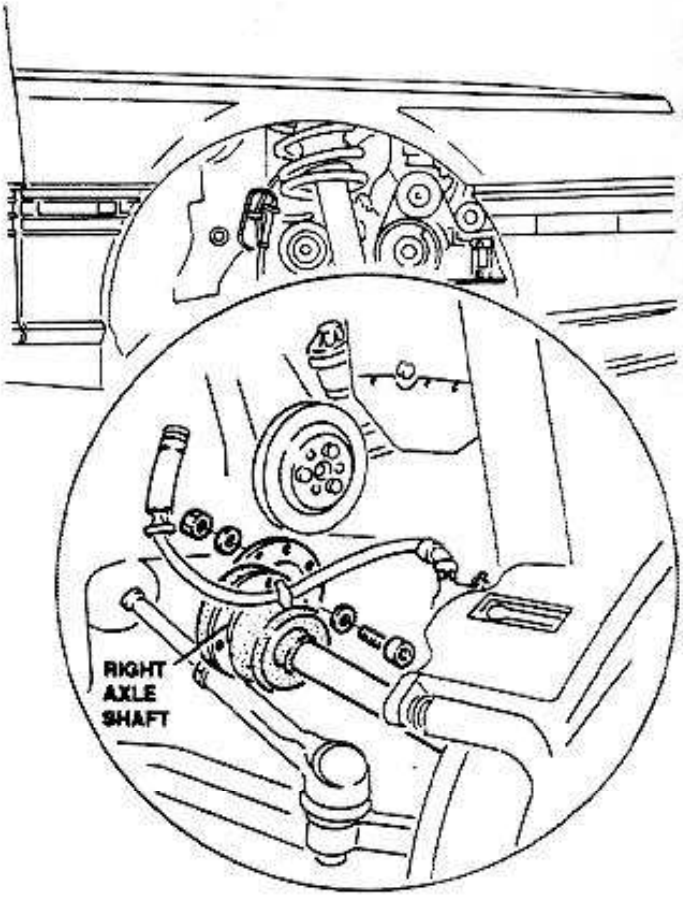
- Disconnect timing belt central protection cover.



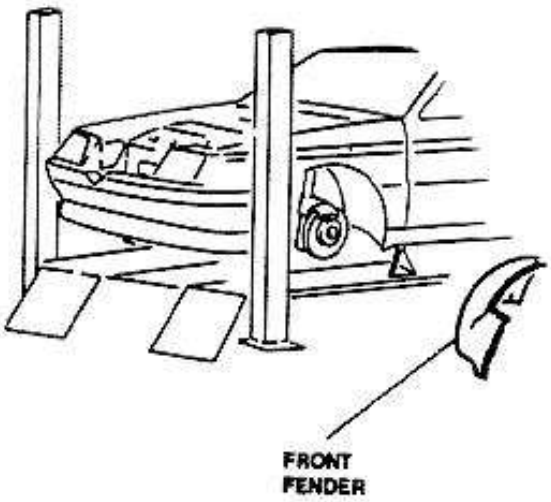
- Loosen power steering pipes.



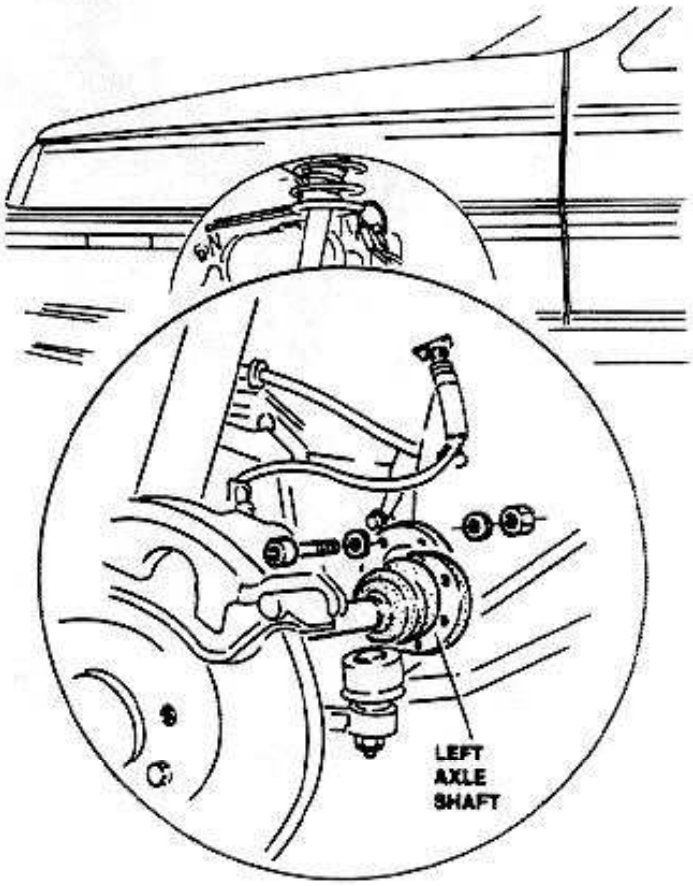
- Disconnect right axle shaft.



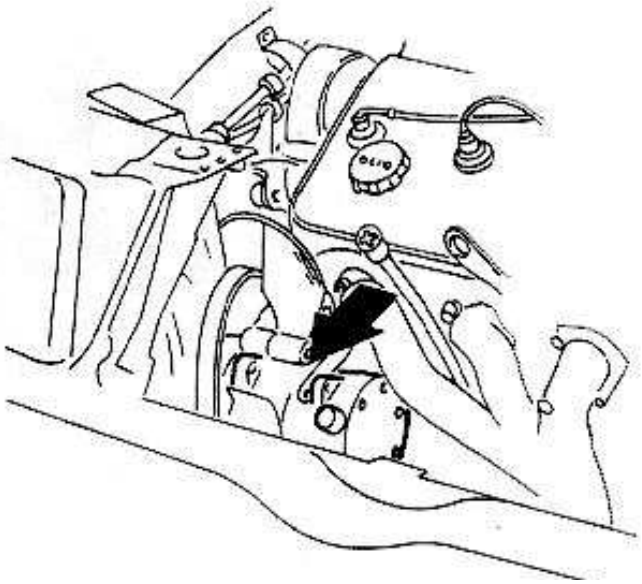
- Disconnect front fender acting from left wheel bay.



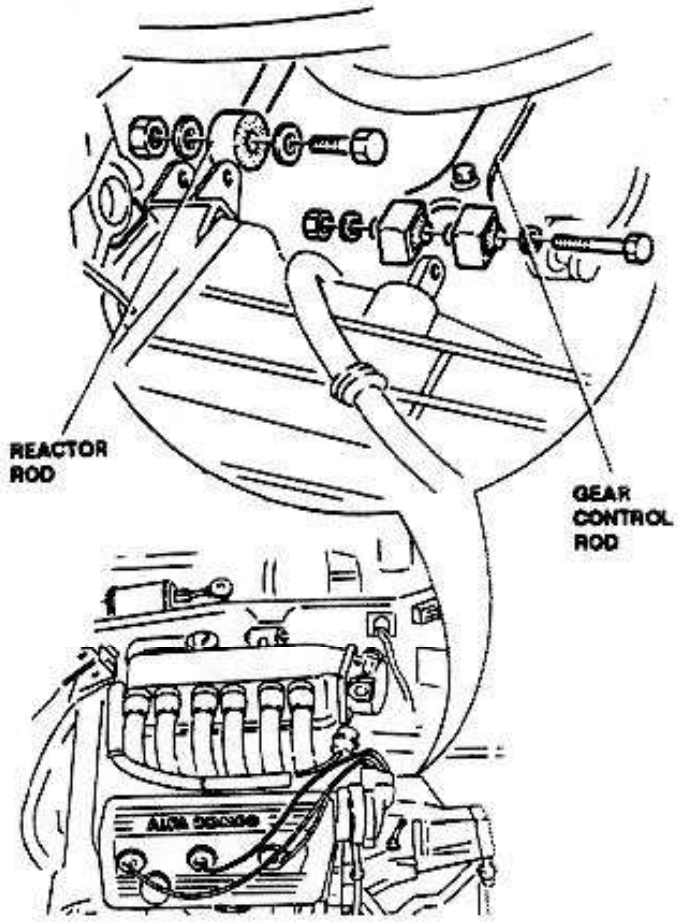
- Disconnect left axle shaft



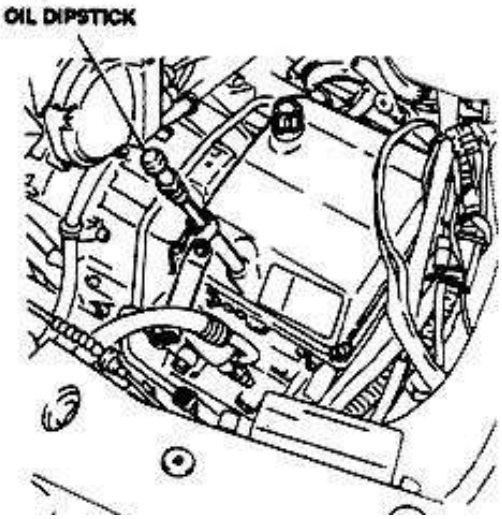
- Acting in engine compartment, move air conditioning apart and lower it into engine compartment



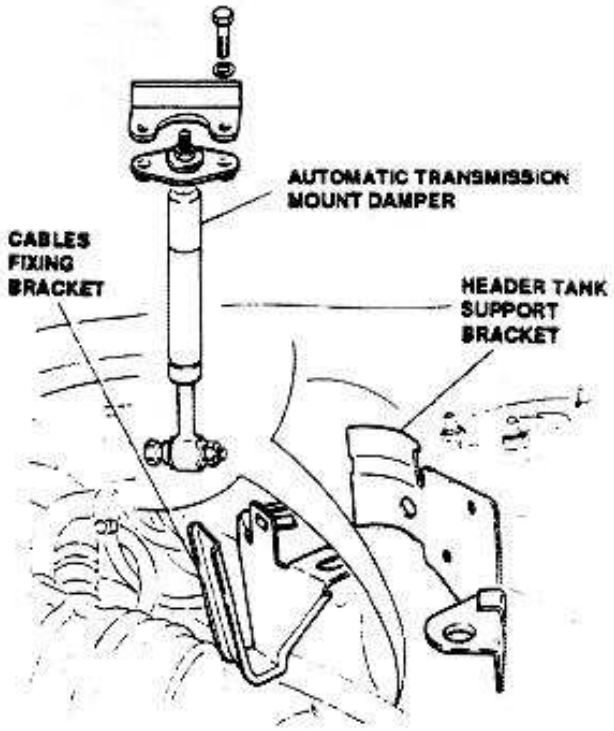
- On vehicles equipped with Manual Transmission:
  - Disconnect gear control rod.
  - Disconnect reactor rod.



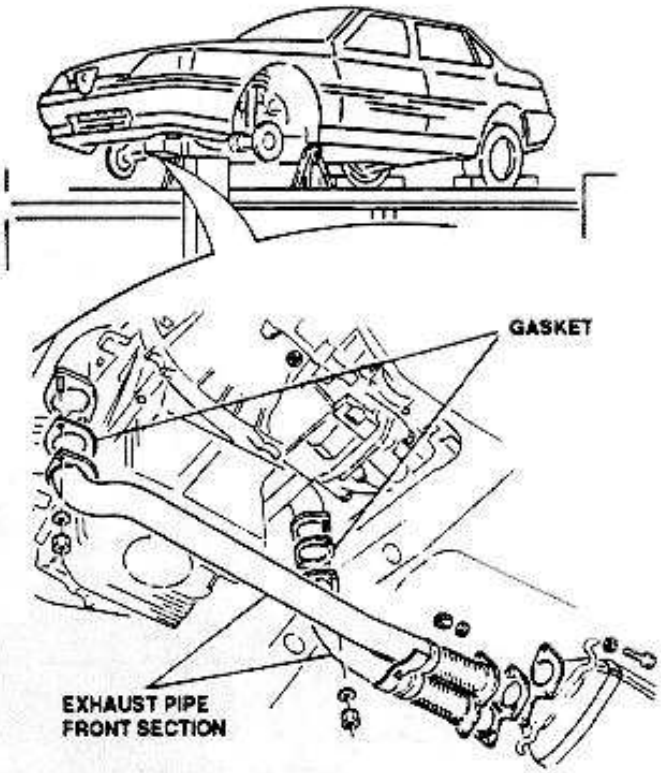
- On vehicles equipped with Automatic Transmission:
  - Remove oil dipstick and plug opening.



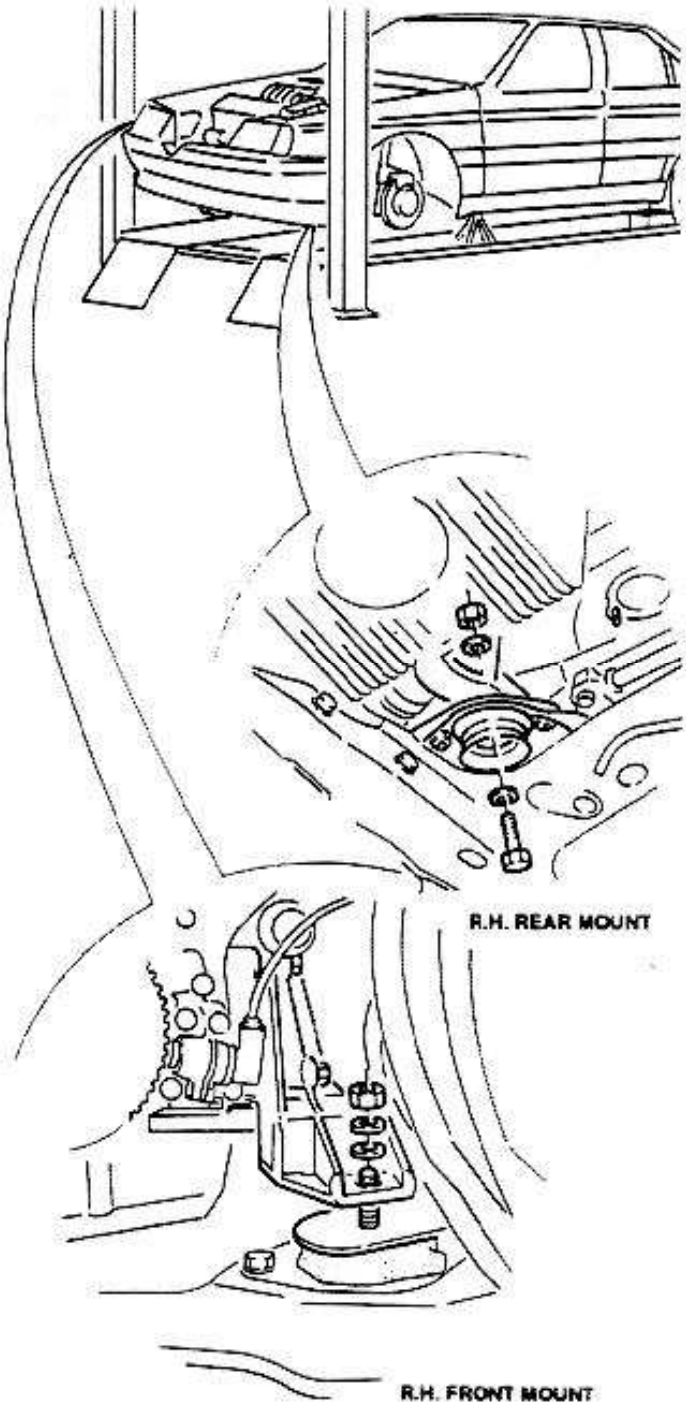
- Disconnect automatic transmission mount damper after the two support brackets have been removed.



- Lift vehicle on auto elevator.
- Disconnect front section of exhaust pipe and remove it; remove gaskets.

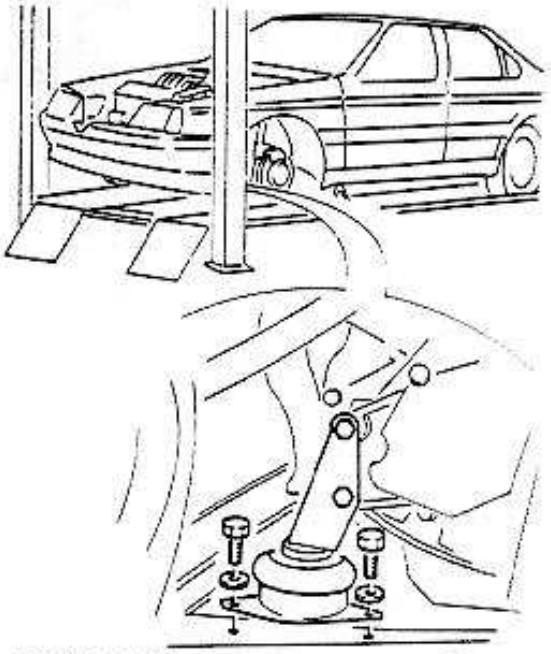


- Remove right front and rear mounts from their attachments



- Place a hydraulic jack below engine compartment, then extend jack until it contacts the gearbox.

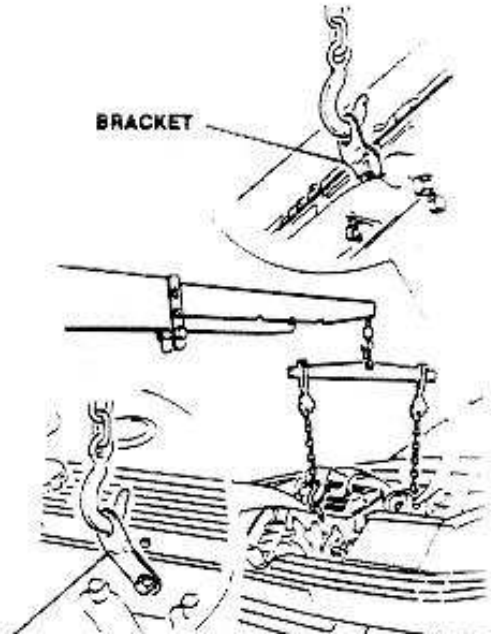
- Disconnect and remove engine mount on gearbox side.



ENGINE MOUNT, GEARBOX SIDE

- Connect hook of a suitable hoist to lifting brackets.

CAUTION:
Clear the electric cables from any clamping device and move them away from engine to prevent any interference during engine removal.



- Lift engine group.

CAUTION:
At the beginning of lifting operation check that all pipes, ducts and electric wires have been disconnected from engine

CAUTION:
Pay necessary attention to prevent damages to any component, and in particular to the power steering box, A.B.S. system rigid lines and to the air conditioning compressor and condenser.

INSTALLATION

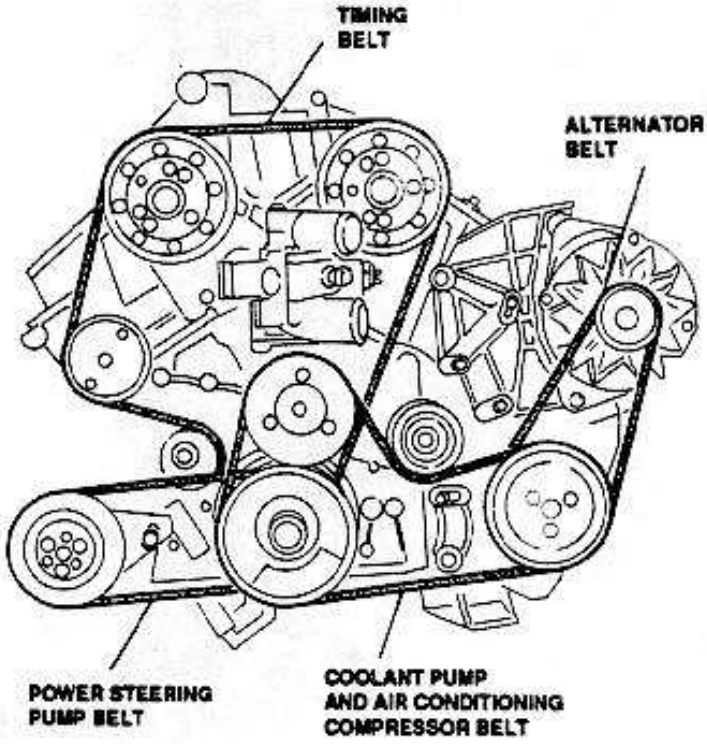
Repeat in reverse order the removal procedure, taking into account the following recommendations:

- Prepare engine compartment for insertion of engine group by placing all electric wires, pipes, etc. so that they will not interfere during engine installation.
- Pay necessary attention when lowering engine into its compartment to prevent damaging any component, and in particular the power steering box, A.B.S. system rigid pipes and the air conditioning compressor and condenser.

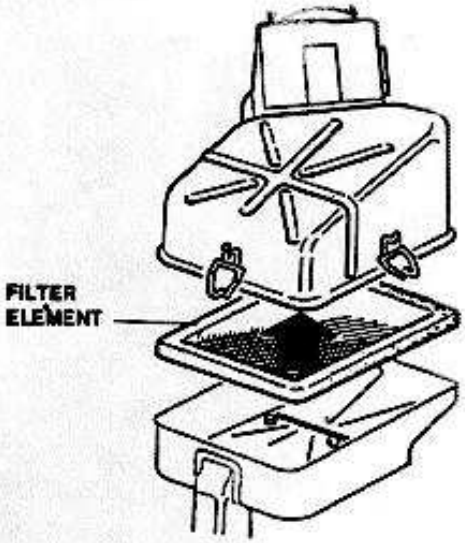
CAUTION:
Ensure the right side mounts are properly seated in their respective attachment points.

- Following installation, adjust tension of alternator drive belt, and check proper tension of all the other

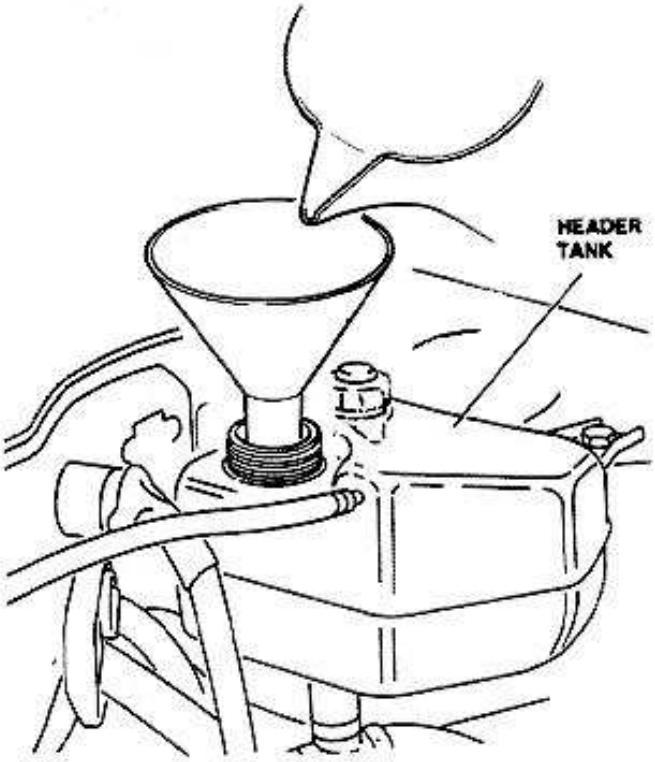
Belts (Refer to Group 00).



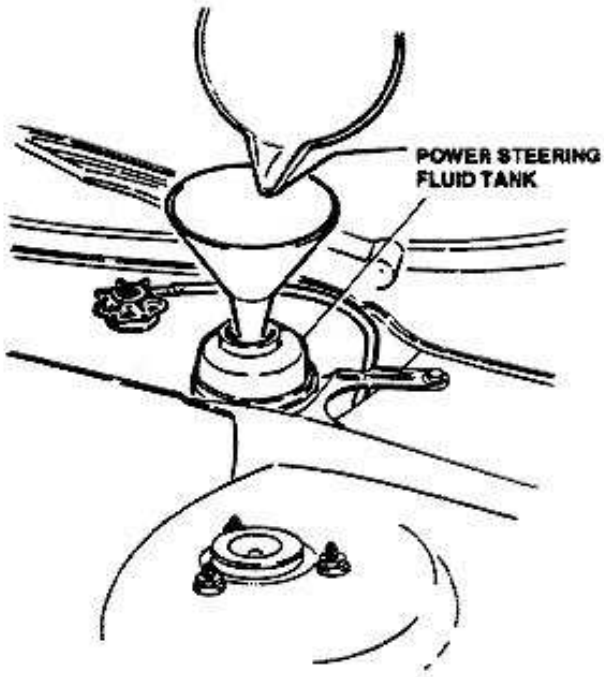
- On installation of air filter, place filter element with screen upside.



- Service engine cooling system with the prescribed quantity of coolant (Refer to **Group 07**)



- Service power steering hydraulic system with the prescribed quantity of fluid (Refer to **Group 23**).



- Check for proper level of all other fluids.
- Perform all prescribed adjstments and checks as stated in **Group 00**.

ENGINE BENCH OVERHAUL

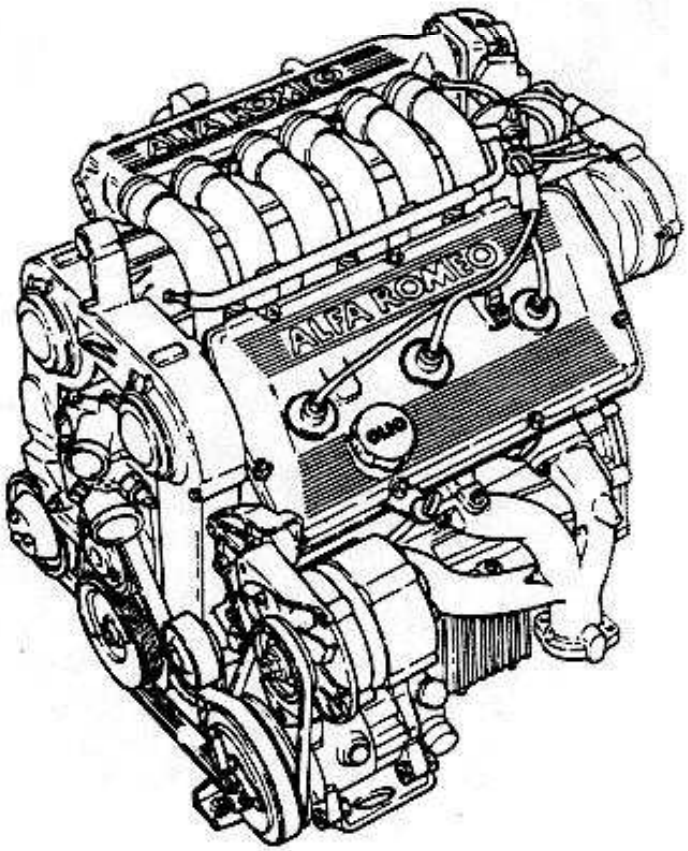
The instructions in the following paragraphs describe the complete engine bench overhaul, after the engine has been removed from the vehicle.
The instructions are divided as follows:

- **Engine disassembly and reassembly**: removal (and subsequent installation) of the gear box, accessories, ecc. off the engine, and disassembly of engine into its major groups.
- **Disassembly and overhaul of cylinder heads**: complete overhaul of cylinder heads, including even the smallest items.
- **Engine block checks and inspections**: complete overhaul of transmission drive components.
- **Precautionary instructions for the reassembly**: include specific reassembly operations that differ totally from disassembly instructions.

All the disassembly procedures stated in the following are applicable for engine reassembly if performed in reverse order, except where specifically stated.

- **Electrical components checks and inspections**: checks and inspections of electrical components installed in engine compartment.

The following procedures refer to the complete overhaul of the complete engine; nevertheless, parts of these procedures may be used separately, when necessary for treatment of specific items.



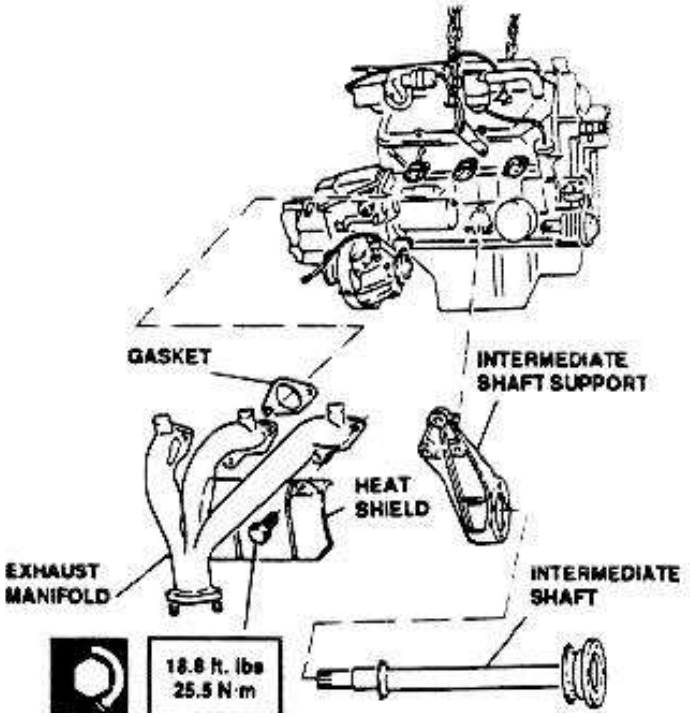
ENGINE DISASSEMBLY AND REASSEMBLY

This paragraph includes:

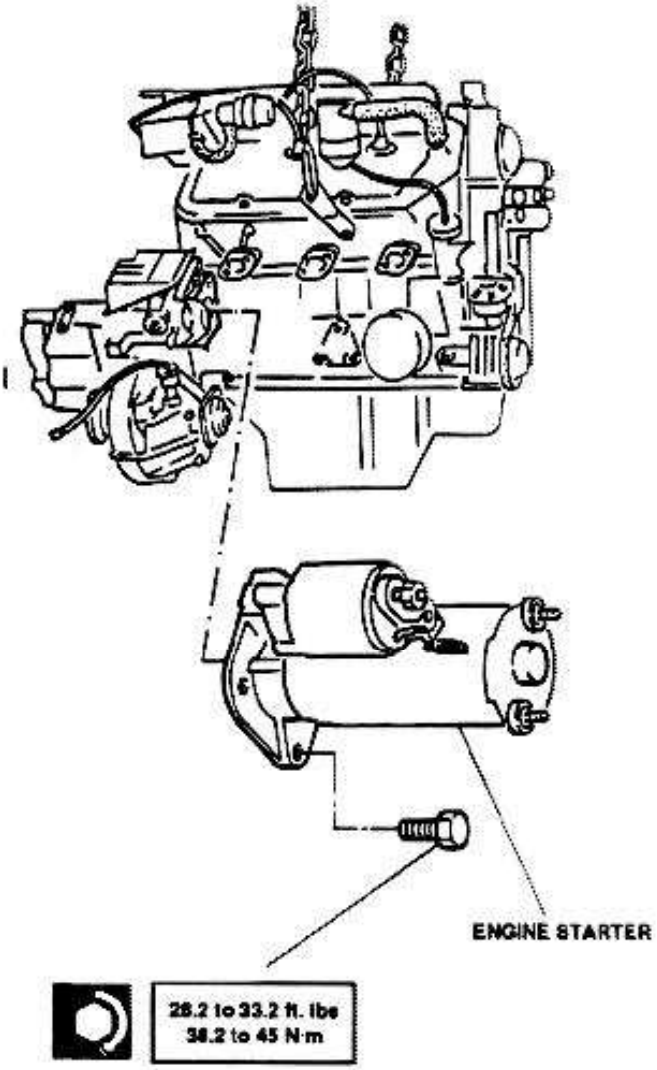
- R.H. side components removal.
- Gearbox-differential unit separation.
- Front side components removal.
- Lubrication system draining.
- Clutch disk removal (manual transmission only).
- Air collector box removal.
- Timing belt removal.
- Cylinder head components removal.
- Cylinder heads removal.
- Hydraulic belt tightener removal.
- Engine block components removal.
- Oil pump disassembly.
- Cylinder liners and pistons removal.
- Engine block components removal (continues).
- Crankshaft removal.

R.H. SIDE COMPONENTS REMOVAL

1. Remove exhaust manifolds.
2. Remove exhaust manifold gaskets.
3. Remove engine starter heat shield.
4. Drain oil from gearbox-differential unit.
5. Disconnect intermediate shaft from differential.
6. Remove intermediate shaft support.

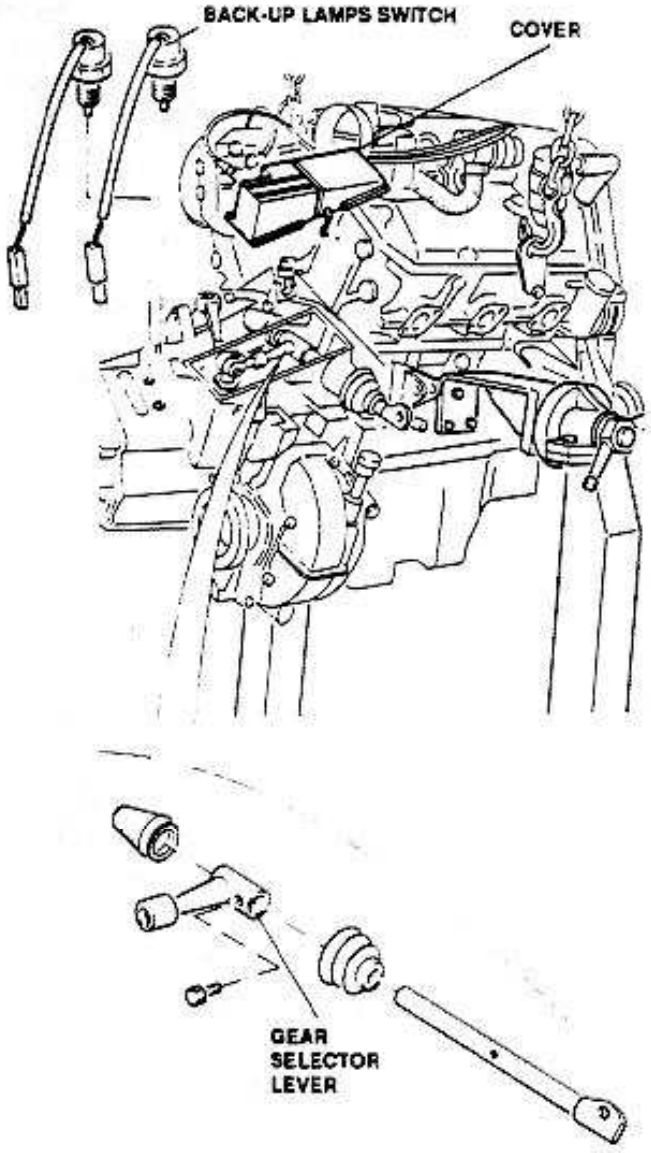


7. Remove engine starter

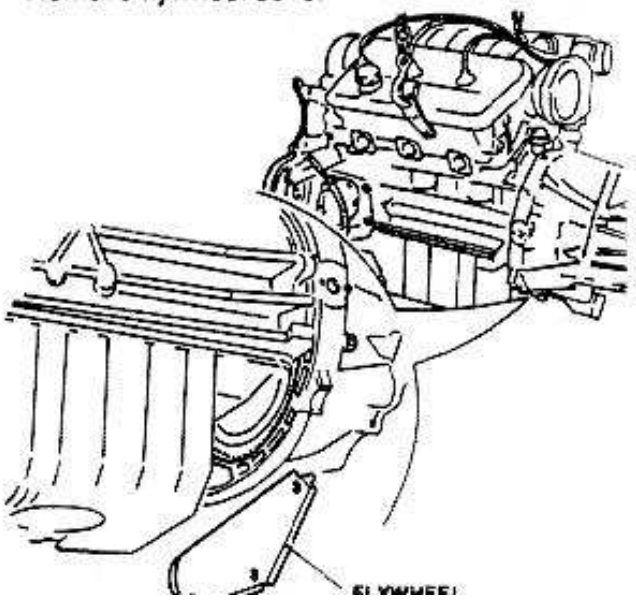


GEARBOX-DIFFERENTIAL UNIT SEPARATION (MANUAL TRANSMISSION)

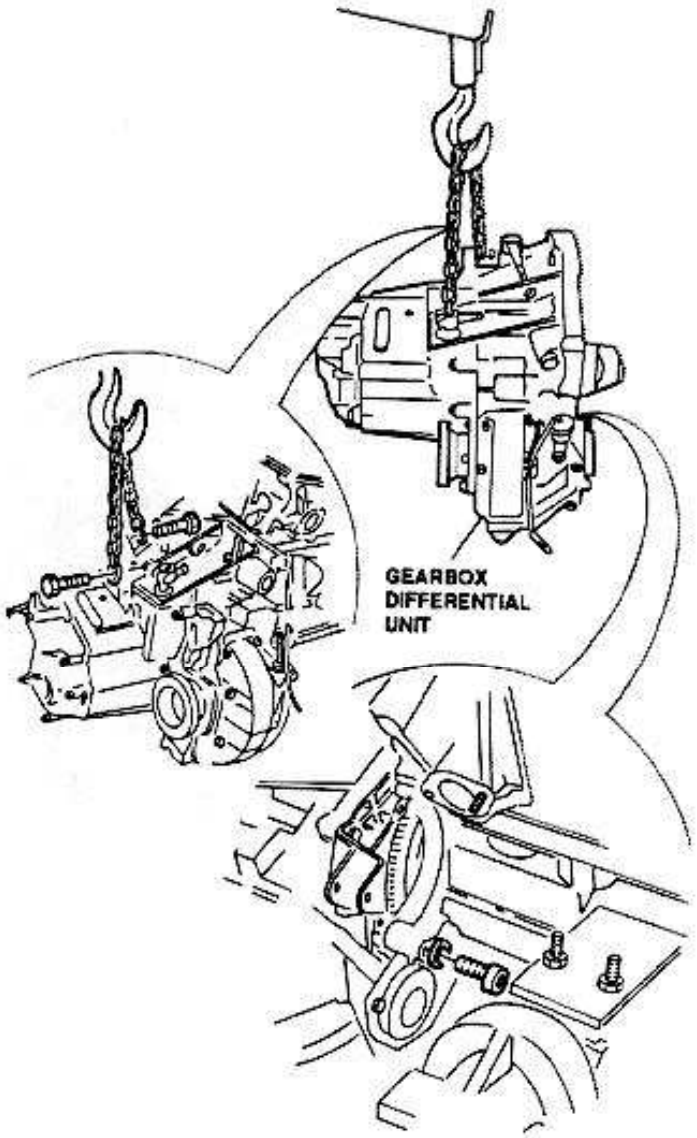
1. Place engine on a suitable work stand.
2. Remove gear selector lever cover.
3. Remove gear selector lever.
4. Remove back-up lamps switch.
5. Remove the gearbox sensor ("S" version only).



5 Remove flywheel cover



6. Remove gearbox-differential unit using a suitable hydraulic hoist



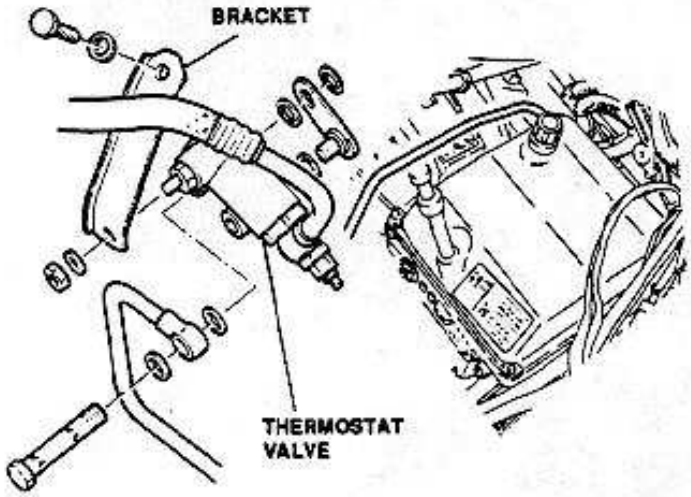
NOTE: For complete overhaul of manual transmission, refer to Group 13.

GEARBOX-DIFFERENTIAL UNIT SEPARATION (AUTOMATIC TRANSMISSION)

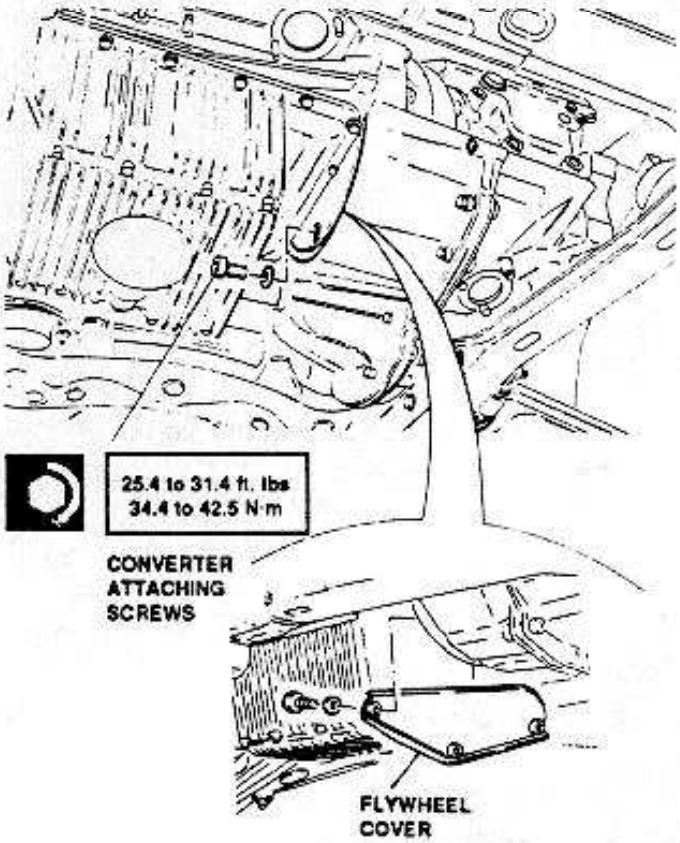
1. Remove thermostat valve and relevant bracket and

COVER

pipes.

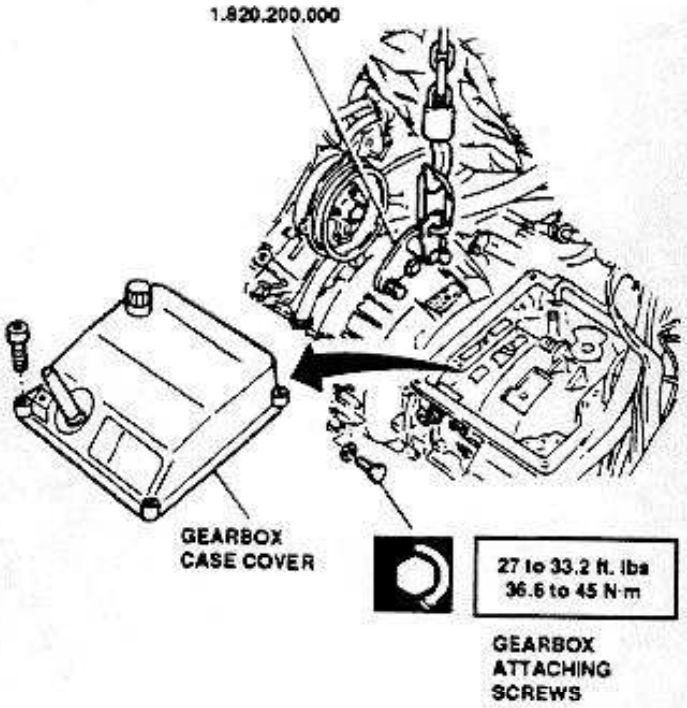


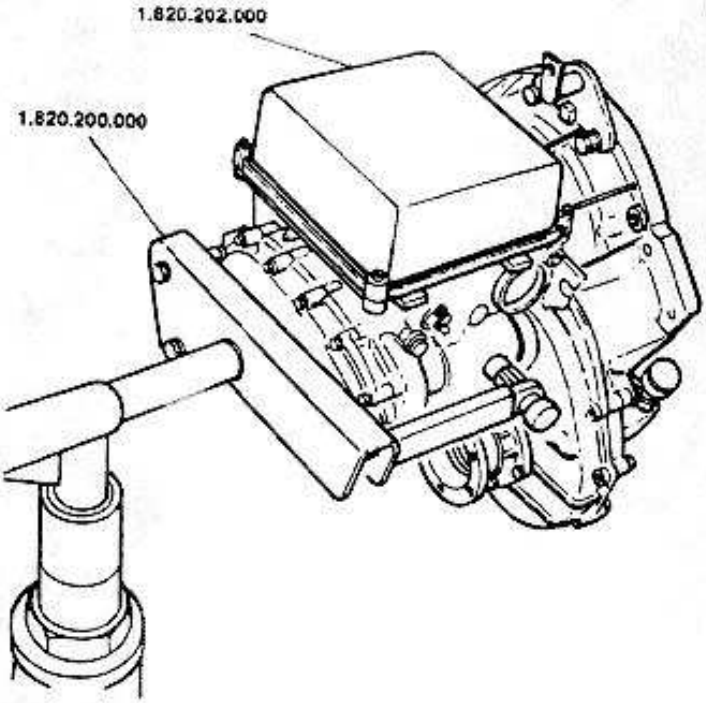
2. Remove flywheel cover.
3. Remove screws attaching converter to flywheel by locking engine pulley with a suitable wrench.



4. Remove screws attaching the gearbox to engine.
5. Remove gearbox cover and install at its place the protection cover **1.820.202.000.**

6. Install tool **1.820.200.000**, connect it to a suitable hoist and separate gearbox from engine.

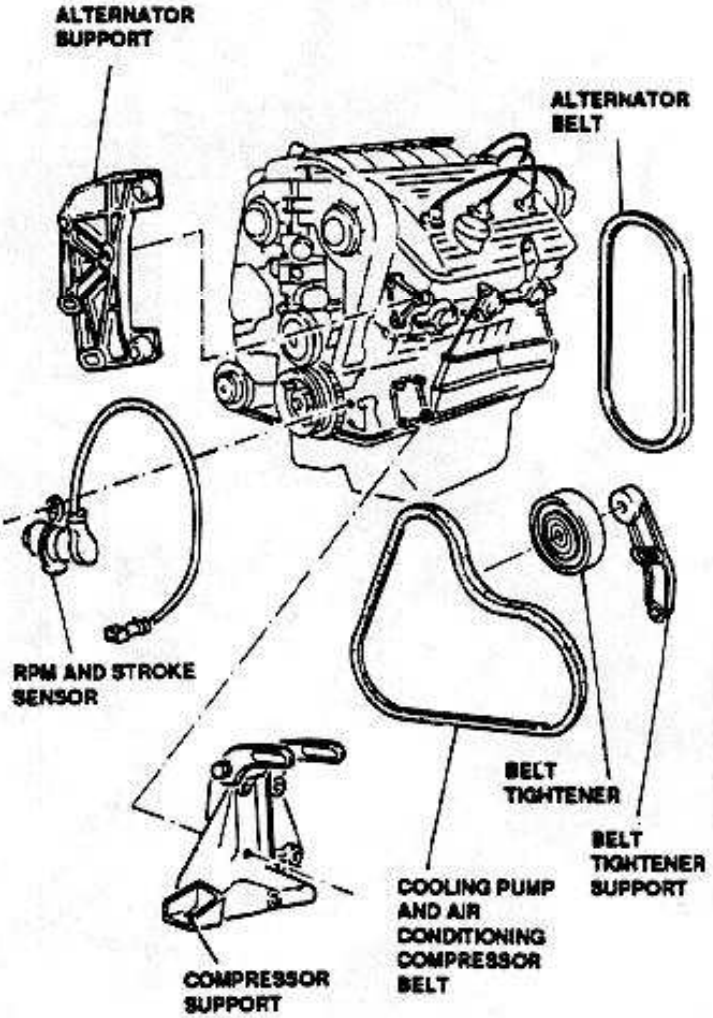




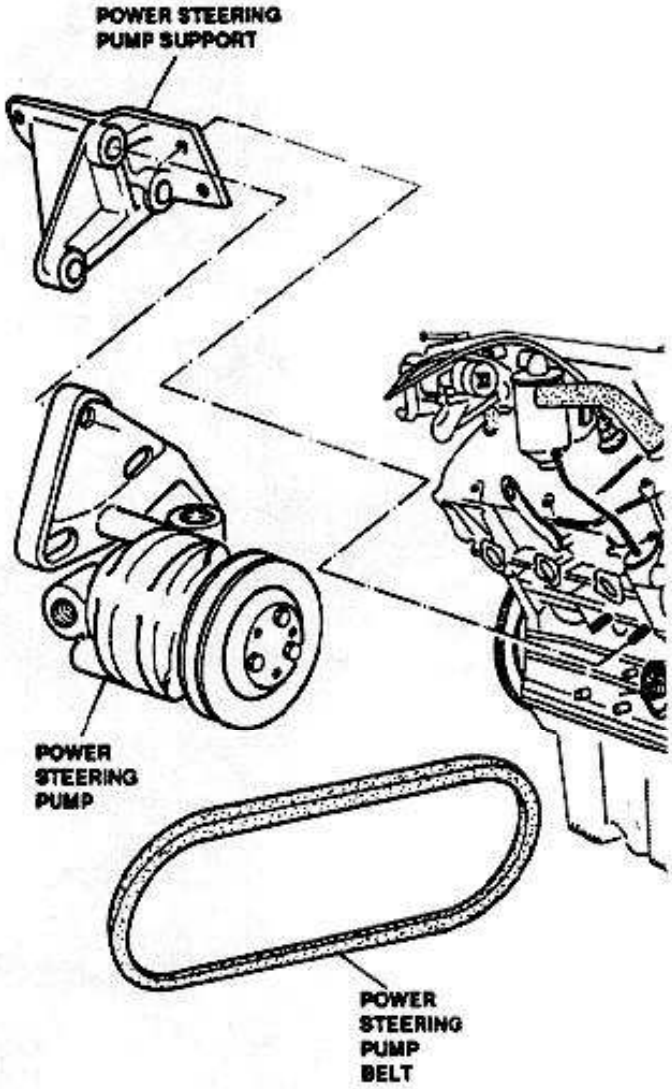
NOTE: For complete overhaul of automatic transmission refer to Group 16.

FRONT SIDE COMPONENTS REMOVAL

1. Remove alternator support.
2. Remove air conditioning compressor support and alternator drive belt.
3. Remove coolant pump and air conditioning compressor drive belt tightener and relevant support; remove drive belt.
4. Remove RPM and stroke sensor.



5. Remove power steering pump and support, remove drive belt.



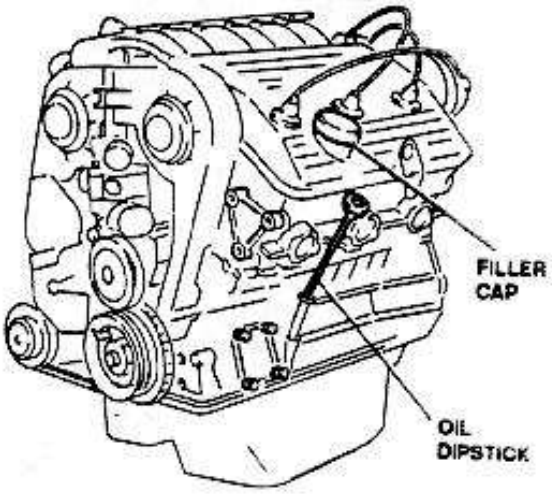
For belt tensioning at reassembly refer to Group 00.

LUBRICATION SYSTEM DRAINING

WARNING:
Engine oil is harmful for body skin; reduce to minimum contact of oil with skin; in case of contact wash the affected parts with water and soap.

1. Remove filler cap.
2. Remove oil dipstick.

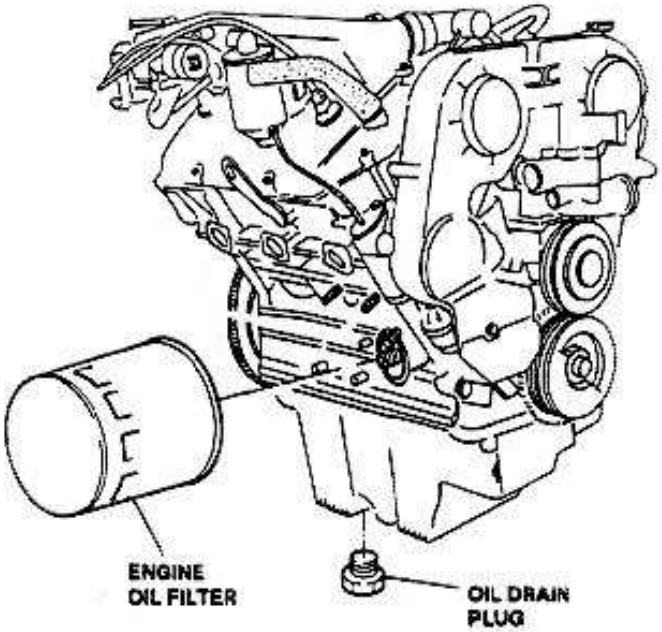
2. Remove oil dipstick.



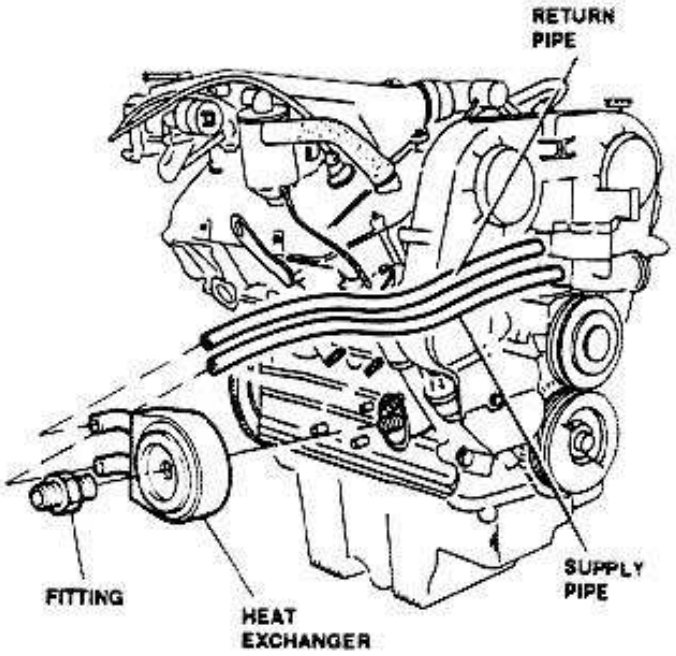
3. Unscrew drain plug and leave oil to drain completely for at least 15 minutes.

WARNING:
Do not disperse used oil to avoid environment pollution; inquire where used oil is safely collected in your area.

4. Unlock and remove oil filter using the proper wrench.

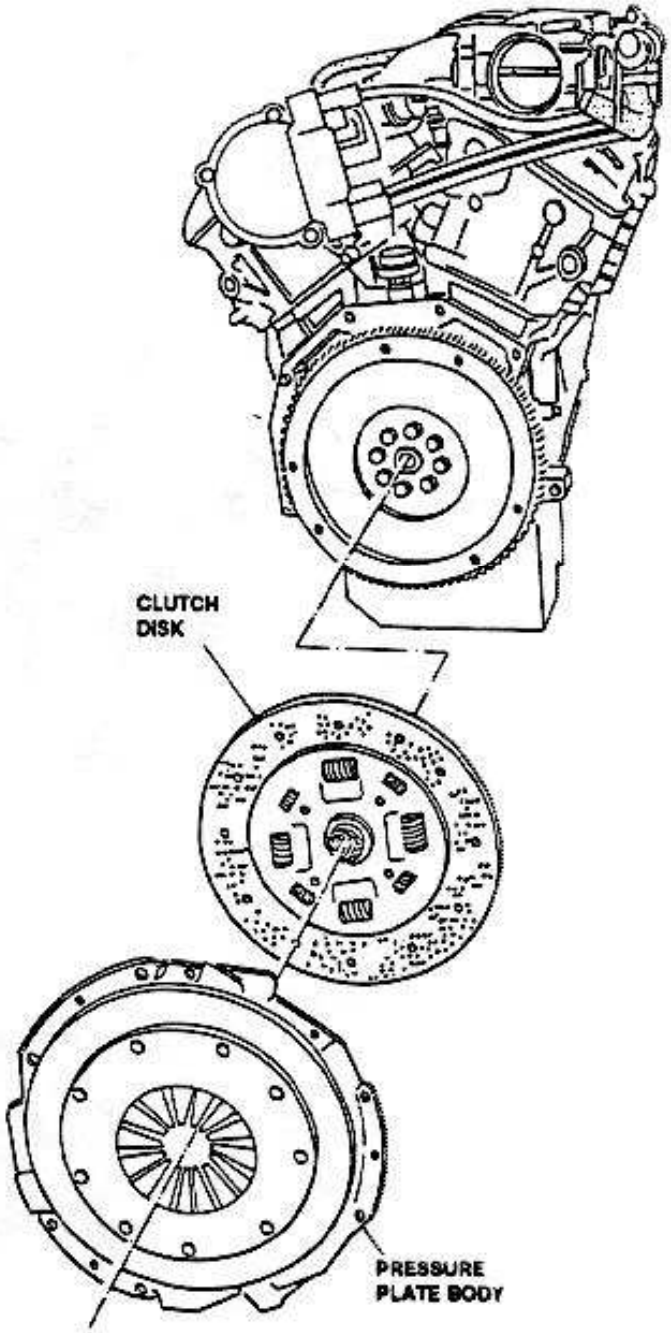


5. Carefully clean drain plug and reinstall on oil sump with relevant seal.
6. **Only for vehicles equipped with water-oil heat exchanger:** disconnect engine coolant supply and return pipes and remove oil filter heat exchanger; remove fitting.



CLUTCH DISK REMOVAL (MANUAL TRANSMISSION ONLY)

1. Remove disk pressure plate body.
2. Remove clutch disk.

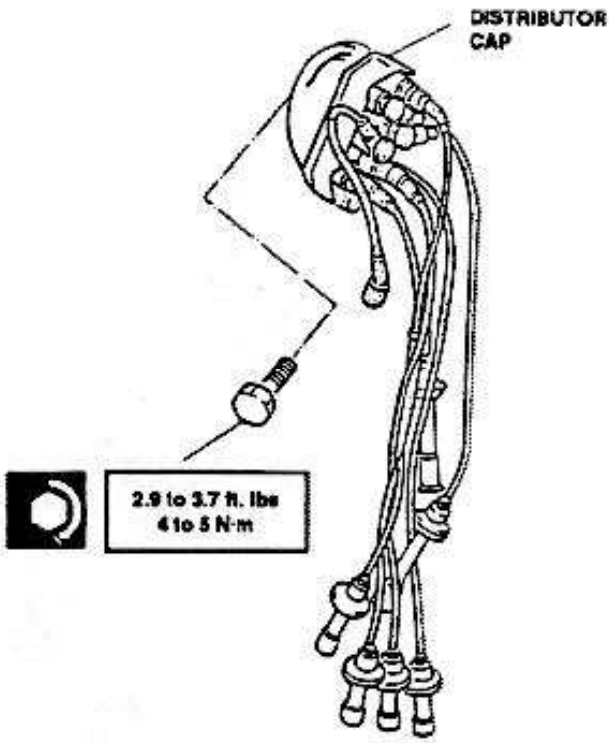


NOTE: For further details on operation of clutch and its components refer to Group 12.

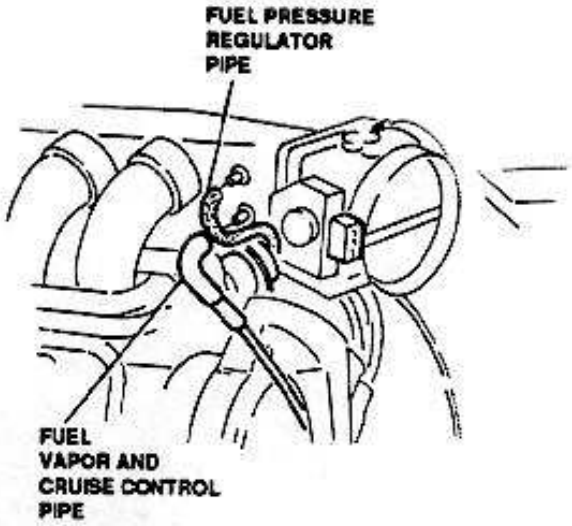
AIR COLLECTOR BOX REMOVAL

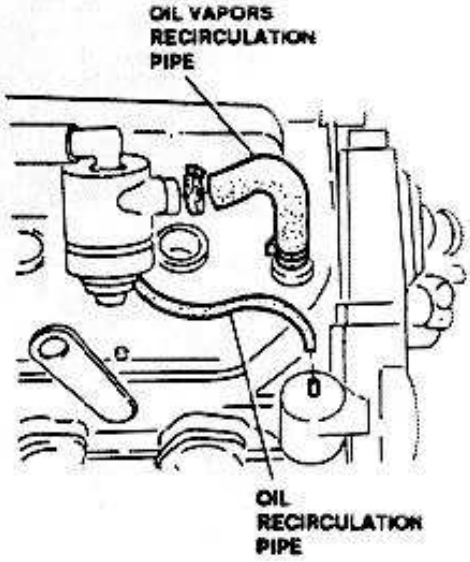
NOTE: For further disassembly and checks of the fuel supply system refer to Group 04.

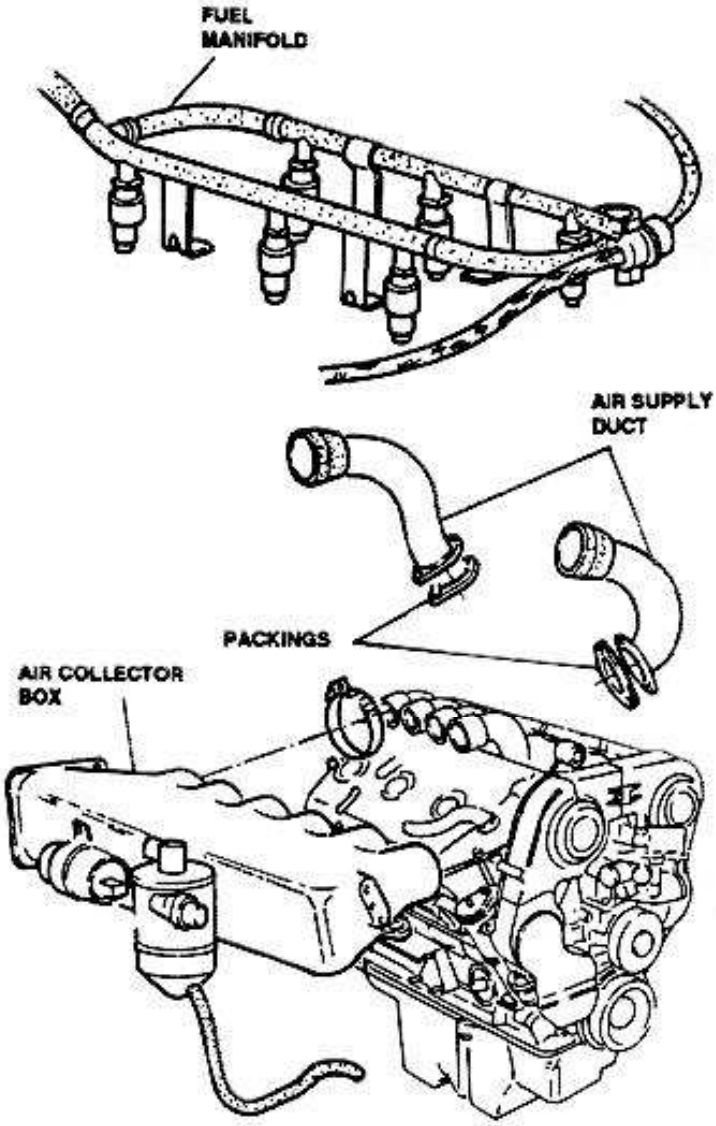
1. Disconnect spark plug leads and remove distributor cap.



2. Disconnect fuel vapor and Cruise Control pipe.
3. Disconnect fuel pressure regulator pipe.
4. Disconnect oil vapors recirculation.
5. Disconnect oil recirculation pipe.



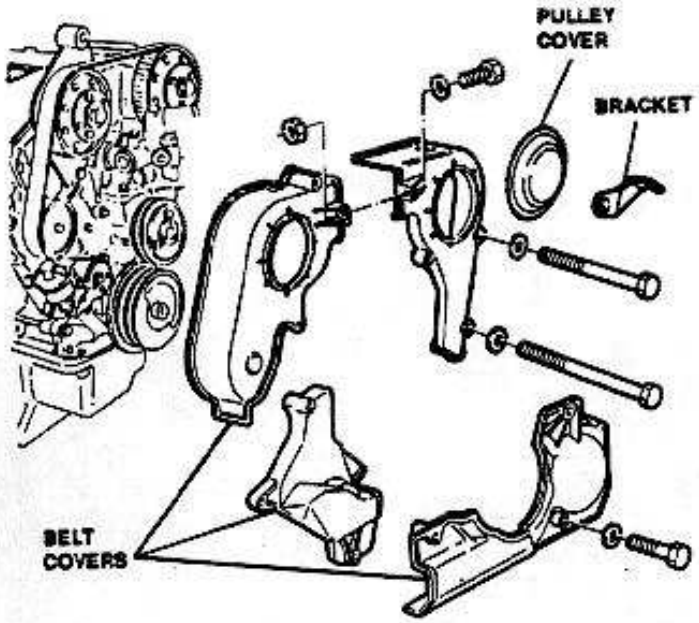


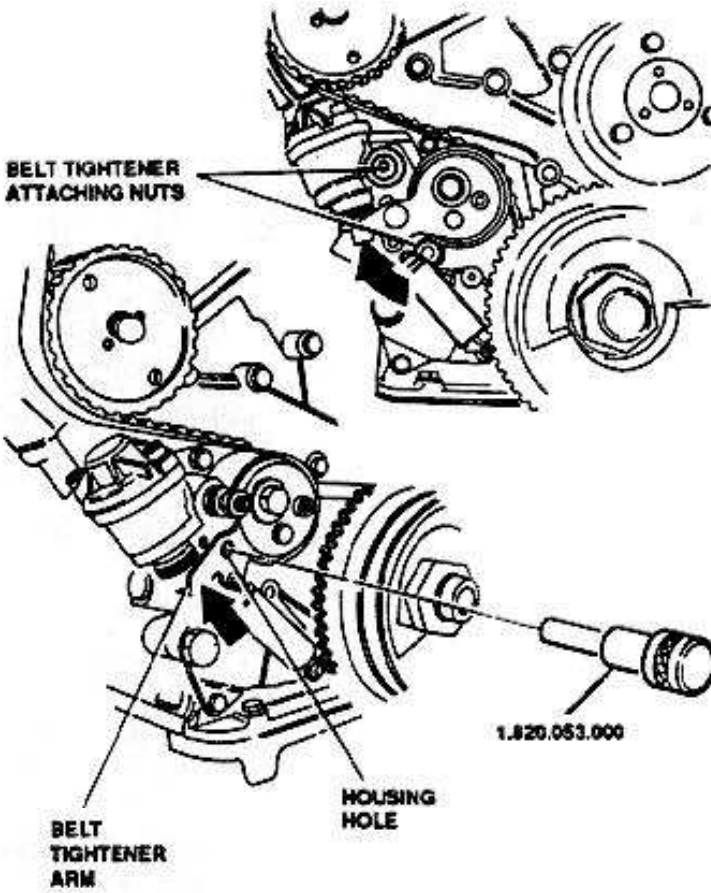


6. Remove air collector box.
7. Remove air supply ducts.
8. Remove air supply duct packings.
9. Remove fuel manifold and electronic injectors.

TIMING BELT REMOVAL

1. Remove timing pulley covers.
2. Remove timing belt covers.
3. Remove cable attachment bracket.



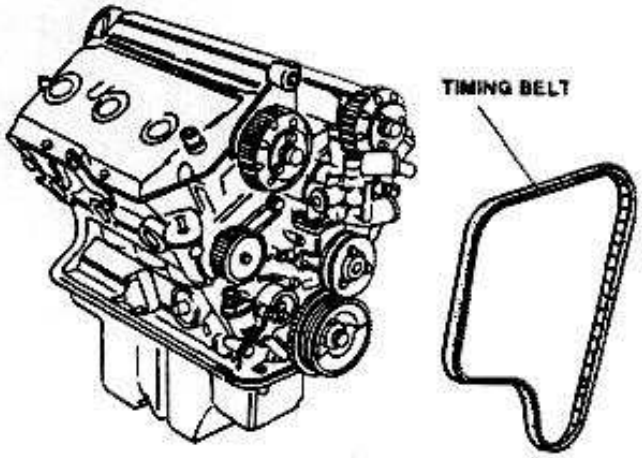


4. Lift hydraulic belt tightener arm and lock belt tightener using tool **1.820.053.000.**

NOTE: Align housing hole to hole on tightener body to allow installation of tool **1.821.053.000.**

5. Loosen the two nuts attaching tightener body to engine block.
6. Turn hydraulic tightener upwards and lock in position by tightening bolt loosened at step 5.

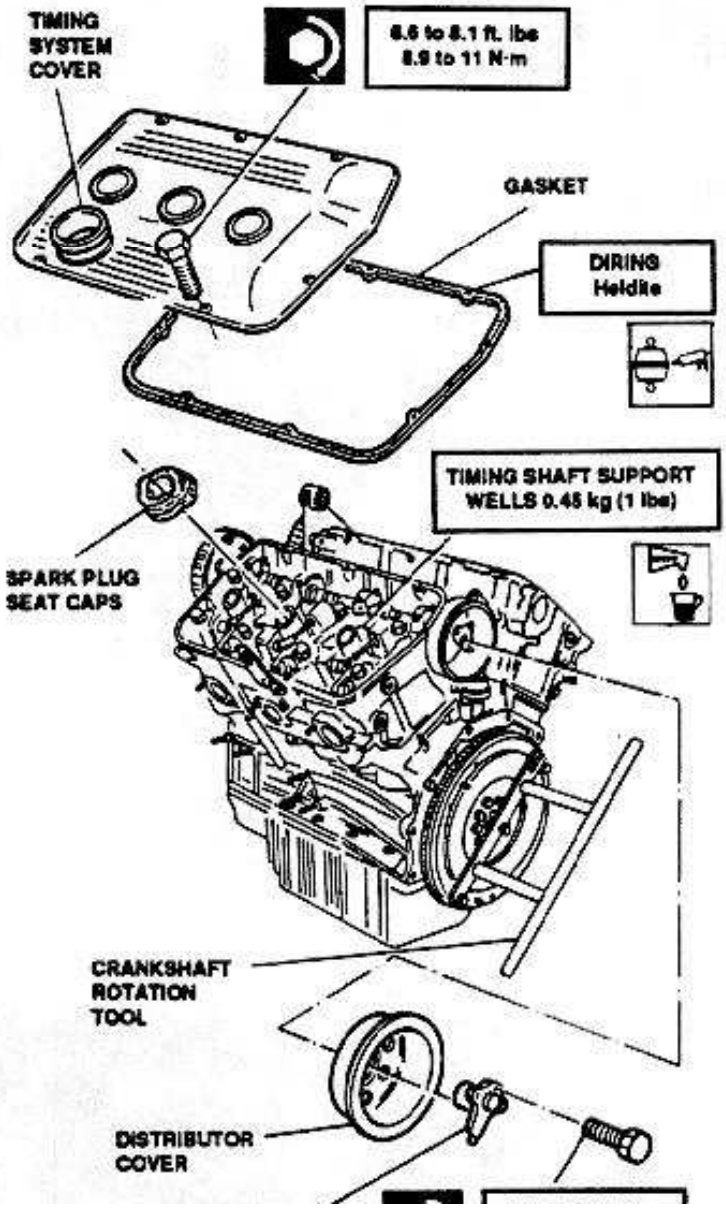
7. Remove timing belt from toothed pulley on cylinder heads and remove from crankshaft front pulley.



For timing belt installation and checks refer to further relevant paragraph.

CYLINDER HEAD COMPONENTS REMOVAL

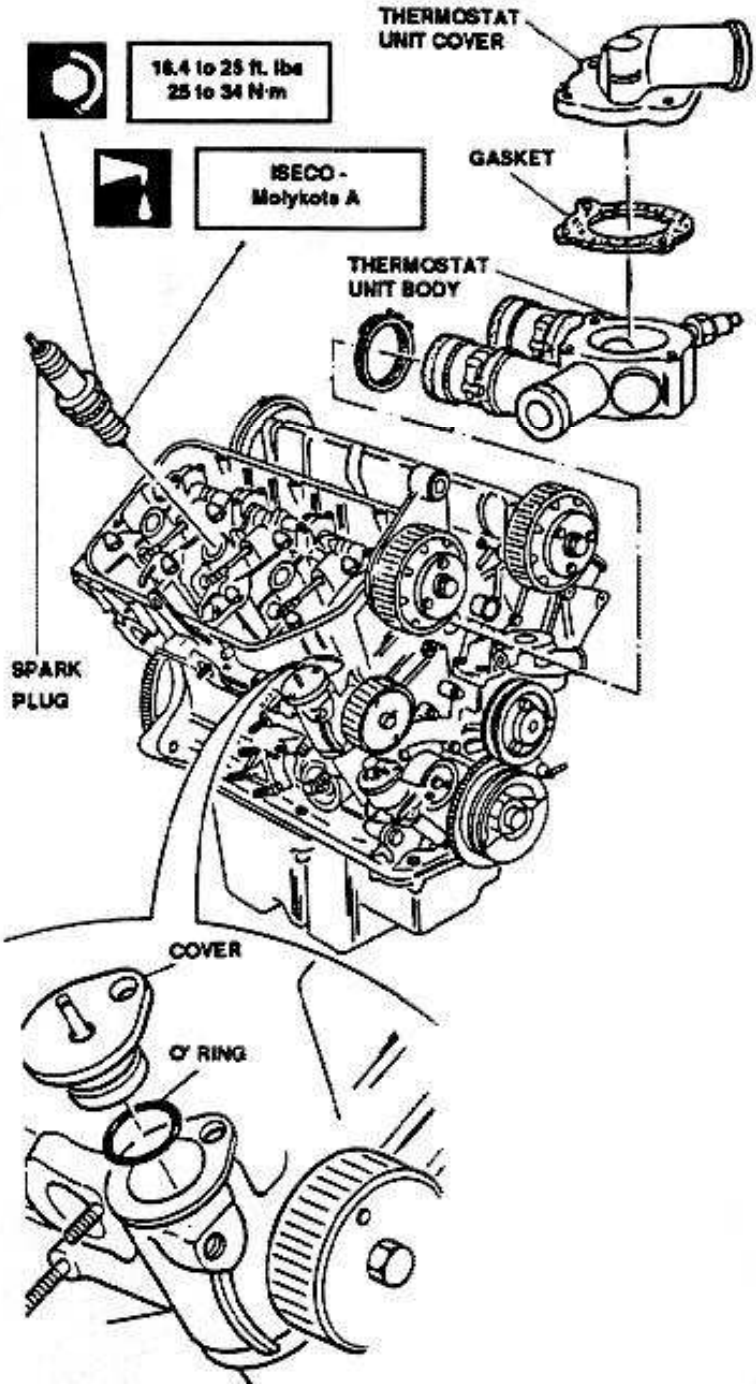
1. Remove distributor rotor arm.
2. Remove cover.
3. Remove timing system covers.
4. Remove gasket between timing system covers and cylinder heads.
5. Remove spark plug seat caps.
6. Install a suitable tool to allow rotation of engine crankshaft.



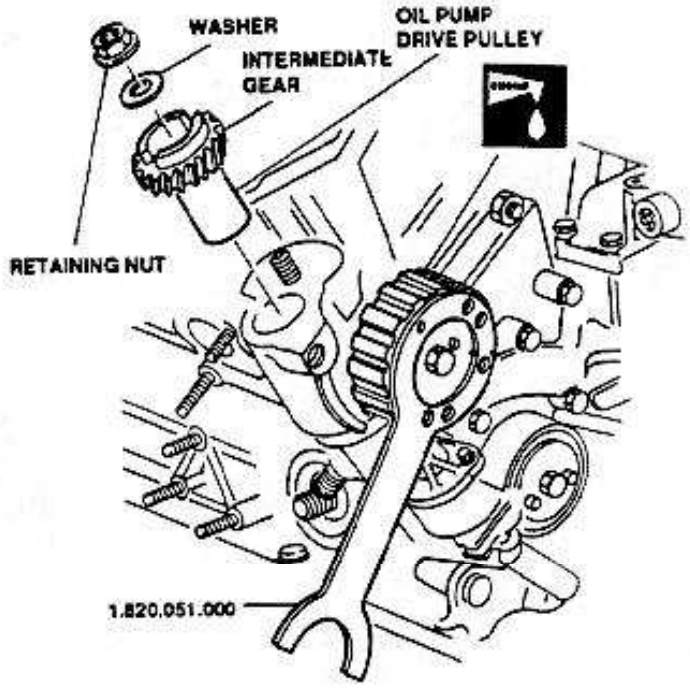
7. Remove thermostat unit cover and gasket.
8. Remove thermostat unit body by disconnecting it from cooling duct of each cylinder head.

NOTE: For thermostat unit disassembly and inspection refer to **Group 07.**

9. Remove spark plugs.
10. Remove cover and relevant o'ring.

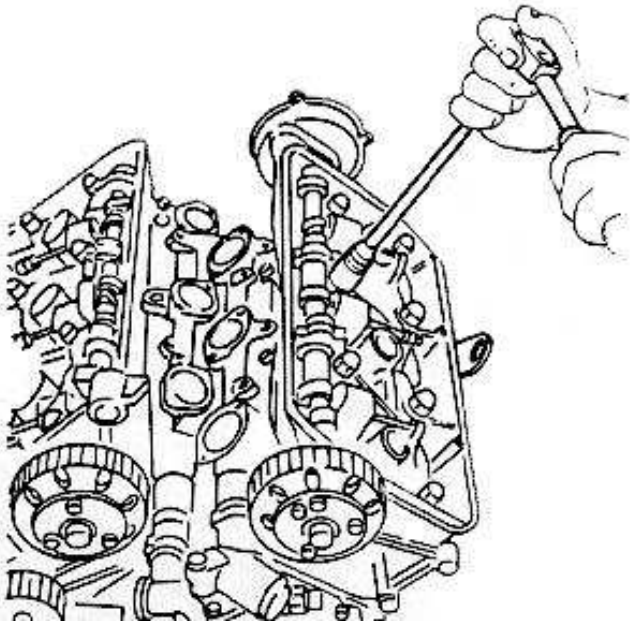


11. Prevent rotation of oil pump drive pulley using tool **1.820.051.000.**
12. Unscrew oil pump drive intermediate gear retaining nut.
13. Remove washer.
14. Remove intermediate gear.



CYLINDER HEADS REMOVAL

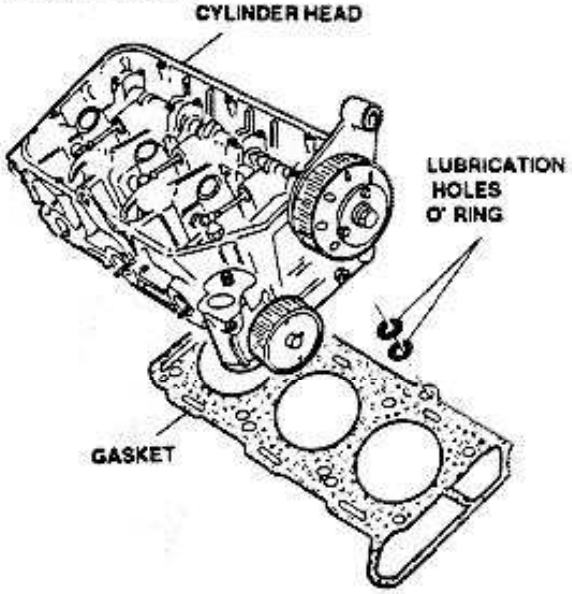
1. Remove nuts and washers (eight for each head) attaching cylinder head to engine block.



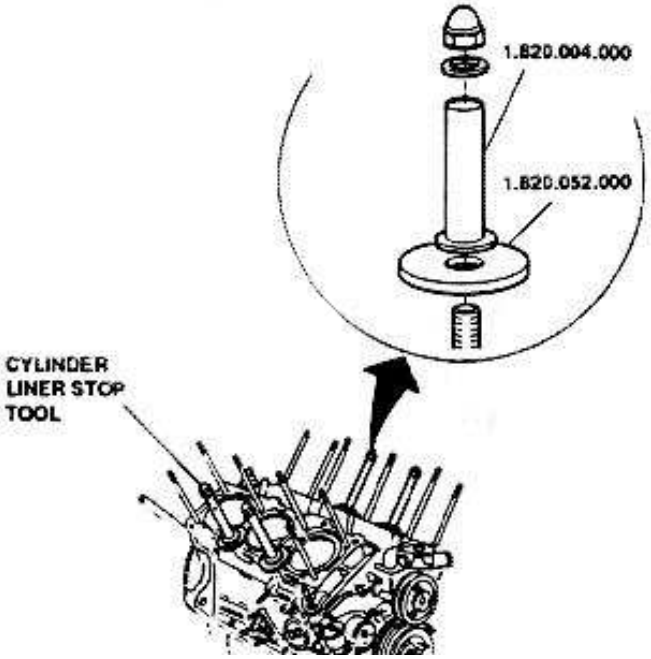
2. Remove cylinder heads.

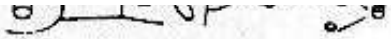
CAUTION:
Take care not to damage engine block studs during heads removal.

3. Remove gaskets between cylinder heads and engine block.
4. Remove lubrication holes o'rings (two on each side of engine block).



5. Install cylinder liner fixing tool **1.820.004.000** and relevant additional washers **1.820.052.000.**



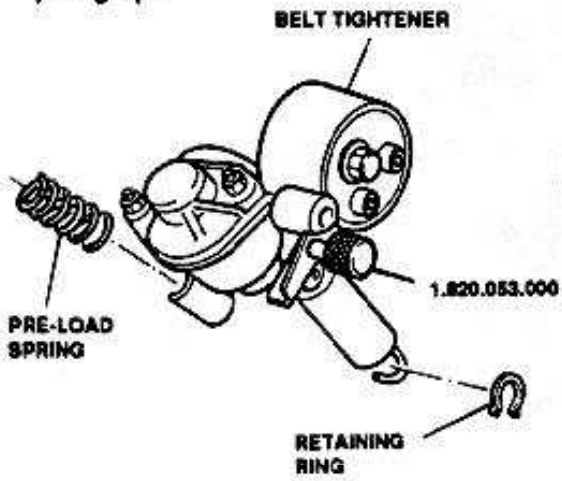


For cylinder head installation , refer to further relevant paragraph

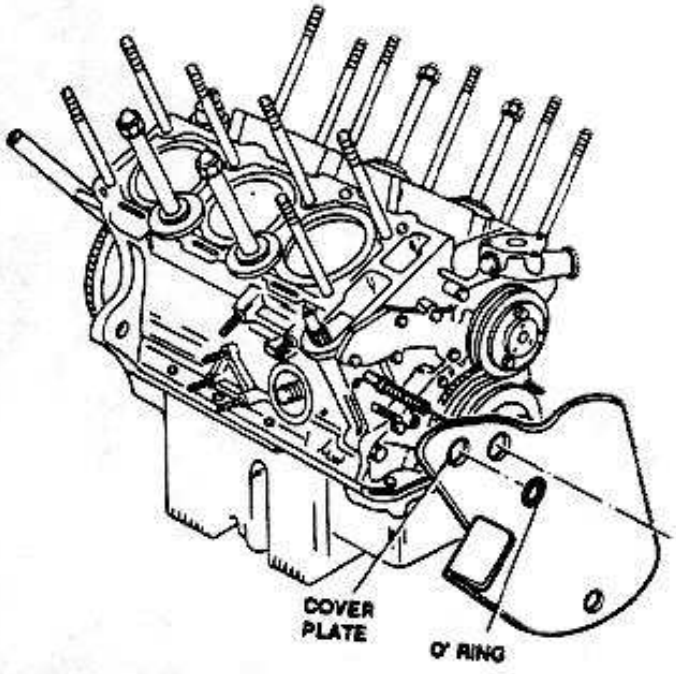
HYDRAULIC BELT TIGHTENER REMOVAL

1. Remove retaining ring.
2. Remove hydraulic belt tightener.
3. Withdraw pre-load spring.

NOTE: For belt tightener overhaul, refer to relevant paragraph



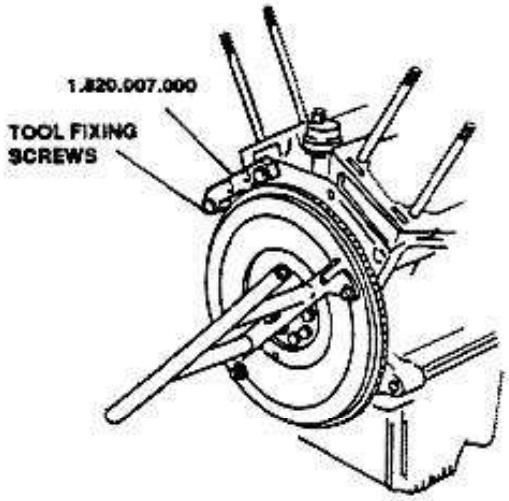
4. Remove spring cover plate.
5. Remove o'ring.



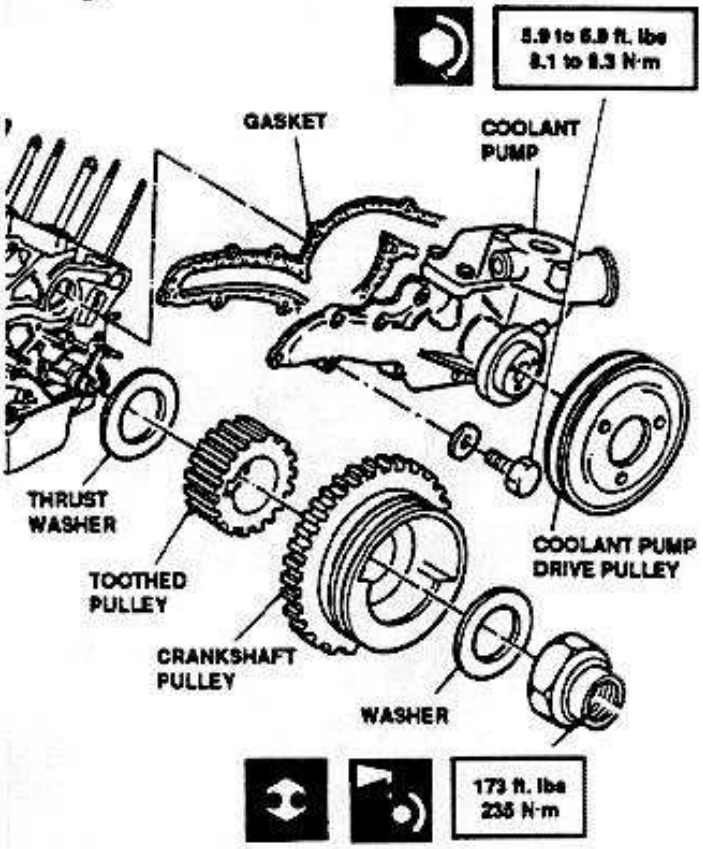
At reassembly, ensure belt tightener is locked with tool 1.820.053.000.

ENGINE BLOCK COMPONENTS REMOVAL

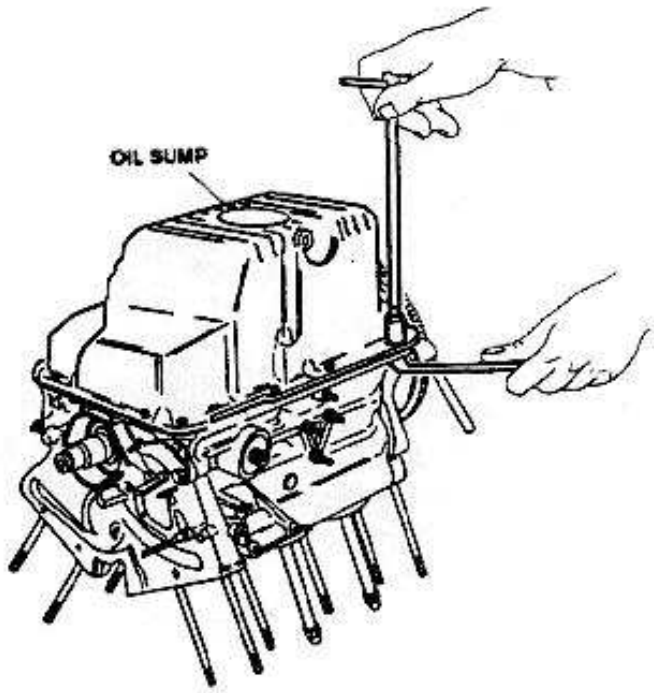
1. Prevent flywheel rotation using tool 1.820.007.000; before fixing the tool with relevant screws, note that tooth is properly aligned to tooth of flywheel ring gear.



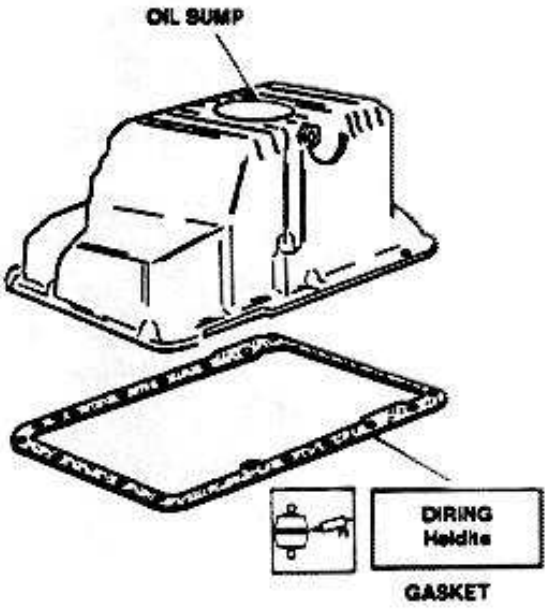
2. Remove coolant pump drive pulley.
3. Remove crankshaft pulley.
4. Remove timing belt toothed drive pulley.
5. Remove washer.
6. Remove thrust washer (at reassembly, the thrust washer convex side must be faced towards front cover).
7. Remove engine coolant pump.
8. Remove coolant pump gasket.



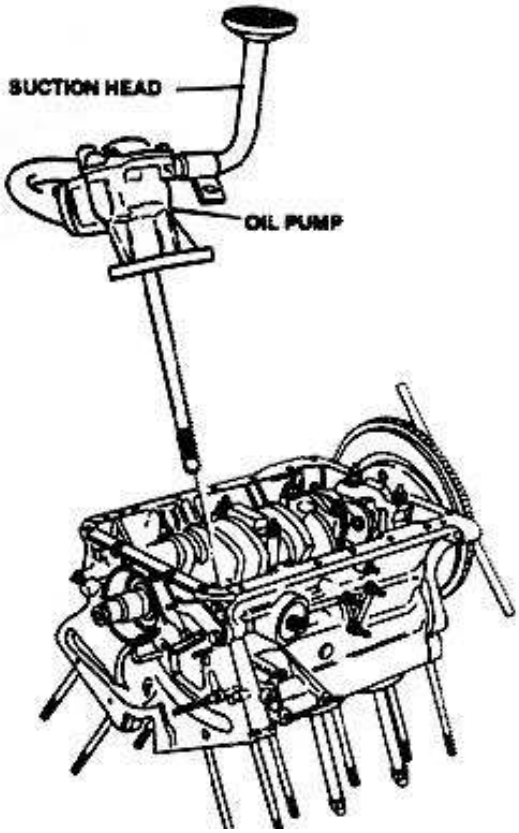
9. Unlock work stand and rotate engine group of 180°.
10. Unscrew all screws fixing oil sump to engine block.



11. Remove the complete oil sump and gasket. If necessary, remove traces of sealing compound from oil sump and engine block.



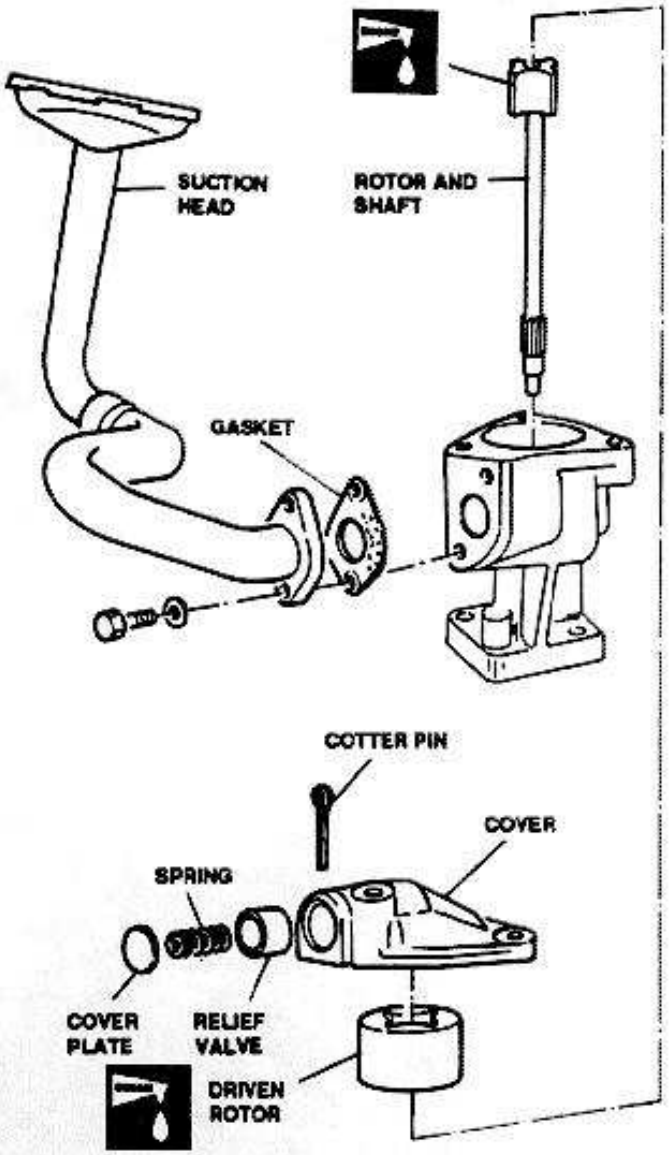
12. Remove oil pump and suction head.



OIL PUMP DISASSEMBLY

1. Remove suction head.
2. Remove gasket between pump body and suction head.
3. Remove cover.
4. Remove cotter pin.
5. Remove cover plate.
6. Remove spring.
7. Remove oil pressure relief valve.
8. Withdraw driven rotor from pump body.
9. Remove inner rotor and shaft from body.

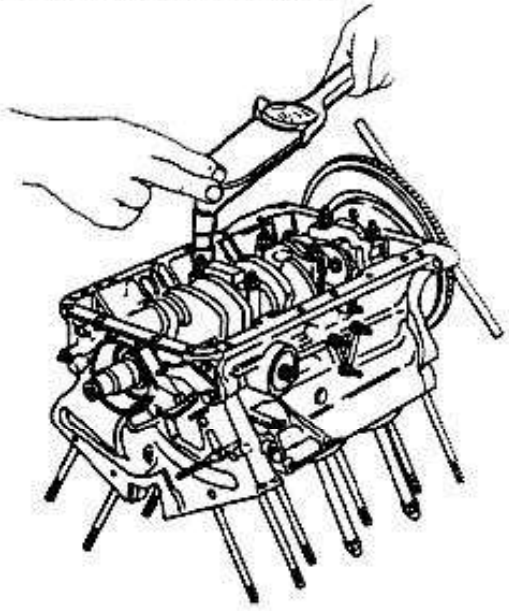
NOTE: Do not remove inner rotor from shaft.



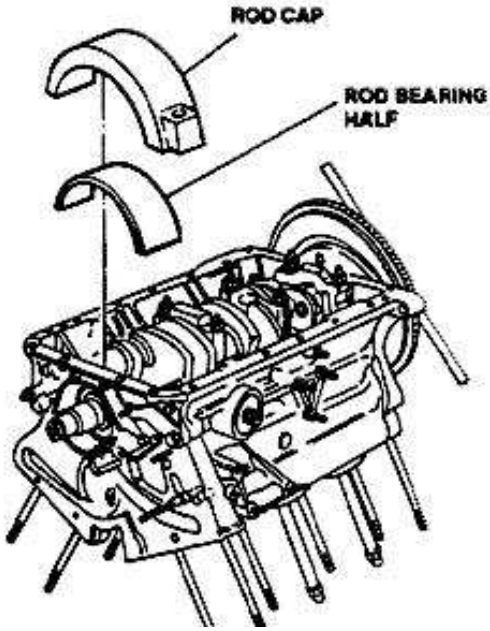
NOTE: For pump complete overhaul, refer to oil pump

CYLINDER LINERS AND PISTONS REMOVAL

1. Operate on right row of cylinders (1st, 2nd and 3rd cylinders).
2. Remove tool 1.820.007.000 that prevents rotation of flywheel.
3. Rotate crankshaft as required to gain access to rod cap attaching screws.
4. Loosen and remove screws.

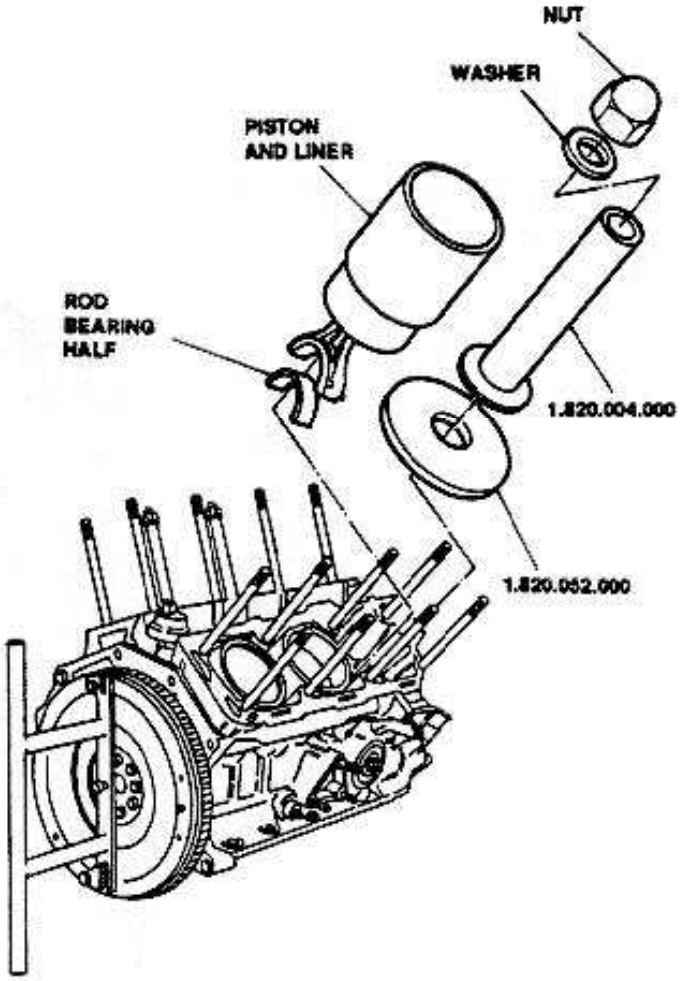


5. Remove rod caps of 1st, 2nd and 3rd cylinder.
6. Remove relevant rod bearing halves.



checks and inspections paragraph.

7. Unlock workstand and rotate engine group of 180°.
8. Remove nut and washer.
9. Remove cylinder liner fixing tool **1.820.004.000** and relevant washers **1.820.052.000** from relevant row of cylinders.
10. Withdraw all piston-rod groups together with cylinder liners from engine block.
11. Remove rod bearing halves.
12. Rotate engine block 180° and act in analogy on opposite row of cylinders (4th, 5th and 6th cylinders).



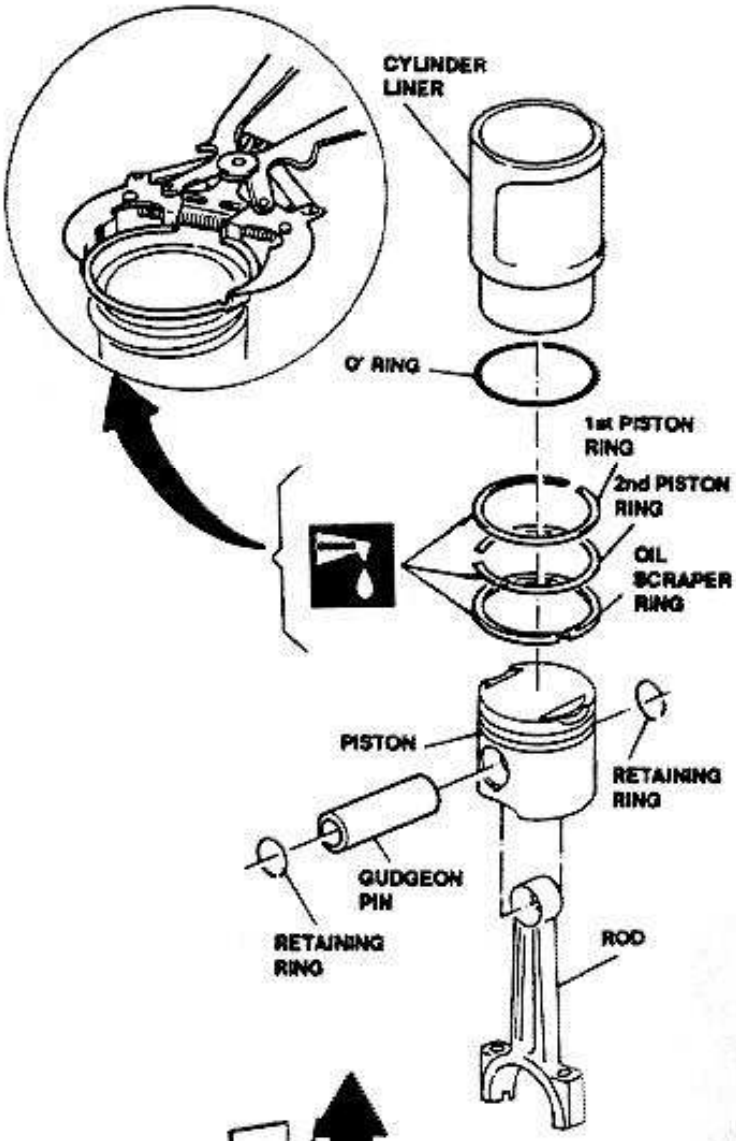
13. Withdraw cylinder liners.
14. Remove o'ring.
15. Withdraw piston rings and oil scraper ring from piston using a suitable tool.

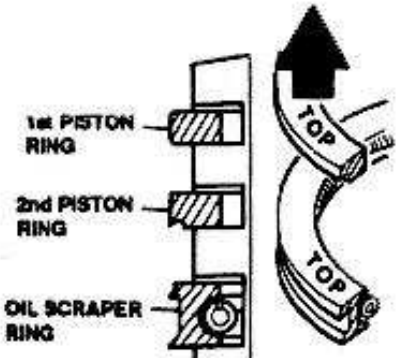
CAUTION:
Operate with precaution to avoid accidental breakage of piston rings, since they could be eventually reused

At reassembly, locate seal rings so that "TOP" marking on rings is faced upwards.

16. Remove retaining rings fixing gudgeon pin.
17. Remove gudgeon pin and separate piston and rod.

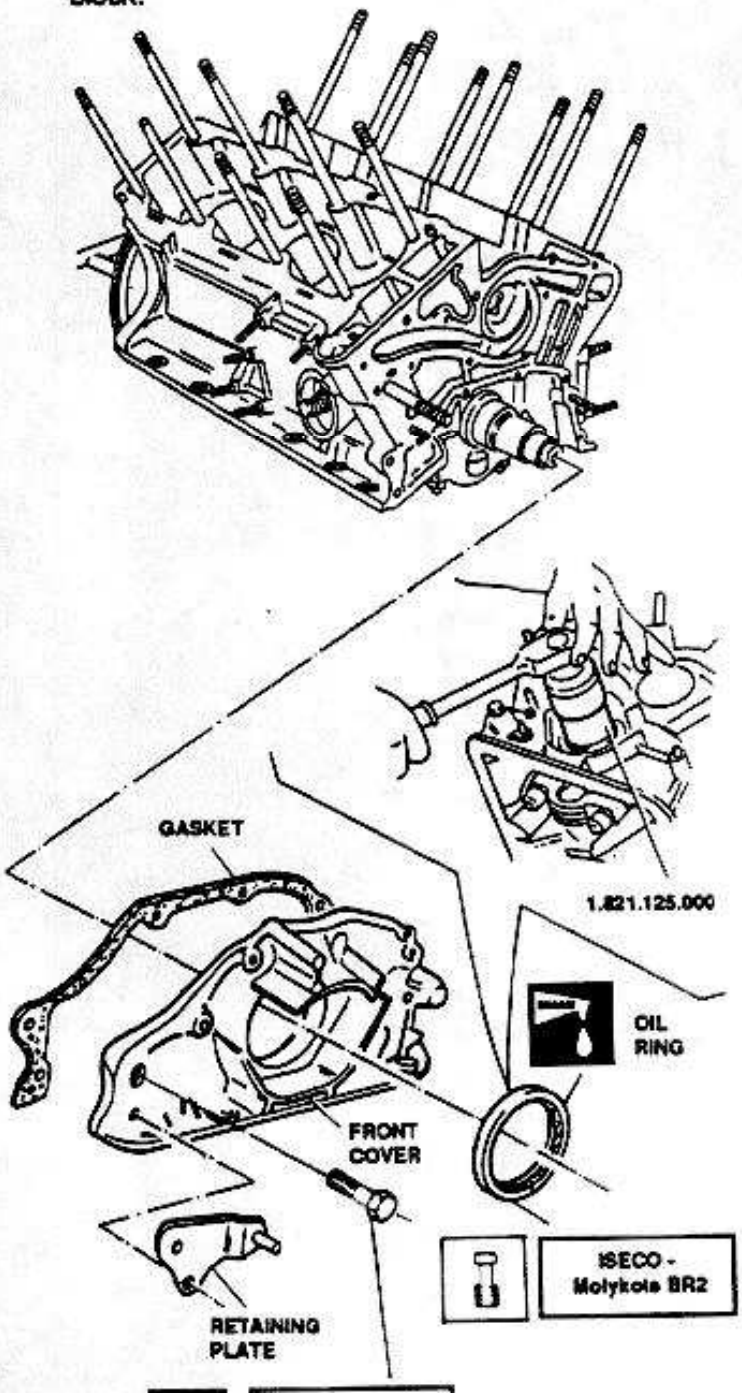
For reassembly refer to cylinder liners, pistons and rods installation paragraph.



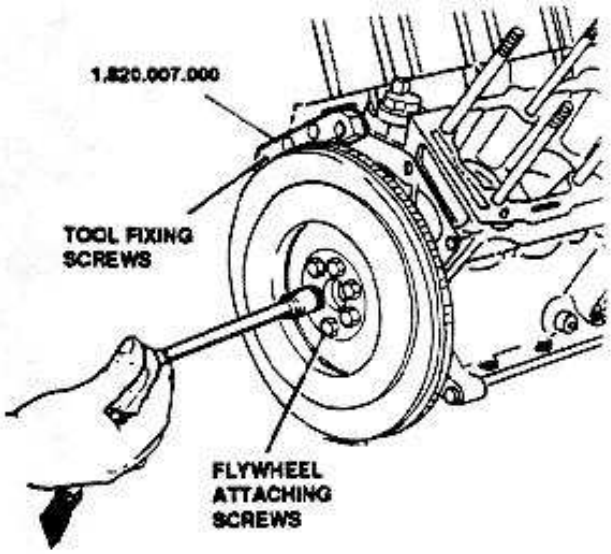


ENGINE BLOCK COMPONENTS REMOVAL (CONTINUES)

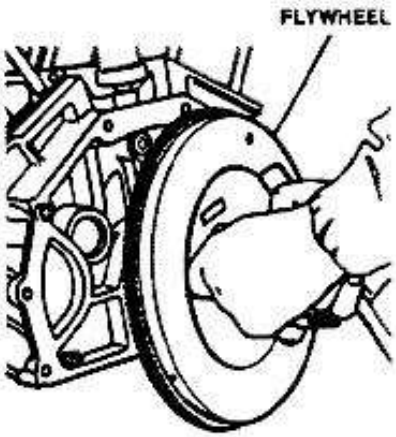
1. Remove front cover.
2. Remove hydraulic belt tightener spring retaining plate.
3. Remove oil ring (for reassembly use inserting tool **1.821.125.000.**
4. Remove gasket between front cover and engine block.



5. Slightly tilt engine block and install tool **1.820.007.000**; lock tool using the relevant fixing screws.
6. Unscrew screws fixing the flywheel to crankshaft.



7. Remove tool **1.820.007.000**.
8. Remove flywheel.

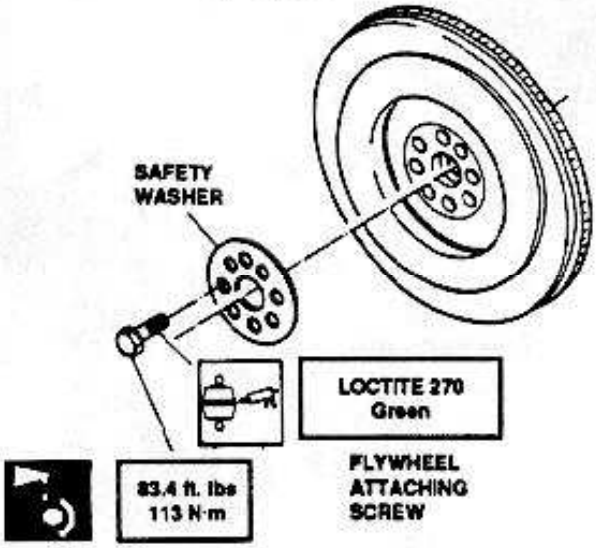


NOTE: In case of flywheel grinding observe dimensions shown in the "TECHNICAL CHARACTERISTICS AND SPECIFICATIONS" paragraph.

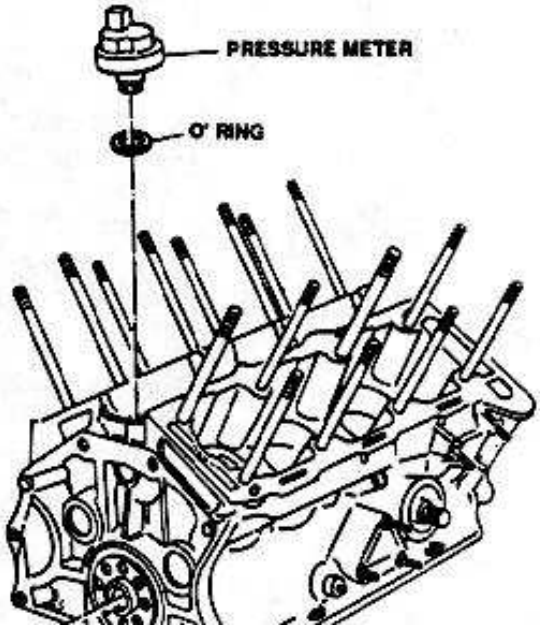
At reassembly, before applying locking compound to screws thread, remove any trace of old locking compound.

NOTE: **Flywheel can be located in one position only due to asymmetric spacing of screw holes.**

9. Remove safety washer.

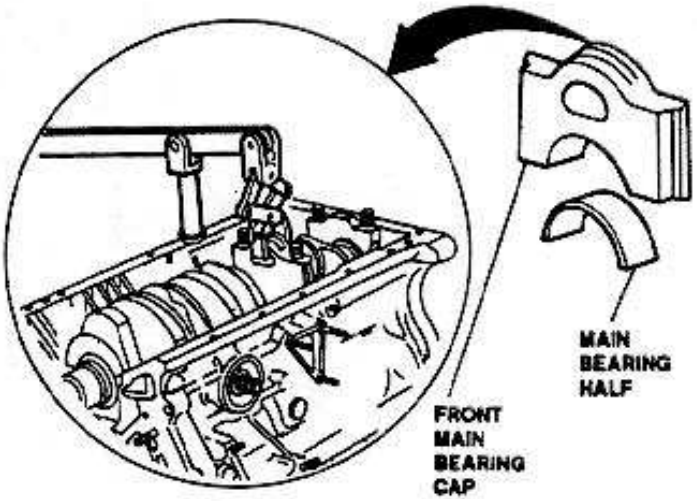


10. Remove engine oil pressure meter and o'ring.

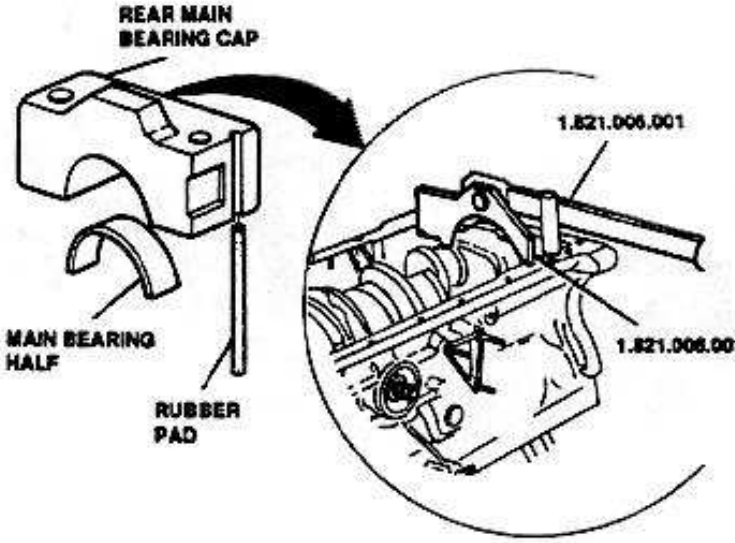


CRANKSHAFT REMOVAL

1. Remove six nuts and screws fixing the front main bearing caps.
2. Remove the three front main bearing caps; if required, used a suitable puller.
3. Remove relevant main bearing half.



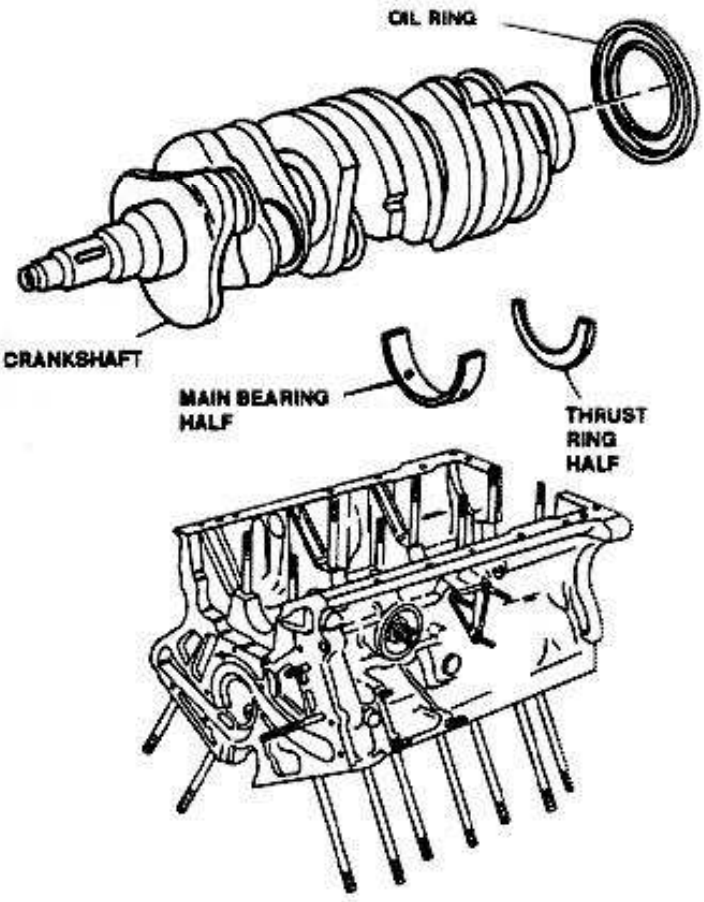
4. Remove rear main bearing cap using puller consisting of lever **1.821.006.001** and fork **1.821.006.002.**
5. Remove relevant main bearing half.
6. Remove rubber pads.



7. Remove oil ring.
8. Remove crankshaft.
9. Remove thrust ring halves.
10. Remove main bearing halves from engine block

NOTE: Note reciprocal position in case the parts are re-used for reassembly

For crankshaft installation observe warnings on relevant paragraph.



CYLINDER HEADS OVERHAUL

This paragraph includes:

CYLINDER HEADS DISASSEMBLY:

- Preliminary operations.
- Camshaft pulley removal.
- Timing distributor removal and disassembly.
- Engine upper mount bracket and oil pump pulley removal.
- Camshaft and rocker arms shaft removal.
- Valves disassembly.
- Intake manifold removal.

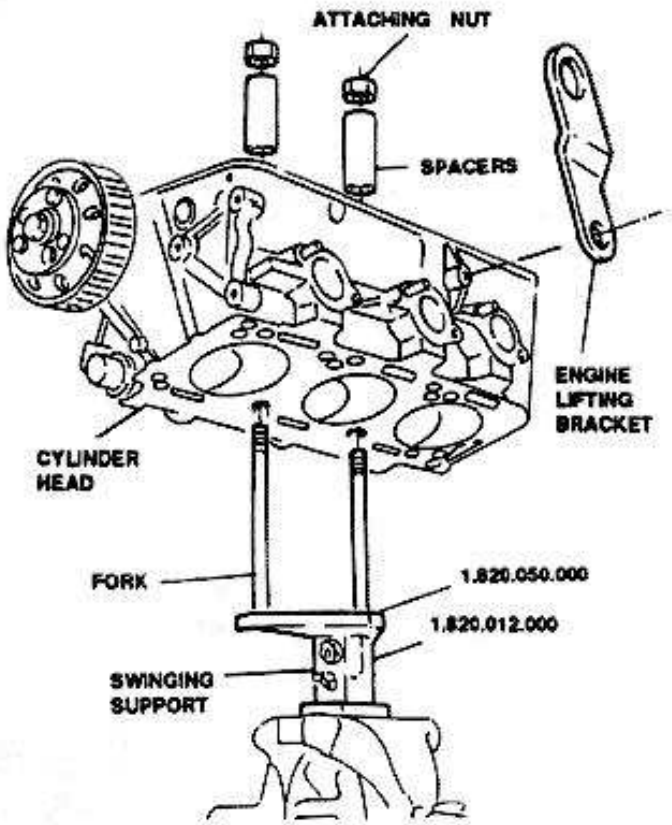
CYLINDER HEADS OVERHAUL:

- Cylinder head lower plane check.
- Cylinder head bushings check.
- Valve seats replacement.
- Clearance between valve guide and valve stem.
- Valve guide replacement.
- Valves.
- Valve seat turning.
- Valve springs.
- Valve cup seats.
- Rocker arms and rocker arms shaft.
- Camshaft and supports.
- Camshaft axial play check.

PRELIMINARY OPERATIONS

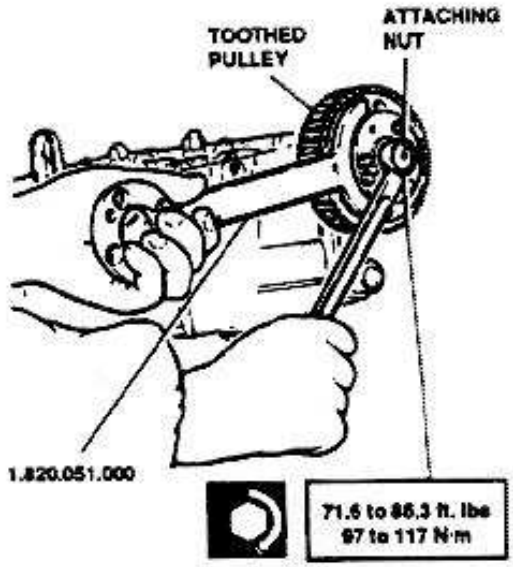
NOTE: **The disassembly procedures described in the following are referred to left cylinder head (except where specifically stated); disassembly of right cylinder head is performed in analogy.**

1. Lock swinging support **1.820.012.000** in a vice.
2. Install fork **1.820.050.000** and lock it to swinging support.
3. Lower cylinder head onto fork studs.
4. Lock cylinder head with two spacers and nuts.
5. Remove engine lifting bracket.

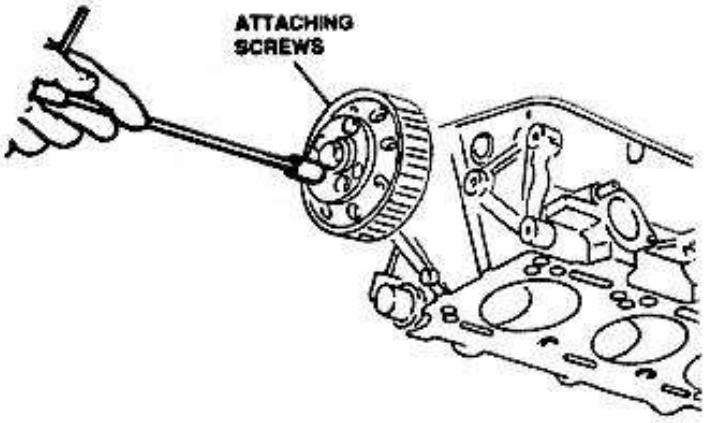


CAMSHAFT PULLEY REMOVAL

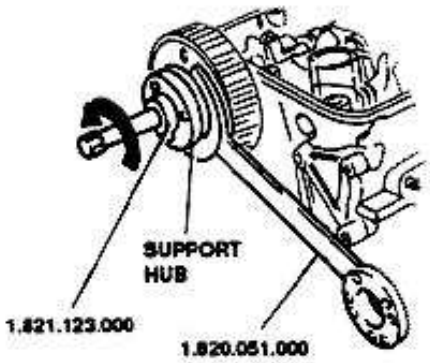
1. Use torque reactor **1.820.051.000** and remove attaching nut.



2. Remove the three screws attaching support hub to toothed pulley.

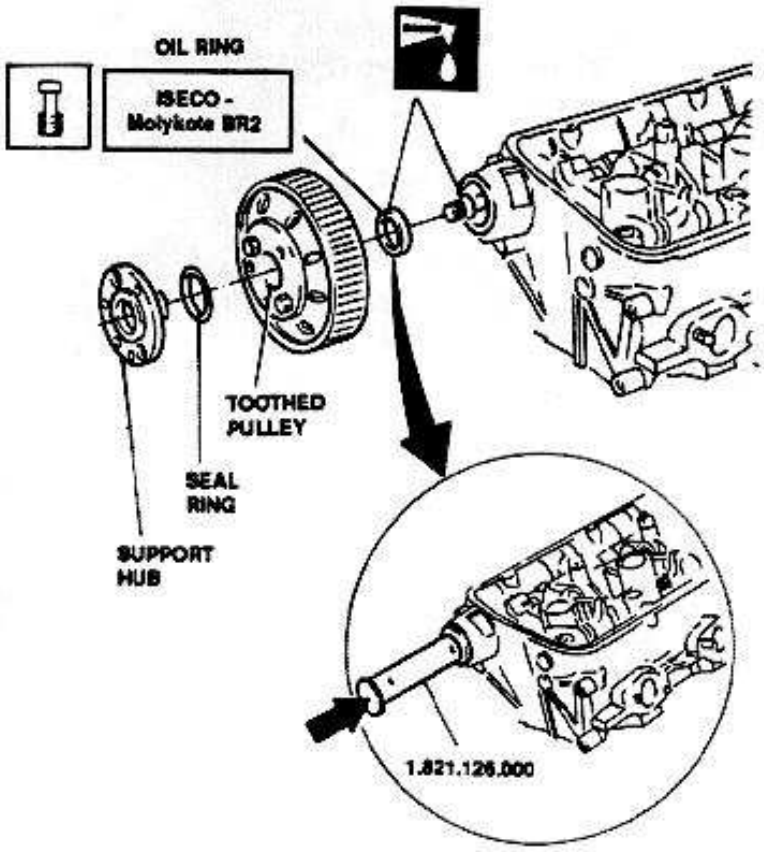


3. Using puller **1.821.123.000** and torque reactor **1.820.051.000**, remove support hub.



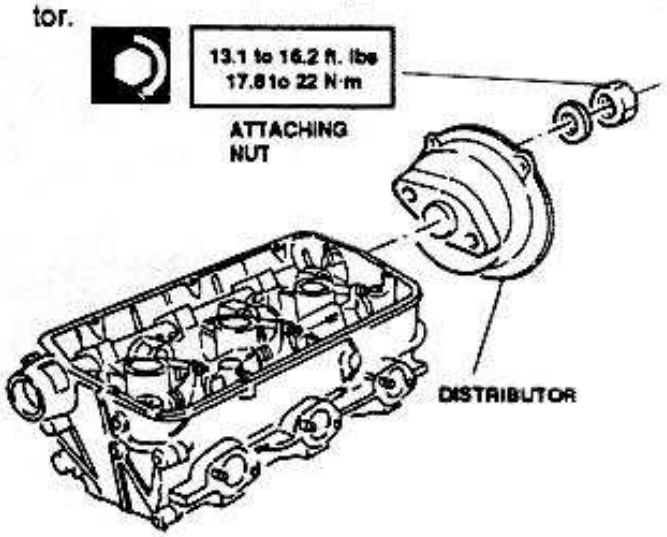
4. Remove seal ring from hub .
5. Remove toothed pulley .
6. Remove oil ring.

At reassembly, use inserting tool **1.821.126.000**.

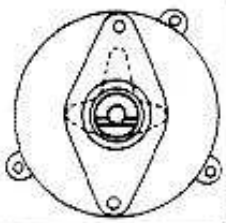


TIMING DISTRIBUTOR REMOVAL AND DISASSEMBLY (left cylinder head only)

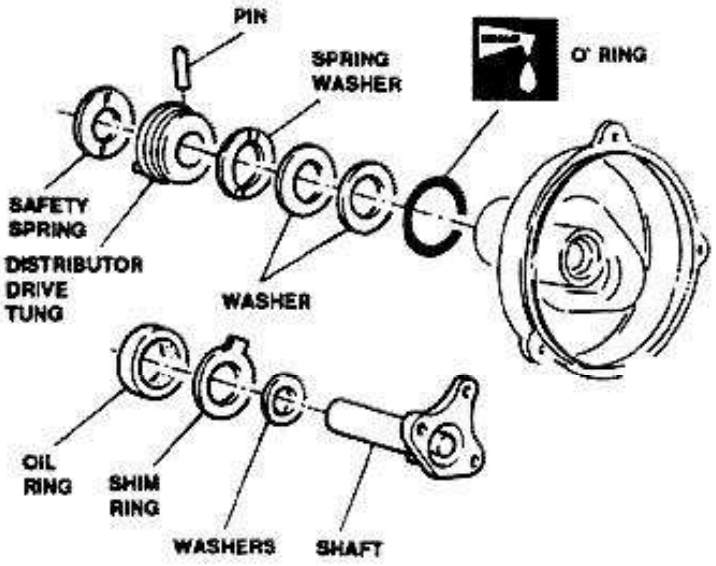
1. Unscrew the two attaching nuts and remove distributor.



At reassembly install the distributor as shown in figure, in order to avoid a 180° timing error.



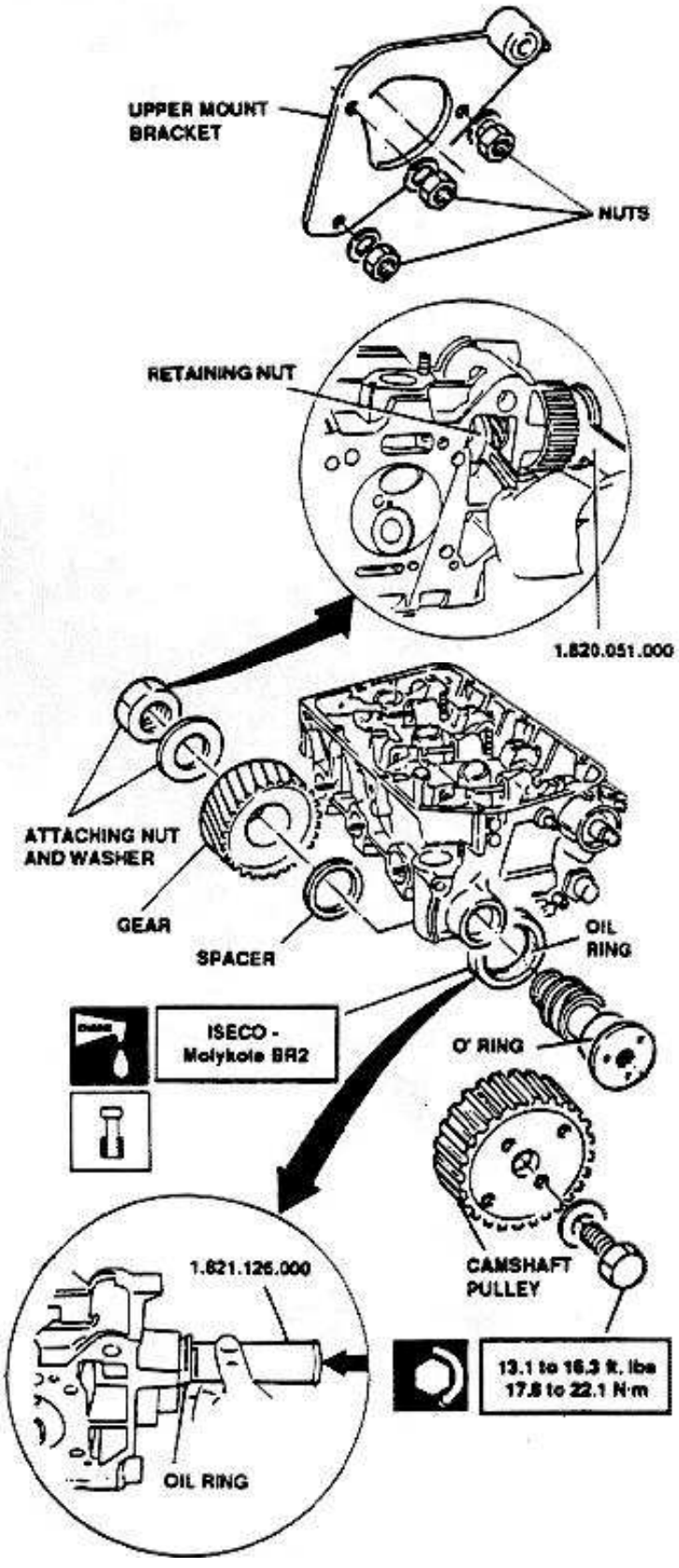
2. Remove o'ring.
3. Remove safety spring.
4. Remove pin.
5. Remove distributor drive tung.
6. Remove spring washer.
7. Remove the two washers.
8. Remove shaft.
9. Remove washer.
10. Remove shim ring.
11. Remove oil ring.



ENGINE UPPER MOUNT BRACKET AND OIL PUMP PULLEY REMOVAL (right cylinder heat only)

1. Remove camshaft pulley.
2. Unscrew the three nuts and remove engine upper mount bracket.
3. Using torque reactor 1.820.051.000 remove retaining nut after the safety lock has been lifted; remove washer.
4. Remove pulley complete of drive shaft.
5. Separate pulley and drive shaft.
6. Remove spacer.
7. Remove oil ring.

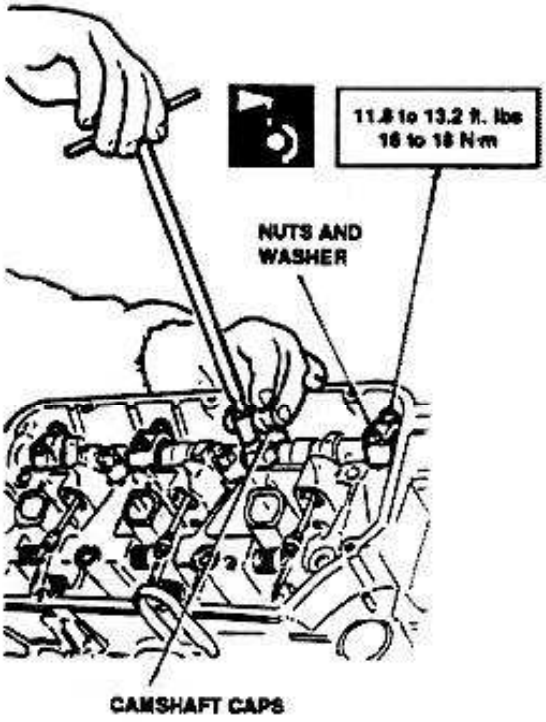
At reassembly, use inserting tool 1.821.126.000.

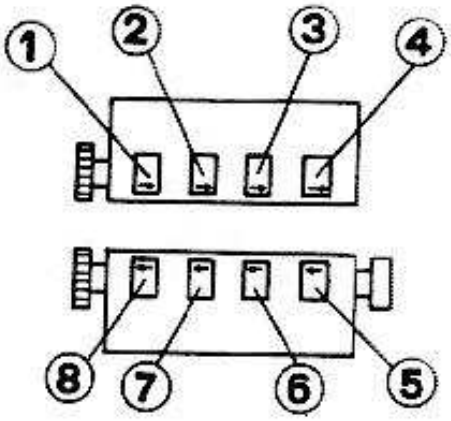


CAMSHAFT AND ROCKER ARMS SHAFT REMOVAL

1. Remove camshaft caps.

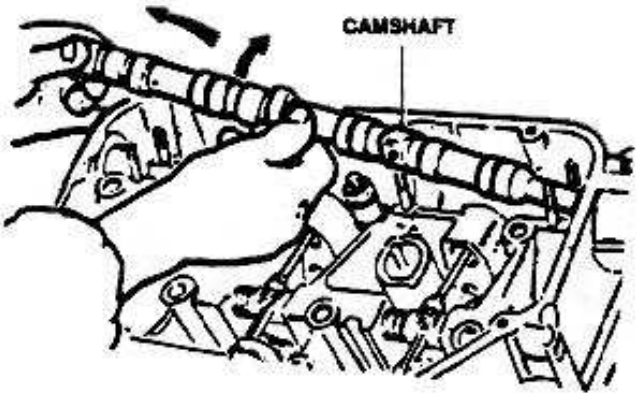
Caps are numbered in sequence (1, 2, 3 and 4 on right cylinder row; 5, 6, 7, and 8 on left cylinder row).
At reassembly, install caps in the same order.





NOTE: If not previously performed, remove timing distributor.

2. Remove camshaft by lifting rear end first, and pulling it out as shown by the arrows in the figure below.

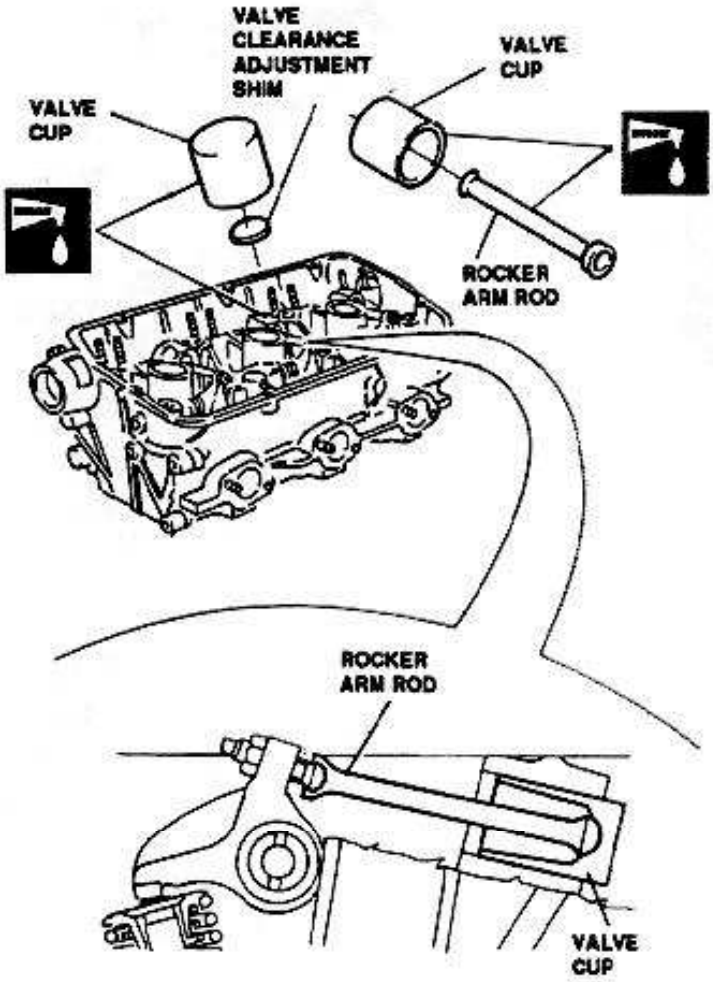


CAUTION:
Operate with precaution: cams and supports mating surfaces could be easily damaged.

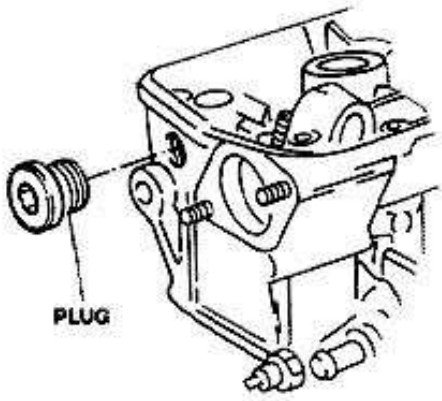
3. Remove intake side valve cups and relevant valve clearance adjustment shims.
4. Remove exhaust side valve cups and relevant rocker arm rods.

NOTE: Place items in sequence order in case they are re-used at reassembly.

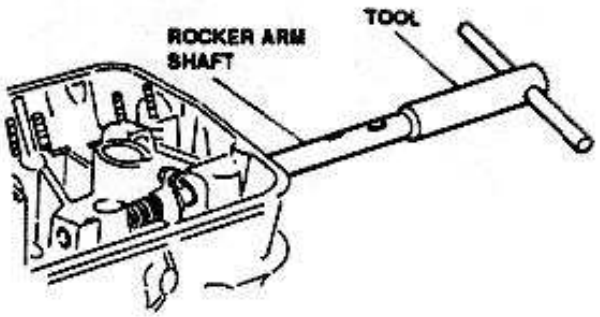
NOTE: For valve clearance check and adjustment observe warnings on relevant paragraph



5. Remove rocker arm shaft plug.

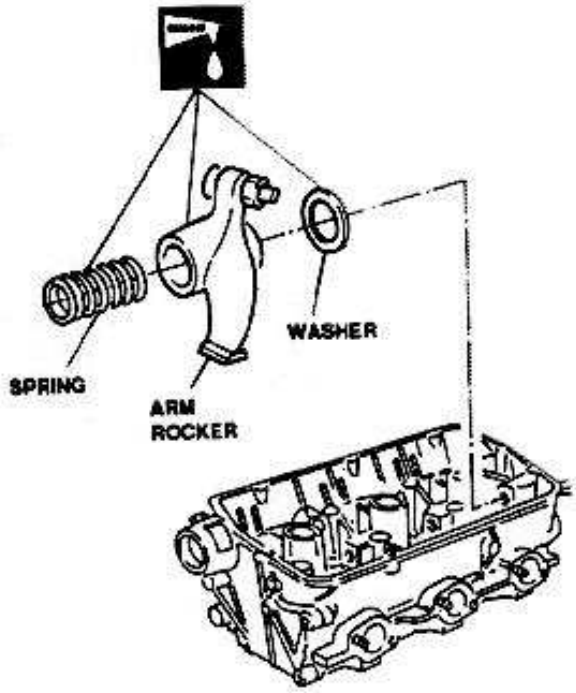


6. Screw a suitable tool onto threaded tug of rocker arm shaft.
7. Gradually withdraw rocker arm shaft.



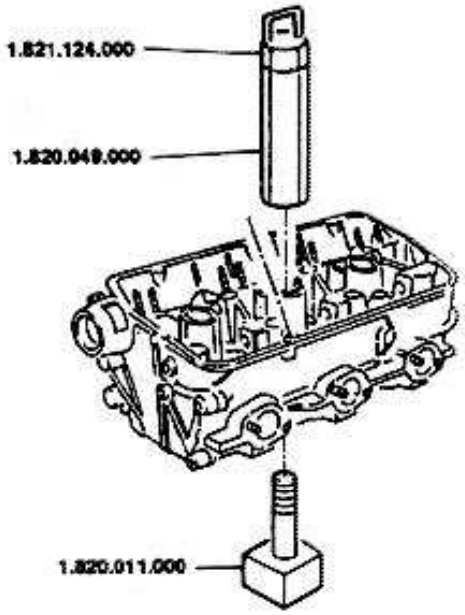
At reassembly, for proper positioning of rocker arm shaft follow warnings in **"ROCKER ARM"** paragraph.

8. Remove springs.
9. Remove rocker arms.
10. Remove washers.

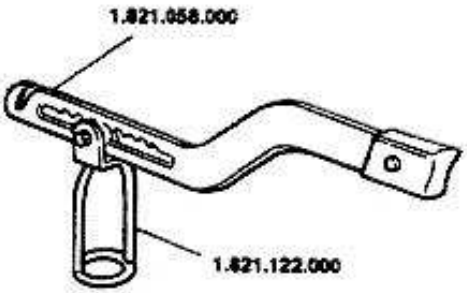


VALVES DISASSEMBLY

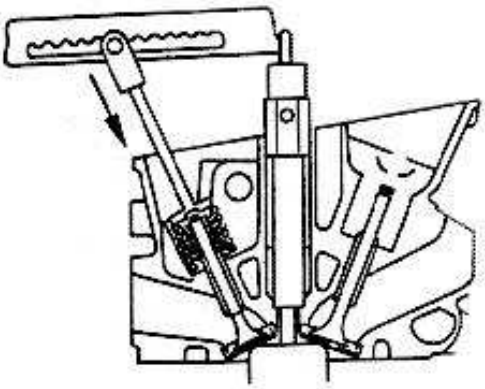
1. Insert valve supporting tool **1.820.011.000** through lower side of spark plug well, and lock tool **1.820.049.000**.
2. Install support tool **1.821.124.000** onto threaded end of tool **1.820.049.000**.



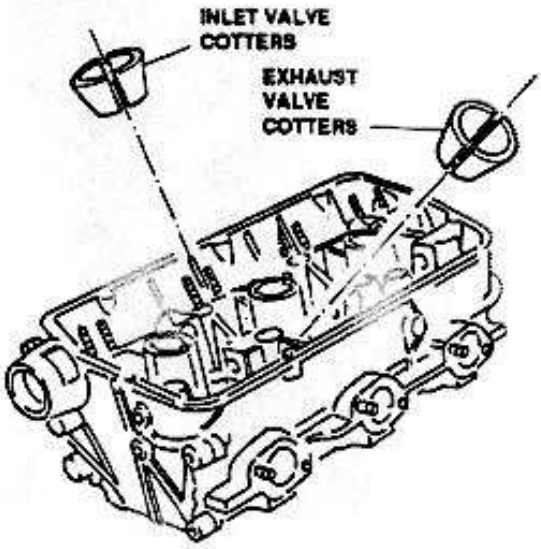
3. Install cone halves disassembly/reassembly cage **1.821.122.000** on tool **1.821.058.000**.



4. Position tools assembled at previous steps as illustrated in figure below.



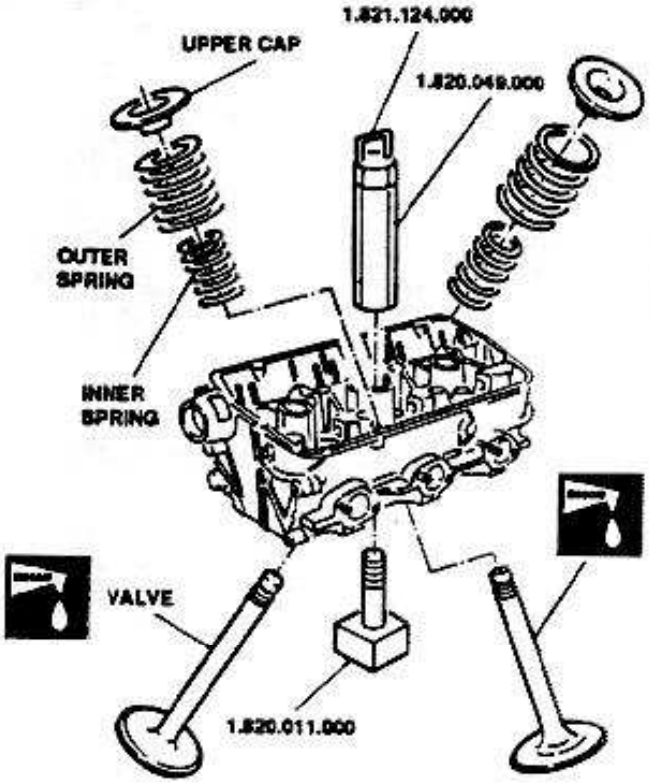
5. Press lever of tool **1.821.058.000** to contrast resistance of valve springs.
6. Remove intake and exhaust valve cotters.



7. Remove upper caps.
8. Remove outer springs.
9. Remove inner springs.
10. Remove tools **1.820.049.000**, **1.821.124.000** and **1.820.011.000**..

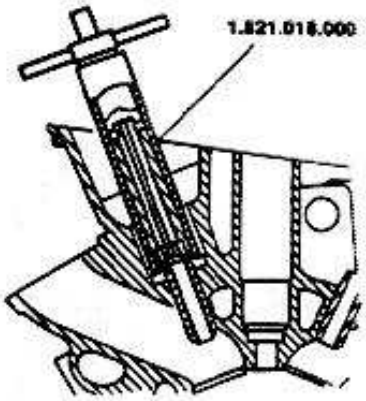
11. Withdraw the two valves (intake and exhaust).

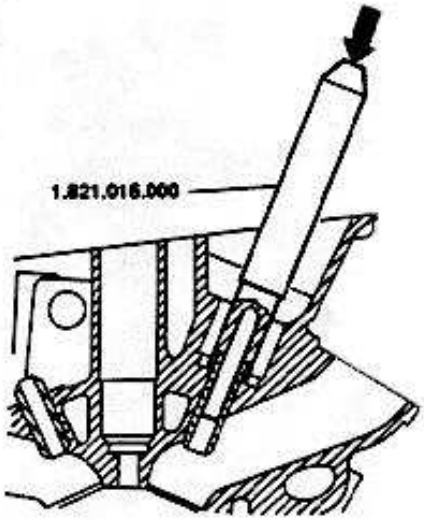
NOTE: Proceed in analogy on the other cylinder heads using the same tools.



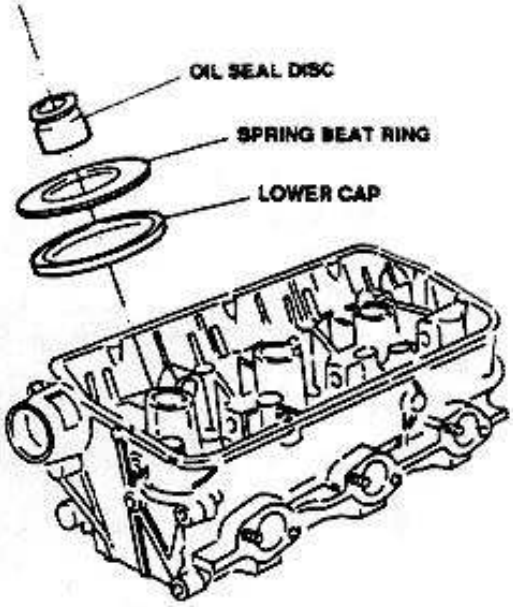
12. Remove the oil sealing pads using tool **1.821.018.000**.

At reassembly, use inserting tool **1.821.016.000**.



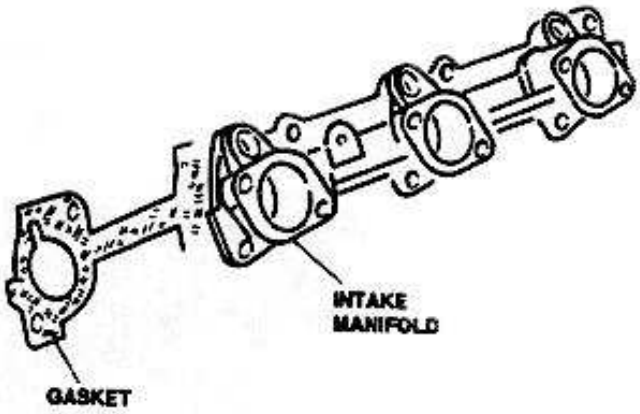


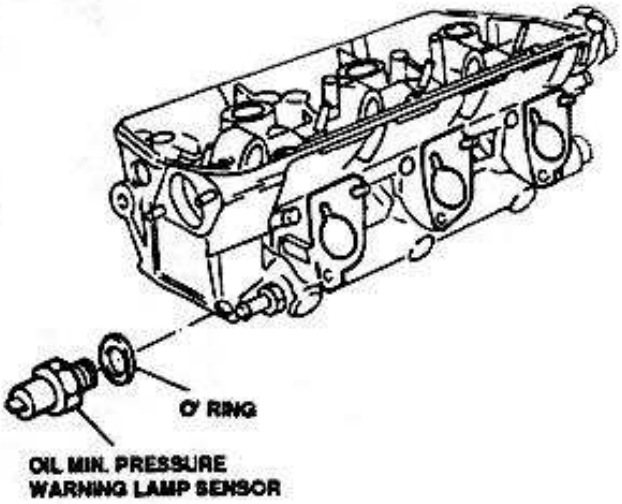
13. Remove lower caps.



INTAKE MANIFOLD REMOVAL

1. Remove intake manifold.
2. Remove gasket between manifold and cylinder head.
3. If required, remove engine oil minimum pressure warning lamp sensor and relevant o'ring (only on the left cylinder head).





CYLINDER HEAD LOWER PLANE CHECK

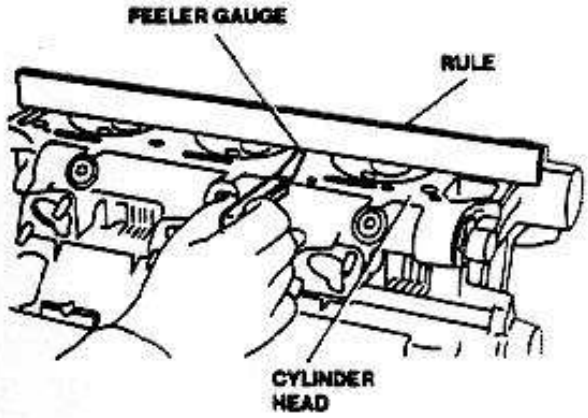
1. Thoroughly clean the cylinder heads plane from any trace of old gasket.
2. Visually inspect cylinder head carefully for presence of cracks, traces of overheating, scoring or excessive

wear.

3. Check lower plane flatness and, if excessively distorted, carry-out facing of lower plane.

NOTE: Facing must be carried-out on both heads.

Max heads lower plane flatness error
0.05 mm (0.0019 in)

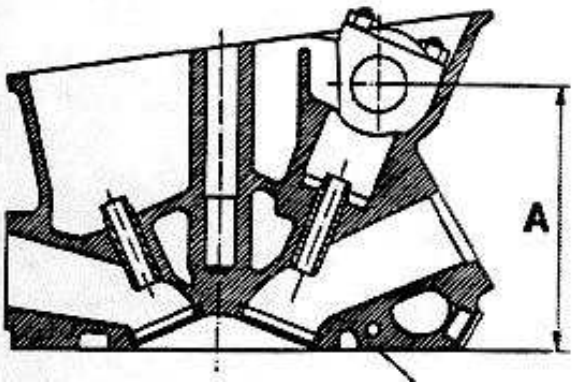


4. After facing, check that head height is above the minimum allowable value.

CAUTION:
Do not exceed minimum allowable value to prevent serious engine malfunction.

5. Check that head lower plane surface finish is of required quality.

Minimum allowable heads height after facing
A = 124.85 to 125.15 mm (4.915 to 4.927 in)

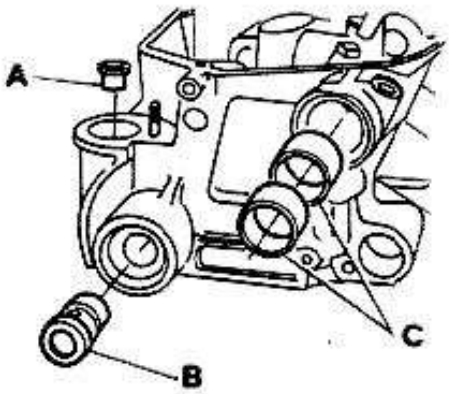


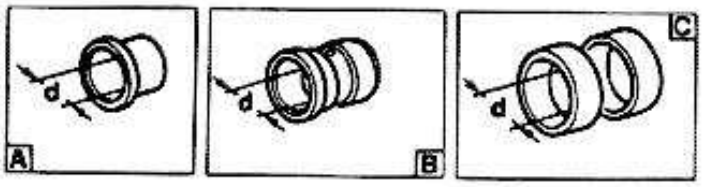
CYLINDER HEAD BUSHINGS CHECK

1. Measure inner diameter "d" of bushings installed on cylinder heads, and verify that dimension is within prescribed limits:

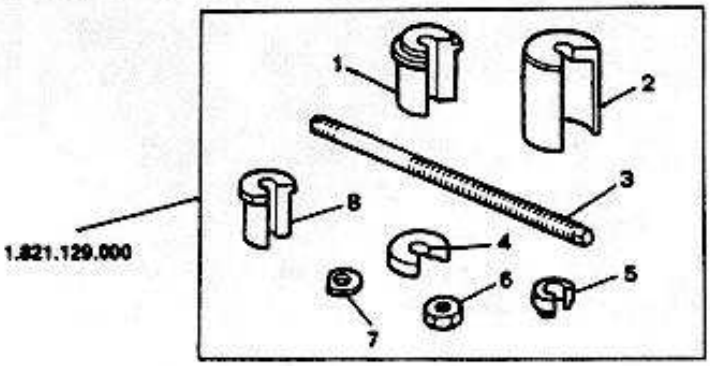
"A" (Right cylinder head only)
Oil pump drive gear bushing.
"B" (Right cylinder head only)
Oil pump drive toothed pulley shaft bushing.
"C" Camshaft drive toothed pulley hub bushings.

"d" bushings inner diameter	
"A"	19.000 to 19.021 mm (0.7480 to 0.7488 in)
"B"	19.000 to 19.021 mm (0.7480 to 0.7488 in)
"C"	32.000 to 32.025 mm (1.2598 to 1.2608 in)





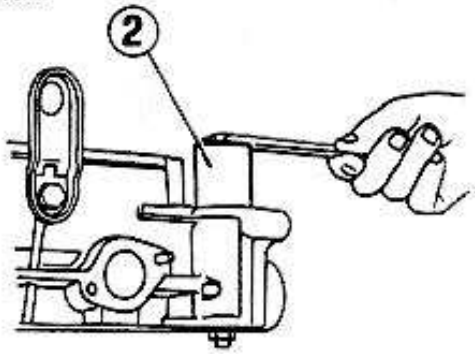
NOTE: If dimension as measured are not within the prescribed limits, replace affected bushings using tool **1.821.129.000** as described in the following paragraphs.

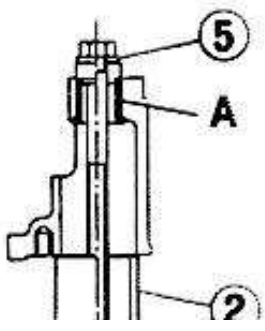


Parts of tool **1.821.129.000**	
1 Reactor block	5 Special washer
2 Cup	6 Nut (M10 x 1.5)
3 Tie rod	7 Formed washer
4 Flange	8 Reactor block

REMOVAL OF BUSHING "A"
(For oil pump drive gear)

1. Withdraw oil pump drive gear bushing "A" using the special washer "5" as a pressure disc, and cup "2" as a reactor.

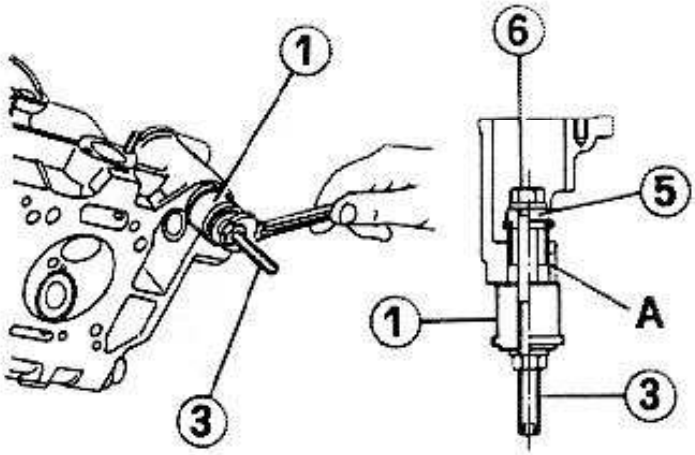




INSERTION OF BUSHING "A"
(For oil pump drive gear)

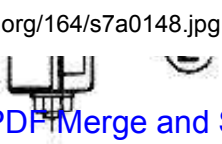
Insert the oil pump drive gear bushing "A" as follows:

1. Position new bushing.
2. Insert tie-rod "3" complete of nut "6" and special washer "5" (acting as a pressure disc).
3. Insert reactor block "1" on opposite end of tie-rod and complete bushing installation.



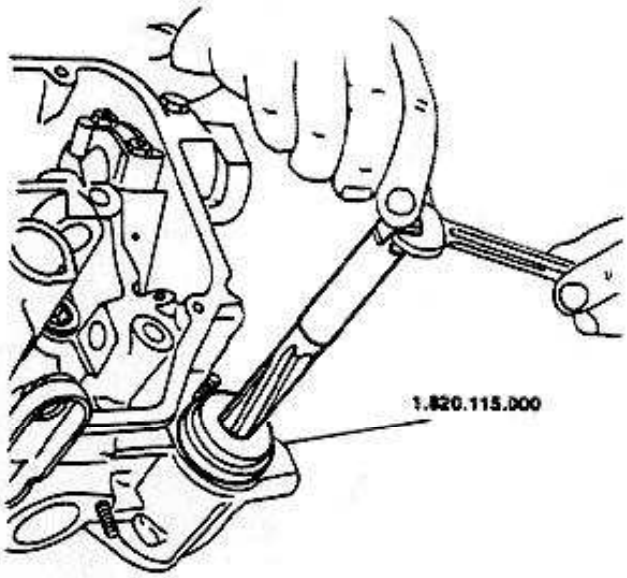
REAMING OF BUSHING "A"
(For oil pump drive gear)

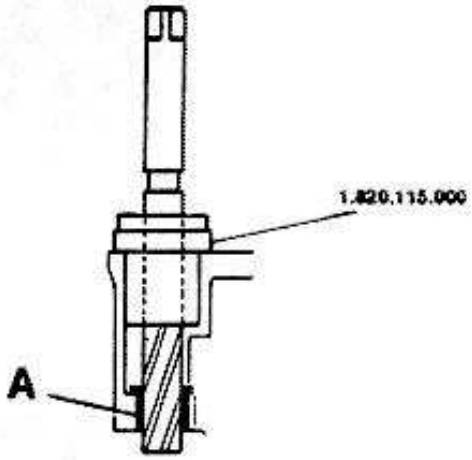
1. After installation, ream bushing "A" to the prescribed dimension using drive tool **1.820.115.000** and a



suitable reamer (19 mm, H7).

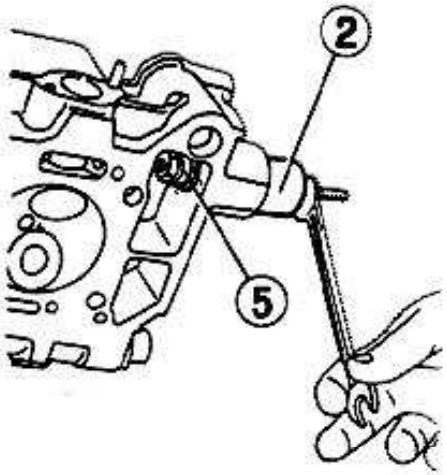
Oil pump drive gear hub bushing inner diameter (reaming)
19.000 to 19.021 mm (0.7480 to 0.7488 in)

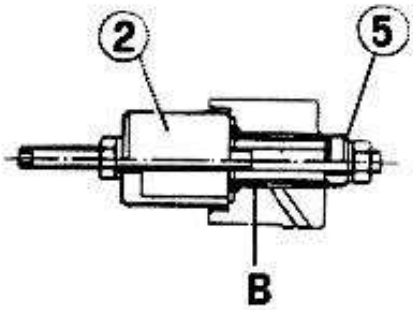




REMOVAL OF BUSHING "B"
(For oil pump drive toothed pulley shaft)

1. Withdraw oil pump drive toothed pulley shaft bushing "B" using the special washer "5" as a pressure disc, and cup "2" as a reactor.

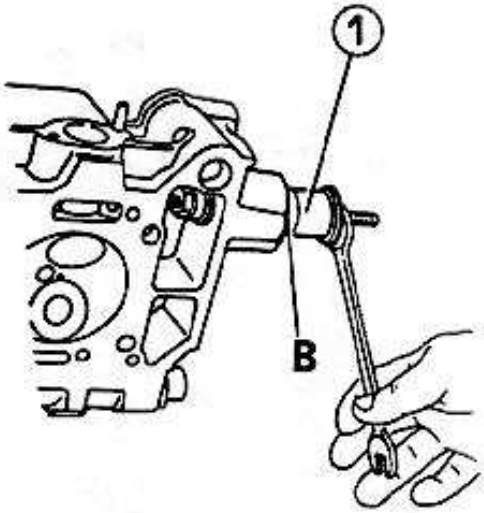


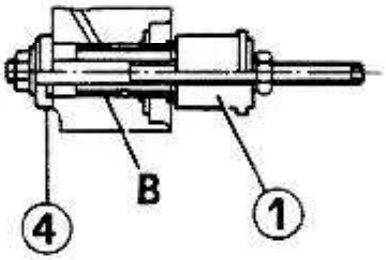


INSERTION OF BUSHING "B"
(For oil pump drive toothed pulley shaft)

1. Insert oil pump drive toothed pulley shaft bushing using block "1" as a pressure tool, and flange "4" as a reactor.

a reactor.

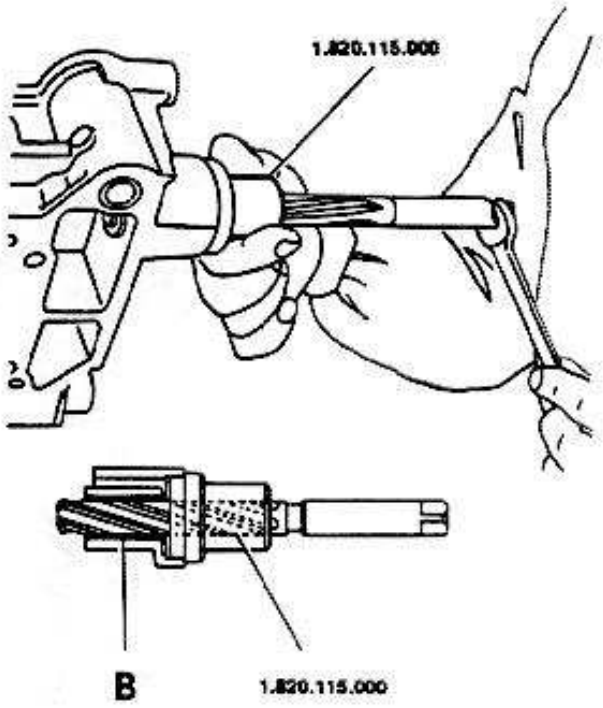




REAMING OF BUSHING "B"
(For oil pump drive toothed pulley shaft)

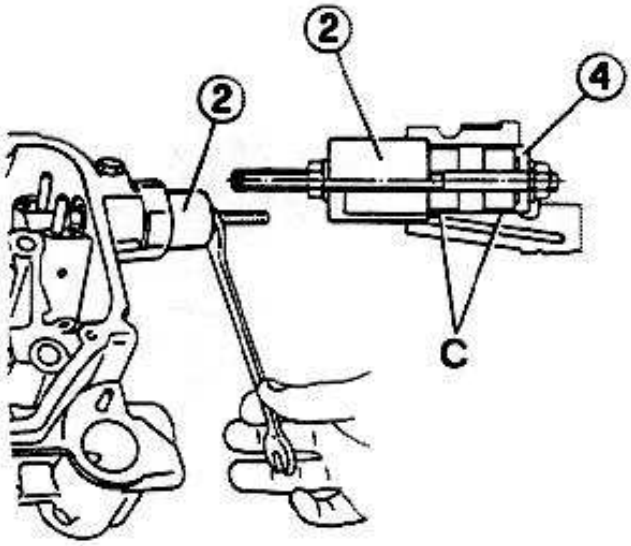
1. After installation, ream bushing "B" to the prescribed dimension using drive tool 1.820.115.000 and a suitable reamer (19 mm, H7).

∅	Oil pump drive gear hub bushing inner diameter (reaming)
	19.000 to 19.021 mm (0.7480 to 0.7488 in)



REMOVAL OF BUSHINGS "C"
(For camshaft drive toothed pulley hub)

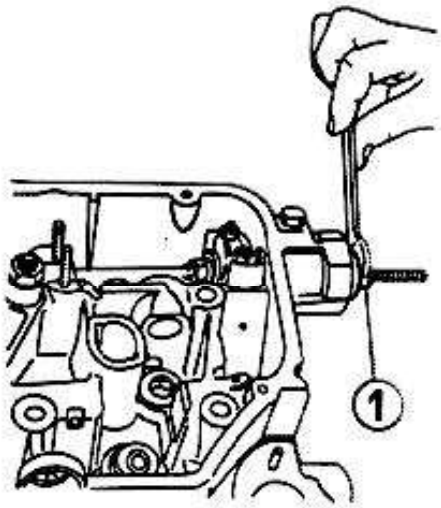
1. Withdraw camshaft drive toothed pulley hub bushings "C" using flange "4" as a pressure disc, and cup "2" as a reactor.

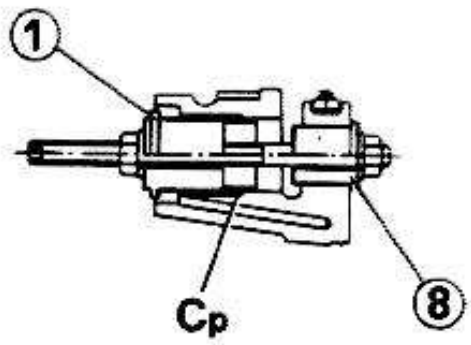


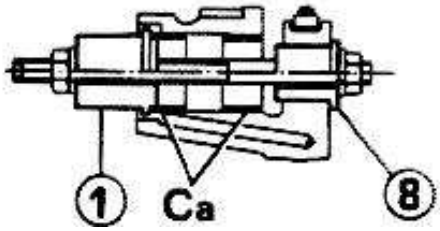
INSERTION OF BUSHINGS "C"
(For camshaft drive toothed pulley hub)

Insert the camshaft drive toothed pulley hub bushings "C" as follows:

1. Install adiacent camshaft cover and lock it with two nuts.
2. Start rear bushing "Cp" identified by lower thickness, until it is sufficiently centered into its seating.
3. Insert bushing "Cp" using block "1" as a pressure block, and block "8" as a reactor.
4. Proceed in analogy to insert bushing "Ca", but using block "1" in reversed position.



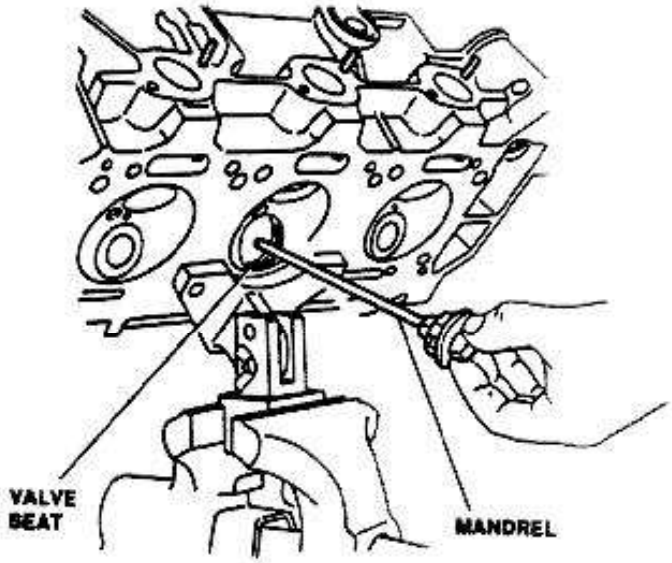




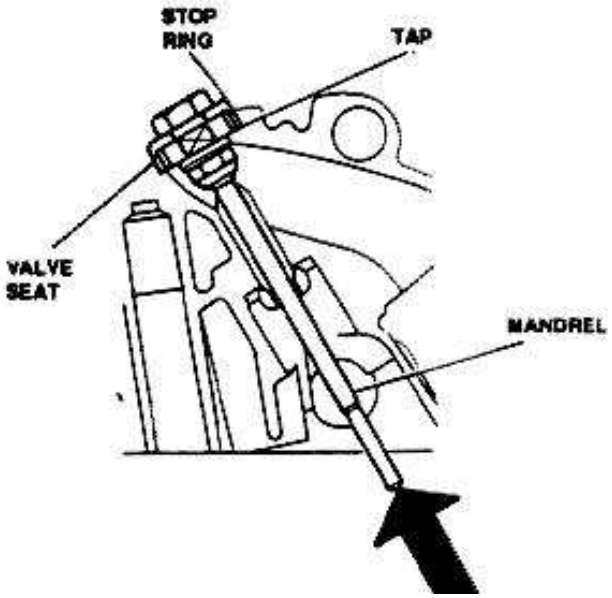
VALVE SEATS REPLACEMENT

Remove worn valve seats using a suitable tool as indicated in figure below; proceed as follows:

1. Install on mandrel the lock ring and tap selected to fit diameter of valve seat to be removed.
2. Insert the assembly prepared at step 1. above into valve guide until tap contacts against the valve seat.
3. Thread valve seat acting with a suitable wrench on mandrel head, until the ring touches the valve seat plane; then unscrew 1/2 turn.

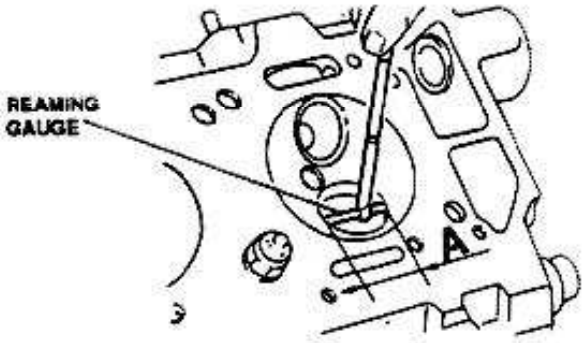


4. Withdraw the valve seat while beating on mandrel end protruding from cylinder head.



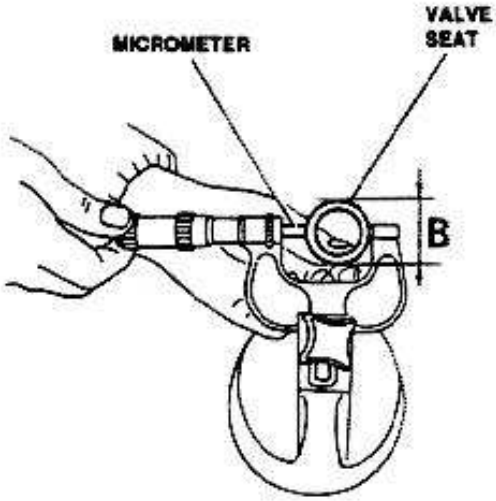
5. Check that diameter of valve seat housing "A" is within prescribed limits.

"A" valve seat housing diameter		
Normal	Intake	45.000 to 45.025 mm (1.7716 to 1.7726 in)
	exhaust	39.000 to 39.025 mm (1.5354 to 1.5364 in)
Oversized	Intake	45.300 to 45.325 mm (1.7835 to 1.7844 in)
	exhaust	39.300 to 39.325 mm (1.5472 to 1.5482 in)

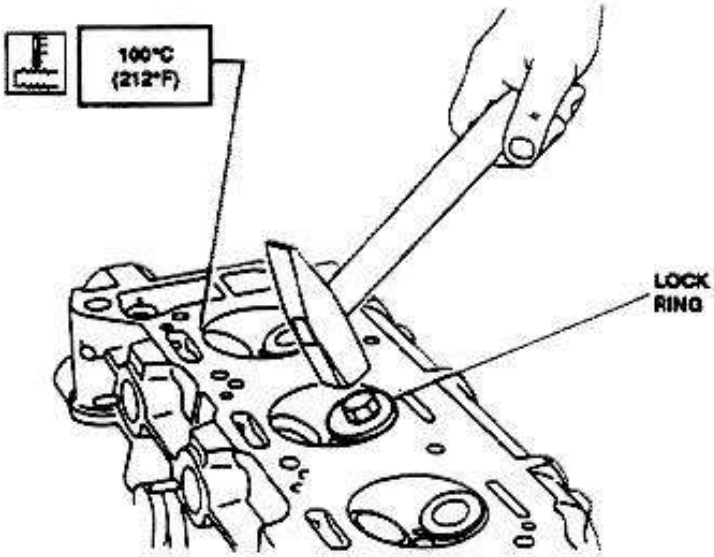


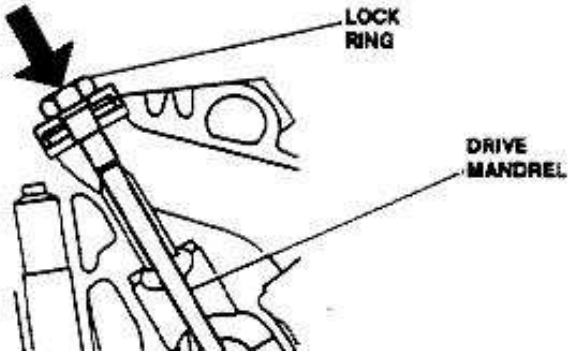
6. Check that outer diameter of replacement valve seat "B" is within prescribed limits.

"B" valve seat outer diameter		
Normal	Intake	45.065 to 45.100 mm (1.7742 to 1.7756 in)
	exhaust	39.065 to 39.100 mm (1.5380 to 1.5393 in)
Oversized	Intake	45.365 to 45.400 mm (1.7860 to 1.7874 in)
	exhaust	39.300 to 39.325 mm (1.5498 to 1.5512 in)



7. Heat head to temperature of about 100°C (212°F).
8. Install and lock on mandrel a lock ring selected to fit diameter of valve seat to be installed.
9. Insert assembly prepared at step 8. above until the lock ring contacts against valve seat.
10. Insert valve seat by beating on mandrel end protruding from cylinder head.

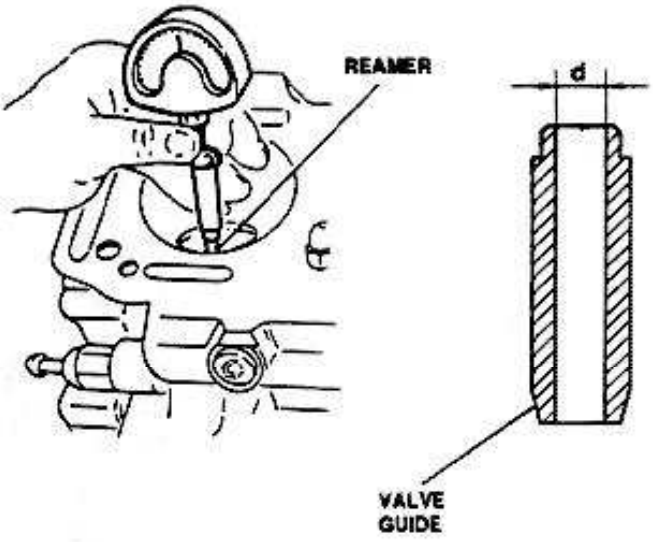




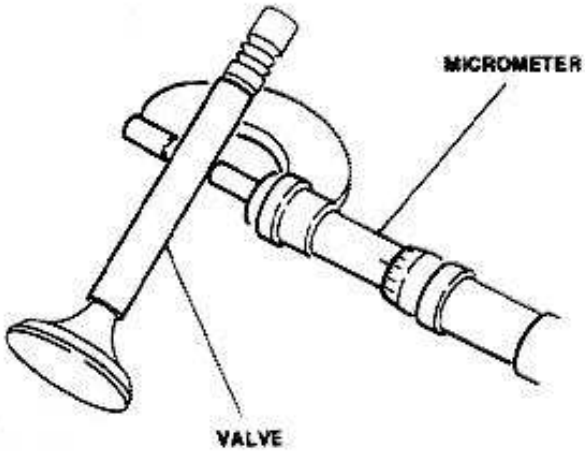
CLEARANCE BETWEEN VALVE GUIDE AND VALVE STEM

1. Measure inner diameter "d" of valve guide and check dimension is within prescribed limits.

"d" valve guide inner diameter	
Intake and exhaust	9.000 to 9.015 mm (0.3543 to 0.3549 In)



2. Measure diameter of valve stem in at least three different locations 90° apart from each other.

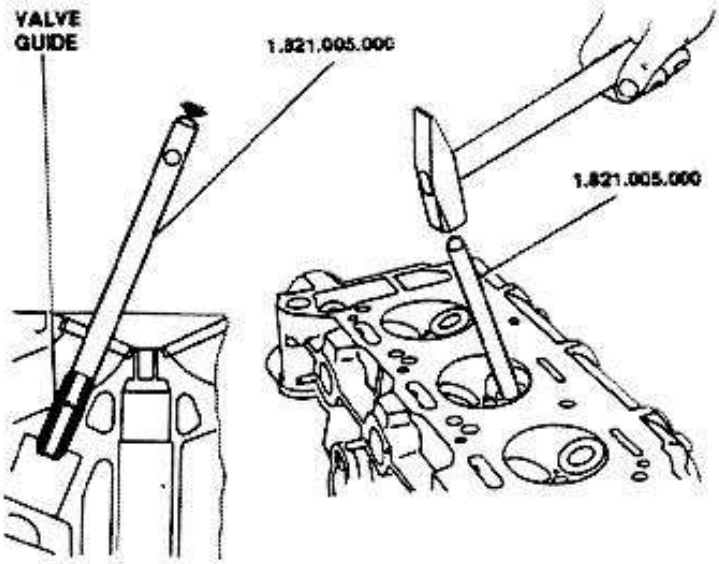


3. Calculate clearance by subtracting the maximum stem dimension from inner diameter of valve guide; replace items if clearance is not within prescribed limits.

Clearance between valve stem and valve guide	
Intake	0.013 to 0.043 mm (0.0005 to 0.0017 In)
exhaust	0.045 to 0.075 mm (0.0018 to 0.0029 In)

VALVE GUIDE REPLACEMENT

1. Visually check the valve guides for absence of nicks, scoring, distortion or displacement from original position of installation.
2. If necessary, withdraw valve guide using puller **1.821.005.000**.



3. Measure diameter of valve guide seat and outer diameter of the new valve guide; the installation interference must be within prescribed tolerances.

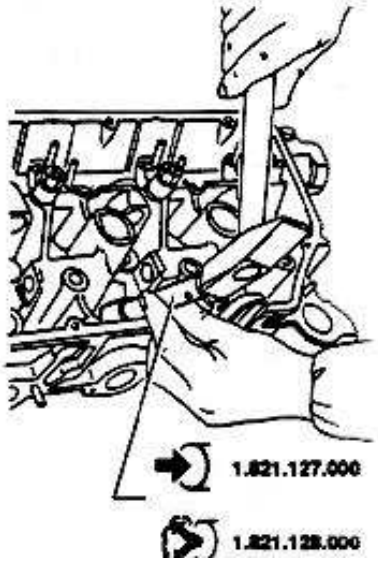
Valve guide seat diameter	
Intake and exhaust	13.990 to 14.018 mm (0.5507 to 0.5519 in)

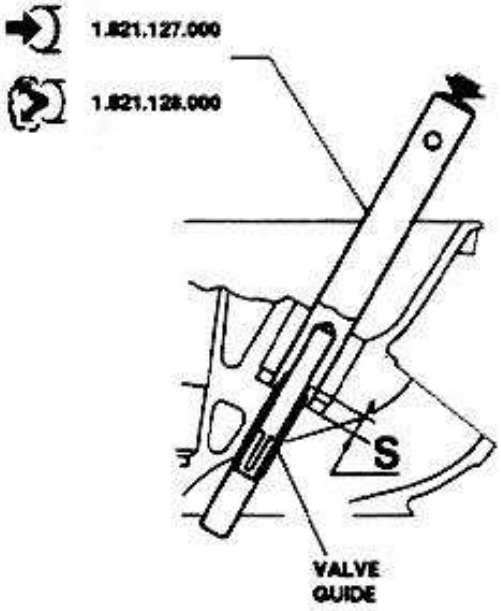
Valve guide outer diameter	
Intake	14.033 to 14.044 mm (0.5525 to 0.5529 in)
exhaust	14.048 to 14.059 mm (0.5531 to 0.5535 in)

Interference between valve guide and valve guide seat	
Intake	0.015 to 0.054 mm (0.006 to 0.0021 in)
exhaust	0.030 to 0.069 mm (0.0011 to 0.0027 in)

4. Insert new valve guides using the special inserting tools that ensure the correct protrusion values are obtained.

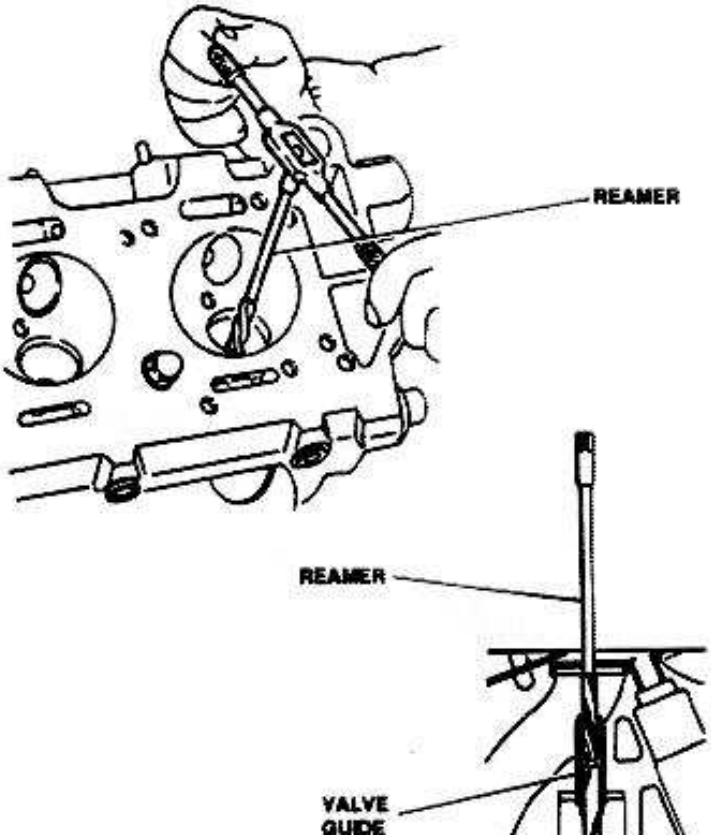
Valve guide "S" protrusion	
Intake and exhaust	10.2 to 10.6 mm (0.40 to 0.42 in)





5. Ream the new valve guides (intake and exhaust) by means of a reamer (dia. 9 mm, H7) to bring holes to the prescribed diameter.

Valve guide inner diameter	
Intake and exhaust	9.000 to 9.015 mm (0.3543 to 0.3549 in)



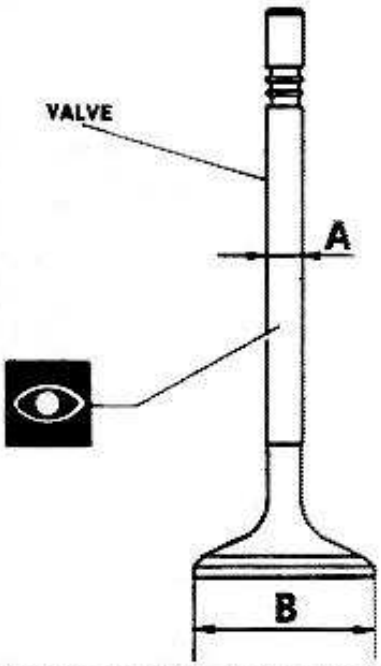
VALVES

1. Check valves for absence of nicks, burnings and noticeable traces of scoring with corresponding seating or cylinder heads; replace valves if necessary.
2. If valves are in good condition proceed to dimensional check of stem and head diameters; verify the diameters are within prescribed limits.

"A" valve stem diameter	
Intake	8.972 to 8.987 mm (0.3532 to 0.3538 in)
exhaust	8.940 to 8.955 mm (0.3520 to 0.3525 in)

"B" valve head diameter	
Intake	43.850 to 44.000 mm (1.7264 to 1.7322 in)
exhaust (*)	38.500 to 38.700 mm (1.5157 to1.5236 in)

(*) for LIVIA type valves: 38.45 to 38.60 mm (1.514 to 1.519 in)



NOTE: If valves are "burned", check proper operation of springs and check valve clearance

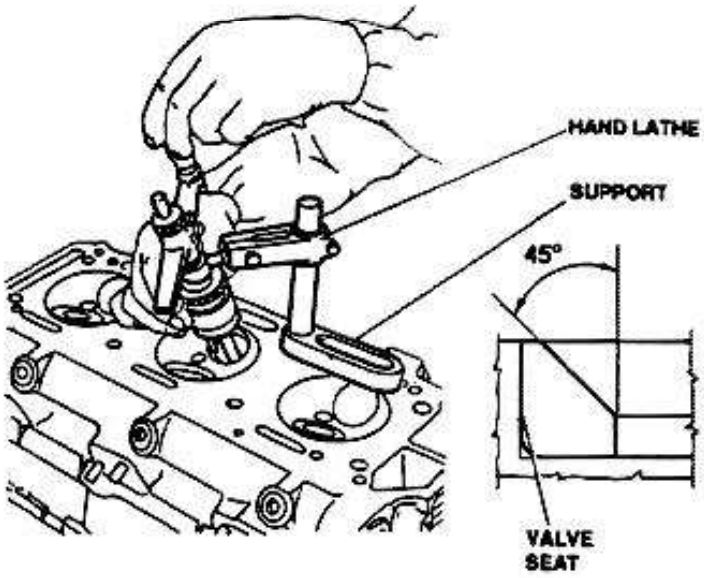
VALVE SEAT TURNING

The turning of valve seats that do not require replacement is useful to remove all minor defects present on working surfaces; however, before carrying-out turning, ascertain that sufficient stock is available.

1. If necessary, carry-out valve seating turning by means of suitable tools.

NOTE: Taper "C" can be obtained by positioning the hand lathe tool to an angle of 45°.

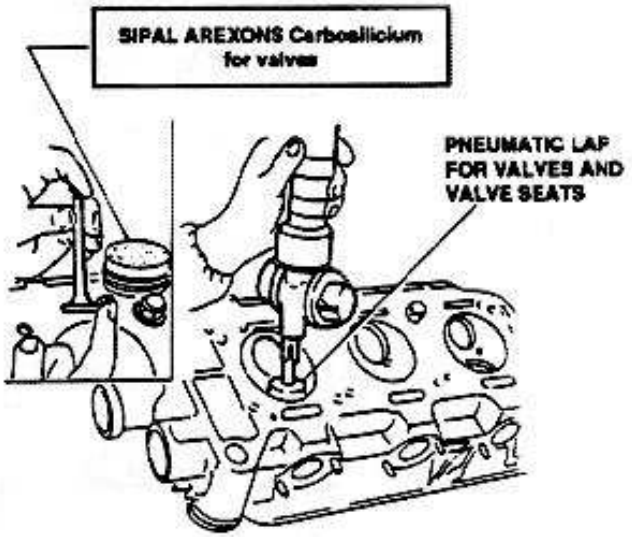
Intake and exhaust valve seat taper
"C" = 90° ± 20°



2. Smear the mating surfaces of valves and relevant seats with abrasive paste (SIPAL-AREXSONS Carbosilicium for valves).
3. Lubricate valve stem with engine oil.
4. Fix inner surface of valve head to the suction cup of a pneumatic lap.
5. Insert valve in relevant guide and carry-out grinding

tion of springs and check valve clearance. 3. Insert valve in relevant guide and carry-out grinding.

6. After grinding, thoroughly clean both valves and relevant seats.



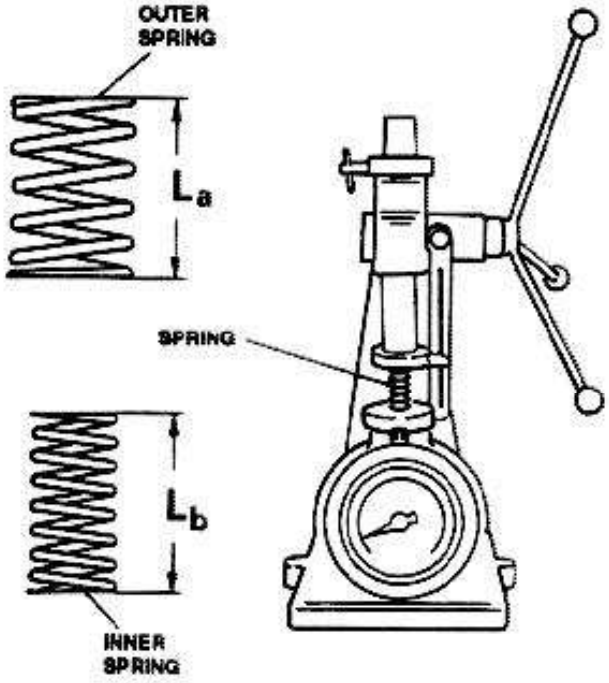
VALVE SPRINGS

1. Check that length of "free" springs is within prescribed limits. The terminal planes must be parallel to each other and perpendicular to spring axis (max. error 2°).
2. Check with a dynamometer that characteristic data of springs are within prescribed limits.

Free spring length	
outer spring La	44.6 mm (1.75 in)
inner spring Lb	44.1 mm (1.73 in)

Outer spring		
spring length	mm (in)	N (lbs)
with valve closed	32.5 (1.28)	243 to 252 (54.6 to 56.6)
with valve open	23.5 (0.92)	470 to 488 (105.6 to 109.7)

Inner spring		
spring length	mm (in)	N (lbs)
with valve closed	30.5 (1.20)	126 to 130 (28.3 to 29.2)
with valve open	21.5 (0.84)	222 to 231 (49.9 to 51.9)

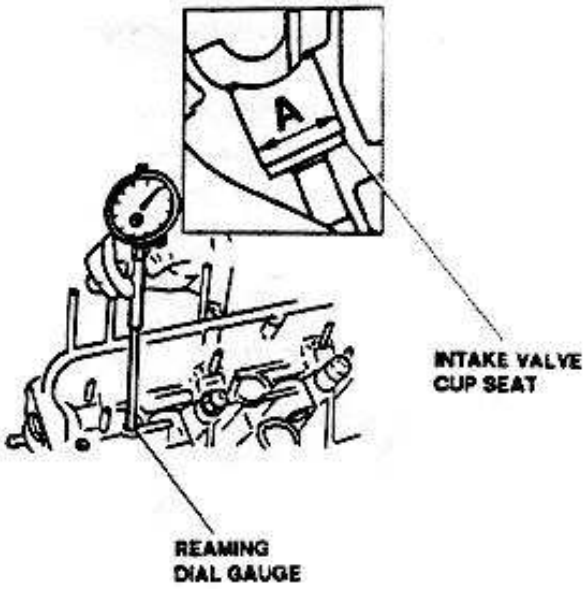


VALVE CUP SEATS

INTAKE SIDE

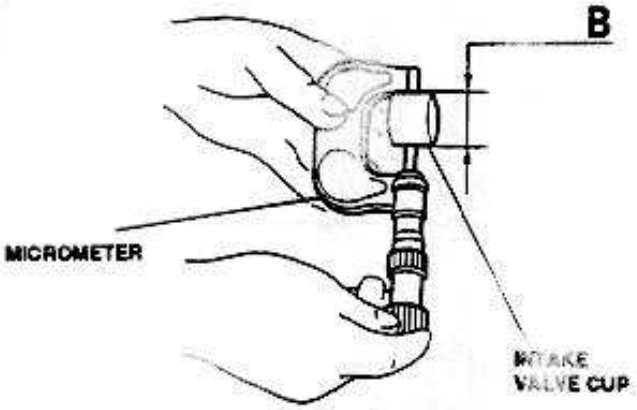
1. Check that outer surfaces of valve cups, and upper plane on which the cams work, are free of any traces of seizing, nicks or abnormal wear. In case the cups are still serviceable proceed to the dimensional check.
2. Check valve cup seats diameter is within prescribed limits.

Intake valve cup seat diameter
A = 35.000 to 35.025 mm (1.3780 to 1.3789 in)



3. Check valve cups outer diameter is within prescribed limits.

Intake valve cup diameter
B = 34.973 to 34.989 mm (1.3769 to1.3775 In)



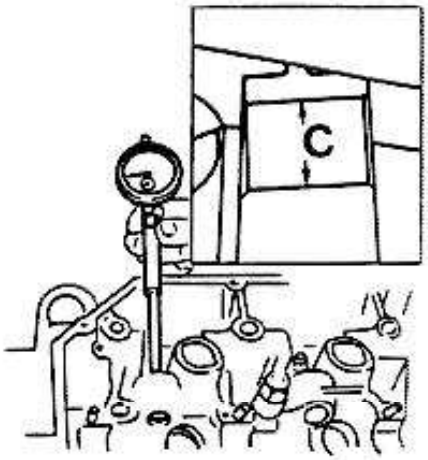
VALVE CUP SEATS

EXHAUST SIDE

1. Check that outer surface of valve cups, and upper plane on which the cams work are free of any traces of seizing, nicks or abnormal wear. In case the cups are still serviceable proceed to the dimensional check.

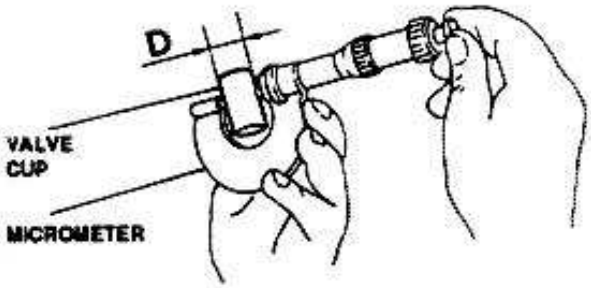
2. Check valve cup seats diameter is within prescribed limits.

Exhaust valve cup seat diameter
C = 22.000 to 22.021 mm (0.8661 to 0.8670 In)



3. Check valve cups outer diameter is within prescribed limits.

Exhaust valve cup diameter
D = 21.971 to 21.989 mm (0.8650 to 0.8657 In)

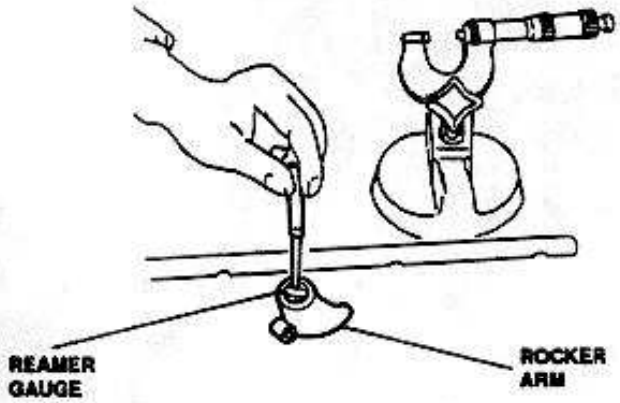


NOTE: **If dimension of cups are not within prescribed limits, the engine will produce excessive noise.**

ROCKER ARMS AND ROCKER ARMS SHAFT

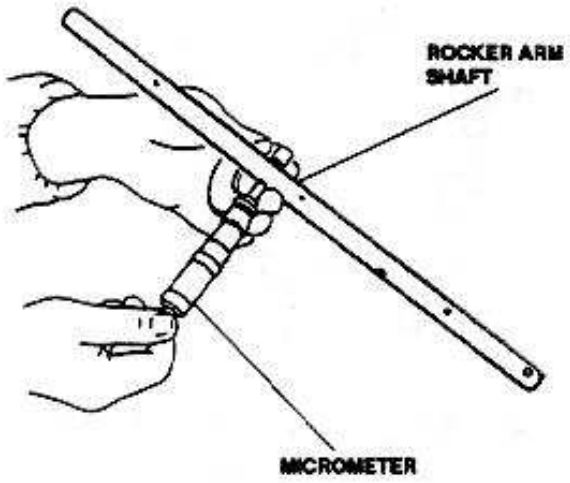
1. Check rocker arms inner diameter is within prescribed limits.

Rocker arm inner bore diameter
16.016 to 16.034 mm (0.6305 to 0.6312 in)



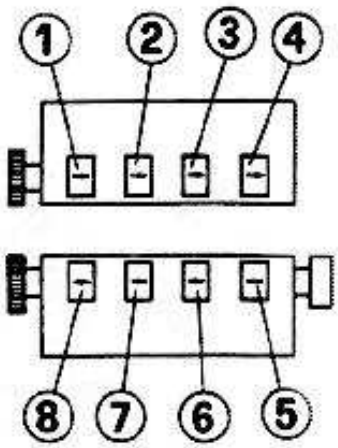
2. Check rocker arms shaft diameter is within prescribed limits.

Rocker arm shaft diameter
15.988 to16.000 mm (0.6294 to 0.6299 in)



CAMSHAFTS AND SUPPORTS

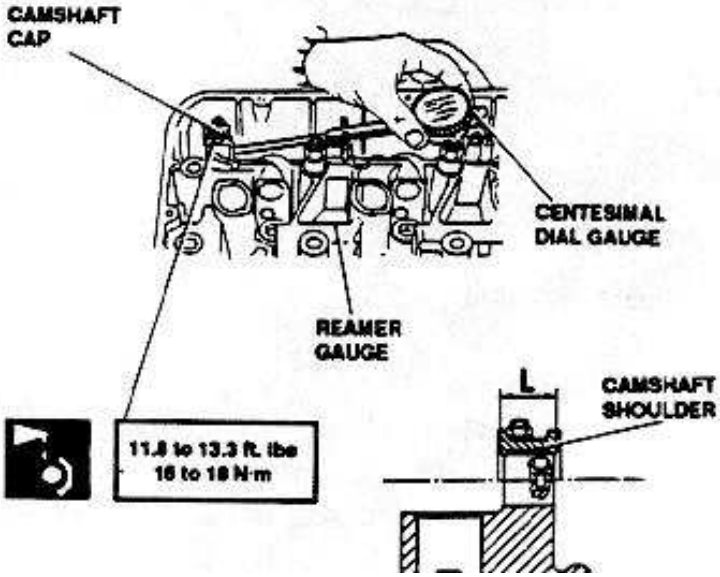
1. Install caps following identification numbers and direction shown by the arrow on the caps; torque lubricated nuts to the prescribed value.



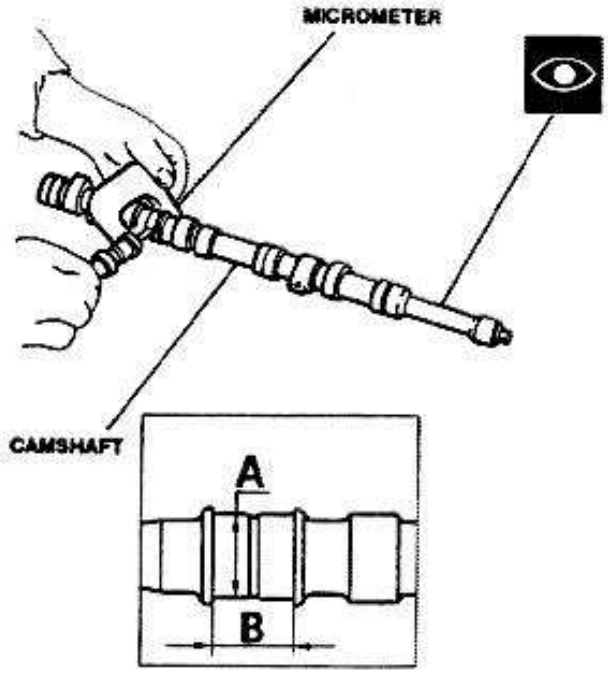
2. Check diameter of camshaft supports is within prescribed limits.
3. Check maximum width "L" of shoulder is within prescribed limits.

Camshaft support diameter
27.000 to 27.033 mm (1.0630 to 1.0643 in)

Support shoulder width "L"
26.851 to 26.940 mm (1.0571 to 1.0606 in)



4. Carefully check the cams and camshaft working surfaces are free of scoring, traces of binding or overheating, and abnormal wear.
5. Check journals diameter "A" is within prescribed limits.
6. Check cams height is above minimum allowable dimension.
7. Check cam shoulder length "B" is within prescribed limits.
8. Check maximum eccentricity between journals does not exceed prescribed limit.



Camshaft journal diameter
A = 26.949 to 26.970 mm (1.0610 to1.0618 in)

Cams minimum height	
Intake	9.1 mm (0.36 in) (*)
Exhaust	6.4 mm (0.25 in)

(*) for "S" version: 10.1 mm (0.40 in)

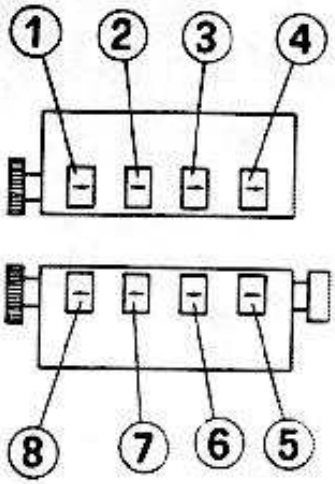
Shoulder length
B = 27.000 to 27.052 mm (1.0630 to 1.0650 in)

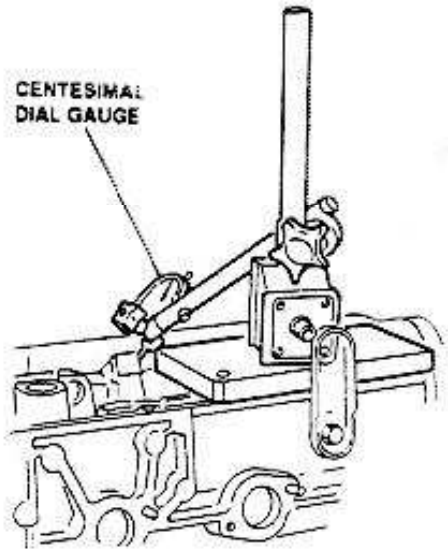
Max eccentricity between camshaft journals
0.03 mm (0.0012 in)

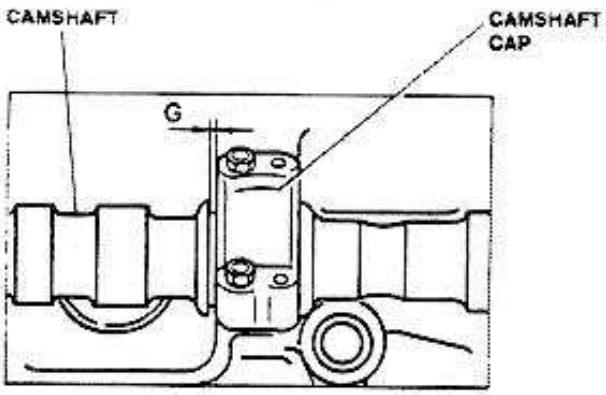
CAMSHAFT AXIAL PLAY CHECK

1. Position camshafts.
2. Install caps following identification numbers and direction shown by the arrow on the caps; torque lubricated nuts 11.8 to 13.2 ft lb (16 to 18 Nm).
3. Apply a centesimal dial gauge and measure axial play "G" of camshafts; verify the play is within prescribed limits.

Camshafts axial play
G = 0.060 to 0.201 mm (0.0023 to 0.0079 in)







NOTE: **A camshaft, when worn or with dimensions out of prescribed limits, will cause a variation of the correct valve clearance, abnormal and noisy engine operation.**

ENGINE BLOCK CHECKS AND INSPECTIONS

This paragraph includes:

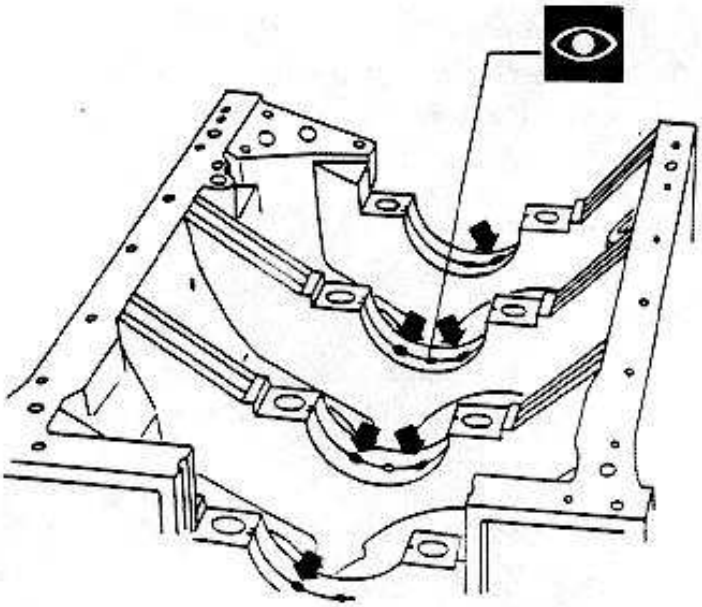
- Piston cooling oil spraying valves.
- Main and rod bearing halves - Thrust rings.
- Crankshaft.
- Main journal caps.
- Cylinder liners.
- Pistons and gudgeon pins.
- Pistons rings and oil scraper rings.
- Rods.
- Weight difference check between single pistons and rods.
- Flywheel ring gear replacement.

PISTON COOLING OIL SPRAYING VALVES

- The engine block is provided with six oil spraying valves (pointed out by arrows in the figure) directly fed by the main journals.
  The task of these oil spraying valves is to cool and lubricate the pistons and the relevant piston gudgeons.

- Carefully clean the spraying valves and check they are not damaged or choked

- Using a compressed air jet, check that the cooling valves open at the prescribed pressure.



Oil spraying valve opening pressure
2.5 ±0.25 bar

Class	Main half-bearing thickness
Green	1.8420 to 1.8465 mm (0.07252 to 0.0727 in)
Blue	1.8375 to 1.8420 mm (0.07234 to 0.07252 in)
Red	1.8330 to 1.8375 mm (0.07216 to 0.07234 in)

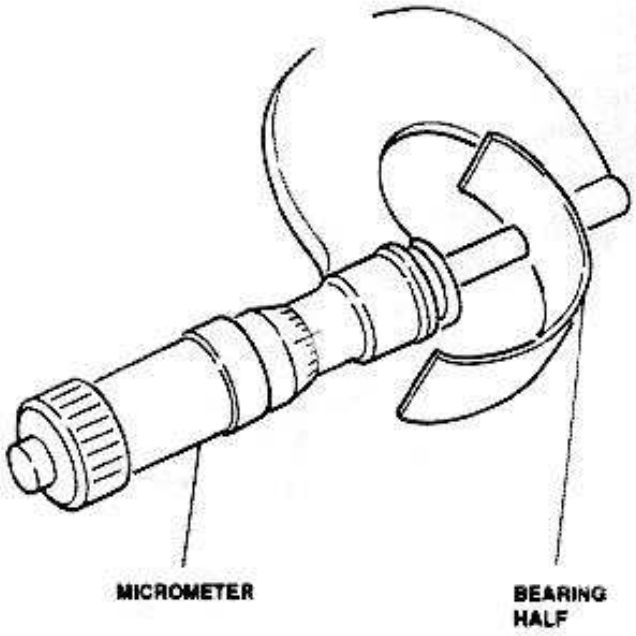
Class	Big end half-bearing thickness
Red	1.17370 to 1.745 mm (0.06839 to 0.0687 in)
Blue	1.741 to 1.749 mm (0.06854 to 0.06886 in)

MAIN AND ROD BEARING HALVES - THRUST RINGS

1. Clean main and rod bearing halves and visually check for scoring and traces of binding. Replace all bearing halves if traces of wear are detected .

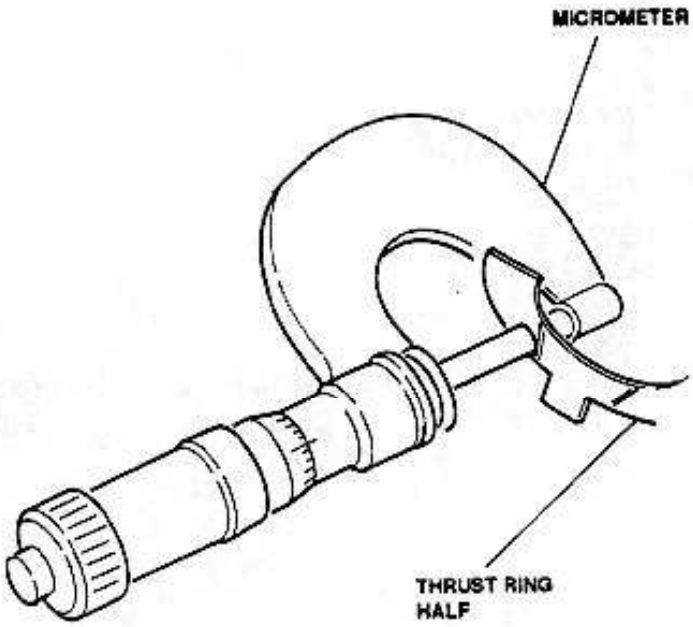
NOTE: Coupling between main and big end bearing halves, and crankshaft must be carried-out by matching parts of the same dimensional class identified by dots of the same color, RED or BLUE, located on bearing half side and on the relevant crankshaft main journal.

2. Check with a micrometer the thickness of bearing halves, and compare measured dimension with values shown in table.



3. Check thickness of thrust rings is within prescribed limits.

Thrust ring halves thickness
2.310 to 2.360 mm (0.0909 to 0.0929 in)



CRANKSHAFT

MAIN JOURNALS AND ROD JOURNALS

1. Check main and rod journals work surfaces for absence wear, nicks, traces of seizing or overheating.

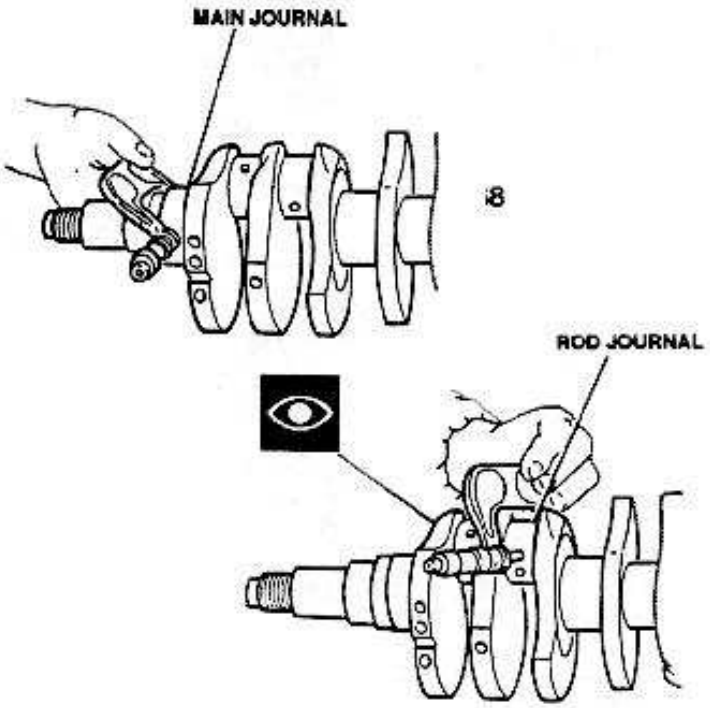
NOTE: The nitring treatment carryed-out on the crankshaft does not allow any grinding operation; replace crankshaft in case of excessive wear.

2. Place crankshaft on bench and dead center and measure diameter of main and rod journals. Compare measured dimension with the prescribed dimension.

NOTE: The crankshaft journals are divided into two classes and are identified by RED and BLUE dots for the rod journals and GREEN-BLUE or RED dots for main journals, according to the operational tolerances.

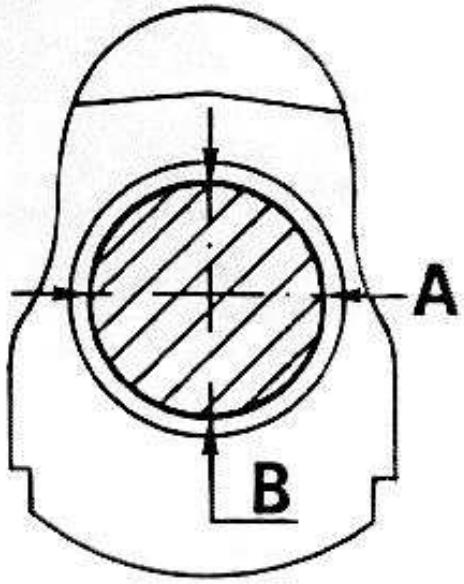
Main journal diameter	
Green	59.961 to 59.967 mm (2.3607 to 2.3609 in)
Blue	59.967 to 59.973 mm (2.3609 to 2.3611 in)
Red	59.973 to 59.979 mm (2.3611 to 2.3614 in)

Rod journal diameter	
Red	51.990 to 52.000 mm (2.0468 to 2.0472 in)
Lt blue	51.980 to 51.990 mm (2.0465 to 2.0468 in)



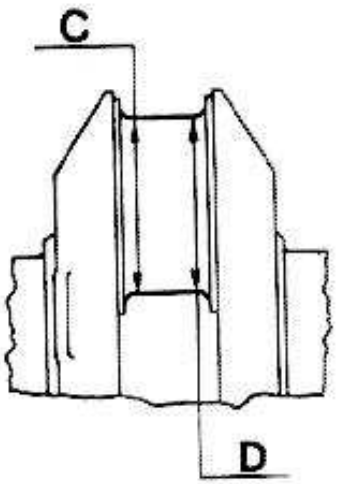
3. Check ovalization of main and rod journals is within prescribed limits.

Main and rod journals max ovalization error
A-B = 0.004 mm (0.0002 in)



4. Check taper of main and rod journals is within prescribed limits.

Main and rod journals max taper error
C-D = 0.010 mm (0.0004 in)



5. Check eccentricity of central main journal and front and rear main journals is within prescribed limits.

Main journals max eccentricity error
C- D = 0.040 mm (0.0016 in)

6. Check parallelism between main and rod journals generatrix.

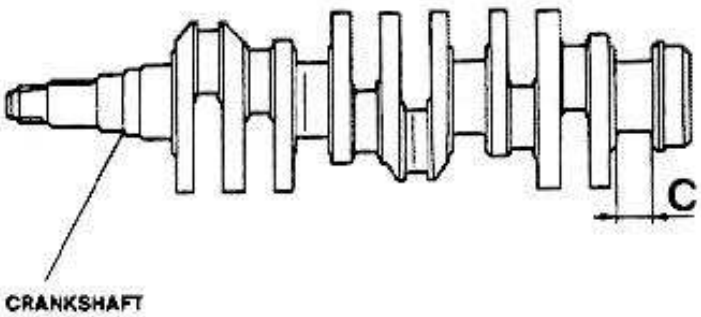
Max parallelism error between main and rod journals
0.015 mm (0.0006 in)

7. Check length "C" of tail journal is within prescribed limits.

Tail journal length
C = 31.300 to 31.335 mm (1.2323 to1.2337 in)

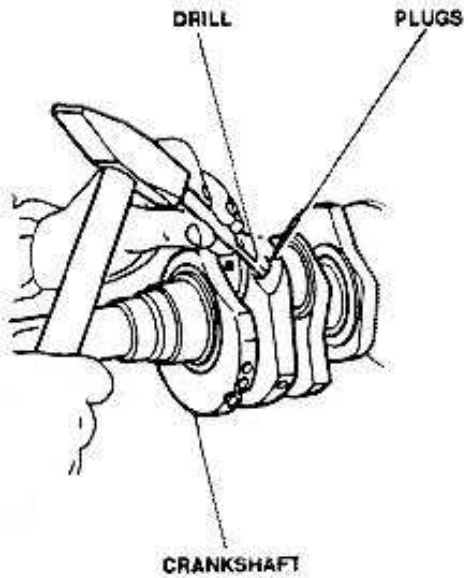
8. Check shifting of crankshaft centerline with respect to main journals centerline is within prescribed limits

Crank centerline max shifting to main journals centerline
0.3 mm (0.0118 in)

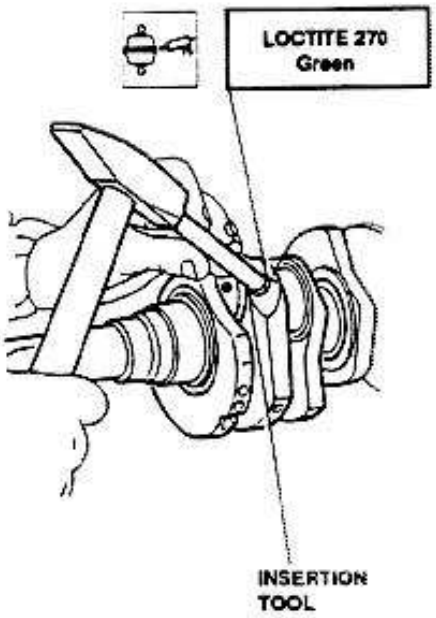


CLEANING OF LUBRICATION GROOVES

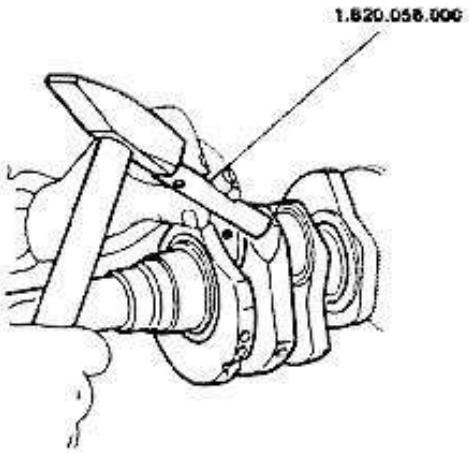
1. Remove oil groove plugs using a drill; clean oil grooves from any burrs of previous staking.



2. Thoroughly clean lubrication grooves using warm petrol, then dry with compressed air.
3. Apply prescribed sealing compound (LOCTITE 270 Green) to new plugs, then insert plugs in the lubrica-



4. Stake plugs using tool **1.820.056.000**.

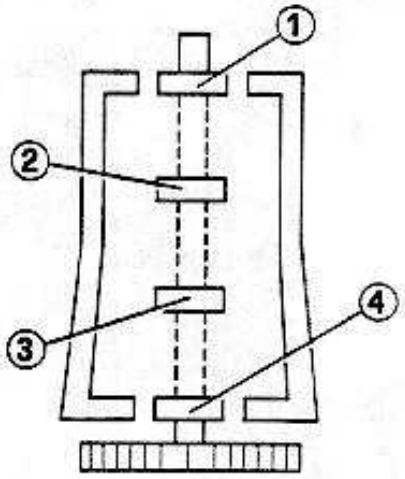


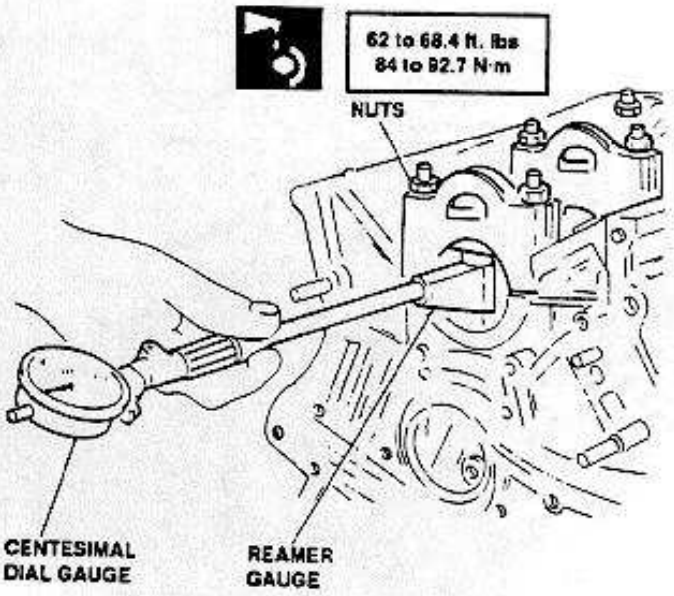
MAIN JOURNAL CAPS

1. Install main journal caps in the position and direction identified by numbering on the cap itself.
2. Torque lubricated nuts to the prescribed value and measure diameter of main bearings with a centesimal dial gauge; check diameter is within prescribed limits.

∅	Main bearings diameter
	63.657 to 63.676 mm (2.5062 to 2.5069 in)

tion groove orifices using a suitable tool.





3. Check length of tail bearing shoulder is within prescribed limits.

Tail bearing shoulder length
26.45 to 26.50 mm (1.0413 to 1.0433 in)

CYLINDER LINERS

1. Note cylinder liner class.

NOTE: Cylinder liners are selected according to their inner diameter, and are divided in categories A, B and C. The categories are identified with BLUE, PINK or GREEN dots on the outer surface.

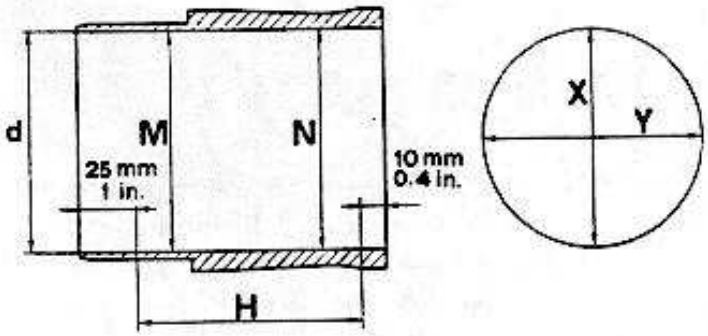
2. Using a reamer applied to a centesimal dial gauge, measure inner diameter of cylinder liners on 120° of the upper and lower median circumferences inside of the "dimensional check zone" shown in figure below.
3. Check inner diameter, taper and ovalization are within prescribed limits.

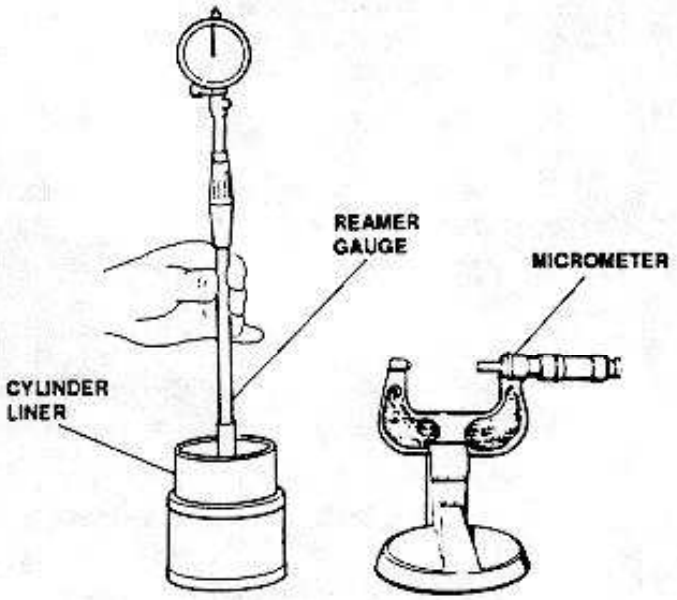
Diameter (d)	
Class A (blue)	92.985 to 92.994 mm (3.6608 to 3.6612 in)
Class B (pink)	92.995 to 93.004 mm (3.6612 to 3.6616 in)
Class C (green)	93.005 to 93.014 (3.6616 to 3.6620 in)

Max taper (M-N)
0.01 mm (0.0004 in)

Max ovalization (X-Y)
0.01 mm (0.0004 in)

H = dimensional check zone





PISTONS AND GUDGEON PINS

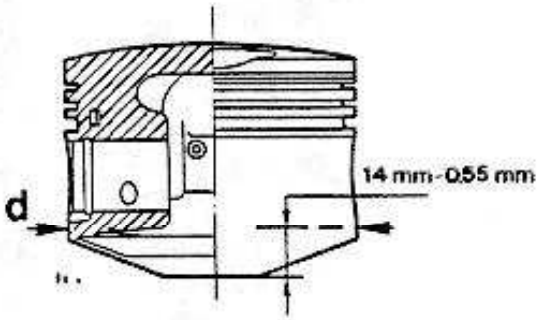
1. Check pistons class.

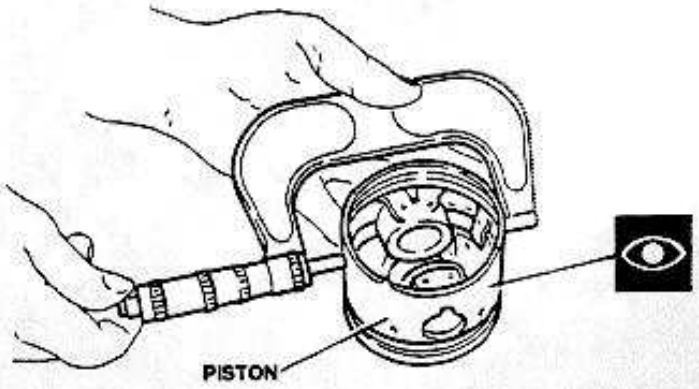
NOTE: As for the cylinder liners, pistons are divided in three classes according to manufacturing tolerances. These classes, identified by the letters A, B and C, are differentiated by BLUE, PINK and GREEN dots on piston ceiling.

2. Check piston outer diameter is within prescribed limits.

NOTE: Piston diameter must be measured perpendicularly to the gudgeon pin hole, and 14 mm (0.55 in) in from lower edge of skirt.

Outer diameter (d)	
Class A (blue)	92.925 to 92.935 mm (3.6584 to 3.6588 in)
Class B (pink)	92.935 to 92.945 mm (3.6588 to 3.6592 in)
Class C (green)	92.945 to 92.955 mm (3.6592 to 3.6596 in)



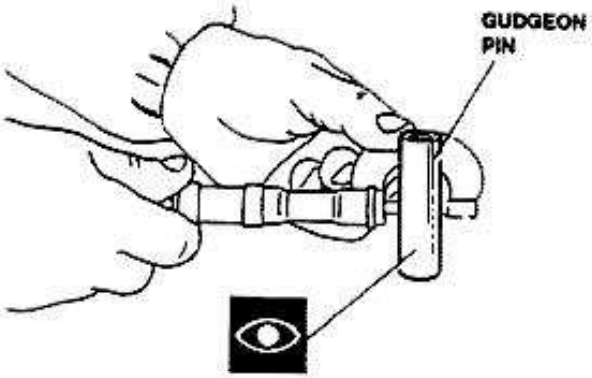


3. Check gudgeon pin class.

NOTE: The gudgeon pins and relevant mating holes on the piston are divided into two classes according to the manufacturing tolerances. These classes are identified with BLACK or WHITE dots on the inner surface of pins and on the outer surface of piston hub.

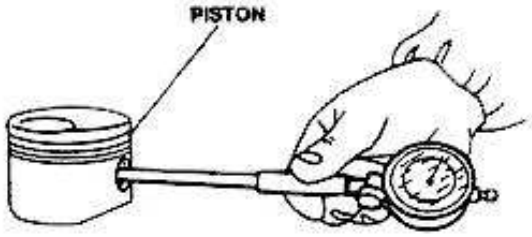
4. Measure with a micrometer the gudgeon pin outer diameter is within prescribed limits.

Gudgeon pin outer diameter	
black	21.994 to 21.997 mm (0.8659 to 0.8660 in)
white	21.997 to 22.000 mm (0.8660 to 0.8661 in)



5. Measure with a reamer gauge the piston hole for gudgeon pin is within prescribed limits.

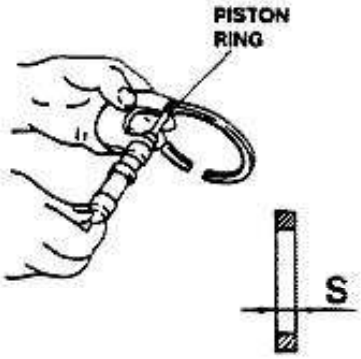
Gudgeon pin hole diameter	
black	22.003 to 22.006 mm (0.8663 to 0.8664 in)
white	22.006 to 22.009 mm (0.8664 to 0.8665 in)



PISTON RINGS AND OIL SCRAPER RINGS

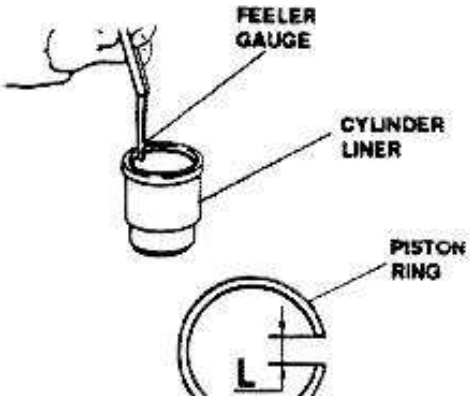
1. Check thickness "S" of piston rings and of oil scraper rings is within prescribed limits.

"S" Thickness	
1st piston ring	1.478 to1.490 mm (0.0581 to 0.0586 in)
2nd piston ring	1.478 to 1.490 mm (0.0581 to 0.0586 in)
Oil scraper ring	3.478 to 3.490 mm (0.1369 to 0.1374 in)



2. Insert piston rings inside cylinder liner and check dimension of gap "L" with a feeler gauge.

"L" Gap	
1st piston ring	0.40 to 0.65 mm (0.016 to 0.026 in)
2nd piston ring	0.40 to 0.65 mm (0.016 to 0.026 in)
Oil scraper ring	0.30 to 0.60 mm (0.012 to 0.023 in)

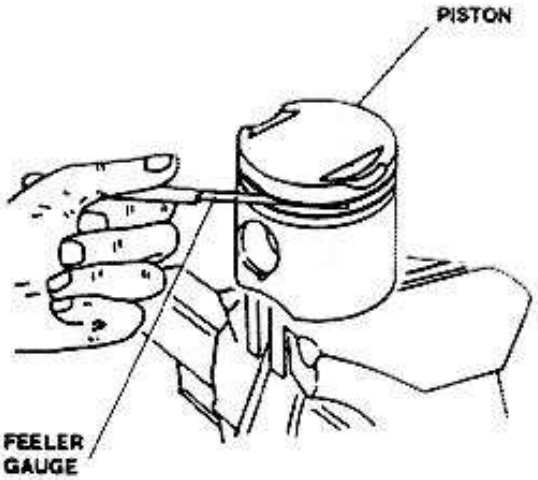


3. Lubricate piston rings with clean engine oil.
4. Insert clips and oil scraper ring in their relevant seating on third piston groove, observing that clips junction is located at 180° from piston ring gap.
5. Insert second piston ring in second piston groove.
6. Insert first piston ring in first piston groove.

At reassembly, locate rings so that TOP marking stenciled on rings is faced upwards.

7. Measure play between piston rings, oil scraper ring and seating on piston using a feeler gauge.

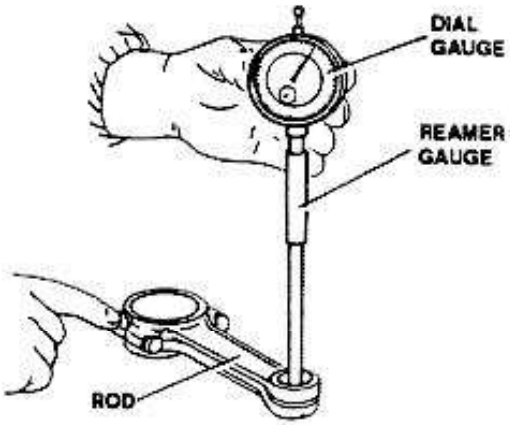
Axial play between oil rings and seatings	
1st piston ring	0.035 to 0.067 mm (0.0014 to 0.0026 In)
2nd piston ring	0.035 to 0.067 mm (0.0014 to 0.0026 In)
Oil scraper ring	0.025 to 0.057 mm (0.0010 to 0.0022 In)



RODS

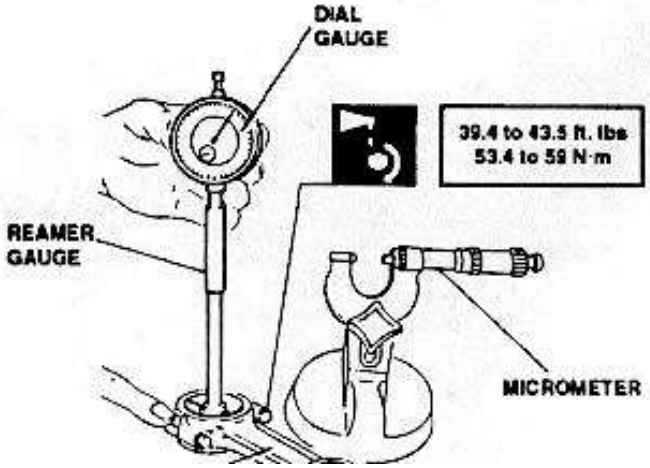
1. Visually check rods for evidence of cracks, scoring and excessive wear.
2. Using a reamer and centesimal dial gauge, measure diameter of rod small end bushing is within prescribed limits.

Rod small end bushing hole diameter
22.005 to 22.015 mm (0.8663 to 0.8667 In)



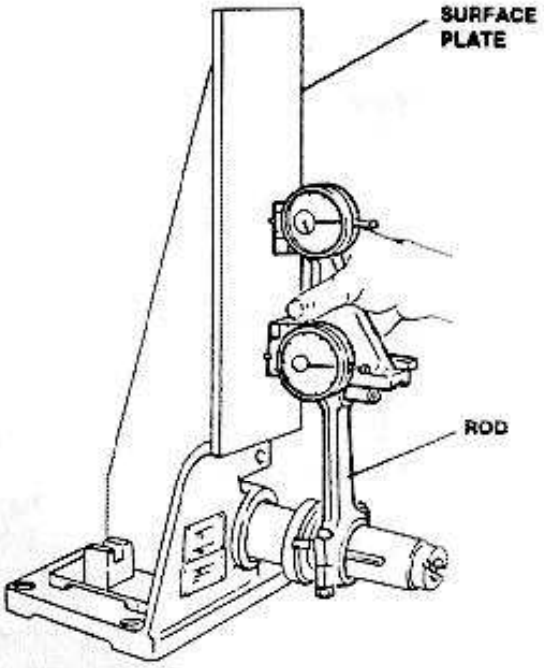
3. Install rod caps, torque lubricated screws to prescribed value.
Measure diameter as described at step 2. above and check it is within prescribed limits.

Rod big end inner diameter
55.511 to 55.524 mm (2.1855 to 2.1860 In)



4. Check rods perpendicularity using a surface plate as show in the illustration.

NOTE: If rod perpendicularity is not appropriate, replace rod to prevent abnormal loads during engine operation, and consequent abnormal wear of piston and rod.



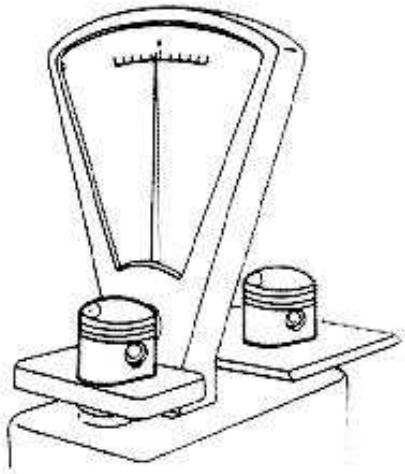
WEIGHT DIFFERENCE CHECK BETWEEN SINGLE PISTONS AND RODS

1. Select matched gudgeon pins and pistons according to the colored dot (having the same color dot, WHITE or BLACK).
   The dot is located on outer surface of hub and on inner surface of pin.

NOTE: Whenever the parts are re-used, ensure the work surfaces are free of any scratches, in particular the gudgeon pin seat.

2. Insert gudgeon pin into piston ensuring the proper class, WHITE or BLACK, has been selected.
3. Lock gudgeon pins using relevant retaining rings, and install piston rings and oil scraper ring.
4. Weigh pistons and check the weight difference is within prescribed limits.

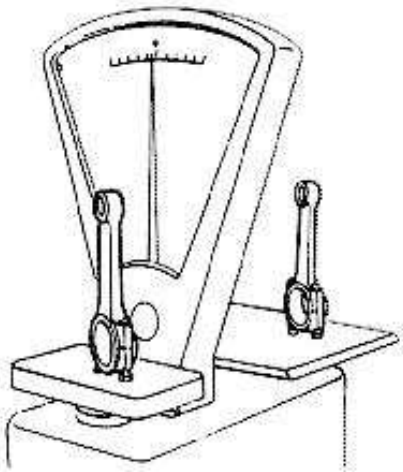
Weight difference between pistons
≤ 4 grams (0.15 oz.)

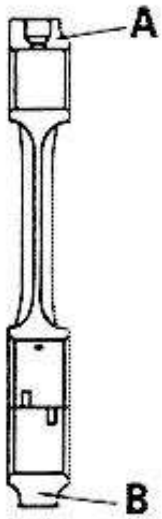


5. Weight rods (complete of caps, bearing halves and screws) and check the weight difference is within prescribed limits.

Weight difference between rods
≤ 2 grams (0.07 oz)

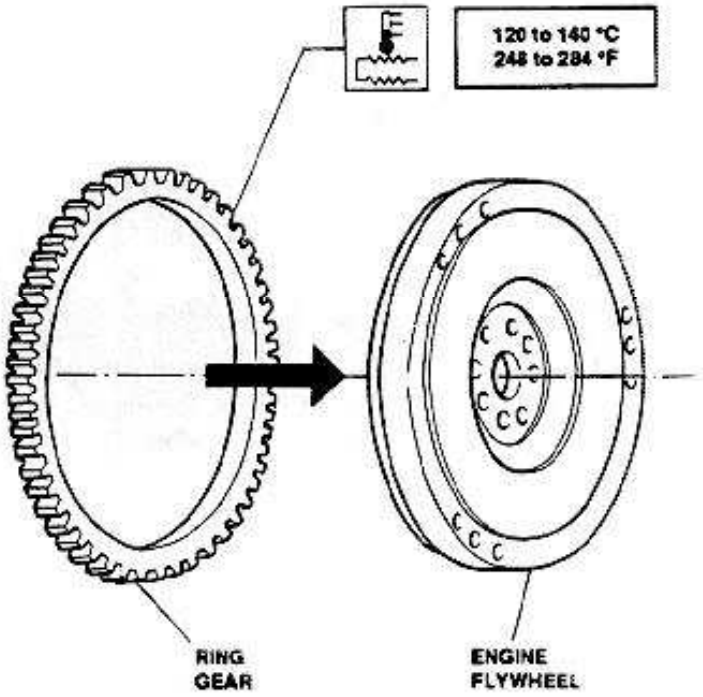
To restore correct weight, remove excess metal from points **A** and **B** shown in the illustration.





FLYWHEEL RING GEAR REPLACEMENT

1. Inspect flywheel ring gear and, if required, replace it as follows.
2. Remove old ring gear using a hydraulic press.
3. Thoroughly clean mating surfaces of new ring gear and of flywheel.
4. Pre-heat uniformly the new ring gear to 120 to 140°C (248 to 284°F) and fit it on engine flywheel.
5. Let the parts cool down to ambient temperature; do not force cooling of the parts.



WARNINGS FOR REASSEMBLY

This paragraph includes:

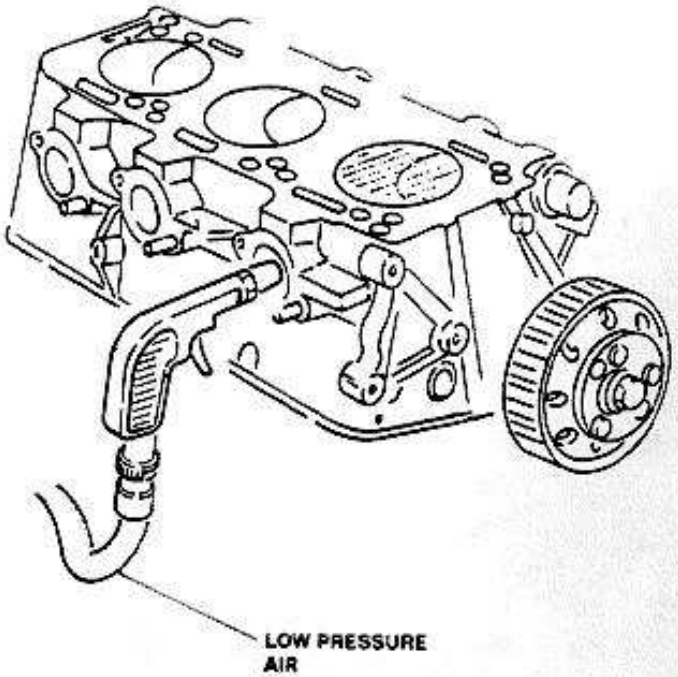
- Valves leakage check
- Correct positioning of rocker arms shaft
- Valve clearance check and adjustment
- Crankshaft installation
- Crankshaft axial play check
- Rear oil seal installation
- Cylinder liners, pistons and rods installation
- Oil pump checks and inspections
- Hydraulic belt tightener overhaul
- Cylinder heads installation
- Timing belt installation and engine timing check
- Engine mount bracket elastic bushing replacement
- Cylinder compression test

For reassembly, carry-out in reverse order the disassembly procedure steps, with the exception of warnings stated in the following.

VALVES LEAKAGE TEST

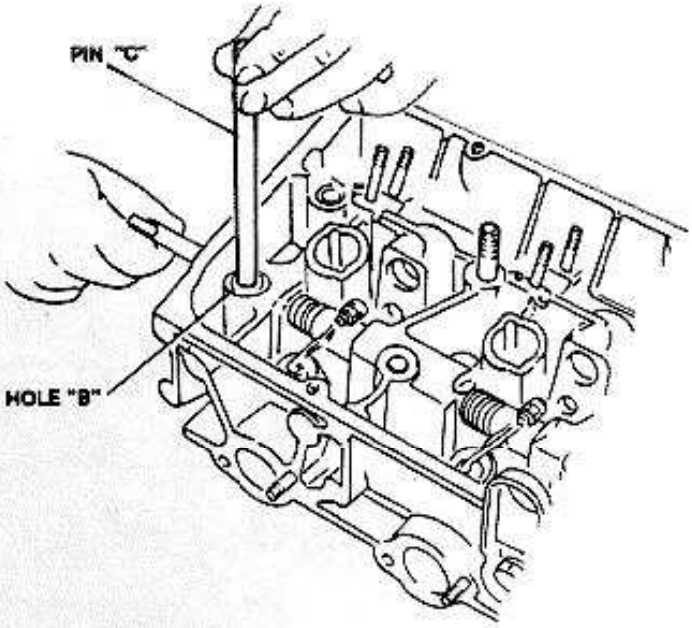
After installing the cone halves, check valve leakage as follows:

1. Screw down spark-plugs in their seats.
2. Pour enough petrol in a combustion chamber so as to cover the valve heads.
3. Blow low-pressure air in the intake and exhaust ports and check that no bubbles come to the surface of petrol; otherwise make sure of the correct assembly and, if necessary, grind the valves seats again.

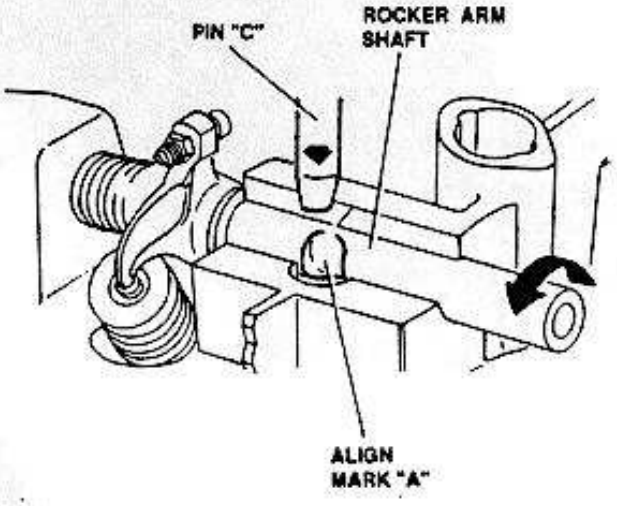


CORRECT POSITIONING OF ROCKER ARMS SHAFT

1. After installation of washers, rocker arms and springs has been completed, rotate shaft to align marks "A" to holes "B" and allow the passage of cylinder head support studs.



2. Use pin "C" (dia. 12 mm - 0.47 in) to ensure proper alignment has been obtained.



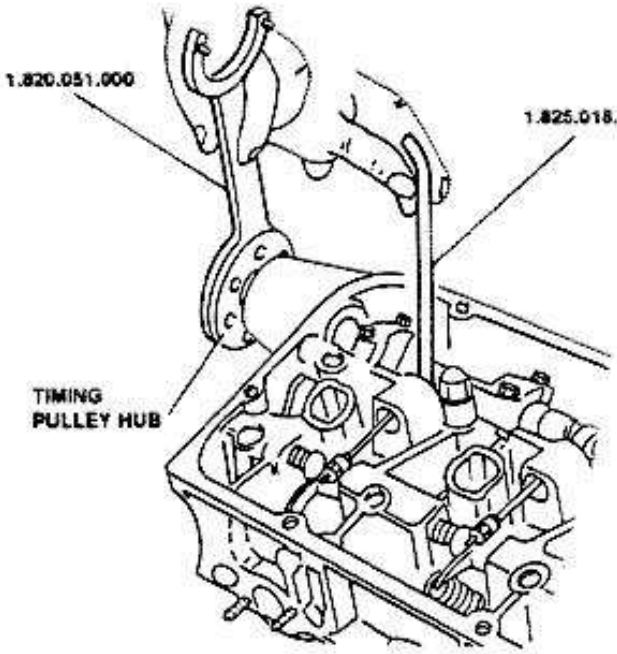
VALVE CLEARANCE CHECK AND ADJUSTMENT

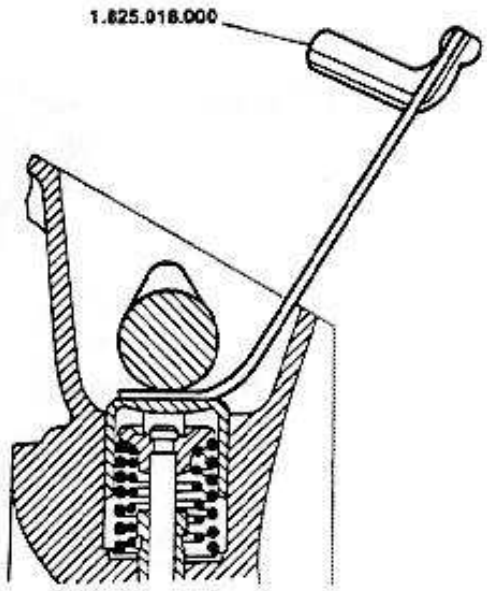
INTAKE VALVES CLEARANCE CHECK

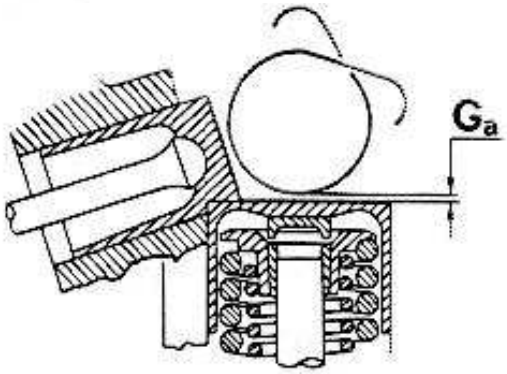
After installation of camshaft check intake valves clearance as follows:

1. Temporarily install timing system drive toothed pulley hub.
2. Using tool **1.820.051.000** for rotation of camshaft and feeler gauge **1.825.018.000** check clearance "Ga" between cams heel radius and valve cups is within prescribed limits; otherwise, replace intake valve caps with another having the required thickness.

Valve clearance Intake side
Ga = 0.475 to 0.500 mm (0.0187 to 0.0197 in)

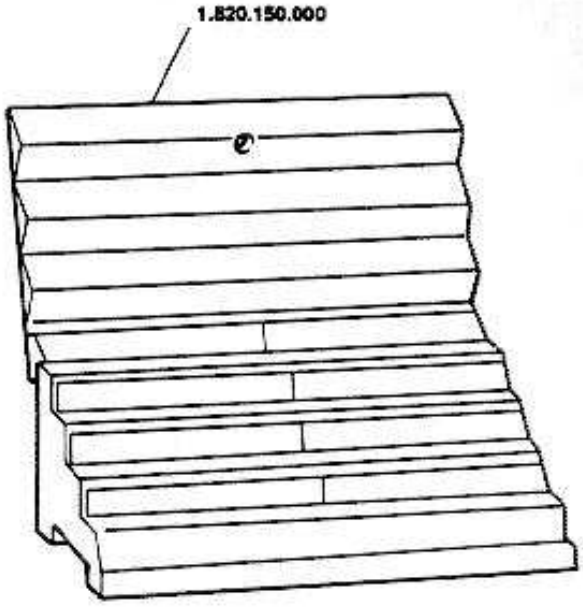


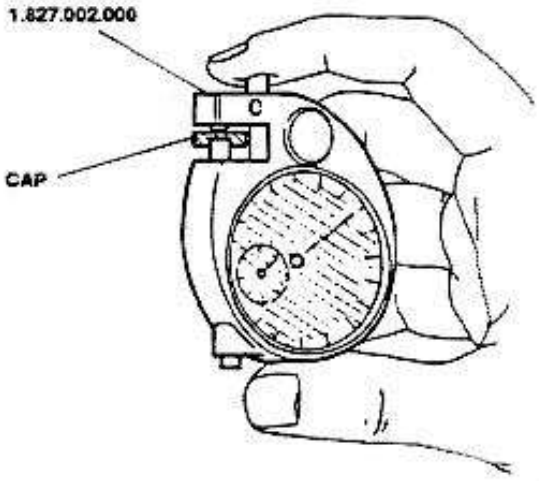




INTAKE VALVES CLEARANCE ADJUSTMENT

1. Remove camshaft caps.
2. Remove camshaft.
3. Remove valve cups and valve clearance adjustment caps.
4. Measure thickness of caps with dial gauge **1.827.002.000** then, for difference with respect to dimension previously measured, select among parts of set **1.820.150.000** the caps of thickness suitable to restore correct valve clearance.
5. Reinstall caps, camshaft and cups; torque camshaft cap nuts to 11.8 to13.2 ft lb (16 to18 Nm) and check valve clearance is within prescribed limits.



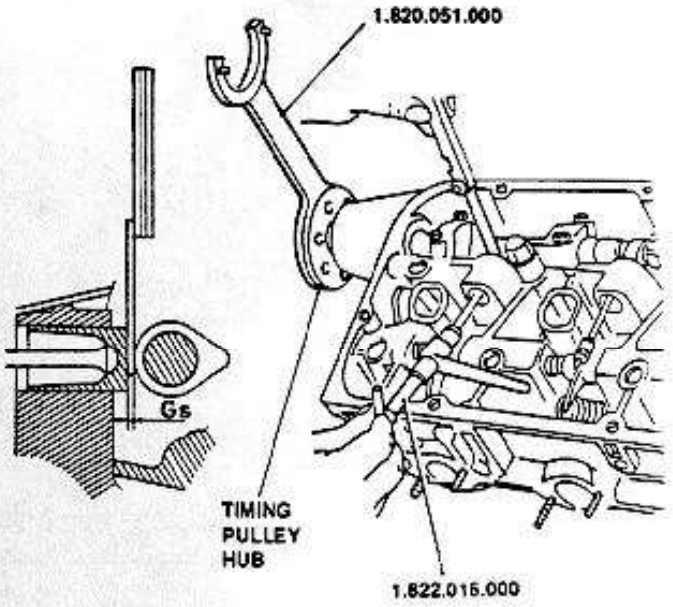


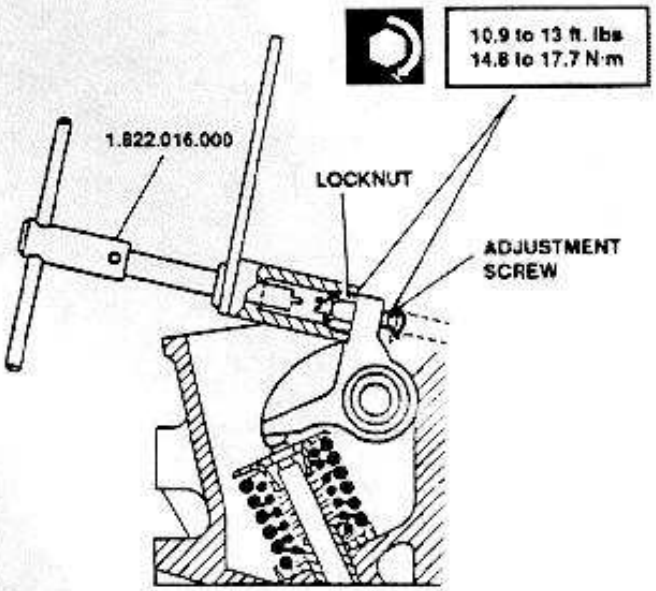
EXHAUST VALVES CLEARANCE CHECK AND ADJUSTMENT

1. Temporarily install timing system drive toothed pulley hub.
2. Using tool **1.820.051.000**, rotate camshaft until the feeler gauge can be inserted between cams heel radius and respective cups.
3. Record values obtained on each valve and compare with prescribed values.

4. If necessary, act on intermediate lever of tool **1.822.016.000** and loosen locknut fixing the adjustment screw.
5. Using the same tool, act on adjustment screw until the prescribed clearance is obtained.
6. Lock locknut and re-check valves clearance.

Valve clearance exhaust side
Gs = 0.225 to 0.250 mm (0.0088 to 0.0098 in)



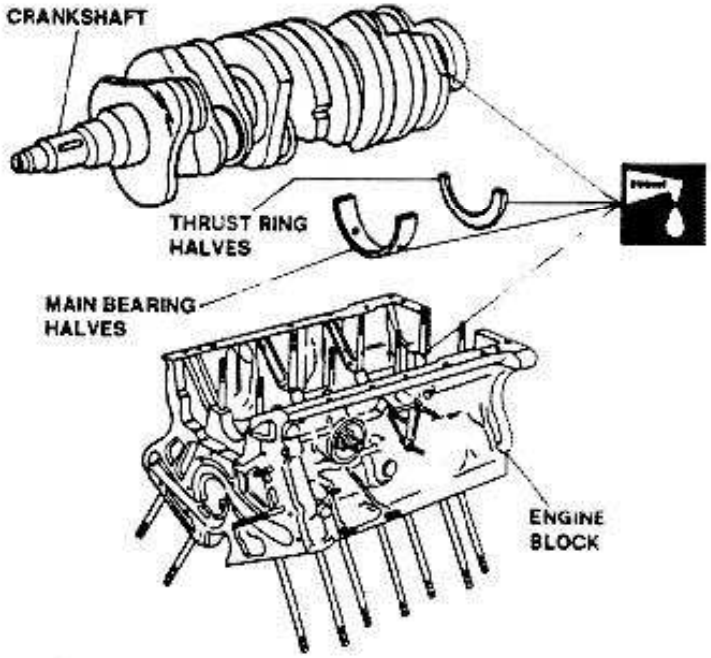


CRANKSHAFT INSTALLATION

1. Seat main bearing halves onto main bearings.

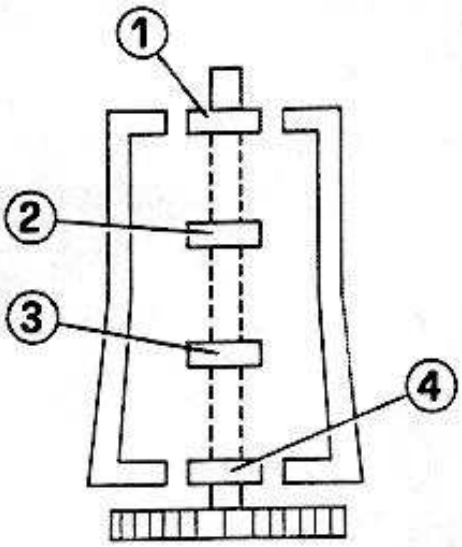
NOTE: The assembly on the crankshaft must be carried-out by matching parts of the same dimensional class (identified by three GREEN, BLUE or RED stripes on side of bearing half, and GREEN, BLUE or RED dots on respective crankshaft journal).

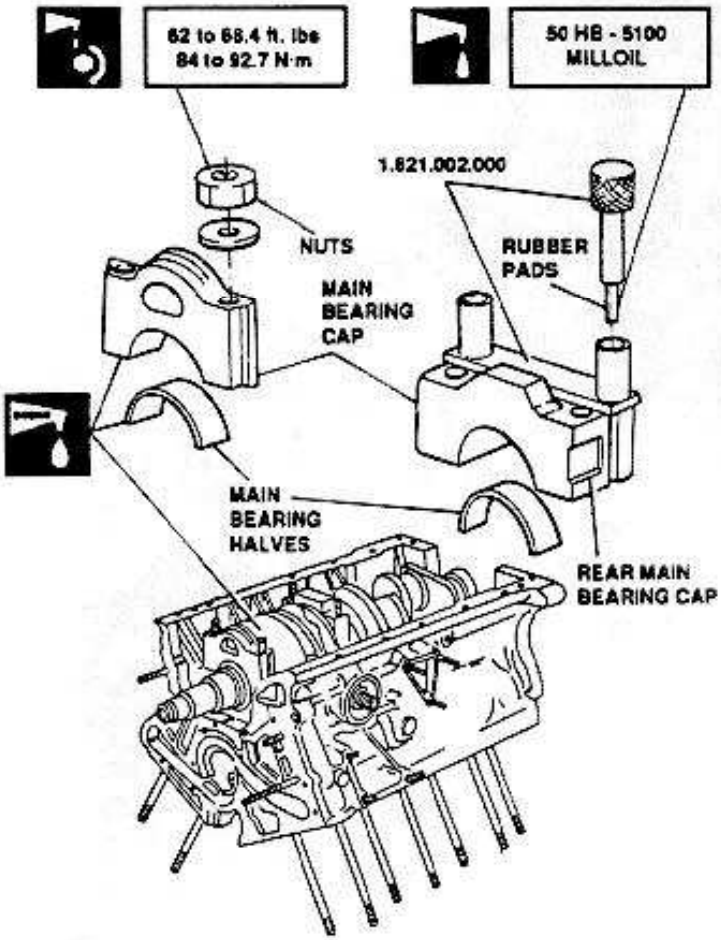
2. Install thrust ring halves in their seatings and ensure the lubrication grooves are faced to crankshaft shoulders.
3. Position crankshaft.



4. Position main bearing halves into main bearing caps.
5. Install the four main bearing caps according to the numbering shown in the illustration (insert one at a time the rubber pads on rear main bearing cap using tool **1.821.002.000**).

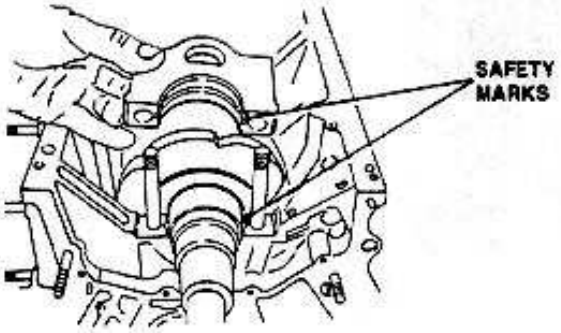
NOTE: Coupling of main bearing half and crankshaft journal must be obtained by matching parts of the same dimensional class (identified by three GREEN, BLUE or RED stripes on side of bearing half, and GREEN, BLUE or RED dots on respective crankshaft journal).





CAUTION:
The safety marks located on engine block and on main bearing caps must be located on the same side as shown in the illustration.

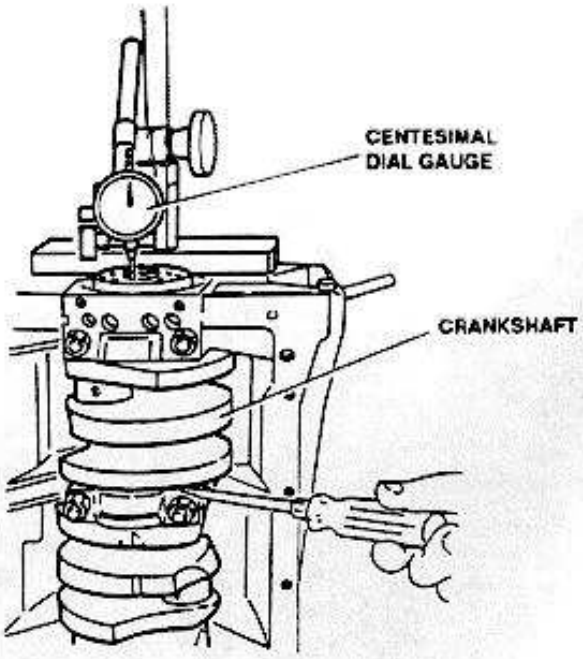
6. Torque lubricated main bearing cap nuts to prescribed value (in two or three stages).



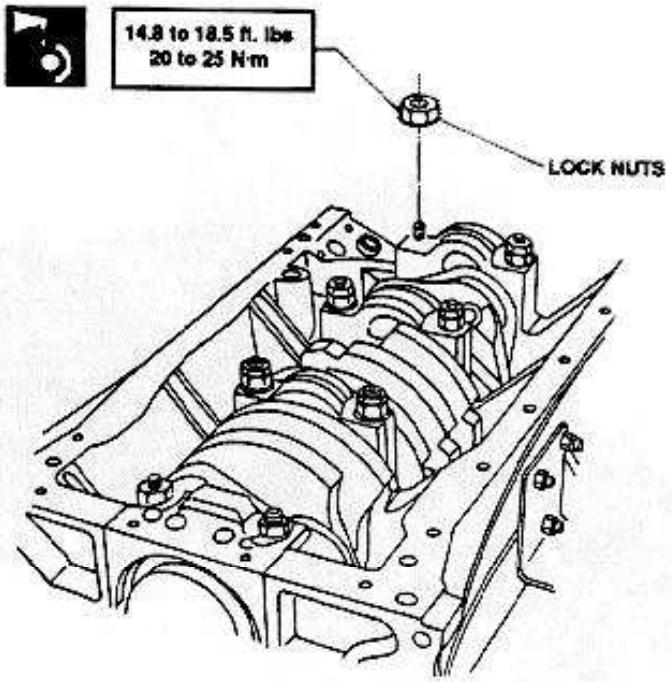
CRANKSHAFT AXIAL PLAY CHECK

1. Check axial play of crankshaft is within prescribed limits using a centesimal dial gauge mounted on a magnetic platform.

Crankshaft axial play
0.080 to 0.265 mm (0.0031 to 0.0104 in)



2. Screw and tighten to the specified torque the lubricated lock nuts on the 1st, 2nd and 3rd main bearing caps.



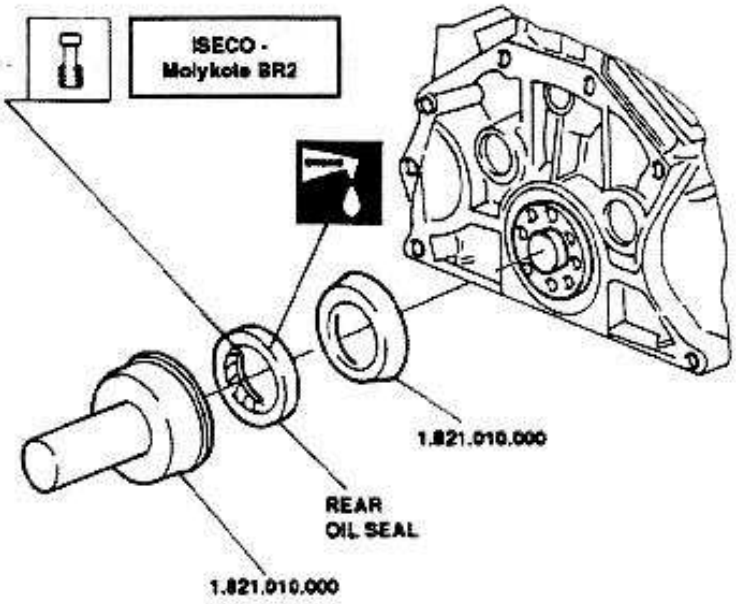
NOTE: Noisy engine operation can be expected if crankshaft axial and radial plays are excessive.

REAR OIL SEAL INSTALLATION

1. Install rear oil seals using inserting tool 1.821.010.000.

NOTE: Restrain oil seal inner spring with a light coat of grease ISECO MOLYKOTE BR2.

CAUTION:
Take care during reassembly of correct positioning of inner spring and oil seal.

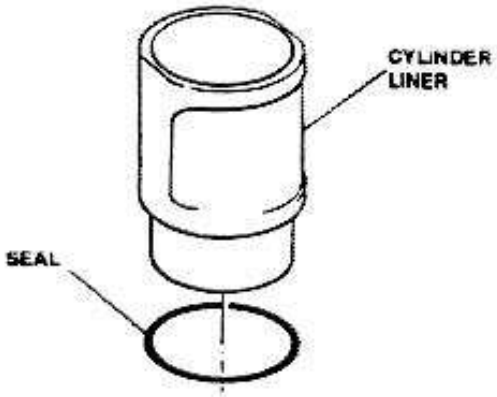


CYLINDER LINERS, PISTONS AND RODS INSTALLATION

NOTE: Whenever cylinder and pistons are excessively worn, carefully check dimensions and clearances as indicated in the following. Furthermore, ensure the engine oil is of the prescribed type and the air filter is clean and serviceable.

CYLINDER LINERS PROTRUSION CHECK

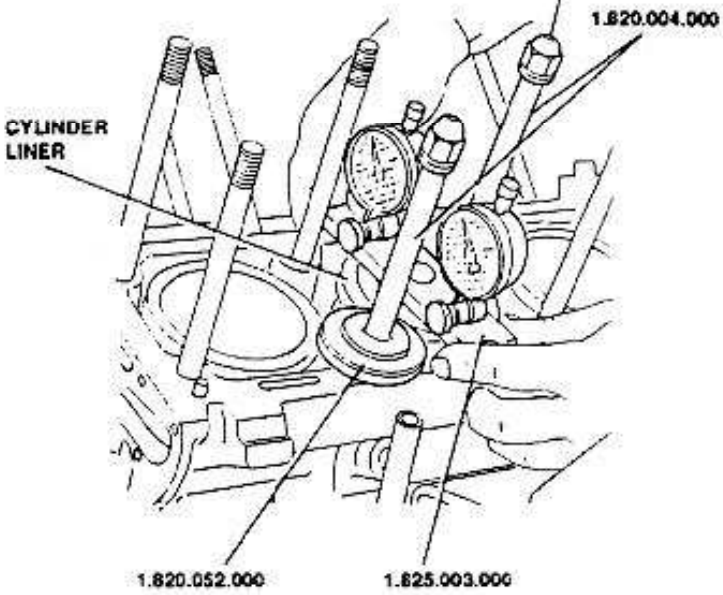
1. Install seals in cylinder liners.

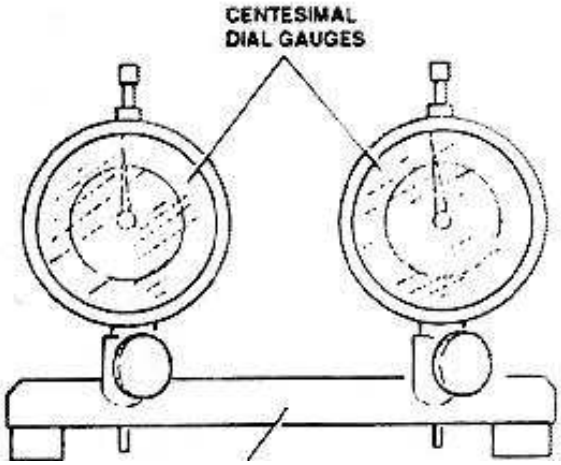


2. Insert cylinder liners into engine block.
3. Fix liners to engine block using cylinder liners fixing tools **1.820.004.000** complete of supplementary rings **1.820.052.000**.
4. Lock liner fixing tool nuts to the prescribed torque.
5. Apply two centesimal dial gauges to the tool **1.825.003.000** and reset them on a datum plane.
6. Place tool **1.825.003.000** on engine block so that dial gauge pins contact the liner edge; check liner protrusion in within prescribed limits.

Cylinder liners protrusion from engine block
0.01 to 0.06 mm (0.004 to 0.024 In)

7.3 to 11 ft. lbs
10 to 15 N·m

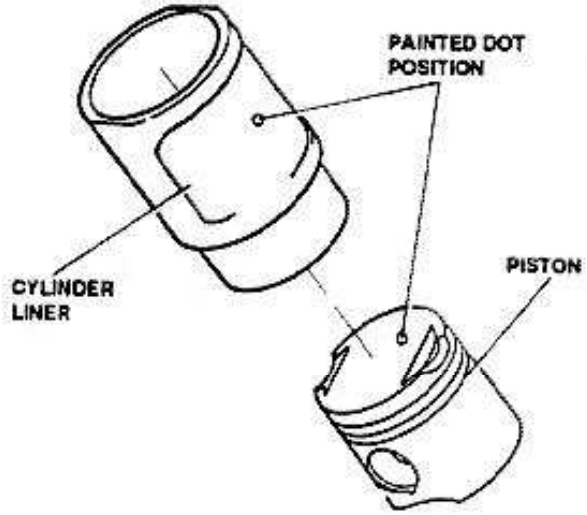




MATCHING OF CYLINDER LINERS AND PISTONS

1. Match parts of the same dimensional class (identified by dots of the same color):
   - A (**BLUE**), B (**PINK**) or C (**GREEN**) on piston top and on outer surface of cylinder liner.

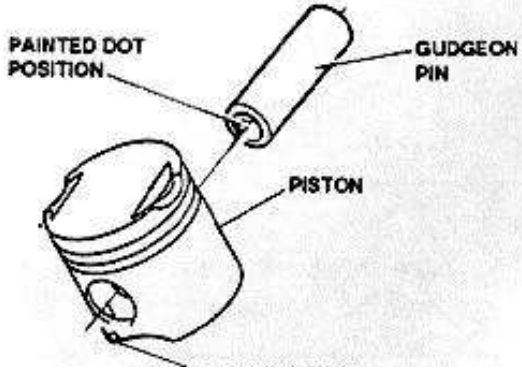
Clearance between cylinder liner and piston
0.050 to 0.069 mm (0.0020 to 0.0027 In)

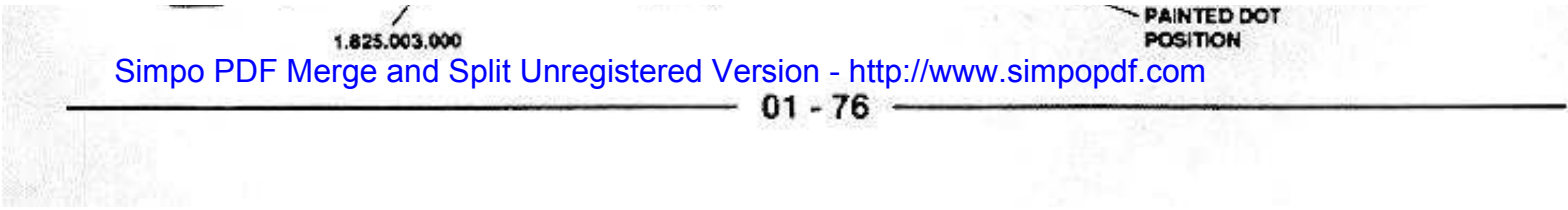


MATCHING OF PISTONS AND GUDGEON PINS

- **BLACK** or **WHITE** on inner surface of gudgeon pin and on outer surface of piston hub.

Clearance between piston hole and gudgeon pin
0.006 to 0.012 mm (0.0002 to 0.0005 In)



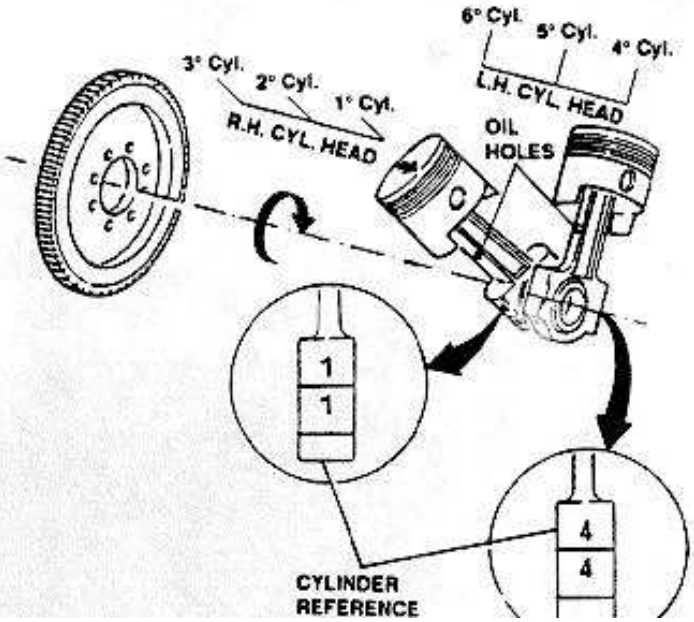


NOTE: If excessive axial play of gudgeon pin into piston is found during reassembly, replace gudgeon pin to prevent noisy operation of engine.

MATCHING OF PISTONS - RODS AND RODS - CRANKSHAFT

1. Arrow engraved on piston top must be oriented towards front side of engine.
2. Lubricating holes on rod side must be oriented towards right side of engine block (for both the right and left side rods).
3. Each rod is provided with a number on the big end that identifies the respective cylinder number; this number is located on the right side of rods of the right row, and on left side of rods of the left row.
4. Similarly, also the rod caps are provided on their side with a number that identifies the respective cylinder number. At reassembly, these numbers must be located on the same side of that engraved on rod big end.

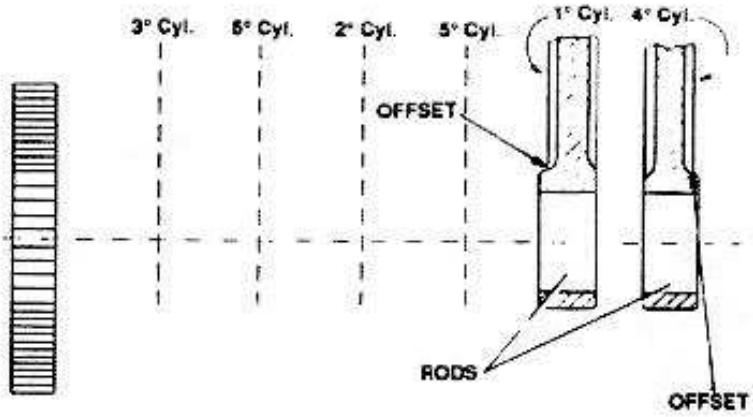
Clearance between rod small end bushing and gudgeon pin	
black	0.008 to 0.021 mm (0.0003 to 0.0008 In)
white	0.005 to 0.018 mm (0.0002 to 0.0007 In)



NOTE: Noisy engine operation can be expected if play between rod, gudgeon pin and piston exceeds the prescribed limits.

5. Rods pertaining to right side of engine (1st, 2nd and 3rd cylinders) shall be installed with the offset facing towards the rear end of engine; rods pertaining to the left side of engine (4th, 5th and 6th cylinders) shall be installed with the offset facing the front end of engine

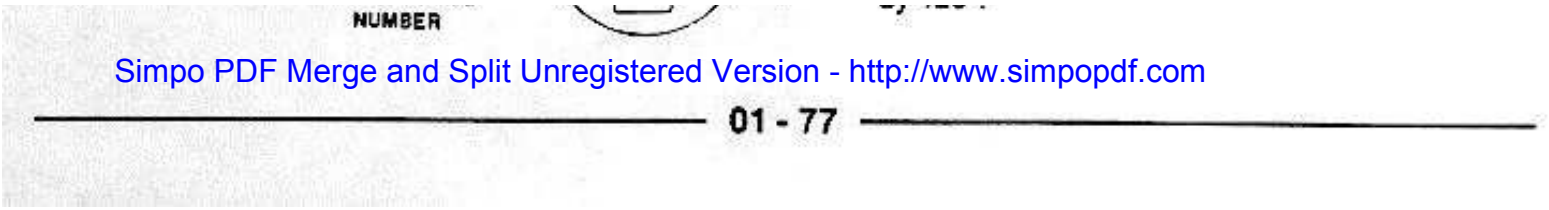
CAUTION:
Rods pertaining to the right side of engine are not interchangeable with rods of the left side and viceversa since, in addition to the offset, correct positioning of lubricating hole on the rods must be observed.



6. Locate rod big end bearing halves on rod big ends.

NOTE: The assembly on the crankshaft must be carried-out by matching parts of the same dimensional class (tagged by RED or BLUE dots on the half-bearing sides and RED or LIGHT BLUE on the relevant crankshaft journal).

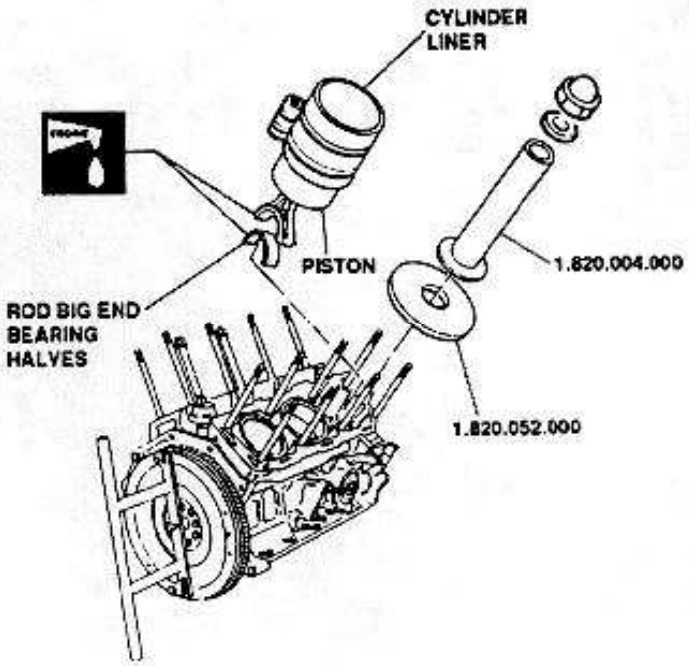
7. Insert piston rings on pistons with the gaps staggered by 120°.

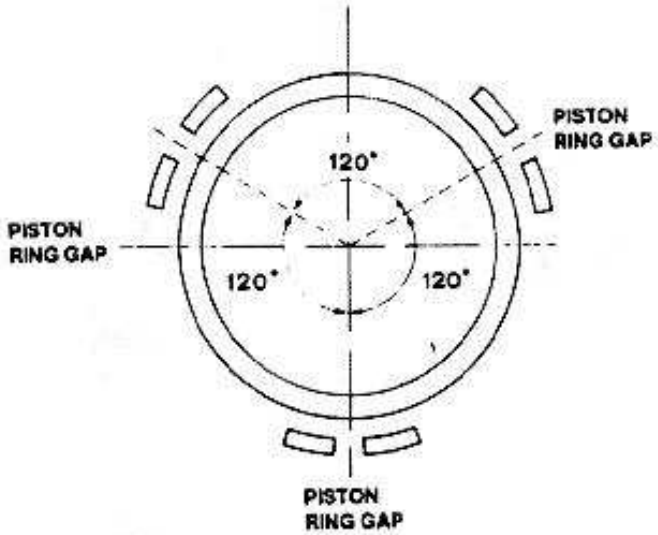


8. By means of suitable tool, install pistons and rods on the cylinders of one row of engine.

CAUTION:
Point the arrow printed on the piston crown towards the engine front side.
Install the connecting rods with their offset facing the right side of engine block.

9. Install the cylinder liner fixing tools **1.820.004.000** complete of supplementary washers **1.820.052.000** on both row of cylinders.





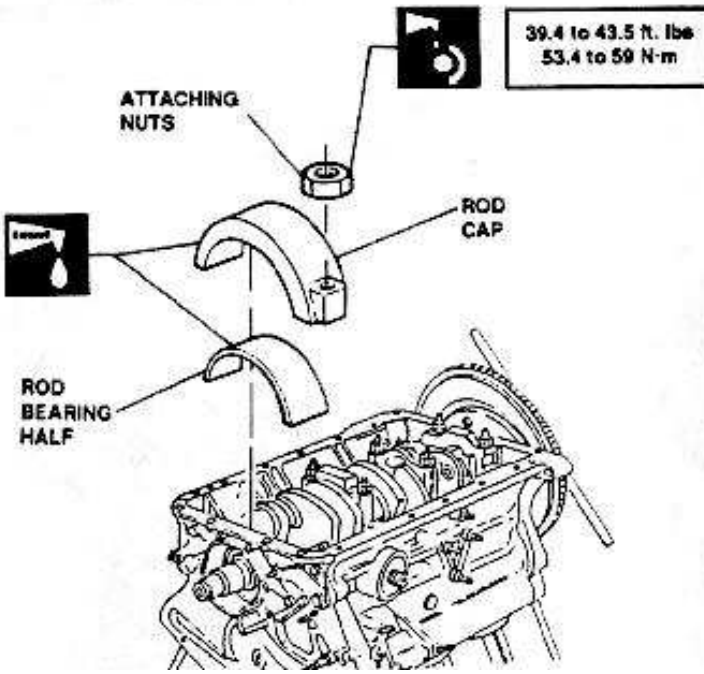
10. Rotate engine block of 180°.
11. Position rod bearing halves in rod caps.

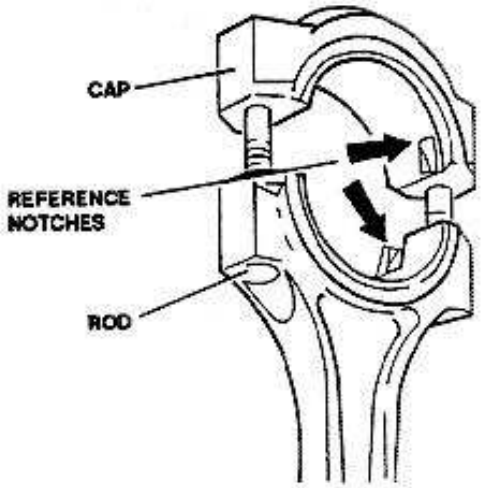
NOTE: **The assembly on the crankshaft must be carried-out by matching parts of the same dimensional class (identified by three GREEN, BLUE or RED stripes on side of bearing half, and GREEN, BLUE or RED dots on respective crankshaft journal).**

12. Install rod caps of the row of cylinder being reassembled, positioning the reference notch towards the side of the corresponding notch on the rod big end.

CAUTION:
Each rod cap has the number corresponding to its cylinder printed on its side; on assembling, this number must face the side of relevant number printed on the rod big end.

13. Torque to prescribed value lubricated cap nuts.
14. Assembly in analogy pistons and rods of the opposite row of cylinders.

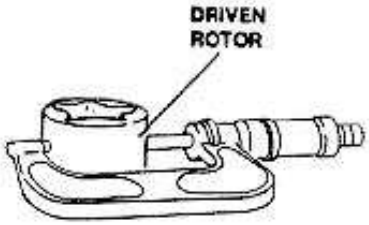


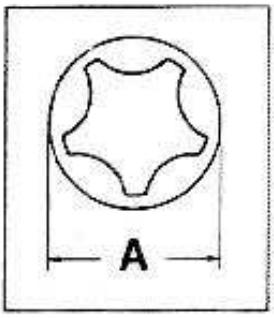


OIL PUMP CHECKS AND INSPECTIONS

1. Check outer diameter of driven rotor is within prescribed limits.

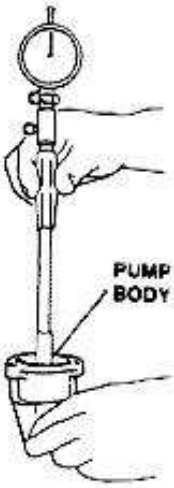
Driven rotor outer diameter
A = 49.100 to 49.155 mm (1.9331 to 1.9352 In)

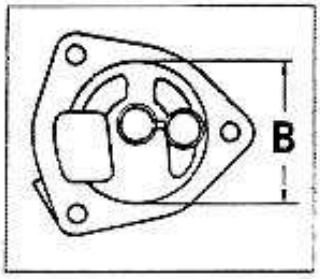




2. Check inner diameter of pump body is within prescribed limits.

Pump body rotor seat diameter
B = 49.325 to 49.375 mm (1.9419 to 1.9439 in)

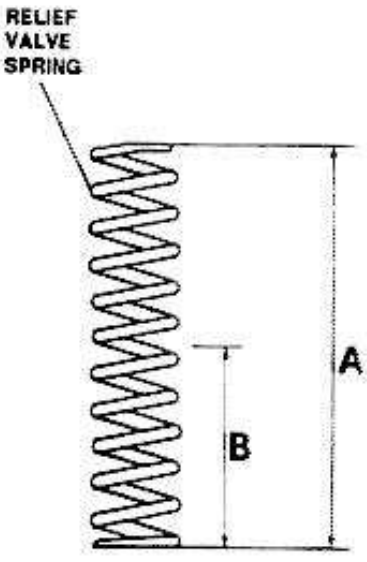


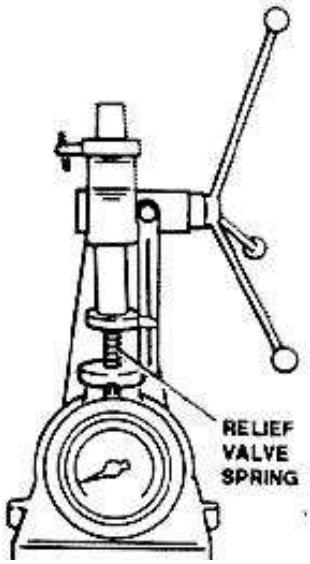


3. Check with a dynamometer the charactenstic values of spring actuating the oil pressure relief valve

Spring free length (A)	49.29 mm (1.941 In)
Loaded spring length (B)	31.90 mm (1.256 In)

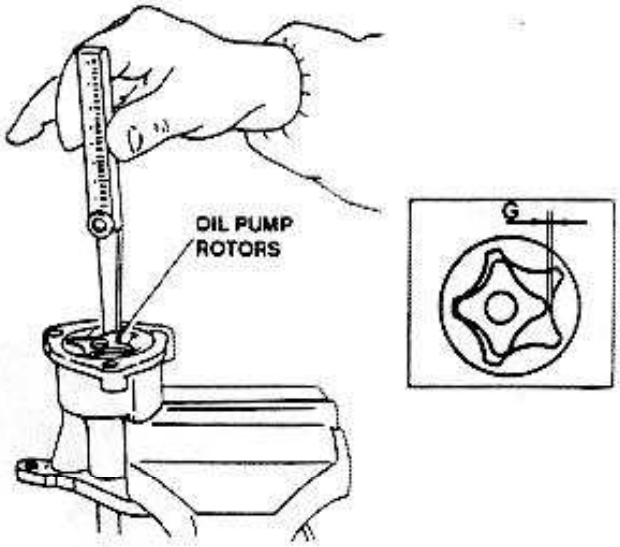
(1) Test load : 170 to176 N (38.2 to 39.6 lbs)





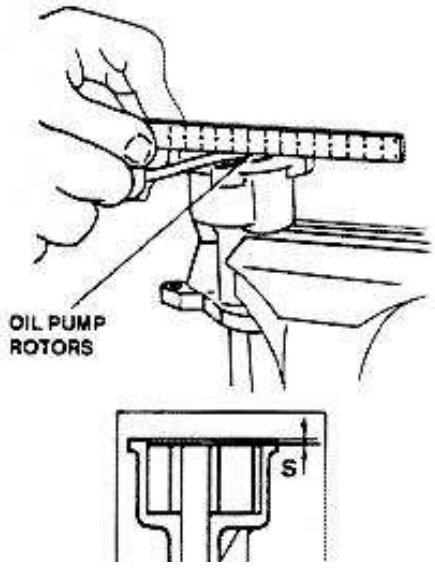
4. Position the two rotors inside the pump body; check clearance "G" between inner rotor lobe and that of driven rotor is within prescribed limits.

Clearance between driven rotor and inner rotor
G = 0.040 to 0.290 mm (0.0016 to 0.0114 in)



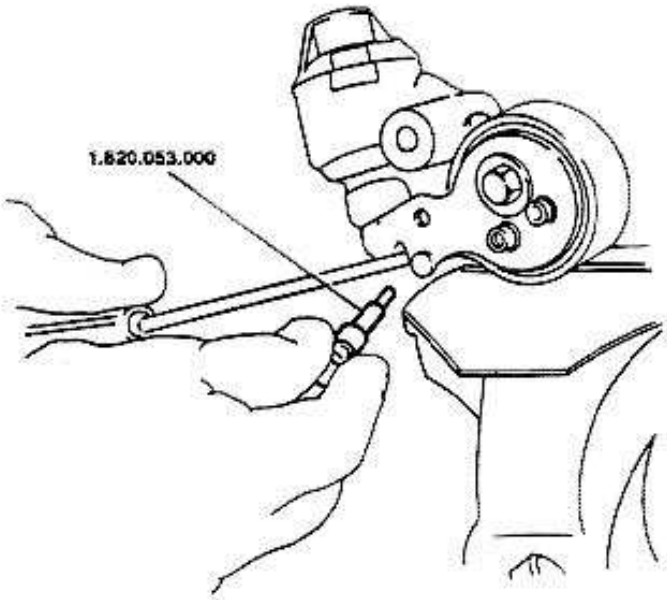
5. Check axial play "S" of the two rotors with respect to pump body plane is within prescribed limits

Axial play between the two rotors with respect to pump body plane
S = 0.025 to 0.075 mm (0.0010 to 0.0030 in)

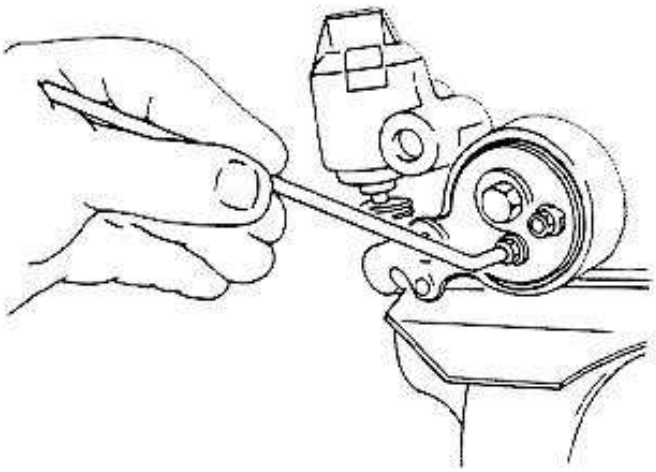


HYDRAULIC BELT TIGHTENER OVERHAUL

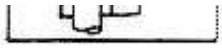
1. Withdraw tool **1.820.053.000** to release inner spring.



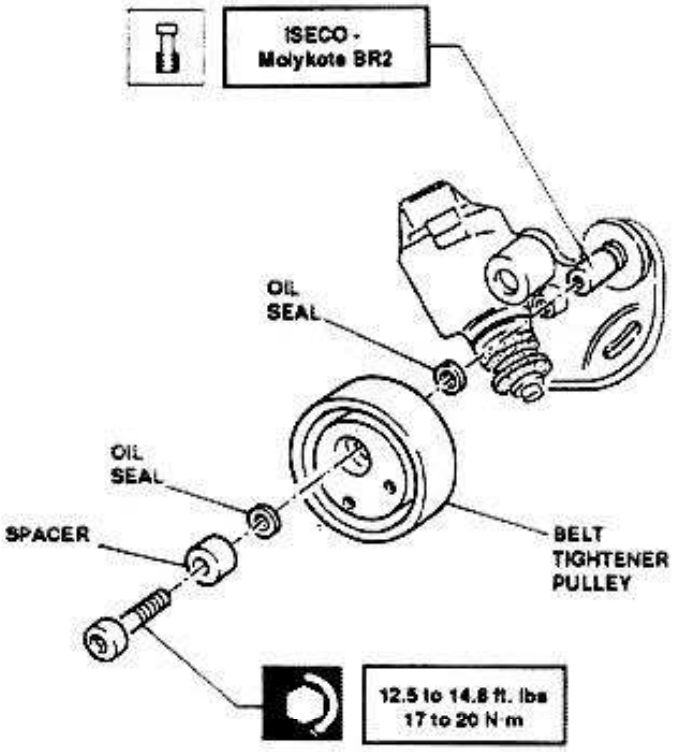
2. Remove belt tightener plate



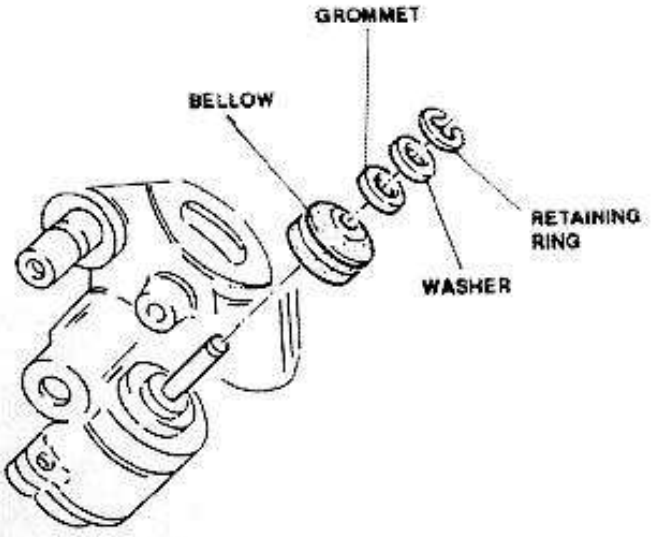
3. Unscrew attachment screw and remove belt tightener pulley.
4. Remove spacer.



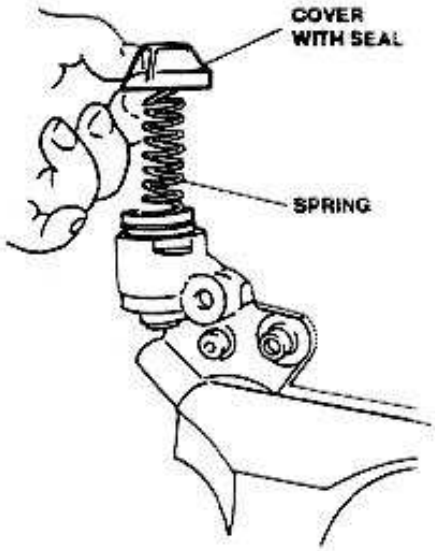
5. Remove oil seals.



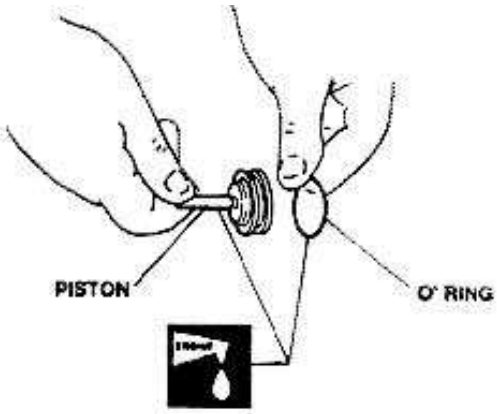
6. Remove retaining ring.
7. Remove washer.
8. Remove grommet.
9. Remove bellow.



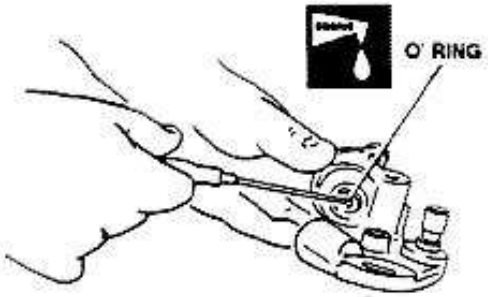
10. Remove cover and relevant seal.
11. Remove spring.



12. Remove piston from tightener body.
13. Remove o'ring.

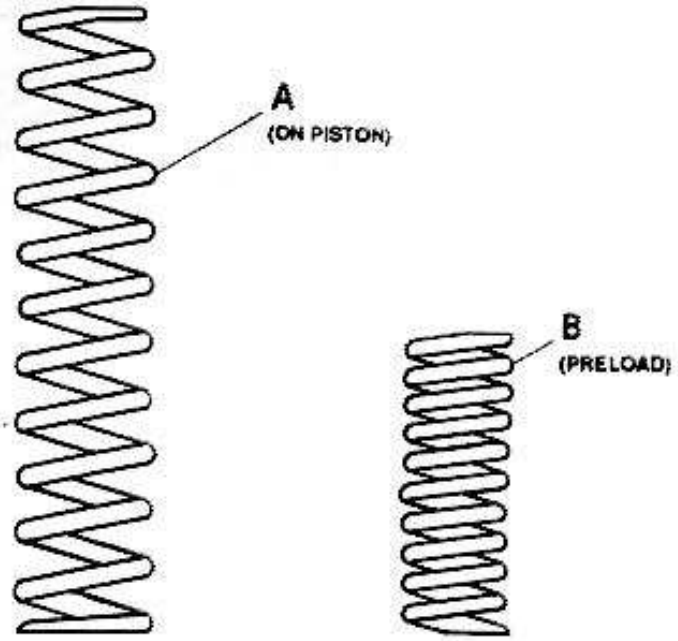


14. Remove o'ring from lower side of tightener body.



15. Carry-out the following inspection of belt tightener:
    a. Examine spring "A" (acting on piston) and spring "B" (preloading the hydraulic belt tightener) and verify the springs characteristic data conform to the prescribed values.

	Spring A	Spring B
Useful number of turns	12	9
Spring free length	93 mm (3.7 In)	45.5 mm (1.8 In)
Static test load	93.16 N (21 lbs)	98 N (22 lbs)
Loaded spring length	48 mm (1.9 In)	30 mm (1.2 In)

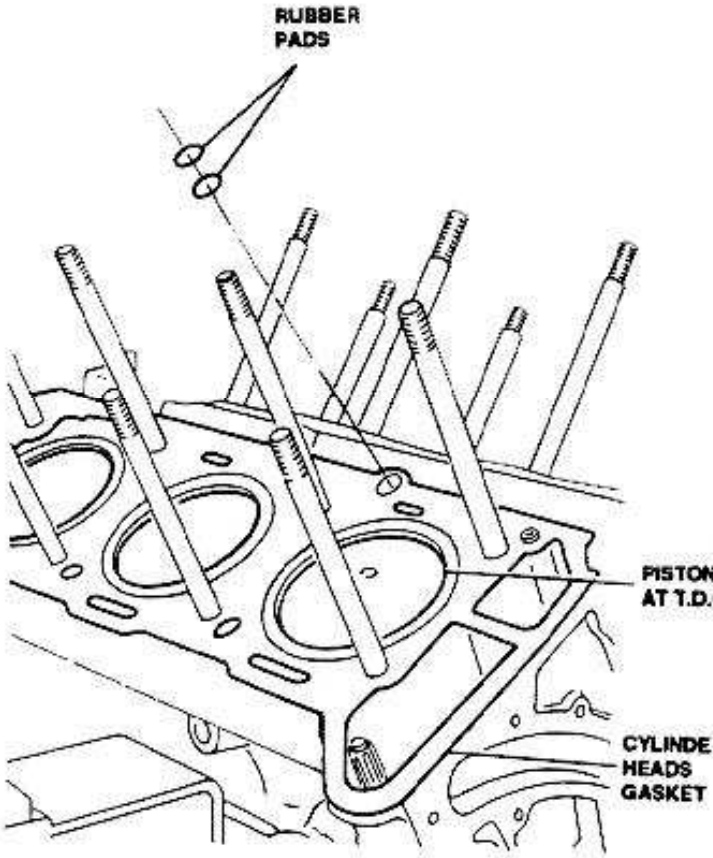


    b. Reassemble hydraulic belt tightener by reversing the order of disassembly procedure.

CAUTION:
It is recommended to replace all seals and o'rings at every overhaul of tightener.

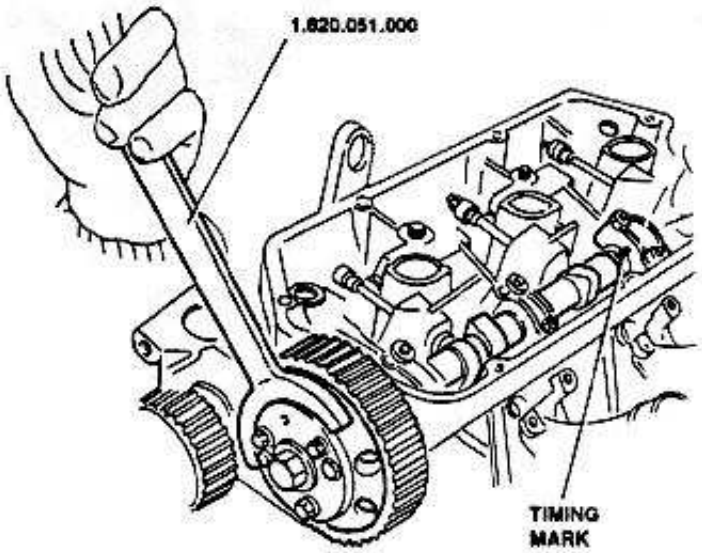
CYLINDER HEADS INSTALLATION

1. Rotate crankshaft as required to bring piston of firs cylinder at T.D.C. position.
2. Remove liners fixing tool **1.820.004.000** and supple mentary washers **1.820.052.000**.
3. Position cylinder head gaskets.
4. Position rubber pads sealing the oil passages (two for each row of cylinders).

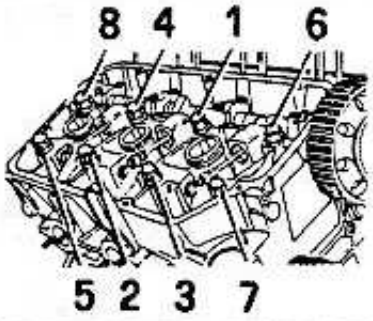


5. Using lever tool **1.820.051.000** rotate camshaft of each cylinder head to align timing marks on camshaft to those on one of the camshaft caps.

NOTE: On right cylinder head the timing mark is located on cap No. 3, while on left cylinder head the mark is located on cap No. 7.



6. Install cylinder heads on engine block.
7. Lubricate with engine oil the nuts thread and washers then torque, in two or three stages, the eight nuts attaching each cylinder head following instructions in the table below.



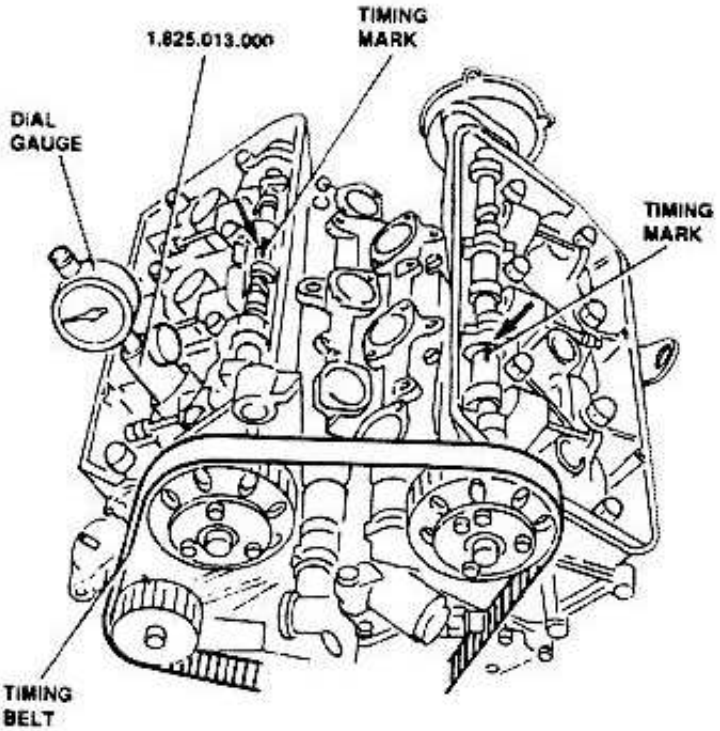
- At reassembly, tighten gradually, in the sequence shown above to the torque of :	65.3 to 72.2 ft lbs 88.5 to 97.8 Nm
- After about 650 miles, and with cold engine, loosen nuts of one turn in the sequence shown above, wipe nuts with engine oil and tighten in the sequence shown above to the torque of:	72.2 to 79.8 ft lbs 97.8 to108.2 Nm

TIMING BELT INSTALLATION AND ENGINE TIMING CHECK

1. Install tool **1.825.013.000** complete of dial gauge into seat of first cylinder spark plug.
2. Rotate crankshaft in normal operating direction and bring piston of first cylinder to exact T.D.C. in firing phase (both valves closed).
3. Verify the alignment of marks engraved on camshafts to those on relevant caps.

CAUTION:
During timing belt installation, check that above mentioned alignment is maintained.

4. Fit timing belt, while keeping in tension the stretched arms, and observing the following order:
   1°- Crankshaft toothed pulley.
   2°- Left cylinder head toothed pulley.
   3°- Right cylinder head toothed pulley.
   4°- Oil pump drive toothed pulley.
   5°- Hydraulic belt tightener pulley.



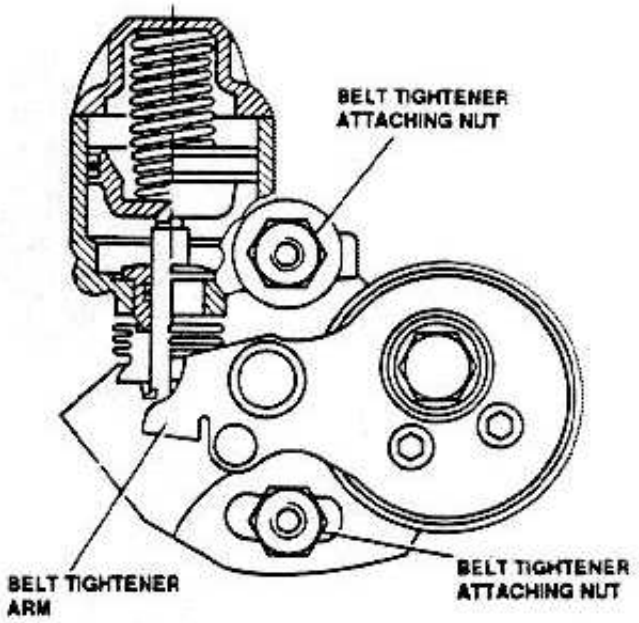
CAUTION:
Prevent oils and solvents from contacting the belt: the belt elasticity could be affected and cause slipping of teeth.

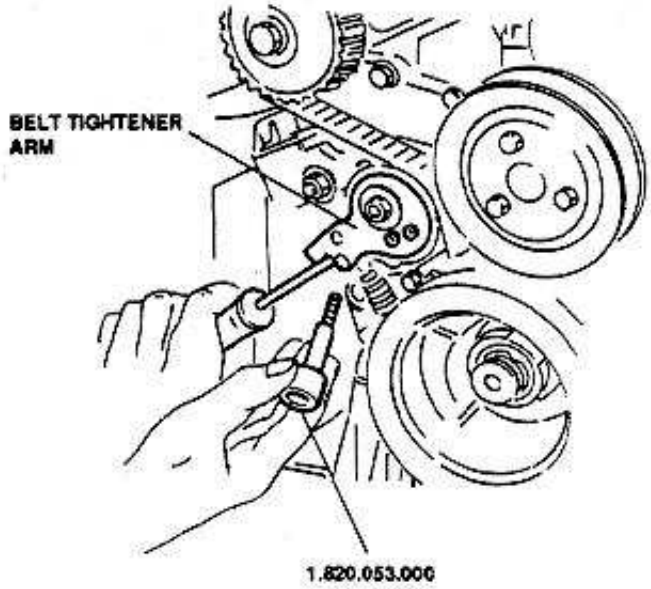
5. Loosen belt tightener attaching nuts.
6. Settle the timing belt by slightly rotating the crankshaft in normal sense of rotation.
7. Rotate crankshaft in normal sense of rotation for two or three complete revolutions, having care to maintain always in tension the drive arms of the toothed belt.

NOTE: **Never turn the crankshaft in direction opposite to normal sense of rotation.**

8. Keep the belt under tension, push tightener pulley against the belt and lock the two previously loosened attaching nuts .
9. Slightly lift belt tightener arm and remove tool **1.820.053.000**.
10. Return piston of first cylinder to T.D.C. in firing phase and check alignment of all timing marks.

NOTE: **If proper alignment of all timing marks is not obtained, check for proper installation of timing belt and, if required, proceed to engine timing adjustment (Refer to Group 00).**

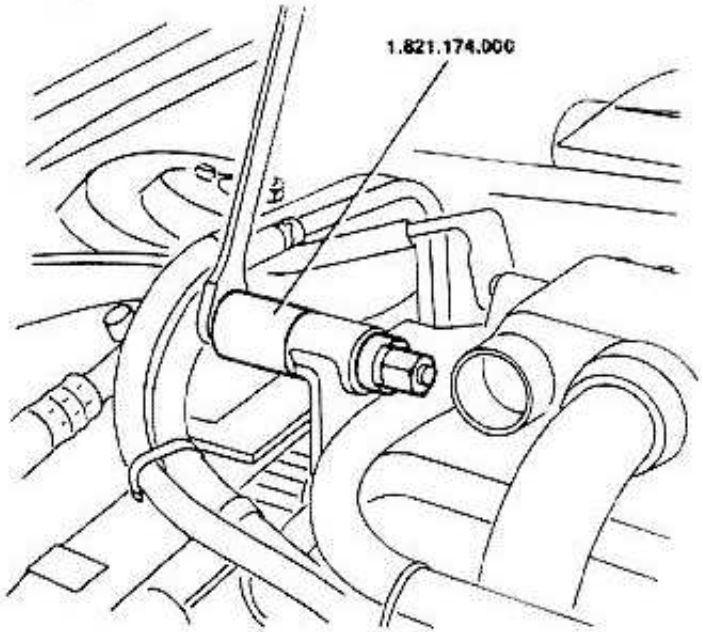




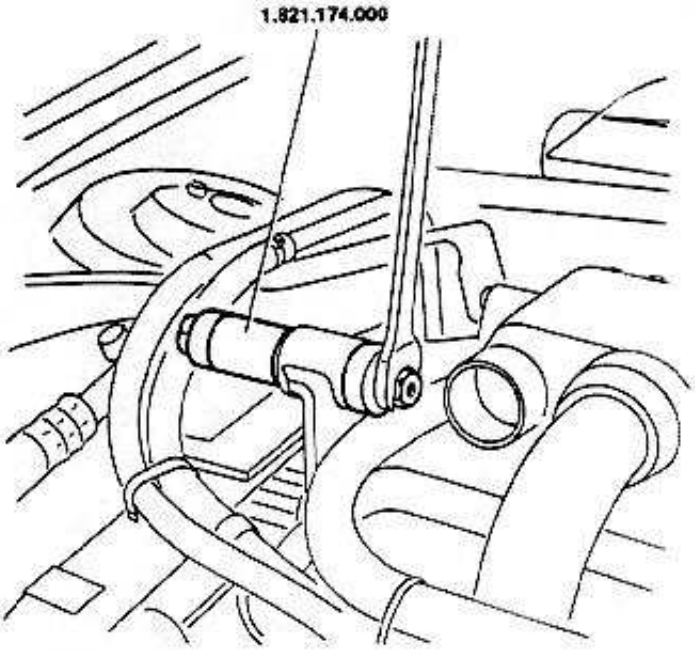
ENGINE MOUNT BRACKET ELASTIC BUSHING REPLACEMENT

During final phase of engine reassembly, check that bushing in upper engine mount bracket is in proper condition, and free of distortion or wear: if damaged or worn replace bushing as follows:

1. Remove upper engine link rod.
2. Remove air intake duct of fourth cylinder.
3. Using tool **1.821.174.000**, remove elastic bushing from the upper engine mount bracket.

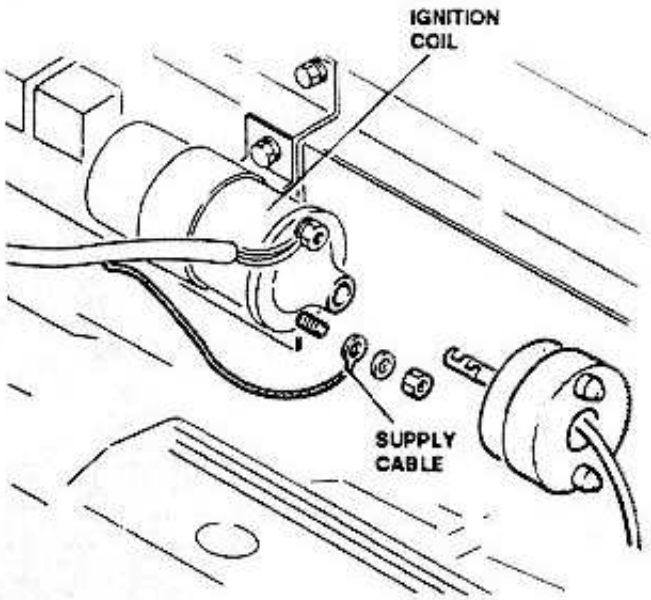


4. Insert new bushing using tool **1.821.174.000.**

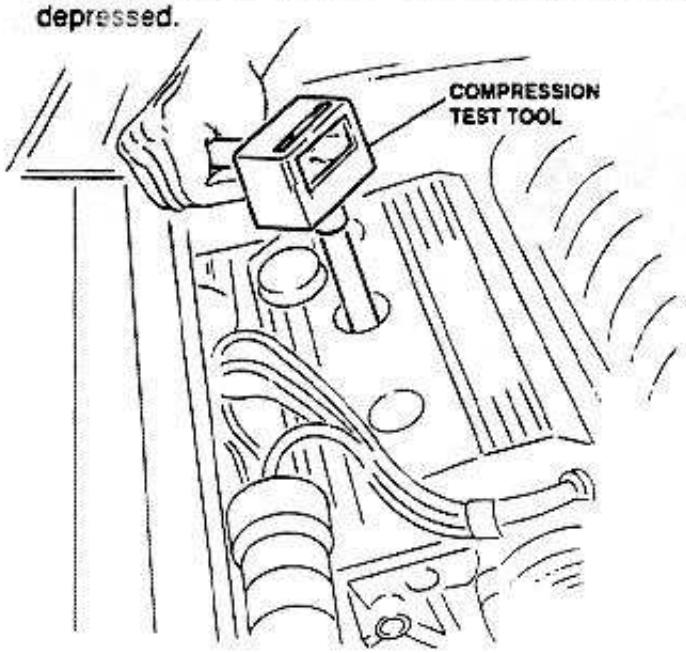


CYLINDERS COMPRESSION TEST

1. Start engine and let it run until normal operating temperature is reached.
2. Remove spark plugs.
3. Disconnect ignition coil supply cable (+15).
4. Disconnect fuel pump relay.



5. Insert compression test tool in the seat of a spark plug.
6. Crank the engine for a few revolutions by means of the starter motor with the accelerator pedal fully depressed.



CAUTION:
Verify for absence of leaks from tool fitting.

7. Repeat the test on the remaining cylinders, resetting the tool writing tip at each test

NOTE: Whenever an excessive difference is noted between pressure readings on the cylinders, troubleshoot the fault by checking the sealing of valves and eventually of pistons and pistons rings.

AT THE COMPLETION OF ENGINE REASSEMBLY, it is always advisable to carry-out the above described CYLINDER COMPRESSION TEST in addition to ALL CHECKS AND INSPECTIONS ESTABLISHED FOR ORDINARY MAINTENANCE (refer to Group 00) and checks relevant to the FUEL SUPPLY SYSTEM (refer to Group 04) and COOLING SYSTEM (refer to Group 07).

ELECTRIC COMPONENTS CHECKS AND INSPECTIONS (located in engine compartment)

- **Engine oil pressure meter.**
- **Minimum engine oil pressure warning lamp sensor.**
- **Minimum engine oil level warning lamp sensor.**
- **Odometer and speedometer pulse generator.**

For the remaining electric components and sensors located in engine compartment refer to the detailed information contained in the specific Groups. e.g.:

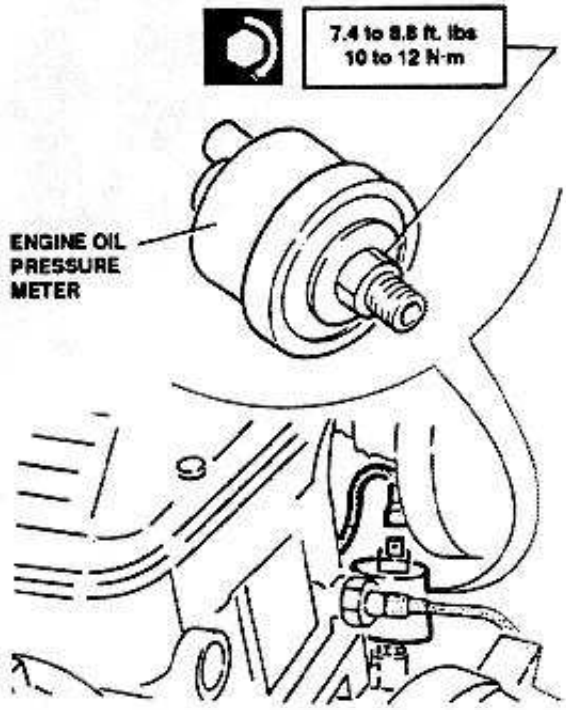
- Motronic system sensors: refer to **Group 04**.
- Automatic transmission oil temperature sensor: refer to **Group 16.**
- A.B.S. hydraulic control unit: refer to **Group 22.**
- Alternator, engine starter, etc.: refer to **Group 05.**

Etc.

ENGINE OIL PRESSURE METER

1. Check calibration of oil pressure meter. Replace meter if correct values are not met.

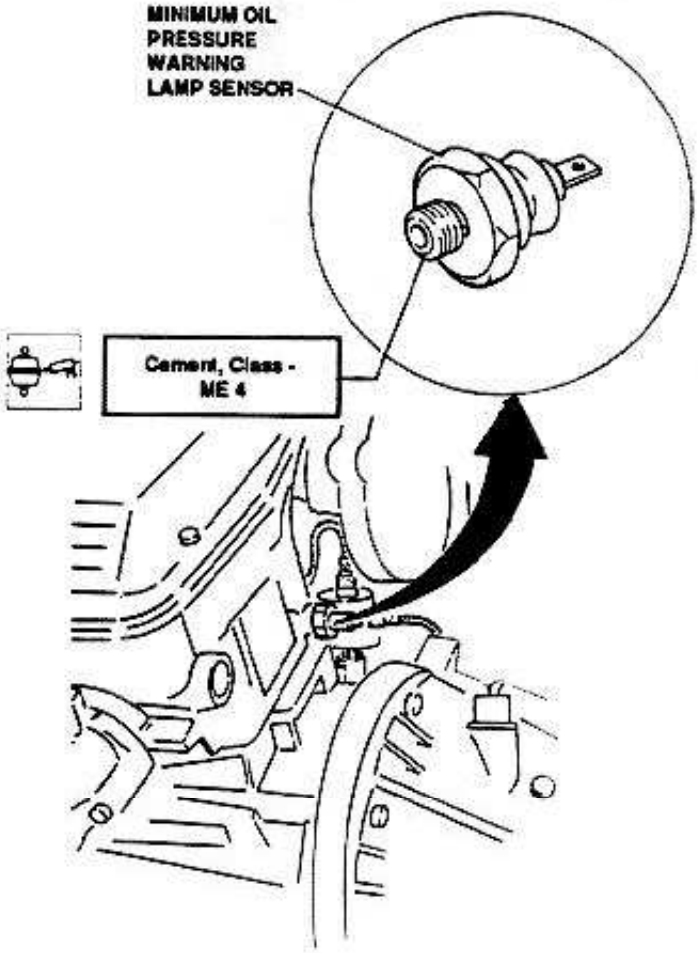
Pressure	Resistence
bar (p.s.i.)	Ω
0	290 to 320
0.4 (5.8)	270 to 300
4 (58)	103 to 133
8 (116)	0 to 25



MINIMUM ENGINE OIL PRESSURE WARNING LAMP SENSOR

1. Check calibration of minimum engine oil pressure warning lamp sensor. Replace sensor if correct values are not met.

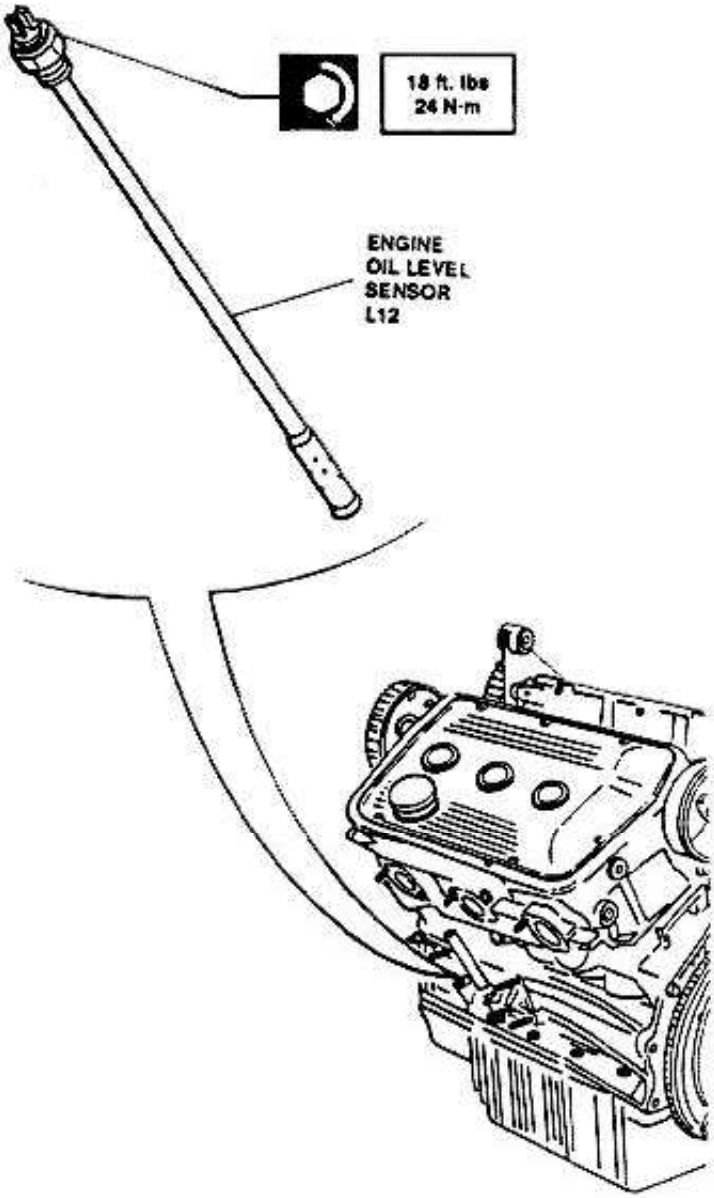
Pressure:	kPa	p.s.i.
test	14.7 to 44.1	2.13 to 6.39
allowance	589	85.42
allowable peak during cold start	981	142.27



MINIMUM ENGINE OIL LEVEL WARNING LAMP SENSOR

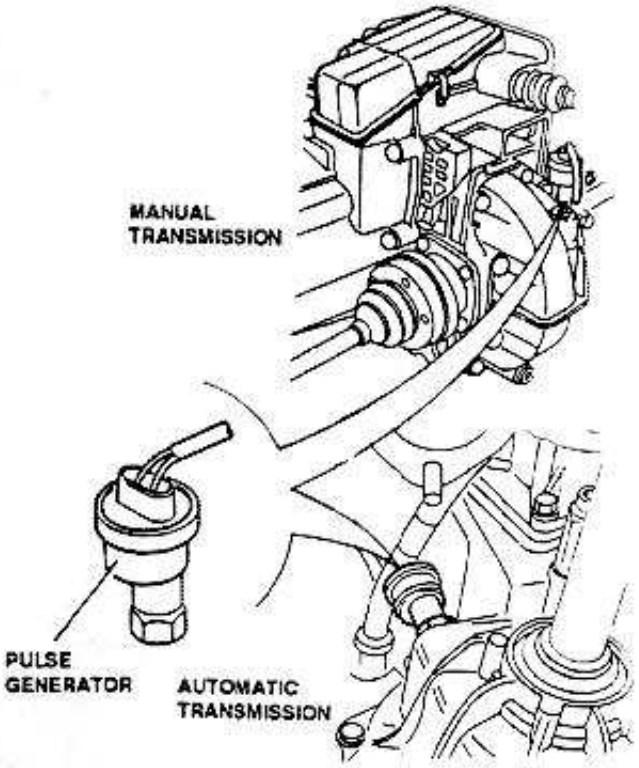
1. Check calibration of engine oil level sensor. Replace sensor if correct values are not met.

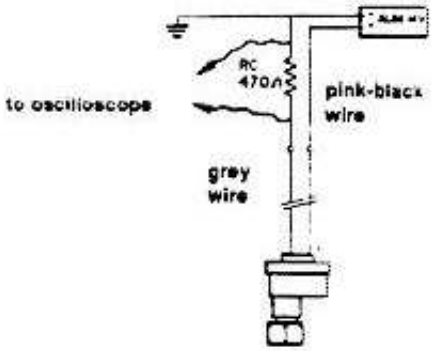
Circuit resistance
12 Ω ± 5%

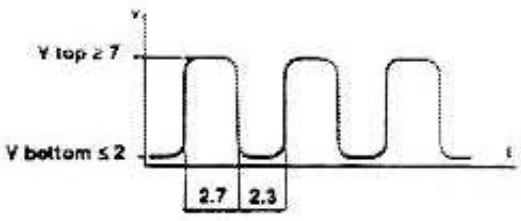


ODOMETER AND SPEEDOMETER PULSE GENERATOR

1. Check calibration of odometer and speedometer pulse generator. Replace pulse generator if correct values are not met.
2. With gearbox to neutral and engine running, check that no tachometer signals are emitted .
3. Connect pulse generator as shown in the illustration and check, with an oscilloscope across the load resistance, that the wave form is the specified one at 3000 r.p.m.







"ON VEHICLE" OPERATIONS

The preceding chapter includes and illustrates the complete engine bench overhaul.
However, some of these operations can be carried-out **"on vehicle"**, without removal of the engine from the vehicle.

NOTE: **However, the decision of removing the engine or perform the required activity "on vehicle" is left to the operator's experience.**

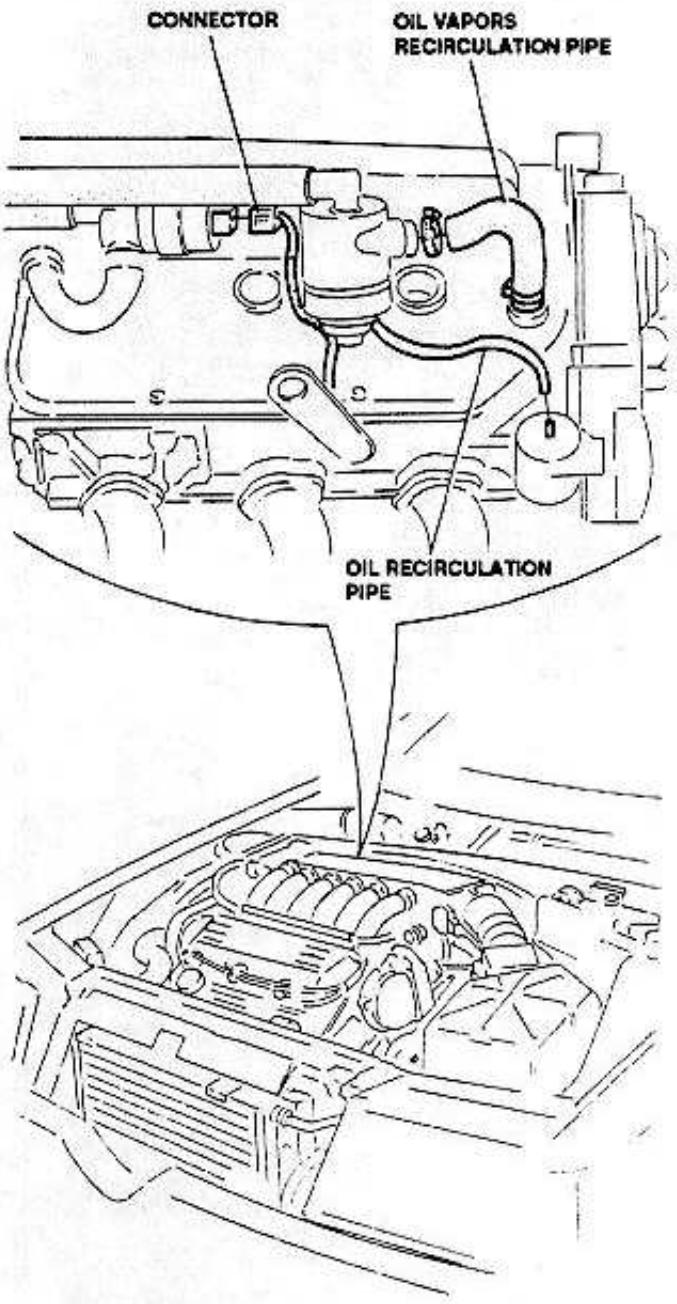
Among the most frequent operations, it is possible to carry-out the cylinder heads **removal/installation** directly "on vehicle" as indicated below.
Other operations as the oil cup removal/installation are not feasible "on vehicle", and require engine removal.

NOTE: **Refer to Group 00 for further details about the most frequent maintenance operations which can be carried-out with engine installed on the vehicle.**

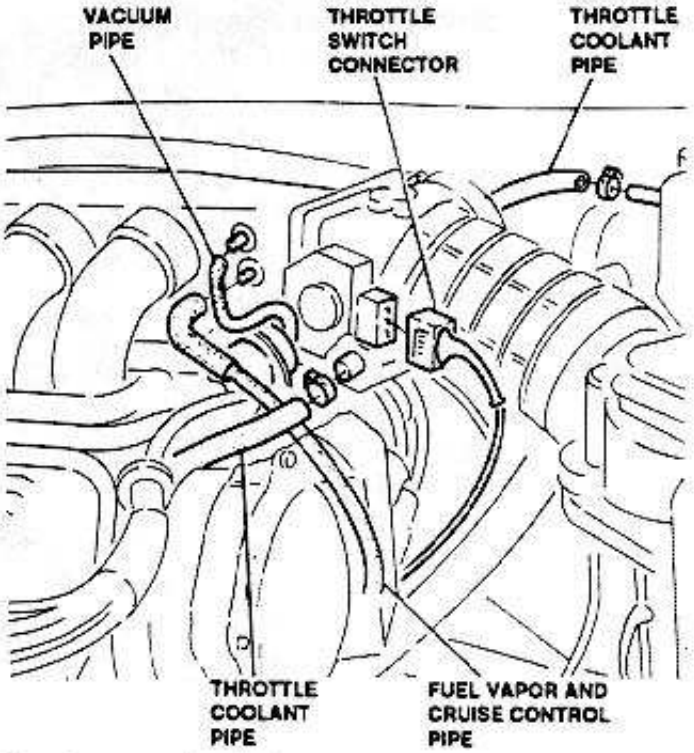
CYLINDER HEADS REMOVAL AND INSTALLATION

NOTE: **The operations described in the following procedure are referred only to right cylinder head (1st, 2nd and 3rd cylinders). Removal and installation of the left cylinder head do not present substantial differences from engine bench DISASSEMBLY and REASSEMBLY procedures.**

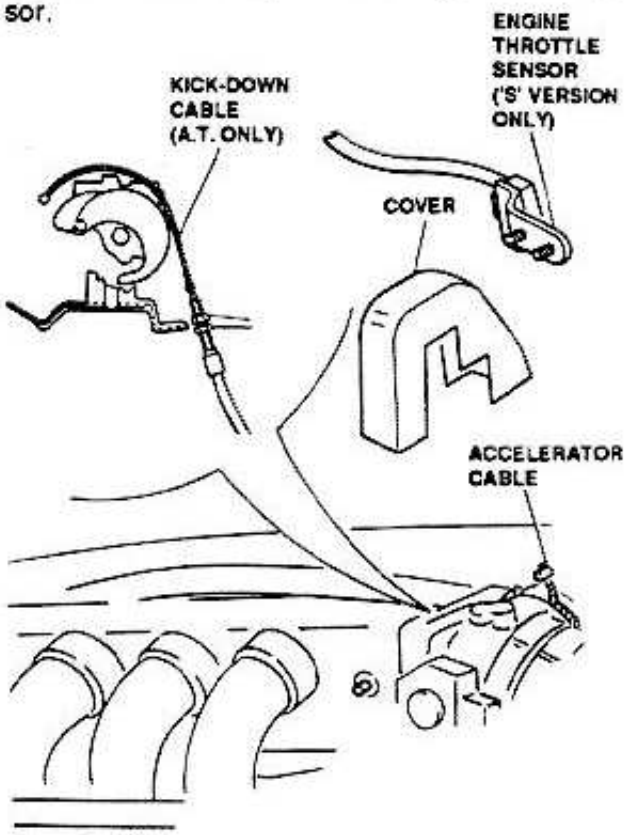
1. Disconnect battery (-) lead.
2. Disconnect connector from constant idle speed actuator.
3. Disconnect oil vapors recirculation pipe and idle speed actuator.
4. Disconnect oil recirculation pipe.



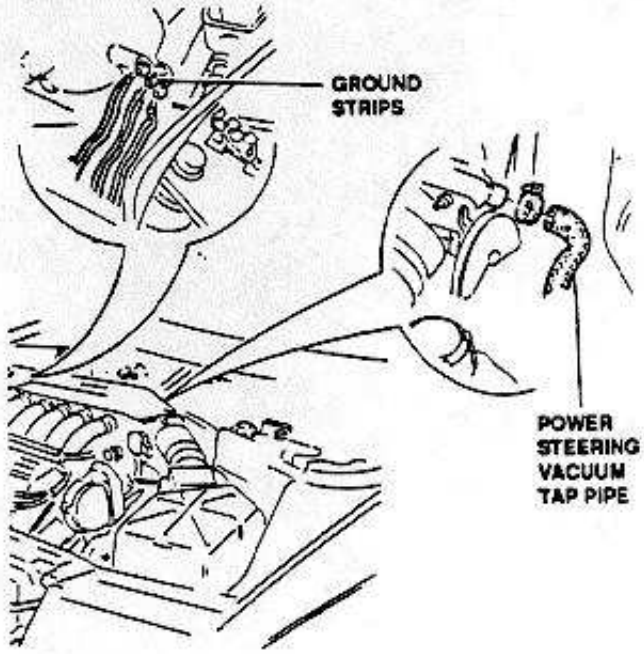
5. Disconnect connector from minimum and maximum throttle opening switch.
6. Disconnect vacuum pipe for fuel pressure regulator and pipe from the fuel vapor solenoid valve and cruise control actuator.
7. Disconnect coolant inlet and outlet pipes from throttle body.



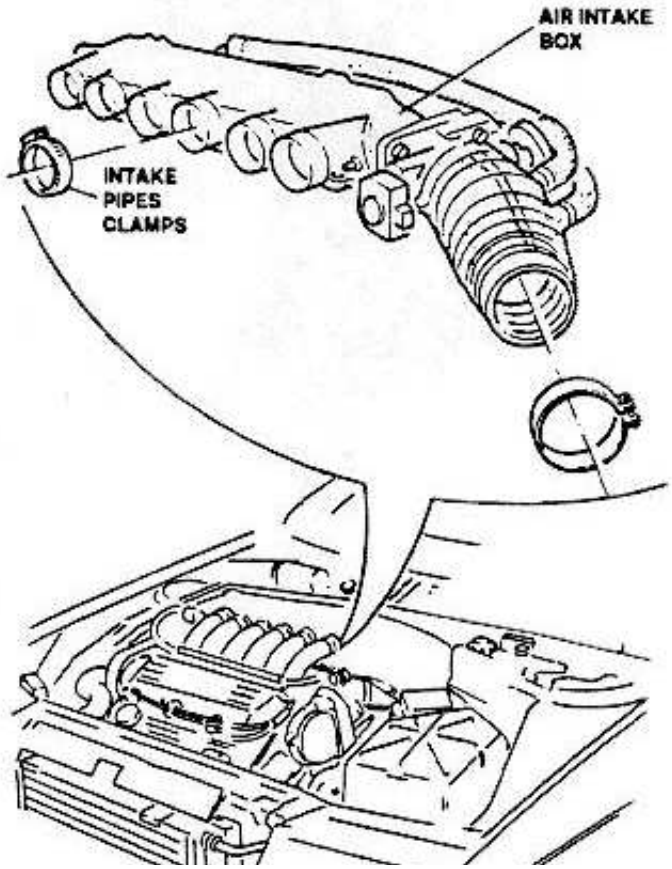
8. Remove throttle body cover.
9. Disconnect accelerator cable.
10. **On vehicles equipped with automatic transmission**: disconnect the "Kick-down" cable.
11. **On "S" version only**: remove engine throttle sensor.



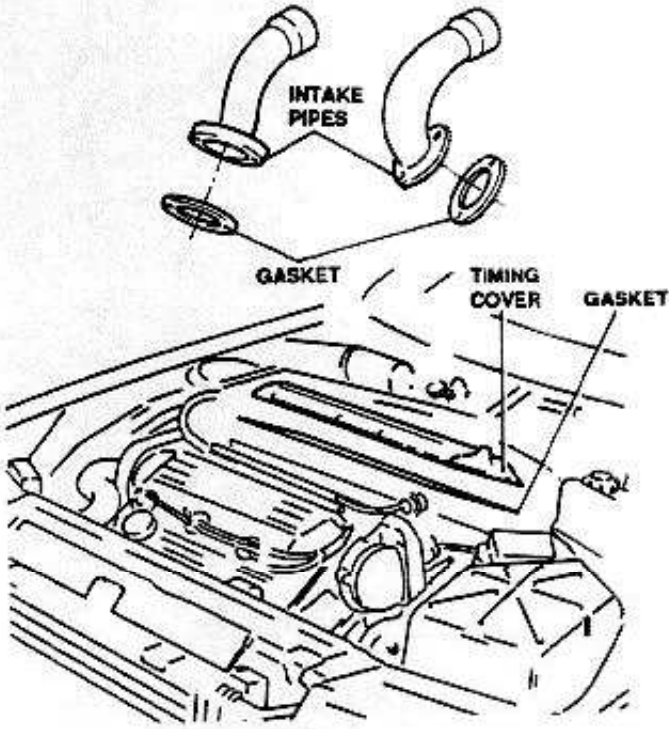
12. Disconnect ground strips.
13. Disconnect power steering vacuum tap pipe.



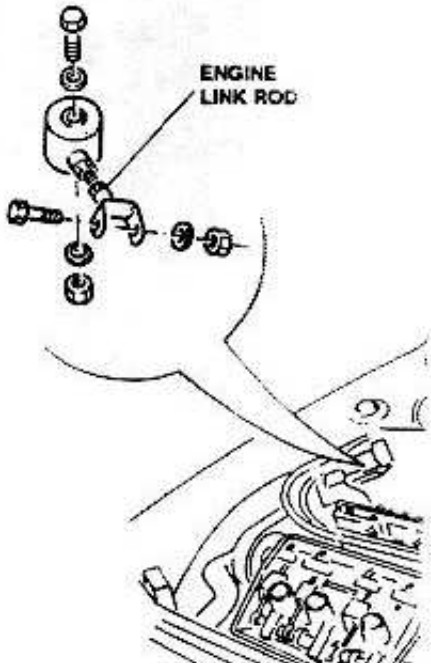
14. Remove three attaching screws and loosen clamps on ducts and intake pipes, them remove the air intake box.



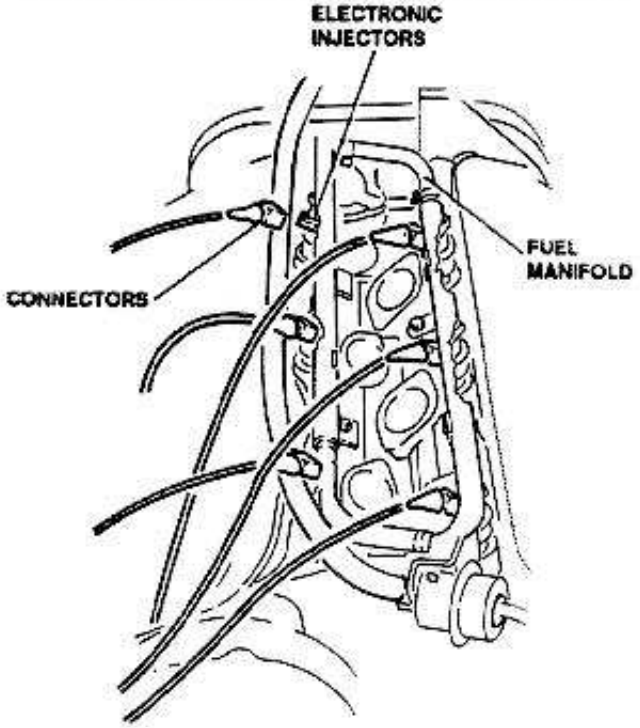
15. Disconnect spark plug leads from 1st, 2nd and 3rd cylinders.
16. Remove the six air intake pipes and relevant gaskets.
17. Remove timing cover and relevant gasket.



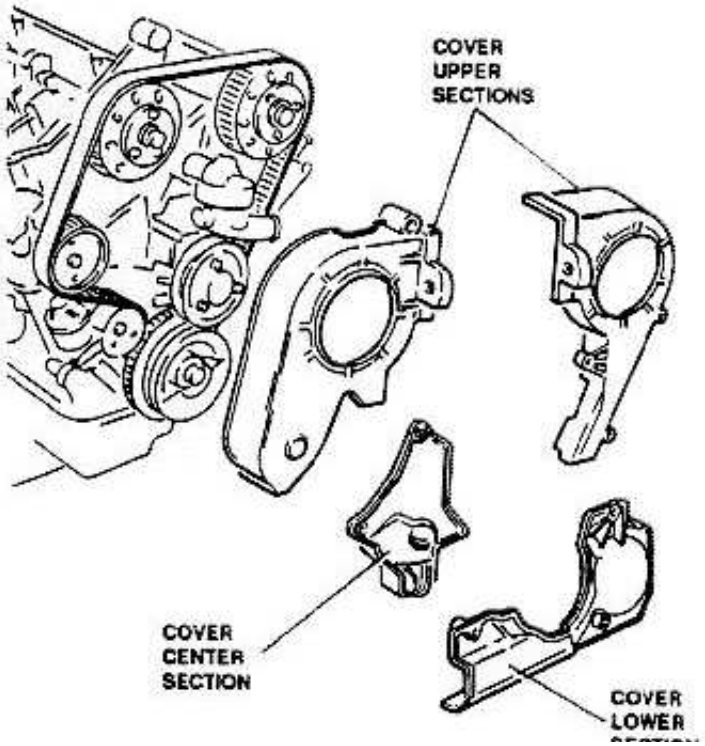
18. Remove upper engine link rod.



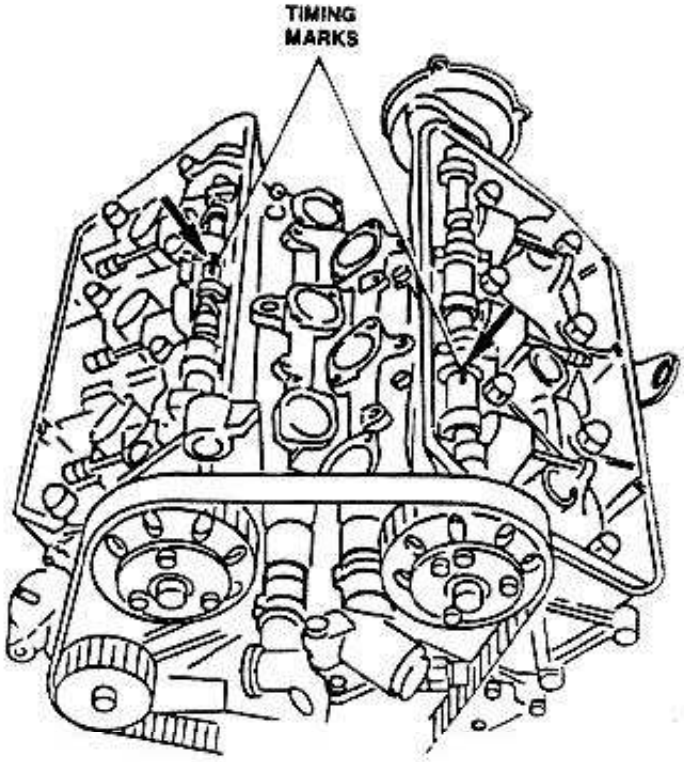
19. Disconnect connector from electronic injectors and remove fuel manifold complete of fuel injectors without disconnecting fuel delivery and return pipes.



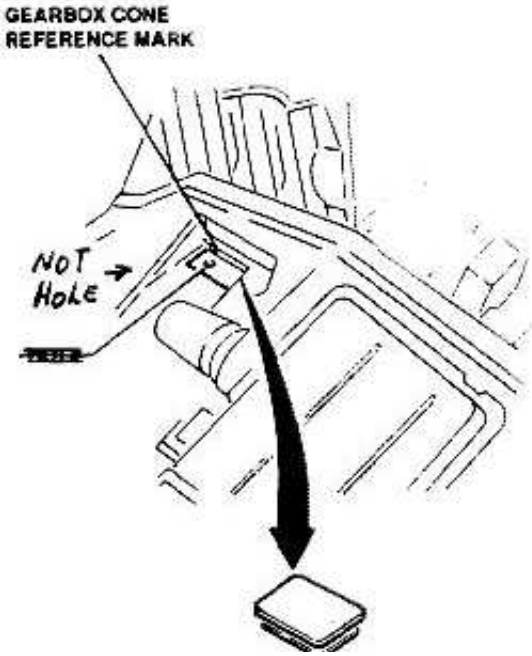
20. Clean spark plug housings, remove spark plugs and cap holes to prevent entry of foreign matter.
21. Remove upper section of timing belt cover.
22. Remove center and lower section of timing belt cover.



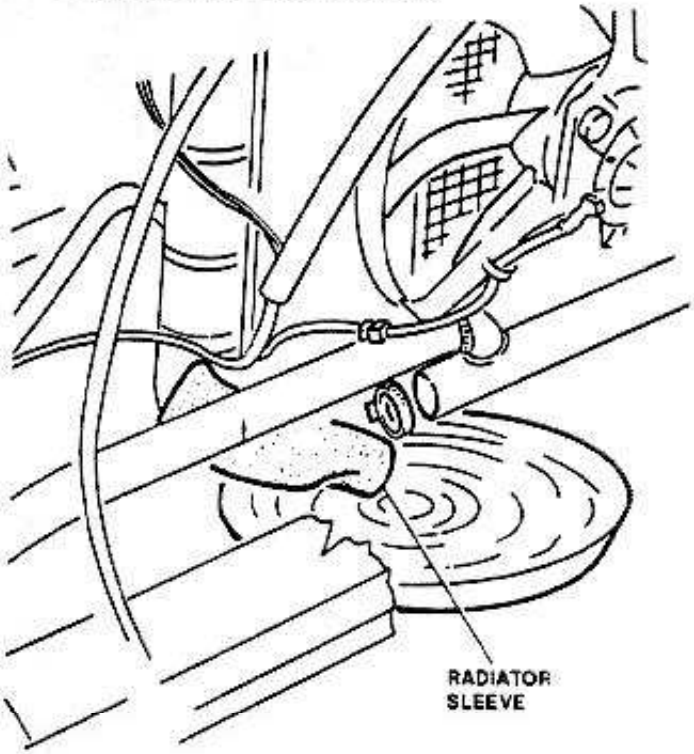
23. Rotate crankshaft and align timing marks on the camshaft to marks on relevant caps.



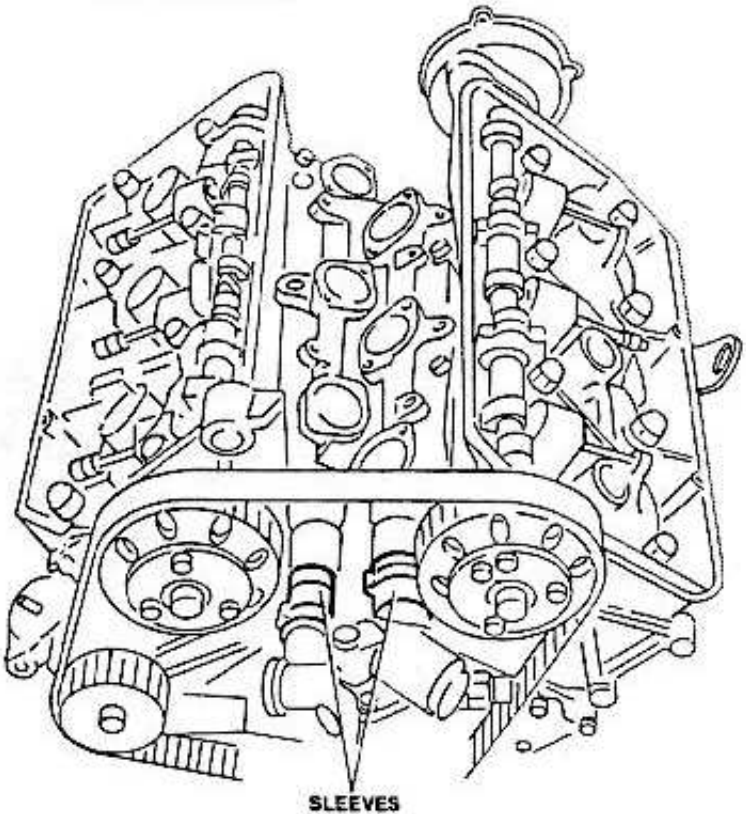
24. In the position determined at step 23. above (cylinder No. 1 at T.D.C. in firing phase), the SCRIBED LINE on the flywheel and the mark engraved on the gearbox cone must be aligned.



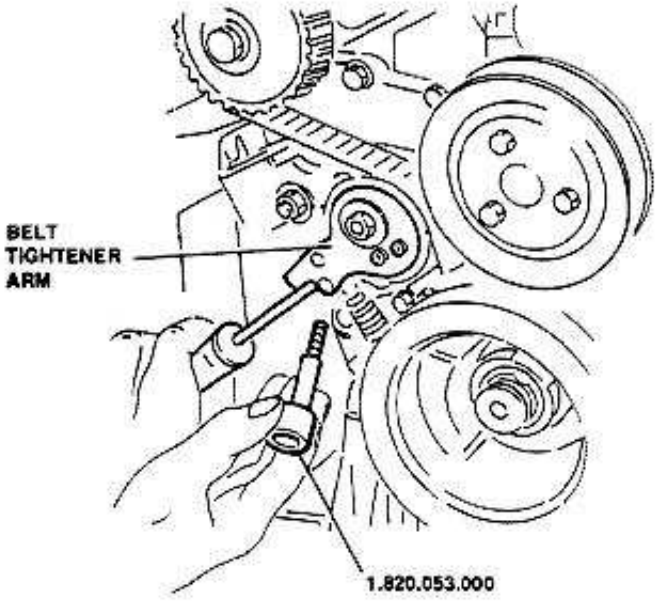
25. Remove header tank cap.
26. Disconnect radiator outlet sleeve and drain engine coolant in a suitable container.



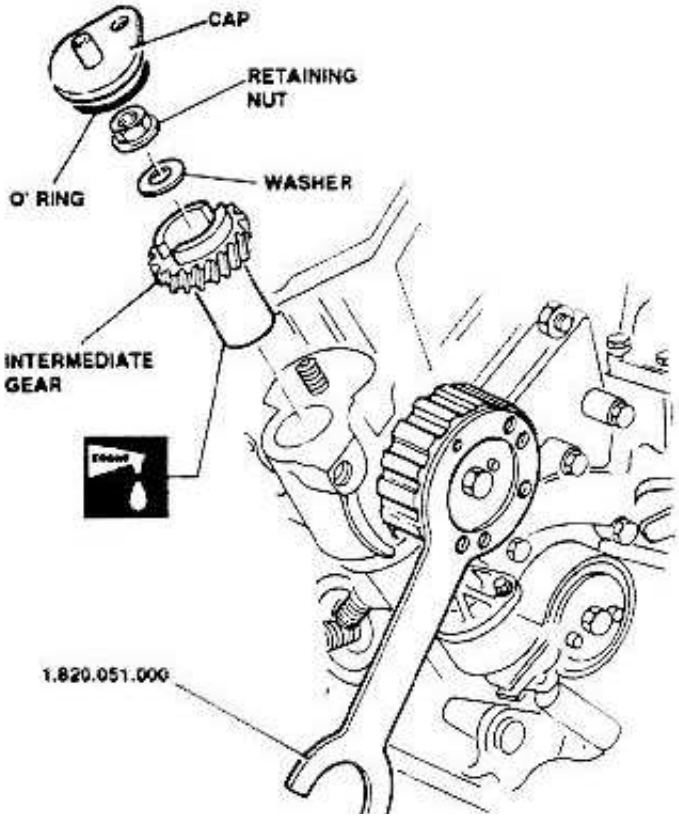
27. Disconnect sleeves connecting cylinder heads to thermostat unit.



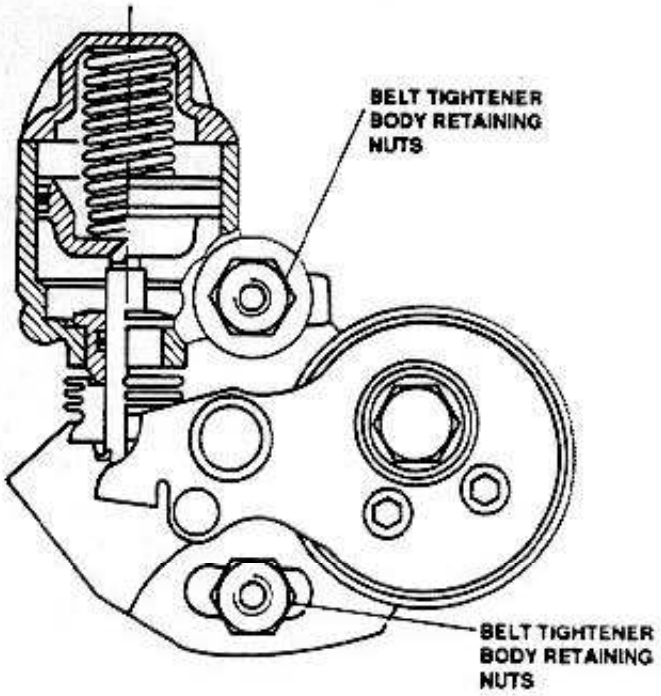
28. Lift hydraulic belt tightener arm and lock the tightener with tool **1.820.053.000**.



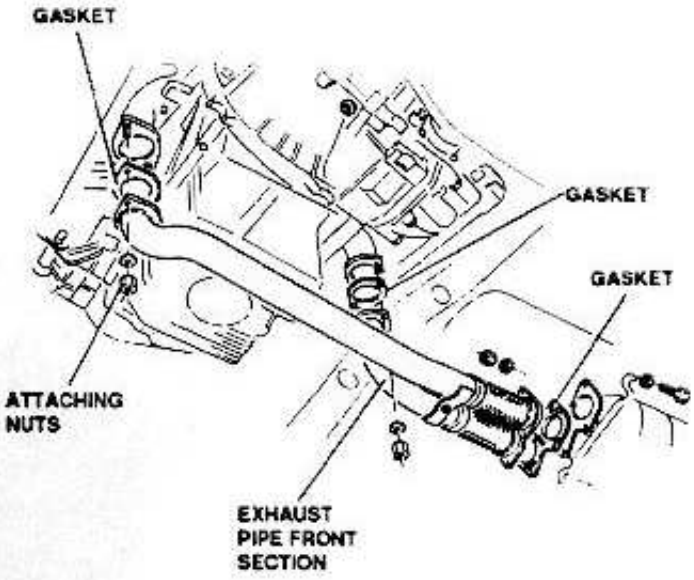
29. Remove cap and relevant o'ring.
30. Prevent rotation of oil pump pulley using tool **1.820.051.000**.
31. Unscrew oil pump intermediate gear retaining nut.
32. Remove washer.
33. Remove intermediate gear.



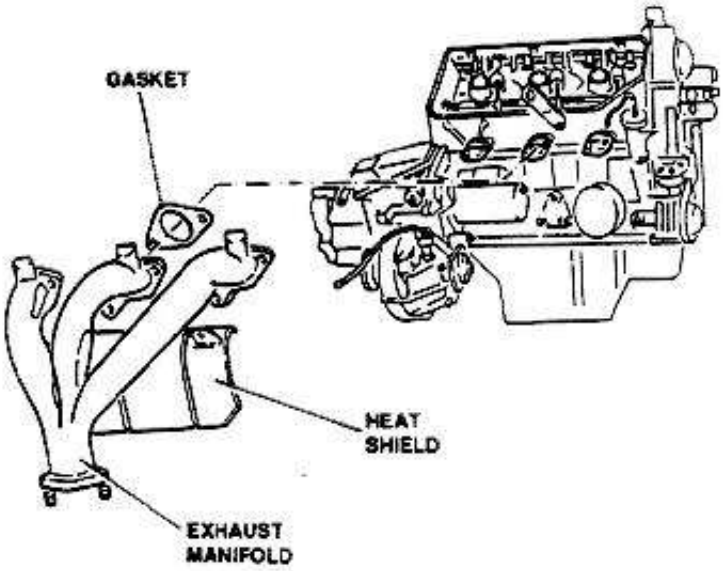
34. Loosen two nuts fixing belt tightener body to engine block.
35. Rotate hydraulic belt tightener upwards and lock in this position by tightening nuts loosened at step 34. above.
36. Remove toothed belt from camshaft drive pulleys.



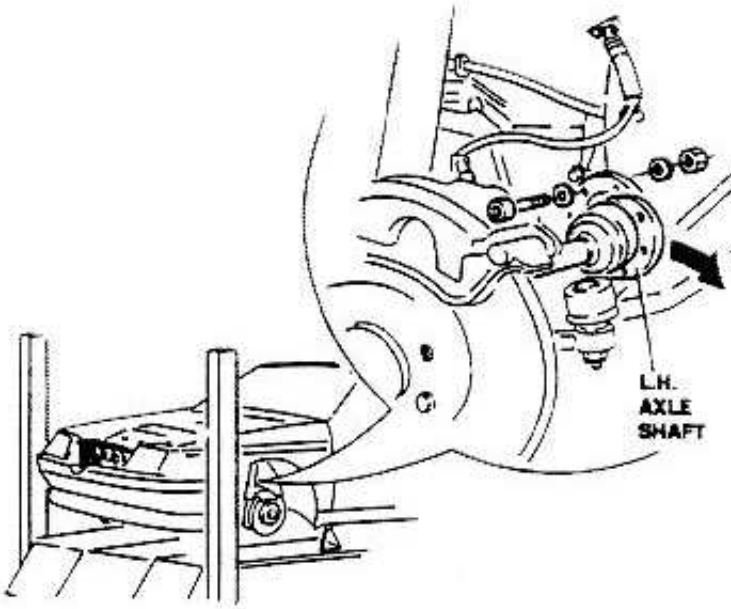
37. Remove front section of exhaust pipes.
38. Remove gaskets.



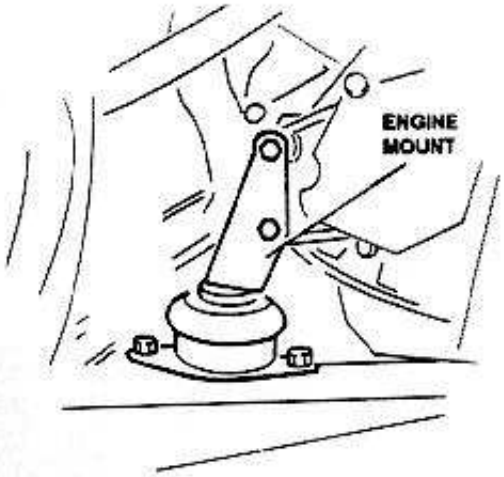
39. Remove exhaust manifold.
40. Remove exhaust manifold gaskets.
41. Remove engine starter heat shield.



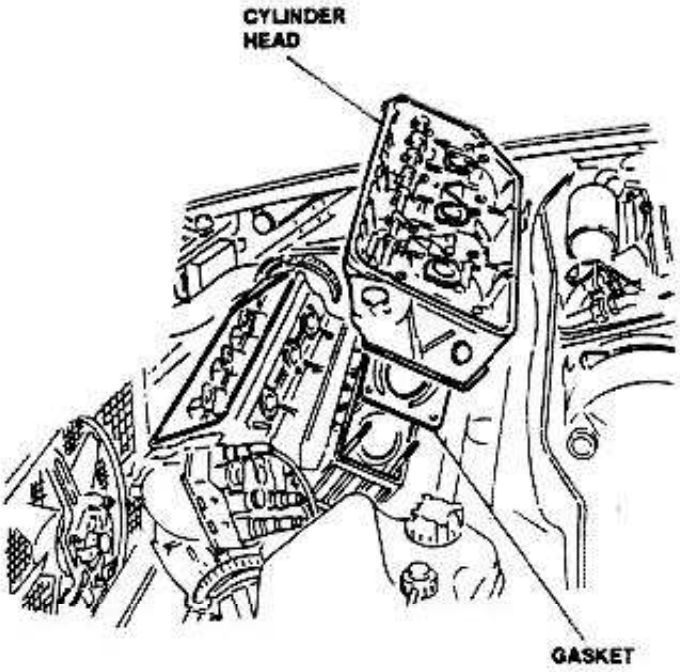
42. Remove left front wheel.
43. Disconnect left axle shaft and move it rearwards so that it will not hamper the following of operations.



44. Disconnect engine mount on gearbox side after a suitable hydraulic jack has been placed below the oil sump.



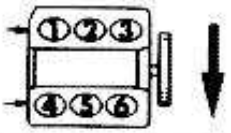
45. Carefully remove the complete engine mount on gearbox side, and tilt the engine until the gearbox cone comes in contact with the auxiliary frame.
46. Remove right cylinder head and relevant gasket.



TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

All technical, dimensional, checks and inspections characteristics and specifications relevant to 3.0 6V engine are presented below.
The same data have been included in the previously presented repair procedures, and have been synthetically enlarged herein with other useful data necessary for the complete inspection of the engine and relevant units.
The order in which the components are presented is that of overhauled engines reassembly order.

ENGINE SPECIFICATIONS

	164 - 164 "L"	164 "S"
Type	Otto cycle, 4-stroke	
Cylinder numbers and arrangement	6, 60°V	
Cylinder numbering and running direction	R.H. HEAD ①②③ L.H. HEAD ④⑤⑥ 	
Bore-Stroke mm (in) Displacement cm^3 (cu.in)	93-72.6 (3.66-2.86) 2959 (180.6)	
Combustion chamber volume cm^3 (cu.in)	54.8 (3.3)	
Compression ratio	9.5:1	10:1
Maximum power output (HP - SAE) HP	183 at 5600 rpm	200 at 5800 rpm
Maximum torque (HP - SAE) ft.lbs (Nm)	191 (259) at 4400 rpm	195 (265) at 4500 rpm
Mean effective piston speed (1) m/s (ft/s)	10.04 (46.03)	.....
Engine oil pressure (2) kPa (psi) at 800-900 rpm at 5000 rpm	80 (11.6) 450 (65.2)	

(1) At maximum output rpm

(2) Check with oil at operating temperature (90°C - 194°F)

ENGINE BLOCK

ENGINE BLOCK

MAIN BEARING DIAMETER	63.657 to 63.676 mm	2.5062 to 2.5069 in
TAIL BEARING SHOULDER LENGTH	26.450 to 26.500 mm	1.0413 to 1.0433 in
PISTON COOLING OIL SPRAYING VALVE OPENING PRESSURE	2.25 to 2.75 kPa	32.63 to 39.87 psi

CRANKSHAFT

MAIN JOURNAL DIAMETER	GREEN	59.961 to 59.967 mm	2.3607 to 2.3609 in
	BLUE	59.967 to 59.973 mm	2.3609 to 2.3611 in
	RED	59.973 to 59.979 mm	2.3611 to 2.3614 in
ROD JOURNAL DIAMETER	RED	51.990 to 52.000 mm	2.0468 to 2.0472 in
	LIGHT BLUE	51.980 to 51.990 mm	2.0465 to 2.0468 in
TAIL JOURNAL LENGTH		31.300 to 31.335 mm	1.2323 to 1.2337 in
MAX. OVALIZATION FOR MAIN AND ROD JOURNAL		0.004 mm	0.0002 in
MAX. TAPER ERROR FOR MAIN AND ROD JOURNAL		0.010 mm	0.0004 in
MAX PARALLELISM ERROR BETWEEN MAIN AND ROD JOURNAL		0.015 mm	0.0006 in
MAX. ECCENTRICITY BETWEEN MAIN JOURNALS		0.040 mm	0.0016 in
MAX. DEVIATION BETWEEN AXES OF CRANK AND AXES OF CRANKPINS		0.300 mm	0.0118 in

MAIN BEARING HALVES

MAIN HALF BEARING THICKNESS	GREEN	1.8420 to 1.8465 mm	0.07252 to 0.07270 in
	BLUE	1.8375 to 1.8420 mm	0.07234 to 0.07252 in
	RED	1.8330 to 1.8375 mm	0.07216 to 0.07234 in
CLEARANCE BETWEEN MAIN BEARING AND MAIN JOURNAL	GREEN	-0.003 to 0.031 mm	-0.00012 to 0.00122 in
	BLUE	0.000 to 0.034 mm	0.0000 to 0.00134 in
	RED	0.003 to 0.037 mm	0.00012 to 0.00146 in

THRUST RING HALVES

THRUST RING HALF THICKNESS	2.310 to 2.360 mm	0.0909 to 0.0929 in

CRANKSHAFT AXIAL PLAY	0.080 to 0.265 mm	0.0031 to 0.0104 in

CYLINDER LINER

CYLINDER LINER DIAMETER	Class A (Blue)	92.985 to 92.994 mm	3.6608 to 3.6612 in
	Class B (Pink)	92.995 to 93.004 mm	3.6612 to 3.6616 in
	Class C (Green)	93.005 to 93.014 mm	3.6616 to 3.6620 in
PROTRUSION OF CYLINDER LINER FROM ENGINE BLOCK		0.01 to 0.06 mm	0.0004 to 0.0024 in
LINER OVALIZATION AND TAPER LIMITS		0.01 mm	0.0004 in

OIL PUMP

CAMSHAFT PULLEY HUB BUSHING DIAMETER	32.000 to 32.025 mm	1.2598 to 1.2608 in
CAMSHAFT PULLEY HUB DIAMETER	31.959 to 31.975 mm	1.2582 to 1.2589 in
OIL PUMP PULLEY HUB BUSHING DIAMETER (1)	19.000 to 19.021 mm	0.7480 to 0.7489 in
OIL PUMP PULLEY HUB DIAMETER (1)	18.967 to 18980 mm	0.7467 to 0.7472 in
OIL PUMP DRIVE GEAR HUB BUSHING DIAMETER (REAMING) (1)	19.000 to 19.021 mm	0.7480 to 0.7489 in
OIL PUMP DRIVE GEAR HUB DIAMETER (1)	18.967 to 18.980 mm	0.7467 to 0.7472 in
DIAMETER OF DRIVEN ROTOR SEAT IN PUMP BODY	49.325 to 49.375 mm	1.9419 to 1.9439 in
OIL PUMP DRIVEN ROTOR OUTER DIAMETER	49.100 to 49.155 mm	1.9331 to 1.9352 in

(1) R.H. CYLINDER HEAD ONLY

CLEARANCE BETWEEN DRIVEN ROTOR AND INNER ROTOR (1)	0.040 to 0.290 mm	0.0016 to 0.0114 in
AXIAL PLAY BETWEEN ROTORS AND PUMP BODY PLANE	0.025 to 0.075 mm	0.0010 to 0.0030 in
CLEARANCE BETWEEN OUTER ROTOR AND PUMP BODY	0.170 to 0.275 mm	0.0067 to 0.0108 in
CLEARANCE BETWEEN CAMSHAFT BUSHING AND PULLEY HUB	0.025 to 0.066 mm	0.0010 to 0.0026 in
CLEARANCE BETWEEN OIL PUMP BUSHING AND PULLEY HUB (2)	0.020 to 0.054 mm	0.0008 to 0.0021 in
CLEARANCE BETWEEN OIL PUMP BUSHING AND GEAR HUB (2)	0.020 to 0.054 mm	0.0008 to 0.0021 in

(1) Measure with rotors in position shown in the illustration

(2) R.H. cylinder head only

OIL PRESSURE RELIEF VALVE SPRING

FREE SPRING LENGTH	49.29 mm	1.941 in
LOADED SPRING LENGTH	31.90 mm	1.256 in
TEST LOAD	170 to 176 N	38.2 to 39.6 lbs

HYDRAULIC TIGHTENER SPRING

SPRING "A" (PISTON)	USEFUL NUMBER OF TURNS	12	
	FREE SPRING LENGTH	93 mm	3.7 in
	LOADED SPRING LENGTH	48 mm	1.9 in
	STATIC TEST LOAD	93.16 N	21 lbs
SPRING "B" (PRE-LOAD)	USEFUL NUMBER OF TURNS	9	
	FREE SPRING LENGTH	45.5 mm	1.8 in
	LOADED SPRING LENGTH	30 mm	1.2 in

	STATIC TEST LOAD	98 N	22 lbs

FLYWHEEL

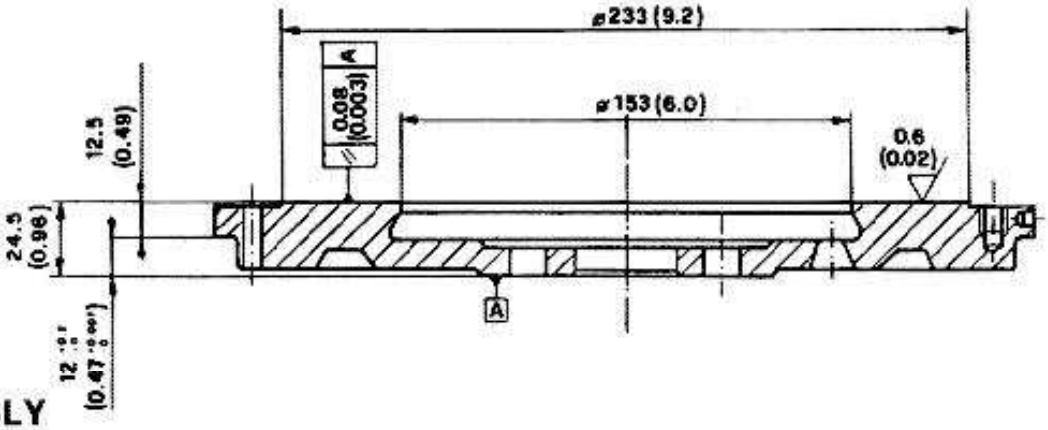
CENTER BUSHING INNER DIAMETER	REAMING	35.000 ± 0.025 mm	1.3780 ± 0.0010

FLYWHEEL RING GEAR INSTALLATION HEATING TEMPERATURE	120 to 140°C	248 to 284°F

FLYWHEEL GRINDING DIMENSIONS AND WORKING TOLERANCES

Dimensions: mm (in)

▽= Roughness: (µm) (µ in)
//= Parallelism: mm (in)



PISTON AND ROD ASSEMBLY

PISTON

PISTON DIAMETER (1)	Class A (BLUE)	92.925 to 92.935 mm	3.6584 to 3.6588 in
	Class B (PINK)	92.935 to 92.945 mm	3.6588 to 3.6592 in
	Class C (GREEN)	92.945 to 92.955 mm	3.6592 to 3.6596 in
1st RING GROOVE HEIGHT		1.525 to 1.545 mm	0.0600 to 0.0608 in
2nd RING GROOVE HEIGHT		1.525 to 1.545 mm	0.0600 to 0.0608 in
OIL SCRAPER RING GROOVE HEIGHT		3.515 to 3.535 mm	0.1384 to 0.1392 in
GUDGEON PIN HOLE DIAMETER	BLACK	22.003 to 22.006 mm	0.8663 to 0.8664 in
	WHITE	22.006 to 22.009 mm	0.8664 to 0.8665 in

(1) Measure perpendicularly to piston pin hole and at 14 mm (0.55 in) from lower edge

CLEARANCE BETWEEN CYLINDER AND PISTON	0.050 to 0.069 mm	0.0020 to 0.0027 in

WEIGHT DIFFERENCE BETWEEN PISTONS	≤4g	≤0.15 oz.

PISTON RINGS

RING THICKNESS	1st RING	1.478 to 1.490 mm	0.0581 to 0.0586 in
	2nd RING	1.478 to 1.490 mm	0.0582 to 0.0587 in
	OIL SCRAPER RING	3.478 to 3.490 mm	0.1369 to 0.1374 in
RING GAP (1)	1st RING	0.40 to 0.65 mm	0.016 to 0.026 in
	2nd RING	0.40 to 0.65 mm	0.016 to 0.026 in
	OIL SCRAPER RING	0.3 to 0.6 mm	0.012 to 0.023 in

(1) Measured in checking fixture or in cylinder liner

AXIAL PLAY BETWEEN SEATINGS AND PISTON RINGS	1st RING	0.035 to 0.067 mm	0.0014 to 0.0026 in
	2nd RING	0.035 to 0.067 mm	0.0014 to 0.0026 in
	OIL SCRAPER RING	0.025 to 0.057 mm	0.0010 to 0.0022 in

GUDGEON PIN

GUDGEON PIN OUTER DIAMETER	BLACK	21.994 to 21.997 mm	0.8659 to 0.8660 in
	WHITE	21.997 to 22.000 mm	0.8660 to 0.8661 in
CLEARANCE BETWEEN PISTON HOLE AND GUDGEON PIN	BLACK	0.006 to 0.012 mm	0.0002 to 0.0005 in
	WHITE	0.006 to 0.012 mm	0.0002 to 0.0005 in

ROD

ROD SMALL END BUSHING HOLE DIAMETER		22.005 to 22.015 mm	0.8663 to 0.8667 in
ROD BIG END INNER DIAMETER		55.511 to 55.524 mm	2.1855 to 2.1860 in
WEIGHT DIFFERENCE BETWEEN RODS		≤2g	≤0.07 oz.
CLEARANCE BETWEEN SMALL END BUSHING AND GUDGEON	BLACK	0.008 to 0.021 mm	0.0003 to 0.0008 in

PIN	WHITE	0.005 to 0.018 mm	0.0002 to 0.0007 in

ROD BEARING HALVES

ROD HALF BEARING THICKNESS	RED	1.737 to 1.745 mm	0.0684 to 0.0687 in
	BLUE	1.741 to 1.749 mm	0.0685 to 0.0688 in
AXIAL PLAY BETWEEN PIN AND BIG END BEARING	RED	0.021 to 0.060 mm	0.0008 to 0.0023 in
	BLUE	0.023 to 0.062 mm	0.0009 to 0.00024 in
BIG END AXIAL PLAY		0.2 to 0.3 mm	0.008 to 0.012 in

CYLINDER HEAD

CYLINDER HEAD

VALVE GUIDE SEAT DIAMETER			13.990 to 14.018 mm	0.5507 to 0.5519 in
VALVE GUIDE PROTRUSION			10.2 to 10.6 mm	0.40 to 0.42 in
VALVE CUP SEAT DIAMETER		INTAKE	35.000 to 35.025 mm	1.3780 to 1.3789 in
VALVE CUP SEAT DIAMETER		EXHAUST	22.000 to 22.021 mm	0.8661 to 0.8670 in
VALVE SEAT MOUSING DIAMETER	Normal	INTAKE	45.000 to 45.025 mm	1.7716 to 1.7726 in
		EXHAUST	39.000 to 39.025 mm	1.5354 to 1.5364 in
	Oversized	INTAKE	45.300 to 45.325 mm	1.7835 to 1.7844 in
		EXHAUST	39.300 to 39.325 mm	1.5472 to 1.5482 in
CYLINDER HEAD MINIMUM ALLOWABLE HEIGHT AFTER FACING			124.85 to 125.15 mm	4.915 to 4.927 in
MAX FLATNESS ERROR OF HEAD LOWER PLANE			0.05 mm	0.0019 in
HEAD UPPER PLANE TILT			7°55' to 8°5'	

VALVE GUIDE

VALVE GUIDE OUTER DIAMETER	INTAKE	14.033 to 14.044 mm	0.5525 to 0.5529 in
	EXHAUST	14.048 to 14.059 mm	0.5531 to 0.5535 in
VALVE GUIDE INNER DIAMETER (AFTER REAMING)		9.000 to 9.015 mm	0.3543 to 0.3549 in
INTERFERENCE BETWEEN VALVE GUIDE AND SEAT	INTAKE	0.015 to 0.054 mm	0.0006 to 0.0021 in
	EXHAUST	0.030 to 0.069 mm	0.0011 to 0.0027 in

VALVE SEAT

VALVE SEAT OUTER DIAMETER	Normal	INTAKE	45.065 to 45.100 mm	1.7742 to 1.7756 in
		EXHAUST	39.065 to 39.100 mm	1.5380 to 1.5393 in
	Oversized	INTAKE	45.365 to 45.400 mm	1.7860 to 1.7874 in
		EXHAUST	39.365 to 39.400 mm	1.5498 to 1.5512 in
VALVE SEAT TAPER			90°±20'	
INTERFERENCE BETWEEN VALVE SEAT AND VALVE SEAT INSERT			0.040 to 0.100 mm	0.0016 to 0.0040 in
CYLINDER HEAD SHRINK-FIT TEMPERATURE FOR VALVE SEAT INSTALLATION			100°C - 212°F	

VALVE

VALVE STEM DIAMETER	INTAKE	8.972 to 8.987 mm	0.3532 to 0.3538 in
	EXHAUST	8.940 to 8.955 mm	0.3520 to 0.3525 in
VALVE HEAD DIAMETER	INTAKE	43.85 to 44.00 mm	1.7264 to 1.7322 in
	EXHAUST	38.50 to 38.70 mm (1)	1.5157 to 1.5236 in (1)

(1) For LIVIA type valves = 38.45 to 38.60 mm (1.514 to 1.519 in)

CLEARANCE BETWEEN VALVE STEM	INTAKE	0.013 to 0.043 mm	0.0005 to 0.0017 in

AND VALVE GUIDE	EXHAUST	0.045 to 0.075 mm	0.0018 to 0.0029 in

VALVE SPRING

FREE VALVE SPRING LENGTH (L1)	OUTER SPRING INNER SPRING	44.6 mm 44.1 mm	1.75 in 1.73 in
SPRING LENGTH WITH VALVE CLOSED (L2)	OUTER SPRING INNER SPRING	32.5 mm 30.5 mm	1.28 in 1.20 in
SPRING LENGTH WITH VALVE OPEN (L3)	OUTER SPRING INNER SPRING	23.5 mm 21.5 mm	0.92 in 0.84 in
LOAD CORRESPONDING TO LENGTH L2	OUTER SPRING INNER SPRING	243 to 252 N 126 to 130 N	(54.6 to 56.6 lbs) (28.3 to 29.2 lbs)
LOAD CORRESPONDING TO LENGTH L3	OUTER SPRING INNER SPRING	470 to 488 N 222 to 231 N	(105.6 to 109.7 lbs) (49.9 to 51.9 lbs)

VALVE CUP

VALVE CUP DIAMETER	INTAKE	34.973 to 34.989 mm	1.3769 to 1.3775 in
	EXHAUST	21.971 to 21.989 mm	0.8650 to 0.8657 in
RADIAL PLAY BETWEEN VALVE CUP AND HOUSING	INTAKE	0.011 to 0.052 mm	0.0004 to 0.0020 in
	EXHAUST	0.011 to 0.050 mm	0.0004 to 0.0020 in

CYLINDER HEAD BUSHINGS

BUSHING "A" INNER DIAMETER	19.000 to 19.021 mm	0.7480 to 0.7488 in
BUSHING "B" INNER DIAMETER	19.000 to 19.021 mm	0.7480 to 0.7488 in
BUSHING "C" INNER DIAMETER	32.000 to 32.025 mm	1.2598 to 1.2608 in

CAMSHAFT

CAMSHAFT JOURNAL DIAMETER	26.949 to 26.970 mm	1.0610 to 1.0618 in
CAMSHAFT SUPPORT DIAMETER	27.000 to 27.033 mm	1.0630 to 1.0643 in
MAX. ECCENTRICITY BETWEEN JOURNALS	0.03 mm	0.0012 in
CAMSHAFT SUPPORT SHOULDER WIDTH	26.851 to 26.940 mm	1.0571 to 1.0606 in

CAMSHAFT SHOULDER LENGTH	27.000 to 27.052 mm	1.0630 to 1.0650 in

RADIAL PLAY BETWEEN CAMSHAFT JOURNAL BEARING AND JOURNAL	0.030 to 0.084 mm	0.0012 to 0.0033 in
CAMSHAFT AXIAL PLAY	0.060 to 0.201 mm	0.0023 to 0.0079 in

ROCKER ARM

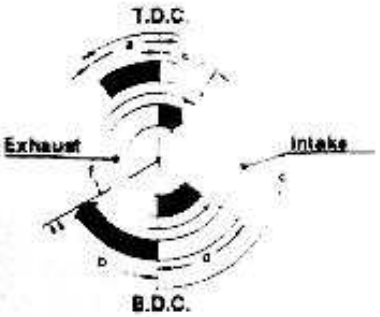
ROCKER ARMS SHAFT DIAMETER	15.988 to 16.000 mm	0.6294 to 0.6299 in
ROCKER ARM INNER BORE DIAMETER	16.016 to 16.034 mm	0.6305 to 0.6312 in
RADIAL PLAY BETWEEN VALVE CUP AND ROCKER ARMS SHAFT	0.016 to 0.046 mm	0.0006 to 0.0018 in

VALVES CLEARANCE

VALVES CLEARANCE (COLD ENGINE)	INTAKE EXHAUST	0.475 to 0.500 mm 0.225 to 0.250 mm	0.0187 to 0.0197 in 0.0088 to 0.0098 in
NOMINAL CAM HEIGHT	INTAKE EXHAUST	9.1 mm* 6.4 mm	0.36 in* 0.25 in
TIMING MARKS POSITION ANGULAR VALUE	R.H. HEAD	15°	
	L.H. HEAD	15°	

* 164S: 10.1 mm (0.40 in)

ANGULAR VALUES OF ACTUAL TIMING DIAGRAM
(Crankshaft cw Sense of Rotation When Viewed From Front Side)



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INTAKE	OPENING (BTDC)	(a)	32° 30'
	CLOSING (ABDC)	(b)	67° 30'
	INTAKE ANGULAR VALUE	(c)	280°
EXHAUST	OPENING (BBDC)	(d)	59° 55'
	CLOSING (ATDC)	(e)	33° 55'
	EXHAUST ANGULAR VALUE	(f)	263° 50'

164 S

INTAKE	OPENING (BTDC)	(a)	32° 50'
	CLOSING (ABDC)	(b)	73° 50'
	INTAKE ANGULAR VALUE	(c)	286° 40'
EXHAUST	OPENING (BBDC)	(d)	66° 55'
	CLOSING (ATDC)	(e)	29°55'
	EXAUST ANGULAR VALUE	(f)	276° 50'

FLUIDS AND LUBRICANTS

Application	Type	Name	Q.ty-Liters (Gals)
Engine oil	OIL	AGIP Nuovo Sint 2000 10W/40 SHELL Fire & Ice 10W/40	
- full capacity			7.5 (2)
- routine changes (pan and filter)			7 (1.9)
- filter			0.6 (0.16)
- cylinder head sumps			0.51 (0.14)
Cylinder head stud bolts			-
Intake and exhaust valves and cups			-
Camshaft journal bearings			-
Oil pump shaft			-
Distributor oil seal			-
Rear main journal cap seal sleeves	FLUID	MILLOIL compound for rubber channels	-
Oil pump drive shaft		UNION CARBIDE CHEMICALS Co.	-
Crankshaft oil seals		Ucon lubricant 50HB-5100	-
Rear cover			-
Rocker arm rods, rocker arms shaft, rocker arms			-
Hydraulic belt tightener pin	GREASE	ISECO MOLIKOTE BR2	-
Camshaft oil seals			-
Crankshaft oil seals			-
Spark plugs thread	OIL	ISECO MOLIKOTE A	-

SEALING AND LOCKING COMPOUNDS

Application	Type	Name	Q.ty-Liters (Gals)
Hydraulic belt tightener attachment stud	CEMENT	LOCTITE 270 (Green)	-
Flywheel attachment screws			-
Crankshaft oil plugs			-
Cylinder head cover gaskets (head side)	CEMENT	DIRING Heldite DOW CORNING Hermetic	-
Oil sump gasket			-
Min. engine oil pressure warning lamp sensor	CEMENT	Cement, class S-ME4	-

ABRASIVES

Application	Type	Name	Q.ty-Liters (Gals)
Valve seats grinding	GRINDING PASTE	SIPAL AREXONS Carbosilicium	-

TIGHTENING TORQUES

Engine block

Main bearing caps to engine block attaching nuts (1)	62 to 68.4 ft.lbs	84 to 92.7 Nm
Main bearing cap lock nuts (1)	14.8 to 18.5 ft.lbs	20 to 25 Nm
Flywheel to crankshaft attaching screws (with specified sealant)	84.4 ft.lbs	113 Nm
Crankshaft front pulley attaching nut (1)	173 ft.lbs	235 Nm
Rod cap screws (1)	39.4 to 43.5 ft.lbs	53.4 to 59 Nm
Coolant pump to engine block attaching screws	5.9 to 6.9 ft.lbs	8.1 to 9.3 Nm
Tightener pulley attaching screw	12.5 to 14.8 ft.lbs	17 to 20 Nm
Converter attaching screws (vehicles with automatic transmission only)	25.4 to 31.4 ft.lbs	34.4 to 42.5 Nm
Gearbox attaching screws (vehicles with automatic transmission only)	27 to 33.2 ft.lbs	36.6 to 45 Nm
Exhaust manifold attaching screws	18.8 ft.lbs	25.5 Nm
Front cover attaching screws	5.9 to 6.9 ft.lbs	8.1 to 9.3 Nm
Starter tightening	28.2 to 33.2 ft.lbs	38.2 to 45 Nm

Cylinder head

Camshaft bearing cap nuts (1)	11.8 to 13.2 ft.lbs	16 to 18 Nm
Camshaft front hub attaching nut	71.6 to 86.3 ft.lbs	97 to 117 Nm
Spark plugs tightening	18.4 to 25 ft.lbs	25 to 34 Nm
Oil pressure meter	7.4 to 8.8 ft.lbs	10 to 12 Nm
Oil level warning lamp sensor	18 ft.lbs	24 Nm
Distributor cap tightening	2.9 to 3.7 ft.lbs	4 to 5 Nm
Distributor attaching nuts	13.1 to 16.2 ft.lbs	17.8 to 22 Nm
Distributor arm tightening	1.8 to 2.2 ft.lbs	2.5 to 3 Nm
Rocker arm adjustment screw-nut tightening	10.9 to 13 ft.lbs	14.8 to 17.7 Nm
Oil pump drive pulley attaching screws	13.1 to 16.3 ft.lbs	17.9 to 22.1 Nm
Timing system cover attaching screws	6.6 to 8.1 ft.lbs	8.9 to 11 Nm

(1) Lubricate with engine oil

Cylinder head to engine block nuts tightening

Tightening Sequence	At reassembly torque gradually in sequence shown	65.3 to 72.2 ft.lbs	88.5 to 97.8 Nm
	After about 650 miles, with cold engine, loosen nuts for one turn in the sequence shown; smear with engine oil and torque in the sequence	72.2 to 79.8 ft.lbs	97.8 to 108.2 Nm

shown

SPECIAL TOOLS

Tool Number	Description
1.820.004.000	Cylinder liners locking tool (2 pieces)
1.820.007.000	Flywheel locking tool (bench maintenance)
1.820.011.000	Valves support tool
1.820.012.000	Cylinder head support tool base
1.820.049.000	Valve support tool special nut
1.820.050.000	Cylinder head support fork
1.820.051.000	Camshaft pulley and auxiliary units rotation tool
1.820.052.000	Cylinder liners stop tool
1.820.053.000	Hydraulic tightener stop pin
1.820.056.000	Camshaft oil hole plugs staking tool
1.820.200.000	Transmission lifting
1.820.202.000	Protective cover
1.820.115.000	Guide tool for reaming of oil pump shaft seating (with 19 mm reamer)
1.820.150.000	Valve clearance adjustment cups container
1.821.002.000	Rear main journal rubber discs inserting tool
1.821.005.000	Valve guide puller
1.821.006.001	Rear main bearing cap removal lever
1.821.006.002	Rear main bearing cap removal fork
1.821.010.000	Rear crankshaft oil seal insertion tool
1.821.016.000	Valve guide cap inserting tool
1.821.018.000	Valve guide cap puller
1.821.058.000	Valve removal/assembly lever
1.821.122.000	Valve removal/assembly cage
1.821.123.000	Camshaft pulley puller
1.821.124.000	Valve removal/assembly support
1.821.125.000	Crankshaft front oil seal inserting tool
1.821.126.000	Camshaft and auxiliary units drive front oil seal inserting tool
1.821.127.000	Intake valve guide inserting tool
1.821.128.000	Exhaust valve guide inserting tool
1.821.129.000	Camshaft bushings removal/installation tool
1.821.174.000	Upper engine mount bracket elastic bushing replacement tool
1.822.016.000	3mm (0.118 in) wrench, exhaust timing system adjustment
1.825.003.000	Cylinder liner and pistons protrusion from engine block check tool
1.825.013.000	T.D.C. Check tool
1.825.018.000	Valve clearance check curvic feeler gauge
1.827.002.000	Valve cups check comparator

TROUBLESHOOTING PROCEDURE: ENGINE - LUBRICATION

TROUBLES AND SYMPTOMS	FAULT ISOLATION	TEST REFERENCE
OIL LEAKS	Visual detection of oil leaks causing dropping, stains, soiling of engine.	A
LOSS OF OIL PRESSURE	Pressure gauge on instrument panel indicates decrease (sudden or gradual) of engine oil pressure: at very low pressure the relevant warning lamp illuminates. **NOTE**: It is advisable to ascertain first that pressure gauge on instrument panel, pressure meter and min. pressure sensor are operational checking the actual engine oil pressure with a pressure gauge - refer to **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS Book - INSTRUMENT PANEL.**	B
EXCESSIVE OIL CONSUMPTION **NOTE**: A high consumption of oil during the **first 5000 miles** must not be considered abnormal, since due to settling of the engine.	Oil consumption noticeably increases with respect to stated values and those noted during life of vehicle.	C

WARNING:

- **Engine oil is harmful for your skin: reduce to minimum the contact or permanence of stains or drops of oil on your skin: wash out oil with soap and water.**
- **Do not disperse exhausted oil! Investigate where exhausted oil is collected in your area.**

OIL LEAKS	TEST A

TEST STEPS	RESULTS	REMEDY
FOREWORD: It is absolutely necessary to identify exactly the engine component or area causing the leak. If cause can not be identified visually, it is suggested to wash the engine with water, dry it, then start it with vehicle standing, or perform a short test run, and wait that leaks become evident. Subsequently, act on affected component reserving to check the other components in a subsequent phase.		
A1 DRAIN PLUG CHECK - Check drain plug for correct torque and absence of damage	OK ▶ ~~OK~~ ▶	Carry-out **step A2** Torque or replace plug, as necessary
A2 OIL SUMP CHECK - Check: • oil sump for damages, distortions or micro-cracks • sealing of gasket between sump and engine block • sump attaching screws for proper torque	OK ▶ ~~OK~~ ▶	Carry-out **step A3** Replace sump or gasket, if necessary. Torque sump screws to prescribed value.
A3 OIL FILTER CHECK - Check for absence of leaks in the oil filter area; verify tightness of seal	OK ▶ ~~OK~~ ▶	Carry-out **step A4** Replace seal and torque filter properly

(Cont.d)

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OIL LEAKS	TEST A

TEST STEPS	RESULTS	REMEDY
A4 OIL SEALS CHECK - Remove covers and gain access to crankshaft and camshafts oil seals: check for absence of leaks in those areas. Refer to **Group 01 - ENGINE DISASSEMBLY AND REASSEMBLY** for further details	OK ▶ ~~OK~~ ▶	Carry-out **step A5** Replace affected oil seals
A5 HYDRAULIC BELT TIGHTENER CHECK - Check for absence of leaks from the hydraulic belt tightener	OK ▶ ~~OK~~ ▶	Carry-out **step A6** Replace hydraulic belt tightener or oil seal
A6 MISCELLANEOUS COMPONENTS CHECK - Check for absence of leaks from any other component not listed in the previous test steps; correct fault in analogy to remedies indicated above	~~OK~~ ▶	Replace affected components

End of test A

LOSS OF OIL PRESSURE	TEST B

TEST STEPS	RESULTS	REMEDY
B1 OIL LEVEL CHECK		
- Check with the dipstick that level of engine oil is correct	OK ▶	Carry-out step B2
	~~OK~~ ▶	Top-up oil level
B2 OIL AND FILTER GRADES CHECK		
- Check that: • engine oil is of the prescribed type (**SAE 10 W/40**) • engine oil filter is of the prescribed type, and properly installed AGIP NUOVO SINT 2000 10 W/40 SHELL FIRE & ICE MOTOR OIL 10 W/40 Total capacity 2 Gals (7.5 l.) Oil change 1.9 Gals (7.0 l.) Filter 0.15 Gals (0.6 l.)	OK ▶	Carry-out step B3
	~~OK~~ ▶	Service with prescribed oil to proper level. Replace filter if necessary
B3 OIL PUMP CHECK		
- Check oil pump for traces of binding or overheating of all its components. Furthermore, perform check of dimensions and clearances. Refer to **Group 01 - OIL PUMP CHECKS AND INSPECTIONS**	OK ▶	Carry-out step B4
	~~OK~~ ▶	Replace defective items

(Cont.d)

LOSS OF OIL PRESSURE	TEST B

TEST STEPS		RESULTS	REMEDY
B4	PRESSURE RELIEF VALVE CHECK		
- Check: • pressure relief valve for proper seal, integrity and cleanliness • valve spring for yielding or breakage		OK ▶ ~~OK~~ ▶	Carry-out step B5 Replace defective components
B5	OIL PASSAGES CHECK		
In case of **complete engine overhaul** only: - Verify oil passages in engine block and cylinder heads for obstruction caused by oil residues or foreign matter - Check plugs on crankshaft for sealing and integrity. Also refer to **Group 01 - ENGINE DISASSEMBLY AND REASSEMBLY - CLEANING OF LUBRICATION GROOVES**		~~OK~~ ▶	Thoroughly clean affected items; replace if necessary

End of test B

EXCESSIVE OIL CONSUMPTION	TEST C

TEST STEPS	RESULTS	REMEDY
FOREWORD: Check that excessive oil consumption is not caused by leakage. Refer to **Test A**.		
C1 SEEPAGE TROUGH VALVES CHECK - Remove cylinder heads and check for absence of traces of oil in the combustion chambers. In this event check: • dimensions and clearances between valve stem and relevant valve guide, and between valve guide and valve guide seats in cylinder head; • seal pad located above the valves for integrity; • valve stem for traces of binding or scoring	OK ▶ ~~OK~~ ▶	Carry-out step C2 Replace defective items
C2 SEEPAGE THROUGH PISTON RINGS CHECK - Check for seepage through piston rings. In this event check piston rings for: • breakage or damages; • proper installation (TOP mark faced upwards); • proper distribution of gap along circumference (gaps located at three different angles). • binding into their seating or excessive wear	OK ▶ ~~OK~~ ▶	Carry-out step C3 Replace defective piston rings
C3 CYLINDER LINERS CHECK - Check: • roughness of cylinder liners (excessive wear could cause an excessively smooth surface) • principal dimensions are within limits. Refer to **Group 01 - ENGINE DISASSEMBLY AND REASSEMBLY - CYLINDER LINERS**	~~OK~~ ▶	Replace affected cylinder liners if necessary

End of test C

TROUBLESHOOTING PROCEDURE: ENGINE - NOISY OPERATION

FOREWORD:

Ascertain noises are really caused by the engine, and not by other components as:

- Coolant pump.
- Alternator.
- Power steering pump.
- Air conditioning compressor.
- Hydraulic belt tightener.

Note if noise is mainly present when engine is cold or in normal operating range, when engine is at idle speed, or if noise increase as engine revs increase.

Noise is produced by the engine if:

- Noise is present when vehicle is standing, and during run.
- Noise is present when clutch is engaged and disengaged.

TROUBLES AND SYMPTOMS	FAULT ISOLATION	TEST REFERENCE
BEAT WHEN ENGINE IS AT IDLE	More or less constant noise is present when engine is at idle, in normal operating temperature; noise comes from the timing system covers area	A
BEAT WITH COLD ENGINE	Continuous beat more or less intense, coming from one or more cylinders NOTE: **Beat disappears when engine is at normal operating temperature.** The affected cylinder can be easily identified disconnecting one spark plug at a time	B
INTENSE AND INCONSTANT BEAT	Very intense beat that can be heard during clutch engagement and disengagement, and during sudden accelerations	C

TROUBLESHOOTING PROCEDURE: ENGINE - NOISY OPERATION

TROUBLES AND SYMPTOMS	FAULT ISOLATION	TEST REFERENCE
BACKGROUND BEAT (DUE TO CRANKING)	Background beat that can be heard when engine is under load, or noise coming from rods-crankshaft and pistons - cylinder liners coupling	**D**

NOTE: Prior to perform the tests indicated in the following, **check oil level, and grade of oil and oil filter.** If necessary, change engine oil and filter using prescribed quantities and grades.

BEAT WHEN ENGINE IS AT IDLE	TEST A

TEST STEPS	RESULTS	REMEDY
A1 VALVES CLEARANCE CHECK - Check clearance between cams heel radius and top of valve cup is within prescribed limits	OK ▶ ~~OK~~ ▶	Carry-out **step A2** Adjust clearance
A2 CAMS AND CUPS VISUAL CHECK - Visually check cuspid of cams and top of cups for absence of wear, scoring, binding, etc.	OK ▶ ~~OK~~ ▶	Carry-out **step A3** Replace defective items
A3 AXIAL PLAY CHECK - Check camshaft axial play is within prescribed limits	OK ▶ ~~OK~~ ▶	Carry-out **step A4** Replace affected camshaft
A4 CUPS AND HOUSINGS CHECK - Check outer diameter of cups and diameter of relevant housings; also check for absence of scoring, binding, etc.	~~OK~~ ▶	Replace affected cups, and/or relevant cylinder head

End of test A

BEAT WITH COLD ENGINE	TEST B

TEST STEPS		RESULTS	REMEDY
B1	PISTON-CYLINDER LINER COUPLING CHECK		
- Check clearance between cylinder liner and piston is within prescribed limits		OK ▶	Carry-out step B2
		~~OK~~ ▶	Replace affected cylinder liner and piston
B2	GUDGEON PIN CHECK		
- Check clearances between piston hole and gudgeon pin, and between rod small end bushing hole and gudgeon pin are within prescribed limits		~~OK~~ ▶	Replace affected items

End of test B

INTENSE AND INCONSTANT BEAT	TEST C

TEST STEPS	RESULTS	REMEDY
C1 CRANKSHAFT PULLEY ATTACHMENT CHECK - Check that nut securing cranks haft pulley is not loosen Tightening torque: 173 ft lbs (235 Nm)	OK ▶ ~~OK~~ ▶	Carry-out step C2 Torque nut to prescribed torque, or replace nut, if defective
C2 FLYWHEEL ATTACHMENT CHECK - Check that screws securing flywheel to crankshaft are not loosen Tightening torque: 84.4 ft lbs (113 Nm)	~~OK~~ ▶	Torque screws to prescribed torque, or replace screws if damaged. Use locking compound LOCTITE 270

End of test C

BACKGROUND BEAT (DUE TO CRANKING)	TEST D

TEST STEPS	RESULTS	REMEDY
D1 MAIN AND ROD BEARING CASTING CHECK		
- Check : • main and rod bearings for absence of traces of overheating, flaking, etc. • crankshaft journals for absence of damages	OK ▶ ~~OK~~ ▶	Carry-out **step D2** Replace crankshaft. Wash engine block lubricating system and overhaul or replace oil pump, if necessary
D2 CONNECTING ROD AND BACKGROUND BEAT CHECK		
Check: • clearances between rod big end anc crankshaft, and between crankshaft journals and relevant bearings • tightening torques of main bearings and rod big end are within prescribed limits	OK ▶ ~~OK~~ ▶	Carry-out **step D3** Replace crankshaft and/or affected rod. Torque to prescribed value
D3 CRANKSHAFT BEAT CHECK		
Check crankshaft axial play is within prescribed limits	OK ▶ ~~OK~~ ▶	Carry-out **step D4** Replace thrust half rings

(Cont.d)

BACKGROUND BEAT (DUE TO CRANKING)	TEST D

TEST STEPS		RESULTS	REMEDY
D4	PISTON BINDING BEAT CHECK		
- Visually check mating surfaces of cylinder liners and pistons for absence of overheating, binding, scoring etc., and that piston rings move free into relevant grooves on piston		OK ▶	Carry-out step B
		OK ▶	Replace cylinder liner and piston of affected cylinder

End of test D

IMPORTANT NOTE:

For any other trouble that hampers proper operation of engine **REFER TO TROUBLESHOOTING included in Group 04.**

For example:

- engine does not start
- engine stumbles
- irregular engine idle speed
- excessive fuel consumption
- excessive CO percentage
- Etc...

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GROUP 05

ENGINE ELECTRICAL UNITS

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GROUP 05

ENGINE ELECTRICAL UNITS

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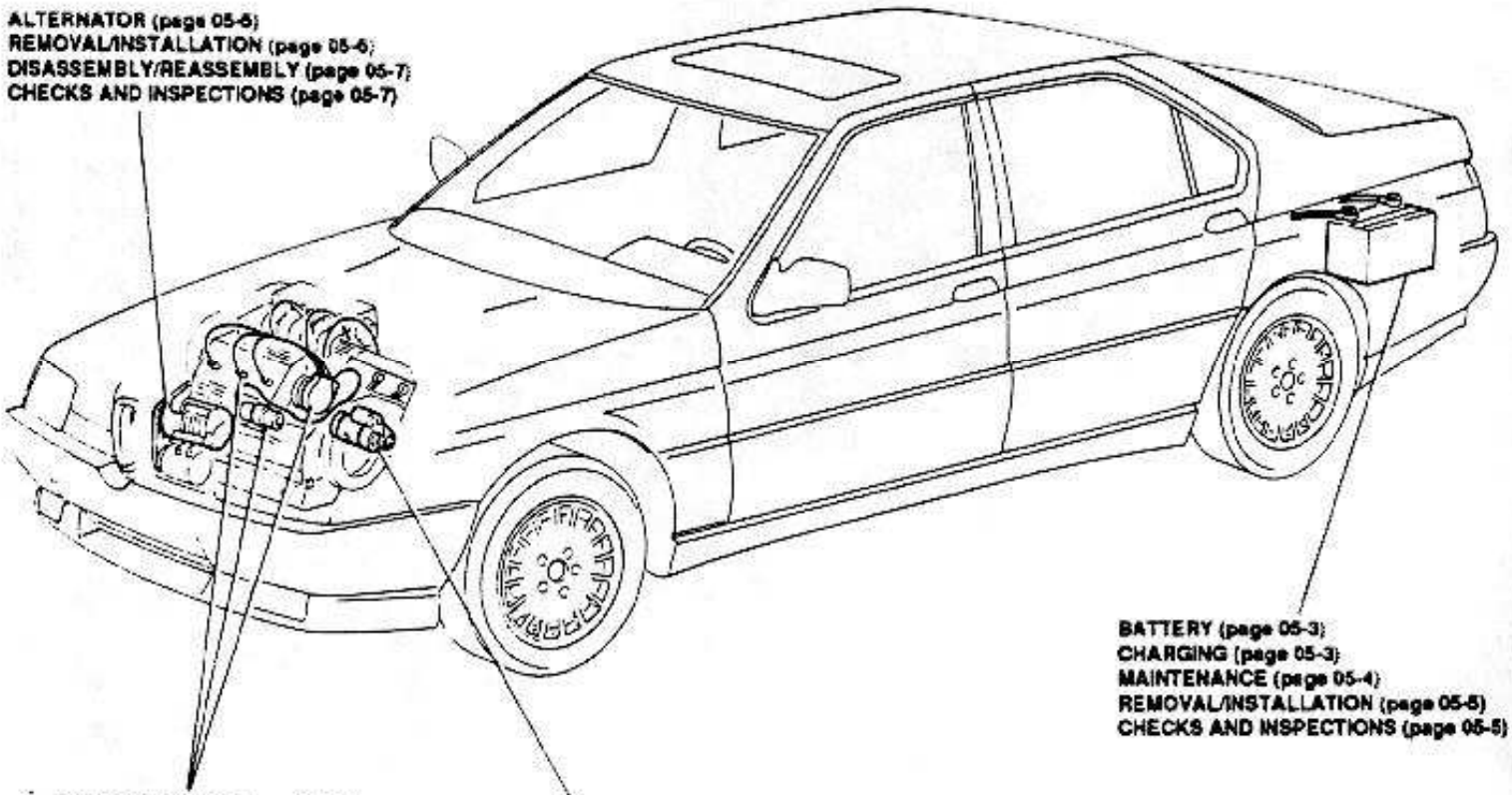

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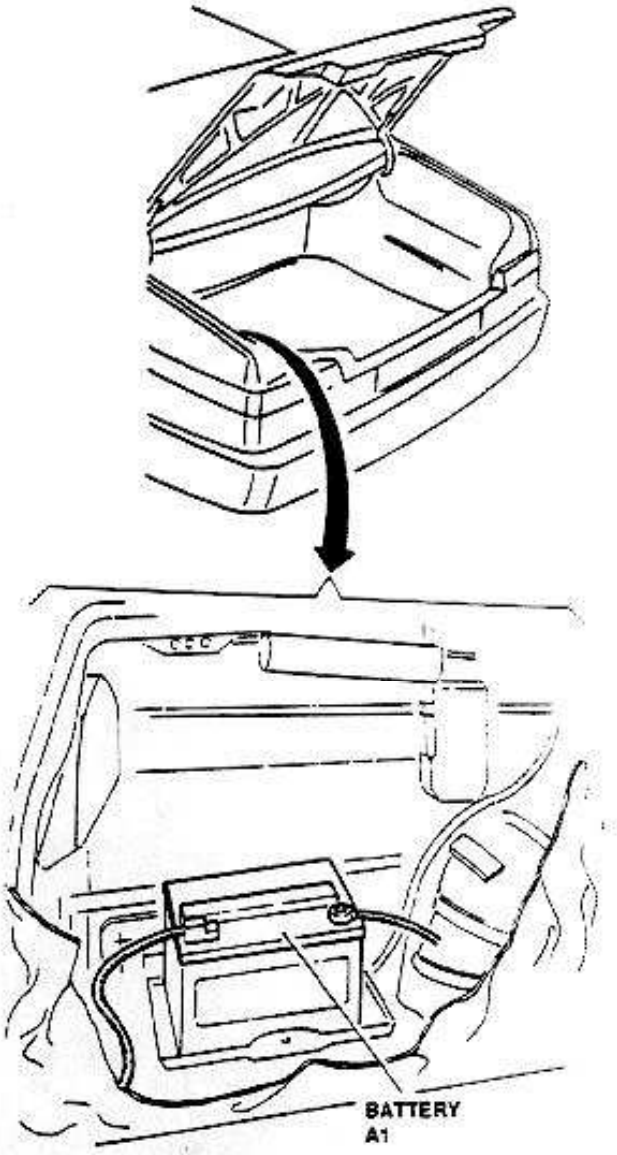
BATTERY

The battery is located in the left side of trunk.

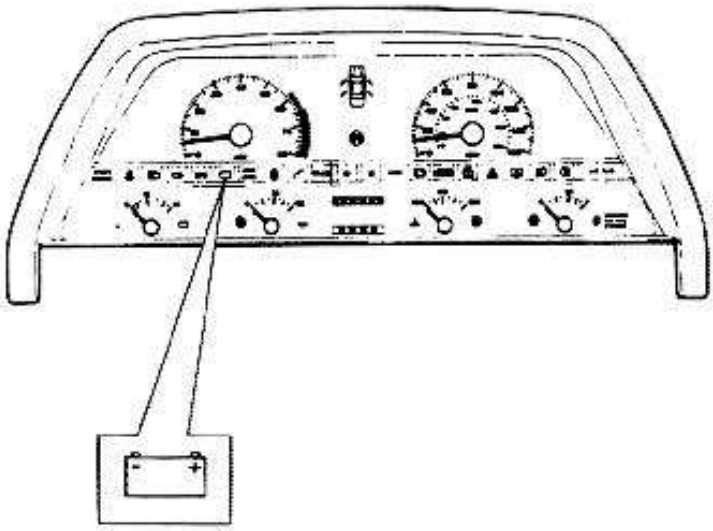


The battery has been designed according to criteria enabling the engine to be started in the shortest possible time. To this purpose, a high torque and a fixed minimum RPM are required. The above requirements are guaranteed by the optimal sizing of the six battery cells, each one supplying a voltage of about 2V (total voltage 12V).
The battery is of the maintenance-free type; it is substantially identical to conventional batteries, it maintains its charge for a remarkably longer time, and contains diluted solphoric acid. For this reason it is necessary to maintain the battery in an upright position even when not installed charging phase is reduced to minimum.
Due to the reduced volume of generated gas, the absence of corrosion and improved electric contact of terminals is assured.
The advantages of a maintenance-free battery are:

- Maximum reduction of water consumption due to the new type of alloy used for the manufacturing of the grids and plates, and therefore periodic servicing is not required.
- Optimum starting capability due to the highly reduced self-discharging, up to a seven month period, and therefore suitable for long storage (at temperatures below 28°C (82.4°F)).

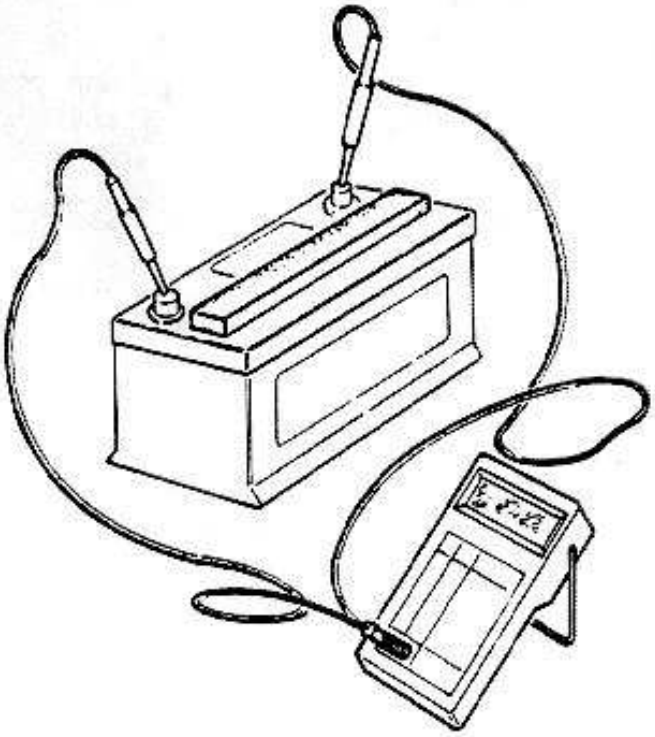
CHARGING

When the vehicle is running, the alternator recharges the battery; whenever the charging is insufficient or the connection between the alternator and the battery is interrupted, the malfunction is indicated by the illumination of a warning lamp on the instrument panel.



In case of a presumed discharged battery, check the

on the vehicle. The battery case is provided with small breathing holes since the formation of gas during the battery charge measuring the loadless voltage at battery terminals using a voltmeter.



If the voltage is lower than 12.30V the battery is charged to 50%; if the voltage reaches 12.48V the charge is at 75%; the battery is fully charged when the voltage reaches 12.66V.

CAUTION:
If the level of the electrolyte in one or more cells is below the minimum level mark engraved on the battery plastic case, carefully remove the cover of filling caps row, and add distilled and deionized water as normally done on traditional batteries.

NOTE: **You are absolutely advised against quick battery charging with voltage above 15.5V and high current rate. For the charging, use a normal 12V charging equipment and connect positive pole (red) to (+) pole of the battery, and negative pole (black) to (-) pole of the battery. In case of temporary jumping to an auxiliary battery, always connect positive pole to positive pole, and negative**

CAUTION:
- **Never disconnect or connect the battery to the vehicle's electrical system when the engine is operating.**
- **Do not reverse the polarity of connecting cables (even for few instants) to prevent damaging of alternator rectifier.**
- **During charging operations, always connect first the charging equipment cables to the battery, then switch on the equipment.**
- **If the conditions require to start the engine using jumper cables and an auxiliary battery, the voltage of the auxiliary battery must not exceed 12V.**
- **Disconnect negative pole (-) terminal from the battery before charging.**
- **During charging, check that the electrolyte temperature does not exceed 45°C (113°F).**

WARNING:
- **Never touch with your hands the negative and positive poles of the battery simultaneously.**
- **During charging, never approach open flames to the battery.**

In case the battery is replaced,it is suggested to observe the prescribed operating specifications. If the current capacity of the replacement battery is higher than that of the battery being replaced, a higher output voltage could cause the melting of starter rotor winding, or damages to pinion or crown gear.

MAINTENANCE

The battery capability of starting the engine depends on the condition of its charge; it is therefore necessary to perform regular checks and maintenance, particularly

pole to negative pole.

during the cold season, due to the higher load applied to

the starter and to the reduced capacity of the battery when subject to low temperatures.
Carefully clean the battery case, terminals and cable terminals with a solution of water and sodium bicarbonate. Coat terminals with grease before re-connection.

CAUTION:
Avoid entry of cleaning solution inside the battery to prevent chemical reactions with the electrolyte.

WARNING:
The electrolyte is an acid, and is therefore harmful for your eyes, hands and cloths.

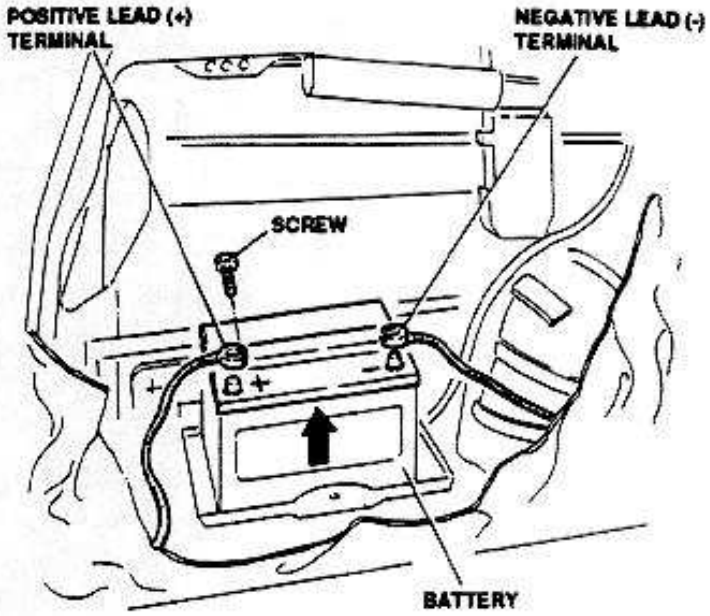
NOTE: **The batteries, when stored or left unused on the vehicle for prolonged time are subject to a low self-discharge. It is therefore necessary to re-charge the batteries before their use.**

REMOVAL/INSTALLATION

1. Remove the screw securing the lead terminals to battery terminals; disconnect negative (-) lead first, then positive (+) lead.

CAUTION:
When disconnecting the leads from the battery, ensure the engine is not running. On the opposite, serious damage to the alternator will occur.

2. Remove the battery, paying attention to maintain it in upright position.
3. Perform installation in reverse order, and clean and



CHECKS AND INSPECTIONS

Check the battery case for absence of cracks; checks that level of the electrolyte is about 5 mm (0.2 in) above the upper surface of electrodes. Check the battery top surface for cleanliness, and the terminals for absence of oxidation.
Furthermore, ensure the lead terminals are properly secured to battery terminals to provide a positive electric contact.

TROUBLESHOOTING

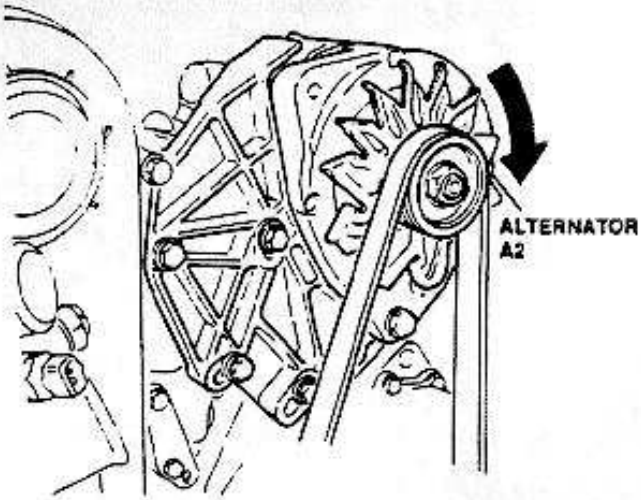
A detailed troubleshooting of battery failures and malfunctions is included in the **"WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS" Book - MOTRONIC ON BOARD DIAGNOSIS (TEST A).**

ALTERNATOR

When the engine is operating, the alternator supplies electrical power to the vehicle's monitoring systems (electronic ignition and injection, ABS, air conditioning etc.) and to the various accessories which can be activated in any moment. In addition, the alternator charges

grease the leads and battery terminals with suitable products (RENACH E10 TAC).

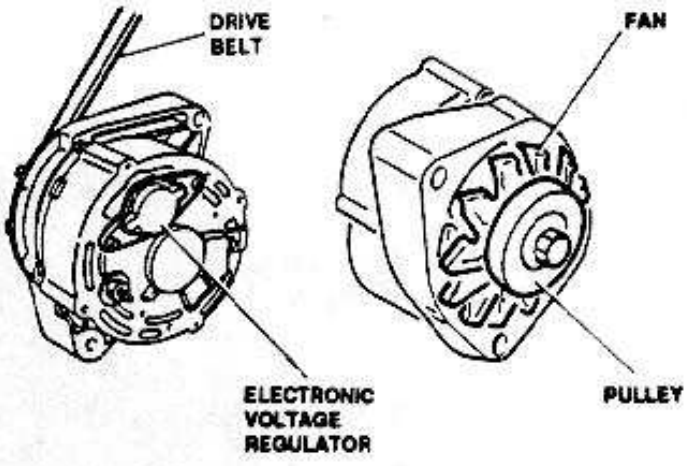
the battery that is the only electric power source of the vehicle when the engine is not operating.



The electric power is produced by a rotor that "cuts" the magnetic field generated by a stator winding. The rotor is fixed to a pulley directly connected to the engine crankshaft by means of a belt. Brushes supply the excitation current to the rotor. The alternated voltage generated by the alternator is rectified by diodes and by the voltage regulator located on the alternator body.

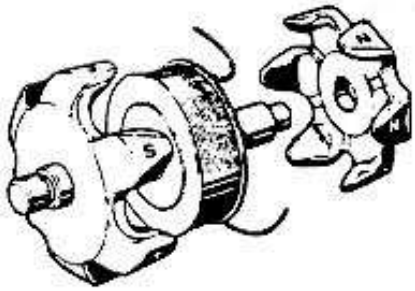
The electronic voltage regulator, not subject to wear and of reduced overall dimensions, supplies a constant voltage at any engine operating range, even with the widest changes of load and range.

A cooling fan rotates together with the drive pulley and prevents reaching of alternator temperatures that could affect its proper operation.



The alternator used on the 164 is of the clawn poles and commutator rings type, very compact and of reduced weight.

Attachment of the alternator to the engine is by means of a swinging bracket, thus allowing easy tensioning of the

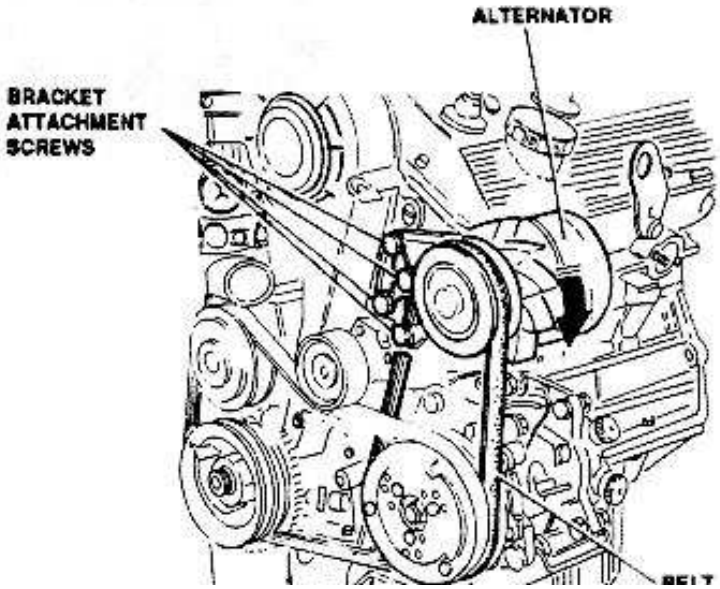


CAUTION:
Proper cooling of the alternator is ensured if the fan rotates in the proper direction. CORRECT ALTERNATOR SENSE OF ROTATION: CLOCKWISE (LOOKING FROM PULLEY SIDE).

REMOVAL/INSTALLATION

1. Disconnect battery (-) lead.
2. Remove right front headlamp unit (refer to **Group 40**).
3. Disconnect alternator cables.
4. Loosen the screws securing the alternator bracket and remove drive belt from the pulley.
5. Remove the alternator.

At installation, tighten the drive belt as indicated in **Group 00.**

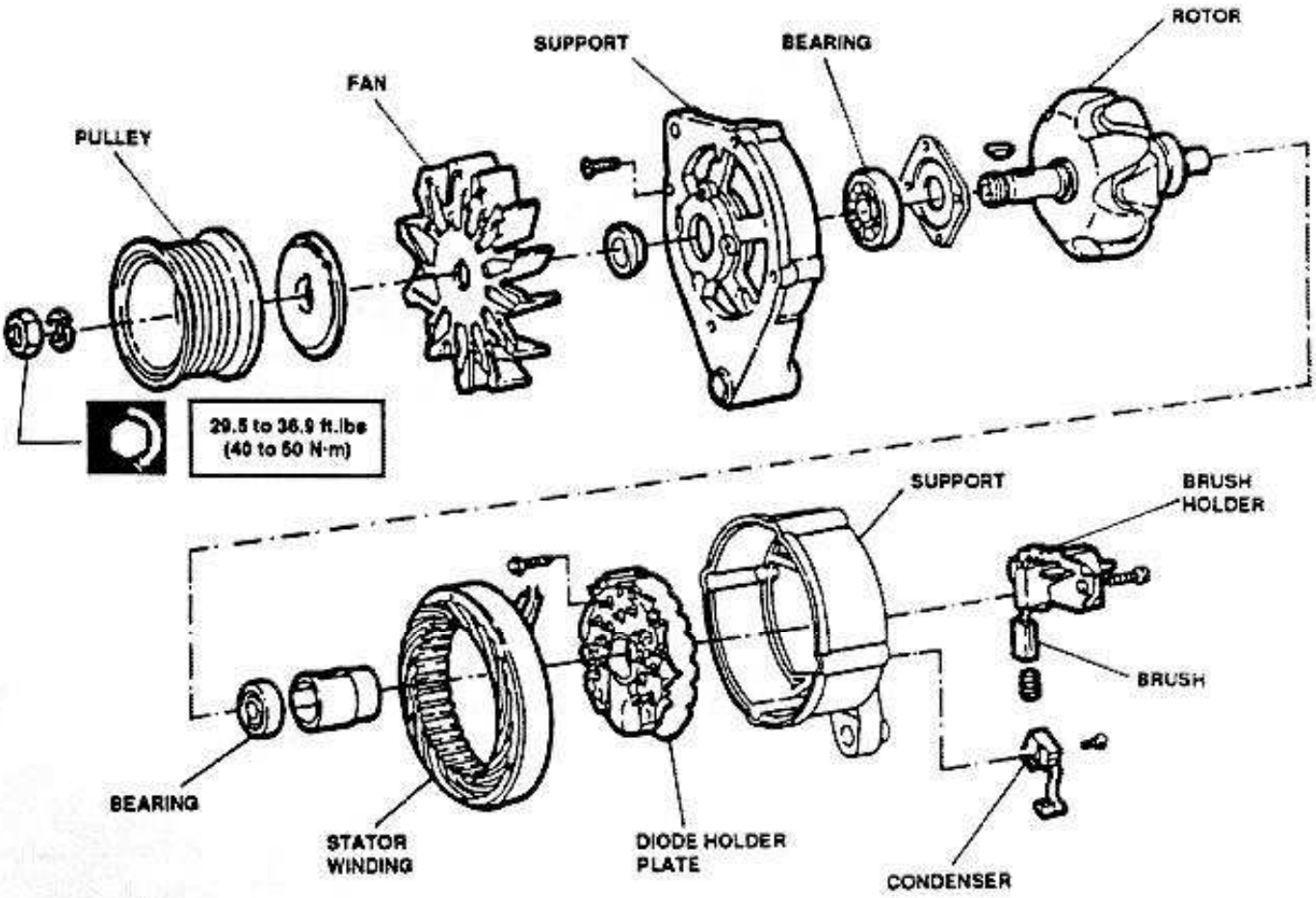


drive belt (refer to **Group 00**).

DISASSEMBLY/REASSEMBLY

Disassembly the alternator into its components.

NOTE: Do not unsolder parts unless necessary for parts replacement.



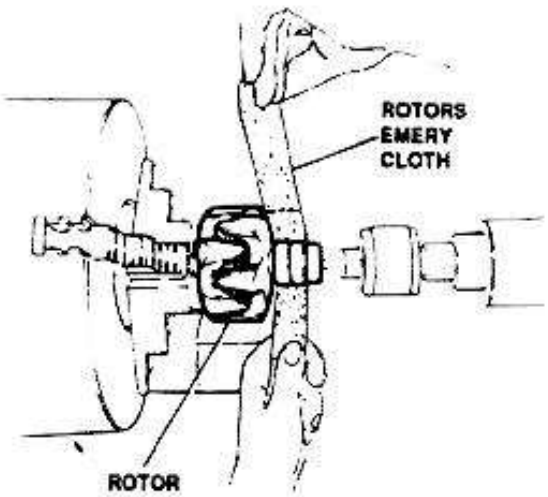
CHECKS AND INSPECTIONS

NOTE: Before proceeding to electrical checks, thoroughly clean the affected parts with compressed air.

Bearings: check for absence of wear or damages; replace parts if above defects are found.

Commutator rings: check for wear:

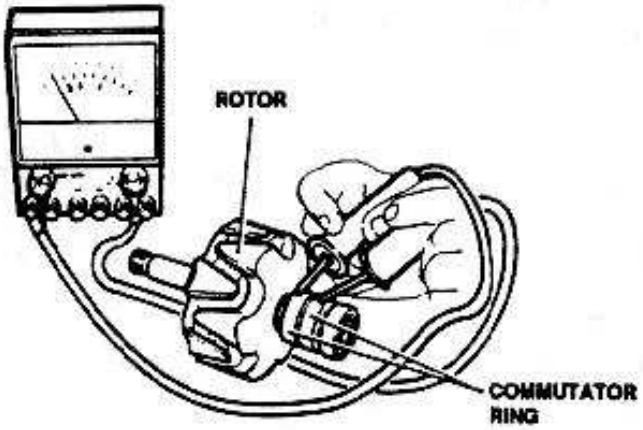
- Minor scoring can be lathe-removed using emery



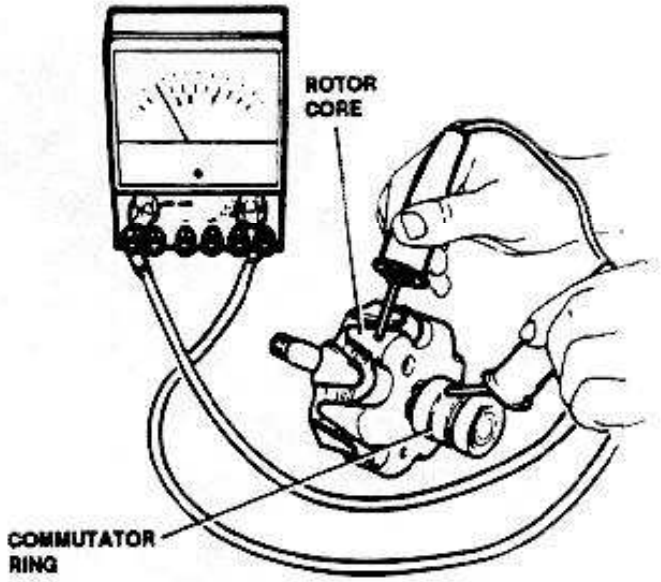
cloth suitable for commutator rings.

- Deeper scoring requires replacement of rotor.

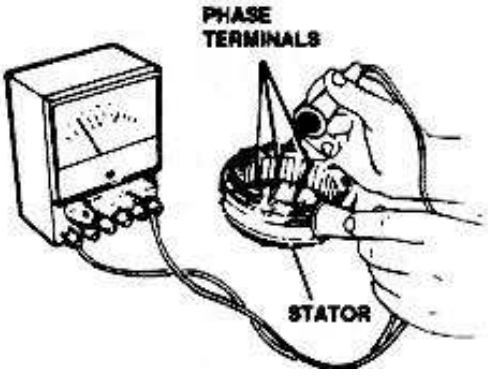
Rotor electric continuity check: check with an ohmmeter for continuity between commutator rings.



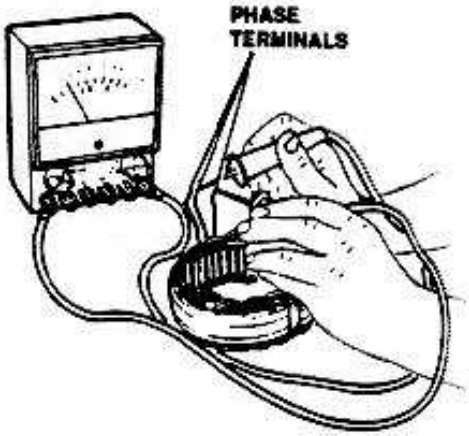
Rotor insulation check: using an ohmmeter, check that the electric resistance between one commutator ring and rotor core is infinite (insulation). Replace rotor if required insulation is not met.



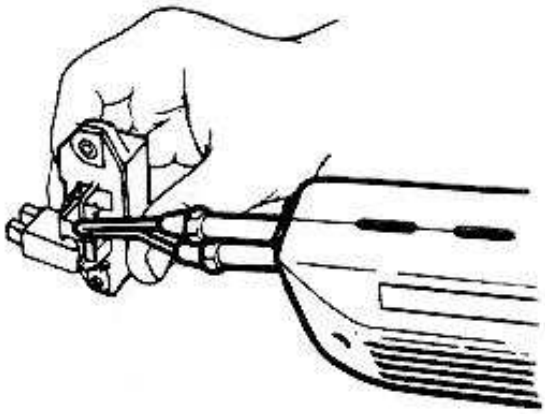
Stator insulation check: using an ohmmeter, check that the electric resistance between the stator pack and phase terminals is infinite (insulation). Replace rotor if insulation is insufficient.



Stator electric continuity check: using an ohmmeter, check for continuity between the various stator phases: 1-2, 1-3, 2-3.
Replace stator if required continuity is not found.



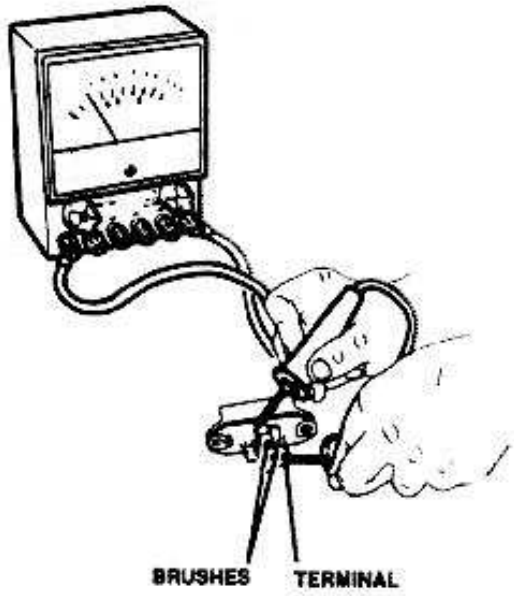
Brushes check: check alternator brushes for absence of chipping and carbon deposits.
Replace brushes, if excessively worn, by unsoldering as depicted in the illustration below.



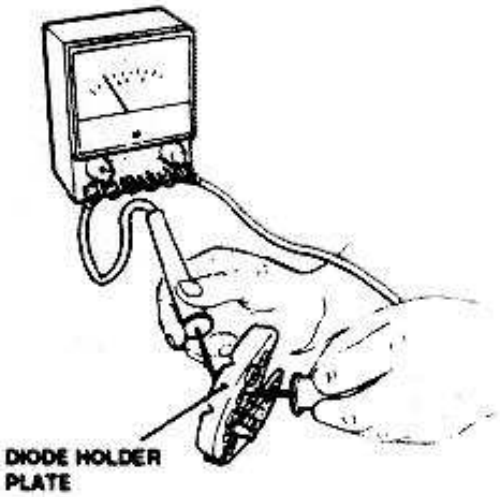
CAUTION:
Reduce to minimum the duration of unsoldering to prevent overheating of diodes.

Brush holder electric continuity check: using an ohmmeter, check for continuity between the brushes and the terminals. In case of lack of continuity, check brush seating and, if necessary, replace the brushes and/or the

brush holder.



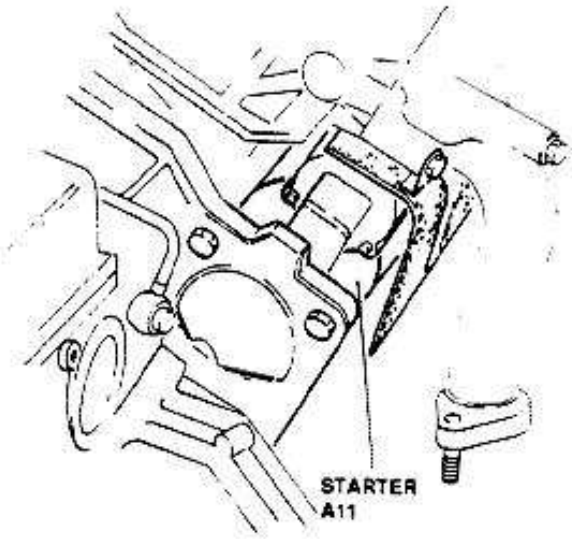
Diodes check: using an ohmmeter, check diodes for continuity in one sense, and insulation in opposite sense (reverse terminals). Replace diode holder plate if proper operation is not found.



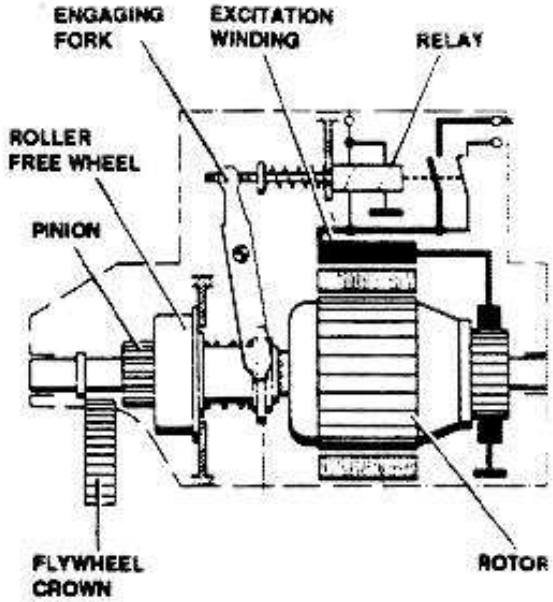
STARTER

The starter cranks the engine, overcoming the inertia and friction forces, and brings it to a rotating range such as to start the formation of the air-fuel mixture necessary to start the combustion and subsequent self-operation of the engine.

The movement is transmitted by a direct current electric



A freewheel disengages the pinion when the crankshaft revolutions exceed the starter revolutions (overrunning). A relay excited by starter current engages the pinion by means of a fork.

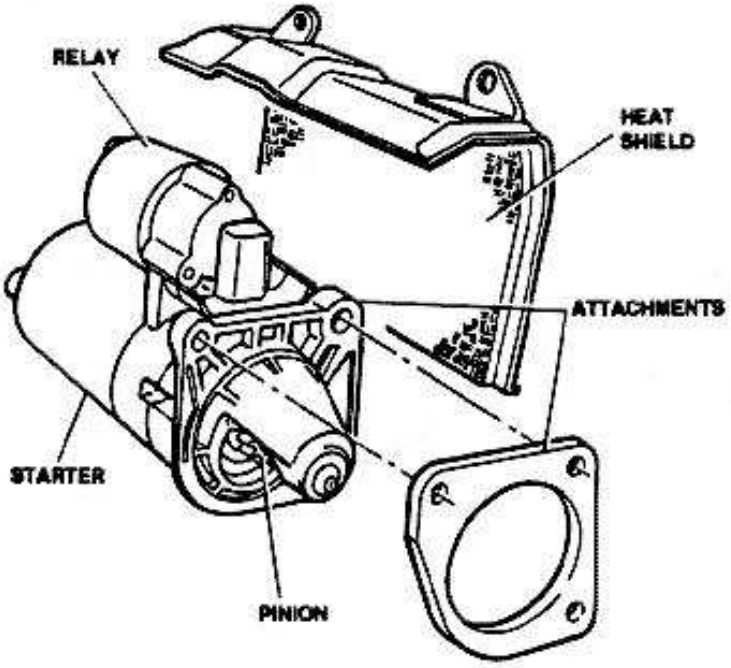


The starter used on the 164 is of the translating and screwing pinion type, with the relay located directly above the starter.

The starter is attached to the engine by means of brack-

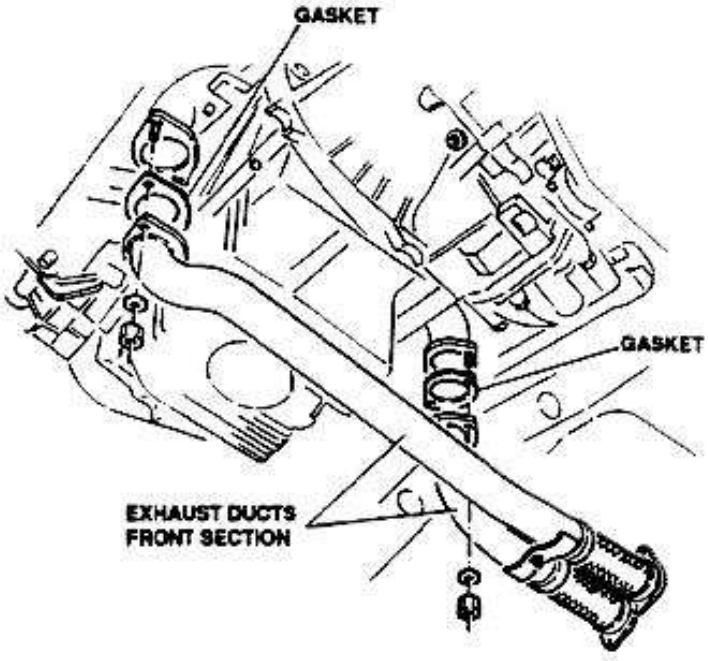
motor, powered by the battery, through a drive pinion that engages the teeth of the flywheel crown.

ets. A heat shield protects the starter from excessive heating.

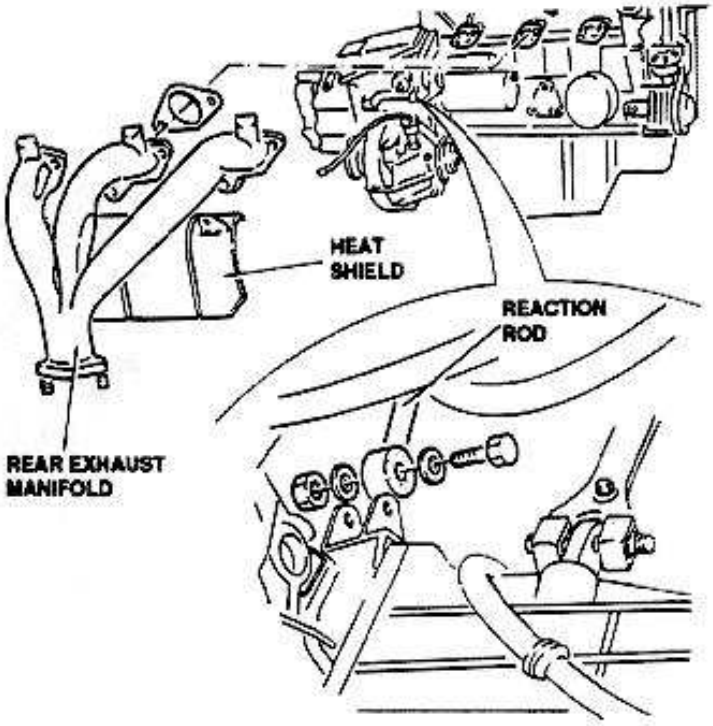


REMOVAL /INSTALLATION

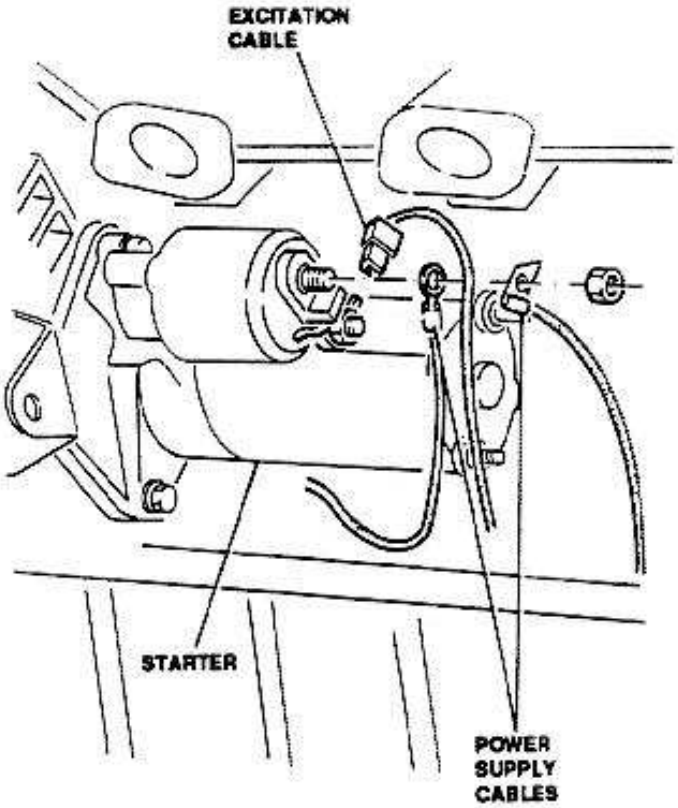
1. Disconnect battery (-) lead.
2. Remove front section of exhaust ducts and relevant gaskets.



3. Remove the rear exhaust manifold and relevant gaskets.
4. Remove the starter heat shield.
5. **On vehicles equipped with automatic transmis-**



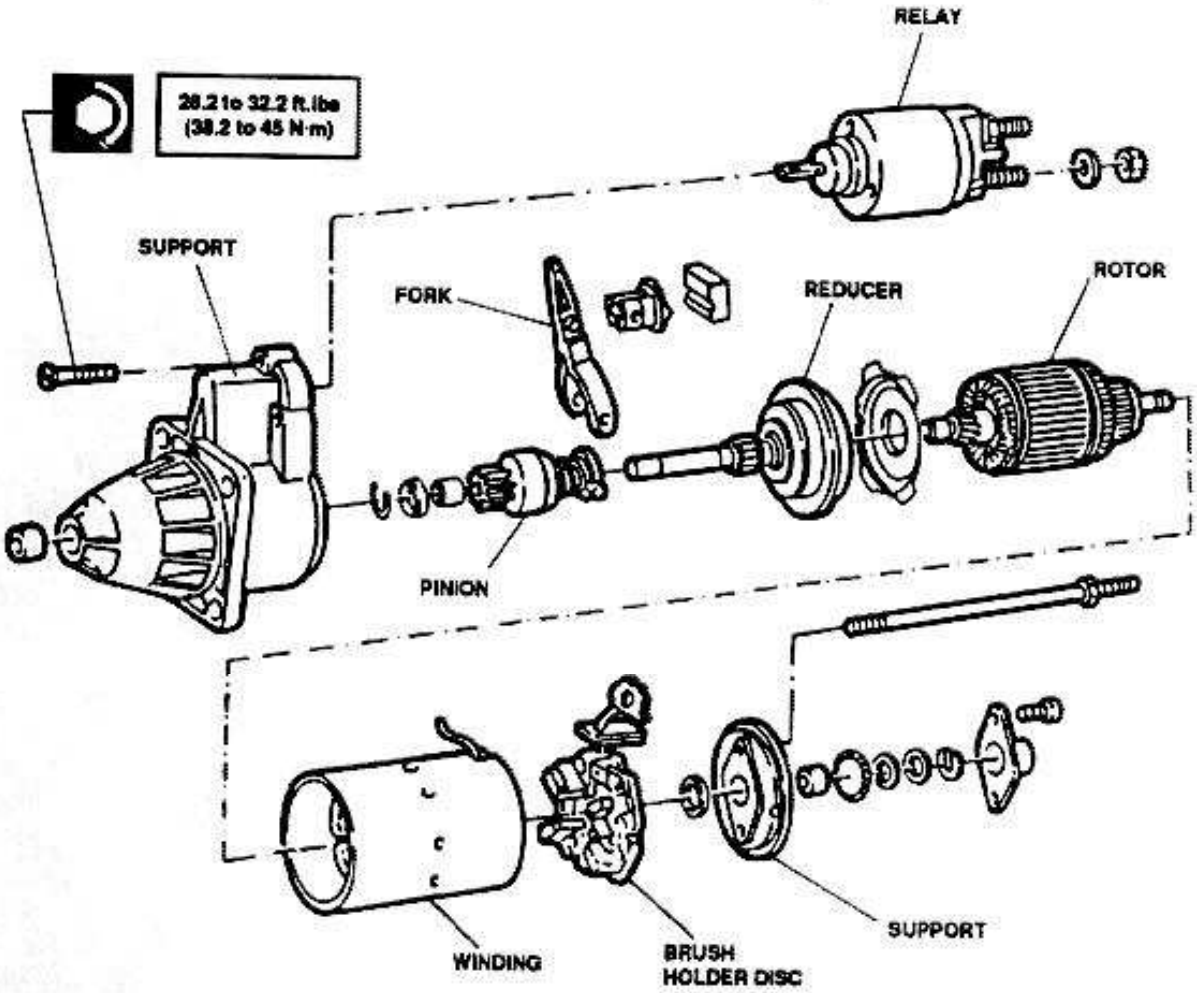
6. Disconnect the starter excitation cable.
7. Disconnect the starter power supply cables.
8. Remove the starter.



sion: disconnect the reaction rod.

DISASSEMBLY/REASSEMBLY

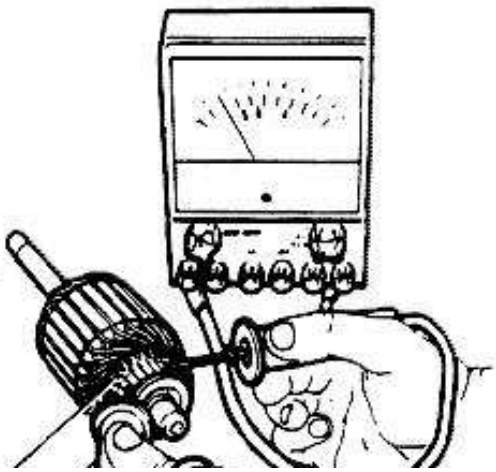
Disassemble the starter into its components.



CHECKS AND INSPECTIONS

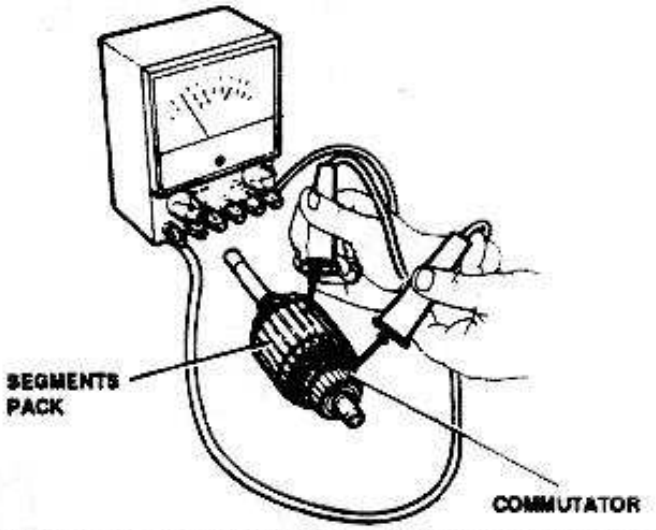
NOTE: **Before proceeding to electrical checks, thoroughly clean the affected parts with compressed air.**

Rotor electrical continuity check: using an ohmmeter, check for electrical continuity between two pairs of adiacent commutator segment packs.
Repeat the check on all the corresponding segment pairs.

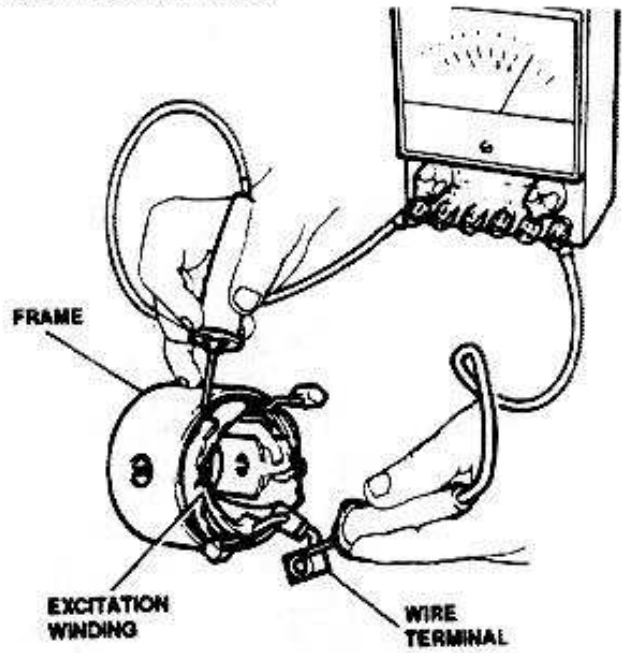


Replace rotor in case of lack of electrical continuity.

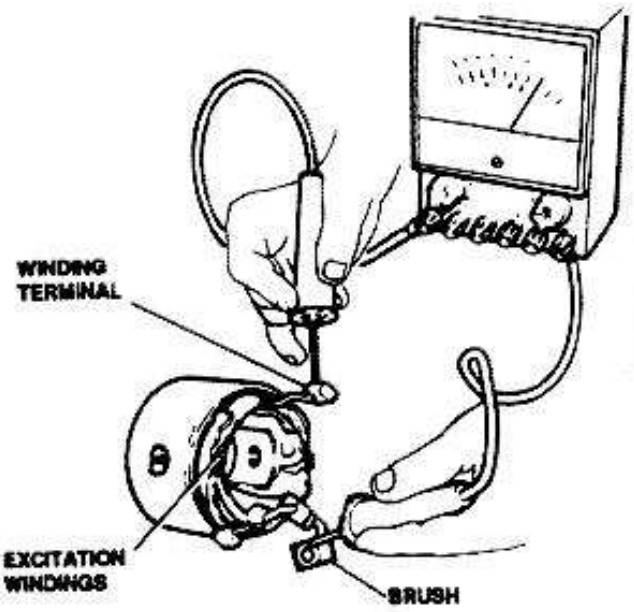
Rotor insulation check: using an ohmmeter, check that the resistance between the commutator and the segment pack is infinite (insulation). Repeat the check on all the corresponding segment pairs.
Replace rotor if proper insulation is not found.



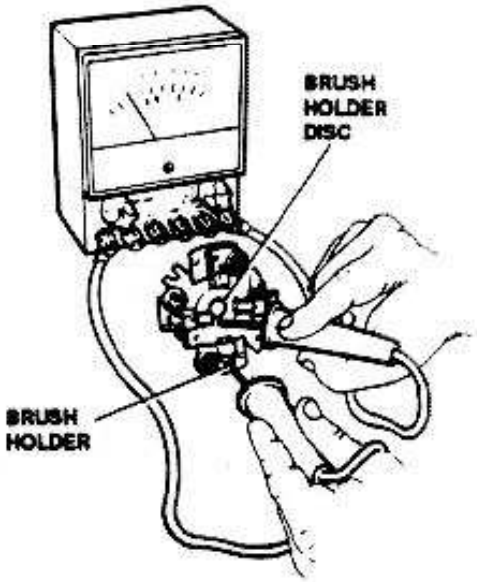
Excitation winding insulation check: using an ohmmeter, check that the resistance between the winding terminals and the frame is infinite (insulation).
Remove windings from the frame and replace them if insulation is insufficient.



Excitation windings electrical continuity check: using an ohmmeter, check the electric continuity between the winding terminals and one of the brushes.
Repeat the check on the other brush.
Remove windings from the frame and replace them if the



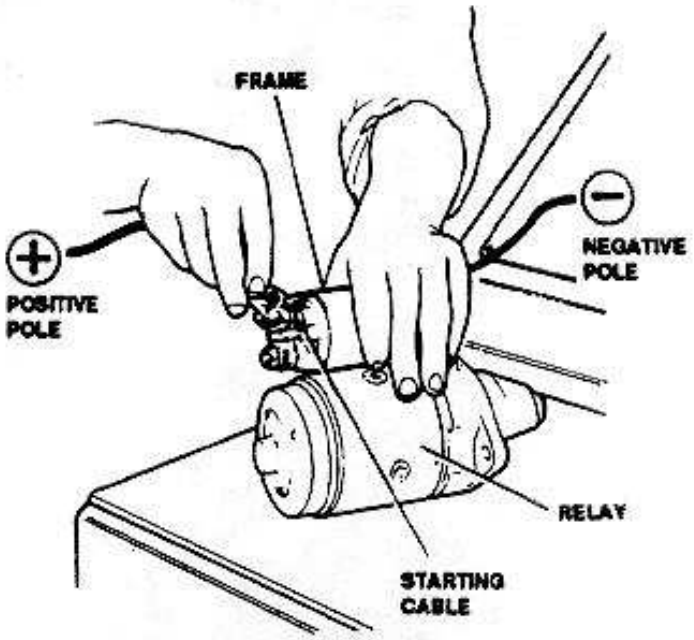
Brush holder insulation check: using an ohmmeter, check that the resistance between the brush holder disc and one brush holder is infinite (insulation).
Replace brush holder disc if insulation is insufficient.

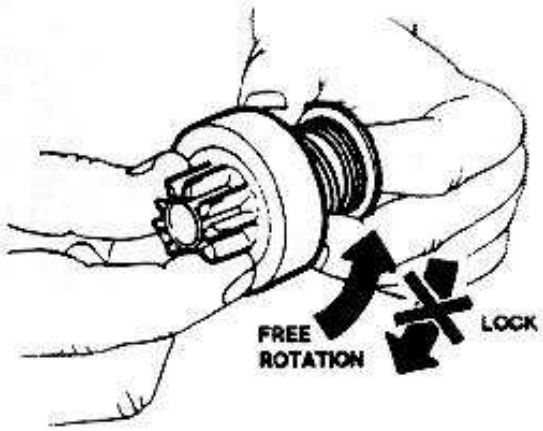


Brushes check: check rotor and stator brushes (excitation windings) for chipping and carbon deposits. Replace affected brushes if excessively worn.

Relay check: connect relay body to (-) pole of the battery, and (+) pole of relay to (+) pole of the battery, shorted with the starting cable: the relay must actuate the fork control pin.

proper continuity is not found.	Replace the relay if the above condition is not met.





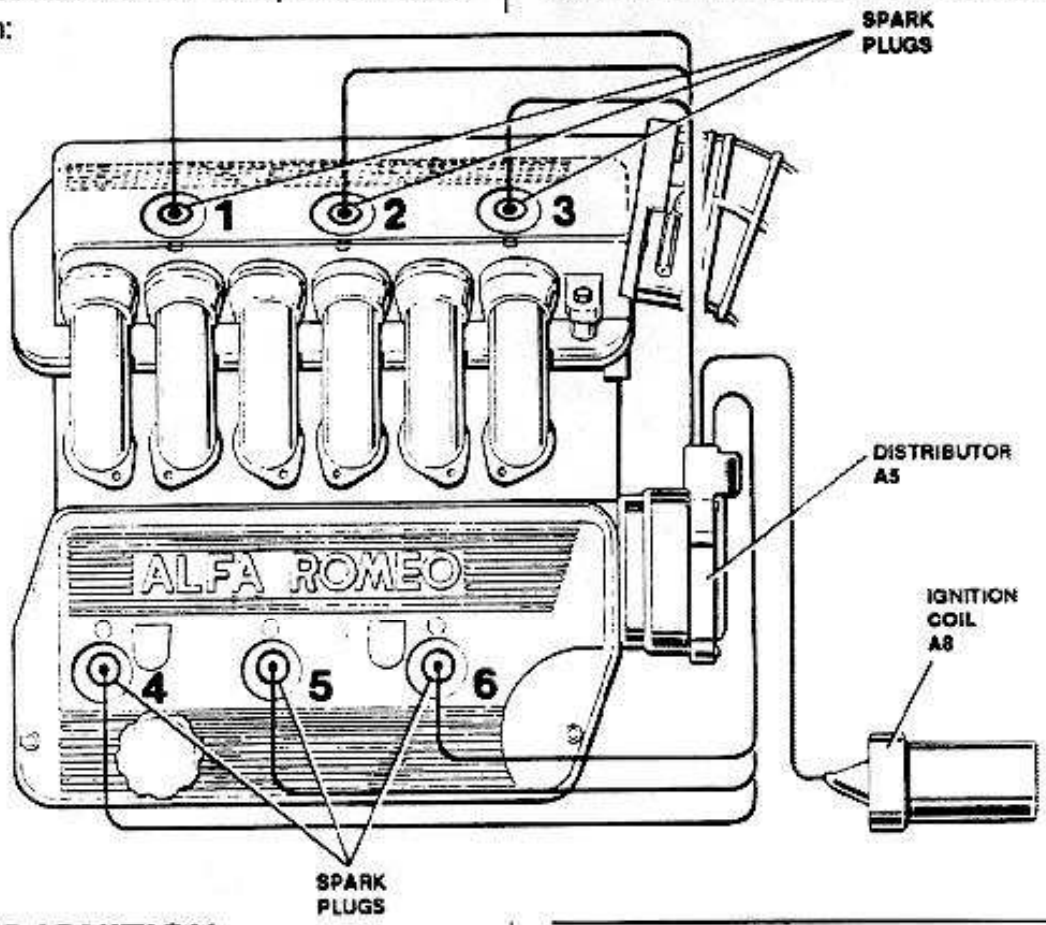
Pinion efficiency check: check the pinion for freedom of rotation in counterclockwise direction, and that it locks when rotated in clockwise direction (engagement direction). Furtherly, visually check the pinion for integrity of teeth. Replace the pinion complete of engagement mechanism if operation is not satisfactory.

IGNITION SYSTEM

The ignition system is integrated with the injection system in the Motronic system.
This paragraph describes the main components of the ignition sub-system:

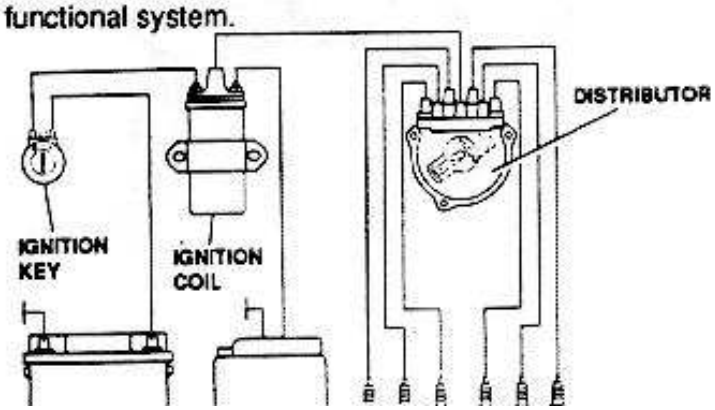
- Distributor
- Ignition coil
- Spark plugs

For the information concerning the remaining component of this sub-system refer to **Group 04 - MOTRONIC ML 4.1 IGNITION AND INJECTION SYSTEM.**



ELECTRONIC IGNITION

The adjustment of the spark plug advance is realized using the Motronic control unit memory maps, that supply a signal directly to the ignition coil, and from there to the distributor. This enabled to set-up a simple and very functional system.



WARNING:
INCREASED CAPACITY IGNITION SYSTEM. DANGEROUS LOW AND HIGH VOLTAGES.
The electronic ignition system operates in a dangerous voltage range, in both the low voltage range, and even more in the high voltage range.
Before performing any activity on the ignition system, assure the ignition is disconnected or disconnect the power supply source.
Never connect test equipment, stroboscopic guns, etc. to the ignition system; always connect the above equipment to the

battery.

BATTERY

MOTRONIC CONTROL UNIT

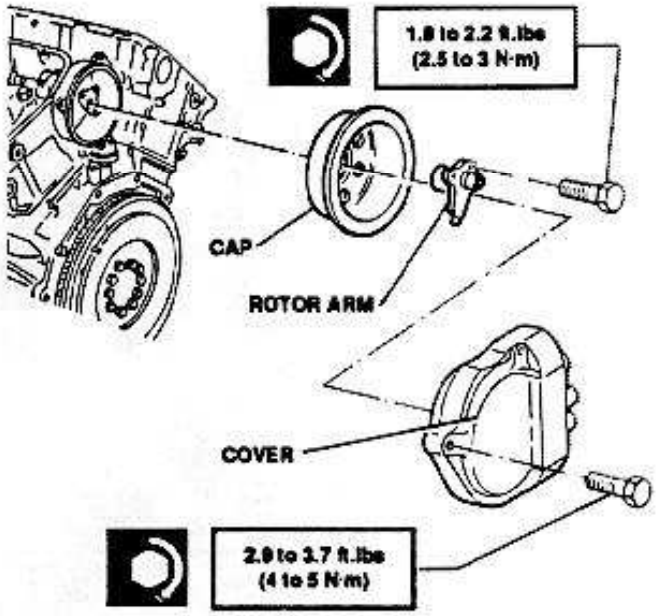
SPARK PLUGS

DISTRIBUTOR

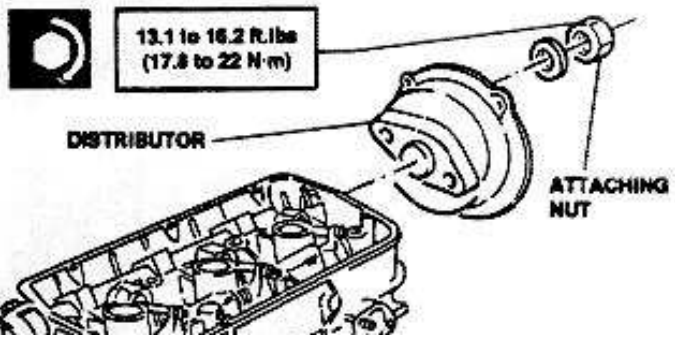
The distributor used in the electronic ignition system has the only purpose of delivering to the spark plugs the high voltage supplied by the ignition coil: this function is performed by means of a rotor arm connected by a shaft to the left cylinders camshaft. A plastic cap protects the rotor arm, and also assures isolation and radio noise suppression.

REMOVAL /INSTALLATION

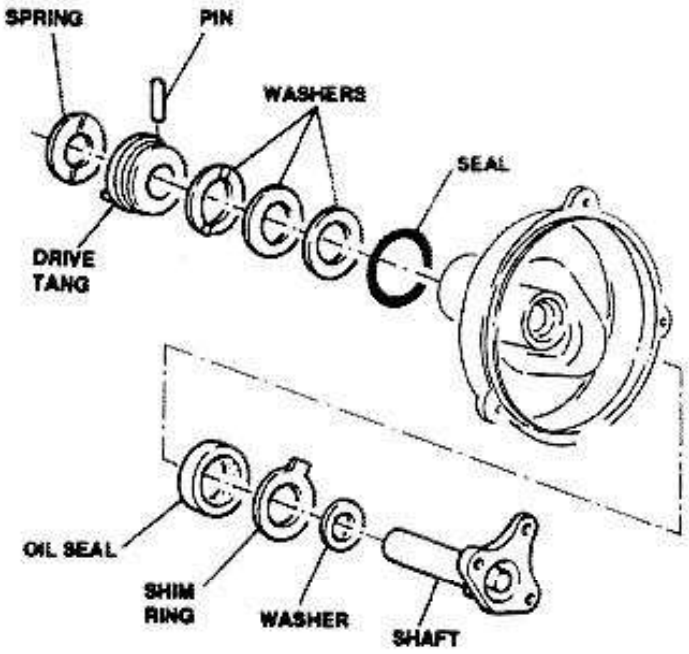
1. Remove protective cover
2. Remove rotor arm and cap.



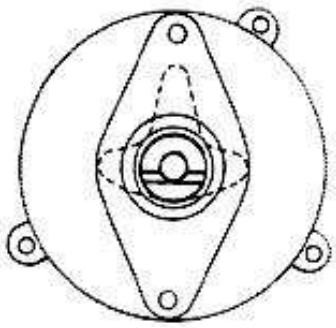
3. Remove two screws and remove distributor from cylinder head.



4. Disassemble the distributor into its components, if necessary.
5. When installing, torque hardware to the specified values.



NOTE: On reassembly, pay due attention that shaft is positioned as depicted in the illustration below: improper positioning of shaft could lead to 180 degrees phase displacement.

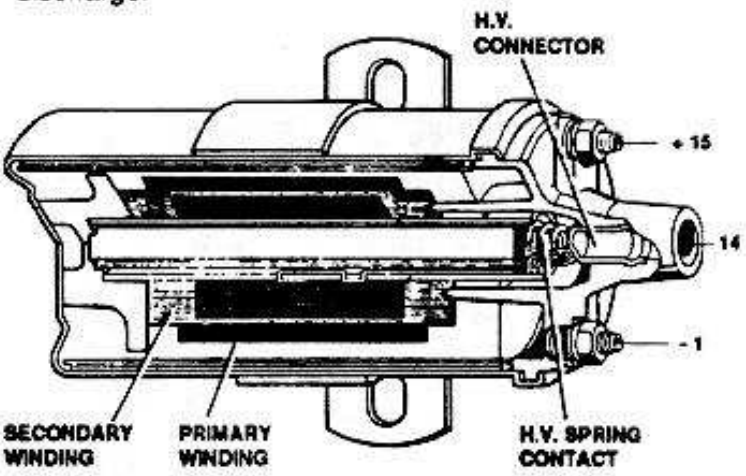


On reassembly, lubricate distributor seal with

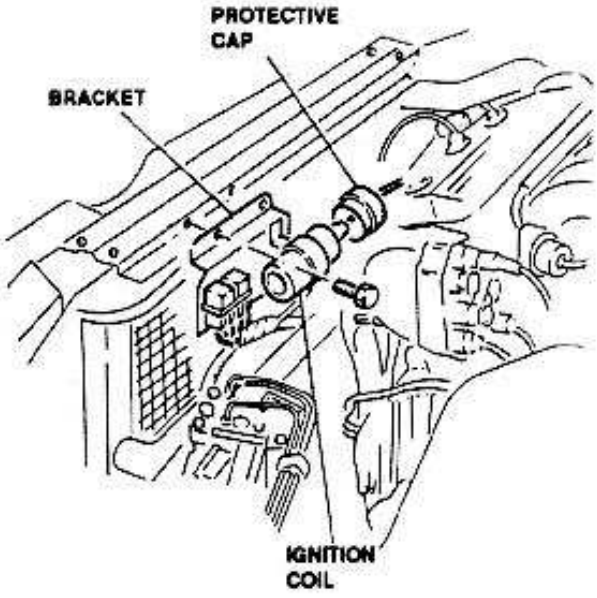
grease (ISECO Molycote BR2).

IGNITION COIL

The ignition coil accumulates the energy required to produce a high voltage capable of providing duration and intensity of required sparks. The energy stored through the primary winding is then delivered to the distributor through the secondary winding in the form of high voltage discharge.



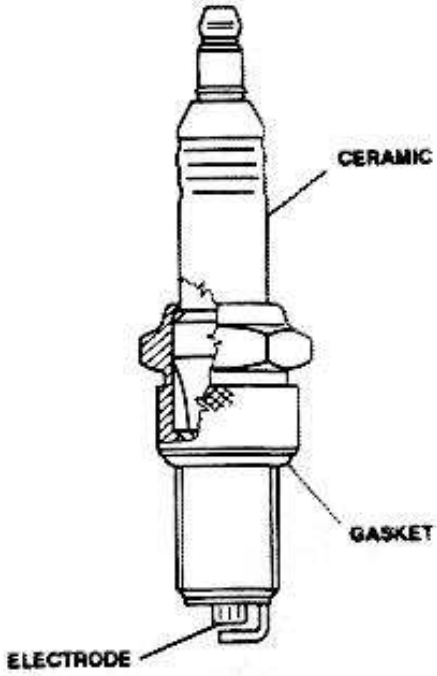
The ignition coil is located inside the engine compartment, and is installed on a bracket near the coolant radiator.



SPARK PLUG

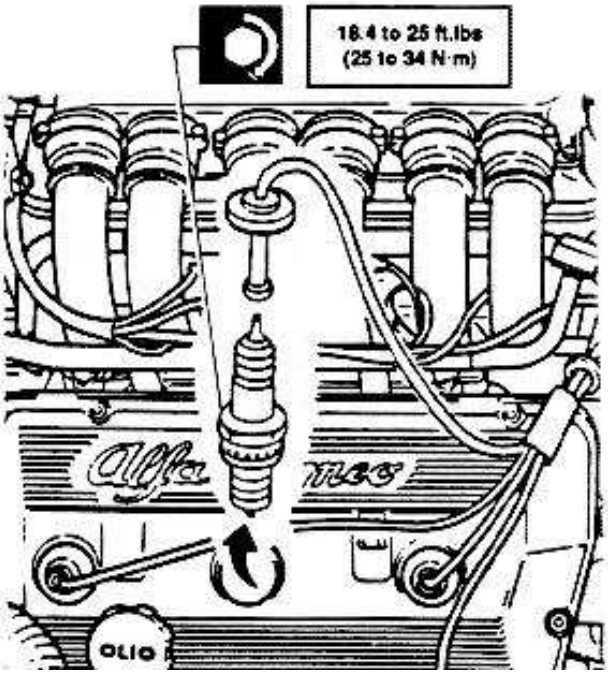
The adopted spark plug types are:

— Champion RN7YC (164 - 164L)



MAINTENANCE

Periodically check the electrode for cleanliness.
Also check the electrode for wear, and the ceramic for breakage.
Replace the spark plugs if damaged or work.
At installation, lubricate spark plug thread (ISECO Molycote A) and torque to specified value.



CAUTION:
Use of spark plugs having specifications and dimensions different from those specified could cause severe engine damage, and alter the level of harmful exhaust emissions.

CAUTION:
A fouled or burnt spark plug is always a symptom of abnormal operation of the engine supply system.
For example:

- **Traces of carbon deposits: improper fuel-air mixture. Air cleaner very dirty.**
- **Oil stains: oil seepage through piston rings**
- **Ash deposits: presence of aluminum particles, particularly in the lubricating oil.**
- **Melted electrodes: overheating due to use of improper fuel, defective valves, defective distributor, etc.**
- **Excessive electrode wear: presence of harmful additives in the fuel or oil knocking, overheating.**
- **Etc.**

Refer to troubleshooting procedure in Groups 01 and 04 for further details concerning the above malfunctions.

TROUBLESHOOTING

The troubleshooting contained in Group 04 also includes the troubleshooting of the ignition system components.

TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

BATTERY

Type		DELCO 1980775
Voltage	V	12
Capacity (20 hours)	Ah	102
Cold discharge current (at -18°C/0°F)	A	400

ALTERNATOR

Type			BOSCH N1-> 14V 40/115A
Rated voltage		V	14
Current output	- Rated current	A	115
	- Minimum speed (0A speed)	RPM	950
	- 40 A speed	RPM	1500
	- Rated current speed	RPM	6000

STARTER

Type			BOSCH 12V 1.4 kW
Rated voltage		V	12
Rated power		kW (HP)	1.4 (1.9)
Full load test	- Voltage	V	9
	- Current	A	350 max
	- Speed	RPM	1500 min
	- Torque	ft.lbs (Nm)	6.3 (8.5)
Short circuit test	- Voltage	V	4
	- Current	A	750 max
	- Torque	ft.lbs (Nm)	11 (15)
Flywheel overrunning torque		ft.lbs (Nm)	0.09 to 0.013 (0.12 to 0.18)
Pinion teeth module		mm (in)	2.1167 (0.08333)

IGNITION COIL

Primary winding resistance	Ω	0.45 to 0.55
Secondary winding resistance	kΩ	5400 to 6600

SPARK PLUGS

	164 - 164L	164S GAP .024 - .028
Type	Champion RN7YC GOLDEN LODGE 2 HL	NGK PGR6A

FLUIDS AND LUBRICANTS

Application	Type	Name	Quantity
Battery leads	GREASE	Reinach E10 TAC	–
Distributor ring seal	GREASE	ISECO Molycote BR2	–
Spark plug threads	OIL	ISECO Molycote A	–

TIGHTENING TORQUES

Alternator pulley nut	29.5 to 36.9 ft.lbs	40 to 50 Nm
Starter attachment	28.2 to 32.2 ft.lbs	38.2 to 45 Nm
Distributor rotor arm attachment	1.8 to 2.2 ft.lbs	2.5 to 3 Nm
Distributor cover attachment	2.9 to 3.7 ft.lbs	4 to 5 Nm
Distributor to cylinder head attaching screws	13.1 to 16.2 ft.lbs	17.8 to 22 Nm
Spark plugs (with oil)	18.4 to 25 ft.lbs	25 to 34 Nm

TROUBLESHOOTING PROCEDURE: IGNITION

TROUBLES AND SYMPTOMS	TEST REFERENCE
WITH THE ENGINE RUNNING, IGNITION IS IRREGULAR	A
AT HIGH SPEEDS, IGNITION IS IRREGULAR	B
WITH THE IGNITION KEY SET TO "START", THE STARTER RUNS BUT THE ENGINE DOES NOT START	C
ENGINE DIAGNOSIS ACCORDING TO THE SPARK PLUG CONDITIONS	D

TROUBLESHOOTING PROCEDURE: START-UP

TROUBLES AND SYMPTOMS	TEST REFERENCE
WITH THE IGNITION KEY SET TO "START", THE STARTER DOES NOT RUN AND THERE IS NO CURRENT ABSORPTION	E
WITH THE IGNITION KEY SET TO "START", THE STARTER ABSORBS CURRENT BUT DOES NOT RUN, OR RUNS SLOWLY, OR DOES NOT START THE ENGINE	F
WITH THE IGNITION KEY SET TO "START", THE STARTER RUNS BUT DOES NOT START THE ENGINE	G
WITH THE IGNITION KEY SET TO "START", THE STARTER RUNS NORMALLY BUT EXCESSIVE OR UNUSUAL NOISE IS HEARD	H
WITH THE IGNITION KEY SET TO "START", THE STARTER DOES NOT DEVELOPE ITS MAXIMUM POWER	I
EXCESSIVE WEAR OF STARTER BRUSHES	J
SPARKING AT THE STARTER COMMUTATOR	K

TROUBLESHOOTING PROCEDURE: RECHARGE

TROUBLES AND SYMPTOMS	TEST REFERENCE
THE ALTERNATOR DOES NOT CHARGE	L
THE ALTERNATOR IS NOISY	M
DURING THE ALTERNATOR NORMAL OPERATION, THERE IS AN INSUFFICIENT OR IRREGULAR CURRENT SUPPLY	N
DURING THE ALTERNATOR NORMAL OPERATION, THERE IS AN EXCESSIVE CURRENT SUPPLY	O

WITH THE ENGINE RUNNING, IGNITION IS IRREGULAR	TEST A

TEST STEPS	RESULTS	REMEDY
A1 HIGH VOLTAGE CONNECTION CHECK		
- Check that the ignition coil protective cap is free from burning	OK ▶	Carry-out **step A2**
	~~OK~~ ▶	Replace the **ignition coil**
A2 WIRING CHECK		
- Check that the distributor cap is free from burning	OK ▶	Carry-out **step A3**
	~~OK~~ ▶	Replace the **distributor cap**
A3 DISTRIBUTOR CHECK		
- Check that the distributor rotor is free from burning	OK ▶	Carry-out **step A4**
	~~OK~~ ▶	Replace the **distributor rotor**
A4 COIL WINDING CHECK		
- Check that the spark plug spark is not of week intensity (which is due to a broken coil secondary winding or in short circuit)	OK ▶	Carry-out **step A5**
	~~OK~~ ▶	Replace the **ignition coil**

(Cont.d)

WITH THE ENGINE RUNNING, IGNITION IS IRREGULAR	TEST A

TEST STEPS		RESULTS	REMEDY
A5	ROTOR - STATOR AIR GAP CHECK		
- Check that there is no air gap between the ignition distributor rotor and stator		OK ▶	See "WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS"
		~~OK~~ ▶	Replace the involved components inside the ignition distributor

End of test A

AT HIGH SPEEDS, IGNITION IS IRREGULAR	TEST B

TEST STEPS		RESULTS	REMEDY
B1	LOW VOLTAGE CONNECTION CHECK		
- Check the low voltage connections for integrity		OK ▶	Fully tighten the **fixing points**, check the **electric connections** for integrity, perform **beading on the contacts**

End of test B

WITH THE IGNITION KEY SET TO "START", THE STARTER RUNS BUT THE ENGINE DOES NOT START	TEST C

TEST STEPS	RESULTS	REMEDY
C1 COIL PROTECTIVE CAP CHECK - Check that the ignition coil protective cap is not perforated by high voltage or connected to ground	OK ▶ ~~OK~~ ▶	Carry-out **step C2** Replace the **ignition coil**
C2 DISTRIBUTOR CAP CHECK - Check that the distributor cap is not perforated by high voltage or connected to ground	OK ▶ ~~OK~~ ▶	Carry-out **step C3** Replace the **distributor cap**
C3 DISTRIBUTOR ROTOR CHECK - Check that the distributor rotor is not perforated by high voltage or connected to ground	OK ▶ ~~OK~~ ▶	Carry-out **step C4** Replace the **distributor rotor**
C4 COIL WINDING CHECK - Check that the coil secondary winding is not broke, in short circuit, or connected to ground	OK ▶ ~~OK~~ ▶	Carry-out **step C5** Replace the **ignition coil**

(Cont.d)

WITH THE IGNITION KEY SET TO "START", THE STARTER RUNS BUT THE ENGINE DOES NOT START	TEST C

TEST STEPS		RESULTS	REMEDY
C5	SECONDARY WINDING CHECK		
- Check that the dary winding of the ignition coil is not broken		OK ▶	See "WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS" or "TROUBLESHOOTING PROCEDURE" Group 04
		OK ▶	Replace the ignition coil

End of test C

ENGINE DIAGNOSIS ACCORDING TO THE SPARK PLUG CONDITIONS	TEST D

Normal condition

Insulator noses grayish-white or grayish-yellow to brown. Engine is in order. Heat range of plug correct. Mixture setting and ignition timing are correct, no misfiring. Cold-starting device functioning. No deposits from fuel additives containing lead or from alloying constituents in the engine oil. No overheating.

Sooted-carbon-fouled

Insulator nose, electrodes and spark-plug shell covered with velvet-like, dull black soot deposits. Cause: incorrect mixture setting (fuel injection); mixture toorich, air filter very dirty, automatic choke not in order. Spark plug too cold, heat range code number too low.

Oil-fouled

Insulator nose, electrodes and spark-plug shell covered with shiny soot or carbon residues. Cause: too much oil in combustion chamber. Oil level too high, badly worn position rings, cylinders and valve guides.

Formation of ash

Heavy ash deposits from oil and fuel additives on the insulator nose, in the scavenging area and on the ground electrode. The structure of the ash is loose to cinder-like.
Cause: Alloying constituents, in particular from oil, can deposit this ash in the combustion chamber and on the spark-plug face.

Partially melted electrodes

Cauliflowaer-like appearance of the electrodes. Possible deposits of materials not originating from the plug. Cause: overheating due to autoignition, e.g. due to over-advanced ignition timing, combustion deposits in combustion chamber, defective valves, defective ignition distributor or insufficient fuel quantity.

Heavy wear on ground electrode

Excessively large electrode gap owing to excessive wear. Cause: aggressive fuel and oil additives. Unfavorable influences of gas turbulence in the combustion chamber, possibly caused by deposits. Knocking. No overheating.

End of test D

WITH THE IGNITION KEY SET TO "START", THE STARTER DOES NOT RUN AND THERE IS NO CURRENT ABSORPTION	TEST E

TEST STEPS	RESULTS	REMEDY
E1 WIRING CHECK - Check that no breaks are present on the electric circuit between battery and starter	OK ▶ ~~OK~~ ▶	Carry-out **step E2** Locate and repair the break (see: **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS**). Also check **battery terminals**, cranking cable ferrules, by fully tightening the fixing nuts
E2 WIRING CHECK - Check that no breaks are present on the electric circuit between the ignition switch and the starter	OK ▶ ~~OK~~ ▶	Carry-out **step E3** Locate and repair the break (see: **WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS**). Also check the conditions of the **ignition switch contacts**, replace it if necessary
E3 BATTERY TERMINAL CHECK - Check that the battery terminals are not oxydated and the post clamps are not slackened	OK ▶ ~~OK~~ ▶	Carry-out **step E4** Clean the **battery terminals** and fully tighten the **post clamps**

(Cont.d)

WITH THE IGNITION KEY SET TO "START", THE STARTER DOES NOT RUN AND THERE IS NO CURRENT ABSORPTION	TEST E

TEST STEPS		RESULTS	REMEDY
E4	BRUSH CHECK		
- Check that the brushes are not excessively worn andthe contact with the commutator is correct		OK ▶	Replace the **brushes** and check the **commutator** for integrity

End of test E

WITH IGNITION KEY TO "START", THE STARTER ABSORBS CURRENT BUT DOES NOT RUN, RUNS SLOWLY OR DOES NOT START THE ENGINE	TEST F

TEST STEPS	RESULTS	REMEDY
F1 ROTOR CHECK - Check that the rotor rotates freely and is not stuck against the pole shoes	OK ▶ ~~OK~~ ▶	Carry-out step F2 Should bearings be excessively worn, replace the complete bearing assy. Also check bearings for correct alignment and rotor shaft for integrity; check that pole shoes are correctly positioned and tightened
F2 ROTOR SHAFT CHECK - Check that the rotor shaft is not sized	OK ▶ ~~OK~~ ▶	Carry-out step F3 Replace the sized rotor and bearing
F3 EXCITATION COIL CHECK - Check that the excitation winding of the coils is not short-circuited or connected to ground	OK ▶ ~~OK~~ ▶	Carry-out step F4 Replace the excitation coils
F4 ROTOR CHECK - Check that the rotor is not broken or connected to ground	OK ▶ ~~OK~~ ▶	Carry-out step F5 Replace the rotor

(Cont.d)

WITH IGNITION KEY TO "START", THE STARTER ABSORBS CURRENT BUT DOES NOT RUN, RUNS SLOWLY OR DOES NOT START THE ENGINE	TEST F

TEST STEPS		RESULTS	REMEDY
F5	ROTOR CHECK		
- Check that the rotor is not short-circuited		OK ▶	Clean the **commutator** and the **brush holders** from copper and carbon residues. Also check the **rotor** for integrity and replace it if necessary

End of test F