

# GROUP 15

# **TRANSMISSION**

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### **TRANSMISSION**

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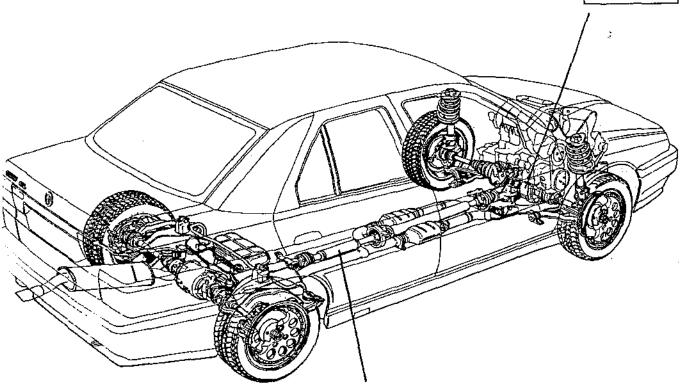
### **FERGUSON VISCOUS JOINT**

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### **MAIN SHAFT**

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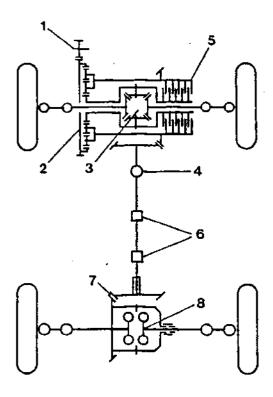
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## **TRANSMISSION**

### DESCRIPTION

In order to optimize the sports features of the 155 range, improving both functionality and driving safety, the 2.0 turbopetrol 16 valve version has been equipped with a permanent four-wheel drive system.



- 1. Gearbox countershaft
- 2. Epicycloidal differential or torque distribution frame
- 3. Front differential
- 4. Constant speed joint
- 5. Ferguson viscous coupling
- 6. Universal couplings
- 7. Pinion set
- 8. Torsen rear differential

The permanent four-wheel drive transmission adopted for the vehicle is a three-differential type.

The deflecting torque distributed on the two axies by an epicycloidal differential is divided -47% on the front axie and 53% on the rear axie (see: GR. 13 - GEARBOX - TORQUE DISTRIBUTION FRAME - DIFFERENTIAL AND DRIVING GEAR).

This torque distribution is proportional to distribution of weights on the two axies permitting the typical features of front-wheel drive and a greater deflecting torque on the rear axie.

Thanks to a "Ferguson" viscous coupling, linked to the central differential, it is possible to redistribute the deflecting torque on the two axles, in the case of low roadholding conditions.

The front differential is of the traditional type and the transmission to the rear axle is carried out by a pinion set and a main shaft divided in three sections, connected by a constant speed joint and two universal couplings. The rear differential has a low internal output, of the Torsen type 5:1 (see: GR. 18 - FOUR-WHEEL DRIVE REAR AXLE).

This type of transmission optimizes engine power exploiting the full adhesion of each wheel, particularly during acceleration and when travelling uphill. There is no incompatibility incompatibility with ABS system during braking and turning, thanks to the action of the central differential, which permits the necessary slipping between the two axies. Driving conditions are improved with regard to directional stability and traction, even under the most critical of road conditions.



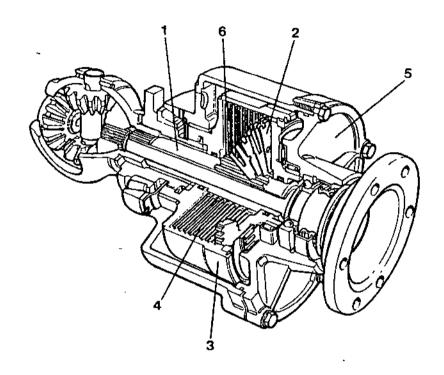
#### WARNING:

If it is necessary to tow the vehicle, the operation must be carried out with all the four wheels touching the ground; if this is not possible, the vehicle must be transported when completely raised. Never tow the vehicle with two wheels on the ground and two raised as this could damage transmission.



### FERGUSON VISCOUS JOINT

### DESCRIPTION



The viscous coupling consists of:

- 1. Hub (shaft)
- Disks machined onto the hub
- 3. External casing

The disks machined onto the casing are located alternately to the coupled disks on the hub, and are immersed in silicone oil. The distance between the facing surfaces is small. If the disks of the two types have the same speed, the movement of the fluid adopts the characteristics of a passive entrainment, if, in the other hand, the two rows of disks turn at a different speed, the fluid is entrained by the disks rotating at a higher speed. Due to the viscosity, the fluid which adheres to the fastest disks transmits a torque to the next fluid layers and these to the following layers and so on until it begins to afffect the opposite row of disks.

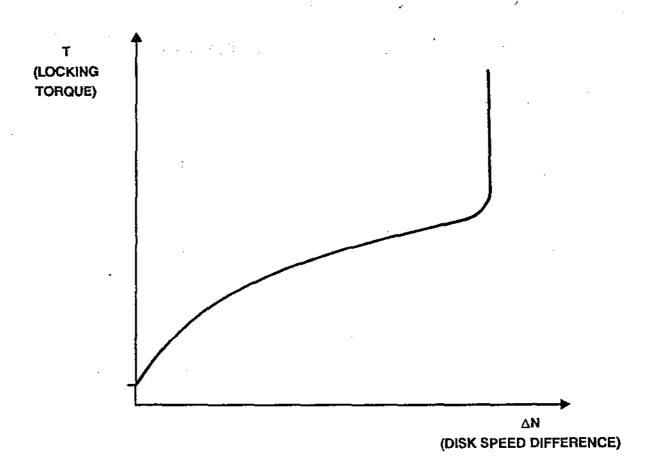
- 4. Disks machined onto the casing
- 5. Casing cover
- Viscous fluid (silicone oil)

The decrease in fluid viscosity following a rise in temperature is compendated for by its dilation which brings about an increase in pressure resulting in the coupling blocking. The locking torque value increases as the relative speeds between the two rows of disks, and therefore the pinion shaft and pinion, increases. Thus the central sifferential with viscous coupling described previously as being an epicycloidal gear with low internal output can be adequately defined as an epicycloidal gear with variable internal output.



The curve characteristic of the viscous coupling is shown below. It shows how the locking torque (T) varies as the

difference in speed between the disks varies ( $\Delta N$ ).



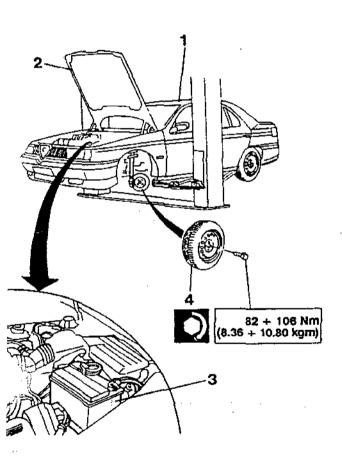
## REMOVAL AND REFITTING

- . Put the vehicle on the lift.
- 2. Raise the bonnet.
- Disconnect and remove the battery.
- Remove the front wheels.

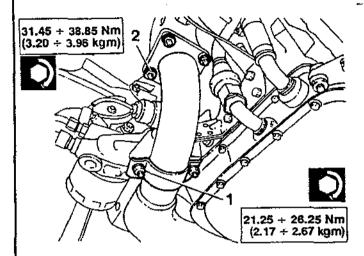


### WARNING:

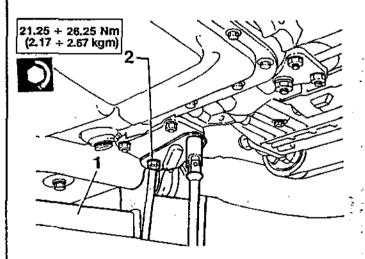
Protect the area around the engine compartment with soft material in order to avoid the accidental damage to the body.



- -- Raise the vehicle.
- Unscrew the nuts securing the exhaust pipe retaining brackets to engine linkage bracket.
- Unscrew the nuts securing the piping to the exhaust manifold.

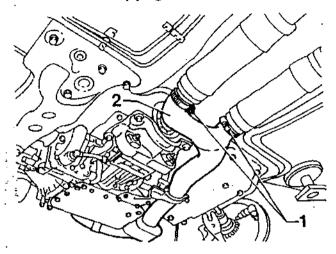


- Using a suitable tool and a hydraulic jack, support the front end of the exhaust piping.
- 2. Unscrew the nuts securing the differential to the retaining bracket of the exhaust piping.

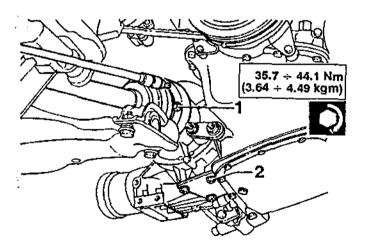




- Loosen the clamps securing the front end of the exhaust piping.
- Lower the hydraulic jack and remove the front end of the exhaust piping.



- Disconnect and remove the front end of the main shaft (see: Main shaft - Removal and refitting).
- Loosen the screws securing the right axle shaft to the differential flange and disconnect the axle shaft.
- 2. Remove the bracket fastening the exhaust piping.

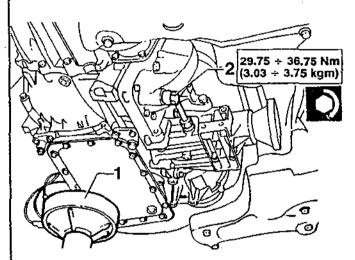


- 1. Using a jack, support the power unit group.
- After arranging a suitable container, loosen the oil supply union to the support pinion and drain the differential oil.

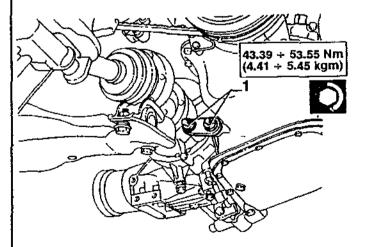


#### WARNING:

When refitting refill the front differentialdrive gear group with the recommended oil (see: TECHNICAL CHARACTERISTICS AND SPECIFICATIONS - GENERAL SPE-CIFICATIONS → Fluids and lubricants).

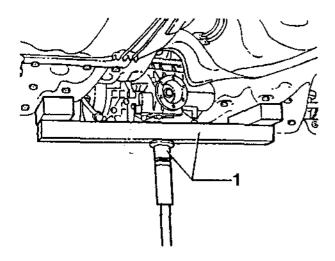


 Loosen the nuts securing the tie-rod to the differential-engine sump and remove the tie rod.

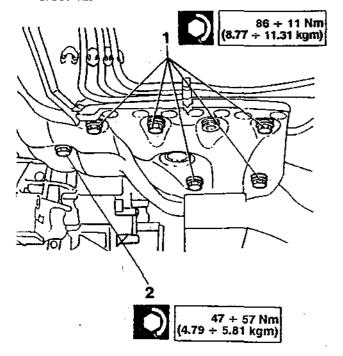




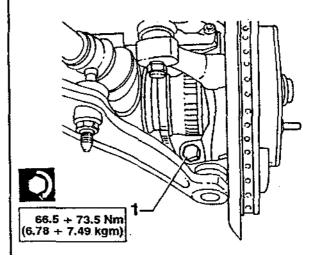
. Using a hydraulic jack and a suitable wooden support, support the crossrail.



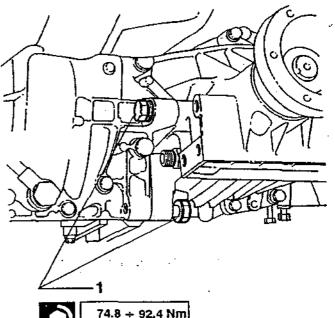
- Loosen the screws securing the crossarall to the body.
- Loosen the screws securing the steering box to the crossrait.



- Loosen and remove the bolts securing the suspen- ° slon swinging arms to the wheel support.
- Lower the jack and remove the crossrail.



 Loosen the lower screws securing the differential group to the torque distribution frame.

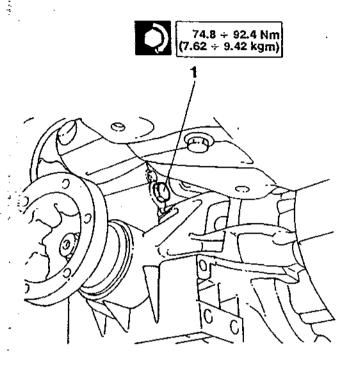




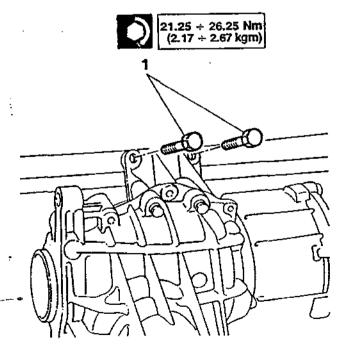
74.8 + 92.4 Nm (7.62 ÷ 9.42 kgm)



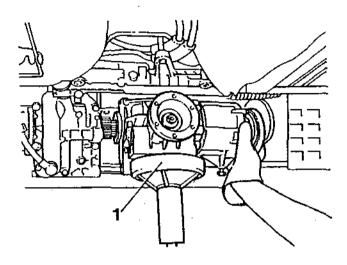
 Loosen the upper screw securing the differential group to the torque distribution frame.



 Loosen the screws securing the differential group to the cylinder block.



 Using a jack, remove the differential group in order to move the hollow shaft of the torque distribution frame, then remove the differential group.



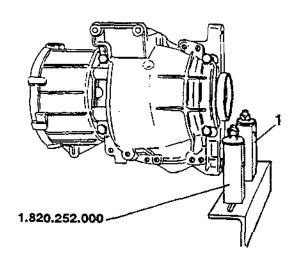


Refit by reversing the procedure followed for removal, tightening the nuts and screws to the torque indicated.

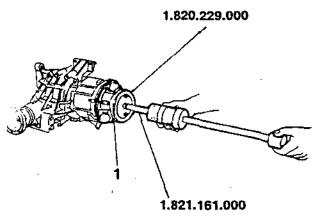


# ENCH DISASSEMBLY AND LEASSEMBLY

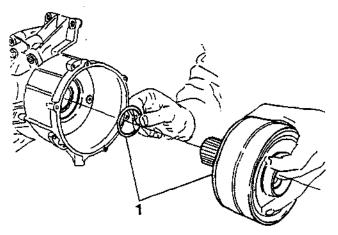
Place differential-drive gear group on support No. 1.820.252.000 and fit it in vice.



 Loosen the screws securing the viscous coupling cover and remove it along with the intermediate shaft, using tool No. 1.821.161.000 fixed to the pulley halfshaft by flange No. 1.820,229.000.

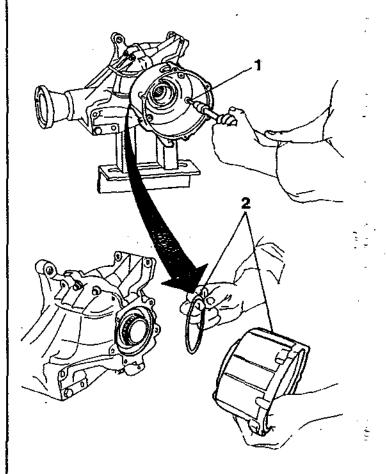


1. Remove the viscous coupling and shim ring.



NOTE: The coupling cannot be overhauled and must therefore be replaced.

- Loosen the screws securing external casing of the viscous coupling and remove it along with three O-rings.
- 2. Remove the cup and shim ring.



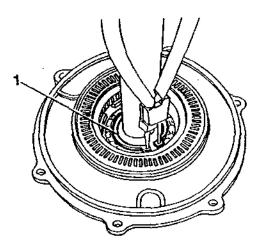




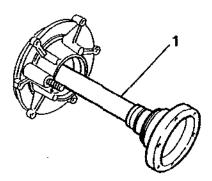
Reassemble by reversing the proceedure followed for disassembly and tighten to the specified torque.

# DISASSEMBLY AND REASSEMBLY OF "FERGUSON" VISCOUS COUPLING COVER

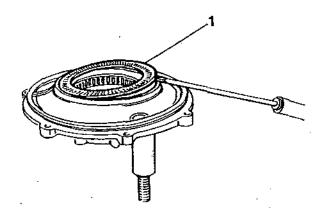
1. Remove snap ring retaining intermediate shaft.



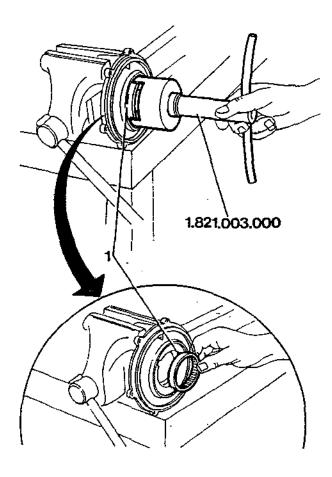
 Remove the Intermediate shaft from "Ferguson" viscous coupling casing cover.



 Remove superficial roller bearing of "Ferguson" viscous coupling support.

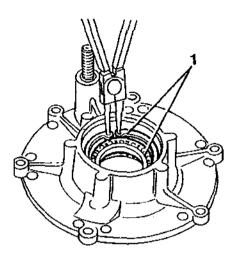


 Using No. 1.821.003.000 remove internal roller bearing of the "Ferguson" viscous coupling support...



POST

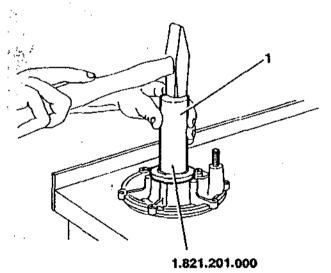
Remove oil guard, snap ring retaining the ball bearing of intermediate shaft support and ball bearing.



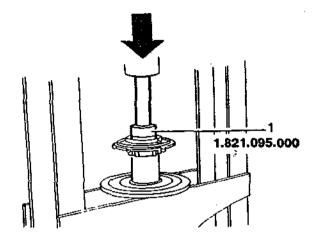


Refit by reversing the proceedure followed for disassembly, adhering to the instructions given below:

 Fit oil guard using the inserting tool No. 1.821.201.000.



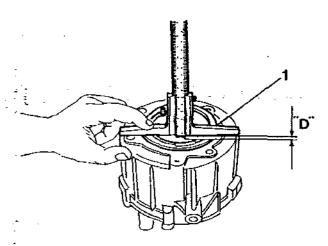
Install the roller bearing of the viscous coupling support using the press and the illustrated part of the inserting tool No. 1.821.095.000, together with a rotation spacer.



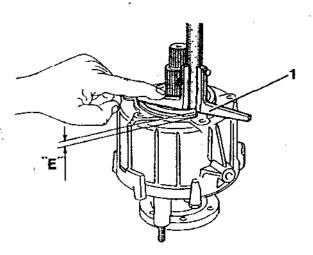


# ADJUSTMENT OF "FERGUSON" VISCOUS COUPLING

 Install the viscous coupling and the cover on the relative casing using a depth gauge, measure the distance "D" between the casing edge and the shim ring terminal plane on the viscous coupling.



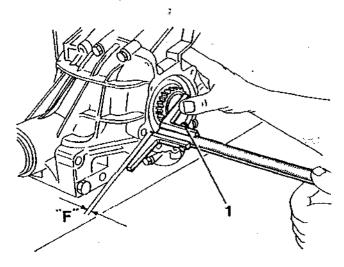
 Measure distance "E" between the edge of the viscous coupling external casing and the supporting surface with casing of differential group support.

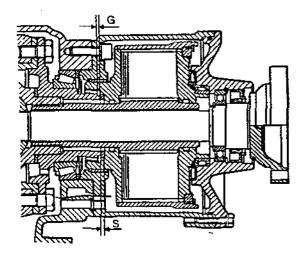


- Measure the distance "P" between clutch gear and supporting surface on differential box.
  - Thickness "S" of the shim ring clarance between the viscous coupling and the clutch gear is obtained using the following formula:

$$S = D - E - F - G$$

NOTE: 0.13 ÷ 0.25 mm is the required clearance between the viscous coupling and the clutch gear.

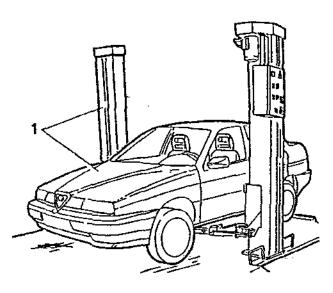




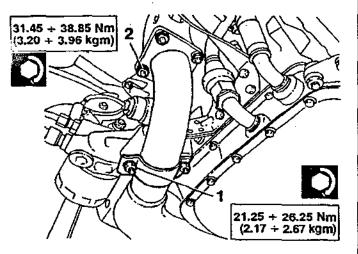
## **MAIN SHAFT**

### REMOVAL AND REFITTING

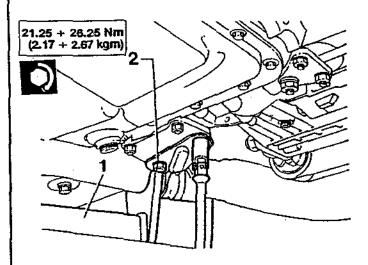
Put the vehicle on the lift and raise it.



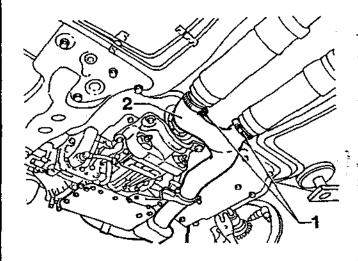
- Loosen the nuts securing the exhaust pipe supporting bracket to the engine linkage bracket.
- Loosen the nuts securing piping to the exhaust manifold.



- Using a suitable tool and a hydraulic jack, support the front end of the exhaust piping.
- 2. Loosen the nuts securing the exhaust pipe bracket to the differential.

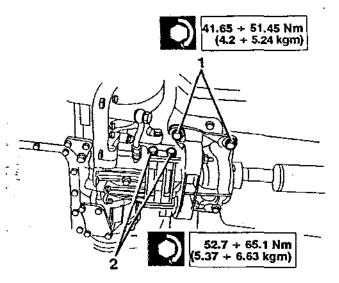


- 1. Release the clamps securing the front section of the exhaust pipe.
- Lower the hydraulic jack and remove the front section of the exhaust pipe.

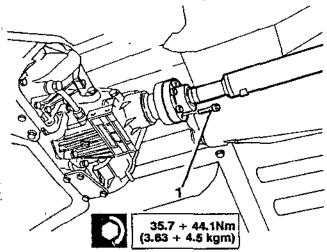




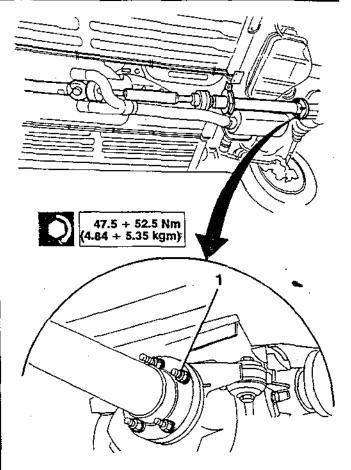
- Loosen the four screws securing the differential support to the crossrail.
- Loosen the two bolts securing dashpots support to the differential and remove the support.



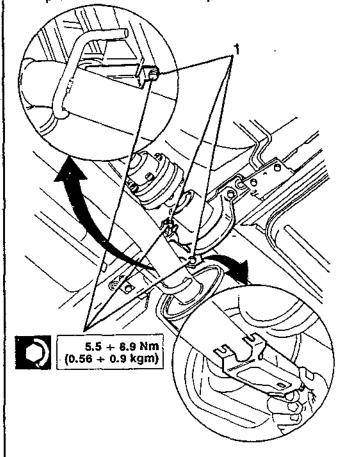
 Loosen the six screws securing the front constant speed joint to the front differential flange and remove them together with the safety plates.



 Loosen the six nuts securing the main shaft rear flange to the rear differential flange and remove them together with the safety plates.



 Loosen the nuts securing the handbrake cable relay protection and remove the protection.

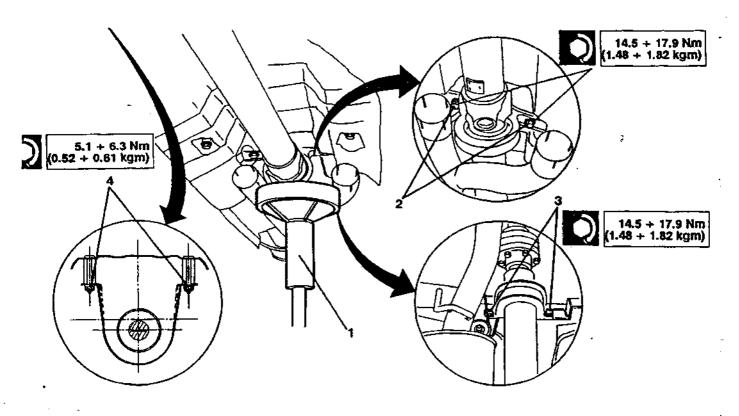




Support the main shaft by using a hydraulic jack. Loosen the screws securing the intermediate safety flexible support to main shaft.

Loosen the screws securing the rear safety flexible support to main shaft.

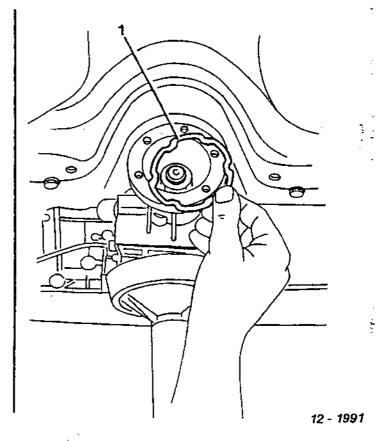
Loosen the nuts securing the front safety brace to °
the main shaft, then lowering the hydraulic jack
remove the whole main shaft.



Remove the gaskets on the flange of the front and rear differentials.



Refit by reversing the proceedure followed for removal, tightening the nuts and screws to the required torque and fitting new gaskets to the differential flange.





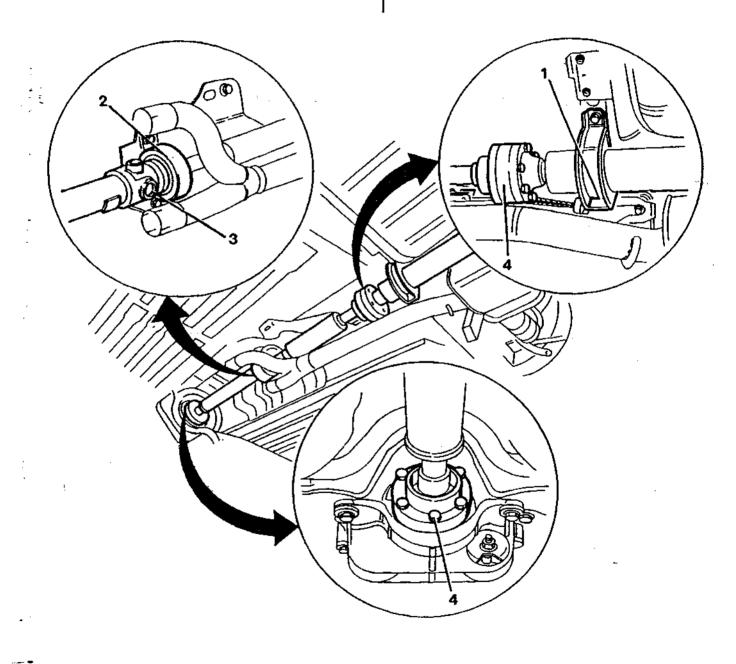
# **DISASSEMBLY AND REASSEMBLY**

The main shaft can be broken down into the following amain components:

- 1. Rear flexible support
- 2. Intermediate flexible support
- 3. Universal coupling
- 4. Constant speed Joints

NOTE:

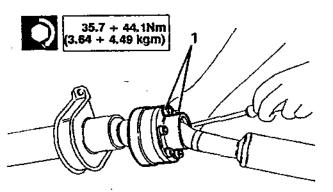
Before beginning the next disassembly phases it is advisable to mark the respective positions of the parts concerned.



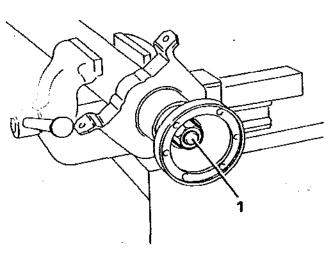


### REAR ELASTIC SUPPORT

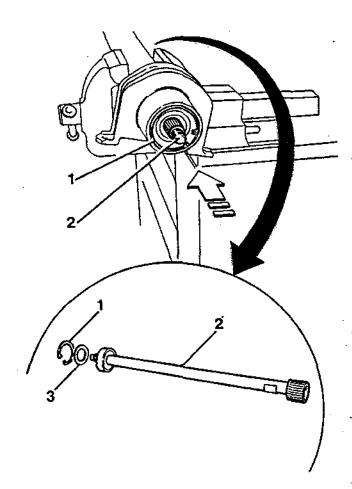
 Loosen the screws and remove safety plates, then disconnect the constant speed joint from flange of main shaft rear section.



 Operating in vice, remove the grease present on the actuating flange of the constant speed joint, then chamfer the nut securing the flange, loosen it and remove the flange.

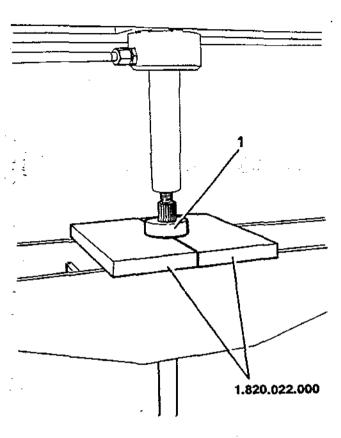


- 1. Remove snap ring retaining the bearing.
- Using a hammer of a soft material, beat in the direction indicated by the arrow and remove the shaft from the protective sheath.
- 3. Remove from sheath the ball bearing shim.





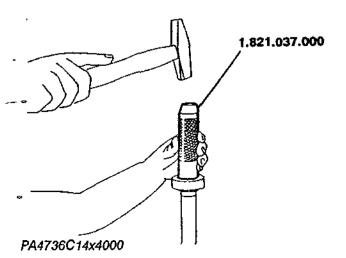
 Using a hydraulic press and half plates No. 1.820.022.000 remove the shaft from bearing.





Reassembly by reversing the proceedure followed for disassembly adhering to the instruction given below:

- Verify the integrity of the components concerned (see: INSPECTIONS AND CHECKS) and replace them, if necessary.
- Refit bearing on main shaft using tool No. 1.821.037.000.

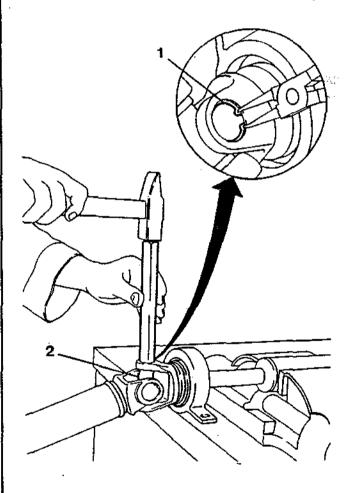


 Replace and chamfer the nut securing the main shaft to the actuating flange of constant speed joint.

# UNIVERSAL COUPLING AND INTERMEDIATE FLEXIBLE SUPPORT

### Universal coupling

- Remove the snap rings retaining the needle bearings.
- Operating in vice and using a suitable die, remove the roller bearing from seatings on the constant speed joint yokes.





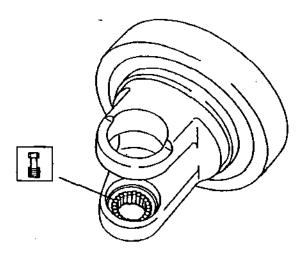
Reassembly by reversing the proceedure fol lowed for disassembly and adhering to the instructions given below:

 Verify the integrity of the components concerned (see: CHECKS AND CON TROLS) and replace them, if necessary.



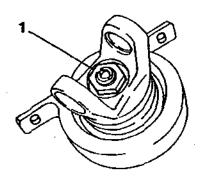
OTE: The universal coupling crosses are supplied together with roller bearings as a spare part.

Lubricate abundantly, using the specified grease (see: TECHNICAL CHARACTERISTICS AND SPECIFICATIONS - GENERAL SPECIFICATIONS - FLUIDS AND LUBRICANTS), the roller bearings and the universal coupling cross.

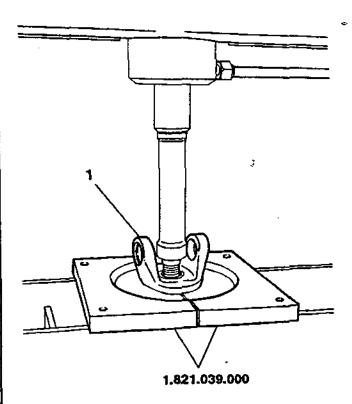


### Intermediate flexible support

 Operating in vice, chamfer and loosen the nut securing the half cross to the main shaft.

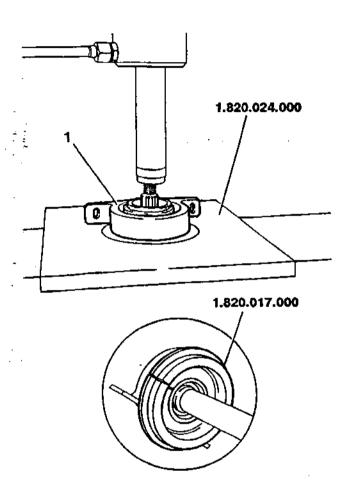


Using a hydraulic press and half plates<sup>\*</sup>,
 No. 1.821.039.000 remove the shaft from half cross.





 Using the half rings No. 1.820.017.000 placed between cup and flexible support and acting with a hydraulic press equipped with plate No. 1.820.024.000 withdraw the intermediate flexible support together with the bearing from main shaft.

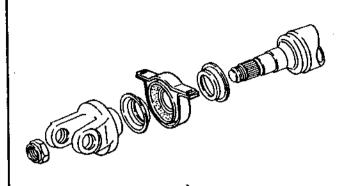




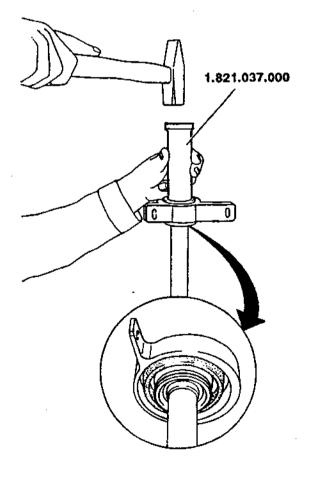
Reassembly by reversing the proceedure followed for disassembly and adhering to the instructions given below:

 Verify the integrity of the components concerned (see: INSPECTIONS AND CHECKS) and replace them, if necessary.

NOTE: The intermediate flexible support is as a spare part together with its bearing, therefore damage to the external structure, to the rubber crown gear or to the roller bearing mean that the entire component must be replaced.

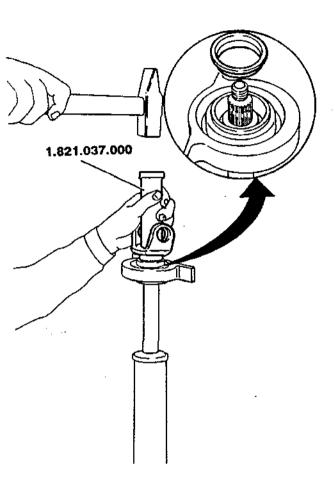


 Before refitting the new support verify the correct position of the rear cup, then using the inserting tool No. 1.821.037.000 insert the support on the main shaft.





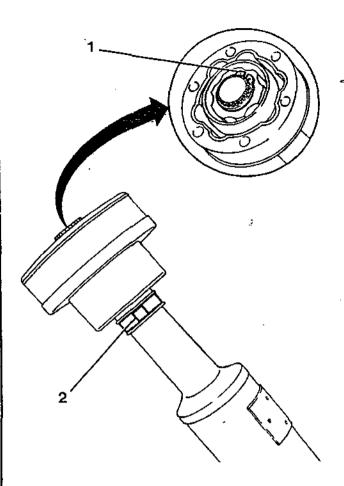
 Verify the correct position of the front cup, then using inserting tool No. 1.821.037,000 insert the half yoke on the main shaft.



 Replace and chamfer the nut securing the half cross to the main shaft.

### **CONSTANT SPEED JOINTS**

- Operating with the main shaft in vice, remove the snap ring securing the constant speed joint.
- 2. Remove the clamp securing the hood.

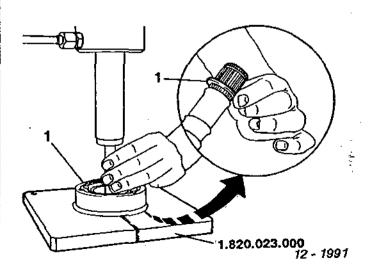


Using a hydraulic press, half plates.
 No. 1.820.023.000 and a suitable die, remove the shaft from the constant speed joint along with the shim ring.



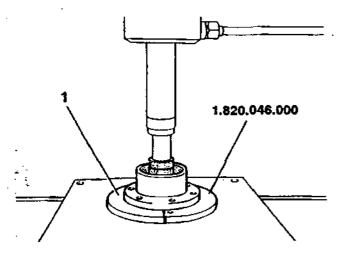
#### WARNING:

Removing the joint very carefully in order to avoid damaging the joint hood.





 Using a hydraulic press, half plates No. 1.820.046.000 and a suitable die, slide off the hood from the constant speed joint.





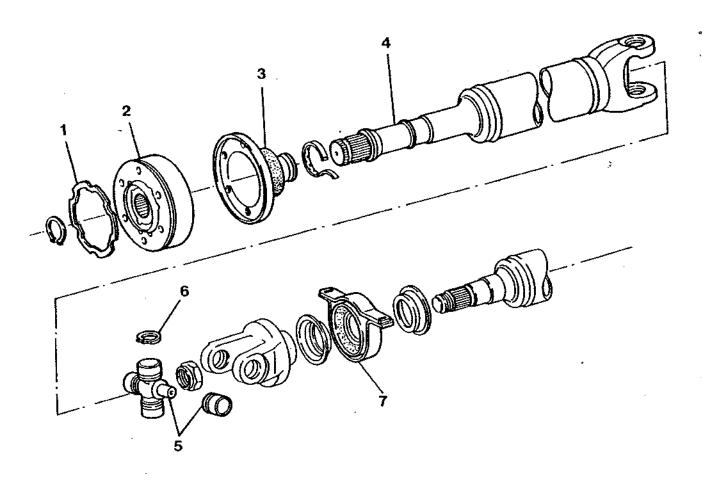
Reassembly by reversing the proceedure followed for disassembly and adhering to the instructions given below:

- Verify the Integrity of the components concerned (see: INSPECTIONS AND CHECKS) and replace them, if necessary.
- Before installing the hood on the joint, using two reference screws, check the exact alignment of the holes present on the hood and the joint.
- Lubricate abundantly, using the specified grease (see: TECHNICAL CHARAC-TERISTICS AND SPECIFICATIONS -GENERAL SPECIFICATIONS - FLUIDS AND LUBRICANTS) constant speed joint balls and holes.



### INSPECTIONS AND CHECKS

Before reassembling of each component, act as indicatted below:



- Check the condition of the gaskets located in connection with the front constant speed joint and the flange connecting the post differential and replace if necessary.
- Carefully wash the constant speed joint with diesel
  oil or petrol and verify visually that balls and respective seatings are perfectly specular and do not show
  signs of selzing or scoring. Otherwise replace the
  damaged joint.
- Check the condition of the hood and if replace if cracked or distorted.
- Check the conditions of the different sections of main shaft and sheath ensuring there is no distortion, cracking or anomaly. Replace if necessary.

- Check the superficial bearing interference conditions; replace the crossmember if cracks, negative allowances or excessive play between the parts are present.
- Check that the axial play of the cross is between 0.01 and 0.04 mm, if the above play is higher it is necessary to replace the safety snap rings choosing the exact thickness among the following rings 1.50 1.53 1.56 1.59 1.62.
- 7. Check the general conditions of the flexible supports, verify that the play of the support ball bearing is not excessive and does not roll roughly. Check that the flexible support has not been deformed, that the rubber part is not worn and that it has its original flexibility. Otherwise replace the damaged supports.

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# **ON VEHICLE OPERATIONS**

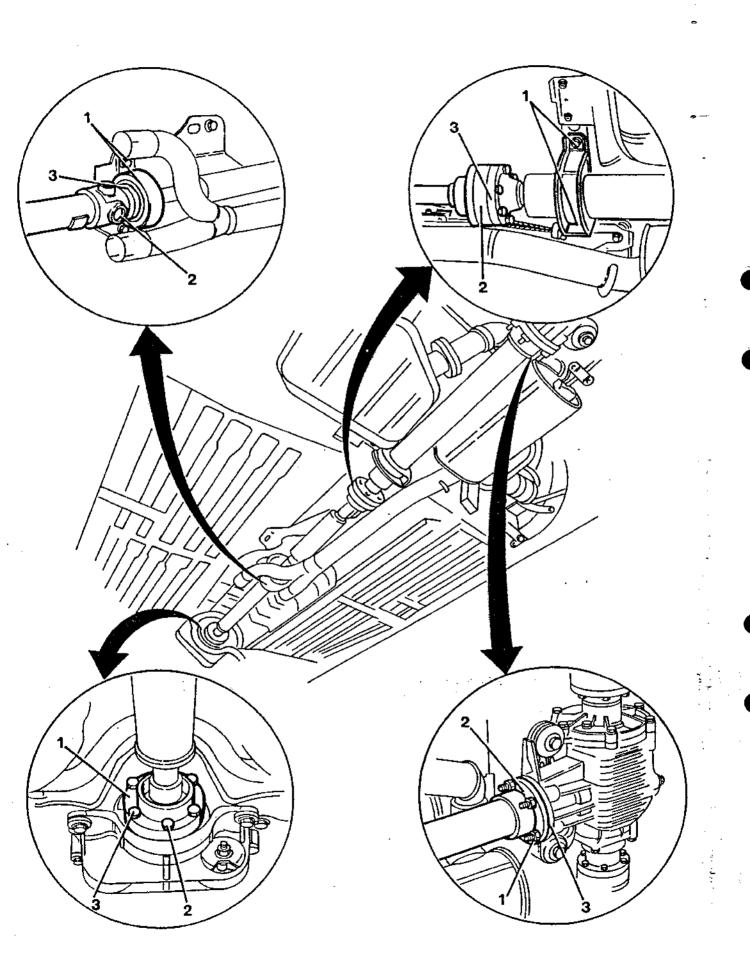
### **MAIN SHAFT INTEGRITY CHECKS**

 Check the safety support of main shaft for damage and the relative securing devices.

- Verify the integrity of joints and flanges securing the shaft to the differentials.
- Verify that the universal coupling cross and differential are not leaking grease or oil.
- If necessary, check the damaged components (see: DISASSEMBLY AND REASSEMBLY).

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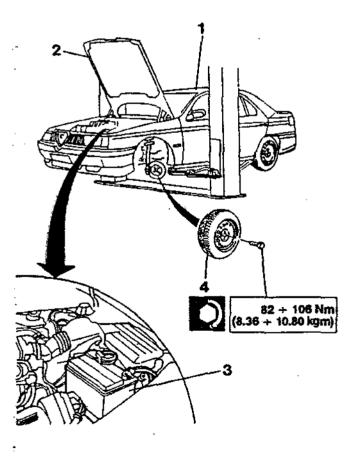
# DIFFERENTIAL CASING OIL SEAL REPLACEMENT - ENGINE SIDE

- 1. Put the vehicle on lift.
- 2. Raise the bonnet.
- 3. Disconnect battery.
- 4. Remove front wheels and gravel guards.

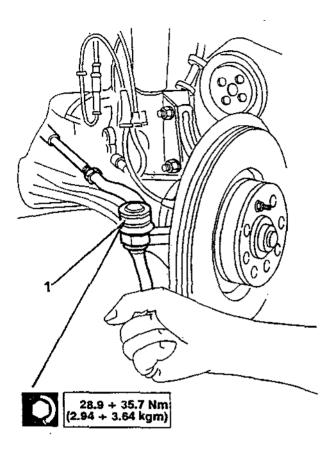


### **WARNING:**

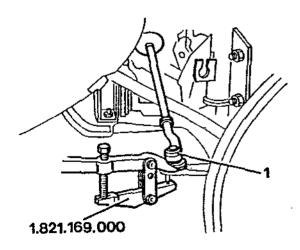
Protect the area surrounding the engine compartment with soft material in order to avoid accidental damage to the body.



 Loosen and remove the nut securing the steering tie-rod ball- pin to the wheel support.

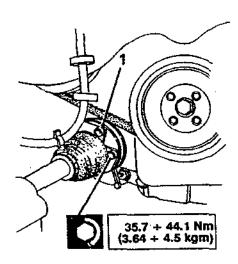


 Using tool No. 1.821.169.000 remove the ball pin from the wheel support.

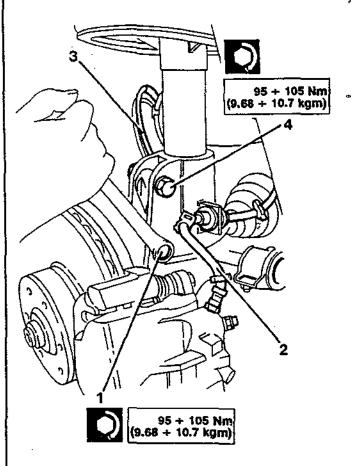




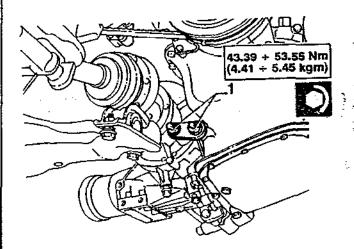
 Loosen and remove, together with three safety plates, the nut securing constant speed joint to the flange.



- Loosen and remove the upper bolt securing the wheel support to the shock absorber stem.
- Disconnect brake system oil piping from bracket on damper stem.
- Disconnect ABS system wiring from respective bracket (for vehicle fitted with controlled damping suspension only).
- Disconnect S.C.S. system solenoid valve wiring, located on the shockabsorber, from its bracket.
- Loosen the lower nut securing the wheel support to the damper stem, then remove the half shaft.

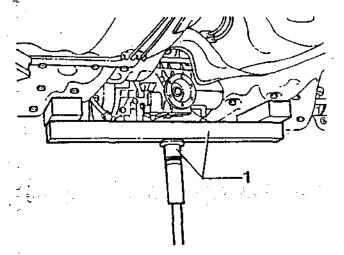


 Loosen nuts securing the linkage bracket to the viscous coupling and engine oil sump, then remove the bracket.

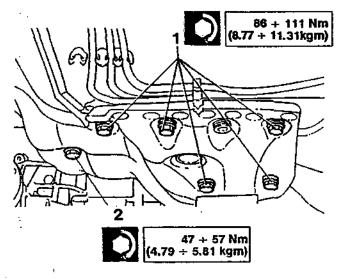




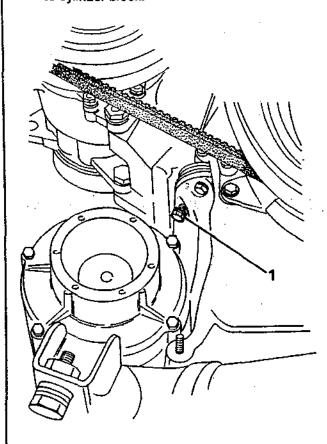
 Using a hydraulic jack fitted with a suitable device, support the crossrail.



- As far as possible loosen but do not remove, the screws securing cross member to body.
- Loosen as much as possible, without removing, the screws securing steering box to crossrail.

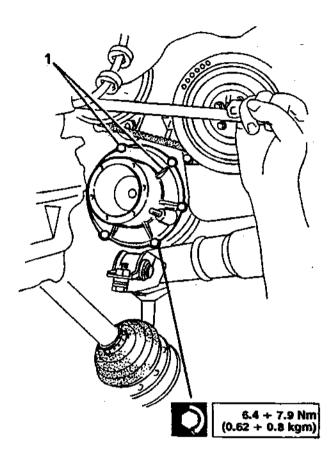


 Remove screw (shown in figure) securing oil sump to cylinder block.





 Loosen and remove the six screws securing the cover of the viscous coupling, then by lowering the hydraulic jack in order to allow the power unit group to be lowered remove the cover together with the drive shaft.



 Replace oil seal and O-rings on viscous coupling cover (see: "FERGUSON" VISCOUS JOINT COVER DISASSEMBLY AND REASSEMBLY).



Reassembly by reversing the proceedure followed for disassembly and tighten the screws and nuts to required torque.

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# **TECHNICAL FEATURES AND PRESCRIPTIONS**

### **TECHNICAL FEATURES**

### MAIN SHAFT

Туре:	into three sections	
Flexible supports:	N° 1 on central section with ball bearing in support	
	N° 1 on rear section with ball bearing installed inside the fixed sheath on support	
Constant speed joints:	N° 1 on front section (between shaft and front differential)	
	Nº 1 on intermediate section (between intermediate and rear sections)	
Universal couplings:	N° 1 between front and intermediate sections	
Cross radial play: mm	0.01 + 0.04	
Thickness of safety snap rings for adjustment cross radial play: mm	1.5 - 1.53 - 1.56 - 1.59 - 1.62	

### **GENERAL PRESCRIPTIONS**

### **FLUIDS AND LUBRICANTS**

APPLICATION	TYPE	NAME
Universal coupling cross and roll bearings	GREASE	TUTELA MRM2
Constant speed joints balls and holes		
Gearbox-differential unit oil refili	OIL	TUTELA ZC 80/S

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# **IGHTENING TORQUES**

### **RONT DIFFERENTIAL-VISCOUS JOINT**

Description	kg-m	N-m
levolving union securing oil supply piping to pinion support and oil whaust	29.75 + 36.75	3.03 + 3.74
End straight union securing oil supply piping to pinion support	29.75 + 36.75	3.03 + 3.74
Nut securing front differential rod to engine sump	43.35 + 53.55	4.41 + 5.46
Screw securing pinlon support to gearbox	74.8 + 92.4	7.62; + 9.42
Screw securing pinion support to alternator	21.25 + 26.25	2.16 + 2.67
Screw securing viscous coupling external casing to differential	21.25 + 26.25	2.16 + 2.67
Screw securing viscous joint casing cover	6.37 + 7.87	0.65 + 0.80

### MAIN SHAFT

Description	kg-m	N-m	
Nut locking main shaft union screws to front differential and sections	35.7 + 44.1	3.64 ÷ 4.49	
Nut securing safety brace to front section main shaft	5.1 + 6.3	0.52 + 0.64	
Screw securing support flexible plug to main shaft intermediate joint	14.45 + 17.85	1,47 + 1.82	
Screw securing support flexible plug guard pipe of main shaft rear section	14.45 + 17.85	1.47 + 1.82	
Nut securing main shaft rear section guard pipe to differential	47.5 + 52.5	4.84 + 5.35	
Taper screw securing support to cross member	41.65 + 26.25	4.24 + 5.24	
Self-locking nut securing gearbox in bushings	52.7 ÷ 65.1	5.37 + 6.64	
Self-locking flanged nut securing pulley cover to handbrake cables	5.53 + 8,93	0.56 + 0.91	

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# **SPECIAL TOOLS**

TOOL NUMBER TOOL	DESCRIPTION
1.820.017.000	Half rings for extracting intermediate flexible support (Use with 1.820.024.000)
1.820.022.000	Half plates for extracting main shaft rear section bearing
1.820.023.000	Half plates for extracting constant speed joint
1.820.024.000	Plate supporting half rings (Use with 1.820.017.000)
1.820.046.000	Half plates for extracting constant speed joint hood
1.820.229.000	Flange for extracting Intermediate shaft
1.820.252.000	Differential support to bench
1.821.003.000	Internal bearing puller to viscous coupling
1.821.037.000	Bearing inserting tool to main shaft
1.821.039.000	Half plates for extracting main shaft universal coupling half cross
1.821.095.000	Inserting tool for bearing viscous coupling support
1.821.161.000	Mallet (Use with 1.820.229.000)
1.821.169.000	Puller for steering side tie rod pin
1.821.201.000	Oil seal inserting tool

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